Marvin T. Nordbo
Assistant Agricultural Economist
Virgil Weiser
Extension Soils Agent

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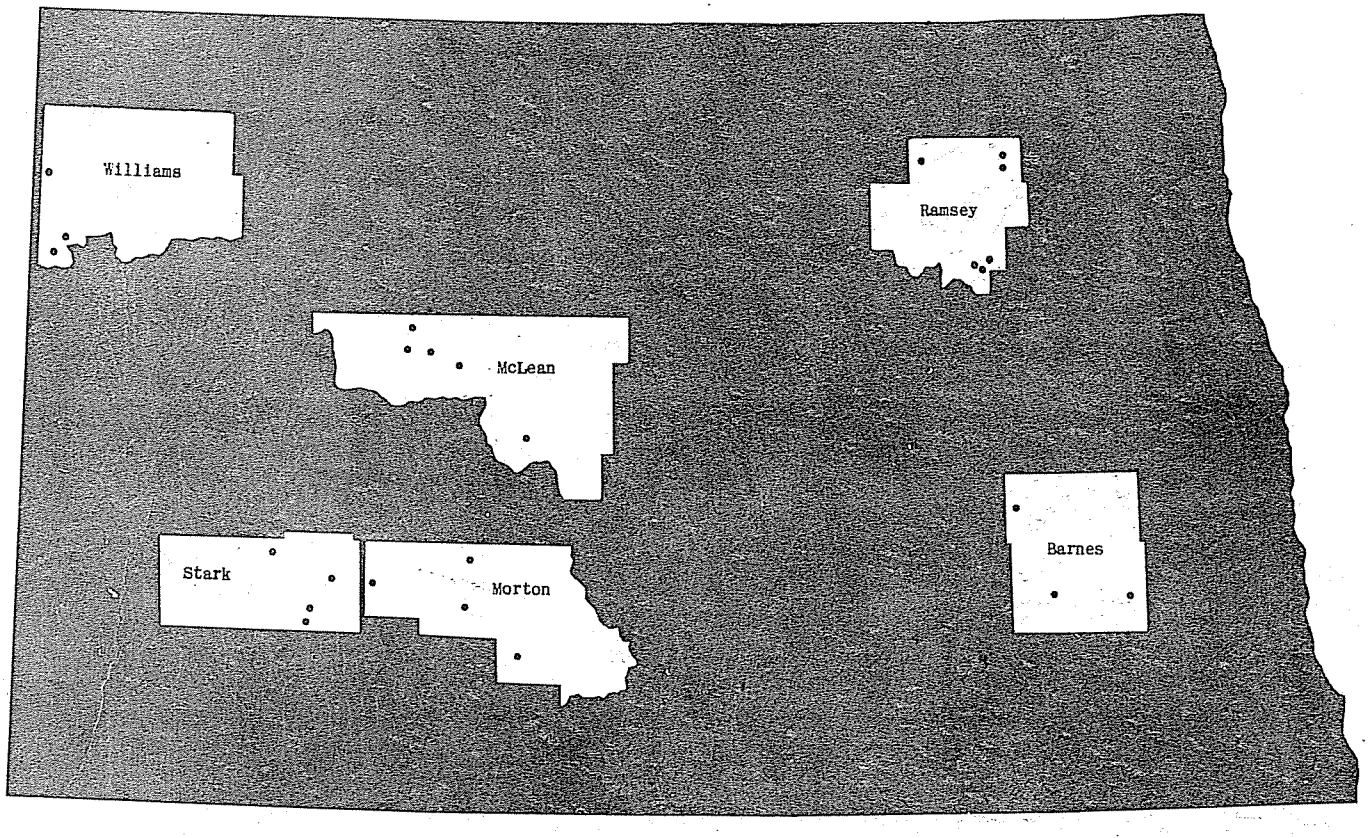
Agricultural Economics
Report No. 22

the 1961 REPORT ★

ON TEST DEMONSTRATION FARMS IN NORTH DAKOTA



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Department of Agricultural Economics
North Dakota Agricultural Experiment Station
and North Dakota Extension Service

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THE 1961 REPORT ON TEST-DEMONSTRATION PROGRAM IN NORTH DAKOTA

Marvin T. Nordbo[1] and Virgil Weiser[2]

The Tennessee Valley Authority and the North Dakota State University of Agriculture and Applied Science have cooperated for five years in conducting a test-demonstration program in North Dakota. The broad objectives of this program are:

1. To introduce TVA experimental fertilizers in farm fertilizer programs in the state,
2. To determine cooperating farmer's acceptance of these fertilizer materials,
3. To demonstrate and test the effects of recommended fertilizer treatments on individual crop yields and over-all farm income,
4. To promote agricultural developments in North Dakota through improved use of fertilizers in combination with other recommended farm and home practices.

The North Dakota Agricultural Experiment Station and the North Dakota Extension Service cooperate in conducting this program within the state. The Agricultural Economics Department conducts its share of the program under Station Project (S-3-5) which has as its objective an economic evaluation of a recommended and balanced fertilizer program as it applies to the over-all farm. The responsibilities of the various cooperating personnel are explained in the 1960 report. (Agricultural Economics Report No. 18).

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[1]Assistant Agricultural Economist, North Dakota Agricultural Experiment Station.

[2]Extension Soils Agent, North Dakota State Extension Service.

Active Test-Demonstration Farms in North Dakota

The Test-Demonstration Program was initiated in Barnes, Ramsey, Morton and Stark Counties in 1957 with 18 cooperating farms. Fourteen of these cooperators have remained in the program for five years. McLean and Williams Counties were added in 1958 with nine cooperators. Eight of these farmers have actively cooperated for four years. The cooperating farmers have been very stable, with only five dropping out of the program (Table 1). Two of these placed their farms in the soilbank, two dropped out after the first year because of poor physical qualities in fertilizer materials received and one dropped out due to too many off-farm work conflicts. Three cooperators were added as replacements for the five who dropped out. No changes in farm cooperators were made during the 1960 and 1961 cropping seasons.

The location of participating counties and relative location of individual farm cooperators are shown in Figure I.

TABLE 1. TENURE OF FARM COOPERATORS IN TEST-DEMONSTRATION PROGRAM, 1957-1961

County	Original Cooperators	Drop Outs	Replacements	Active Cooperators 1961
Barnes	3	1	1	3
Ramsey	6	-	-	6
Morton	4	1	1	4
Stark	5	2	1	4
McLean	5	-	-	5
Williams	4	1	-	3
Total	27	5	3	25

Land Tenure and Land Use on Cooperating Farms

Eleven cooperators owned all the land they operated, nine were part-owners and five rented all their land. Small grains were grown on all cooperating farms and the majority of the cooperators had some type of livestock enterprise in addition to their cash-grain enterprise. Three cooperators were strictly cash-grain farmers.

