4-1956

Agricultural Research at the Central Substation, Highmore, South Dakota: A Progress Report

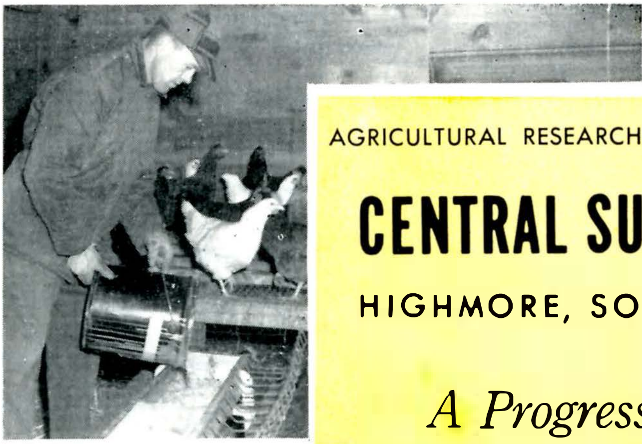
W. Pringle
South Dakota State University

F. Westin
South Dakota State University

G. Buntley

B. Brage

CIRCULAR 124 ⬥ APRIL 1956



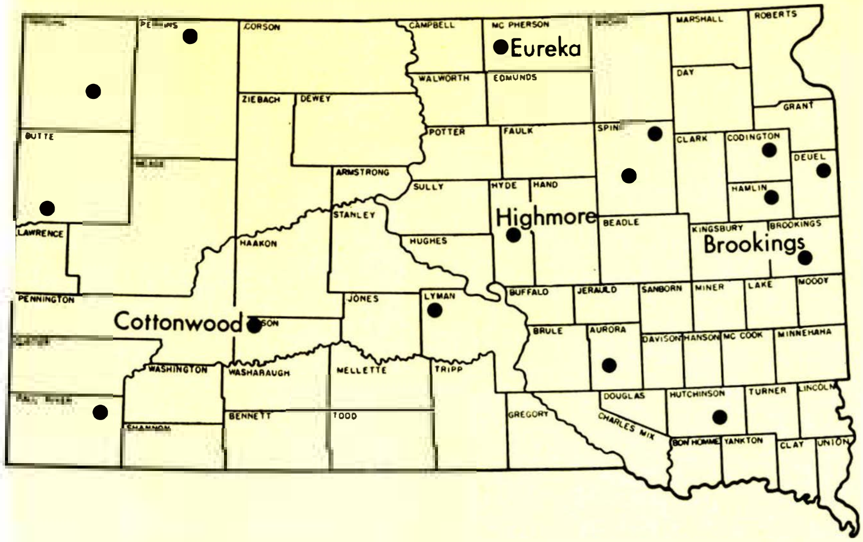
AGRICULTURAL RESEARCH AT THE

CENTRAL SUBSTATION

HIGHMORE, SOUTH DAKOTA

A Progress Report

AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE
College Station, Brookings, South Dakota



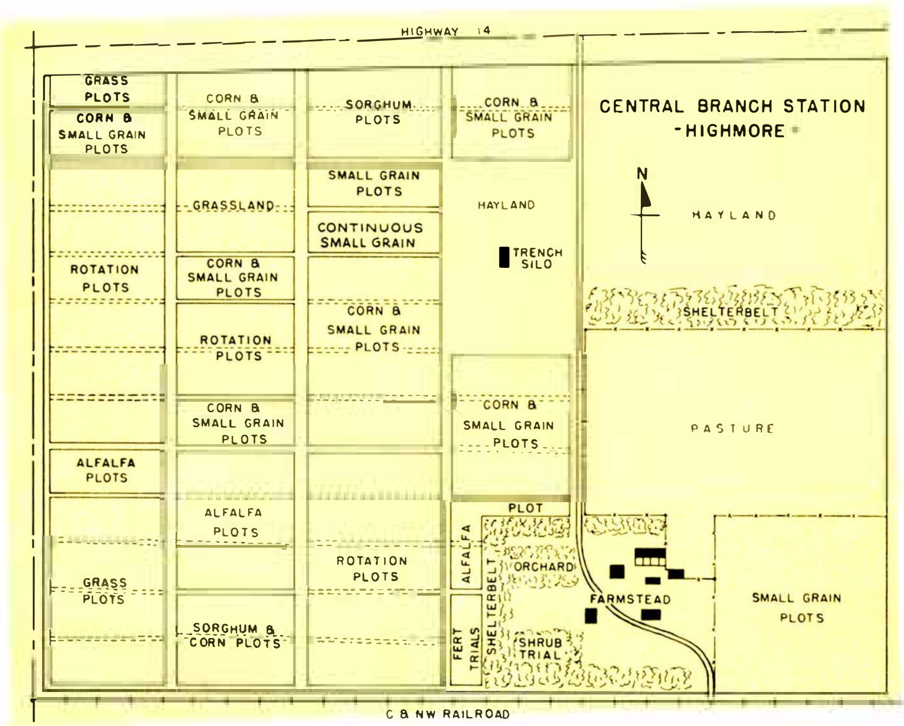
Areas where research is being carried on by the South Dakota Experiment Station. Locations are indicated by the black circles.

Superintendent Wade Pringle and family.

Contents

COVER—(Top) The superintendent caring for birds on an egg performance test. (Center) A group of farmers watch a top grafting demonstration at a field day. (Bottom) A small grain nursery where hundreds of new strains are grown in rows and tested for adaptability for the Highmore area.

Farmstead and layout of experimental plots of the Central Substation



A Note from the Superintendent

CENTRAL SUBSTATION has been serving central South Dakota for over 50 years. It was established in 1901 on land deeded to the state by Mr. and Mrs. Frank Drew in 1899. There are 117.15 acres, and the location is immediately northwest of Highmore on Highway 14.

For many years the research was conducted under the watchful eye of the late Steve Sussex. He served as superintendent from 1908 to 1948. After Mr. Sussex retired, he and Mrs. Sussex continued to live at the substation. I became superintendent in 1950 and found his counsel very helpful in carrying on the research activities. Gerald Keehn had served as superintendent from 1948 to 1950.

Much has been accomplished at the station since the original one-tenth-acre plots were laid out permanently in 1908. In July 1932, crop yields over a 19-year period were summarized in Experiment Station bulletin 272.

Four types of crop rotations were started in 1912 and have been continued ever since. The fruits of these trials are perhaps just being realized. That is the great value of your experiment stations. They formulate recommendations from results obtained over 5 or 10 or even 40 years or more of research—not just a year or two.

Extreme care must be taken to avoid errors in our results. That is why we use long-time research results and repeat each trial a number of times and at various locations. Highly trained scientists of the State Experiment Station staff help us conduct the research.

We find that people of this area have a friendly feeling toward the substation and its activities. Results of the research have been brought to their attention through field days and reports in newspapers and publications.

When Mr. Drew donated the land for the substation he said that knowledge secured from this land would serve as a basis for farming. We should keep his foresight in mind.

Wade Pringle

Soil and Weather

BETWEEN THE Missouri River and the James River lowland lies an unevenly dissected upland called the Missouri Coteau. This plateau-like highland is about 75 miles wide at the North Dakota boundary and narrows to the south where it ends in the southeast corner of Charles Mix County.

The Missouri Coteau is characterized by several conspicuous sags which traverse it in a general east-west direction. One of these, called the Great Ree Valley by Todd,[1] traverses Hughes, Hyde, and Hand Counties. The Great Ree Valley, although lower in elevation than the Orient Hills, which bound it on the north, and Ree Heights, which bound it on the south, has an elevation of about 1,890 feet. This is higher by several hundred feet than the James River lowland to the east.

This valley is thought by Flint[2] to have been the bed of the east flowing preglacial Bad River. The Highmore substation is located in this wide flat valley-like sag of the Central Missouri Coteau.

Topography and Climate

The landscape of the Highmore substation is nearly level to gently undulating and consists of low rounded hills interspersed with large flats. In detail the low hills and flats are dotted with numerous depressions of all sizes, most of which are closed.

Although some streams have developed on the Missouri Coteau, most of the surface runoff in the Highmore area drains into local depressions where it either evaporates or slowly leaches into the soil.

Nearly all of the Missouri Coteau has been glaciated and in the area around Highmore and on the substation itself glacial till is the parent material of the soils. The till of the substation is of Mankato age.

Climate of the Highmore area is typically continental with extremes of summer heat and winter cold and rapid changes of temperature. Average annual precipitation is between 17 and 18 inches with most of it falling in the spring during frontal storms. Less rainfall is received during the conventional thundershower type of summer storm.

Soil Types

The soils of the Highmore substation have developed on nearly level slopes and in shallow basins (see soil map). The soils of the gentle slopes are: Williams loam and Williams loam, deep phase. These are classified as chestnut soils so named because of their color. The Williams soils, which are loams, have quite

[1]Todd, J. E., 1885. The Missouri Coteau and its moraines. Am. Assoc. Proc. 33, 1884, p. 381-393.

[2]Flint, R. F., "Pleistocene Geology of Eastern South Dakota," USGS Prof. Paper 262, 1954.

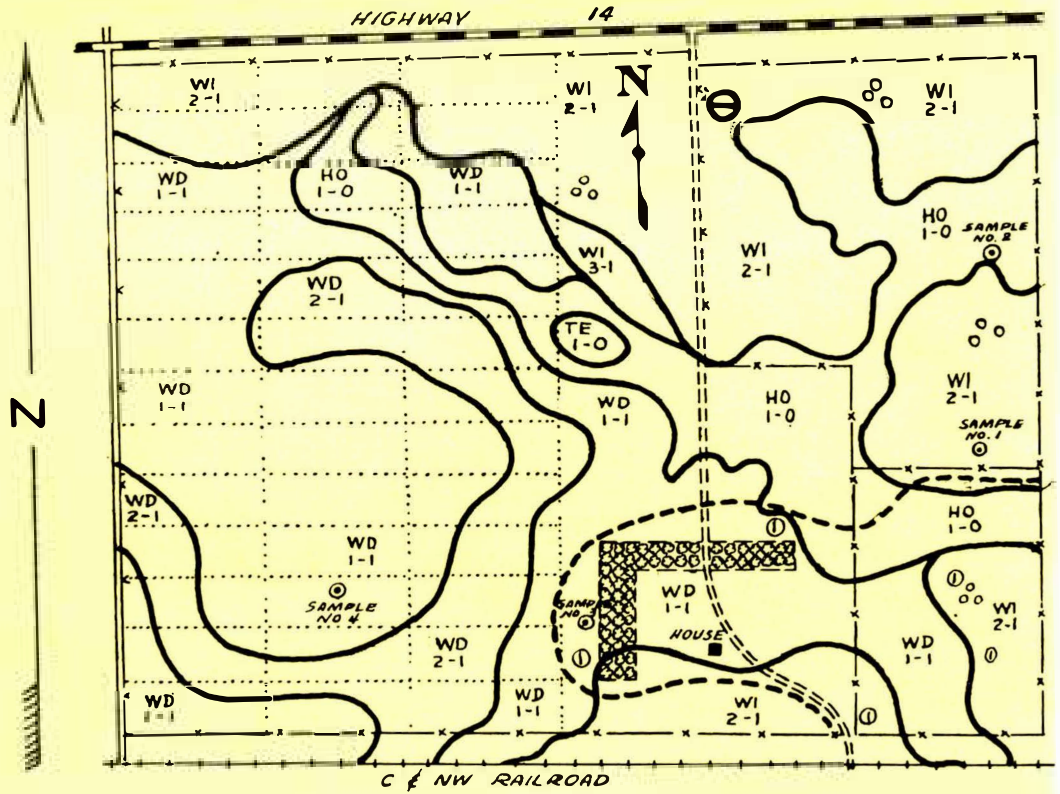
Explanation of Symbol

WI
2-1

Where W is Soil Symbol, 2 is slope (in %) and 1 is erosion (1 — slight, 2 — moderate, 3—severe).

