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Progress Report of Research in Crops and Soils at the South Dakota Experiment Station

W. W. Worella
South Dakota State University

A. N. Hume
South Dakota State University

L. F. Puhr

J. E. Grafius

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PROGRESS REPORT OF RESEARCH

In Crops and Soils

AGRONOMY
DEPARTMENT
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION
SOUTH DAKOTA STATE COLLEGE • BROOKINGS, S. DAK.

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Table of Contents

Cover: Dr. John Grafius, agronomist, explaining the work of developing new crop varieties to one of the groups at Agronomy Field Day.

Explanation of Tables

Least significant difference. The minimum amount by which two varieties must differ in yield in order for that difference to be considered statistically significant.

PROGRESS REPORT OF RESEARCH IN CROPS AND SOILS

By W. W. Worzella, A. N. Hume, L. F. Puhr, J. E. Grafius, C. J. Franzke, D. B. Shank, V. A. Dirks, J. G. Ross and M. W. Adams[1]

The Agronomy Farm, located one mile east of Brookings, is representative of a large area of land in eastern South Dakota. It consists of 160 acres, of which about 130 acres are now laid out in various soil and crop experiments (Fig. 1). The soil, commonly called "loam" and classified as Barnes Loam, is in a good state of fertility.

Results of the experiments on this farm will closely indicate what may be expected from similar soil management, cropping systems and crop varieties on the same type of soil and under similar climatic conditions.

Numerous experiments are now in progress on this farm. The information given in this circular represents a progress report on only those experiments for which results can now be evaluated. Further results will be published at intervals as the experiments progress.

Crop Variety Tests

The annual tests of varieties of small grains, soybeans, corn and sorghum are rotated on nine ranges of approximately four acres each.

Spring Wheat Variety Tests. The results of spring wheat variety trials are given in Table 1. Among the hard red spring wheat varieties, Rushmore

Table 1. Results of Spring Wheat Variety Tests, 1946—1950

	Yield in bushels per acre							1950				1948		1949
Variety	1946	1947	1948	1949	1950	1946-50 Av.	1948-50 Av.	Test wt. lb./bu.	Date headed	% Stem rust	% Leaf rust	% stem smut	% bunt	% breaking
Hard Red Spring														
Rival	44.8	22.5	31.0	25.0	28.1	30.1	28.0	58.8	6/28	40	50	40	0	30
Rushmore	39.6	21.3	32.1	24.2	27.7	29.0	28.0	60.3	6/25	15	50	45	T—†	14
Pilot	37.7	22.2	31.4	22.0	25.4	27.7	26.3	58.1	6/29	15	55	45	0	15
Ceres	39.4	20.6	29.4	22.2	26.5	27.6	26.0	58.0	6/28	30	60	35	1	30
Mida	30.2	23.0	28.8	24.6	30.8	27.5	28.1	61.0	6/27	30	45	55	3	18
Thatcher	38.3	18.2	31.9	19.6	26.9	27.0	26.1	58.4	6/26	12	75	35	0	9
Cadet	40.4	17.4	29.2	17.8	25.4	26.0	24.1	57.1	7/3	25	60	20	T—	—
Lee	—	—	30.4	26.8	32.8	—	30.0	60.8	6/23	15	12	60	10	8
Tri. x That. 630*	—	—	27.9	26.1	31.6	—	28.5	60.5	6/24	20	10	35	T	13
HRP x C 2202*	—	—	28.7	23.8	32.4	—	28.3	61.1	6/28	20	10	40	1	26
Ns. 1831*	—	—	32.1	23.4	25.8	—	27.1	57.8	7/1	20	55	45	0	12
Redman	—	—	—	21.0	26.2	—	—	57.0	6/28	8	45	50	0	13
Ns. 2211*	—	—	—	—	29.3	—	—	59.1	6/25	35	45	30	0	—
Durum														
Stewart	43.1	29.7	34.9	20.8	25.4	30.7	27.0	60.2	7/1	10	0	18	0	0
Mindum	39.8	27.5	32.4	23.2	28.9	30.3	28.2	61.0	6/30	50	3	35	0	5
Vernum	30.6	28.4	30.6	23.0	32.4	29.0	29.0	62.5	6/28	30	0	55	0	0
Ld. 306*	—	—	—	22.1	28.1	—	—	59.2	6/28	45	0	60	0	0
Nugget	—	—	—	—	29.3	—	—	59.6	6/25	50	0	70	0	0
L.S.D.‡	4.0	2.3	2.2	1.8	2.3	1.2	1.2							

*Experimental numbers not named and not available for distribution.
†T— = Trace minus; T = Trace.
‡L.S.D. = Least Significant Difference.