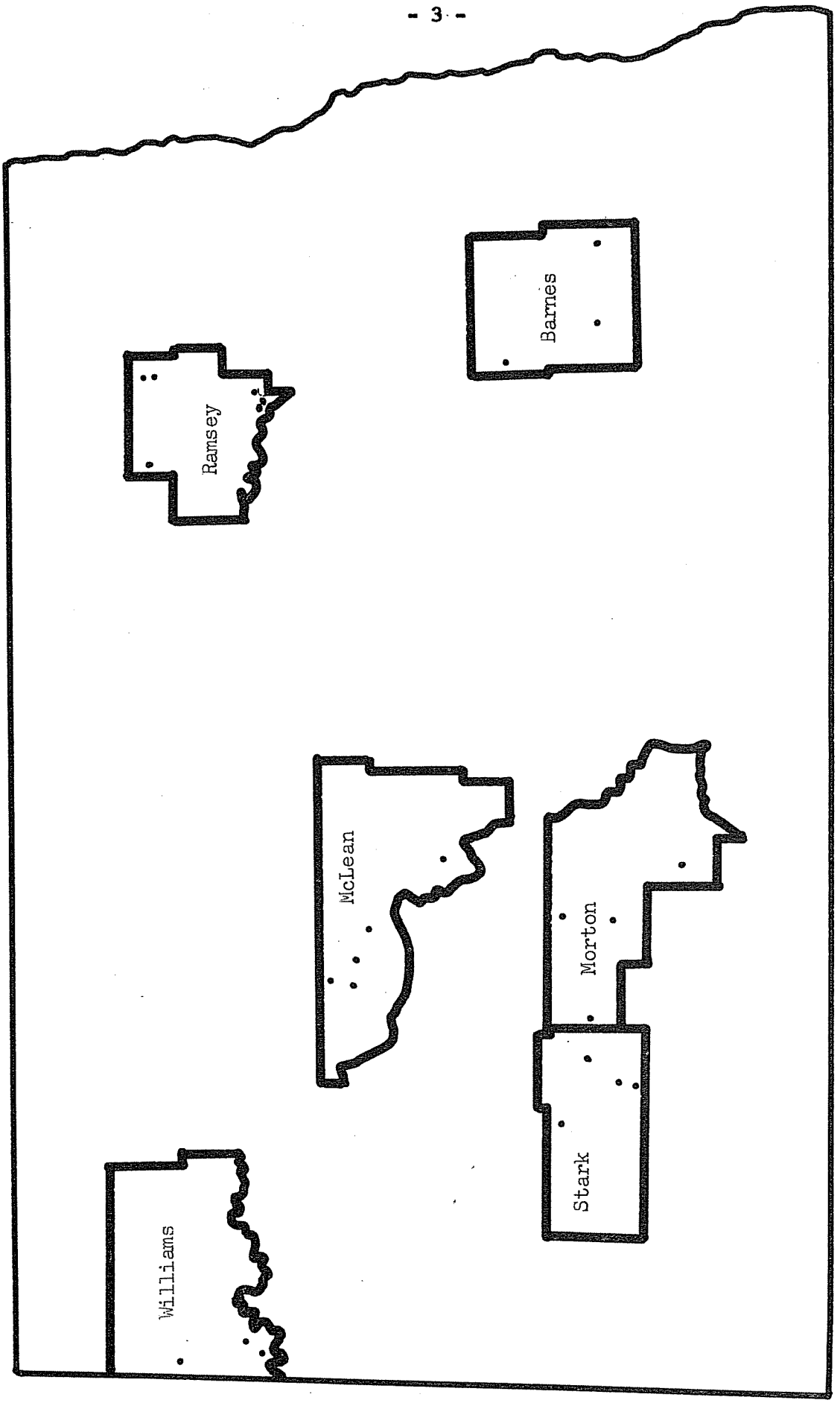

Figure 1. Location of Test - Demonstration Farms.

The test-demonstration cooperators operated a total of 30,673 acres of farm land (Table 2). Approximately 61 per cent of this acreage was tillable.

TABLE 2. PROPORTION OF LAND OWNED AND RENTED, AND TILLABLE ACREAGE ON TEST-DEMONSTRATION FARMS, 1961

	Acres	Per Cent of Total Farmland
Farmland Owned	19,705	64.2
Farmland Rented	10,968	35.8
Total Farmland	30,673	100.0
Tillable Acreage	18,757	61.2

Wheat (hard red spring and durum) was the leading cash crop on the test-demonstration farms. Twenty-nine per cent of the total cropland was devoted to wheat production in 1961 (Table 3). Wheat was also the favored small grain crop for fertilizer treatment, 85.5 per cent of the wheat acreage was fertilized and 63.9 per cent of the barley acreage. Two cooperators are on irrigation units in Williams County and produce sugar beets. The total acreage of this crop was fertilized.

Amount of Fertilizer Material Used

A total of 243.71 tons of fertilizer was purchased from the Tennessee Valley Authority by the test-demonstration cooperators for the 1961 crop. Diammonium phosphate (20-52-0) was the material in greatest demand; 103.60 tons were used on these farms (Table 4). Cooperators also used a substantial amount of high analysis superphosphate (0-53-0) in 1961. This material was in granular form and very satisfactory from the standpoint of handling and spreading qualities.

Additional fertilizer materials were purchased locally to supplement the materials received from the Tennessee Valley Authority.

TABLE 3. DISTRIBUTION OF CROP ACREAGES AND USE OF FERTILIZER ON TEST-DEMONSTRATION FARMS IN 1961

Crop	Acreage Grown	Per Cent of Total Cropland	Acreage Fertilized	Per Cent of Crop Fertilized
Wheat & Durum	5,442	29.0	4,654	85.5
Barley	2,904	15.5	1,856	63.9
Corn	1,263	6.7	99	7.8
Oats	1,059	5.6	279	26.3
Flax	446	2.4	--	--
Alfalfa	768	4.1	131	17.1
Grass & Pasture	1,115	5.9	--	--
Rye	413	2.2	211	15.1
Sugar Beets	89	.5	89	100.0
Millet	66	.4	--	--
All Crops	13,565	72.3	7,319	54.0
Fallow	3,919	20.9	--	--
Soil Bank	1,273	6.8	--	--
Total Cropland	18,757	100.0	7,319	39.0

TABLE 4. TONNAGE OF TVA FERTILIZER MATERIALS USED ON TEST-DEMONSTRATION FARMS IN 1961

County	Tons of Material					
	0-63-0	0-53-0	20-52-0	20-20-0	30-10-0	Total
Barnes	9.76	.88	31.80	--	21.00	63.44
Ramsey	--	9.76	34.24	--	22.29	66.29
Morton	--	12.72	10.84	--	--	23.56
Stark	--	8.32	12.80	--	--	21.12
McLean	--	33.28	1.84	--	--	35.12
Williams	3.96	5.28	12.08	6.76	6.10	34.18
Total	13.72	70.24	103.60	6.76	49.39	243.71

Fertilizer Responses in 1961

The test-demonstration farm cooperators fertilized 6, 789 acres of small grains (wheat, barley and oats) in 1961. Harvest yields were measured on fertilized and unfertilized portions of 3,586 acres. (This includes 3,506 acres of crop on dryland and 180 acres of irrigated small grains). Most of

North Dakota experienced an abnormally dry season in 1961. The average annual precipitation was 12.80 inches compared to a long time average of 16.94 inches, consequently poor fertilizer responses were experienced by most cooperators. Several fertilized fields were abandoned due to drought. Responses on the harvested fields also were poor (Table 5). Durum was the only small grain crop producing a paying return to fertilizer (Table 6). This was due largely to the favorable market price for this crop rather than good yield increases. The mid October price was $3.16 per bushel compared to $1.89 the previous season. The crop yield responses to fertilizer treatments were poorer than those of previous seasons.

TABLE 5. AVERAGE FERTILIZER TREATMENT AND CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, 1961[1]

Crop	Nutrients Per Acre	Yield - Bu./Acre		
		Fertilized	Check Strip	Difference
Wheat on Fallow	2-28-0	12.9	11.7	1.2
Wheat on Nonfallow	22-30-0	15.9	13.3	2.6
Durum on Fallow	2-25-0	12.7	11.4	1.3
Durum on Nonfallow	21-30-0	12.7	9.7	3.0
Barley on Fallow	5-24-0	14.1	12.5	1.6
Barley on Nonfallow	19-28-0	23.1	18.9	4.2

McLean and Ramsey counties were the only two counties which showed an overall profit on the crops checked at harvest time (Table 7). Much of this may be attributed to the favorable market price for durum rather than the bushel responses. Sixty-eight per cent of the crops checked in McLean County was durum grown on fallowed land. In Ramsey County, durum made up 45 per cent of the crops checked, and 76 per cent of the durum was grown on fallowed land. The other counties

had relatively little or no durum and consequently did not have the product price advantage to make up for the small yield increases resulting from fertilizer treatments.

The crop yield responses to fertilizer treatments varied from county to county as shown in Tables 8, 9, 10 and 11. Barnes County had the best over-all yield increase but also had the largest fertilizer inputs. The fertilizer rates applied were varied from county to county on the basis of available soil moisture at seeding time. The crop yields and yield responses on the individual fields and individual cooperators are listed by counties in Appendix A, Table 1 through 6. The average costs and returns to fertilizer treatments on individual farms are listed in Appendix B, Tables 1 through 6.

TABLE 7. COSTS AND RETURNS FROM FERTILIZER INVESTMENTS ON 3,686 ACRES OF SMALL GRAIN CROPS, 1961

County	Acreage Checked	Fertilizer Cost Per Acre ($)	Total Added Return/Acre ($)	Per Cent Net Return
		Dryland		
Barnes	1,174	6.15	5.98	-2.8
Ramsey	1,049	3.88	4.04	4.2
Morton	176	2.53	1.95	-22.8
Stark	387	3.98	3.07	-22.9
McLean	650	2.67	3.08	15.5
Williams	70	2.70	1.63	-39.6
All Dryland	3,506	4.33	4.25	1.9
		Irrigated Land		
Williams	180	7.00	24.22	230.4
		Irrigated and Dryland		
All T-D Farms	3,686	4.48	5.23	16.6

TABLE 8. AVERAGE YIELDS AND FERTILIZER RESPONSES OF WHEAT AND DURUM ON FALLOWED LAND, 1961[1]

County	Number of Fields	Average Fertilizer Treatment	Yield-Bushels/Acre		
			Fertilized	Check	Difference
Barnes	3	8+29+0	25.1	20.9	4.2
Ramsey	9	3+24+0	18.2	16.9	1.3
Morton	9	1+26+0	12.2	10.8	1.4
Stark	8	1+31+0	9.8	8.6	1.2
McLean	22	0+26+0	9.1	8.1	1.0
Williams	1	0+27+0	6.5	5.7	.8
Total (Dryland)	52	1+26+0	12.2	10.9	1.3

[1]Simple averages of harvest yields.

TABLE 9. AVERAGE YIELDS AND FERTILIZER RESPONSES OF WHEAT AND DURUM ON NON-FALLOWED LAND, 1961[1]

County	Number of Fields	Average Fertilizer Treatment	Yield-Bushels/Acre		
			Fertilized	Check	Difference
Barnes	8	27+31+0	18.3	15.3	3.0
Ramsey	2	21+33+0	14.3	10.3	4.0
Morton	--	--	--	--	--
Stark	8	12+30+0	7.3	5.9	1.4
McLean	--	--	--	--	--
Williams	--	--	--	--	--
Total (Dryland)	18	20+31+0	13.0	10.6	2.4
Irrigated	7	25+40+0	48.4	39.4	9.0

[1]Simple averages of harvest yields.

