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

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PROGRESS REPORT

OF

RESEARCH

IN

CROPS and SOILS

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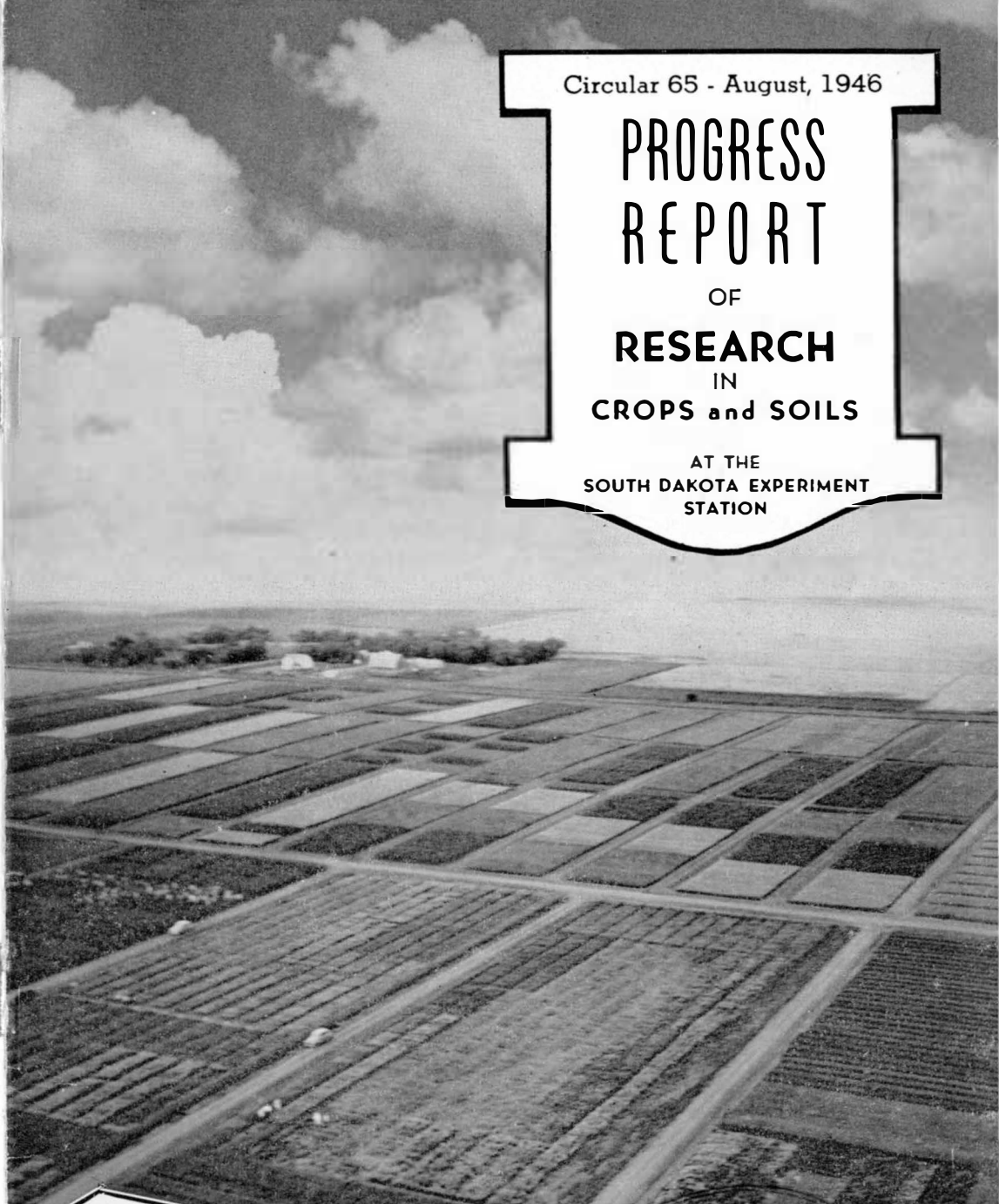
SOUTH DAKOTA EXPERIMENT STATION



Aerial View of Crops and Soils Research Plots

Agricultural Experiment Station
SOUTH DAKOTA STATE COLLEGE - BROOKINGS
AGRONOMY DEPARTMENT

Contents

Explanation of Tables

Least Significant Difference. This term means that a difference of the given number of bushels per acre is required for a difference in yielding ability between varieties.