[1]Agronomy Department, South Dakota Agricultural Experiment Station.

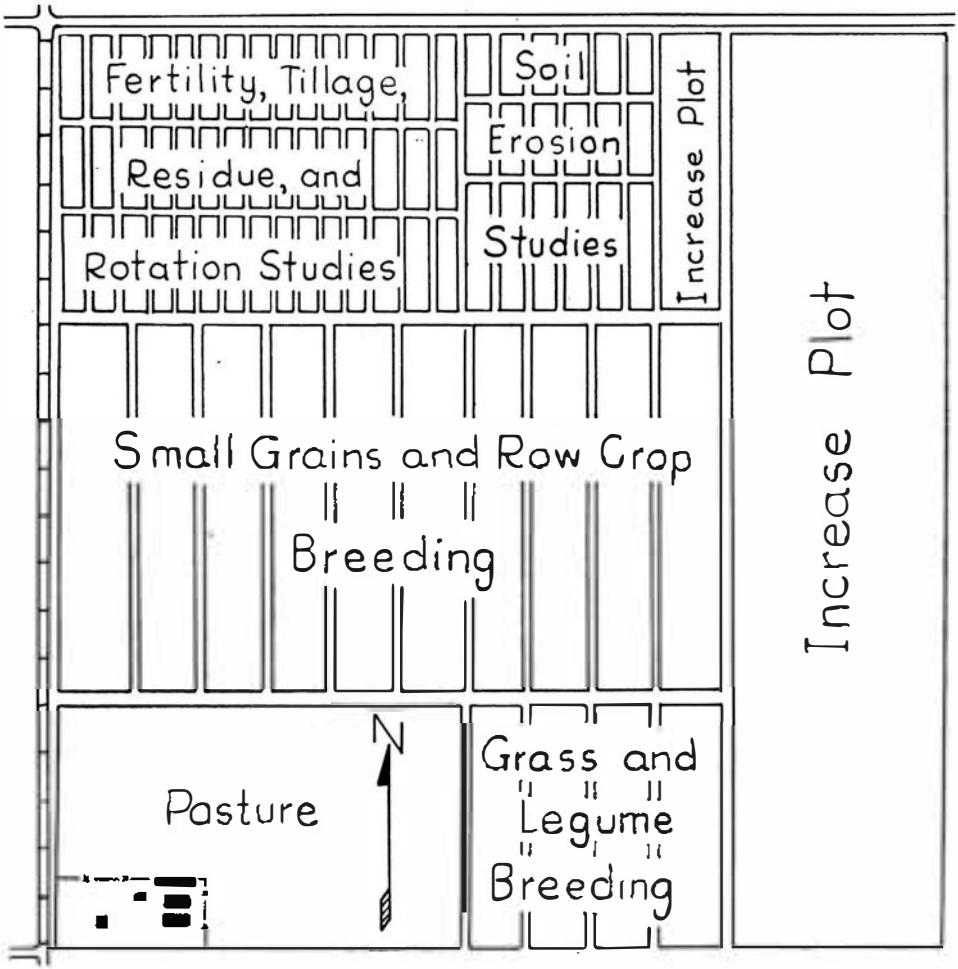

Fig. 1. Diagram of the Agronomy Farm showing location and arrangement of the more permanent experiments.

and Rival have excelled in yield. The late variety, Cadet, has been definitely inferior. During the three-year period in which it has been tested, Lee, a moderately leaf rust resistant, very early variety, has yielded satisfactorily even though it is susceptible to loose smut. In the durum wheats, the varieties Stewart and Mindum have performed very well.