TABLE 10. AVERAGE YIELDS AND FERTILIZER RESPONSES OF BARLEY ON FALLOWED LAND, 1961[1]

County	Number of Fields	Average Fertilizer Treatment	Yield-Bushels/Acres		
			Fertilized	Check	Difference
Barnes	1	12+31+0	7.4	7.3	.1
Ramsey	1	0+16+0	27.5	24.8	2.7
Morton	--	--	--	--	--
Stark	1	0+32+0	10.7	8.0	2.7
McLean	--	--	--	--	--
Williams	--	--	--	--	--
Total (Dryland)	3	4+26+0	15.2	13.4	1.8

[1]Simple averages of harvest yields.

TABLE 11. AVERAGE YIELDS AND FERTILIZER RESPONSES OF BARLEY ON NONFALLOWED LAND, 1961[1]

County	Number of Fields	Average Fertilizer Treatment	Yield-Bushels/Acres		
			Fertilized	Check	Difference
Barnes	11	24-30-0	24.0	19.6	4.4
Ramsey	9	13-25-0	24.2	21.0	3.2
Morton	--	--	--	--	--
Stark	1	12-31-0	2.3	1.5	.8
McLean	--	--	--	--	--
Williams	--	--	--	--	--
Total (Dryland)	21	18-28-0	23.1	19.4	3.7
Irrigated	2	16-42-0	53.2	41.7	11.5

[1]Simple averages of harvest yields.

Handling and Spreading Characteristics of Test-Demonstration Fertilizer Materials

Five different types of TVA fertilizer materials were used during the 1961 cropping season. They were calcium metaphosphate (0-63-0), high analysis superphosphate (0-53-0), diammonium phosphate (20-52-0), leached zone fertilizer (20-20-0), and ammonium phosphate nitrate (30-10-0). The cooperators experienced very little trouble with any of these materials. The physical condition of all materials received was generally good and all material arrived in good condition. The high analysis superphosphate which had caused severe problems in spreading during previous seasons was in granular form and caused no trouble this year. The overall quality of materials was improved to make this the most trouble-free experience during the past five year period.

Uses Made of Test-Demonstration Farms

The primary objective of the test-demonstration program in North Dakota is to determine the economic effects of a recommended fertilizer program and to demonstrate how fertilizer may best be used as a tool to improve farm income.

The crop yield comparison obtained from the fertilized portions of fields and the unfertilized check strips are used to demonstrate the effects of recommended fertilizer treatments on individual fields and crops.

In 1961, the 25 test-demonstration farmers applied fertilizer on 265 different fields. Unfertilized check strips were left in 146 of these fields and 122 fields had harvest yield comparisons made of the fertilized and unfertilized portions. Several fields were planted and fertilized in the spring but were abandoned before harvest due to drought conditions.

Local farmers, elevator men and fertilizer dealers have shown much interest in the fertilized fields and check strip demonstrations on these farms. These people visited the various demonstrations throughout the season to observe visual effects on crop growth. The yield results and income effects are of particular interest to all farmers in the state. Results obtained on these farms have been used by extension service people and others in farm meetings, news stories, radio and television programs.

An enumeration of fertilizer check strip demonstrations on the cooperating farms in 1961 follows:

Kind of Demonstration	Number of Demonstrations
Small grains grown on fallow	63
Small grains grown on nonfallow	74
Corn	3
Alfalfa	4
Sugar beets	2

No exact records were kept on how extensively these demonstrations were used in the extension program within each county because results from these demonstrations were most generally included as a part of other extension programs rather than separate programs. However, an estimate of uses made was as follows:

Number of people who visited fertilizer demonstrations (Including tour groups and individual visits)	450
Number of tour groups who saw fertilizer demonstrations	5
Number of news articles mentioning one or more of these demonstration and/or results from these demonstrations	40
Number of radio and television programs in which reference was made to these demonstrations and results obtained	45

Information obtained from these test-demonstration farms has been used in a variety of educational activities. Extension agents have used the information for many farm meetings, individual farm visits and news articles. Results published in the annual reports are used as references and fertilizer response information in many activities. Over 250 copies of last year's report have been distributed.

Representatives from the Tennessee Valley Authority and the Land- Grant Institutions of the Tennessee Valley States visited North Dakota on July 10 and 11, 1961. This group came to study the test-demonstration program in North Dakota. Upon arrival in Fargo they were toured through the North Dakota State University Campus and the Red River Valley en route to Valley City. An orientation on the North Dakota Test-Demonstration program was presented by the project leaders. This group visited the Lyle Guscette and Riedman Brothers test-demonstration farms in Barnes County before continuing their tour to Wisconsin and Pannsylvania.

Continuation of Test-Demonstration Program

All but three cooperators in Barnes, Ramsey, Morton and Stark Counties completed their fifth year of cooperation in the test-demonstration program in 1961. This is the maximum permitted period for cooperators. This necessitated

selection of new cooperators for continuation of the program. Cooperators in McLean and Williams Counties will complete their fifth year in 1962.

Eight new counties were selected for continuation of the program. Theee were: Bottineau, Renville and Burke Counties in the north and northwest portion of the state; Hettinger, Adams and Bowman Counties in the southwestern portion of the state; Traill and Cass Counties in the Red River Valley. These counties were selected because they represent major areas of the state relative to soils, precipitation, and cropping systems. Five cooperators were selected in each of the eight counties, providing a total of 40 new cooperators.

Complete farm records will be kept on each of the test-demonstration farms plus five additional non-demonstration farms in each county, making a total of 80 farm records. These records will provide a broader base for comparative analysis of various fertilizer inputs on North Dakota farms. The North Dakota Agricultural Extension Service has a farm account route operative in Barnes, Stutsman, Eddy and Benson Counties. Farm records obtained through the test-demonstration program will be analyzed in conjunction with the farm account route records. The coordination of these two projects will strengthen both projects and provide more data for the farm account analysis.

Five Year Results

The test-demonstration program has been carried on for a five year period in North Dakota, 1957 through 1961. The program was initiated with 18 farm cooperators in Barnes, Ramsey, Morton and Stark Counties in 1957. Fourteen of these original cooperators have participated in the program for five years. Four cooperators withdrew from the program and three were added to the program in 1958 with nine additional cooperators. Eight of these cooperators are continuing to participate.

Two-thirds of the crop acreage on these test-demonstration farms has been devoted to wheat, barley and oats during this five year period (Table 12). These three crops also have comprised 93 per cent of the acreage fertilized during this period. Other minor crops such as corn, alfalfa, rye and sugar beets have been fertilized with varying degrees of success. These crops, however, comprise such a small portion of the fertilizer history on these farms that they will be ommitted from this report. The results to be reported will be confined to wheat, barley and oat crops.

About 89 per cent of the wheat seeded on these farms has been fertilized. This reflects that wheat has been fertilized without any reservations because a large portion of the remaining 11 per cent of the crop has not required fertilization as the soil tested high in phosphate and the crop was seeded on fallowed land. Wheat has been the most dependable producer of profitable fertilizer returns (Table 13). The major portion of the barley acreage, 68 per cent, has been fertilized.

Barley seeded on fallow land has produced a 99 per cent average return to the fertilizer input in the five year period. However, barley grown on land following another crop has been much more erratic in responding to fertilizer treatments and resulted in an average five per cent return on the fertilizer investment. A portion of the fertilized oat acreage produced favorable returns but the average return for the five year period was a four per cent loss.

TABLE 12. DISTRIBUTION OF CROP ACREAGES AND USE OF FERTILIZER ON TEST-DEMONSTRATION FARMS, 1957-1961

Crop	Acreage Grown[1]	Percentage of Cropland	Acreage Fertilized[2]	Percentage of Crop Fertilized
Wheat	25,082	28.7	22,219	88.6
Barley	13,267	15.2	9,062	68.3
Corn	6,661	7.6	1,360	20.4
Oats	5,403	6.2	1,596	29.5
Flax	3,488	4.0		
Alfalfa	4,392	5.0	346	7.9
Pasture & Grass	5,109	5.8	15	.3
Rye	1,268	1.5	421	33.2
Sugar Beets	339	.4	339	100.0
Speltz	205	.2	96	46.8
Millet	216	.2	--	--
Sorghum	26	.05	--	--
Safflower	51	.1	--	--
Sweet Clover	80	.1	--	--
Sudan Grass	50	.1	--	--
Soybeans	20	.05	20	100.0
All Crops	65,657	75.2	35,474	54.0
Fallow	17,683	20.2	--	--
Soil Bank	3,999	4.6	--	--
Total Cropland	87,339	100.0	35,474	40.6

[1]Total acreage for five year period
[2]Total acreage fertilized during five year period.