Average yields. 2-year averages are for 1944-45; 3-year averages, 1943-45; 4-year averages, 1942-45; 5-year averages, 1941-45. All other figures in the tables represent 1945 crops.

Disease Percentage. Figures given under the columns, "rust" or "pasmo" indicate percentage of susceptibility to these diseases.

PROGRESS REPORT OF RESEARCH IN CROPS AND SOILS

By W. W. Worzella, A. N. Hume, L. F. Puhr, J. E. Grafius, E. L. Erickson, K. F. Manke, C. J. Franzke *and* E. C. Joy*

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 100 acres are now laid out in various soil and crop experiments. 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 only on 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. Recent results of spring wheat variety tests are given in Table 1. Among the hard red wheats, Rival, Pilot and Mida rank high in yield, disease resistance and test weight. All three varieties possess satisfactory milling and baking qualities. Of the durum varieties, Stewart and Mindum have performed the best. Some of the new numbered wheats look promising, but further testing is necessary to determine their adaptability.

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Table 1. Results of Spring Wheat Variety Tests

Variety	Yield in Bushels per Acre 1945*	2 yr. Av.	3 yr. Av.	4 yr. Av.	5 yr. Av.	Date Headed	Leaf Rust %	Height In.	Test Wt. Lbs./Bu.
Hard Red Spring									
Rival	40.3	25.8	24.2	27.5	26.2	6/29	20	46	57.0
Pilot	32.7	25.6	24.4	28.2	26.8	6/30	20	46	54.5
Thatcher	24.0	19.2	19.4	19.7	18.9	6/28	80	42	52.0
Regent	26.9	20.7	19.5	21.3	21.1	6/28	50	42	52.0
Ceres	28.3	16.4	15.4	18.4	17.5	6/30	70	45	55.5
R x T 2259	40.2	27.9	26.8	31.2		6/29	20	46	55.0
R x T 2403	41.0	30.6	28.0	29.8		6/28	20	44	57.0
R x T 2280	37.9	30.8	28.1	29.7		6/28	30	43	56.5
Mida	42.8	29.4	27.1			6/28	20	46	57.5
Cadet	30.6	23.7	22.4			7/2	10	46	53.5
R x T 2266	44.8	32.0	29.5			6/28	15	46	55.5
Newthatch	26.2	21.2				6/29	50	41	49.5
Pilot x Mida 1756	45.1					6/29	15	46	59.5
Durum									
Stewart	44.7	24.5	24.5			7/2		55	61.5
Mindum	44.1	24.6	22.9			6/30		54	59.5
LD 153	41.6	24.4	22.9			6/30		55	58.5
Carleton	38.1	21.6	19.8			7/2		56	58.5

*Least significant difference 2.5 Bu.

Barley Variety Tests. The results of variety tests of barley are reported in Table 2. Of the older varieties, Odessa still ranks on top in yielding ability. It is a six-rowed, rough-awned barley with a somewhat stiffer straw than Trebi. It is acceptable on the market as malting or distiller's barley. Wisconsin 38 is six-rowed, smooth-awned and a good malting barley but has a tendency to be weak-strawed.

Table 2. Results of Barley Variety Tests

Variety	Yield in Bushels per Acre 1945*	2 Yr. Av.	3 Yr. Av.	4 Yr. Av.	5 Yr. Av.	Date Headed	Lodging	Test Wt. Lbs./Bu.
Odessa	59.3	49.8	46.2	41.0	43.3	6/28	20	43
Wisc. 38	56.0	38.4	36.6	35.6	35.4	6/29	45	42
Manchuria	52.1	40.6	34.3	32.4	33.5	6/28	20	46
Spartan	51.9	36.1	32.1	30.5	33.6	6/24	Tr.	48
Trebi	47.4	39.9	36.7	35.4	37.9	6/29	20	38
L x M 1340	39.6	30.8	28.1	30.1	31.9	6/29	5	44
Velvet	39.2	29.5	26.5	25.9	27.8	6/29	15	41
P x V 391	62.4	49.4	46.7	42.4		6/26	10	44
P x V 385	52.1	46.6	42.7	41.1		6/26	Tr.	44
P x D 252	54.9	48.7	40.8	40.6		6/24	15	43
Tregal	48.5	39.4	35.7			6/28	Tr.	44
Plush	24.3	22.4	23.4			6/29	10	39
OAC 21	45.3					6/28	40	42
Kindred	45.6					6/26	45	44