Soils

WI—Williams loam
WD—Williams loam deep phase
HO—Hoven
TE—Tetonka
⁂ Stone symbol
- - - area included appears to have been leveled



Soils map of the Central Substation, Highmore.

lightly oxidized colors in the B horizons. In the deep phase of the Williams soil, the horizon of calcium carbonate accumulation occurs at about 22 inches, while it is found at about 15 inches in the regular Williams soil. The calcium carbonate is found in disseminated form.

Soils of the shallow basins are Hoven silty clay loam and Tetonka silt loam. The Hoven is classified as a Solonetz soil and its profile consists of a thin gray A horizon over a thick, black, dispersed B horizon which is only very slowly permeable. Below the B horizon is usually found a saline-alkali substratum.

The Tetonka soil is classified as a solod soil. Its profile consists of a thick gray platy A horizon over a strongly degraded B horizon. Its substratum is usually leached free of salts, alkali, and calcium carbonate. This soil occupies the depressed spots in a Hoven basin or it may occur in a depression associated with the Williams soils.

Some characteristics and qualities of the soils at the Highmore substation are given in table 1.

Table 1. Characteristics and Qualities of the Soils at the Highmore Substation

Soil Symbol	Soil Type	Topographic Position	Natural Drainage	Effective Depth	Texture of Surface Soil	Subsoil Texture	Subsoil Permeability	Kind of Underlying Material	Soil Classification
W	Williams loam	upland	well drained	deep	loam	clay loam	moderate	glacial till	Chestnut
WD	Williams loam deep phase	upland	well drained	deep	loam	clay loam	moderate	glacial till	Chestnut
Ho	Hoven silty clay loam	basin	poorly drained	shallow	silty clay loam	silty clay	slow	clayey alluvium over glacial till	Solonetz
TE	Tetonka silt loam	depression	poorly drained	moderately deep	silt loam	silty clay	moderate to slow	clayey alluvium over glacial till	Solod

Soil Fertility

EVEN THOUGH the South Dakota soils have been cropped for a relatively short period, yields of crops are much lower than they should be because of improper soil management. It is, therefore, desirable to review the data from the soil management experiments at the Highmore substation to determine the more adaptable systems.

Soil experiments were begun at the substation in 1912 to investigate problems pertaining to the fairly level till soils in east central South Dakota. Some very fundamental research in soils was done in the early years at the substation. Results of these early experiments were published in two South Dakota Agricultural Experiment Station publications—bulletin 272 "Crop Yields Over Nineteen Years from Highmore Experiment Farm," 1932, and bulletin 325, "Thirty Years of Soil Fertility Investigations in South Dakota," 1938. These early experiments were reduced sharply in the early thirties due to lack of funds.

Soils research discussed in this publication will concern investigations made after 1942 when funds were again available. The problems reviewed will include: (1) effect of crop sequence on crop yield, (2) effect of tillage and soil treatment on crop yield, and (3) effect of fallow and sorghum on the following wheat crop yield.

Crop Rotation

Continuous cropping to small grain versus alternate cropping of small grain with other crops is always a question under dryland farming. With this question in mind, an experiment involving a comparison of crop sequences was established in 1942. It included the following: (1) continuous wheat, (2) corn-wheat, (3) sorghum-wheat, (4) corn-wheat-sweet clover fallow, (5) sorghum-wheat-sweet clover fallow, and (6) fallow-wheat. The data from these crop sequences are presented in table 2.

When wheat was grown continuously, the yields decreased as much as 9 bushels per acre during the time interval from 1942 to 1955. Where either fallow or sweet clover fallow were used, yields remained at essentially the same level in 1955 as in 1942. Inclusion of a row crop in the crop sequence increased the yield of wheat considerably over yields obtained from continuous wheat. This was especially true in the latter period, 1954-55.

Yields of wheat following corn have been a bushel or two more than the yields following sorghum during all three periods. When sweet clover fallow was substituted for regular fallow (without the sweet clover) the wheat yields were slightly below those following regular fallow.

Table 2. Effect of Crop Sequence on the Yield of Spring Wheat

Crop Sequence	Av. for Period of Years		
	1942-47	1948-53	1954-55
	Bu/A	Bu/A	Bu/A
Continuous wheat	17.5	10.4	8.7
Sorghum-wheat	18.6	15.6	15.5
Corn-wheat	19.3	17.5	16.9
Sorghum-wheat-sw. cl. fallow	19.8	18.8	18.5
Corn-wheat-sw. cl. fallow	22.0	19.3	23.2
Fallow-wheat	23.9	20.2	23.3

Table 3. Effect of Crop Sequence on the Yield of Row Crop

Crop Sequence	Av. for Period of Years		
	1942-47	1948-53	1954-55
	Yield of Corn in Bu/Acre		
Corn-wheat	21.7	25.2	35.2
Corn-wheat-sw. cl. fallow	16.2	23.8	36.6
	Yield of Sorghum in Bu/Acre		
Sorghum-wheat	13.6	13.7	26.1
Sorghum-wheat-sw. cl. fallow	12.1	11.0	15.7

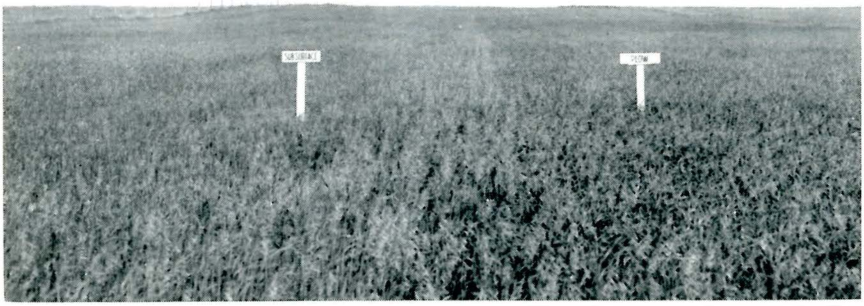
Corn has consistently yielded 5 to 10 bushels more grain than sorghum during the past 14 years of the study (see table 3). On the average, both row crops yielded approximately 2 bushels less when they followed sweet clover fallow than when they followed small grain. The greater depression in yield of sorghum following sweet clover fallow for the 1954-55 period was partially due to poor stand.

In years when moisture conditions were favorable in the Highmore area, corn following sweet clover fallow yielded more than when it followed small grain. In a favorable year, 1954, corn yielded 12 bushels more on the sweet clover fallow ground than on stubble ground. In a less favorable year, 1955, corn yielded 10 bushels less on the sweet clover ground than on the stubble ground.

Tillage Methods

The major expense item involved in grain farming is tillage. It is, therefore, of utmost importance to know which tillage method will be most beneficial in crop yield returns. Two experiments involving tillage were started in 1941.

In one experiment, two methods of tillage and three methods of soil treatment were compared in a sorghum-wheat-oats rotation. Methods of tillage were: (1) plow and (2) subsurface. Plowing was done in the regular manner. The subsurface operation was accomplished by use of the Nobel blade. Plowing and subsurfacing operations were completed in the fall. There were three



Comparison of the effect of tillage on oats crop in 1955. Oats after plowing yielded 48 bushels per acre while oats after subsurfacing yielded 36 bushels.

methods of soil treatment on both the plowed and subsurfaced plots. The three methods of soil treatments were: (1) all residues removed, (2) all residues returned, and (3) all residues removed, but 8 tons of manure applied per acre every 3 years after the oats was harvested.

For the 1942-47 period there was no real difference in yield of wheat between tillage methods or between soil treatment (see table 4). However, during the period of 1948-53 as well as 1954-55 there was a marked increase in yield of wheat when the soil was plowed compared to when the soil was subsurfaced.

During 1948-53 and 1954-55, plots which received 8 tons of manure every 3 years yielded 2 to 5 bushels more than plots which received no manure or residues. Manure and residues were more effective in increasing yields on the subsurfaced plots than the plowed plots, although the actual yields for each treatment were always less on the subsurfaced plots.

Yields of oats on soil that was subsurfaced were generally less than those that followed plowing during the entire period from 1942 to 1955 (see table 5 and the picture above.) The greatest yield depression for subsurfacing occurred in

Table 4. Effect of Tillage and Soil Treatment on Yield of Wheat in a Sorghum-Wheat-Oats Rotation

Treatment	Av. for Period of Years 1942-47 Plow	1942-47 Subsurface	1948-53 Plow	1948-53 Subsurface	1954-55 Plow	1954-55 Subsurface
	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
Residues removed	18.8	19.9	16.3	12.8	14.6	12.8
Residues returned	19.4	20.9	16.3	13.9	15.1	14.0
Manure	19.6	20.8	19.7	17.4	16.4	15.1
Average	**19.3**	**20.5**	**17.4**	**14.7**	**15.4**	**14.0**

Table 5. Effect of Tilage and Soil Treatment on Yield of Oats in a Sorghum-Wheat-Oats Rotation

Treatment	Av. for Period of Years					
	1942-47		1948-53		1954-55	
	Plow	Subsurface	Plow	Subsurface	Plow	Subsurface
	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
Residues removed	47.0	41.3	37.8	33.1	39.4	30.2
Residues returned	48.6	43.4	41.8	33.7	40.3	28.0
Manure	53.1	48.9	43.8	39.7	48.2	35.5
Average	**49.6**	**46.5**	**41.1**	**35.5**	**42.5**	**31.2**

Table 6. Effect of Tillage and Soil Treatment on Yield of Sorghum in a Sorghum-Wheat-Oats Rotation

Treatment	Av. for Period of Years					
	1942-47		1948-53		1954-55	
	Plow	Subsurface	Plow	Subsurface	Plow	Subsurface
	Lb/A	Lb/A	Lb/A	Lb/A	Lb/A	Lb/A
Residues removed	4734	3616	4169	2655	2784	2269
Residues returned	4646	3752	4264	3077	3024	2511
Manure	4926	3702	4171	3137	3221	2801
Average	**4769**	**3690**	**4201**	**2956**	**3010**	**2527**

1954 and 1955 when oats yielded 9 bushels less on subsurfaced soil than on soil that was plowed.

Manured plots yielded the most oats throughout the experiment. Yields from plots on which residues were returned were generally intermediate between the manured plots and those from which the straw and cane were removed.

Yields of sorghums were consistently higher when sorghum followed plowing rather than subsurfacing (see table 6). The difference in yield was due mainly to difference in stand. Stands were more difficult to establish on subsurfaced soil than on plowed soil. Small, but fairly consistent, increases were realized when manure was used in the rotation. Yield results show that the return of residues was also beneficial to the yield of cane.

Fallow

The second experiment started in 1941 was a comparison of the effect of fallow to that of sorghum on wheat yields. Both the fallow and sorghum plots had the following treatments: (1) all residues removed, (2) all residues returned, and (3) all residues removed, but 8 tons of manure every other year.

During the 1942-47 period there was very little advantage for planting wheat after fallow compared to planting wheat after sorghum (see table 7). Since 1948, however, wheat has yielded on the average

Table 7. Effect of Past Management and Soil Treatment on the Yield of Wheat in a Sorghum-Wheat or Fallow-Wheat Rotation

	Av. for Period of Years					
	1942-47		1948-53		1954-55	
	After Fallow	After Sorghum	After Fallow	After Sorghum	After Fallow	After Sorghum
	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
Residues removed	21.0	19.5	17.6	12.2	16.1	10.8
Residues returned	20.8	19.2	19.2	13.7	17.1	12.8
Manure	20.7	19.9	19.9	16.8	17.1	17.1
Average	**20.8**	**19.5**	**19.5**	**14.2**	**16.8**	**13.6**

about 5 bushels more when it followed fallow than when it followed sorghum. The loss of a year of cropping must, however, be taken into consideration before fallow is substituted for a row crop.