Moisture stored in the ground at seeding time and precipitation during the growing season have an appreciable effect on fertilizer responses in North Dakota. Many of the fertilizer responses obtained on these test-demonstration farms have been under abnormally dry conditions. The general moisture situation of North Dakota is illustrated in Figure 2. This does not show the specific rainfall situations for the individual counties or farms but points out that most of the crop reporting districts have had less than average rainfall in most of last five seasons. The authors consequently feel that the average crop yield responses to fertilizer treatments obtained during this past five year period are smaller than may be expected over a longer period of time or in a period of more normal rainfall. The crop yield responses in Barnes County have been

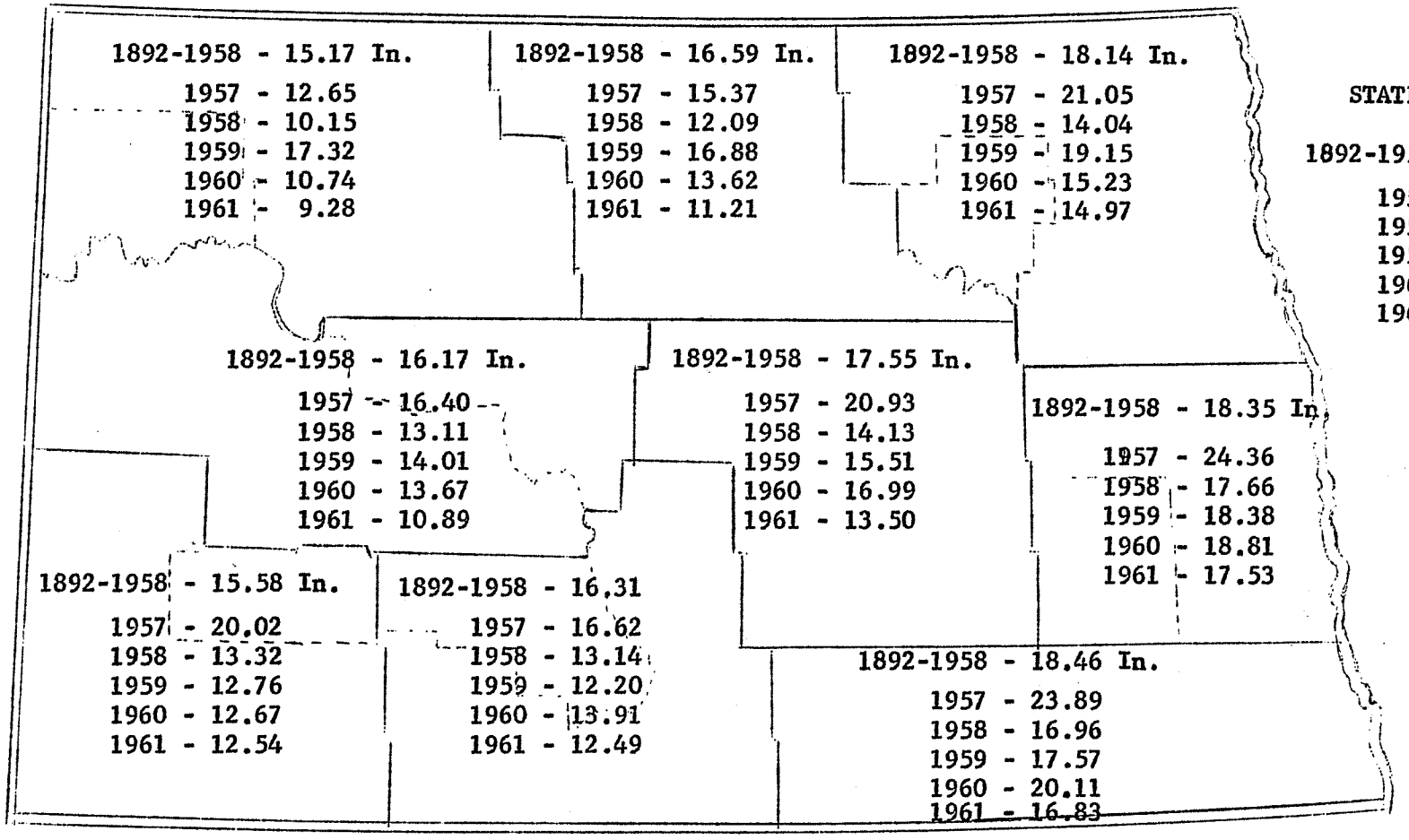

FIGURE 2. AVERAGE ANNUAL PRECIPITATION BY CROP REPORTING DISTRICTS, NORTH DAKOTA

SOURCE: North Dakota Crop and Livestock Statistics and North Dakota Weekly Weather and Crop Report

greater than in the other counties. The annual precipitation records as shown in Figure 2 reflect that this county is located in an area where the moisture situation has been more nearly normal in each of the past five seasons.

TABLE 13. FERTILIZER RESPONSES, AVERAGE COSTS AND RETURNS ON TEST-DEMONSTRATION FARMS, 1957, 1961[1]

Crop	Acreage Checked	Bushel Increase Per Acre[2]	Fertilizer Cost Per Acre[3]	Net Return Per Acre[4]	Per Cent Return
			($)	($)	
Wheat on Fallow	6,613	3.4	3.06	3.53	115
Barley on Fallow	492	7.0	2.81	2.77	99
Wheat on Nonfallow	4,732	4.8	6.18	3.07	50
Barley on Nonfallow	5,519	8.0	6.09	.29	5
Oats on Nonfallow	532	14.5	6.73	-.30	-4
All Small Grains	17,888	--	4.92	2.26	46

[1]This summary includes only the results obtained on nonirrigated land.
[2]The yield responses obtained from the harvest samples are assumed to be representative of the field in which they were obtained.
[3]Fertilizer costs are 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.
[4]The mid-October prices for grains per season are used to determine value of yield increase.

The yield responses to fertilizer treatments have varied substantially from county to county during the five year period. The five year yield advantage has averaged 3.4 bushels per acre for all test-demonstration cooperators when fertilizing wheat seeded on fallowed land (Table 14). However, the five year average for Barnes County was 6.6 bushels per acre while in Williams County it was 1.7 bushels. Similar variations in yield responses were experienced in other small grain crops.

TABLE 14. CROP YIELD INCREASES DUE TO FERTILIZER TREATMENTS ON TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, 1957-1961[1]

County	Crop After Fallow			Crop After Crop		
	Wheat	Barley	Oats	Wheat	Barley	Oats
	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre
Barnes[2]	6.6	7.7	--	6.6	9.7	18.5
Ramsey[2]	2.7	5.6	--	5.4	7.4	8.0
Morton[2]	3.4	3.9	5.0	3.5	2.1	7.9
Stark[2]	3.8	3.8	--	3.1	5.8	13.1
McLean[2]	3.4	8.5	--	2.1	5.8	--
Williams[2]	1.7	--	--	.5	2.0	--
All Counties[2]	3.4	7.0	5.0	4.8	8.0	14.5
Williams[3]	--	--	--	7.9	12.7	10.2

[1]The yield responses obtained from the harvest samples are assumed to be representative of the field in which they were obtained. These yield increases represent those fields which were checked at harvest time.

[2]All nonirrigated acreage.

[3]All irrigated acreage.

The crop yield responses also have varied from season to season. Wheat on fallowed land, for example, has averaged an increase of 3.4 bushels per acre for the five year period (Table 15). However, in 1961 the average increase was 1.3 bushels per acre while in 1960 it averaged 4.6 bushels. The yield increase variation from season to season has been equally as great or greater in the other crops. These summaries illustrate the yield variations between seasons and between areas as these crops have been subjected to different growing conditions.

TABLE 15. AVERAGE CROP YIELD RESPONSES TO FERTILIZER TREATMENTS BY SEASON ON NORTH DAKOTA TEST-DEOMONSTRATION FARMS, 1957-1961[1]

Season	Crop After Fallow			Crop After Crop		
	Wheat	Barley	Oats	Wheat	Barley	Oats
	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre	Bu./Acre
1957	2.6	3.9	5.0	6.1	9.3	14.8
1958	4.4	5.4	--	5.5	12.1	16.3
1959	4.0	12.6	--	3.5	6.7	9.9
1960	4.6	12.2	--	5.7	8.4	17.7
1961	1.3	1.6	--	2.8	4.2	--

[1]These responses are all obtained on nonirrigated land. The yield responses obtained from the harvest samples are assumed to be representative of the field in which they were obtained. These results represent only the fields which were checked at harvest time and not the entire acreage which was fertilized.

The total returns to the fertilizer investment on these test-demonstration farms were favorable even though many of the crop yield responses were reduced by adverse weather and moisture conditions. By projecting the results obtained on 18,599 acres of wheat, barley and oats checked at harvest time onto 32,732 acres of these crops fertilized, a fertilizer investment of $154,787 produced additional crop yields worth $226,706. This created an additional income of $71,919 on these farms (Table 16). Fertilizer costs on crops lost due to hail and drought were included in determining these returns.

Yield differences and earnings from fertilizer have varied from county to county and season to season. This also has been the experience for the individual farm cooperators.[3] One cooperator (U2-4) in McLean County has experienced a 176 per cent average return to his fertilizer investment. However, in 1961 he had only a one per cent return while in 1958 he had a net return of 256 per cent. Practically all of this cooperator's fertilizer investment has

[3]Average annual costs and returns for individual cooperators are shown in Appendix C, Tables 1 through 7.

been applied to wheat seeded on fallowed land with an average fertilizer investment of $2.81 per acre. Another cooperator within the same county has experienced a loss of 25 per cent on his fertilizer investment even though he had a 124 per cent return in one of those years. The average fertilizer investment on this farm has been $3.18 per acre. The average return for all cooperators in the county was 70 per cent on a fertilizer investment averaging $3.34 per acre. Similar variations from season to season and cooperator to cooperator were experienced in all counties.