Barley Variety Tests. The results of the variety tests of barley are reported in Table 2. Odessa is still the best yielding malting variety in eastern South Dakota on the basis of five-year averages. It may be concluded that

Table 2. Results of Barley Variety Tests, 1946–1950

Variety	Yield in bushels per acre					5-yr. av.	1950 Date headed	1950 Height inches	1950 Test wt. lbs./bu.
	1946	1947	1948	1949	1950				
Feebar	43.2	47.4	40.5	58.6	55.9	49.1	6/29	20	44
Kindred	33.8	43.0	33.1	59.5	51.3	44.1	6/29	21	46
Manchuria	40.1	45.9	35.7	62.4	57.8	48.1	7/1	23	48
Odessa	49.5	47.5	37.9	57.2	56.4	49.7	7/1	22	48
Plains	28.6	46.8	38.9	77.4	45.8	47.5	6/25	23	50
Spartan	34.4	43.8	30.1	62.8	50.0	44.2	6/25	22	50
Tregal	54.2	51.7	44.1	65.6	64.2	56.0	7/1	22	46
Velvon 11	52.1	50.8	44.1	71.7	59.1	55.6	7/1	23	44
Wisc. 38	38.5	47.8	35.3	64.2	57.1	48.6	7/3	26	47
Mars	—	43.7	34.0	58.6	46.3	—	6/28	20	48
Moore	—	46.0	36.9	52.5	55.0	—	7/2	27	47
Montcalm	—	—	41.5	62.8	50.4	—	7/2	26	47
Least significant difference	3.6	6.4	3.7	8.0	4.8	2.5			

the early varieties such as Mars, Plains, and Feebar do not fully utilize the growing season when the spring and early summer is cool and moist. During hot, dry growing seasons, where earliness is at a premium, one may expect higher relative yields from these varieties. The two feed barleys, Velvon 11 and Tregal have given excellent yields.

Oat Variety Tests. Table 3 summarizes the results of five years of plot tests on oat varieties. Clinton and Mindo have been superior in yield. Over a shorter period, the new hulless variety, James, has an excellent record.

Table 3. Results of Oats Variety Tests, 1946–1950

Variety	Yield in bushels per acre					1946-50 Av.	1948-50 Av.	Test wt. lbs./bu.	Date headed	Red leaf[1]	% Leaf rust	% Stem rust	Degree lodged	Heat damage
	1946	1947	1948	1949	1950					1950			1948	1949
Richland	76.2	53.6	73.2	68.0	79.8	70.1	73.6	33.2	6/26	L	20	10	18	L+
Tama	71.1	72.8	68.8	72.7	72.5	71.6	71.3	34.0	6/28	M—	T	10	50	L
Vikota	66.0	73.7	67.4	70.9	76.8	70.9	71.7	35.0	6/28	M—	T	10	35	L
Brunker	56.2	71.6	59.9	81.5	68.8	67.2	70.1	35.6	6/21	L+	20	40	65	L—
Trojan	61.7	55.8	73.6	74.6	65.9	66.3	71.3	33.2	6/21	L+	15	30	5	L—
Clinton	91.8	92.5	64.4	71.6	73.2	78.7	69.7	38.1	6/26	M—	30	20	5	M
Mindo	93.0	89.4	72.0	73.0	73.9	80.2	72.9	35.5	6/22	M	20	10	0	L+
Bonda	91.0	82.8	67.4	64.5	68.1	74.7	66.6	40.0	6/26	M	25	15	6	M
Cherokee	—	89.8	77.0	69.4	69.5	—	71.9	38.2	6/24	H—	20	15	5	H—
Nemaha	—	94.1	72.8	66.3	64.4	—	67.8	38.2	6/24	H—	20	15	5	H—
Osage	—	71.8	56.9	65.9	68.6	—	63.8	32.0	6/24	L+	T	10	10	M—
James[2]	—	105.0	80.7	79.5	84.8	—	81.0	47.0	6/25	L+	25	20	10	M
41115-1087†	—	101.0	73.2	81.2	82.7	—	79.0	36.4	6/26	M	30	15	20	M
41125-1138†	—	93.2	77.5	83.3	83.4	—	81.4	39.2	6/26	L+	20	8	12	M+
Andrew	—	—	77.0	73.0	79.0	—	76.3	33.2	6/22	L+	5	15	1	L+
Zephyr	—	—	74.2	66.6	80.5	—	73.7	33.8	6/29	L—	20	20	20	H
Shelby	—	—	74.8	70.6	81.3	—	75.5	38.5	6/30	L	15	15	64	H
41115-1111†	—	—	74.3	80.1	86.4	—	80.2	36.5	6/24	M	15	5	13	L
CI 4672†	—	—	—	—	79.0	—	—	36.5	6/22	L	15	10	—	—
L. S. D.[3]	3.7	8.1	5.2	10.0	6.4	3.1	4.3							

[1]L = Light; M = Moderate; H = Heavy
[2]hulless, yields adjusted.
†Experimental numbers not named and not available for distribution.
[3]L.S.D. = Least Significant Difference.