Manure had little effect on wheat yields during the 1942-47 period whether wheat followed fallow or sorghum. Since 1947, manure did not increase yields to any extent when the use of fallow was practiced; but when sorghum preceded wheat, the yield was generally 4 to 7 bushels greater for the manure treatment.

Small Grains

CENTRAL SUBSTATION at Highmore has been a key location in small grain breeding and testing ever since the station was established. It was here that Acme wheat, Cole oats, and Dryland barley were selected. It was here that Edgar McFadden made the plant selection that became Hope wheat—a variety that has so greatly affected wheat breeding for 30 years. This wheat, through its progeny, contributed immeasurably to the wealth of the area.

Yields and varietal performances at this station from 1942 through 1951 were summarized in South Dakota Agricultural Experiment Station bulletin 422. Changes in varieties occur frequently, and as a result, the yields used for this summary do not go back beyond 1948 (1947 in the case of winter grains). The tables for each crop furnish 1955 yields and test weights and 1948 to 1955 averages where applicable.

Since a great many new varieties made their appearance in 1952-53, averages for the 3-year period, 1953-55, also have been calculated. Notes on disease infection of varieties and observations on heat resistance and lodging are included in the tables.

Central South Dakota is a major small grain producing area, and its small grain income and production problems are very properly the concern of the plant breeder.

Certain varietal types, such as Rushmore wheat or Vikota oats, fit this area very well. These represent high levels of climatic adaptation, and breeding efforts are made to improve these types further.

In this area, production problems of both the humid and dryland areas appear. These problems are all serious enough to be considered. Stem rust of wheat, oats, and barley has been a major hazard; drought and heat have caused crop failures. Lodging has occurred in some years and grasshopper infestations in others. This multiplicity of hazards is typical of a transitional area and requires varieties with resistance to a wide variety of conditions if they are to continue in production. The problem is not impossible, for varieties have been produced which have been productive over long periods, involving many hazards.

Spring Wheat

Central South Dakota is part of the great hard red spring wheat area of North America, which has long been the source of the best quality milling wheats in the world. Keeping this reputation for high quality is vital to the grower because the quality of hard spring wheat makes it desirable in the markets of the world. Spring wheat varieties for central South Dakota must, therefore, have high market quality as well as adaptation and yielding ability. Table 8 lists the performance of wheat varieties at the Highmore station, and it is apparent that high yield and quality have been combined in varieties like Rushmore, Lee, and Selkirk, which are recommended for this area at present.

Yield of spring wheats in this area is affected by climate—especially variable rainfall, drought, and hot winds. Wheat diseases, especially steam rust, have greatly reduced yields in some periods. Severe stem rust in 1952-54, involv-

Table 8. Spring Wheat Yield Tests at Highmore, 1948-55

Variety	Yield in Bu/A. 1948-55 Av.	1953-55 Av.	1955	Test Wt. Lb./Bu. 1955	Stem Rust % 1955	Leaf Rust % 1955	Lodging Rating* 1955	Heat Damage* 1954
Bread Wheats								
Rushmore	21.4	24.5	24.7	59	10	40	1	7
Lee	21.4	23.5	21.3	59	15	10	5	5
Selkirk		27.6	26.2	56	8	20	2	5
Cadet	20.5	24.1	27.7	51	20	60	1	6
Ceres	19.1	18.9	22.1	59	40	50	5	9
Conley			21.6	57	T	5	3	7
Mida	20.1	20.1	21.9	60	28	50	3	6
N. D. 3			24.2	57	4	10	1	5
Pilot	19.4	20.6	22.7	59	30	40	6	9
Rival	17.3	17.5	20.7	58	40	45	2	8
Spinkota		23.0	28.4	61	15	40	4	3
Thatcher	20.1	21.4	21.3	58	22	50	2	9
3880-227			27.8	60	6	T	2	6
Marquis	17.5	16.6	19.7	56	40	40	1	9
R. H. 1935		25.5	22.7	59	3	3	2	5
Willet		25.8	21.6	59	2	T	1	7
Durum Wheats								
Vernum	16.5	15.4	22.7	62	20	5	6	7
Nugget		17.9	18.3	56	40	5	6	6
Stewart	18.8	16.4	23.9	61	50	5	1	5
Mindum	16.5	14.8	20.8	61	25	5	5	5
Sentry		24.1	25.4	62	5	0	5	6
Yuma			28.4	61	T	0	5	6
Ramsey			27.4	62	0	0	3	6
Towner			21.7	62	2	0	3	6
Langdon			25.9	60	2	0	3	4
Ld. 373			27.3	61	5	0	6	5
Least significant difference	1.4	2.5	5.7	—	—	—	—	—

*Where 1 is best, 10 poorest.

ing Race 15B, to which all varieties available at the time were susceptible, reduced the yields. High temperatures, as occurred in July 1954, reduce yields and test weights. Lodging can also be serious in this area in some years.

Consequently, a suitable variety, combining high quality and yielding ability, must have resistance to plant diseases and their specific races, as well as drought resistance, heat resistance, standability, and shattering resistance. The yield averages in the table reflect the degree to which this combination has been realized.

Central South Dakota is not a major durum wheat producing area. New varieties — Yuma, Ramsey, Towner, and Langdon—have been developed by the North Dakota Experiment Station and the USDA since Race 15B of stem rust practically wiped out the old varieties in 1952-54. These are being released to growers this year and will again make durum wheat a reasonable alternative to bread wheat.

Oats

Yield tests at the Highmore station have established the superiority of a very specific plant type in oats. The varieties that approach this type have been the high yielders under a wide variety of conditions.

This plant type, or ideal variety, has to be medium early in maturity, vigorous, with light green foliage and fairly high disease resistance. It has to make economical use of the available moisture to make maximum grain yields and will, therefore, be relatively short and fine strawed. Varieties that fit this pattern include Vikota, Osage, Dupree, Mo. 0-205, and Trojan. These are the varieties that in this area have have outyielded all the varied varieties produced for more humid or cooler conditions. This is evident from the yields reported in table 9.

Heavy strawed or late oats, such as the Bond-type varieties and the newer Canadian varieties, appear to be at a disadvantage, which becomes especially critical in years of midsummer drought, like 1954. In that year the late variety, Rodney, yielded only 29.8 bushels per acre—less than half the yield of Vikota. Such low yields are associated with light test weights. Grasshoppers, an ever present danger in central South Dakota, seem to have a preference for heavy strawed oats, probably because of its succulence.

Oat diseases, especially stem rust, are serious in this area in some years. In 1955 humid June and July weather favored stem rust, especially on the second growth tillers. The stem rust readings indicate the presence of at least three major races of oat stem rust and suggest caution in the selection of varieties for the coming years. The early variety, Ransom, may provide needed disease insurance combined with an adapted plant type.

Barley

Barley has been grown as a feed grain in this area since the turn of the century. Production of malting barley is not usually favored by climate; the frequent midsummer heat waves shrivel the grain and cause undesirable malting characteristics even in malting barley varieties.

The yield level of malting varieties, generally of Manchurian type, has been lower than that of the feed barleys bred for the Great Plains. These feed varieties are typically selections from crosses of Manchurian with Coast types or their derivatives. The Mediterranean ori-

Table 9. Oat Variety Tests at Highmore, 1948-55

Variety	Yield in Bu/A. 1948-55 Av.	Yield in Bu/A. 1953-55 Av.	Yield in Bu/A. 1955	Test Wt. Lb/Bu. 1955	Stem Rust % 1955	Leaf Rust % 1955	Straw Breaking % 1954	Grass-hopper Shelling* 1954	Maturity Class*
Ajax	56.9	54.5	52.3	35	35	15	50	8	6
Andrew	56.9	58.6	51.8	36	55	45	43	9	2
Branch	—	57.8	49.0	35	25	10	12	2	7
Brunker	52.4	53.1	38.0	31	25	30	58	5	1
Cherokee	54.3	50.6	43.3	33	40	50	34	8	3
Clarion	—	64.4	56.3	37	50	60	25	2	5
Clintafe	—	50.0	44.9	32	55	10	15	5	6
Clintland	—	47.5	39.4	33	50	10	12	5	4
Clinton	52.9	50.9	46.7	32	40	55	19	5	4
Deedee	—	—	51.6	36	45	10	—	—	6
Dupree	—	62.4	52.1	32	35	35	39	2	2
Garry Sel.	—	—	56.6	37	5	17	—	—	7
Jackson	—	67.3	51.8	37	50	60	35	3	6
James	63.6	48.7	47.5	38	40	25	38	5	5
Marion	58.2	56.8	50.2	33	55	45	18	2	4
Mindo	55.4	51.6	39.8	33	50	55	21	5	2
Minland	—	—	51.2	29	17	20	25	2	2
Mo. 0-205	—	68.0	63.8	33	40	25	16	2	3
Nemaha	51.8	52.9	46.4	30	50	45	21	9	3
Newton	—	—	45.6	35	50	22	11	5	3
Osage	60.2	70.2	56.7	33	30	7	41	2	1
Ransom	—	58.7	57.7	35	2	35	16	5	2
Richland	57.4	61.0	53.0	35	25	40	31	5	3
Rodney	—	—	47.0	37	15	35	15	7	8
Sauk	—	61.0	45.5	36	25	5	6	2	6
Shelby	—	45.2	35.8	34	60	55	44	8	6
Simcoe	—	—	51.2	39	40	15	—	—	6
Trojan	56.4	65.4	59.6	32	45	35	12	2	1
Vikota	60.7	63.7	44.5	34	20	5	5	5	3
Waubay	—	62.1	56.1	38	40	50	6	2	6
Least significant difference	3.4	5.7	10.7						

*Where 1 is best, 10 poorest.

Table 10. Barley Yield Tests at Highmore, 1948-55

Variety	Yield in Bu/A. 1948-55 Av.	1953-55 Av.	1955	Test Wt. Lb/Bu. 1955	Stem Rust % 1955	Lodging Score* 1955	Heat Injury* 1954	Leaf Rust % 1954	Bacterial Stripe* 1953
Odessa	32.2	36.3	34.0	47	10	3	7	6	4
Kindred	27.4	33.2	30.2	45	1	2	8	7	6
Wisconsin 38	29.7	38.3	38.2	45	15	3	5	3	5
Spartan	28.8	35.0	33.6	50	15	3	2	3	6
Trebi	32.5	33.5	34.2	42	15	7	5	5	4
Plains	31.2	38.8	30.4	48	2	0	2	4	6
Feebar	29.2	32.8	35.1	43	T	0	2	3	6
Titan	36.3	44.5	46.5	48	30	2	3	6	5
Mars	27.6	35.5	39.5	48	T	0	5	7	8
Velvon 11	34.6	37.3	41.0	43	20	4	3	6	6
Tregal	34.0	37.7	29.7	43	15	2	4	6	5
Custer		42.5	35.6	44	25	1	5	7	5
Compana		31.8	32.9	46	30	1	5	5	8
Traill		41.5	42.3	48	1	1	7	6	5
S. D. 1761		47.0	46.3	47	T	1	3	4	6
S. D. 1776		45.3	43.3	48	T	2	4	4	4
Montcalm		32.6	29.0	47	30	1	4	6	6
Husky			42.0	46	T	0	4	5	
Least significant difference	2.6	4.8	9.0						

*Where 1 is best, 10 poorest.

gin of the Coast barleys suggests their adaptation to adverse conditions.

High yield is all important in the feed barleys. High yield in barley in this area is associated with early to midseason maturity, heat and drought resistance, standability, and disease resistance. Barleys that have been widely grown in this area have most or all of these characteristics. They include Plains, Spartan, Trebi, and Velvon 11. In years like 1954, late varieties (especially malting) were very severely injured by hot winds. In some years disease resistance has been important in protecting the crop.

Early barleys are drought escaping but require good management to yield well. Sound moisture conservation and soil fertility practices can make the growing of early feed barleys very profitable.

Table 10 shows barley performance at this station.