*Least significant difference 7.7 Bu. Tr.—trace

Oat Variety Tests. Table 3 gives the results of variety tests of oats. Vikota and Tama are medium early yellow oats derived from a cross of Victoria x Richland. Because they are resistant to leaf rust, stem rust and loose and covered smut, they have performed very well in eastern South Dakota. Clinton, a new oats developed by the Iowa Agricultural Experiment Station in cooperation with the U.S.D.A., has yielded even higher than Vikota or Tama. However, only a limited amount of seed of Clinton will be released in 1947.

Table 3. Results of Oat Variety Tests

Variety	1945*	Yield in Bushels per Acre 2 yr. Av.	3 yr. Av.	4 yr. Av.	5 yr. Av.	Date Headed	Lodging	Rust % Leaf	Stem	Ht. In.	Test Wt. Lbs./Bu.
Richland	70.5	50.0	51.5	50.2	46.6	6/27	20	30	5	36	27.0
Tama	99.1	88.2	81.8	80.8	76.0	6/27	20	5	10	36	33.0
Vikota	99.5	86.7	80.4	80.0	75.6	6/27	20	5	10	37	33.5
Brunker	57.8	48.0				6/23	45	20	30	36	29.5
Trojan	56.8	48.2				6/25	Tr.	30	20	38	26.5
Clinton	113.7	101.3				6/27	10	0	1	41	36.5

*Least significant difference 14.3 Bu. Tr—Trace

Flax Variety Tests. The result of variety tests of flax are given in Table 4. Koto, a mid-season, brown-seeded variety, is resistant to wilt and moderately susceptible to pasmo and rust. It has an excellent plant type and competes more successfully with weeds than Redwing, Buda or Crystal.

Table 4. Results of Flax Variety Tests

Variety	1945*	Yield in Bushels per Acre 2 yr. Av.	3 yr. Av.	4 yr. Av.	5 yr. Av.	Date Ripe	Rust	Pasmo	Ht. In.	Test Wt. Lbs./Bu.
Redwing	17.7	17.4	16.9	17.1	16.6	8/4	M	M+	24	55.5
Bison	14.6	15.1	14.2	14.6	14.7	8/6	H	L+	27	56.0
B. Golden	20.8	15.0	13.6	13.5	13.3	8/4	O	H+	20	54.0
Buda	19.8	15.2	14.4	15.0	14.0	8/6	M—	M	28	56.5
Redson	21.6	18.3	17.0			8/4	M	M+	24	56.5
Biwing	18.6	17.2	16.7			8/5	M—	M+	24	56.0
Koto	18.0	18.4	17.0			8/7	M+	L	27	55.5
Crystal	22.5	17.4	14.5			8/7	O	L+	27	55.0
Dakota	24.4	20.4				8/8	O	L	29	56.5
Royal	19.6					8/10	Tr.	M	26	57.0

*Least significant difference 3.1 Bu.

O—None, Tr—Trace, L—Light, M—Medium, H—Heavy (degree of susceptibility)

Rye Variety Tests. Yields, lodging and test weight results for rye varieties are shown in Table 5. The variety Dakold is very winter-hardy

and can survive the severe South Dakota winters. The new varieties, Imperial and Balbo, have been tested only during the 1944-45 season, which was mild. More years of testing are needed to determine whether they can withstand our winters and are as suitable as Dakold or Common.

