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Spring Wheat Nursery Plots at Brookings During the Early Part of Season of 1931

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Agricultural Experiment Station
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Agriculture and Mechanic Arts
Brookings

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Introduction

Due to the very severe climatic conditions during the past two seasons many South Dakota grain producers are faced with the task of having to purchase a part or all of their seed for planting next year's crop. There is at this time need of a guide as to the proper varieties of the different cereal crops, seed of which will be purchased for planting, so that individual producers may take advantage of the facts found in the experiments to be reported here on varietal adaptation. Frequently crop yields can be increased by from ten to twenty per cent by no other means than by selecting the variety especially adapted to the conditions under which the crop in question is to be grown. Since such increases in yields are obtainable at no added expense to the producer it is obvious that his net returns can be materially influenced by his choice of the proper variety.

There is definite need for crop standardization. The marketing of all grains can be greatly facilitated by united community action and cooperation. It is to the advantage of progressive producers and grain men alike to be informed on the varieties of the commercially important field crops best adapted to their respective sections of the state, and then to encourage the growing of such adapted and recommended varieties to the exclusion of poor yielding varieties, or varieties of inferior market characteristics. A good variety combines yielding capacity with quality. Through united effort any community can build up a reputation for producing grain of quality. This demands the giving of proper attention especially to the varietal factor and to the elimination of diseases. Before pur-

The author wishes to express his appreciation to the following persons for their efforts in contributing in the tasks of obtaining parts of the yield data used in this publication: Dr. A. N. Hume, Agronomist and Superintendent of Substations; Mr. Rex Bankert, Mr. S. W. Sussex, and Mr. Walter Schonbrod, foremen of the stations at Brookings, Highmore and Eureka, respectively, and to Mr. W. J. Fuerstenau, formerly foreman at the Cottonwood substation.

chasing seed and growing a new variety one should take advantage of the services offered by his experiment station; chances are that the variety in question has been tested and that information relative to its yielding ability and market quality are available for the grower's benefit. New, often inferior varieties, continually find their way into the state and are responsible for loss to producers, not only from the standpoint of the lower yields incurred, but also from the fact that such new varieties occasionally become mixed with the better varieties and thus lower the market value of all the grain produced in the community. The introduction of Quality, also known as Burbank and Siberian, a white spring wheat, into a section known for the production of hard red spring wheat offers a good illustration of this point. The growing of Trebi, strictly a feed barley, in a section adapted to the production of malting types of barley offers another illustration.

The varietal yield data of all the cereal crops and of flax are treated in this publication. In order to present this information in a concise manner only average yields for a comparable period of years are given in the tabulated results of tests conducted. Furthermore, only the yield data of the more important varieties or strains tested are presented. The reader interested in the annual performance records, descriptions and more detailed discussions of varieties of cereals is referred to the following publications: Hardies (2)*, Hume et. al. (4) and Klages (5), (8), (9). Due to the severity of climatic conditions during the past two seasons yield data for most of the crops to be discussed are not available for 1933 and 1934.

The Importance of Small Grains in South Dakota Agriculture

The general welfare and economic life of South Dakota is intimately associated with the yields of the grain crops sown within the borders of the state. The returns obtained through the direct and indirect sale of grains account for a high per centage of the incomes of the majority of the people of South Dakota. Climatic conditions and the soils over much of South

*Reference by number is to "Literature Cited" p. 42.

Dakota are favorable to the extensive production of cereal crops. Even with the low prices such as prevailed in 1930 the aggregate value of the corn, wheat, oats, barley, rye, and flax crops for that year amounted to the very significant sum of $87,145,000. For the decade 1920-1929 the average annual value of the grain and flax crops produced in South Dakota was $134,881,000. The corn crop of the state produced on the average 43.83 per cent of this sum. The other crops contributed in the following order: wheat 23.59, oats 17.13, barley 8.86, flax 4.98 and rye 1.61 per cent respectively.

TABLE 1.—Comparative acreages and values of grain and flax crops produced in South Dakota in 1930

Crop	Acreage 1000 acres	Production in 1000 bushels	Farm price per bu. in cents	Value in 1000 dollars	Per cent of total grain crops	
					Acreage	Farm value
Corn	4,965	76,958	47	36,170	36.44	41.51
All wheat *	3,420	40,840	...	18,929	25.10	21.72
a. Hard red spg. wheat	1,940	22,504	49	11,027	14.24	12.65
b. Durum wheat	1,360	16,320	42	6,854	9.98	7.87
c. Winter wheat	120	2,016	52	1,048	.88	1.20
Oats	2,236	64,844	21	13,617	16.41	15.62
Barley	1,935	42,570	29	12,345	14.20	14.17
Flax	670	3,484	133	4,634	4.92	5.32
Rye	400	5,800	25	1,450	2,93	1.66
Total	13,626	234,496	...	87,145	100.00	100.00

* Sub-total not considered in grand totals.

Table 1 gives the comparative acreages and values of the grain crops produced in South Dakota in 1930. Corn occupies the place of first importance; 36.44 per cent of the entire acreage devoted to the production of the grain and flax crops was given over to corn production. Corn produced 41.51 per cent of the total value of these crops as compared to 58.49 per cent for the small grains and flax. The latter group of crops arranged in the order of their relative importance, both from the standpoints of the acreage devoted to their production and their estimated farm values are, wheat, oats, barley, flax, and rye.

The relative importance and distribution of the various grain crops in South Dakota is brought out graphically in Figures 1 to 9, showing the acreages of corn, all classes of wheat, hard red spring wheat, durum wheat, winter wheat, oats, barley, flax, and rye harvested in each county of the state in the

season of 1930. No effort was made to designate the distribution of these crops within the separate counties. A uniform scale, namely each dot representing 1000 acres, was used in the construction of all the figures presented. The data used for the compilation of Table 1 and for the construction of the distribution maps were taken from Borum and Paulson (1).

Distribution of the Various Cereal Crops and Flax South Dakota

Fig. 1 gives a graphic view of the distribution of corn production in South Dakota. Corn is an important crop in all of the eastern half of the state. The most intensive areas of production are found, however, in the southeastern portion of the state where the crop is favored by the greater length of the growing season common to that section. Since corn is able to utilize fully a relatively long growing season it is more efficient in the production of carbohydrates than the cereals, which make use of only a short season or only of a part of the growing season in regions favored with a long period between killing frosts. The cereal crops, on the other hand, do not demand as long a period for the completion of their life cycles as does corn and are consequently more efficient and better adapted to regions where cooler and shorter growing seasons prevail. Corn production will not be discussed in this publication. It is interesting, however, to compare the distribution of the main cereal producing areas of the state in relation to the main corn producing sections.

Wheat is a crop of importance in all counties of South Dakota with the exception of six counties in the east-central portion the state. As may be seen from Fig. 2, showing the distribution of all classes of wheat, Brookings, Lake, Moody, Minnehaha, Turner, and Lincoln counties produce but little wheat. The crop attains its greatest importance in the northeastern and north-central sections of the state but is of considerable importance in the entire east-central area. Fig. 10 gives the location of the principal soil areas of South Dakota. The most intensive wheat producing area of the state extending through Brown and Spink counties corresponds well with the distribu-

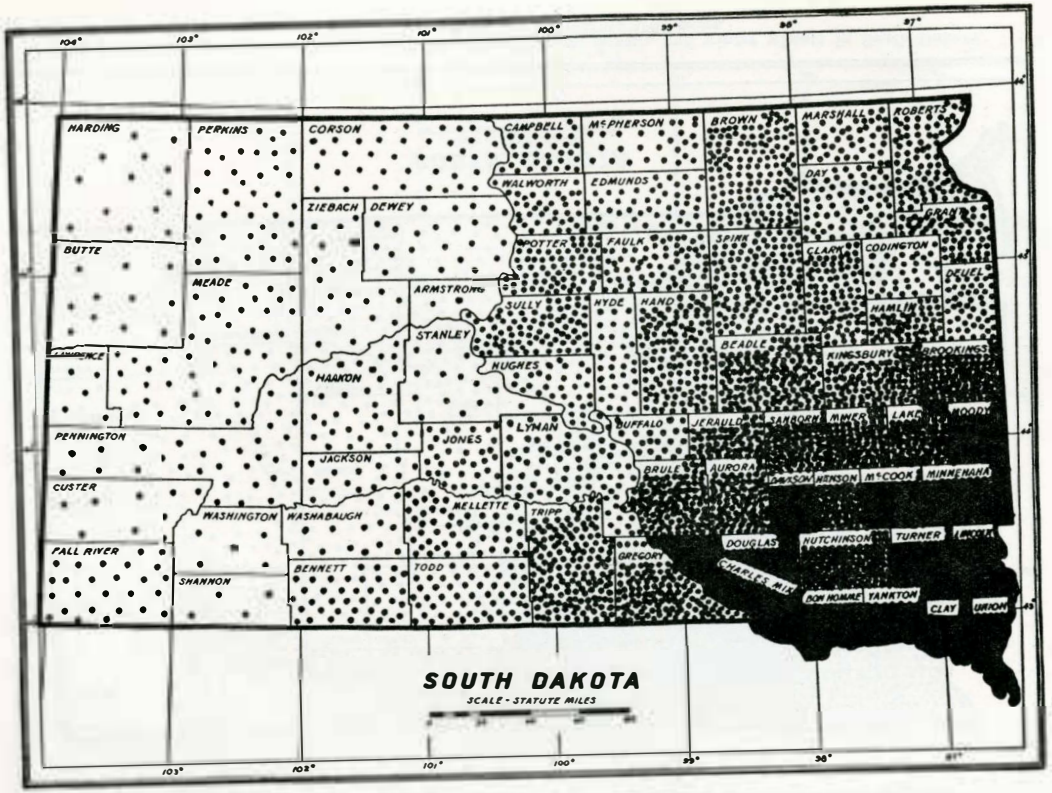


Fig. 1.—Distribution of corn acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

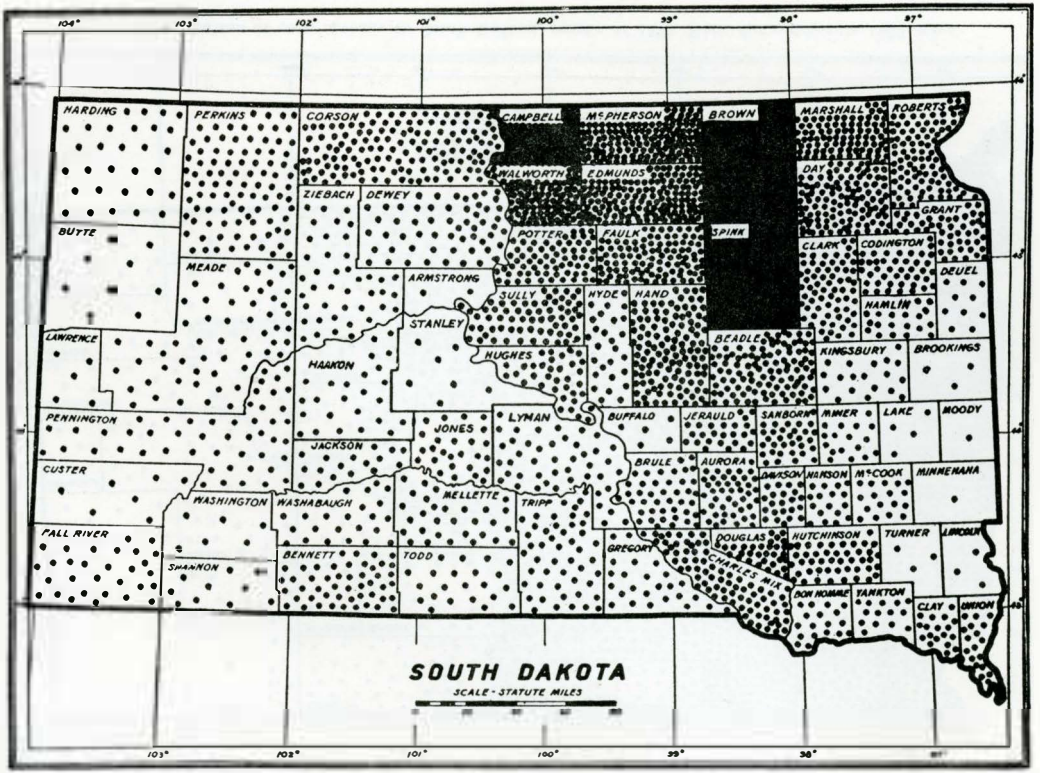


Fig. 2.—Distribution of all wheat acreage (hard red spring, durum, and winter wheat) in South Dakota, season of 1930. Each dot represents 1000 acres.

tion of the lacustrine soils. The crop is also, however, of great importance on the glacial soils immediately to the west of that area.