Flax

Flax yield tests at Highmore have been run continuously since 1948. Generally, the problem has been one of growing flax rather than varietal performance. Average yields over the period have varied greatly, from yields of 27 bushels to 1 bushel per acre. Variety differences have not been significant (see table 11).

The good performance of the rust susceptible varieties, Koto and Dakota, appears due to the absence of flax rust at the station in the years of the tests. The Koto and Dakota plant types appear suitable to this area. However, use of these varieties over large areas would certainly involve a danger from rust. Since there is no yield advantage for later maturing varieties, the choice of early maturing varieties is indicated.

Winter Wheat

Winter wheat production is limited in the central area. Winters tend to be open and winter survival of the available varieties is poor. Paramount, however, is fall drought. In the 9-year span indicated in table 12, winter wheat could only be seeded in 4 years. The development of a moisture conserving system of farming appears essential to successful winter wheat culture in this area.

Minter is the hardiest and highest yielding variety available for

Table 11. Flax Variety Yield Tests at Highmore, 1948-55

Variety	Yield in Bu/A. 1948-55 Av.	1948-51 Av.	1952-55 Av.	1955	Test Wt. Lb/Bu. 1955
Redwing	11.6	9.8	13.3	19.6	54
Sheyenne	10.8	10.4	11.1	12.2	54
Marine	—	—	14.8	27.0	56
Koto	12.2	10.3	14.1	17.9	55
Dakota	12.3	10.6	14.0	17.9	54
Bison	—	10.2	—	—	—
Redwood	—	—	12.8	19.0	55
B-5128	—	—	11.1	12.2	55
Rocket	—	—	11.8	14.1	56
Yield differences not significant					

Table 12. Winter Wheat Variety Test at Highmore, 1947-55

Variety	Yield in Bu/A. 1947-55 Av.	1954	1955	Test Wt. Lb/Bu. 1955	Stem Rust % 1955	Survival % 1947-55 Av.	1954	1955
Minter	23.9	20.1	32.2	58	28	72	38	95
Nebred	21.5	21.2	25.1	56	25	66	50	75
Pawnee	18.7	13.3	22.1	54	40	50	22	70
Wichita	—	—	19.6	55	30	—	—	65
Sioux	—	19.6	23.8	53	50	—	42	70
Yogo	—	—	28.0	53	55	—	—	80
Minturki	—	—	25.2	54	40	—	—	90
Mint. x Tim—Vulg² (12806)	—	—	24.8	57	22	—	—	70
Least significant difference	2.0	5.0	3.8					

this area. The yields obtained indicate that where fall moisture permits, it may be planted with a reasonable expectation of survival and yield.

Rye

Rye has a permanent place in the central area. It provides late fall and early spring pasture; it is extremely early, and does not suffer from the ravages of plant diseases as do the wheats. Like winter wheat, rye could not be sown every fall because of lack of soil moisture.

The results in table 13 indicate that several rye varieties have the winter hardiness and yielding power to make rye a profitable crop at Highmore. Pierre, Antelope, and Caribou have sufficient hardiness for even unusually cold winters in this area and yield well. The variety, Tetra Petkus, is not hardy under Highmore conditions, and consequently its yields are low.

Table 13. Rye Variety Test at Highmore, 1947-55

	Yield in Bu/A.			Test Wt.	Survival %		
Variety	1947-55 Av.	1954	1955	Lb/Bu. 1955	1947-55 Av.	1954	1955
Pierre	24.3	40.3	28.7	53	86	50	85
Dakold	25.2	45.1	32.0	52	82	55	80
Emerald	24.7	41.9	31.9	52	78	60	82
White Soviet	—	42.6	33.6	52	—	50	80
Caribou	—	50.8	29.2	52	—	45	90
Antelope	—	—	33.6	53	—	—	100
Tetrapetkus	—	10.1	16.2	48	—	15	50
Adams			30.4	52	—	—	80
Least significant difference	1.3	3.1	5.6	—	—	—	—

Row Crops

Corn

Central Substation is located in an area of the state where corn yields are never high. Frequent periods of low rainfall, which may or may not be accompanied by frequent periods of high temperature, lower the production per acre which may be obtained in areas in the eastern section of the state. However, corn is still planted on a large number of acres in the region. It is used as feed for the livestock industry of the area or as a fallow substitute in preparation for small grain the following year.

Because corn yields have not been high and a smaller percentage of the cultivated acres is devoted to corn than in eastern South Dakota, little attention has been given by commercial corn companies toward the development of hybrids adapted for the area. Therefore, the Experiment Station conducts corn yield trials each year at the Central Substation to help farmers choose the best available hybrids. Another purpose is to select from the station's corn breeding program those experimental numbers best adapted for the region. Such hybrids should increase future corn yields. Approximately 25 leading hybrids and varieties are included each year in the commercial test. They include hybrids recommended by county agents in the area and by the commercial companies selling the seed. Experimental work consists of tests of new single and double crosses. In addition to these yield trials, a 10-year experiment on rate and date of planting hybrids was completed in 1954.

Commercial Corn Yield Trials

Information obtained from these tests consists of yield in bushels per acre and percent moisture at harvest. The latter is correlated with maturity and indicates whether or not an entry has been able to produce a good quality of grain in the available growing season. Results of the 1955 trial and 5-year averages are presented in table 14.

Acre yields ranged from 15.0 to 51.5 bushels. Such wide differences in yield were undoubtedly caused in part by the growing season. April and early May were dry, but the latter part of May and all June and July had above average rainfall. August and September were again dry months. Only June had below average temperatures while in August the mean was 5°F. above the long-time average. The high August temperatures coupled with low rainfall and high winds definitely lowered the yields of many late maturing entries. In addition, the hot dry weather toward the end of the growing season reduced moisture percent to an average of 13.

Table 14. Commercial Hybrid Yield Test, Hyde County, 1955

Hybrid or Variety	1955 Performance Score*	Acre Yield Bu.†	Moisture %	5-Year Av. Yield Bu.	5-Year Av. Moisture %
Pfister P.A.G. 33	131	51.5	10.2	—	—
Agsco 301	124	47.6	9.7	—	—
Pioneer 388	123	46.8	9.9	—	—
Pioneer 377-A	122	47.8	15.8	39.4	23.5
South Dakota 400	121	46.3	13.1	37.4	24.4
Haapala H360	119	44.9	11.4	—	—
South Dakota 220	112	40.0	7.5	40.0	15.1
DeKalb 58	108	38.1	9.1	—	—
Sokota S. D. 250	105	36.9	11.4	—	—
Van Tassel V44	105	37.2	13.0	—	—
Peavey PV 355	102	35.8	12.8	—	—
South Dakota 262	102	35.9	15.2	34.5	23.5
DeKalb 56	95	31.0	10.8	—	—
Funk G-26	94	33.0	20.2	—	—
Tomahawk 4A	94	31.0	13.4	—	—
Farmers 222	92	30.7	15.3	—	—
Funk G-18	90	29.3	14.5	—	—
Sokota S. D. 270	90	29.6	17.3	37.7	21.1
Kingscrost KS4	88	28.4	17.3	—	—
United Hagie UH26	86	26.1	11.7	—	—
Trojan C-59	85	25.5	11.1	—	—
South Dakota 224	77	21.1	12.9	33.7	19.9
Jacques 907	68	16.9	16.4	—	—
Disco 95W	66	15.0	12.5	—	—
Average of all entries	—	**34.4**	**13.0**	37.1	21.3

*Varieties are ranked on the basis of the 1955 performance score which is obtained by weighting yield 60 percent and moisture at harvest 40 percent.
†Differences in yield of less than 18.6 bushels per acre are not statistically significant.

On the basis of the 1955 test, the best performing varieties were Pfister P.A.G. 33, Agsco 301, Pioneer 388, Pioneer 377-A, South Dakota 400, Haapala H360, and South Dakota 220 in the order listed. However, the ability to perform well over a period of years is more important than a good showing for a single season. All of these hybrids have not been tested for 5 years. Among those that have been, best performers were South Dakota 220 and Pioneer 377A, with South Dakota 400 and Sokota S.D. 270 doing almost as well.

Single Cross Tests Used

Results in 1955 and 2-year average performances of a group of single cross hybrids are presented in table 15. Here the yields are not as high as in the trial of commercial hybrids. This test was located on a different plot of ground and apparently suffered greater environmental disadvantage. Some entries were able to produce corn under adversities while others could not (note the picture on the next page).

Yields from such single cross tests are used to predict how new double crosses might perform under similar conditions, even before such double crosses have been made. For example, the double cross (Inbred 1 x Inbred 2) (Inbred 3 x Inbred 4) has a predicted yield of 25.6 bushels per acre, based on the 1955 yields, as compared to 23.4 for the check hybrid, South Dakota 220. On the basis of the 2-year averages, the same double has a predicted yield of 28.2 bushels per acre as compared with 23.9 for South Dakota 220. This indicates that there may be new South Dakota experimental hybrids which can and should replace the test hybrids now available for the Central Substation area.

Choice of Planting Date and Rate

In 1954 a 10-year study was completed in which all combinations of three planting rates (2, 3, and 4 plants per hill), three planting dates (May 1, 20, and 30), and three hybrids (early-, mid-, and full-season) were employed.

In 5 years of the 10 where either drought or cold, wet conditions prevailed, the early hybrid planted 2 seeds per hill on May 1 was the best combination. In the other 5 years,

Table 15. Single Cross Test, Hyde County, 1955

Entry	Acre Yield Bu.*	Moisture %	2-Year Average Yield Bu.	2-Year Average Moisture %
Inbred 1 x Inbred 2	27.9	12.7	28.5	19.2
Inbred 2 x Inbred 3	27.2	9.8	25.3	17.2
Inbred 1 x Inbred 4	26.8	15.2	32.2	19.6
Inbred 1 x Inbred 3	24.5	8.5	26.2	15.1
Inbred 5 x Inbred 4	25.6	16.1	28.4	21.4
Inbred 3 x Inbred 6	24.6	11.3	30.8	18.0
Inbred 6 x Inbred 5	24.8	12.7	26.3	21.7
South Dakota 220	23.4	8.0	23.9	14.1
Inbred 2 x Inbred 7	23.4	11.7	24.0	17.7
Inbred 2 x Inbred 4	23.8	17.7	29.2	24.2
Inbred 2 x Inbred 5	23.5	16.4	26.7	22.4
Inbred 1 x Inbred 6	22.2	13.2	23.4	20.3
Inbred 3 x Inbred 4	19.8	17.0	23.8	21.3
Inbred 3 x Inbred 5	17.9	11.3	21.3	17.8
Inbred 7 x Inbred 3	15.4	10.7	22.7	15.1
Inbred 2 x Inbred 6	16.5	20.5	21.7	25.3
Inbred 1 x Inbred 7	14.4	11.9	20.3	17.8
Inbred 7 x Inbred 5	14.5	13.1	22.6	18.0
Inbred 1 x Inbred 5	13.8	12.2	16.5	22.7
Inbred 7 x Inbred 6	11.9	15.2	22.6	20.5
Inbred 6 x Inbred 4	12.0	26.6	19.7	28.5
Inbred 7 x Inbred 4	7.5	15.9	16.3	19.2
Average of all entries	**20.1**	**14.0**	**24.2**	**19.9**

*Differences in yield of less than 8.7 bushels per acre are not statistically significant.

when conditions were more favorable, this combination was at a disadvantage (up to 25 percent less yield) and the best combination was the medium maturity hybrid, planted 3 seeds per hill on May 20 or after. In drought or cold years the latter practice would give either low yields or soft, low quality corn, or both.

A farmer's planting practice must thus involve one of two choices.

One choice is to obtain fair yields of sound corn every year with the early hybrid. The other is to get maximum yields in some years and soft or low quality corn the rest of the time by using a later hybrid, later planting date, and a higher seeding rate.

Detailed results are available in bulletin 455.