Table 5. Results of Rye Variety Tests

Variety	Yield in Bushels per Acre 1945	3 yr. Av.	Lodging %	Degree	Test Wt. Lbs./Bu.
Common	37.5	30.5	75	45	54.8
Dakold	39.6	34.8	80	45	55.0
Imperial	35.9		95	75	54.0
Balbo	38.1		65	30	53.8

Soybean Variety Tests. The results of soybean tests are shown in Table 6. Ottawa Mandarin, Manchukota and Habaro are the varieties adapted to the east central area. Ottawa Mandrin is superior to Wisconsin Mandarin 507 in yield, lodging resistance and oil content. Richland and Earlyana are too late in maturity for east central South Dakota. P.I. 68666 is an experimental variety which yields well but lacks lodging resistance.

Table 6. Results of Soybean Variety Tests

Variety	Yield in Bushels per Acre 1945	4 yr. Av.	3 yr. Av.	2 yr. Av.	Oil Content* (%) 1945	1944	1943	Lodging Score 1945	1944	1943
Manchukota	24.1	25.0	25.0	23.0	18.4	18.5	19.1	3	2	2
Ottawa Mandarin	26.9	27.0	27.0	27.5	18.6	19.8	20.4	1	1	4
Habaro	21.3	24.4	26.0	24.5	18.5	18.4	19.0	3	3	2
Wisc. Mandarin 507				22.2			19.4	3		2
Richland				18.7			19.4			4
Earlyana			25.0	27.0		19.2	19.8	4	4	
P. I. 68666			31.0	28.6		19.8	20.3		3	3

*Conducted in cooperation with U. S. Regional Soybean Laboratory.

Alfalfa Variety Tests. The yields for alfalfa varieties are given in Table 7. 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 market.

Seed of Ranger is still extremely limited but this variety should be chosen in preference to others. Arizona Chilean, Argentine and unadapted seed of other mild climates will neither yield nor maintain stands comparable to adapted varieties.

Table 7. Results of Alfalfa Variety Tests

Variety	Yield of Hay—Tons per Acre Five Year Average 1939-1943 1st Cutting	2nd Cutting*	Total	Reaction to Wilt
Ranger†	2.7	2.3	5.1	Highly resistant
Ladak	2.9	1.7	4.6	Resistant
Hardistan	2.6	2.1	4.7	Resistant
Cossack	2.7	2.1	4.8	Susceptible
Dakota Common	2.4	1.9	4.3	Susceptible
Baltic	2.4	1.9	4.3	Susceptible
Grimm	2.4	2.0	4.4	Susceptible
Hardigan	2.3	1.9	4.2	Susceptible
Kansas Common	2.1	1.6	3.7	Susceptible
Arizona Chilean	1.4	.9	2.3	Susceptible

*Second cutting in 1941 left for seed.
†Two year average 1942 and 1943.

Corn Performance Tests. Table 8 presents results of performance tests of experimental and released station hybrids tested during the 3 year period 1943 to 1945. The results for commercial corn hybrids tested in 1945 at the main station and other locations throughout the state have been published in South Dakota Agricultural Experiment Station Circular No. 60.

Table 8. Results of the Corn Performance Tests, 1943-1945

Hybrid	Yield of ear corn at 15% moisture in grain	Increase or decrease as compared with open-pollinated
	Bu.	*Perct.*
Sokota 204	53.0	3.0
Sokota 208	52.8	2.9
Sokota 212	47.9	−6.4
Sokota 220	60.6	18.1
Sokota 224	55.2	7.6
Sokota 232	55.6	8.4
Sokota 400	50.9	−.8
Sokota 414B	58.6	14.2
Sokota 418	62.0	20.9
Sokota 420	57.7	12.5

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, making them safe to feed without danger of livestock loss by forage poisoning.

Grain sorghum varieties, to be of value, should be even earlier than Sooner Milo in pollinating and should produce high-quality mature grain. Other characteristics to be considered in choosing a variety are standability after the crop has matured, ease of harvesting, disease resistance and adaptability to soil type and the environment under which they are grown.

Sooner Milo and Improved Coes generally produce a high-quality mature grain. Early Kalo, Martin's Combine, Sedan Kafir and Early Hegari are not consistently early from one season to another. They are high yielders but cannot be relied upon for producing high-quality matured grain.