South Dakota produces three general classes of wheat: common spring, durum, and hard red winter. The distribution of each of these classes of wheat will be discussed separately. Some white spring wheat is grown in the state but its production is not recommended.

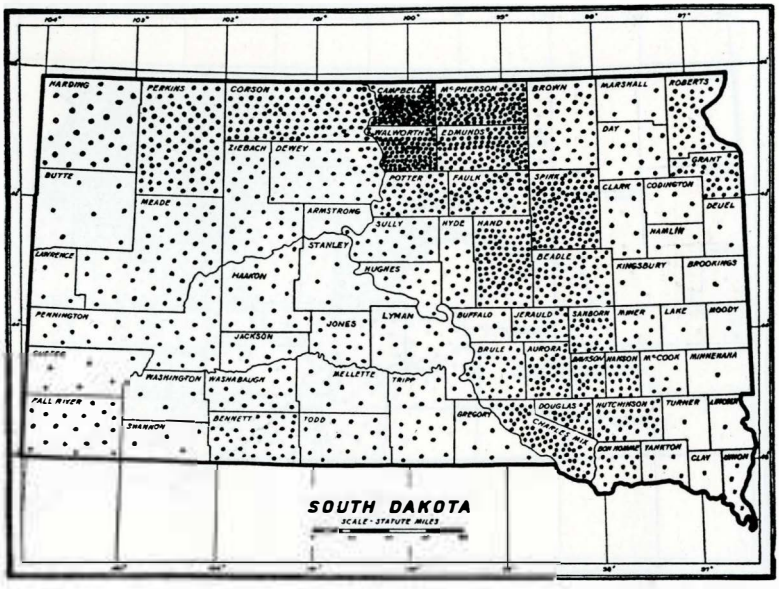


Fig. 3.—Distribution of hard red spring wheat acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

The production of common spring wheat, which consists mostly of hard red spring, is according to Fig. 3, of greatest importance in the north-central and east-central portions of the state. The greatest production is found in the northern counties and follows the valley of the James river across the state. Areas of lesser importance are found in the northeastern counties and in the northern counties west of the Missouri river.

The production of durum wheat, as is evident from Fig. 4, was in 1930 centered largely in the northeastern counties of the state. Much of the durum wheat grown is of low quality. A high percentage of the crop is made up of red durum which brings only feed prices when offered on the market. Unless producers in this area take steps to produce only the highest quality of amber durum wheat, for which the market can pay a premium, they will find it to their advantage to produce hard red spring instead of durum wheat. On the basis of experi-

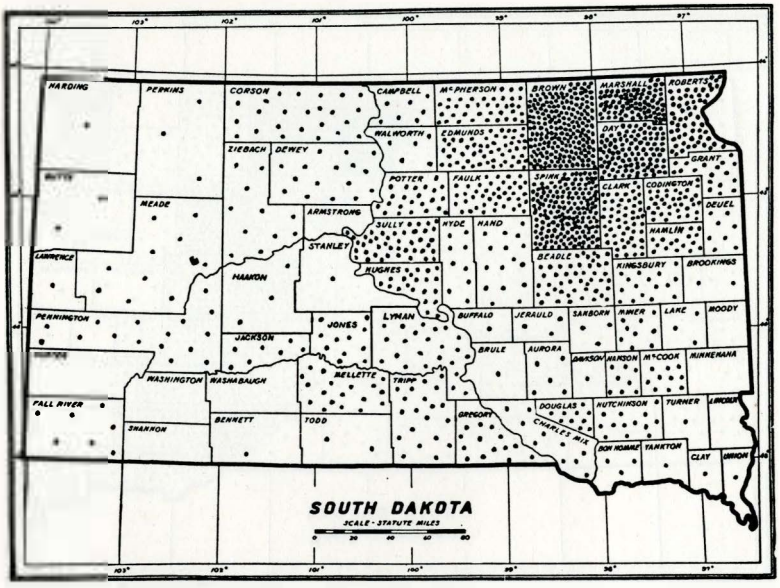


Fig. 4.—Distribution of durum wheat acreage in South Dakota season of 1930. Each dot represents 1000 acres.

mental yield data available from South Dakota stations much of the area now devoted to the production of durum may well be given over to the growing of hard red spring wheat. With the use of the proper variety this can be done without appreciable, if any, sacrifice in yield. Considerable durum wheat is also produced in the central part of the state. Results from the Eureka and Highmore substation indicate that Ceres, a hard red spring wheat, will yield as much as can be expected from the durum wheats in that area.

Due to geographical location winter wheat production in South Dakota is largely limited to the southern and southeastern areas of the state. The total amount of winter wheat produced in South Dakota is small and quite variable; it is, however, a crop of considerable importance, as may be seen from Fig. 5, in the southeastern and south-central counties of the state. Fig. 14 gives the area in which winter wheat may be grown to advantage. Winter wheat is a good crop in the southern and southeastern portions of the state from the stand-

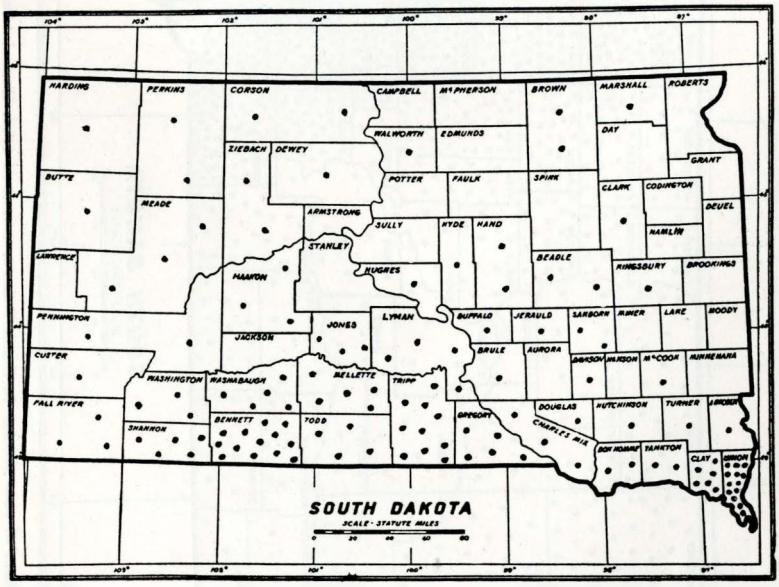


Fig. 5.—Distribution of hard red winter wheat acreage harvested in South Dakota, season of 1930. Each dot represents 1000 acres.

points of incorporating a fall-sown crop into the cropping system and thus lending a greater degree of diversification to the crop producing program. Yield data for a 23 year period of comparison, reported by Klages (6), show that the yields obtained from winter wheat at Brookings were significantly higher than those obtained from either durum or common spring wheat at that station. The most recent, and it may be said, the most active winter wheat producing area of South

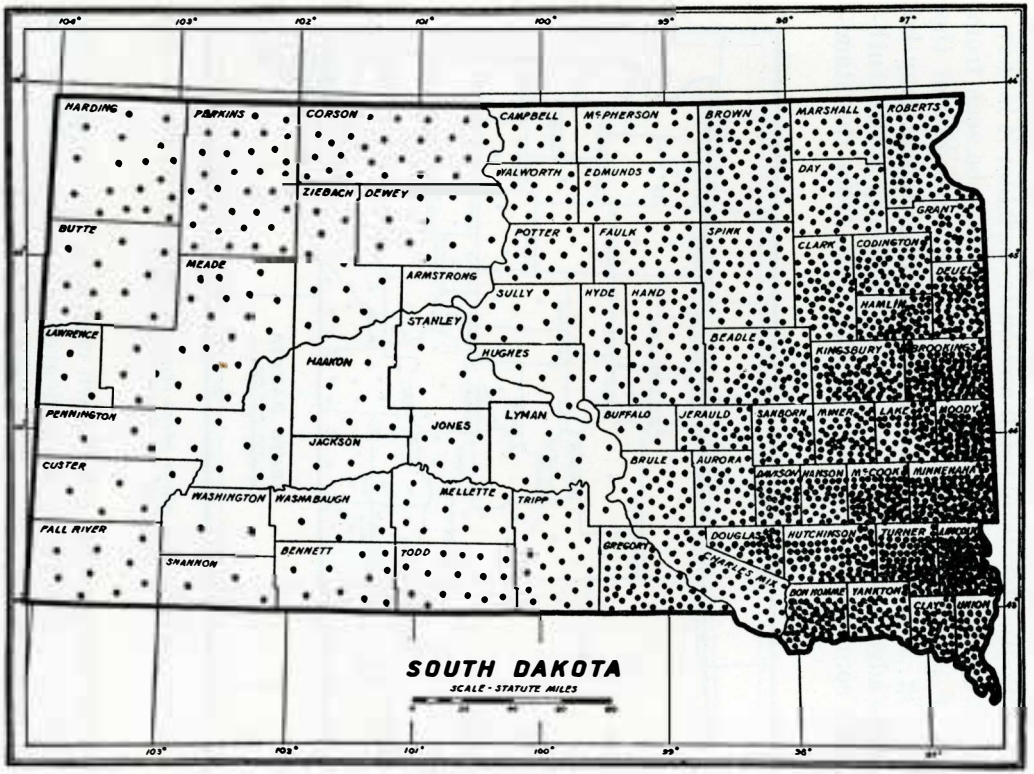


Fig. 6.—Distribution of oats acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

Dakota is found in the south-central and the southwestern portions of the state. A comparison of Figs. 5 and 10 shows that the location of this winter wheat producing area corresponds well with the distribution of the Rosebud soils.

Oats is grown in all counties of South Dakota; the crop is, however, of special importance in the southeastern part of the state. It is interesting to note the similarity between the most intensive oats and corn producing areas. A comparison of Fig. 6 showing oats and Fig. 1 showing corn distribution brings out that these two crops are of importance over the entire eastern half of the state and that the most intensive areas of production of both of these crops are found along the eastern border and especially in the very southeastern section of the state. The fact that oats is commonly sown on corn stalk land accounts for the similarity in the distribution of these two crops.

Barley production in South Dakota, as may be seen from Fig. 7, is quite generally distributed over the eastern half of the state. The main centers of production are somewhat north of the main corn and oats producing areas. The crop attains its greatest importance in the east-central portion of the state. An analysis of the yield data from five South Dakota stations by Klages (5) brought out the fact that more feed per acre could be produced by barley than by oats. Since barley production fits well into the now prevailing systems of cropping, a shift from oats to barley production can, in view of the greater amount of feed generally obtainable from a unit of land devoted to barley rather than to oats, be made to advantage on many South Dakota farms. Both malting and feed barleys are produced in the state. These two types of barley are differentiated primarily by varietal characteristics; the production of a good malting type of barley requires, however, the growing of the proper variety under favorable climatic and soil conditions.

A study of Fig. 8 reveals three general centers of flax production in South Dakota: the northeastern, the north-central and northwestern, and the south-central areas. The rapid extension of tractor farming was, no doubt, a contributing factor in the development of the western areas of flax production.