TABLE 16. ESTIMATED RESULTS ON TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, 1957-1961[1]

County	Acres Fertilized	Comm. Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
		Dryland		
Barnes	5,446	33,530.53	23,294.31	69
Ramsey	9,114	48,746.07	14,538.86	30
Morton	4,725	18,942.36	2,236.73	12
Stark	4,047	19,019.18	5,326.81	28
McLean	6,453	21,582.70	15,180.21	70
Williams	1,989	7,017.65	849.55	12
All Dryland	31,774	148,838.49	61,426.47	41
		Irrigated		
Williams	958	5,948.57	10,492.68	176
		Dryland and Irrigated		
Total	32,732	154,787.06	71,919.15	46.5

[1]Results on total acreage of wheat, barley and oats fertilized, 57 per cent of the total acreage was checked at harvest time. Crop losses due to hail and drought are considered in estimating these total results. State average mid-October prices for grains per season were used in establishing value of crop increases. Fertilizer costs = 14¢ per pound of nitrogen and 10¢ per pound of P_2O_5.

[2]Returns additional to fertilizer cost.

Crop rotations and cropping practices vary from farm to farm. Generally, the test-demonstration farmers who applied the majority of their fertilizer to crops grown on fallowed land have experienced the largest returns from their fertilizer investment. This analysis does not consider the cost of fallowing because the land would have been fallowed regardless of the fertilizer program. Applying phosphate fertilizers to wheat grown on fallowed land has produced a 115 per cent return on the investment. An average fertilizer investment of $3.06 per acre has produced additional wheat worth $6.59, leaving an average return of $3.53 per acre. Fertilizing barley on fallowed land has produced a 99 per cent return. A fertilizer input of $2.81 per acre has produced additional barley worth $5.58.

Fertilizing crops on nonfallow demands a greater fertilizer investment because additional nitrogen is needed. Consequently, the ratio of returns to investment have not been as great as on fallow land. An average fertilizer investment of $6.18 per acre has produced additional wheat worth $9.24 per acre. This is a 50 per cent return on the investment. Barley has been more erratic in its response to fertilizer treatment on nonfallow. Some responses have been good but the average has resulted in a five per cent return or 29 cents per acre. Several good responses have been obtained by fertilizing oats on nonfallow but the test-demonstration farm average is a four per cent loss.

These results suggest that the first fertilizer dollars should be spent on fallowed land, wheat having priority over barley. Fertilizing wheat on nonfallow would be the next choice on a basis of profitable returns. The average experience of these test-demonstration farms does not encourage the investment of fertilizer for barley and oats grown on nonfallow. However, abnormal drought problems during this test period and improved recommendations

for use of nitrogen suggest that many profitable opportunities exist by discreet use of fertilizer on these crops. Recent research by the NDSU Soils Department in the state has proved that nitrogen application rates should be varied in accordance with soil moisture supplies at planting time.[4] This factor, alone, can contribute much to more efficient and profitable fertilizer useage in North Dakota.

The experience of these test-demonstration farms indicates that five years is not an adequate time in which to make a firm appraisal of fertilizer potentials. The results in this report, however, do bear out that even under adverse growing conditions, the average fertilizer responses are generally encouraging.

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[4] North Dakota Fertilizer Guide, Virgil L. Weiser, N.D.S.U. Extension Circular A-350, December 1960.

APPENDIX A

CROP YIELD RESPONSES TO FERTILIZER TREATMENT ON TVA TEST-DEMONSTRATION FARMS IN NORTH DAKOTA 1961

APPENDIX TABLE A-1. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BARNES COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test[1]	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Difference
Lyle	29-2	Fallow	Wheat		0+35+0	37.9	35.1	2.8
Guscette	28-4	Barley	Wheat		29+41+0	44.3	42.4	1.9
	21-2	Wheat	Barley		25+31+0	35.5	35.0	.5
	28-1	Oats	Barley		22+30+0	36.0	34.5	1.5
	24-3	Corn	Barley		29+41+0	33.0	29.3	3.7
Ray	7	Corn	Wheat	M	25+31+0	18.0	15.9	2.1
Stangler	5	Corn	Wheat	VL	25+31+0	16.9	11.7	5.2
	19	Flax	Wheat	L	23+26+0	13.6	9.9	3.7
	21		Wheat	VL	41+21+0	16.0	12.0	3.1
	14+15	Oats+Wht.	Durum	M-VL	25+31+0	10.4	7.5	2.9
	8	Wheat	Barley	L	25+31+0	23.5	24.3	-.8
	3	Flax	Barley	VL	25+31+0	25.5	17.0	8.5
	18	Durum	Barley	VL	23+26+0	15.8	13.1	2.7
	4	Flax	Barley	VL	25+31+0	15.0	12.2	2.8
Riedman	20	Fallow	Wheat		12+31+0	18.0	12.4	5.6
Bro's	17	Fallow	Wheat	VL	12+31+0	19.3	15.2	4.1
	3	Corn	Wheat	M-L	26+29+0	14.4	11.2	3.2
	14+15	Corn	Durum	H	22+35+0	12.4	11.0	1.4
	16	Fallow	Barley	L	12+31+0	7.4	7.3	0.1
	19	Wheat	Barley	VL	19+29+0	27.4	14.3	13.1
	9	Barley	Barley	VL	22+25+0	20.1	13.1	7.0
	10	Flax	Barley	L-M	22+25+0	15.4	13.1	2.3
	5	Wheat	Barley	M	22+25+0	17.3	10.1	7.2
Barnes County Ave.		Fallow	Wheat		9+32+0	22.7	18.3	4.4
		Nonfallow	Wheat		29+31+0	21.6	18.5	3.1
		Nonfallow	Durum		24+28+0	11.4	9.2	2.2
		Fallow	Barley		12+31+0	7.4	7.3	0.1
		Nonfallow	Barley		23+30+0	23.8	18.8	5.0

[1]VL - Soil tested very low in phosphate.
L - Soil tested low in phosphate.
M - Soil tested medium in phosphate.
H - Soil tested high in phosphate.

APPENDIX TABLE A-2. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN RAMSEY COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test[1]	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Difference
E. B. + Don Calderwood	9	Fallow	Durum	L	0+27+0	8.0	6.7	1.3
	12	Corn	Durum	M	28+32+0	14.3	10.3	4.0
	5	Wheat	Barley	H	8+21+0	23.8	18.3	5.5
	15	Wheat	Barley	M	8+21+0	10.0	6.3	3.7
	2	Wheat	Barley	H-M	8+21+0	23.3	20.8	2.5
Willis Calderwood	6	Plowed Up Barley	Durum	M	13+34+0	14.3	10.3	4.0
	2	Plowed Up Barley	Barley	M	13+34+0	13.3	12.5	.8
		Wheat	Barley	M	28+32+0	29.5	24.8	4.7
L.B. Currie	8,9+10	Fallow	Durum	L-M	0+27+0	20.0	20.0	0
	2	Fallow	Wheat	M	0+27+0	16.0	18.7	-2.7
Orville Larson	5	Fallow	Durum	L-M	0+22+0	15.3	13.6	1.7
	10	Fallow	Durum	M-M	9+22+0	25.9	22.8	3.1
	13	Fallow	Durum	H	9+19+0	30.1	28.0	2.1
	9A	Durum	Barley	L-M	12+31+0	36.6	30.3	6.3
	9	Durum	Barley	VL-M	10+19+0	32.7	31.7	1.0
	11	Barley	Barley	VL-M	19+24+0	23.3	25.3	-2.0
Lawrence Stensland	14	Fallow	Durum	M-VL	0+22+0	15.5	15.7	-2
	2	Fallow	Durum	L-H	0+16+0	20.0	14.9	5.1
	10-11	Dur.+Bly.	Barley	VL-M	10+26+0	25.4	18.9	6.7
LeRoy Stensland	8+9	Fallow	Durum	L-M	12+31+0	13.1	12.1	1.0
	7	Fallow	Barley	L	0+16+0	27.5	24.8	2.7
Ramsey County	Ave.	Fallow	Wheat		0+27+0	16.0	18.7	-2.7
		Fallow	Durum		4+24+0	18.0	16.4	1.6
		Nonfallow	Durum		19+33+0	14.3	10.3	4.0
		Fallow	Barley		0+16+0	27.5	24.8	2.7
		Nonfallow	Barley		14+26+0	23.1	19.7	3.4

[1]VL - Soil tested very low in phosphate.
L - Soil tested low in phosphate.
M - Soil tested medium in phosphate.
H - Soil tested high in phosphate.