Table 9. Results of Sorghum Tests, 1942-1944*

Variety	Yield Lbs./A. Forage	Yield Bu./A. Grain	Date Pollinated	Height Inches
Forage sorghum				
39-30-S	9813	51.4	8/6	78
Rancher	10621	39.0	8/11	83
Rox	12507	15.7	8/19	80
Norkan	12818	19.7	8/19	79
Grain Sorghum				
Sooner Milo	8098	27.2	8/14	56
Early White Milo	7707	28.5	8/10	78
Sedan Kafir	8116	42.5	8/12	59
Cheyenne Kafir	6169	32.4	8/6	62
Highland Kafir	7164	31.1	8/12	57
Improved Coes	8453	46.4	8/9	66
Early Kalo	7671	23.7	8/15	60
Modoc	8916	32.2	8/12	66
Early Hegari	8240	44.8	8/11	54
Martin's Combine	7156	23.9	8/16	51
10-A-33-133-1-1	6573	30.9	8/11	67
26-39-2-40	8111	33.8	8/8	56

*Due to poor stands 1945 data were not included.

CROP CULTURAL TESTS

Rate of Planting Corn. Table 10 gives the yield of corn with different numbers of plants per hill. The corn was planted thick and thinned to 2, 3 and 4 plants per hill. Hills were 42 inches apart in each direction. Three kinds of corn were used: early, medium, and full-season corn. The results for 1945 show that the highest yields were obtained with four plants per hill. The percentage of moisture in the corn was not influenced by thickness of stand.

Table 10. Effect of Rate of Planting Corn on Yield 1945*

Number of Plants per Hill	Planted May 3 Early Corn	Planted May 3 Medium Corn	Planted May 3 Full-Season Corn	Planted May 21 Early Corn	Planted May 21 Medium Corn	Planted May 21 Full-Season Corn
2	36.6	28.2	40.2	42.5	46.2	43.3
3	44.3	40.2	42.6	46.2	56.8	54.2
4	51.9	52.8	48.9	61.8	62.6	60.6

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

Date of Planting Corn. Table 11 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. Obviously, one year's work is too short from which to draw definite conclusions, but the results are worth study.

Table 11. Effect of Date of Planting Corn on Yield and Moisture Content 1945*

Kind	Planted May 3 Yield Bu.	Planted May 3 Moisture %	Planted May 21 Yield Bu.	Planted May 21 Moisture %
Early Corn	44.3	17.5	50.2	17.3
Corn with medium growth period	40.4	28.3	55.2	24.7
Full-season corn	43.9	27.6	52.7	29.6

*Yields are per acre of shelled corn with 15 per cent moisture.

SOIL EXPERIMENTS

Crop Yields on Fertility Plots. The object of this trial is to determine the long-time effects of fertilizers or plant food, applied at various rates and combinations, on the yields of crops and the fertility of the soil. The following plant foods and rates per acre were used: 100 pounds ammonium sulphate, 100 pounds treble superphosphate, and 60 pounds of muriate of potash. The fertilizer was applied to these crops in a corn-oats-wheat rotation. The fertility of the soil on this farm had been maintained at a high level previous to establishing the fertilizer trials in 1942. Consequently the immediate effects of fertilizer treatment on crop yelds have not been pronounced

In Table 12 are presented the average yields of crops from 1942 to 1945. The average yields for this period do not show significant differences due to fertilizer treatment. However, the effect of fertilizer treatment is becoming more evident as more crops are produced.

Table 12. Results of Fertility Tests, 1942-1945

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
None	52.2	77.4	24.1
Nitrogen	51.9	70.7	24.0
Phosphorus	52.7	74.7	24.6
Potassium	53.3	70.8	25.4
Nitrogen + Phosphorus	52.9	73.5	26.1
Nitrogen + Potassium	53.1	76.3	25 0
Phosphorus + Potassium	57.7	73.5	24.8
Nitrogen + Phosphorus + Potassium	53.3	76.4	24.7

Tillage and Crop Residue Experiments. The purpose of this trial was to determine the effects of tillage and crop residues on the yields of corn, oats and wheat in a three-year rotation. The average crop yields from 1942 to 1945 are presented in Table 13. During this period the crop yields have fluctuated considerably due to weather and plant diseases.