Flax Variety Tests. Table 4 summarizes the performance of flax varieties. The late, yellow-seeded variety, Crystal, has yielded satisfactorily during the past five years. Dakota has been satisfactory until 1950, when it rusted rather heavily. In the three years in which it has been tested, the midseason variety, Redwood, has been outstanding.

Table 4. Results of Flax Variety Tests, 1946—1950

	Yield in bushels per acre								1950					1949
						1946-50	1948-50	Test wt.	Date		Height			Heat
Variety	1946	1947	1948	1949	1950	Av.	Av.	lbs./bu.	Bloom	Ripe	inches	Rust	Pasmo	damage[1]
Bison	9.6	16.3	20.4	13.0	18.8	15.6	17.4	55.5	6/28	8/12	19	H	M	M
Redwing	10.9	15.4	18.4	12.6	18.8	15.2	16.6	56.2	6/26	8/12	17½	M+	M	L
Koto	10.7	15.6	20.0	13.4	20.5	16.0	17.9	55.4	6/28	8/16	19	H—	M+	M—
Dakota	13.6	16.0	20.4	16.6	21.7	17.6	19.6	55.2	6/27	8/16	19	M+	M+	M—
Crystal	15.5	18.8	17.1	15.8	25.1	18.4	19.3	54.2	6/29	8/17	19	O	M	M+
Royal	15.8	15.2	21.8	15.2	25.9	16.7	20.9	56.0	6/28	8/18	18	M	M	M—
Cheyenne		16.2	20.0	13.8	21.3		18.3	56.0	6/26	8/14	18	O	M—	L
Arrow			20.6	15.8	25.5		20.6	56.0	6/27	8/16	20	M—	M	M—
B-5128*			21.5	16.2	27.2		21.6	55.8	6/30	8/19	20	O	M	M
Minerva			20.5	15.0	24.7		20.1	54.6	6/28	8/19	19	M—	M+	M+
Redwood			22.4	17.4	26.3		22.0	55.4	6/28	8/17	19½	O	M+	M—
C.I.1135*				16.6	23.0			54.8	6/25	8/17	17	O	L—	M—
L.S.D.†	1.7	1.5	1.8	1.4	1.6	0.7	0.9							

[1] L = Light; M = Moderate; H = Heavy

*Experimental numbers not named and not available for distribution.

†L.S.D.—Least Significant Difference.

Rye Variety Tests. An examination of Table 5 will show that Pierre and Emerald have given almost identical four-year average yields. Tests at Eureka have shown that Pierre is more winter hardy than Emerald, and in years where winter killing is a factor, Pierre may be expected to outyield Emerald. Such a year occurred at Brookings in 1947, but the plots were severely damaged by hail so that these yields were not included in the average.

Table 5. Results of Winter Rye Variety Tests, 1946—1950

	Yield in bushels per acre					4-yr.	5-yr. av.	1950 Test
Variety	1946	1947	1948	1949	1950	av.	% winter survival	weight lbs./bu.
Dakold	39.1	Destroyed by hail	40.6	34.6	44.6	39.7	95	55
Emerald	41.3		43.3	36.2	47.1	41.9	93	56
Pierre	44.6		44.8	34.3	43.2	41.7	98	57
White Soviet			42.6	31.5	48.9			56
Least significant difference	3.8		1.7	2.9	4.5	1.7		

Winter Wheat Variety Tests. The results in Table 6 show that Minter has given excellent yields and is quite resistant to winter killing.

Table 6. Results of Winter Wheat Variety Tests, 1946—1950

Variety	Yield in bushels per acre					5-yr. av.	4-yr. av. % winter survival	1950 Date headed	1950 % Leaf rust	1950 % Stem rust	1950 Test wt. lbs./bu.
	1946	1947	1948	1949	1950						
Minter	28.0	35.5	34.9	29.6	31.7	31.9	72	6/26	80	Tr*	60
Minturki	19.9	37.4	33.4	20.2	26.6	27.5	70	6/26	80	Tr	58
Nebred	20.6	36.4	30.3	21.3	29.2	27.6	56	6/24	80	Tr	61
Iohardi				21.9	30.8		58†	6/23	80	1	61
Iowin		27.2	25.0	25.2	27.5		55	6/25	60	Tr	60
Marmin		16.2	36.3	27.5	31.5		72	6/24	80	1	60
Pawnee		14.9	0.0	21.7	16.0		26	6/20	80	1	59
Least significant difference	5.2	3.2	5.6	6.0	1.8	2.0					

*Tr — Trace
†2-year av.