APPENDIX TABLE A-3. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN MORTON COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Difference
Alfred Underdahl	40B	Fallow	Wheat	L	10+26+0	16.4	15.7	.7
	59	Fallow	Wheat	M-VL	0+22+0	15.7	14.5	1.2
	25B	Fallow	Wheat	L	0+32+0	20.0	16.0	4.0
	49	Fallow	Wheat	M	0+27+0	15.2	13.2	2.0
	2	Fallow	Wheat	VL	0+32+0	8.2	6.5	1.7
Ole Wang	5	Fallow	Wheat	H	0+27+0	4.7	4.3	.4
	7	Fallow	Wheat	M	0+27+0	3.2	2.9	.3
Erich Wilkins	27	Fallow	Wheat		0+22+0	13.1	12.1	1.0
Sig Peterson	27	Fallow	Wheat		0+22+0	13.3	12.3	1.0
Morton County Ave.		Fallow	Wheat		0+25+0	10.5	9.5	1.0

[1]VL - Soil tested very low in phosphate.
L - Soil tested low in phosphate.
M - Soil tested medium in phosphate.
H - Soil tested high in phosphate.

APPENDIX TABLE A-4. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN STARK COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test[1]	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Differente
Joseph Link	7	Fallow	Wheat	VL	0+32+0	16.0	13.5	2.5
	22	Fallow	Wheat		0+32+0	3.2	2.4	.8
	30	Fallow	Wheat		0+32+0	10.4	9.5	.9
	36	Fallow	Wheat		0+32+0	8.7	7.2	1.5
	18	Fallow	Wheat	VL	0+32+0	7.2	7.6	-.4
	24	Fallow	Barley		0+32+0	10.7	8.0	2.7
	28	Wheat	Barley		12+31+0	2.3	1.5	.8
Clarence & Daniel Wahlers	28	Fallow	Wheat		12+31+0	16.0	13.2	2.8
	29	Fallow	Wheat		0+32+0	12.3	12.7	-.4
	5	Corn	Wheat	VL	12+31+0	11.5	8.0	3.5
	11	Corn	Wheat		12+31+0	14.0	11.6	2.4
	24	Wheat	Wheat	L	12+31+0	7.7	5.9	1.8
	15	Wheat	Wheat	VL	12+31+0	1.4	.7	.7
	10	Corn	Wheat		12+31+0	9.9	9.5	.4
	26	Wheat	Wheat		12+31+0	6.9	6.6	.3
	22	Rye	Wheat		12+31+0	2.3	2.0	.3
Richard Dohrmann	8	Fallow	Wheat		0+22+0	4.9	2.9	2.0
	14B	Corn	Wheat		10+26+0	5.2	3.2	2.0
Stark County Ave.		Fallow	Wheat		2+31+0	10.3	8.9	1.4
		Nonfallow	Wheat		11+29+0	7.5	5.5	2.0
		Fallow	Durum		0+32+0	10.7	8.0	2.7
		Nonfallow	Barley		12+31+0	2.3	1.5	.8

[1]VL - Soil tested very low in phosphate
L - Soil tested low in phosphate.

APPENDIX TABLE A-5. CROP YIELD RESULTS IN TVA TEST-DEMONSTRATION FARMS IN MCLEAN COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test[1]	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Difference
Melvin Bjornholt	7G	Fallow	Wheat	VL	0+27+0	14.0	11.5	2.5
	13A	Fallow	Wheat		0+27+0	13.3	12.0	1.3
	1A	Fallow	Durum		0+27+0	11.3	12.0	-.7
	1J	Fallow	Durum	M	0+27+0	11.0	9.3	1.7
Alfred Cole		Fallow	Wheat		0+21+0	5.0	5.0	0
		Fallow	Wheat		0+21+0	6.9	7.4	-.5
		Fallow	Durum		0+21+0	6.5	6.3	.2
		Fallow	Durum		0+21+0	7.3	6.6	.7
Denver Rosenberg	21M	Fallow	Wheat		0+27+0	6.0	5.1	.9
	16I	Fallow	Wheat	VL	0+37+0	11.5	10.4	1.1
	16M	Fallow	Durum	VL	0+27+0	9.9	8.8	1.1
	16A	Fallow	Durum	VL	0+22+0	13.5	12.7	.8
	16O	Fallow	Durum	VL	0+22+0	8.4	6.8	1.6
	17F	Fallow	Durum		0+37+0	4.3	3.2	1.1
Norlan Rue	1B	Fallow	Wheat	VL	0+24+0	10.9	10.1	.8
	6C	Fallow	Durum		0+24+0	6.3	6.0	.3
	16A+B	Fallow	Durum	VL	0+24+0	6.9	4.4	2.5
	6	Fallow	Durum		0+24+0	8.7	8.0	.7
Karl Vangsness	20	Fallow	Durum		0+27+0	9.6	8.8	.8
	23	Fallow	Durum		0+27+0	10.7	7.8	2.9
	27+28	Fallow	Durum	L	0+27+0	8.8	8.0	.8
	34+34	Fallow	Durum		0+27+0	9.0	8.3	.7
McLean County Ave.		Fallow	Wheat		0+29+0	9.5	8.6	.9
		Fallow	Durum		0+26+0	8.8	7.6	1.2

[1]VL - Soil tested very low in phosphate.
L - Soil tested low in phosphate.
M - Soil tested medium phosphate.

APPENDIX TABLE A-6. CROP YIELD RESPONSES ON TVA TEST-DEMONSTRATION FARMS IN WILLIAMS COUNTY, 1961

Cooperator	Field No.	1960 Crop	1961 Crop	Soils Test	Nutrients Per Acre	Yield-Bushels/Acre		
						Fert.	Check	Difference
Ardean Aafedt (Nonirrigated)		Fallow	Wheat		0+27+0	6.5	5.7	.8
Paul Motzko (Irrigated)	2	Bly.+Wht.	Durum		20+52+0	43.1	30.1	12.8
	3	Durum	Durum		20+52+0	52.4	48.6	3.8
	7	Sugar Bts.	Durum		20+52+0	40.4	34.4	6.0
	9	Corn	Durum		16+42+0	43.3	38.2	5.1
	12	Barley	Durum		16+42+0	34.9	29.1	5.8
	2	Corn	Barley		16+42+0	54.8	53.0	1.8
	5	Oats	Barley		16+42+0	51.6	30.4	21.2
Raymond Russell (Irrigated)		Sugar Bts.	Durum		40+20+0	59.4	45.9	13.5
		Sugar Bt.s	Durum		40+20+0	65.2	49.2	16.0
Williams County Ave. (Irrigated)		Nonfallow	Durum		25+41+0	49.0	40.2	8.8
		Nonfallow	Barley		16+42+0	53.4	43.2	10.2

APPENDIX B

AVERAGE COSTS AND RETURNS TO FERTILIZER, 1961

APPENDIX TABLE B-1. AVERAGE COST AND RETURNS TO FERTILIZER, BARNES COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost of Fert./Acre[2] ($)	Added Return From Fert./Acre[3] ($)	Net Return From Fert./Acre ($)
Lyle Guscette	Wheat on Fallow	35	3.50	5.71	2.21
	Wheat on Nonfallow	60	8.16	3.88	=4.28
	Barley on Nonfallow	124	7.04	1.88	-5.16
	All Small Grains	219	5.78	3.04	-3.74
Ray Stangler	Wheat on Nonfallow	170	6.96	7.14	.18
	Durum on Nonfallow	77	6.60	9.16	2.56
	Barley on Nonfallow	229	6.34	3.27	-3.07
	All Small Grains	476	6.60	5.62	-.98
Riedman Bros.	Wheat on Fallow	130	4.78	10.00	5.22
	Wheat on Nonfallow	54	6.54	6.53	-.01
	Durum on Nonfallow	70	5.58	4.42	-1.16
	Barley on Fallow	30	4.78	.10	-4.68
	Barley on Nonfallow	195	5.57	8.91	3.34
	All Small Grains	479	5.42	7.68	2.26
Barnes County	Wheat on Fallow	165	4.51	9.09	4.58
	Wheat on Nonfallow	284	7.14	6.34	-.80
	Durum on Nonfallow	147	6.11	6.90	.79
	Barley on Fallow	30	4.78	.10	-4.68
	Barley on Nonfallow	548	6.22	4.96	-1.26
	All Small Grains	1,174	6.15	5.98	-.17

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer= 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S. Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX TABLE B-2. AVERAGE COST AND RETURNS TO FERTILIZER, RAMSEY COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost Of Fert./Acre[2]	Added Return From Fert./Acre[3]	Net Return From Fert./Acre
			($)	($)	($)
E.B. & Don Calderwood	Durum on Fallow	38	2.70	4.11	1.41
	Durum on Nonfallow	45	7.12	12.64	5.52
	Barley on Nonfallow	170	3.22	3.76	.54
	All Small Grains	253	3.83	5.39	1.56
Willis Calderwood	Durum on Nonfallow	71	5.22	12.64	7.42
	Barley on Nonfallow	135	6.53	3.47	-3.06
	All Small Grains	206	6.08	6.62	.54
L.B. Currie	Wheat on Fallow	105	2.70	-5.51	-8.21
	Durum on Fallow	50	2.70	None	-2.70
	All Small Grains	155	2.70	-3.73	-6.43
Orville Larson	Durum on Fallow	96	3.00	7.27	4.27
	Barley on Nonfallow	105	4.08	1.29	-2.79
	All Small Grains	201	3.64	4.19	.55
Lawrence Stensland	Durum on Fallow	116	1.95	6.32	4.37
	Barley on Nonfallow	40	4.00	6.63	2.63
	All Small Grains	156	2.47	6.49	4.02
LeRoy Stensland	Durum on Fallow	58	4.78	3.16	-1.62
	Barley on Fallow	20	1.60	2.67	1.07
	All Small Grains	78	3.96	3.03	- .93
Ramsey County	Wheat on Fallow	105	2.70	-5.51	-8.21
	Durum on Fallow	358	2.87	4.94	2.07
	Durum on Nonfallow	116	5.96	12.64	6.68
	Barley on Fallow	20	1.60	2.62	1.07
	Barley on Nonfallow	450	4.49	3.35	-1.13
	All Small Grains	1,049	3.88	4.04	.16