Winter rye can be produced in all sections of South Dakota;

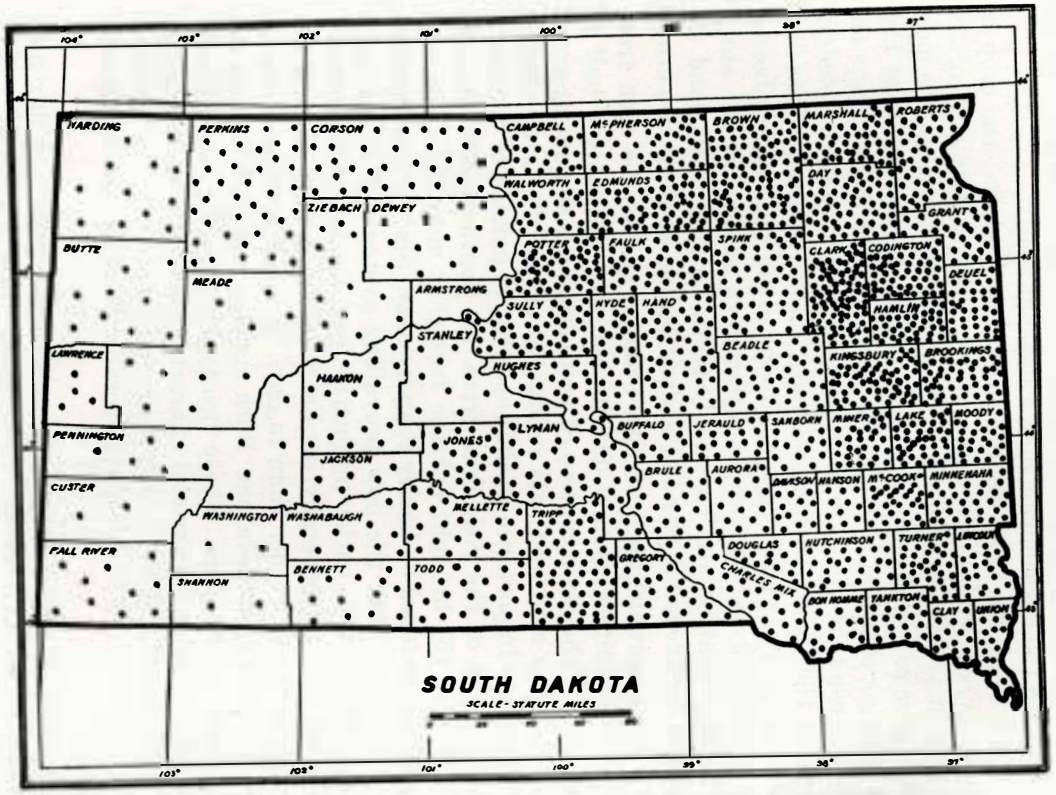


Fig. 7.—Distribution of barley acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

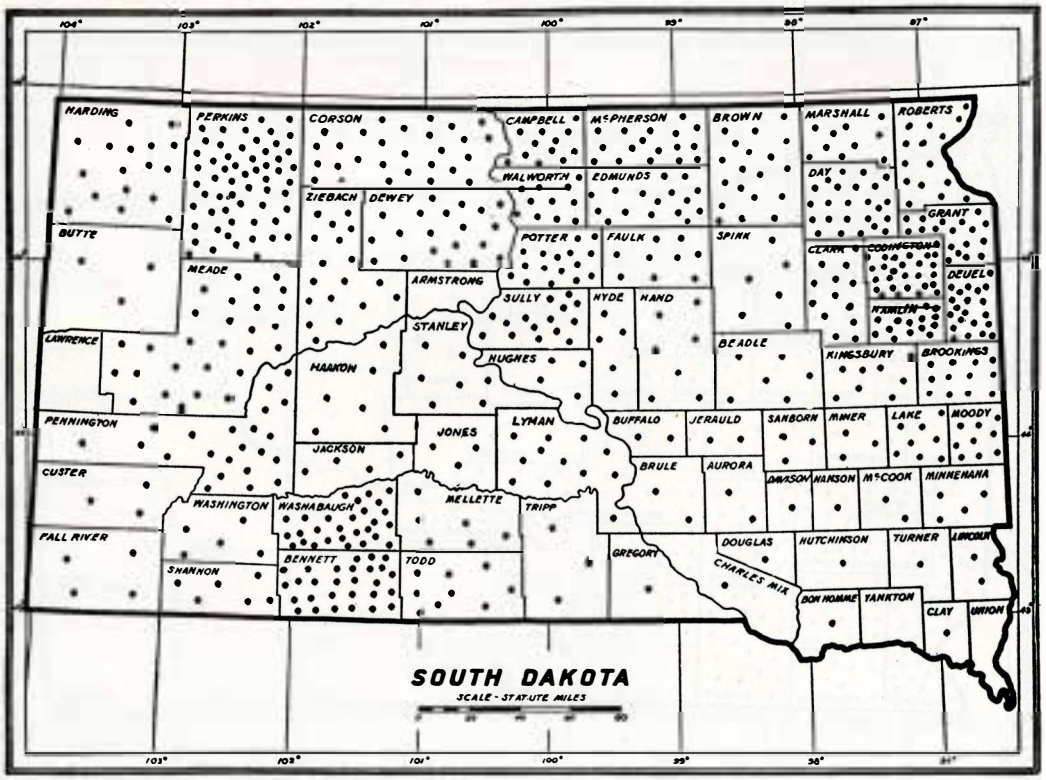


Fig. 8.—Distribution of flax acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

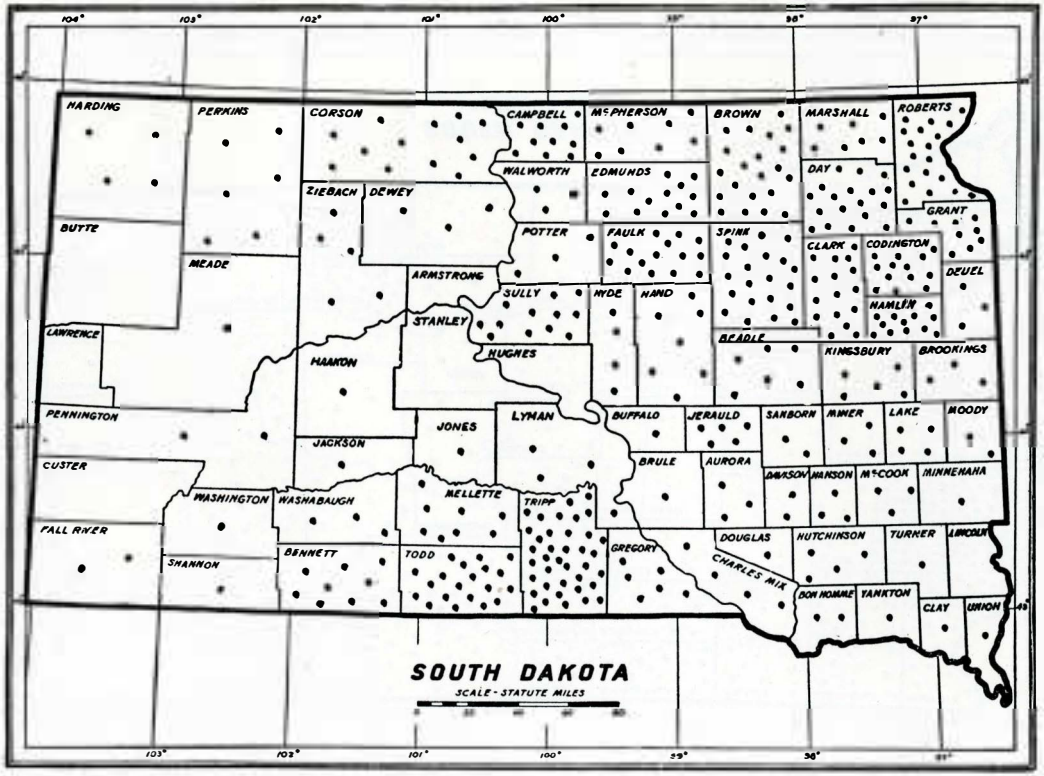


Fig. 9.—Distribution of rye acreage in South Dakota, season of 1930. Each dot represents 1000 acres.

production is centered largely in the northeastern and south-central portions of the state (Fig. 9). Rye can be used especially in those sections of the state where winter conditions are generally too severe for the survival of winter wheat. The crop is recommended for the production of grain and for purposes of supplementing pastures. It has a wider range of adaptation than any other crop for fall seeding.

Results of Variety Tests

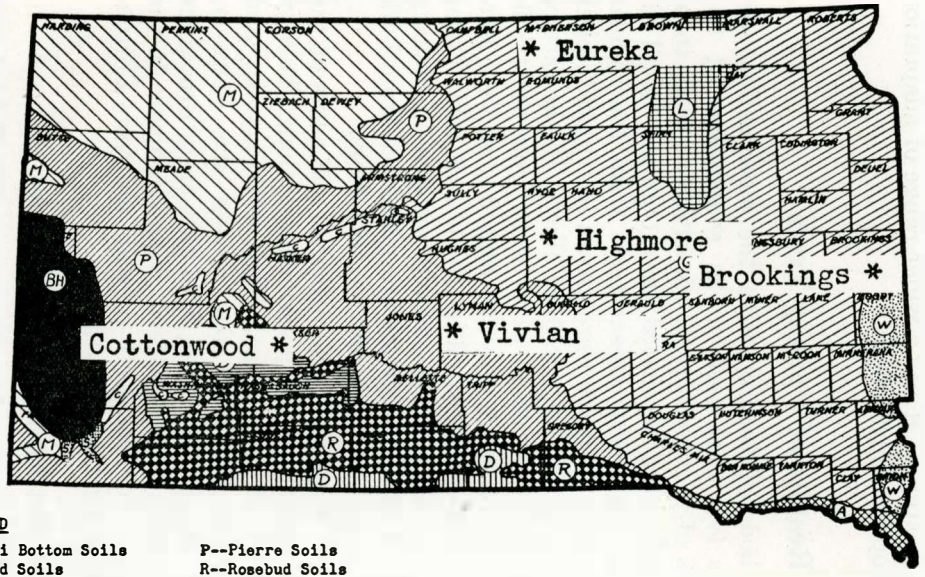
Standard methods of testing, with the modifications described by Klages (7), were used in the evaluations of the yielding capacities of the varieties of the different crops to be discussed. The yield data presented were obtained in all instances except for the winter wheat tests from the regular variety test plots. The varieties were grown in triplicate plots 1/60 of an acre in area and with cropped alleys. In the case of the winter wheat test the results were taken from the triplicate rod row nursery of which only the center rows were harvested for yield determinations and in which each variety was repeated four times. Due to the present interest in malting barley, yield data of barley varieties are presented from both the regular variety test and rod row nursery plots.

Fig. 10 gives the location of the principal soil areas of the state and the five South Dakota experiment stations. Variety tests were conducted at Brookings, Highmore, Eureka and Cottonwood. Only the results of one season are, however, available from the last station. The yield data from Brookings should have application in the eastern, from Highmore in the central, from Eureka for the north-central, and from Cottonwood in the western part of the state.

Hard Red Spring Wheat Varieties

Table 2 gives the comparative average yields of hard red spring wheat varieties tested at Brookings, Highmore, and Eureka for five and three year periods. Three varieties, namely Ceres, Komar, and Reward, are outstanding for the longer period of comparison. The yields of Ceres are especially outstanding when all places and periods of comparison are taken

PRINCIPAL SOIL AREAS IN SOUTH DAKOTA



LEGEND

A--Missouri Bottom Soils
B--Bad Land Soils
C--Cheyenne Loam Soils
D--Dune Sand
G--Glacial Soils
L--Lacustrine Soils
M--Morton Soils
P--Pierre Soils
R--Rosebud Soils
S--Smithwick Loam Soils
W--Loessial Soils
BH-Black Hills

By J. Gladden Hutton, In Charge of
South Dakota Soil Survey. 1929.