Soybean Variety Tests. The results of soybean variety tests are reported in Table 7. The new variety Blackhawk released for the 1951 growing season has been superior on most counts. It has a wide adaptability within its maturity zone and will be superior to Manchukota, Habaro and Earlyana in areas where these varieties have been considered satisfactory. Monroe is not recommended for seed production because of its poor yield record and lower oil content. Ottawa Mandarin continues to be an early and good yielding variety, but is highly subject to pod shattering if not harvested early.

Table 7, Results of Soybean Variety Tests, 1949—1950*

Variety	Yield bushels per acre		Lodging score	
	1949	1950	Maturity†	Av.‡
Blackhawk	12.1	21.7	+7	2.1
Earlyana	10.3	18.6	+7	2.3
Habaro	10.9	18.5	+5	1.5
Harly	11.4	15.3	+5	1.8
Mandarin (Ottawa)	10.1	22.6	0	1.5
Monroe	10.6	19.7	+4	1.8

*Conducted in cooperation with Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.
†Days earlier (—) or later (+) than the check variety, Ottawa Mandarin.
‡Score: 1—desirable; 5—undesirable.

Corn Performance Tests. In addition to numerous tests each year on breeding material, yield trials were conducted in 1948, 1949 and 1950 on commercial hybrids. Included were several Experiment Station numbers. Table 8 shows how they performed. Experiment Station circulars, published each year, give the performance of all the commercial hybrids tested, both at Brookings and at other locations in the state. These circulars can be obtained at county agent's offices or by writing to the Agricultural Experiment Station, Brookings, South Dakota.

Table 8. Results of Corn Performance Tests, 1948–50

Variety	1950 Acre yield bu.	1950 Moisture percent	3-yr. Av. Acre yield bu.	3-yr. Av. Moisture percent	3-yr. Av. Acre yield bu.	3-yr. Av. Moisture percent
Sokota 212*	55.5	36.3	41.5	33.4	51.3	31.3
Sokota 224*	62.3	35.0	46.0	32.2	56.9	29.4
Sokota 400*	61.7	40.6	42.8	39.0	58.6	35.9
S. Dak. 270	60.7	39.7	44.6	36.0	—	—
S. Dak. Exptl. 5	64.5	37.6	—	—	—	—
S. Dak. Exptl. 9	69.1	33.2	52.1	30.3	—	—

*Sokota 212, 224, and 400 are the same as South Dakota 212, 224, and 400, respectively.

Sorghum Variety Tests. The forage and grain sorghum results are reported in Table 9. Rancher and 39-30-S, two low hydrocyanic acid selections, are adapted throughout the state where forage sorghums are grown. These two varieties are early, producing high yields of palatable forage. They are low in hydrocyanic acid content, and are safe to feed without danger of poisoning livestock.

Norghum and Improved Coes, the early maturing grain sorghums, produced the highest yields of grain. Sooner, Midland, Martin and Early Kalo are too late for high yield and high quality grain production in South Dakota.

Table 9. Results of Sorghum Performance Test, 1944–1950

Variety	Pounds per acre forage	Bu./acre	Date pollinated	Height inches
Forage sorghums				
Rancher	9336	32.9	8/7	74
39-30-S	8562	43.6	8/1	73
Rox Orange	10358	12.5	8/19	74
Atlas*	13280	7.6	8/26	75
Norkan	11561	23.5	8/18	74
Leoti Red	11024	9.8	8/24	71
Grain sorghums				
Norghum		49.4	8/2	48
Improved Coes		41.0	8/7	61
Sooner		26.6	8/11	50
Midland		22.7	8/16	46
Martin		23.9	8/15	46
Early Kalo		31.3	8/11	53

*Axtell—1950

Alfalfa Variety Tests. The yields of alfalfa varieties are given in Table 10. High yield and hardiness are the most important factors for most of South Dakota. Wilt resistance should be the first consideration for growers in the eastern one-fourth of the state and for growers who expect to produce seed for the out-of-state market. Argentine and unadapted seed from other mild climates will neither yield nor maintain stands comparable to adapted varieties.