Sorghum

Sorghums have been grown at Highmore since the station's origin in 1908. During the early breeding program three strains of saccharine sorghums were used in selecting for early maturity and for high food value. The three strains used were No. 137 Minnesota Early amber cane, Saltzer's No. 159, and strain No. 341, origin unknown. One of the principal reasons for growing sorghums in this area is their adaptability to hot weather and limited moisture conditions.

Sorghums are a profitable crop to grow where weather conditions are unfavorable for corn production. A 16-year average, 1917-32, showed yields of forage as follows: Rainbow flint corn 3,583 pounds, amber cane 3,381 pounds, Alta dent corn 2,980

Some hybrids can produce corn under conditions of high temperature and low moisture—others cannot. Left, commercial hybrid used as a check; right, single cross (Inbred 2 x Inbred 3).

pounds, Sudan grass 2,306 pounds, and millet 2,151 pounds of fodder per acre. Sudan grass was found to be best for hay and pasture.

The grain sorghums as originally introduced needed considerable improvement. They ripened unevenly. The milos had recurved head stalks that interfered with harvesting; they were too tall for ease of handling and too late maturing to produce high quality grains.

Early maturing grain sorghums were developed that ripen before frost and produce high yields of high quality grain. They are stabilizing sorghum production in central South Dakota.

Norghum and Reliance are early maturing grain sorghums which were bred and selected for South Dakota's climatic conditions. They produced the highest yields of grain, as shown in table 16. These varieties have produced a matured

Table 16. Yields of Grain from Varieties of Grain Sorghum at Highmore (1948-54)*

Variety	Yields per Acre in Bushels						
	1948	1949	1952	1953	1954	1955	Av.
Reliance	41.6	7.9	23.6	92.1	41.8	32.1	39.9
Norghum	42.9	1.0	26.2	87.4	44.5	27.6	38.3
Martin	24.9	0.4	15.7	62.4	18.2	15.4	22.9
Midland	32.6	0.6	14.4	42.4	26.1	12.8	21.5
Sooner	30.1	1.2	23.6	74.9	25.8	7.0	27.1
Early Kalo	38.6	1.1	15.7	84.7	16.3	16.4	28.8
Improved Coes.	30.8	0.6	21.0	76.4	16.8	15.5	26.9

*1950 poor stands due to dry soil (no yields taken), 1951 poor stands due to cutworms and wire worms (no yields taken).

crop before frost while Martin, Midland, and Sooner milo are much later maturing and usually produce lower yields and a poorer quality of grain. Early Kalo and Improved Coes are slightly later maturing than either Norghum or Reliance but are not as well adapted.

Low hydrocyanic acid forage sorghums, Rancher and 39-30-S, are the best forage sorghums to grow when a high tonnage of matured fodder is desired. Sudan grass is an ideal cultivated forage crop, well adapted to South Dakota for pasture, hay, and fodder.

Grasses and Legumes

In the Spring of 1948 an experiment was established to test the yielding ability of various species and strains of grass alone and in combination with alfalfa and creeping red fescue. The grasses were grown in plots 7 feet by 80 feet in each of three replicates as shown on page 28. In each replicate the grass was grown alone, with alfalfa, with creeping red fescue, and with both.

Grass Percentages

The proportion of each grass in the plots was noted in the summer of 1949 and again in 1955, seven years later (see table 17). The first summer the plots were made up wholly of the grass seeded the previous year, but the composition gradually changed over the years until some of the plots were changed completely.

Certain of the grasses, such as smooth bromegrass, and to a much lesser extent crested wheatgrass, alfalfa, and Ree wheatgrass, invaded the other plots. Bromegrass seemed to be by far the most aggressive. Besides maintaining a pure stand in the plots which were sown to that grass, it also invaded to a degree every other plot.

Slender wheatgrass was completely replaced, as might be expected, since it is recognized as a short lived grass. Red fescue did not hold its own well and Russian wildrye and western wheatgrass maintained only 43 percent and 45 percent of a stand, respectively. From this experiment it would appear that smooth bromegrass, standard crested wheatgrass, and Ree wheatgrass would best maintain a stand under Highmore conditions.

Hay Yields

Yields of hay were taken each year from 1949 to 1955 with the exception of 1954. These yields were obtained by harvesting a 3-foot swath through the middle of each plot as shown on page 27. The average yields reported in table 18 indicate that Ree wheatgrass and Lincoln brome are the highest yielding.

Standard crested wheatgrass averaged 0.08 tons per acre less than the top yielding grasses. Since its use is primarily as early pasture in the spring or for fall pasture, this slight lack of yielding ability is not serious.

The yield of slender wheatgrass is not its true yield since the plots of this grass were gradually replaced by other grasses. There seemed to be a stimulation given to the invading grasses by the decaying roots and vegetation in these plots, since the yields of these grasses were much higher than would be expected from their yields in other plots.

Western wheatgrass, a well adapted native grass, did not yield

Table 17. Changes After 7 Years in Composition of Grass Plots Seeded in 1948

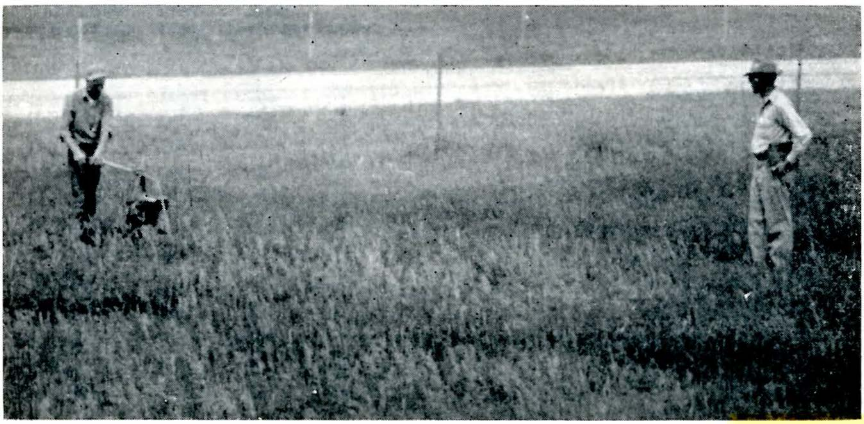
Species + Abbreviation	1949 Composition (%)	1955 Composition (%)
Homesteader brome (br.)	100 br.	100 br.
Lincoln brome (br.)	100 br.	100 br.
Lyons brome (br.)	100 br.	100 br.
Lancaster brome (br.)	100 br.	100 br.
Ree wheatgrass (r.w.)	100 r.w.	87 r.w. 10 br. 3 c.w.
Standard crested wheatgrass (c.w.)	100 c.w.	91 c.w. 8 alf. 1 br.
Western wheatgrass (w.w.)	100 w.w.	45 w.w. 52 alf. 3 br.
Slender wheatgrass (s.w.)	100 s.w.	50 br. 40 cr. 10 alf.
Kentucky bluegrass (k.b.)	100 k.b.	72 k.b. 26 br. 1 r.w. 1 alf.
Russian wildrye (r.w.r.)	100 r.w.r.	43 r.w.r. 40 br. 15 cr. 2 k.b.
Red fescue (r.f.)	100 r.f.	10 r.f. 60 br. 30 alf.

well in comparison with Ree wheatgrass, smooth bromegrasses, or crested wheatgrass. Russian wildrye, which has a well developed basal growth that makes it suitable as an early pasture grass but not for hay, yielded poorly. Both Kentucky bluegrass and red fescue are, in general, poor yielding grasses at all locations in the state.

Red fescue was included in mixtures with each of the grasses to find if an increase might be present in the total yield, since this low-growing grass might take advantage of certain parts of the environment not used by the other species in the mixture. At other localities where this test was conducted, a yield decrease was obtained, indicating that competition between the two grasses brought about a reduction in yield.

At Highmore, however, a slight increase seemed to result from the addition of this grass. This may be due to the different environment at Highmore. In all other cases where

Harvesting grass plots at Highmore with a 3-foot power scythe.



Replicate 1	Replicate 2	Replicate 3
Grass with alfalfa and red fescue	Grass with alfalfa	Grass with alfalfa
Grass with red fescue	Grass alone	Grass alone
Grass with alfalfa	Grass with red fescue	Grass with alfalfa and red fescue
Grass alone	Grass with alfalfa and red fescue	Grass with red fescue

A plan to test yielding ability of grasses alone and in mixtures.

a low yielding grass was included in a mixture there was a decrease in yield, so no recommendations regarding the use of such mixtures can be made on the basis of differing results at only one station.

The addition of alfalfa to a grass seeding, however, was observed to have a tremendously beneficial result; average yields for all the years were double that of the grass alone. In general, the higher yielding grasses tended to have the highest total yield when grown with alfalfa, but this was not always true. In some cases the alfalfa made up most of the yield, leveling off total yields from the various plots.

Effect of Alfalfa

An analysis of the effect of alfalfa on the yields of grass was made by computing, for each year, yield of the grass-alfalfa mixture in terms of percentage of yield of the grass alone (see table 19). If the yields

Table 18. Average Hay Yields at Highmore 1949-55 from Grasses Grown Alone and in Mixture (Yields Not Taken in 1954)

	Alone T/A	With Red Fescue T/A	With Alfalfa T/A	With Alfalfa and Red Fescue T/A
Ree wheatgrass	.58	.57	1.12	.94
Lincoln brome	.58	.58	.90	.92
Lancaster brome	.53	.51	.80	.86
Lyons brome	.52	.53	.86	.82
Homesteader brome	.49	.54	.91	.86
Standard crested wheatgrass	.50	.52	.83	.89
Slender wheatgrass	.45	.52	1.13	1.04
Western wheatgrass	.41	.51	.85	.89
Russian wildrye	.40	.66	1.02	1.36
Kentucky bluegrass	.35	.49	.92	.93
Red fescue	.33	.35	.83	.89
Average	**.47**	**.52**	**.92**	**.94**

Table 19. Percentage of Yield of Grass-Alfalfa Mixtures of the Yield of Grass Alone for Grasses at Highmore 1949-55, Omitting 1954

	1949	1950	1951	1952	1953	1955 No N	1955 66#N	Av.
Rec wheatgrass	82	156	121	162	348	304	140	196
Lincoln brome	110	134	143	171	292	194	92	174
Lancaster brome	83	152	105	136	410	191	87	180
Lyons brome	95	164	146	218	314	124	165	177
Homesteader brome	111	202	158	520	337	208	87	256
Standard crested wheatgrass	161	213	133	173	194	261	100	189
Slender wheatgrass	76	274	111	473	104	169	93	201
Western wheatgrass	128	364	125	175	267	169	136	205
Russian wildrye	121	322	226	473	332	110	128	264
Kentucky bluegrass	344	338	138	243	556	252	162	312
Red fescue	277	227	115	425	947	253	147	374
Average	**144**	**231**	**138**	**288**	**373**	**210**	**117**	

of the mixture and the grass alone were equal, the percentage would be 100.

In general, the lowest yielding grasses such as Kentucky bluegrass and red fescue show the highest increase with alfalfa, while the higher yielding grasses show less effect. Nevertheless, the smallest effect obtained by inclusion of alfalfa (Lyons brome) still gives an average increase in yield of 77 percent over grass by itself. When this increase in yield was computed on the average yearly basis, the increase in the first year was low; it was higher the second, lower for the third, but then continued to increase for the next 2 years so that the average was 373 percent in 1953. In 1955 the average for the unfertilized replicate was 210 percent, while that of the fertilized dropped to 117 percent.

The advantage of the grass-alfalfa over the grass alone appears, therefore, to be largely due to the nitrogen fixing ability of the alfalfa. Nitrogen was probably one of the most important limiting factors in yield every year.

The reason the grass-alfalfa mixture tended to gain more of an advantage each year was that nitrogen became less available. Occasionally in some years a favorable combination of moisture and temperature would allow the nitrogen to become more available in the soil. In these years the differential between the yields of the grass-alfalfa mixture and the grass alone would be less. The small differences noted in 1951 and 1955 would probably be due to such a combination of circumstances.