Fig. 10.—Location of the principal soil areas of South Dakota and the main station and substations of the South Dakota Agricultural Experiment Station

into consideration. Komar and N. Dak. 1656.48 are of the same (Marquis x Kota) parentage as Ceres. Since these two varieties do not generally yield more than Ceres and produce grain of lower quality they are not recommended. Reward gave good yields at Highmore and Eureka. Since, however, the yields of Reward are not higher than those obtained from Ceres, and since the market accepts Ceres more readily, Ceres is recommended over Reward. Producers in the north-central area of the state who have a special preference for an early maturing beardless variety will find Reward to their liking. The average producer, and especially those handling their wheat with a combine, will find Ceres more desirable. Ceres yields well, produces a grain of high quality quite acceptable to the market, has a stronger straw and shatters less than Reward.

TABLE 2.—Comparative average yields of hard red spring wheats at four South Dakota stations for the number of years indicated.

Variety	C. I. No.	Brookings 5 yr. av. 1928-1932	Brookings 3 yr. av. 1930-1932	Highmore 5 yr. av. 1928-1932	Highmore 3 yr. av. 1930-1932	Eureka 5 yr. av. 1928-1932	Eureka 3 yr. av. 1930-1932	Cottonwood 1 yr. 1932
N. D. 1656.48	10014	—	18.9	—	11.8	—	21.7	—
Ceres	6900	20.3	18.7	11.3	12.6	16.0	22.4	32.7
Thatcher	10003	—	17.6	—	—	—	—	—
Reward	8182	18.3	17.4	11.6	13.3	15.9	22.4	28.3
Reliance	7370	—	17.2	—	8.1	15.4	20.3	30.7
Minn. 2305	10005	—	16.8	—	8.8	—	22.3	—
Komar	8004	20.6	16.8	11.7	13.1	—	21.2	28.7
Marquis	3641	16.6	16.3	8.3	8.1	14.5	20.0	25.0
Marquillo	6887	17.4	14.9	9.2	9.5	15.4	20.4	—
Hope	8178	—	12.6	7.7	7.2	—	16.3	—
Supreme	8026	—	12.4	10.0	10.4	14.0	20.1	—

Fig. 11 gives a diagramatic presentation of the performance records of the separate varieties. The varieties are arranged in the order of their respective yields at Brookings.

Fig. 12 shows a map of the state with the varieties of hard red spring wheat recommended for the different sections. Where more than one variety is listed for a certain area they are enumerated in the order of their relative desirability for that particular section of the state. On the basis of the yield data available and taking into consideration the agronomic characteristics of the variety the first choice is given to Ceres in all parts of the state. Reward has already been discussed.

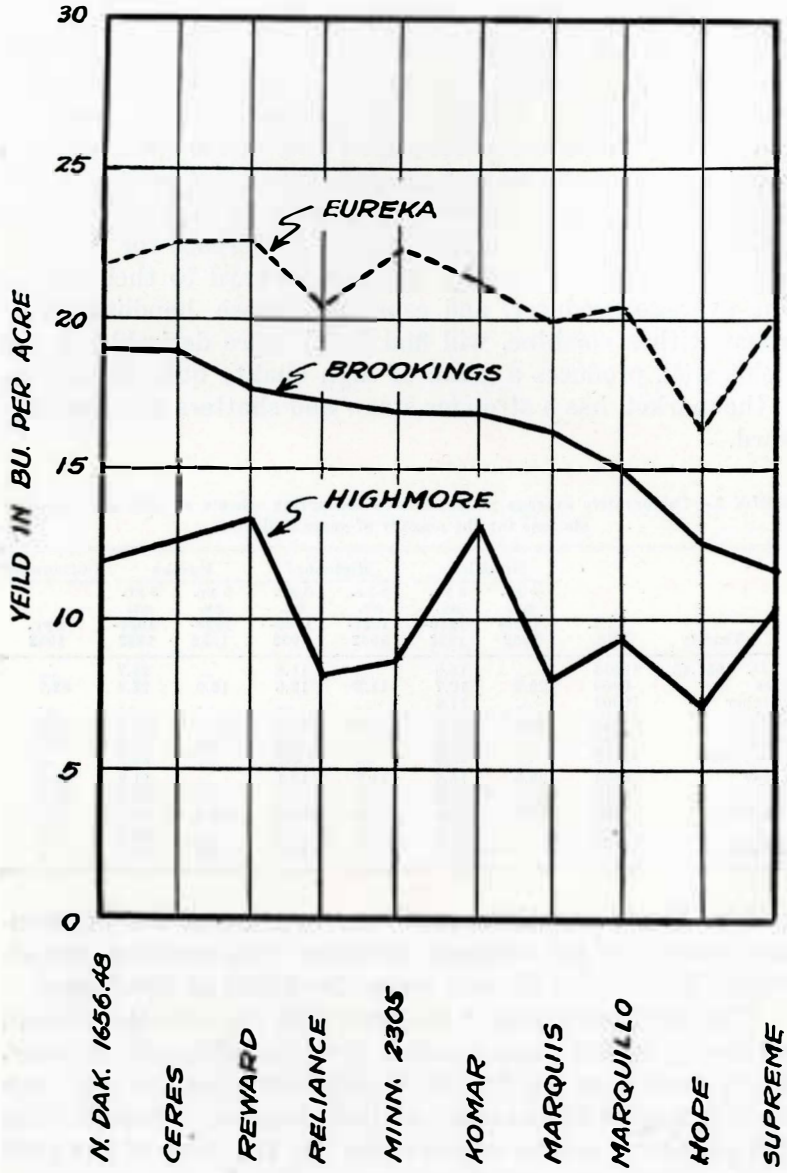


Fig. 11.—Comparative yields of hard red spring wheat varieties at Brookings, Highmore, and Eureka, 3 year averages, 1930-1932.

Marquis is still a good variety for the western portion of the state. It does not yield as well as Ceres, but produces a wheat especially in demand by the market. Unless, however, the market is willing to pay a premium for Marquis to compensate for its lower yielding capacity it will, it is safe to make the prediction, in time give way to Ceres even in the western portions of the state. At Brookings, Highmore, and Eureka, Ceres yielded over a five year period of comparison respectively 23.8, 36.1, and 10.3 per cent more than Marquis.

For an eight year period of comparison, from 1925 to 1932 inclusive, the yields of Ceres at Brookings averaged 21.0 as against only 17.1 bushels per acre for Marquis. With the application of "Student's" method of comparing two results on a probable error basis, as recommended by Love (11), (12), it is found that the odds are approximately 54:1 that Ceres has a greater yielding ability than Marquis in the eastern part of the state. The comparitive yielding abilities of these same varieties are brought out by the results at Highmore. The yields of Ceres and Marquis, for the same period of comparison as given above, averaged 14.0 and 11.2 bushels per acre, respectively, with the odds of approximately 64:1 that Ceres can be expected to give higher yields than Marquis.

Two reasons may be advanced to account for the greater yielding capacity of Ceres over Marquis. First, and this is probably of the more important of the two, it has been found that Ceres is damaged to a lesser degree by high summer temperatures than Marquis. The second reason for the greater yielding ability of Ceres over Marguis is that Ceres is less susceptible to attacks of stem rust than Marquis. Since Marquis is decidedly less resistant to stem rust than Ceres, it should be entirely replaced by Ceres in the eastern portion of the state where rust epidemics are most likely to occur.

Durum Wheat Varieties

Table 3 gives the average yields of three varieties of durum wheat at four South Dakota stations. Mindum was the highest yielding variety at Brookings. This variety has good yielding capacity, produces grain of good quality well suited for the manufacture of macaroni, spaghetti, vermicelli, noodles and

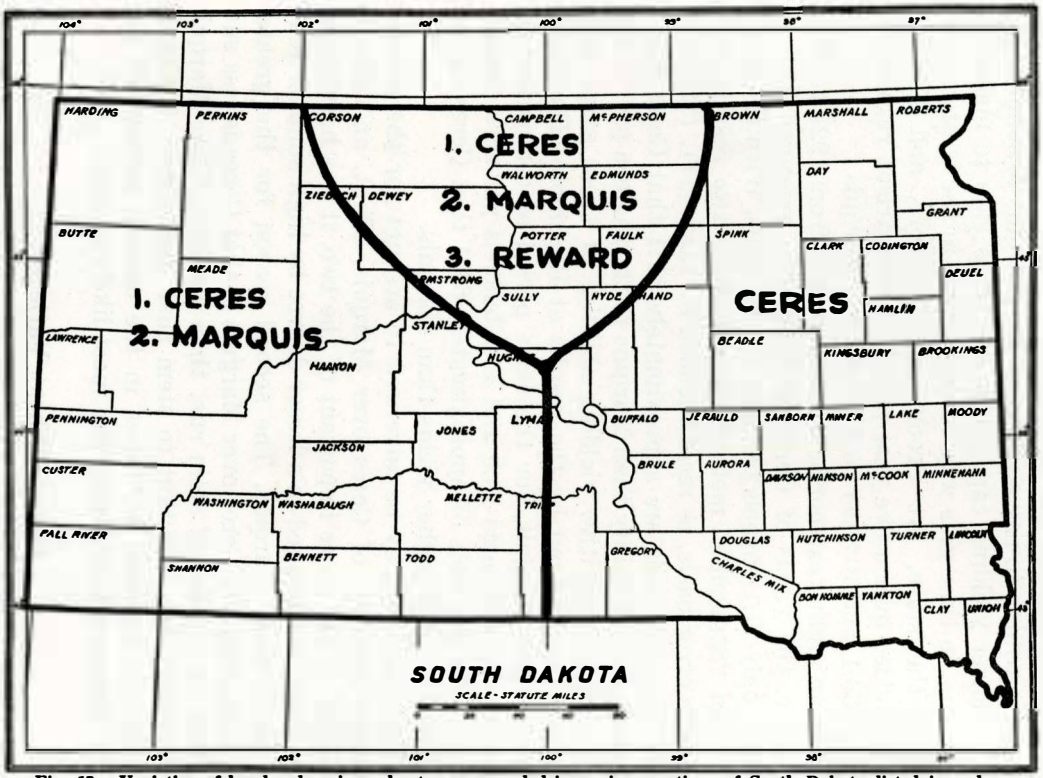


Fig. 12.—Varieties of hard red spring wheat recommended in various sections of South Dakota listed in order of preference where more than one variety is given.

similar products, and is for that reason very acceptable to the market. Mindum gave the highest average yield in a three year nursery test conducted at Brookings from 1929 to 1931, inclusive, in which fifteen varieties of durum wheat were tested for relative yielding capacities. Mindum is the best variety that can be recommended for the eastern one-third of the state. In the central part of the state, as is evident from the average yields obtained at Highmore and Eureka, Mindum yielded no more than Kubanka. Kubanka is a good variety for central and western South Dakota. It is somewhat difficult to obtain pure Kubanka seed. Much of the seed available as "Kubanka" is made up of a mixture of various durum wheats and is frequently of low quality. Pure Kubanka produces a grain of high quality.

TABLE 3.—Comparative average yields of durum wheat varieties at four South Dakota stations for the years indicated

		Brookings		Highmore		Eureka		Cottonwood
Variety	C. I. No.	5 yr. av. 1928-1932	4 yr. av. 1929-1932	5 yr. av. 1928-1932	4 yr. av. 1929-1932	5 yr. av. 1928-1932	4 yr. av. 1929-1932	1932
Mindum	5,296	22.9	22.5	10.2	11.4	15.0	21.2	29.0
Arnautka	4,064	22.1	20.7	—	10.3	—	—	30.0
Kubanka	1,440	19.8	19.4	9.7	11.1	16.9	18.7	32.3

Varieties of durum wheat like Acme, Nodak, Peliss, Algeria and Arnautka lack in quality and should be replaced by Mindum in the eastern third of the state or by either Mindum or Kubanka, provided of course pure Kubanka is obtained, in the central and western portions of the state. Red durum is strictly a feed crop. It is not suitable for the manufacture of macaroni.