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S. Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX TABLE B-3. AVERAGE COST AND RETURNS TO FERTILIZER, MORTON COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost of Fert./Acre[1] ($)	Added Return From Fert./Acre[2] ($)	Net Return From Fert./Acre ($)
Alfred Underdahl	Wheat on Fallow	41.6	2.99	3.26	.27
Ole Wang	Wheat on Fallow	50.0	2.70	.61	-2.09
Erich Wilkins	Wheat on Fallow	40.0	2.20	2.04	- .16
Sig Peterson	Wheat on Fallow	45.0	2.20	2.04	- .16
Morton County	Wheat on Fallow	176.6	2.52	1.92	- .60

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S. Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX TABLE B-4. AVERAGE COSTS AND RETURNS TO FERTILIZER, STARK COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost of Fert./Acres[2] ($)	Added Return From Fert./Acres[3] ($)	Net Return From Fert./Acres ($)
Joseph Link	Durum on Fallow	29.5	3.20	-1.26	-4.46
	Wheat on Fallow	77	3.20	2.86	- .34
	Barley on Fallow	20	3.20	2.67	- .53
	Barley on Nonfallow	19	4.78	.79	3.39
	All Small Grain	145.5	3.41	1.75	-1.66
C. & D. Wahlers	Wheat on Fallow	34	3.99	2.45	-1.54
	Wheat on Nonfallow	133	4.78	4.08	- .70
	All Small Grains	167	4.62	3.76	- .86
Richard Dohrmann	Wheat on Fallow	14.4	2.20	4.08	1.88
	Wheat on Nonfallow	60	4.00	4.08	.08
	All Small Grains	74.4	3.65	4.08	.43
Stark County	Wheat on Fallow	125.4	3.30	2.89	- .41
	Wheat on Nonfallow	193	4.54	4.08	- .46
	Durum on Fallow	29.5	3.20	-1.26	-4.46
	Barley on Fallow	20	3.20	2.67	.53
	Barley on Nonfallow	19	4.78	.79	-3.99
	All Small Grains	386.9	3.98	3.07	- .91

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S. Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX TABLE B-5. AVERAGE COSTS AND RETURNS TO FERTILIZER, MCLEAN COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost of Fert./Acre[2] ($)	Added Return From Fert./Acre[3] ($)	Net Return From Fert./Acre ($)
Melvin Bjornholt	Wheat on Fallow	26	2.70	3.67	.97
	Durum on Fallow	39	2.70	1.58	-1.12
	All Small Grains	65	2.70	2.44	- .26
Alfred Cole	Wheat on Fallow	34	2.10	-.61	-2.71
	Durum on Fallow	18	2.10	1.26	- .84
	All Small Grains	52	2.10	.04	-2.06
Denver Rosberg	Wheat on Fallow	140	3.13	2.24	- .89
	Durum on Fallow	110	2.61	3.79	1.18
	All Small Grains	250	2.90	2.82	- .08
Norlan Rue	Wheat on Fallow	15	2.40	1.63	- .77
	Durum on Fallow	116	2.40	4.11	1.71
	All Small Grains	131	2.40	3.72	1.32
Karl Vangness	Durum on Fallow	152	2.70	4.42	1.72
McLean County	Wheat on Fallow	215	2.86	1.92	-.94
	Durum on Fallow	435	2.57	3.79	1.22
	All Small Grains	650	2.67	3.08	.41

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S. Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX TABLE B-6. AVERAGE COST AND RETURNS TO FERTILIZER, WILLIAMS COUNTY, 1961[1]

Cooperator	Crop	Acres Checked	Commercial Cost of Fert./Acre[2] ($)	Added Return From Fert./Acre ($)	Net Return From Fert./Acre ($)
Ardean Aafedt	Wheat on Fallow	70	2.70	1.63	-1.07
	Irrigated				
Paul Motzko	Durum on Nonfallow	102	7.54	20.22	12.68
	Barley on Nonfallow	37	6.44	10.10	3.66
	All Small Grains	139	7.25	17.53	10.28
Raymond Russell	Durum on Nonfallow	41	7.60	46.72	39.17
Williams County (Irrig)	Durum on Nonfallow	143	7.56	27.83	20.27
	Barley on Nonfallow	37	6.44	10.10	3.66
	All Small Grains	180	7.33	24.22	16.89

[1]Results on acreage checked at harvest time.

[2]Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5.

[3]Mid-October average grain prices:

H.R.S.Wheat = $2.04 per bushel
Durum = 3.16 per bushel
Barley = .99 per bushel
Oats = .55 per bushel

APPENDIX C

ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, 1957-1961

APPENDIX TABLE C-1. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, 1957-1961[1]

County	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Returns[2] ($)	Per Cent Returns
Barnes County	1957	876	5,063.16	7,329.85	145
	1958	1,032	5,791.68	6,052.73	105
	1959	1,098	6,588.29	4,055.28	62
	1960	1,125	7,913.00	6,362.79	80
	1961	1,315	8,174.40	-506.34	- 6
	Total	5,446	33,530.53	23,294.31	69
	Per Acre		6.16	4.28	69
Ramsey County	1957	1,450	7,199.89	2,601.45	36
	1958	1,874	10,477.38	6,788.47	65
	1959	1,938	11,230.52	1,757.40	16
	1960	2,021	11,678.44	4,236.99	36
	1961	1,831	8,159.84	- 845.72	-10
	Total	9,114	48,746.07	14,538.86	30
	Per Acre		5.35	1.60	30
Morton County	1957	796	3,181.70	1,552.25	49
	1958	914	4,114.41	3,345.64	81
	1959	924	4,089.80	-93.55	- 2
	1960	953	4,056.10	- 208.91	- 5
	1961	1,137.6	3,500.35	-2,368.70	-68
	Total	4,724.6	18,942.36	2,236.73	12
	Per Acre		4.01	.47	12
Stark County	1957	608	2,399.80	940.04	39
	1958	949	4,582.99	4,288.36	94
	1959	787	4,312.97	- 383.94	- 9
	1960	980	4,965.15	1,152.11	23
	1961	723.2	2,758.27	- 877.95	-32
	Total	4,047.2	19,019.18	5,326.81	28
	Per Acre		4.70	1.32	28
McLean County	1958	1,514	6,030.55	8,595.50	143
	1959	1,740	6,136.59	2,513.51	41
	1960	1,700	5,285.13	4,394.92	83
	1961	1,499	4,130.43	- 323.72	- 8
	Total	6,453	21,582.70	15,180.21	70
	Per Acre		3.34	2.35	70

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APPENDIX TABLE C-1 (Continued)

County	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Returns[2] ($)	Per Cent Returns
Williams County (Nonirrigated)	1958	1,146	3,781.74	2,150.40	57
	1959	543	2,074.00	-1,664.35	-79
	1960	230	972.90	409.40	42
	1961	70	189.00	-74.90	-40
	Total	1,989	7,017.65	849.55	12
	Per Acre		3.53	.43	12
North Dakota (Nonirrigated)	1957	3,730	17,844.55	12,423.59	70
	1958	7,429	34,778.75	31,221.10	90
	1959	7,030	34,432.18	6,213.35	18
	1960	7,009	34,870.72	16,347.30	47
	1961	6,576	26,912.29	-4,997.33	-19
	Total	31,774	148,838.49	61,426.47	41
	Per Acre		4.68	1.93	41
Williams County (Irrigated)	1958	239	1,340.61	2,848.71	212
	1959	242	1,326.08	590.10	44
	1960	280	1,803.20	3,196.55	177
	1961	201	1,478.68	3,857.32	261
	Total	958	5,948.57	10,492.68	176
	Per Acre		6.21	10.95	176

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns in addition to fertilizer costs.