Narraganset is a new variegated variety, produced by the Rhode Island Experiment Station. It appears to be a very vigorous and hardy strain with rather wide adaptability. Further testing of this strain is desirable. Williamsburg is also a new variety originated by workers in Virginia from a Kansas Common source. It appears somewhat more vigorous than the parent variety, but is probably no better adapted to South Dakota conditions than Kansas Common.

Table 10. Results of Alfalfa Variety Trials

Variety	Yield of hay at 12% moisture-tons per acre: 1949	6-Yr. av.	2-Yr. av.	Percent stand (April 1949)	Reaction to wilt
Ladak	5.01	4.76		68	Slightly resistant
Cossack	4.68	4.49		85	Slightly resistant
Dakota Common	4.70	4.46		80	Susceptible
Kansas Common	3.96	4.07		15	Susceptible
Grimm	4.44	4.51		88	Susceptible
Ranger	4.26	4.31		90	Moderately resistant
Atlantic	4.45		4.81	73	Susceptible
Buffalo	3.99		4.22	50	Moderately resistant
Narraganset	4.95			96	Susceptible
Williamsburg	4.30			66	Susceptible
Oklahoma Common	3.98			42	Susceptible

Grass Species and Variety Tests. Yields of hay in 1949 and 1950 from different species and strains of grass growing alone and with alfalfa are shown in Table 11. The bromegrasses, Ree wheatgrass and alfalfa are the highest ranking yielders when grown alone. Among these, S. D. No. 3 bromegrass, a component of the new variety, Homesteader, is the highest, followed by Ree wheatgrass. Yields of mixtures with alfalfa show less differences, indicating that alfalfa may make a compensating growth when in mixture with the poorer yielding grasses. Grass or alfalfa alone has not yielded as high as mixtures of the two in either of these years.

Table 11. Yields of Species and Strain of Grasses, 1949—1950

Species and strains	Yields of air dry hay—tons per acre: Alone 1949	Alone 1950*	Alone Av.	With alfalfa 1949	With alfalfa 1950*	With alfalfa Av.
S. D. No. 3 bromegrass	2.52	3.02	2.77	3.64	3.02	3.33
Lyons bromegrass	2.14	3.04	2.59	3.24	3.14	3.19
Lancaster bromegrass	2.28	2.42	2.35	3.69	3.14	3.41
Lincoln bromegrass	2.55	2.76	2.65	3.58	3.01	3.29
Ree wheatgrass	2.78	2.71	2.74	3.52	2.83	3.17
Standard crested wheatgrass	1.70	1.46	1.58	3.49	2.78	3.13
Mandan wild rye	2.33	1.90	2.11	3.72	2.51	3.11
Green Stipa grass	0.98	1.53	1.25	2.99	2.47	2.73
Slender wheatgrass	2.24	1.89	2.06	3.78	2.66	3.22
Kentucky bluegrass	1.44	1.47	1.46	2.83	2.83	2.83
Creeping Red Fescue	1.70	1.46	1.58	3.49	2.78	3.13
Ranger alfalfa	3.19	1.93	2.56	3.18	2.07	2.62

*Only one cutting harvested.

Crop Cultural Tests

Rate of Planting Corn. Table 12 gives the corn yields and the number of plants per hill. Corn was planted thick and thinned as nearly as possible to two, three and four plants per hill. Hills were 42 inches apart in each direction. Three kinds of corn were used: early, medium, and full-season corn. Average results indicate that highest yields were secured from four plants per hill.

Table 12. Effect of Rate of Planting Corn on Yield, 1945–1950*

Number of plants per hill	Planted May 1			Planted May 20		
	Early corn	Medium corn	Full-season corn	Early corn	Medium corn	Full-season corn
2	43.1	45.8	53.0	49.1	48.3	52.1
3	48.1	55.4	59.6	56.1	58.3	59.5
4	55.6	57.7	63.5	60.8	64.5	63.3

*Yields are in bushels per acre of shelled corn with 15 percent moisture.

Date of Planting Corn. Table 13 gives yields and moisture content of corn planted on two dates. Three kinds of corn were used: an early corn, a corn with a medium growth period, and a full-season corn. The six-year data indicate that greater yields were obtained in the east-central area by planting corn May 20th than by planting it May 1st. However, corn planted on May 20 contained slightly more moisture than that planted earlier.