Winter Wheat Varieties

The main requirement of a good winter wheat for South Dakota conditions is winter-hardiness. With but few exceptions, those varieties able to survive the winter in good condition are also the highest yielders. Table 4 gives the comparitive average yields and winter survivals of the standard vari-

eties of winter wheat grown in the nursery test at Brookings and Highmore. Varieties showing both good yielding capacity and high degree of winter-hardiness at Brookings are, Minturki, Beloglina and Turkey 144. Kanred gave fair yields but was lacking in winter-hardiness. The oustsanding varieties at Highmore were Beloglina, Minhardi, and Minturki. Since the grain produced by Minhardi is of low quality it is not recom-

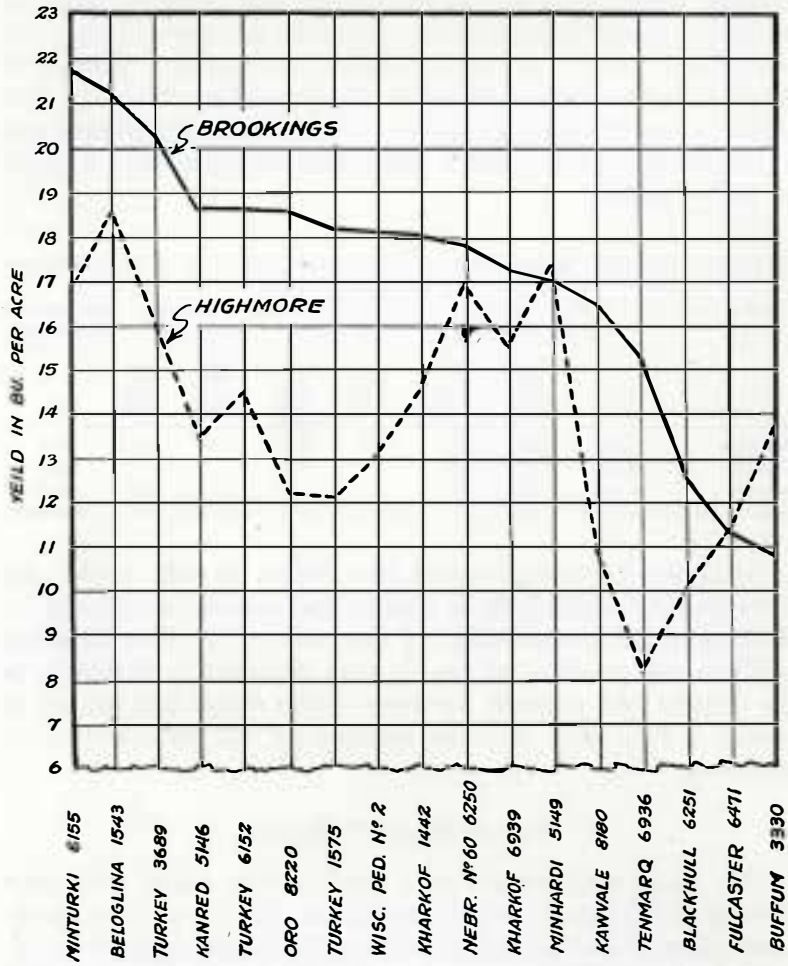


Fig. 13.—Comparative yields of varieties of winter wheat grown in the winter wheat nurseries at Brookings and Highmore, 4 year averages at Brookings, 1929-1932; and 3 year averages at Highmore, 1930-1932.

mended. The yields of the varieties tested are shown diagramatically in Fig. 13.

Fig. 14 shows the portion of South Dakota especially adapted to winter wheat production and lists the varieties recommended; namely, Minturki, Turkey Red, and Beloglina. Not all parts of South Dakota are adapted to winter wheat production. In the northern and central portions of the state winter conditions are generally too severe for the survival of winter wheat; in those areas winter rye is the safer and more desirable crop for fall seeding. Winter injury and possible entire killing are always factors to be considered in the production of winter wheat. As yet, no variety of winter wheat as hardy as winter rye has been produced.

TABLE 4.—Comparative average yields and survivals in spring of standard winter wheat varieties in nursery tests at Brookings and Highmore for the number of years indicated.

Variety	C. I. No.	Brookings		Highmore	
		4 yr. av. yields 1929-1932	4 yr. av. winter survival 1929-1932	3 yr. av. yields 1930-1932	3 yr. av. winter survival 1930-1932
Minturki	6155	21.7	84.8	16.8	67.0
Beloglina	1543	21.2	81.2	18.6	68.0
Turkey 144	1689	20.3	75.5	15.9	65.3
Kanred	5146	18.7	68.3	13.4	57.7
Turkey	6152	18.7	84.0	14.4	64.0
Oro	8220	18.6	74.5	12.2	60.0
Turkey	1575	18.2	72.3	12.1	58.3
Wisconsin Ped. No. 2	----	18.1	75.0	13.1	69.7
Kharkof	1442	18.0	69.0	14.6	57.0
Nebraska No. 60	6250	17.8	71.3	16.9	54.7
Kharkof	6939	17.2	84.0	15.5	72.3
Minhardi	5149	17.0	90.5	17.4	76.7
Kawvale	8180	16.5	56.8	10.8	57.7
Tenmarq	6936	15.3	38.8	8.2	38.7
Blackhull	6251	12.6	40.5	10.1	48.0
Fulcaster	6471	11.3	31.5	11.4	42.3
Buffum	3330	10.8	92.0	13.7	70.0

Oats Varieties

Table 5 gives the comparative yields of important varieties of oats tested in recent years. The yields of the separate varieties at Brookings, Highmore and Eureka are presented diagramatically in Fig. 15. Fig. 16 gives the varieties of oats recommended in the various sections of South Dakota.

The main outstanding feature brought out by the available yield data of oats varieties is the decidedly superior per-

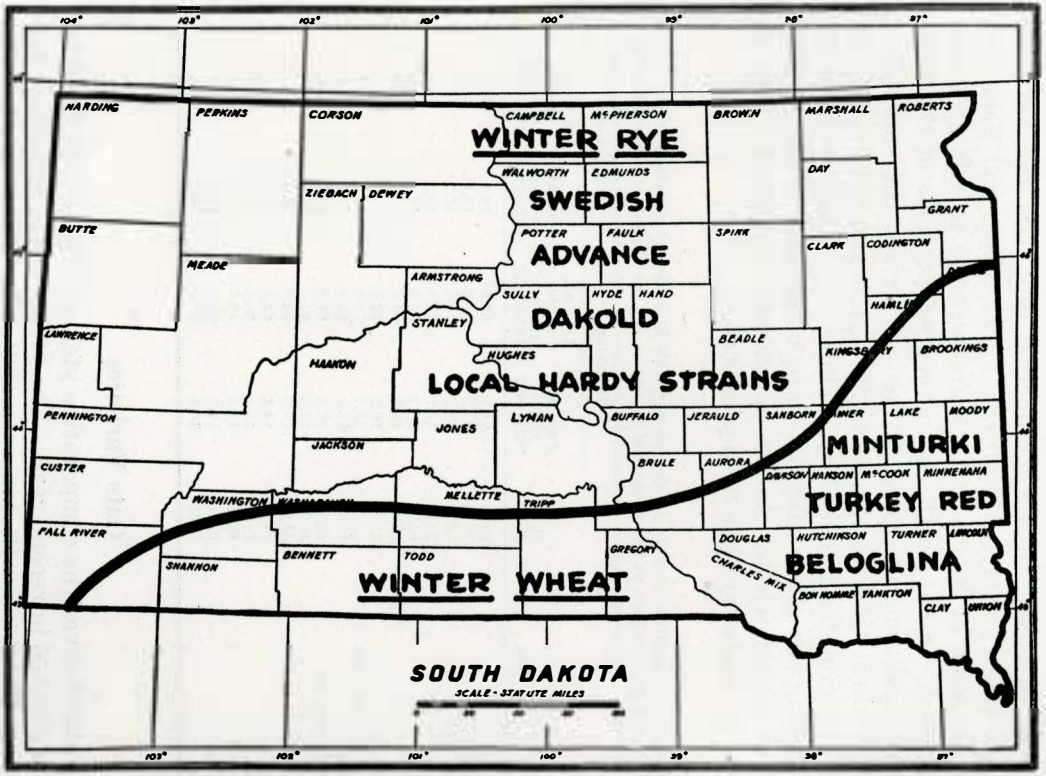


Fig. 14.—Varieties of winter wheat and winter rye recommended in various sections of South Dakota. The map also shows the sections of the state in which winter wheat may be grown to advantage.

formance of the early varieties to the mid-season and late maturing varieties. Over a 16-year period of comparison at Brookings, Richland, an early maturing rust resistant variety, yielded 66.2 bushels per acre as compared to a yield of only 46.3 bushels for Swedish Select, a midseason variety. At Highmore the average yield of Richland for the same period of comparison amounted to 38.9 bushels per acre while Swedish Select yielded but 29.7 bushels. In other words, Richland yielded in the central part of the state 31 and in the eastern part 43 per cent more than Swedish Select. These are very significant differences in favor of the early maturing variety. It has been pointed out by Klages (6) that early varieties of oats in South Dakota can be expected to give not only greater average returns but also somewhat more constant yields, fluctuating less from season to season, than later maturing varieties.

TABLE 5.—Comparative average yields of oats varieties at four South Dakota stations for the number of years indicated.

Variety	S. D. Acc. No.	Brookings		Highmore		Eureka		Cottonwood
		5 yr. av. 1928-1932	3 yr. av. 1930-1932	5 yr. av. 1928-1932	3 yr. av. 1930-1932	3 yr. av. 1930-1932	2 yr. av. 1931-1932	1 yr. 1932
Richland	1042	55.2	45.9	22.9	26.8	41.4	45.1	45.0
Albion	1021	—	45.4	23.8	26.1	—	—	—
Kherson	1328	—	42.5	23.2	24.5	—	—	55.0
Iogold	1314	—	42.3	24.3	26.0	39.0	42.6	60.6
Gopher	1279	53.8	41.7	24.0	24.0	—	—	65.0
Sixty Day	165	50.7	40.4	23.8	26.9	37.4	39.1	—
Iowar	1254	51.0	39.8	21.6	23.5	—	—	—
Cole	316	48.2	39.0	23.3	26.7	37.2	41.5	56.3
Rainbow	1312	—	38.4	—	20.7	34.1	36.9	56.3
Iogren	1252	51.0	34.7	19.4	20.7	—	—	—
Silvermine	443	50.1	34.5	21.3	18.2	—	26.2	—
Swedish Select	112	46.5	33.6	21.2	19.5	35.2	37.8	50.6
Minota	1240	48.3	33.0	19.5	18.8			
White Russian	640	43.1	27.5	13.2	10.4			

Varieties recommended for the eastern portion of the state are Richland, Iogold, Albion and Gopher. Preference is given to the first two varieties on account of their resistance to stem rust. The last two varieties have given high yields but may, due to their lack of resistance to stem rust, be expected to yield less than the first two varieties named in the event of an early rust epidemic. Since they are early maturing they will escape