Plowing has given higher yields of wheat and corn than subsurface tillage.

The return of crop residues to the soil, with plowing as the tillage practice, tended to produce an upward trend in yields which is becoming more pronounced from year to year. The application of nitrogen and phosphorus fertilizer to subsurface and residue tilled soil produced small increases in the yields of oats and wheat in comparison to subsurface and residue tilled soil with no fertilizer. The application of fertilizer with subsurface tillage to the corn crop resulted in small decreases in yield.

Table 13. Results of Tillage and Crop Residue Tests, 1942-1945

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
Plowing	55.6	75.0	23.9
Plowing with residue	55.9	77.2	25.4
Subsurface tillage	52.8	76.0	21.8
Subsurface with residue	53.5	71.7	21.7
Subsurface with residue and manure	51.9	74.3	22.7
Subsurface with residue and nitrogen	49.1	76.8	24.0
Subsurface with residue and phosphorus	51.1	71.0	23.3
Subsurface with residue, nitrogen and phosphorus	48.3	72.6	25.5

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 14. 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 except the stubble.

Table 14. Results of Soil Preparation Experiments, 1942-1945

Treatment	Average yield in bushels per acre Corn	Oats	Wheat
Plow 4″	49.7	76.7	23.7
Plow 7″	52.8	74.5	24.2
Plow 10″	49.9	74.1	26.5
Subsurface	47.5	68.6	21.7
One-way	47.4	67.3	21.9
Double Disk	45.8	62.2	20.2

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 15.

The return of all the sorghum forage to the soil followed by plowing or subsurfacing gave small increases in wheat yields. This would indicate that the sorghum residue in itself does not have any harmful effects on the wheat crop. In order to determine if sorghum reduced the available nitrogen for the following crop, nitrogen fertilizer was applied. In most cases nitrogen increased the yields of wheat about two bushels per acre. It should be noted, also, that the yields of sorghum forage are lower on the subsurface plots when compared to plowing.

Table 15. Results of Cultural Practices on Wheat Yields Following Sorghum, 1942-1945

Treatment	Wheat Bu./A.	Sorghum Lbs. Forage/A.
Plowing	23.16	7612
Plowing with residue	24.29	6996
Plowing with nitrogen	25.44	7443
Plowing with residue and nitrogen	24.91	7292
Subsurfacing	22.98	6700
Subsurfacing with residue	23.00	6993
Subsurfacing with nitrogen	24.29	6605
Subsurfacing with residue and nitrogen	24.96	6748

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 four years and the data are reported in Table 16. The results show that in a two-year rotation, tillage had little effect on crop yields. Wheat yields were

increased only by manure treatment. On subsurfaced plots corn yields were reduced by increasing the amount of straw.

Table 16. Results of Tillage and Rates of Straw on Yields, 1942-1945

Wheat stubble left every other year	Wheat yields Bu/A			Corn yields Bu/A		
	Subsurface	One way	Plow	Subsurface	One way	Plow
Mowed stubble	28.8	28.9	30.7	54.8	52.1	50.6
6″ stubble	29.7	29.0	29.3	49.6	48.4	48.8
6″ stubble and manure	30.4	31.2	29.7	54.0	52.6	52.1
12″ stubble	28.4	28.6	29.1	48.3	50.1	48.1
Combined	28.5	28.2	30.1	47.9	54.0	52.5

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 16. The wind tunnel tests were run for ten minutes at forty miles per hour 18″ above the soil surface, and soil collected in a dust filler. The soil blown off from each plot is reported in Table 17.

The results show that as the amount of straw returned is increased the rate of soil removal by wind is greatly reduced. Subsurfacing is the most effective tillage method in preventing soil removal by wind.

Table 17. Results of Tillage and Residue Treatments on Soil Removal by Wind, 1942-1945

Wheat stubble left every other year	Soil lost from corn stubble, Lbs./A.		
	Subsurface	One way	Plow
Mowed stubble	6373	5812	6014
6″ stubble	4511	6234	6254
6″ stubble and manure	4845	5250	6472
12″ stubble	4688	6442	7629
Combined	2953	4887	4967