Use of Fertilizer

In 1955, two replicates were fertilized with 200 pounds of ammonium nitrate per acre (approximately 66 pounds of nitrogen), while one replicate was left unfertilized. The yields for these treatments are shown in table 20. Without nitrogen the yields were doubled by the ad-

Table 20. Yields of Grass Alone and in Mixture With and Without Nitrogen Application in 1955

	Alone T/A	With R. Fescue T/A	With Alfalfa T/A	With Alf. & R. Fescue T/A
No fertilizer	.54	.53	1.10	.92
200 lbs. of ammonium nitrate (66 lb. N) per acre	1.11	1.17	1.26	1.28

dition of alfalfa, but with nitrogen application, the yields of the grasses and the grass-legume mixtures were almost the same. This high utilization of the applied nitrogen was made possible in that season by the favorable moisture conditions. Such a high response would not always be found.

In conclusion, this experiment indicates that Ree wheatgrass, the smooth bromegrasses, and standard crested wheatgrass are the highest yielding grasses at Highmore. Grass-alfalfa mixtures will on the average yield about twice as much as grass alone and this differential will tend to increase each succeeding year.

The application of nitrogen fertilizer to a grass-legume mixture cannot be expected to increase yield, but will, when applied to grass alone, tend to bring its yield close to that of the grass-alfalfa mixture if the season is favorable.

Sorghum Seed Treatment

POOR STANDS OF SORGHUM occur often in South Dakota and usually are the result of seed decay. The decay, which generally takes place in soil that is too cold for quick seed germination, may be caused either by soil-borne or seed-carried fungi.

Likelihoods of poor stands may be reduced by increasing the rate of seeding or by delaying the time of planting for more favorable weather. They also may be reduced by treating seed with proper fungicides that kill the fungi on the seed and protect the seed from soil-borne fungi.

Fungicidal seed treatments for sorghum have been evaluated at Highmore during the past five seasons. Treated seed of the grain variety, Norghum, was planted each season in randomized blocks of four to six replications. The plots were 33 feet long, spaced 3 feet apart. Mid-May, late May, and early June plantings were made each year as the season permitted.

Twenty - four fungicides were tested during this period as shown in table 21. Not all of these were tested in any one year, but new ones were added and ineffective ones discarded from year to year.

Increases Yields

A summary of the yields over the 5-year period from the more effective fungicides is given in table 22. Yields were increased significantly 4 out of the 5 years by at least one and by as many as eleven fungicides, depending on the weather of the season.

Generally, yields from seed treatment were increased more during wet years of 1952, 1953, and 1955 than during dry years of 1951 and 1954. Also greater yield increases from seed treatment in the wet years were obtained from May plantings than from June plantings. The greatest yield increases from seed treatment during the 5-year period of testing were obtained under the cool, wet conditions of the June 1, 1953 planting.

Under the conditions of the June 1, 1953 planting all fungicides listed in table 22 significantly increased yields from 13.5 bushels per acre for no fungicides to as high as 41.7 bushels per acre with fungicides, although some fungicides increased yields more than others.

Under the warm conditions of the June 12, 1953 planting and under the farm and/or dry planting conditions in the other years, fewer fungicides proved effective in bettering yields; none proved effective in the dry year, 1954. Carbide and Carbon Chemical numbers 224 and 640, panogen, and possibly orthocide 75 and COCS sp C-1 were the most desirable fungicides. They more often improved yields significantly

Table 21. Seed Treatment Fungicides Used on Norghum Sorghum During 1951-55 at Highmore

Fungicide	Dosage Oz Bu	No. Times Used	No. Times Significantly Increased Yields
Actidione	1	3	—
Agrox	½	5	—
Arasan	2	12	2
Arasan & Spergon	0.75:1.5	5	1
Pittsburg Coke & Chemical B-1843	1	2	—
Carbide & Carbon 640	2	12	5
Carbide & Carbon 224	2	12	6
Ceresan M	½	5	—
COCS sp C-1	2	5	—
Copper carbonate	5	8	2
duPont 244	¾ (fluid)	3	—
duPont 364	½ (fluid)	3	—
Ethyl 856	1	5	—
Mercuran A.S.	½	3	—
Mercusal	½	3	—
Orthocide	2	7	2
Panogen	1 (fluid)	10	3
Phygon XL	2	6	—
Puratzed	½	3	—
Spergon	2	10	1
Tennessee Copper 26	4	5	2
Vancide	4 (fluid)	3	—
Mathieson 1562	1	2	—
Mathieson 1488	1:1000 Soak	2	—

under less favorable conditions for seed germination.

Improves Stand

Seed treatment of sorghum thus may be expected to improve yields most of the time in South Dakota. The improvement is largely the result of bettering stands. However, yields will not be increased beyond the limitations set by weather. So poor yields may be expected during dry years in spite of seed treatment and good yields may be expected during wet years.

Since weather conditions cannot be predicted far enough in advance of the planting and growing season, sorghum seed treatment should be a regular yearly practice as insurance to obtain the best possible yields that weather will permit.

Table 22. Sorghum Seed Treatment Fungicides That Produced Yields Significantly Better Than Controls One or More Times During the Period 1951-55 at Highmore

		Yields in Bu/A on Given Dates in Indicated Years												No. Plantings	
		1951			1952		1953		1954			1955			Yields Significantly Increased
Fungicides	Dosage Oz/Bu.	May 23	June 4	June 12	May 15	May 26	June 1	June 12	May 19	June 5	June 17	May 10	June 7	Times Used	Over Control
Arasan	1.5	6.7	9.7	4.9	30.0	31.9	32.7*	40.5	7.0	11.3	3.0	19.3	24.5*	12	2
COCS sp C-1	2.0	......†	......	......	......	......	37.6*	44.4*	8.3	7.9	1.2	......	......	5	2
Carbon & Carbide 224	2.0	9.4	12.0*	8.0*	38.4*	41.1*	36.6*	41.5	8.5	8.2	2.4	21.4*	18.7	12	6
Carbon & Carbide 640	2.0	10.8*	8.8	6.6	34.3	37.0*	41.7*	45.0*	7.9	10.0	1.5	23.2*	19.4	12	5
Copper Carbonate	5.0	9.4	8.2	7.3*	......	......	37.4*	42.0	5.8	8.3	1.5	......	......	8	2
Orthocide‡	1.0	......	......	......	......	......	39.3*	42.4	7.5	10.2	1.5	21.6*	20.6	7	2
Panogen	1 fl. oz.	8.1	10.6*	8.5*	22.9	25.6	38.3*	42.5	6.2	7.3	3.3	......	......	10	3
Spergon	2.0	7.4	9.8	6.1	29.0	29.6	25.5*	41.9	7.9	4.7	1.2	......	......	10	1
Tenn. Cu 26	4.0	......	......	......	......	......	34.9*	46.6*	8.1	7.6	2.4	......	......	5	2
Arasan & Spergon	0.75:1.5	4.7	8.8	5.0	......	......	34.5*	44.2*	......	......	......	......	......	5	2
Arasan Row Dust§	1.5	10.0	7.4	4.4	37.0	35.7*	35.7*	42.6	......	......	......	......	......	7	2
Control—no fungicide	......	7.4	6.7	4.9	29.6	22.9	13.5	43.4	5.4	6.6	1.2	12.8	19.4	......	......
Least significant difference	......	3.3	3.2	2.1	8.5	10.2	1.2	.8	8.0	7.2	2.6	6.6	2.3	......	......

*Significant increase in yield as compared to check or nontreatment.

†Fungicide was not used in that planting.

‡Orthocide 404 used in 1953, orthocide 75 used in 1954 and 1955.

§Fungicide added to soil at a rate of 4.4 lbs. per acre.

Fruits, Vegetables, Shelterbelts

Over much of the plains area the early settlers found native fruit growing along streams and in native thickets. Most wild fruit has disappeared at a rate faster than it has been replaced by domestic plantings. To study the value of a fruit planting, an orchard was established at the Central Substation in 1941. It consisted of 12 apple, 8 crabapple, 20 plum and plum-sandcherry hybrids, 12 sandcherry, and 12 apricot trees. Varieties were those thought to be adapted to the area.

The sandcherry plants produced some fruit the second year after planting. Each year thereafter they produced fruit in abundance until seven crops had been produced. By the end of the seventh year the plants had lost vigor to the extent that they were considered to be of no more value and were removed. An average crop was from 5 to 7 pounds per plant.

The plum-sandcherry hybrids started fruiting 2 years after planting and produced three consecutive crops. As much as 50 pounds per plant was harvested. They showed a loss of vigor and much winter injury and were removed after the fifth and sixth year. This short life we now associate with virus disease. Sapa and Opata were the best varieties.

Plum production was a disappointment. Trees grew poorly and were mostly removed at an age when production should have started. We now associate this with virus disease and believe the test of little value in evaluating varieties. Any stone fruit planting should be virus free.

The apricots have made the greatest growth of the fruit trees planted. Blossoms have suffered from spring frost most seasons. The first crop produced was in the sixth year when the trees averaged 8 pounds of fruit per plant. The apricot has ornamental value and a few trees might be desirable for such purpose. They have shown great drought tolerance and winter hardiness. The varieties Sunshine, Manchu, and Ninguta are among the best available.

The apple yield was measured the seventh year when some trees produced 20 pounds of fruit. After 15 years the apples and crabapples are the only producing trees remaining. They show enough vigor to indicate that they may continue to produce for many years. The varieties planted were selected because of hardiness, and quality was secondary. It appears that better quality varieties can be grown and such are now being used to replace some of the trees.

There has been no serious insect problem in this fruit planting. Insect and disease problems are less

The orchard and a portion of the shelterbelt at Highmore.

troublesome where fruit plantings are isolated. Inexpensive spray equipment should be adequate for most farm fruit plantings.

The ground in this orchard was clean cultivated as long as the stone fruit remained. When cultivation was discontinued grass was seeded between trees and the area around each tree was mulched with straw.

From this fruit planting it appears practical to have a home fruit planting. Wind protection from a shelterbelt would be necessary.

Apple blossoms add beauty and can result in some good fruit.

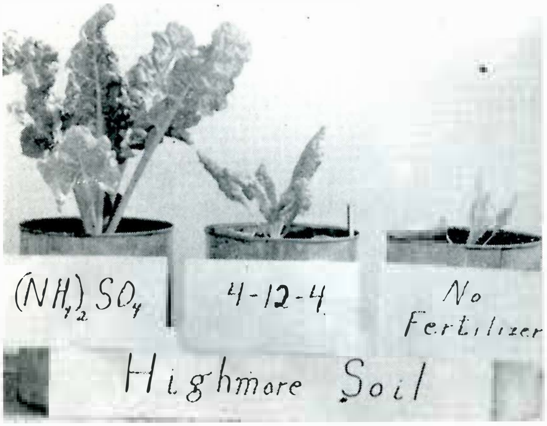
The Vegetable Garden

A vegetable garden will generally make a contribution to the family income. Since 1940 most commonly planted garden vegetables have been planted at the Central Substation. With the exception of cool weather crops such as cauliflower, yields have been satisfactory and quality good. One of the most dependable has been the tomato, especially Sioux and Siouxann.

Heavy applications of commercial fertilizer and manure have increased yield to more than double that part of the garden not so treated. The greatest response has come from nitrogen application, but phosphorus has also been beneficial.

Shelterbelts

The Central Substation is an area where windbreaks are greatly needed. They provide protection from the wind for livestock, reduce home heating costs, protect gardens and lawn, and, in general, make the



Swiss chard, like most leafy vegetables, responds to nitrogen fertilizer.

place more livable. Questions as to the arrangement of the windbreak, its width, species used, effectiveness, and many similar topics were responsible for a shelterbelt being planted.

An 8-row belt was established in 1944 to the west and north of the farmstead. The north-south part of this belt is about 300 feet from the house with the east-west part about 200 feet to the north of the house. This arrangement has provided good snow protection around the buildings.