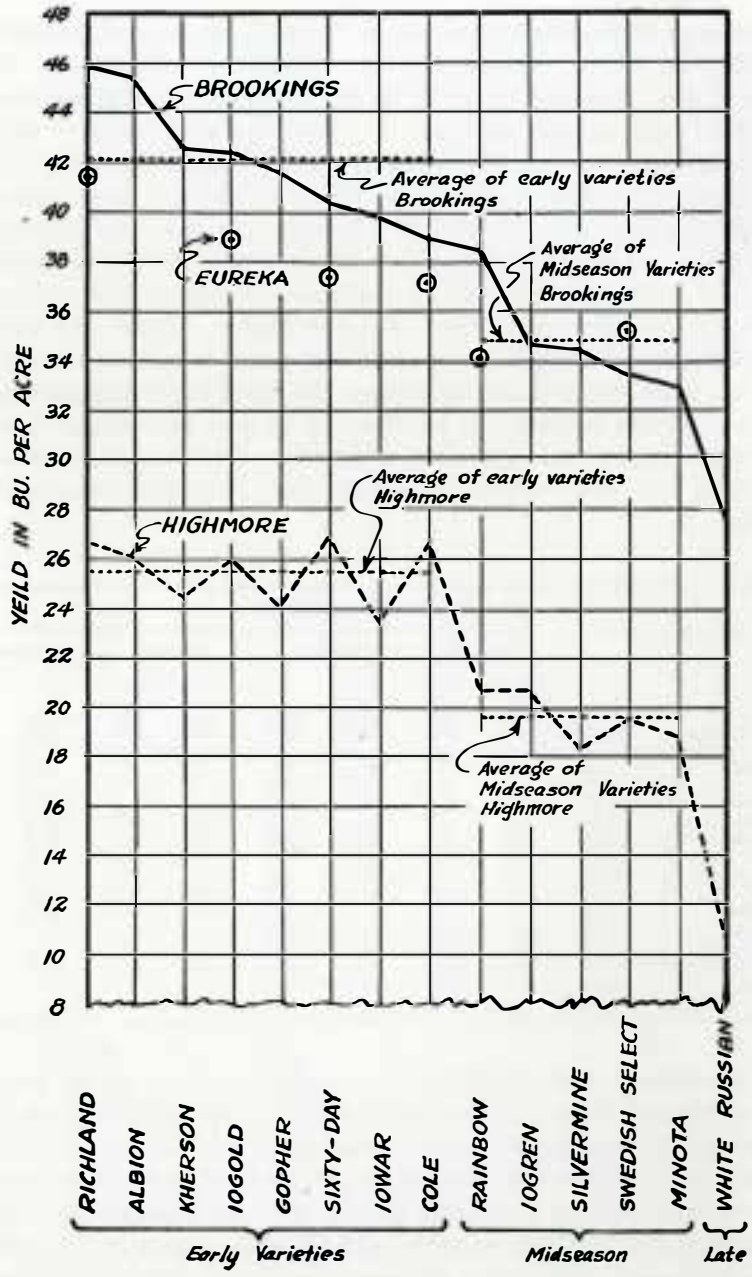


Fig. 15.—Comparative yields of varieties of oats at Brookings, Highmore, and Eureka, 3 year averages, 1930-1932.

rust epidemics occurring during the later part of the growing season. Growers objecting to the growth habits of early varieties, especially to the shortness of the straw produced by them and the conflict in labor distribution on the farm between an early oats harvest and corn cultivatioin, may grow such varieties as Rainbow, a selection from Green Russian, or Silvermine. These later maturing varieties cannot, however, be grown without entailing over a period of years a sacrifice in grain yields. This is indicated by the tabulated yield data. The Rainbow variety is recommended to growers demanding a later maturing variety and to those desiring a larger quantity of good quality of oats straw than can be produced by the short strawed early types. Rainbow is immune to stem rust and is for that reason more desirable than Silvermine.

As indicated in Fig. 16, the varieties recommended for the northern portion of the state are Richland, Iogold, Rainbow and Swedish Select. Richland is recommended especially for locations where due to danger of lodging, a stiff strawed oats is demanded. The tabulated yield data from Eureka show that higher grain yields can be expected from the early than from the later maturing types also in this area. The differences in the yields of these two types are, however, not as great as at Brookings and Highmore.

Richland, Iogold, Albion, Gopher, and Cole are good varieties for the central and western parts of the state. Since stem rust epidemics are less likely in this area than to the east less attention need be given to rust resistance.

Barley Varieties

Table 6 gives the comparative average yields of barley varieties grown in the regular variety test plots at four South Dakota stations. Fig. 17 shows the diagramatic arrangement of the tabulated yield data.

Trebi was the highest yielding variety of barley both for the six and eight-year period of comparison in the regular variety test plots at Brookings. The yields of Trebi were, however, only 0.4 and 1.5 bushels per acre more than those obtained from Odessa for the two respective periods. Other high yielding varieties were the hybrid Lion x Manchuria, Glabron and Horn.

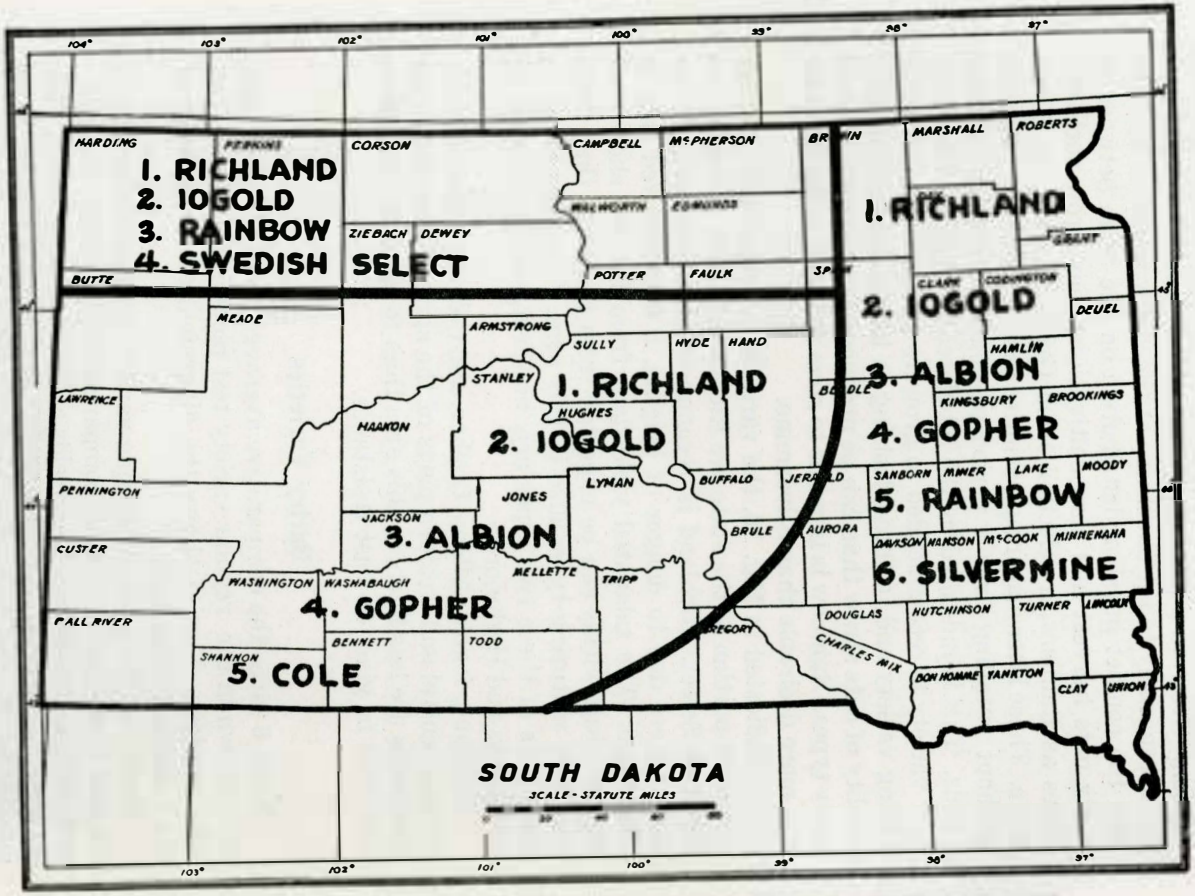


Fig. 16.—Varieties of oats recommended in various sections of South Dakota listed in order of preference.

Velvet and Oderbrucker gave significantly lower yields than Odessa.

The highest yielding varieties at Highmore were Lion x Manchuria, Ace, White Smyrna x Svanhals and Glabron. Other high yielding varieties were Coast x Lion, Horn and Minsturdi. These varieties yielded more than either Odessa or Trebi.

Only two years of yield data are available from Eureka. The high yielding varieties were Odessa, White Smyrna x Svanhals, and Binder. The last two varieties are two rowed barleys.

TABLE 6.—Comparative average yields of barley varieties at four South Dakota stations for the number of years indicated.

Variety	S. Dak. Acc. No.	Brookings 8 yr. av. yields 1927-1934	Brookings 6 yr. av. yields 1927-1932	Highmore 5 yr. av. yields 1928-1932	Eureka 2 yr. av. yields 1931-1932	Cottonwood 1 year 1932
Trebi	1298	39.2	43.6	15.2	---	53.8
Odessa	182	37.7	43.2	15.7	30.9	45.0
Lion x Manchuria	1340	37.0	42.9	21.0	27.8	37.5
Glabron	1290	35.0	40.0	17.6	26.9	50.0
Horn	1299	34.9	41.5	16.7	25.6	46.3
Minsturdi	1245	32.1	38.7	16.5	---	---
Velvet	1286	29.8	35.6	---	---	---
Oderbrucker	1180	28.4	35.5	13.8	---	---
Ace	1173	---	36.4	18.9	---	49.2
White Smyrna x Svanhals	1344	---	---	18.0	30.6	48.2
Coast x Lion	1343	---	---	16.8	24.0	32.1
White Gatami	889	---	---	16.1	---	37.9
Binder	1269	---	---	15.4	29.9	45.8
Hannchen	20	---	---	---	21.1	---

Trebi and Glabron were the highest yielding varieties in the one year test at Cottonwood. But little significance can, of course, be attached to a test extending only over one year.

Due to the present interest in malting types of barley and since one of the more prominent of these barleys, namely Wisconsin 38, has been grown in the regular variety test plots for only two years, the annual and average yields of important varieties of barley grown in the rod row nursery plots at Brookings and Highmore are presented in Table 7. Klages (10) pointed out rather high and significant correlations between the yields of cereal crops in regular variety test and rod row nursery plots at Brookings. High yielding varieties in the nursery tests at Brookings were Trebi, Ace, Odessa, Wisconsin 38, Lion x Manchuria and Glabron. Ace, Trebi, and Lion x Manchuria stand out as high yielding varieties in the two year test at Highmore.