Table 13. Effect of Date of Planting Corn on Yield and Moisture Content, 1945-1950*

Kind	Planted May 1		Planted May 20	
	Yield bu.	Moisture %	Yield bu.	Moisture %
Early corn	49.1	24.8	55.3	29.1
Corn with medium growth perixl	52.9	29.2	57.1	32.8
Full-season corn	58.7	33.9	58.3	34.1

*Yields are Per acre of shelled corn with 15 percent moisture.

Soil Experiments

Crop Yields on Fertility Plots. The object of this trial was to determine the effects of various fertilizers, applied at various rates and combinations, on the yield of crops. The following fertilizers and rates per acre were used: 20 pounds of nitrogen applied as ammonium nitrate, 20 pounds of phosphoric acid applied as treble super phosphate and 30 pounds of potassium oxide applied as muriate of potash. The fertility of the soil on the farm had been maintained at a high level previous to establishing the fertilizer trials in 1942. For this reason the immediate effects of fertilizer treatment on crop yields have not been pronounced. The results obtained are shown in Table 14. The wheat crop has responded more than the corn or the oat crop. However, the effect of fertilizer treatment is becoming more evident as more crops are produced.

Table 14. Results of Fertility Tests, 1942–1950

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
None	45.8	68.9	20.3
Nitrogen	46.9	69.5	22.3
Phosphorus	47.7	68.4	21.4
Potassium	49.7	65.9	21.2
Nitrogen + phosphorus	51.0	74.4	26.4
Nitrogen + potassium	49.3	71.5	23.4
Phosphorus + potassium	52.0	69.0	22.0
Nitrogen + phosphorus + potassium	47.6	71.8	23.9

Tillage and Crop Residue Experiments. The purpose of this trial was to determine the effects of tillage, crop residues, and fertilizers applied with residues, on the yields of corn, oats and wheat in a three-year rotation. The average crop yields from 1942 to 1950 are presented in Table 15. The return of crop residues to the soil, with plowing as the tillage practice, tended to produce an upward trend in crop yields which is becoming more pronounced from year to year. Plowing and subsurface tillage without the return of the crop residues have given about the same crop yields. The application of nitrogen and phosphorus fertilizer to subsurface and residue tilled soil increased the yields of wheat in comparison to subsurface and residue tilled soil with no fertilizer. Corn and oats on subsurface tilled soil were not significantly influenced by fertilizer treatment. The rates of fertilizers applied were the same as for the fertility plots.

Table 15. Results of Tillage and Crop Residue Tests, 1942–1950

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
Plowing	49.3	64.3	20.4
Plowing with residue	54.9	71.3	22.0
Subsurface tillage	47.8	66.8	19.9
Subsurface with residue	48.8	64.8	19.9
Subsurface with residue and manure	49.5	70.3	23.2
Subsurface with residue and nitrogen	47.6	72.4	24.1
Subsurface with residue and phosphorus	47.6	68.0	21.7
Subsurface with residue, nitrogen and phosphorus	46.7	70.9	25.9

Table 16. Results of Soil Preparation Experiments, 1942-1950

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
Plow 4"	46.6	69.5	20.8
Plow 7"	48.8	66.0	20.5
Plow 10"	46.9	69.5	22.0
Subsurface	46.5	63.0	18.9
One-way	46.1	64.5	19.4
Double disc	43.3	61.8	17.9

Methods of Soil Preparation. The influence of different methods of soil preparation on the yields of crops in a three-year rotation, corn-oats-wheat, is shown in Table 16. These data indicate that plowing is the most effective method for seedbed preparation. In this trial, none of the crop residues were returned to the soil.

Effect of Cultural Practices on Wheat Yields Following Sorghum. The purpose of this experiment is to determine the effect of tillage, residue treatments and nitrogen fertilizer on the yield of wheat following sorghum. The results of the various treatments are given in Table 17. The yields of wheat following sorghum were not significantly influenced by tillage, residues or nitrogen fertilizer. It should be noted that the yields of sorghum forage are lower on the subsurface plots than on the plowed plots.

Table 17. Results of Cultural Practices on Wheat Yields following Sorghum, 1942-1950

Treatment	Wheat bu. per acre	Sorghum lbs. forage per acre
Plowing	21.3	7713
Plowing with residue	22.4	7502
Plowing with nitrogen	23.3	8014
Plowing with residue and nitrogen	23.2	7522
Subsurfacing	22.7	6403
Subsurfacing with residue	22.8	6587
Subsurfacing with nitrogen	23.1	6302
Subsurfacing with residue and nitrogen	22.9	6426

Methods of Managing Sweet Clover Rotation. The effect of sweet clover on yields of corn and wheat was studied at two different times of plowing under of the green manure crop, with and without phosphate fertilizer.