It was the opinion of many at the time this shelterbelt was planted that mixing of species in the row was advantageous. To evaluate this feature many different combinations were arranged. Generally speaking, the disadvantages of such an arrangement exceed the benefits. Rows were spaced 10 feet apart with trees spaced 8 feet and shrubs 4 feet in the row. After three seasons of cultivation, growth was such that it was no longer possible to cultivate between the rows.

Row 1. The inside row was planted to lilac. This provides a tight row at the ground and the beauty of its blossom is in clear view of the home.

Row 2. The second row was planted to Ponderosa pine alternated with tatarian honeysuckle, skunkbrush, and sandcherry. Poor survival of the pine and the short life of the sandcherry have left a "hole" and caused a weed problem.

Row 3. This is a shrub row with alternate mixing of species followed by a continuous block of one species. Lilac, tatarian honeysuckle, hawthorn, buckthorn, and wild plum were used in this row. The hawthorn has not been a satisfactory selection and the use of a taller plant in this row would offer some advantages.

Row 4. This is the first row of trees and they were planted in a mixed arrangement similar to row 3. American elm, hackberry, green ash, and honeylocust were used.

Row 5. This row is similar to row 4 except boxelder, hackberry, green ash, and Chinese elm were planted.

Row 6. Same as row 5.

Row 7. Russian olive has been planted in this row except for a few areas where buffalo berry and false indigo are alternated with it.

Row 8. Chokecherry and caragana were used in this row. Both plants have been a good selection for this location. However, on one occasion the chokecherry was severely broken by snow while the caragana suffered but little from snow breakage.

Some general observations can now be made from this planting.

A mixing of species in the row does not appear desirable. If practiced, care should be used in selecting the combinations.

A windbreak provides some protection the second or third year after planting and with good care should last for 40-50 years.

Chinese elm is the fastest growing species in this planting.

Sandcherry will not survive for more than 5 or 6 years.

Eight rows is adequate width for good wind and snow protection.

For protection against summer wind a planting should also be arranged to the south of the farmstead.

Evergreens should have made up a greater part of this planting. Ponderosa pine and cedar are good species for the area.

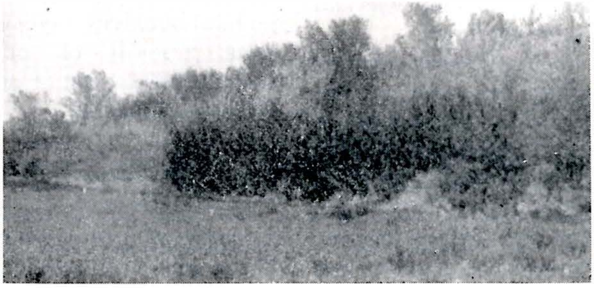
The Highmore substation is one of two locations being used in South Dakota to conduct tests on woody ornamentals under the Regional Woody Plant Sub-project.

Thirteen shrub varieties with a total of 52 plants and three each of five tree varieties were planted May 4, 1954. Of this material 42 plants survived the first year.

In the spring of 1955, 36 shrubs of nine different varieties and three each of three new honeylocust introductions were added to the collection. Replacements were made also for materials not surviving the first year.

Present plans are to add about four tree and twelve shrub varieties to the test area each year.

One section of the shelterbelt at Highmore.



Forage Feeding Trials

WINTER FEEDING TRIALS with Hereford steer and heifer calves were started in the fall of 1950 to determine the influence of protein content of prairie hay on its feeding value.

Harvesting was done at three stages of maturity to get hay that varied in amount of protein. Three stages selected for harvesting were heading (early), seed ripe (medium), and mature and weathered (late). The stage of maturity of the dominant species was used to determine the cutting dates.

Early-cut hay was usually harvested as soon as the needles of the needle-and-thread grass fell, which varied from about the middle of July to early August. The medium-cut hay was harvested in late August, and the late-cut hay was cut after the first killing frost.

The first two stages were selected to represent hay that was cut before and after small grain harvest. However, the presence of a large amount of needle-and-thread often made the early cutting later than desirable. The last cutting was selected to represent extremely late harvesting, and it would also be similar to late fall and winter grazing. Earlier studies had shown that delaying the harvesting date of the hay reduced the yield, protein and phosphorus content, and digestibility of the hay.

Conducting the Trials

The feeding trials were conducted over a 3-year period, 1950-51, 1951-52, and 1952-53. Six steers and four heifers were started in each lot in the 1950-51 and 1951-52 trials. Ten steers were used in the trials conducted during 1952-53. The calves were obtained 2 to 4 weeks before being put on the experimental rations. They were vaccinated against blackleg and sprayed for lice one or more times during the trials. Dehorning was not done until after the close of the trials in the spring.

A good quality prairie hay was fed along with a small amount of oats and soybean meal pellets from the time the calves arrived at the substation until the start of the feeding trials. When the calves were started on the experimental rations, they were fed all the hay they would clean up without undue wastage. Soybean meal pellets were fed in amounts to give approximately 10 percent total protein in the rations with each kind of hay. In this way, each lot of calves received about the same amount of protein even though the amount of protein in the hay was different.

Needle-and-Thread

The results of the trials have been summarized and presented in table 23. In 1951, the early hay was cut

Table 23. Results of Winter Feeding Trials with Prairie Hay of Varying Protein Content Supplemented to Equalize Protein in Total Rations (Average of 3 Years, 1950-53)

	Early-Cut Hay	Medium-Cut Hay	Late-Cut Hay
Total no. calves	20	29	29
Av. no. days fed	126	122	122
Av. initial wt., lbs.	419	400	391
Av. daily gain, lbs.	0.59	0.69	0.69
Av. daily ration fed, lbs.			
Hay	11.2	11.3	10.3
Soybean meal pellets	1.05	1.04	1.61
Feed per 100 pounds gain, lbs.			
Hay	1891	1636	1498
Soybean meal pellets	177	151	233
Av. protein content of hay, %*	7.00	6.58	4.76
Av. protein content of ration, %	9.8	9.5	9.7
Supplement per ton of hay fed, lbs.	187	185	311
Feed cost per head, $†	20.71	20.14	22.37
Feed cost per 100 pounds gain, $	27.76	23.91	26.63
Value per ton of hay for equal cost of gains, $	—	20.00	11.33

*Based on 10% moisture in hay.
†Feed prices per ton: hay, $20; soybean meal pellets, $100.

Steers being fed prairie hay in a trial at the Central Substation.

before the needles of the needle-and-thread grass had fallen. The hay contained about 30 percent needle-and-thread, and the needles were numerous in the hay.

One lot of calves was fed the hay for 112 days, and they lost an average of 0.24 pound per calf daily. The average daily hay consumption was only 5.7 pounds during this period. These calves were then fed a medium-cut hay and about 1.5 pounds of soybean meal pellets per calf daily for a period of 43 days. The average daily gain during the 43 days was 1.72 pounds. This seems to prove that the previous poor performance was due to the large amount of needles in the hay.

When needle-and-thread is present in amounts to cause trouble, either the hay should be cut before the needles appear or after they have fallen. Generally, yield of the hay will not be great enough to harvest before the needles appear; and harvesting should be delayed until they have fallen, even though this procedure will result in a lower nutritive value for the hay.

Hay Yield

In the two trials included in table 23 in which the early-cut hay was fed, the protein content of the hay was nearly the same as for the medium-cut hay. A poor growth was made in the spring but late rains stimulated the growth, and the medium-cut hay was not typical for hay cut in late August. Nearly twice as much hay per acre was obtained from the medium cutting than from the early cutting in 1952. Weather conditions will influence the yield of hay cut at different times of the year and should be considered in selecting the best time to harvest prairie hay.

Rate of Gain

The gains of the calves fed the early-cut hay in the two trials were less than for those fed the medium hay. Similar feeding trials conducted at the Cottonwood and Eureka substations gave about equal gains for the three kinds of hay when supplemented with soybean meal to equalize the total protein in the rations at about 10 percent.

More recent feeding trials at Highmore, in which an early-cut hay has been supplemented in the manner used in these trials, have given much better rates of gain—similar to those at the other two substations. This indicates that the poor showing for the early-cut hay lot shown in table 23 was probably due to factors other than poor utilization of the hay by the calves.

The rate of gain for the lot of calves fed the medium-cut hay and an average of 1.04 pounds per day of soybean meal pellets was the same as for the lot fed the late hay and 1.61 pounds of the pellets. The calves fed the late-cut hay consumed less hay, which resulted in a smaller hay requirement per 100 pounds of gain than for those fed the medium-cut hay. However, the larger amount of protein supplement necessary to give the same amount of total protein as in the medium hay lot resulted in a more expensive ration.

Feed Costs

Feed costs have been calculated using a price of $20 per ton for the hay and $100 per ton for the soybean meal pellets. These were about average prices during the time of these experiments. Current costs of the gains may be calculated using present prices for the hay and supplement and the feed requirements shown in the table.

In these trials, the medium-cut hay ration was the cheapest in cost per head and per 100 pounds of gain. However, as was stated earlier in this report, better results have been obtained with the early-cut hay in more recent feeding trials.

In the 2 years shown for the early-cut hay, the protein content was the same as for the medium. Because of this the value per ton of hay for equal cost of gains has been calculated only for the late-cut hay using the medium as the base for this calculation. The big difference in the amount of protein supplement required resulted in a value of only $11.33 for the late-cut hay for equal costs of gains with the medium hay at $20 per ton. This low value resulted in spite of a smaller hay requirement in the late hay lot.

These results show the importance of considering the protein content of prairie hay when producing or buying hay. They also show the need for considering the protein content of the hay when feeding and of supplementing accordingly. In this way the most economical and efficient use can be made of both the hay and supplement.

Study Silage Stored 5 Years

Corn and cane silages stored separately in a pit covered with 3 feet of earth apparently kept reasonably well for 5 years. No figures are available for the amount of spoilage or other losses. One foot of spoilage was reported at the top.

This silage was fed to calves without difficulty. Analyses showed the silages compared well with other corn and cane silage except that they contained less carotene.

Silage is now similarily stored that will be analyzed and fed after 10 years of storage.

Poultry Performance

A PERFORMANCE testing project was started at this substation in 1952. The purpose was to increase poultry testing facilities for hens from experimental matings, which involved inbred as well as noninbred groups of poultry.

It was hoped that by testing many different types of chickens, their relative performances could be compared and the results could be reported to local farmers. They could then use the performance ratings as guides when choosing egg laying stocks.

A 24- x 34-foot frame house was built in 1952 and divided into four equal-size pens. They are filled yearly with 55 pullets each. The house has a cement floor and is equipped with experimental fan systems. For the first year, a two-fan system was used. A heat-exchange unit was in operation for the following 2 years.

Conducting the Experiments

The procedure that has been followed for testing pullets is as follows. The parents are mated at the South Dakota State College Experiment Station. Eggs are saved, chicks are hatched, and the pullets are raised at Brookings. At hatching time (April) the males are removed from the groups and all the pullet chicks assigned to be tested at Highmore are wingbanded before being mixed.

An attempt is made to expose all of the pullets to similar environmental conditions by raising them in an intermingled group. In the fall the pullets are debeaked and legbanded when they are separated into their four respective groups. When these pullets are approximately 5½ months old, they are transported by truck to the substation. From October 1 until the following August 31, records are kept for the number of eggs laid, size of the eggs, broody periods, and deaths.

The birds are all fed the same diet, which consists of a free choice of oats and a 20 percent protein mash. A pail of water and a container of oyster shells is kept in each pen. Except for the longer summer days, artificial lights are automatically turned on early each morning to give the hens 13 hours of daylight. The hens are confined to the house for the entire period and no culling is practiced.

Objectives

Two of the main objectives in the over-all breeding program are: (1) to evaluate different mating systems and (2) to discover which of the station inbred lines combine best with other breeds or lines to produce better layers.