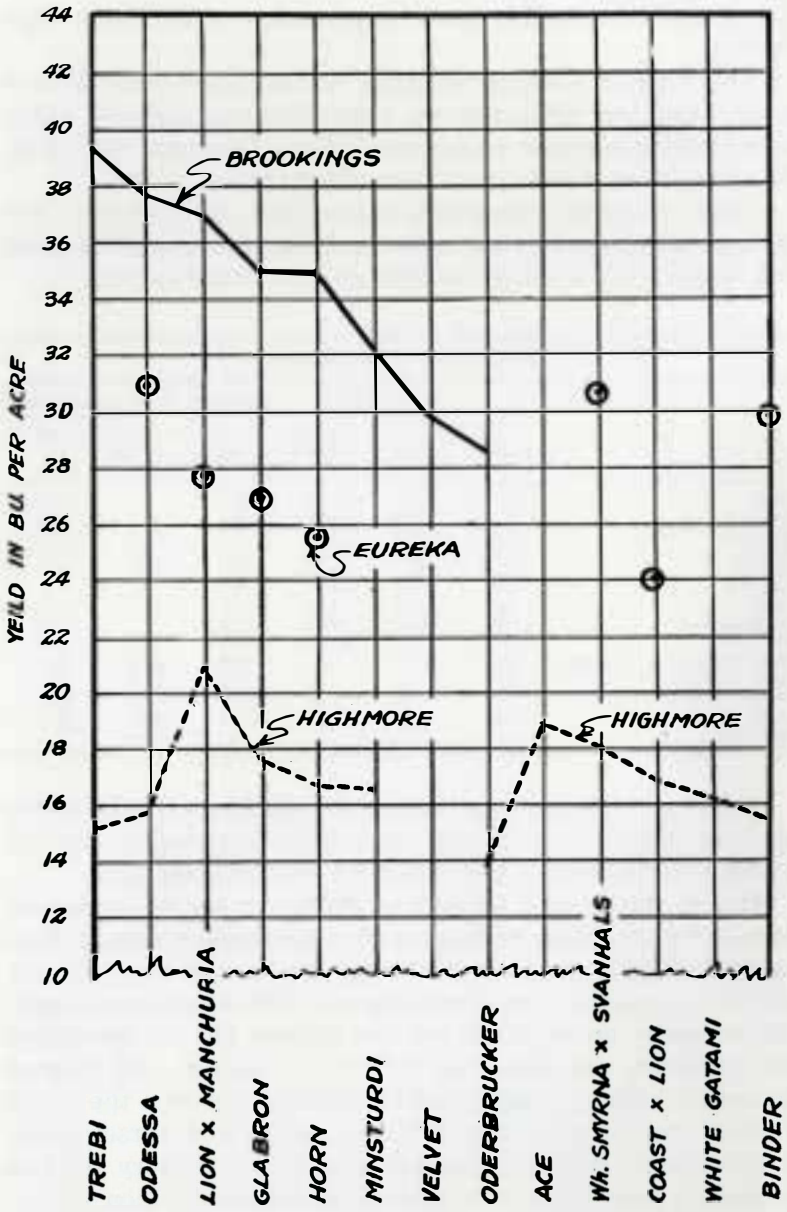


Fig. 17.—Comparative yields of varieties of barley at Brookings, Highmore, and Eureka, 8 year averages at Brookings, 1921-1928, 5 year averages at Highmore, 1928-1932, and 2 year averages at Eureka, 1931-1932.

Wisconsin 38, a late maturing six-rowed smooth awned barley, gave good yields at Brookings but very poor returns at Highmore. The varieties included in both the regular variety test and the nursery plots stand in much the same relationship as to relative yielding capacities in the two sets of trials.

TABLE 7.—Annual and average yields of important varieties of barley grown in the nursery plots at Brookings and Highmore for the number of years indicated.

Rank	Variety	Yields in bushels per acre 1929	1930	1931	1932	Average Yields
		Yields at Brookings				
1.	Trebi	57.2	38.1	31.4	41.4	42.0 ± 1.93
2.	Ace	49.6	37.1	30.6	42.2	39.9 ± 1.74
3.	Odessa	56.1	35.0	25.1	40.8	39.3 ± 1.84
4.	Wisconsin 38	52.7	39.5	29.4	41.8	39.1 ± 1.78
5.	Lion x Manchuria	49 5	36.4	28.9	39.7	38.6 ± 1.71
6.	Glabron	44.1	40.8	30.4	38.5	38.5 ± 1.62
7.	White Smyrna x Svanhals	47.9	36.0	24.9	43.3	38.0 ± 1.65
8.	Horn	48.7	26.9	23.9	46.8	36.6 ± 1.62
9.	Spartan	43.8	35.5	24.2	31.4	33.7 ± 1.52
10.	Velvet	45.8	25.0	24.9	38.0	33.4 ± 1.52
11.	Minsturdi	34.0	37.0	23.5	36.8	32.8 ± 1.32
12.	White Smyrna	35.8	28.1	22.2	40.8	31.7 ± 1.29
13.	Manchuria	39.6	34.5	18.5	33.0	31.4 ± 1.38
14.	Oderbrucker	40.5	29.5	15.1	33.0	29.5 ± 1.35
	Probable error of experiment in per cent	11.47	7.09	7.84	4.15	
		Yields at Highmore				
1.	Ace			17.4	55.5	36.5 ± 3.12
2.	Trebi			11.4	45.8	28.6 ± 2.28
3.	Lion x Manchuria			12.5	41.9	27.2 ± 2.32
4.	Spartan			11.0	41.4	26.4 ± 2.27
5.	White Smyrna			11.9	40.7	26.3 ± 2.26
6.	Horn			9.6	38.7	24.7 ± 2.10
7.	Glabron			14.4	33.7	24.1 ± 2.05
8.	White Smyrna x Svanhals			9.9	38.0	24.0 ± 2.07
9.	Minsturdi			9.3	33.7	21.5 ± 1.86
10.	Odessa			10.4	28.7	19.6 ± 1.66
11.	Velvet			9.5	27.6	18.6 ± 1.58
12.	Manchuria			7.5	27.2	17.4 ± 1.49
13.	Wisconsin 38			4.0	25.5	14.8 ± 1.33
14.	Oderbrucker			5.5	10.2	7.9 ± 0.68
	Probable error of experiment in per cent			15.60	10.11	

Fig 18 gives the barley producing areas of the state with the varieties recommended in each area.

The data obtained at Brookings should provide a good basis for recommendations for the eastern third of the state. Trebi gave the highest average yields in both the regular variety test and rod row nursery plots. Trebi is a feed barley and does not command the prices paid for malting barleys. Furthermore, when the differences in the yields of Trebi, a feed, and Odessa, a malting type of barley, are analyzed in the light of their variability they are too small to be of significance. Trebi yielded 0.4 and 1.5 bushels per acre more than Odessa in the

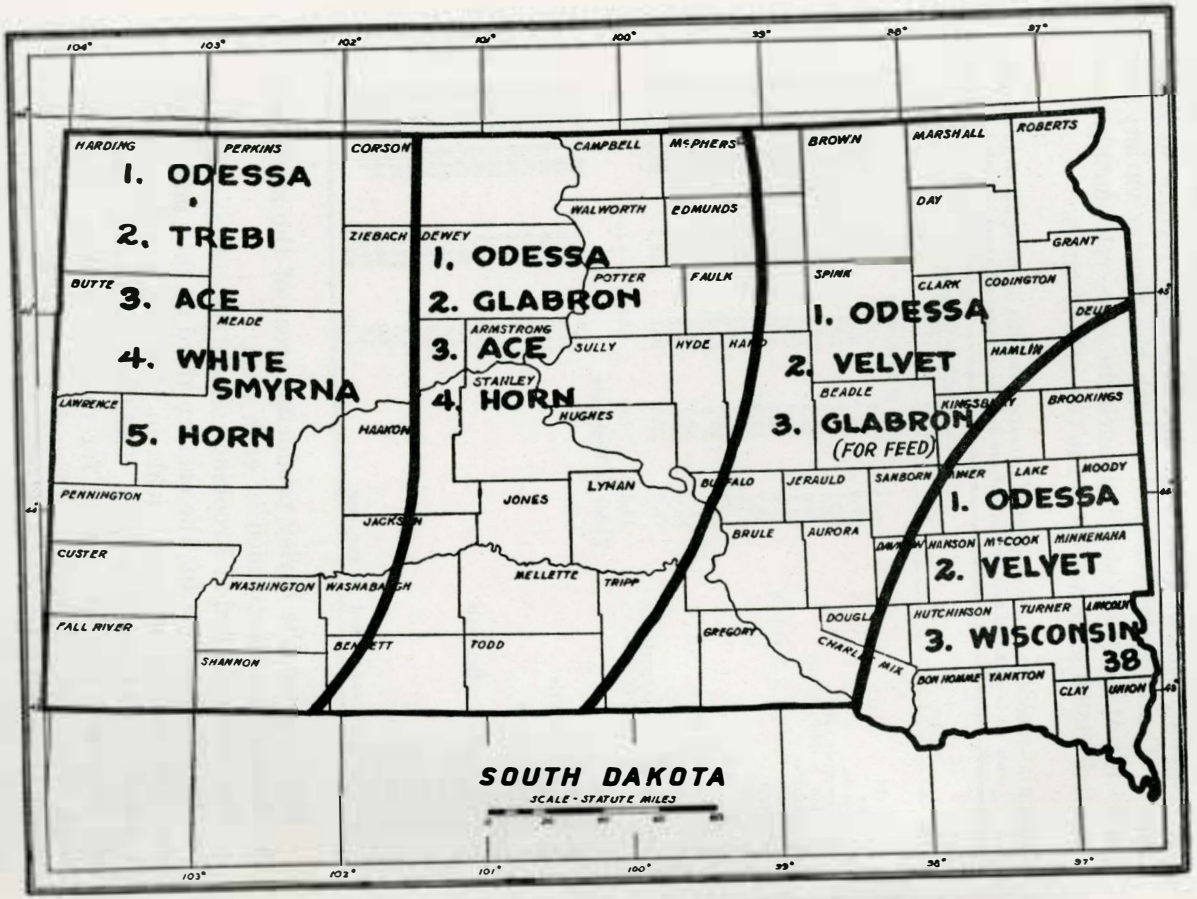


Fig. 18.—Varieties of barley recommended in various sections of South Dakota listed in order of preference.

regular variety test plots and 2.7 bushels more than Odessa in the nursery tests. When the yields of these two varieties in the regular variety test plots are compared on a probable error basis by "Student's" method, the odds are approximately 1:1 and 1:2, respectively, for the six and the eight-year period of comparison, thus showing definitely that the one is not superior in yielding capacity to the other. This is true especially when the yielding capacities in fairly normal seasons are considered, the odds are greater in the eight-year period of comparison, including the abnormally hot seasons of 1933 and 1934, than for the six year period of comparison, made up of fairly normal seasons with the exception of 1931, which was hot at heading time. The four year average yields of Trebi in the nursery tests were 42.0 $\pm$ 1.93 bushels as against 39.3 $\pm$ 1.84 bushels per acre for Odessa. When the probable errors* are taken into consideration it is evident that the difference in the yields of these two varieties is not great enough to be significant. The difference in the average yields of Trebi and Odessa in the four year nursery test, extending from 1929 to 1932 inclusive, is largely accounted for by the lower yield of Odessa in the dry and hot season of 1931. In the other three years of the test the differences in the yields of these two prominent varieties fell well within the limits of the experimental error.

During the seasons of 1930, 1931 and 1932 the Extension Agronomist and the Agronomy Department conducted extensive cooperative barley variety tests in the northeastern portion of the state; to be specific in Brown, Codington, Day, and Marshall counties. In eleven such tests Trebi yielded 33.4 bushels as compared to 32.4 bushels per acre for Odessa. These results agree nicely with the results of the more comprehensive tests at Brookings.

Supported by the yield data cited, and keeping in mind that Odessa is a malting type and Trebi only a feed barley, Odessa is recommended as the best variety so far available for the eastern third of South Dakota. Since mixtures of these two

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*Yields were analyzed by the probable error method, using the formula P. E. $= .6745\sqrt{\frac{\Sigma D^2}{N(n-1)}}$ given by Hayes and Garber (3).

varieties are very objectionable it is highly desirable to keep Trebi out of the section of the state with climatic conditions generally favorable to the production of malting barley. Trebi is being grown extensively as a feed barley; in very dry and hot seasons it can be expected slightly to outyield Odessa, but over a period of years the yield differential in these two varieties will be slight. On the basis of the yield data available there is little justification for the production of Trebi in the eastern third of the state.

The smooth awned hybrid Lion x Manchuria gave practically as high returns in both sets of tests as Odessa. Tests are being conducted on the malting characteristics of this variety at the present time. It will not be distributed until malting data is available.