The sweet clover was planted with the wheat crop and in the following year was plowed under for a green manure crop. The sweet clover was either plowed under in June or mowed. The portion which was mowed was allowed to grow until August and then plowed under. The wheat and corn yields are slightly higher following the August plowing as shown in Table 18.

Table 18. Effect of Sweet Clover Rotation on Crop Yields, 1944–1950

	Yields in bushels per acre Corn	Wheat
Sweet clover plowed June 15	49.3	26.9
Sweet clover plowed June 15 with phosphorus fertilizer	51.2	29.1
Sweet clover plowed August 1	53.5	29.0
Sweet clover plowed August 1 with phosphate fertilizer	53.2	28.9
No legume — corn — oats — wheat rotation	49.3	20.4
Continuous corn or wheat	46.7	20.5

Tillage and Rates of Crop Residue Experiments. In a corn-wheat rotation, three methods of soil preparation were used together with five rates of

straw treatment. The tests were conducted for six years and the data are reported in Table 19. The results show that in a two-year rotation, tillage had little effect on crop yields. Wheat yields were increased only by manure treatment. Corn yields on subsurfaced plots were reduced by increasing the amount of straw.

Table 19. Results of Tillage and Rates of Straw on Yields, 1942-1947*

Wheat stubble left every other year	Wheat yields bushels per acre			Corn yields bushels per acre		
	Subsurface	One way	Plow	Subsurface	One way	Plow
Mowed stubble	27.4	27.9	29.3	50.2	47.2	48.0
6" stubble	28.2	27.8	28.1	45.9	44.7	46.7
6" stubble and manure	29.2	30.9	29.5	49.8	48.7	49.4
12" stubble	27.9	28.1	28.5	44.5	45.6	45.0
Combined	27.6	27.5	29.4	43.6	46.3	49.7

*Conducted in cooperation with the Soil Conservation Service, USDA.

Effect of Tillage and Residue on Soil Removal by Wind Tunnel. Soil removal tests were conducted by means of a special wind tunnel on the corn plots reported in Table 19. The wind tunnel tests were run for 10 minutes at 40 miles per hour, 18 inches above the soil surface, and the soil was collected in a dust filter. The soil blown off from each plot is reported in Table 20.

Results show that as the amount of straw returned is increased, the rate of soil removal by wind is greatly reduced. The only exception is the 12-inch stubble. Subsurfacing is the most effective tillage method in preventing soil removal by wind.

Table 20. Results of Tillage and Residue Treatments on Soil Removal by Wind, 1942–47*

Wheat stubble left every other year	Soil lost from corn stubble, Lb./A.		
	Subsurface	One way	Plow
Mowed stubble	6998	5490	6223
6" stubble	4365	5619	5567
6" stubble and manure	1712	4888	5731
12" stubble	4911	5737	6845
Combined	3266	4563	5093

*Conducted in cooperation with the Soil Conservation Service, USDA.

Effect of Grass Sod upon Crop Yield and Soil Erosion. The purpose of the experiment is to determine the number of years grass residue and roots affect corn and wheat yields and their effectiveness in controlling wind erosion. Two grasses, crested wheatgrass and western wheatgrass are being used. The grass is left in a corn-wheat-grass rotation for a period of two, three and four years. The tests were conducted for six years and the data are reported in Table 21. Wheat yields immediately following a grass sod crop were decreased. Corn following a grass sod had more vigor throughout the growing season and the ears were more mature at time of harvest. To date, the use of grass as a sod crop has not reduced soil losses as measured by the wind tunnel.

Table 21. Results of Grass on Yield and Soil Removal by Wind, 1942–1947*

Previous crop treatment	Years in grass	Wheat yields 1946-47 Bu./A.	Corn yields 1946-47 Bu./A.	Soil lost from corn stubble 1945 Lbs./A.
Crested wheatgrass	2	25.3	42.8	4596
Western wheatgrass	2	25.2	45.6	5341
Crested wheatgrass	3	27.5	45.3	5963
Western wheatgrass	3	27.1	43.4	8594
Crested wheatgrass	4	24.4	45.2	———
Western wheatgrass	4	26.0	45.4	———
Corn-wheat cont.	none	24.6	42.5	6350

*Conducted in cooperation with the Soil Conservation Service, USDA.