At South Dakota State College Experiment Station, it has been shown that none of the nine inbred lines that were developed at the station perform as well by themselves as do the chickens produced by crossing the inbred lines with unrelated strains. Another observation has been that the inbred lines have not produced as well as have the noninbred lines from which they originated.

Results

During the past 3-year period, 12 groups have completed the 11-month testing period. The first year the relative performance of a crossbred (involving two noninbred breeds) with two singlecross topcrosses (having one parent produced by two inbreds and the other parent a noninbred) were tested. One inbred parent was developed at South Dakota, the other was from Nebraska. A control group of commercial hybrids was reared for the fourth test pen.

As seen in table 24, hens in the two singlecross topcross pens layed about 55 more eggs each than did the commercial hybrids. The genetic difference between the two singlecross topcrosses was that the dams of one group were White Leghorns and the other group had Rhode Island Red dams. On a hen housed basis, the pullets from these two matings were markedly similar—their egg size and adult body weight were also similar.

The biggest disadvantage suffered by the control hybrid group was that their mortality was much higher than the other groups—11 of the 55 dying during the 11-month period. It was found that several factors caused the crossbreds to lay fewer eggs. They matured about a week later than the other three groups, they laid at a slower rate when they were laying, and more of the hens became broody.

The second year three different crosses (two involved inbred parents and one noninbreds) were compared with a control pen of noninbred New Hampshires. As seen in table 25, the crosses involving inbred lines each laid over 500 dozen eggs, whereas the other two pens laid less than 400 dozen. Not only did the hens in the singlecross topcross pen lay more eggs than the others, but their eggs were also larger. This was probably due to the larger size of the hens, which averaged approximately a pound heavier than the others. The relatively low egg production for 1953-54 was due largely to a high hen mortality for all of the test pens.

Last year a specific attempt was made to measure what benefits, if any, have resulted from inbreeding. This was done by comparing the performance of pullets produced by mating noninbred New

Some of the birds on an egg performance test at Highmore, 1955-56.

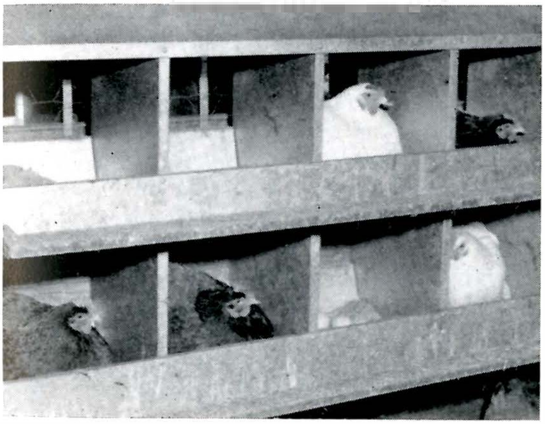


Table 24. Performance of Various Types of Chickens—1952-53

Factors Considered	R. I. Red x B. Rock	(N-2 x SD-1) x W. Leghorn	(N-2 x SD-1) x R. I. Red	Comm. Hybrid
Egg production	9,969	11,152	11,149	11,093
No. deaths	6	4	6	11
Av. egg wt. (oz. per doz.)	24.9	24.5	24.3	25.3
Adult body wt. (lbs.)	5.7	4.5	4.8	4.7

Table 25. Performance of Various Types of Chickens—1953-54

Factors Considered	N. Hamp.	W. Leghorn x N. Hamp.	(SD-4 x SD-11) x B. Rock	(N-2 x SD-1) x (SD-11 x SD-4)
Egg production	3,924	4,629	6,780	6,238
No. deaths	19	34	22	21
Av. egg wt.	24.1	23.6	25.3	23.0
Adult body wt.	5.1	4.5	5.9	5.0

Table 26. Performance of Various Types of Chickens—1954-55

Factors Considered	W. Rock x N. Hamp.	SD-1 x N. Hamp.	(M-540 x SD-11) x (M-210 x SD-4)	Comm. Hybrid
Egg production	7,894	8,519	8,051	9,267
No. deaths	10	8	12	15
Av. egg wt.	27.1	26.3	25.6	25.4
Adult body wt.	6.0	5.4	5.6	4.1

Hampshire hens to (1) noninbred White Rocks and (2) an inbred line of White Rocks that had been started 6 years previously from the same noninbred stock.

Results from these test pens are shown in the first two columns of table 26. The topcross group (from inbred sires) started laying a week before the others and laid nearly a dozen eggs more per hen. The lower body weight of those birds was reflected in lower average egg size. Again, this year, the heaviest hens laid the biggest eggs. However, the eggs from the crossbreds were actually too big, with quite a few weighing more than 28 ounces per dozen.

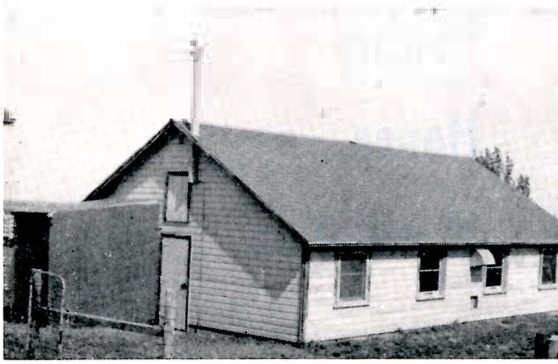
The other two test pens consisted of a commercial hybrid and a four-way cross hybrid that involved two grandparents from Minnesota inbred lines. Despite more deaths in these two groups, they laid more eggs than did the crossbred test pullets from New Hampshire dams. One important reason for the commercial hybrids outlaying all other test pens was their relatively early maturity; they reached 50 percent production a month before the four-way cross group.

Trends

From the performance data collected at this station it is obvious that hens produced from inbreds have outlaid those which had no inbred parents.

As to specific recommendations, we are not yet prepared to state that pullets from any one mating-type are the best. So far, the single-cross topcross birds have performed better than the others. However, there is a tremendous year-to-year fluctuation in total performance, and other environmental factors associated with management must not be overlooked.

Except for two pens in the 1953-54 test, egg size has been good. This suggests that two of the traits that must be concentrated upon in the future are livability and egg production. Although adaptability to local conditions refers to a number of traits on which improvement is sought (including disease resistance), it may be one of the important influences controlling ultimate production.



Poultry house at the Central Substation. The small building at the left end houses air conditioning equipment.

Poultry House Ventilation

A NEW 24- x 34-FOOT insulated poultry house of frame construction was completed and put into use in the fall of 1952.

The ventilating system installed in this building was a two-fan system. It consisted of a small fan which operated continuously except during extremely cold temperatures and a larger fan having a capacity approximately three times that of the small fan, which operated only when the temperature in the building rose above a pre-set temperature such as 35°F.

This ventilating system has been performing satisfactorily. However, some means of supplementary heat should be provided when extremely low temperatures occur, as occasional freezing temperatures were recorded inside the structure.

During the winter of 1953-54 a heat exchanger unit was installed and put into operation. This heat exchanger ventilating system was designed to recover some heat normally lost by ventilation. This unit utilizes the warm air normally exhausted from the building to warm the incoming fresh air, thus reducing the amount of heat lost in ventilation.

The heat exchanger consists of a number of parallel metal tubes enclosed in a duct. As warm air leaves the building through these tubes, cold incoming air passes through the space around the tubes and is warmed before entering the building. Results to date indicate that approximately one-half the heat normally lost by fan ventilation has been recovered by the heat exchanger. Electrical power costs and the accumulation of dust in the fans and tubes have been problems encountered with this system.

In 1955 work was started on a different method of controlling temperature and moisture. This is a mechanical refrigeration system that will act as a heat pump or dehumidifier in winter to dry and to warm exhaust air so that it may be returned to the building.

This machine, with a few minor changes, can also be used for summer air conditioning. With this arrangement it is expected that the desired objective of keeping the temperature in the building within the range of 45° to 75° throughout the year can be achieved.

With the heat exchanger, incoming air is warmed as it passes around a number of parallel tubes through which the exhaust air is forced.

Disposal System

A SEPTIC TANK system was installed to serve the dwelling at Highmore Central Substation in 1948. The tank was built of concrete silo staves in the form of a vertical cylinder with a capacity of 850 gallons. The floor was made of poured concrete and the cover was made of reinforced concrete slabs 8 inches wide. The inside of the silo staves was plastered.

The disposal field used was 4-inch clay tile. However, the soil in this particular area is too tight to use a customary disposal field, so a double, over-under line was installed.

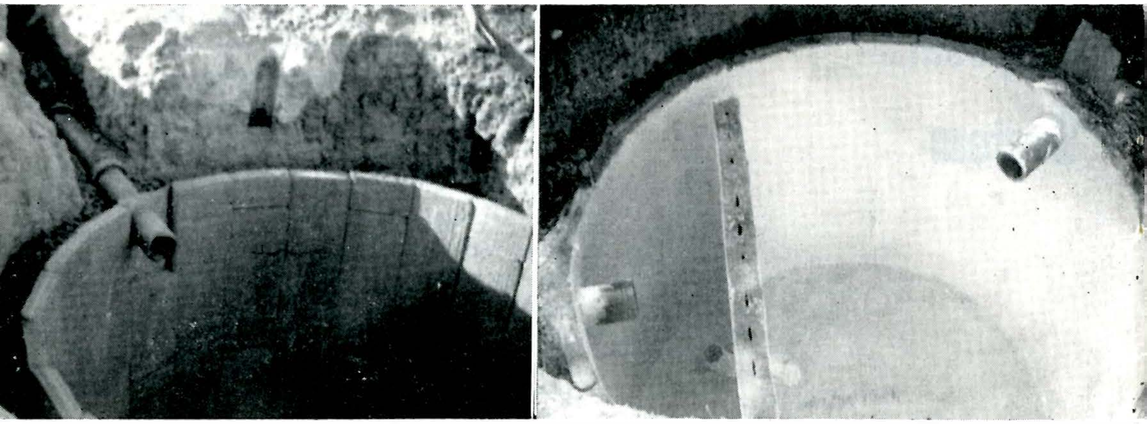
The ditch was approximately 10 inches wide and 4 to 5 feet deep. The upper tile line extended for 150 feet and was laid in gravel and back-filled with soil at a depth ranging from 24 to 36 inches. The lower tile line extended for 100 feet with 75 feet of it being under the upper line. It was laid in gravel fill in the bottom of the trench and approximately 24 inches below the upper line. Gravel was used to fill this 24-inch depth between the two 4-inch clay tile lines.

At the end of the lower tile line a concrete outlet box 27 x 42 x 24 inches was installed. This box was constructed with an outlet valve on the floor which would let the overflow into a pit of sand and gravel.

Purpose of this double line-outlet box arrangement was to provide some measure of aeration and filtration of the effluent as it percolates from the upper tile line and through the gravel to the lower tile. Eventually it enters the lower tile line and is carried to the outlet box where the over-flow could be measured. This gives a means of checking for the size of disposal field needed in the hard, tight soil which prevails in the Highmore area.

This system has operated satisfactorily 4 years, except for absorbing laundry water. Some liquid was present at times in the outlet box

An upper and lower line of tile is used to show the operation of the disposal field in a very nonporous area.



Silo staves can be used for walls of the septic tank. The inside is lined with plaster and then waterproofed.

during the 4-year period and it appeared fairly clean and relatively odorless which indicated the system was operating successfully.

In 1952, approximately 75 feet of the upper tile line was uncovered for inspection. Parts of this line were replaced, as there was some mechanical damage and a few attached joints showed signs of leakage. The lower line, septic tank, and outlet box remained intact.

The tank has never been pumped and it appears that a disposal field of this size in a tight clay soil will operate satisfactorily under normal conditions. At no time has freezing been encountered in the disposal system.

In some locations there may not be sufficient fall to obtain a satisfactory check or outlet for the lower tile line. In such a case a sump pump arrangement could be made to raise the effluent to a surfaced discharge.