Glabron is the highest yielding commercially important smooth awned variety tested in the variety test plots at Brookings. This variety is outstanding from the standpoint of strength of straw. At Brookings it yielded 2.7 bushels per acre less than Odessa. In ten cooperative experimental tests, in the counties previously mentioned, Odessa yielded 29.7 bushels as compared to 26.3 bushels per acre for Glabron. Glabron has many desirable characteristics, but it is more of a feed than a malting barley. Growers expecting to produce malting barley are advised to grow either Odessa, or Velvet, if they have a special preference to smooth awned barleys.

Velvet yielded decidedly less than Odessa at Brookings. In eleven cooperative tests in the eastern part of the state Velvet yielded 6.4 bushels per acre less than Odessa. Velvet produces however, a good type of malting barley and is recommended to growers wishing to grow a smooth awned malting variety.

Wisconsin 38, a new smooth awned malting barley, has been tested for four years in the rod row nursery trial and for only two years in the regular variety test plots. In the latter set of plots it yielded 18.3 bushels as compared to 21.2 bushels per acre for Odessa. These yields were obtained in the very dry seasons of 1933 and 1934. In the four year nursery tests at Brookings, Wisconsin 38 gave practically the same yields as Odessa. Wisconsin 38 is about a week later than Odessa; that it is entirely too late for the central part of the state is shown

by the decidedly low yields at Highmore where Odessa yielded 19.6 bushels as compared to only 14.8 bushels per acre for Wisconsin 38. Because of its lateness this variety is recommended only in the southeastern section of the state.

Odessa, Glabron, Ace, and Horn are recommended in the central part of the state. Glabron is more of a feed than a malting barley. Ace and Horn are two-rowed varieties and are consequently not used for malting purposes. Varieties recommended for the far western portion of the state are Odessa, Ace, White Smyrna, Horn, and Trebi.

Flax Varieties

Table 8 gives the average comparative yields of flax varieties grown at four South Dakota stations. Fig. 19 shows these yields diagramatically.

TABLE 8.—Comparative average yields of flax at four South Dakota stations for the number of years indicated.

Variety	C. I. No.	Brookings 5 yr. av. 1928-1932	Brookings 4 yr. av. 1929-1932	Highmore 5 yr. av. 1927-1932	Highmore 4 yr. av. 1929-1932	Eureka 4 yr. av. 1927-1932	Cottonwood 1932
Bison	389	13.3	11.0	—	3.5	5.8	7.0
Redwing	320	—	10.0	4.8	4.1	5.5	—
Linota	387	—	9.3	5.1	4.3	4.8	9.7
Rio Long	280	—	9.3	—	3.3	4.8	—
Buda	326	10.3	8.9	—	2.9	3.7	7.3
N. D. R. 114	13	9.2	8.4	4.5	3.7	5.4	7.7
Commercial Argentine	—	—	8.2	—	3.7	5.2	7.0
Damont	3	—	7.7	3.2	1.6	4.7	—

Bison and Redwing were, as brought out by the data at Brookings, the highest yielding varieties in the eastern part of the state. Disease resistance is very important in flax. Since Bison is resistant to both flax wilt and rust and shows good yielding capacity, it is recommended especially for the eastern part of the state. Redwing is also a good variety; it is resistant to wilt and fairly resistant to rust but has not yielded quite as well as Bison.

Bison and Redwing are also the highest yielding varieties at Eureka, thus indicating that they are well adapted to the northern portion of the state.

Bison yielded less than either Linota or Redwing at Highmore. Linota and Redwing are early maturing varieties; Bison seems to be too late to give highest yields in the central part of the state.

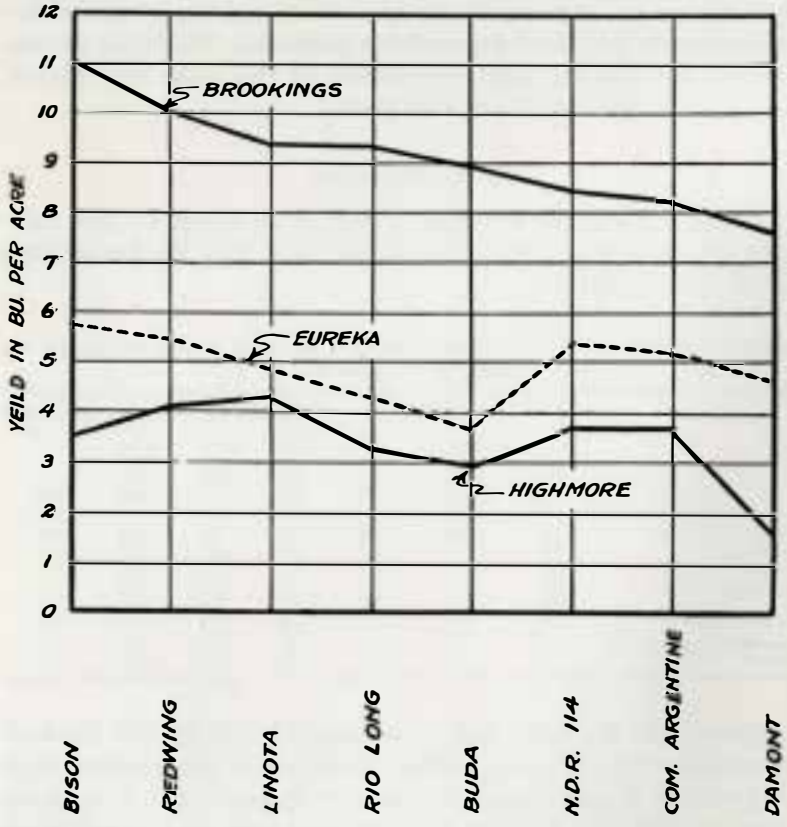

Fig. 19.—Comparative yields of varieties of flax at Brookings, Highmore, and Eureak, 4 years average, 1929-1932.

Linota was the highest yielding variety in the one year test at Cottonwood.

Fig. 20 shows the varieties recommended in the various portions of South Dakota. Bison, a large seeded type, and Redwing

a small seeded variety, are recommended for the eastern and northern areas while Linota and Redwing are recommended for the central and western portions of the state.

Rye Varieties

Winter rye can be grown in all counties of South Dakota. As in winter wheat, so also in the case of winter rye, the prime prerequisite of a good variety for South Dakota conditions is winter-hardiness. Winter rye is hardier than winter wheat and can be grown with safety even in the northern counties of the state. Varieties recommended are Swedish, Advance, Dakold and local hardy strains. Rosen rye has given fair returns in the eastern part of the state. Since Rosen is not as hardy as the varieties mentioned above it is not recommended.

Summary

The varietal recommendations of the various cereal crops and for flax for the different areas of the state are briefly summarized in the following outline.

Crop	Varieties recommended	Main characteristics of varieties and remarks	Area of state where recommended
1. Hard red spring wheat	1. Ceres	Awned, high yielding, good quality, strong straw, fairly resistant to stem rust.	Entire state
	2. Marquis	Awnless, excellent quality, susceptible to stem rust.	Central and western
	3. Reward	Awnless, early maturing.	North-central
2. Durum wheat	1. Mindum	High yielding good quality.	Entire state especially eastern part
	2. Kubanka	Much of seed available is badly mixed.	Central and western
3. Hard red winter wheat	1. Minturki 2. Turkey 3. Beloglina	All awned and hardy, good quality, high yielding.	Southern and east-central

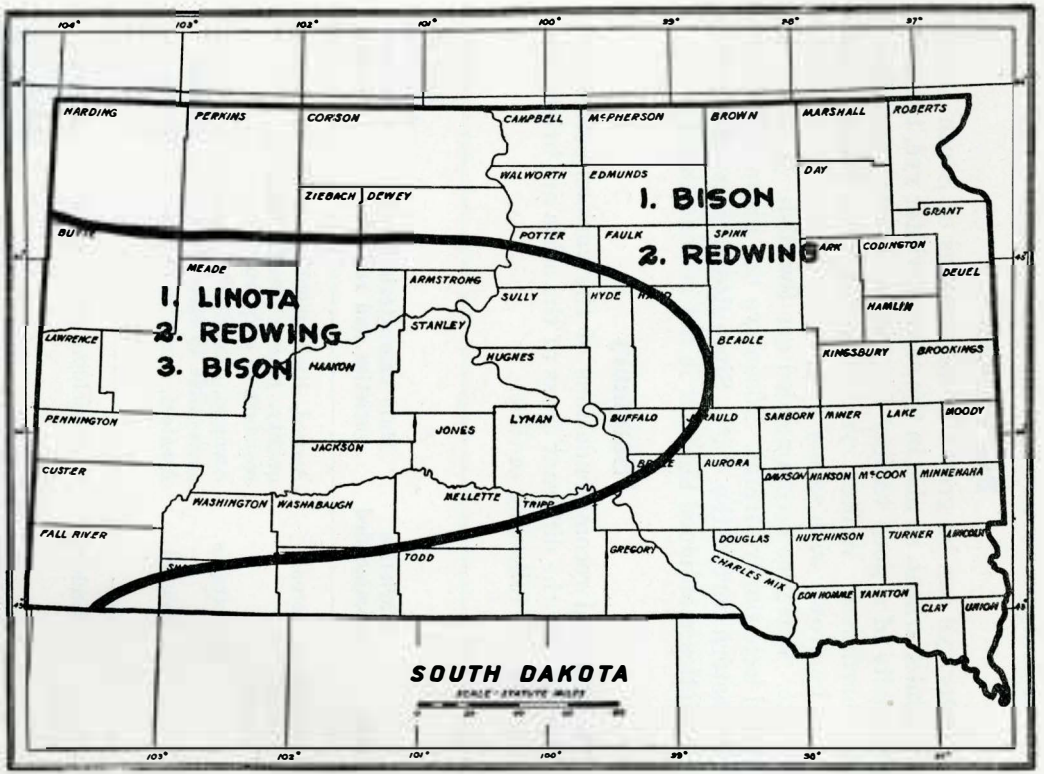

Fig. 20.—Varieties of flax recommended in various sections of South Dakota in order of preference.

4. White wheat	Not recommended for any part of South Dakota		
5. Oats	1. Richland	Early, yellow, stiff strawed resistant to stem rust.	Entire state
	2. Iogold	Early, yellow, slightly taller than Richland, resistant to stem rust.	Entire state
	3. Albion	Early, white kernelled	Eastern and central
	4. Gopher	Early, white, plump kernels, stiff straw.	Eastern and central
	5. Cole	Farly, white, rather weak straw	Central
	6. Rainbow	Mid-season, yellow, does not yield as high as early oats, good leafy straw	Eastern and northern
	7. Silvermine	Mid-season, white, yields less than Richland, not generally recommended, may be used by producers demanding a mid-season oat.	Eastern
	8. Swedish Select	Same remarks as for Silvermine.	Northern
6. Barley	1. Odessa	Six-rowed, rough awned malting type.	Entire state
	2. Velvet	Six-rowed, smooth awned malting type, excellent quality, yields less than Odessa	Eastern third of state
	3. Wisconsin 38	Six-rowed, smooth awned malting type, late maturing	South-eastern
	4. Glabron	Six-rowed, smooth awned feeding type, objected to by malsters, good straw. Recommended for growers desiring a smooth awned feed barley	Eastern and central
	5. Trebi	Six-rowed, rough awned, strictly feed type, should be kept out of sections attempting to produce prime malting barley	Central and western
	6. Horn	Two-rowed, pearling type, long straw	Central and western

	7. White Smyrna	Two-rowed, short straw, pearling type, adapted to dry areas	Western
	8. Ace	High yielding selection from White Smyrna	Central and western
7. Flax	1. Bison	Large seeded, late, resistant to flax wilt and rust	Eastern and northern
	2. Redwing	Small seeded, resistant to flax wilt and fairly resistant to rust	Entire state
	3. Linota	Small seeded, resistant to flax wilt, early	Central and western
8. Rye	1. Swedish 2. Advance 3. Dakold 4. Local hardy strains	Hardy and surest fall sown grain crop	All parts of the state

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