APPENDIX TABLE C-2. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN BARNES COUNTY, 1957-1961[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-1	1957	288	1,743.12	2,098.39	120
	1958	307	1,836.44	1,563.36	85
	1959	345	1,967.59	1,742.14	89
	1960	308	2,355.20	3,295.64	140
	1961	279	1,891.50	-944.89	-50
	Total	1,527	9,793.85	7,754.64	79
	Per Acre		6.41	5.08	79
U2-2	1957	314	1,456.84	1,796.92	123
	Total	314	1,456.84	1,796.92	123
	Per Acre		4.64	5.72	123
U2-3	1957	274	1,863.20	3,434.54	184
	1958	287	1,676.40	2,371.44	141
	1959	301	1,938.56	1,503.44	78
	1960	416	3,351.22	1,047.02	31
	1961	550	3,649.20	-692.59	-19
	Total	1,828	12,478.58	7,663.85	61
	Per Acre		6.83	4.19	61
U2-4	1958	438	2,278.84	2,117.93	93
	1959	452	2,682.14	809.70	30
	1960	401	2,206.58	2,020.13	92
	1961	486	2,633.70	1,131.14	43
	Total	1,777	9,801.26	6,078.90	62
	Per Acre		5.52	3.42	62
Barnes County	1957	876	5,063.16	7,329.85	145
	1958	1,032	5,791.68	6,052.73	105
	1959	1,098	6,588.29	4,055.28	62
	1960	1,125	7,913.00	6,362.79	80
	1961	1,315	8,174.40	-506.34	-6
	Total	5,446	33,530.53	23,294.31	69
	Per Acre		6.16	4.28	69

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns in addition to fertilizer costs.

APPENDIX TABLE C-3. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN RAMSEY COUNTY, 1957-1961[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-1	1957	542	3,071.88	796.17	26
	1958	698	4,522.16	1,883.09	42
	1959	717	4,962.24	431.17	9
	1960	778	5,203.20	1,942.92	37
	1961	697	3,112.88	61.35	2
	Total	3,432	20,872.36	5,114.97	25
	Per Acre		6.08	1.49	25
U2-2	1957	269	1,563.55	735.45	47
	1958	292	2,054.03	2,031.01	99
	1959	299	2,128.88	-27.90	- 1
	1960	329	2,200.88	- 633.92	-29
	1961	330	2,130.90	- 213.21	-10
	Total	1,519	10,078.24	1,891.43	19
	Per Acre		6.63	1.25	19
U2-3	1957	163	433.58	634.07	146
	1958	173	515.04	1,298.32	252
	1959	165	389.40	780.45	200
	1960	164	630.26	762.76	121
	1961	165	459.50	-1,038.05	-226
	Total	830	2,427.78	2,437.55	100
	Per Acre		2.93	2.94	100
U2-4	1957	222	1,120.62	-54.84	- 5
	1958	344	1,762.34	-173.47	-10
	1959	380	2,378.74	-737.71	-31
	1960	352	1,875.39	1,437.71	77
	1961	333	1,533.58	-139.71	-09
	Total	1,631	8,670.67	331.98	4
	Per Acre		5.32	.20	4
U2-5	1957	144	572.76	519.62	91
	1958	182	853.51	723.32	85
	1959	227	807.74	1,064.58	132
	1960	242	1,037.16	523.01	50
	1961	156	385.86	612.12	159
	Total	951	3,656.97	3,442.65	94
	Per Acre		3.85	3.62	94

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APPENDIX TABLE C-3 (Continued)

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-6	1957	110	437.50	-29.02	-7
	1958	185	770.30	1,026.20	133
	1959	150	563.52	246.81	44
	1960	156	731.55	204.51	28
	1961	150	537.18	-128.22	-24
	Total	751	3,040.05	1,320.28	43
	Per Acre		4.05	1.76	43
Ramsey County	1957	1,450	7,199.89	2,601.45	36
	1958	1,874	10,477.38	6,788.47	65
	1959	1,938	11,230.52	1,757.40	16
	1960	2,021	11,678.44	4,236.99	36
	1961	1,831	8,159.84	-845.72	-10
	Total	9,114	48,746.07	14,538.86	30
	Per Acre		5.35	1.60	30

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns additional to fertilizer cost.

APPENDIX TABLE C-4. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED IN TEST-DEMONSTRATION FARMS IN MORTON COUNTY[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-1	1957	54	230.58	-121.26	-53
	Total	54	230.58	-121.26	-53
	Per Acre		4.27	-2.25	-53
U2-2	1957	328	955.64	455.01	48
	1958	180	679.70	409.16	60
	1959	258	786.60	2,879.70	368
	1960	315	1,207.50	858.90	71
	1961	345.6	1,172.43	-434.71	-37
	Total	1,426.6	4,801.87	4,186.06	87
	Per Acre		3.37	2.93	87
U2-3	1957	280	1,200.20	611.20	51
	1958	311	1,394.98	1,276.85	92
	1959	278	1,246.80	-954.20	-77
	1960	267	1,216.20	-731.25	-60
	1961	292	869.90	-791.73	-91
	Total	1,428	5,928.08	-589.13	-10
	Per Acre		4.15	.41	-10
U2-4	1957	134	795.28	607.30	76
	1958	174	970.41	194.61	20
	1959	202	1,070.60	-1,051.25	-98
	1960	135	594.00	232.20	39
	1961	254	728.12	-548.60	-75
	Total	899	4,158.41	-565.74	-13
	Per Acre		4.63	-.62	-13
U2-5	1958	249	1,069.32	1,465.02	137
	1959	186	985.80	-985.80	-100
	1960	236	1,038.40	-568.76	- 55
	1961	246	729.90	-593.66	- 81
	Total	917	3,823.42	-683.20	- 18
	Per Acre		4.17	-.75	- 18
Morton County	1957	796	3,181.70	1,552.25	49
	1958	914	4,113.41	3,345.64	81
	1959	924	4,089.80	-93.55	- 2
	1960	953	4,056.10	-208.91	- 5
	1961	1,137.6	3,500.35	-2,368.70	-68
	Total	4,724.6	18,942.36	2,236.73	12
	Per Acre		4.01	.47	12

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns additional to fertilizer cost.

APPENDIX TABLE C-5. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN STARK COUNTY, 1957-61[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-1	1957	167	499.70	-37.88	- 8
	1958	108	506.91	-50.61	-10
	Total	275		-88.49	- 9
	Per Acre			- .32	- 9
U2-2	1957	79	292.94	180.42	62
	Total	79	292.94	180.42	62
	Per Acre		3.71	2.28	62
U2-3	1957	138	540.08	333.92	62
	1958	259	1,155.00	1,270.48	110
	1959	267	1,183.89	734.56	62
	1960	268	1,335.35	979.99	73
	1961	282	1,080.77	-674.24	-62
	Total	1,214	5,295.09	2,638.19	50
	Per Acre		4.36	2.17	50
U2-4	1957	146	582.94	232.67	40
	1958	141	677.94	42.48	6
	1959	---	---	---	---
	1960	217	1,151.17	333.05	29
	1961	40	160.00	-40.40	-25
	Total	544	2,572.05	567.80	22
	Per Acre		4.72	1.04	22
U2-5	1957	78	484.14	230.91	48
	1958	133	838.54	660.20	79
	1959	198	1,564.20	-264.42	-17
	1960	176	983.84	- 44.16	- 4
	1961	167	771.40	-145.46	-19
	Total	752	4,642.12	437.07	9
	Per Acre		6.17	.58	9
U2-6	1958	308	1,404.60	2,365.81	168
	1959	322	1,564.88	-854.08	-55
	1960	319	1,494.79	-116.77	- 8
	1961	234.2	746.10	- 17.85	- 2
	Total	1,183.2	5,210.37	1,591.82	31
	Per Acre		4.40	1.35	31

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APPENDIX TABLE C-5 (Continued)

Cooperator	Year	Acres[1] Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
Stark County	1957	608	2,399.80	940.04	39
	1958	949	4,582.99	4,288.36	94
	1959	787	4,312,97	-383.94	-9
	1960	980	4,965.15	1,152.11	23
	1961	723.2	2,758.27	-877.95	-32
	Total	4,047.2	19,019.18	5,326.81	28
	Per Acre		4.70	1.32	28

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns additional to fertilizer cost.

APPENDIX TABLE C-6. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN MCLEAN COUNTY, 1958-61[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-1	1958	236	874.31	1,312.65	150
	1959	310	1,080.40	914.06	85
	1960	249	798.52	1,213.12	152
	1961	249	767.20	-209.59	-27
	Total	1,044	3,520.43	3,230.24	92
	Per Acre	---	3.37	3.09	92
U2-2	1958	151	616.74	-373.99	-61
	1959	181	668.06	-663.06	-99
	1960	215	571.39	706.15	124
	1961	108	227.33	-183.01	-80
	Total	655	2,083.52	-513.91	-25
	Per Acre		3.18	-.78	-25
U2-3	1958	545	2,874.50	5,027.10	175
	1959	550	2,187.00	-645.65	-30
	1960	704	2,658.60	324.00	12
	1961	557	1,629.90	-283.29	-17
	Total	2,356	9,350.00	4,422.16	47
	Per Acre		3.97	1.88	47
U2-4	1958	231	717.30	1,839.65	256
	1959	282	917.40	1,855.02	202
	1960	212	504.42	1,091.25	216
	1961	245	588.00	3.87	1
	Total	970	2,727.12	4,789.79	176
	Per Acre		2.81	4.94	176
U2-5	1958	351	947.70	790.09	83
	1959	417	1,283.73	1,053.14	82
	1960	320	752.20	1,060.40	141
	1961	340	918.00	348.30	38
	Total	1,428	3,901.63	3,251.93	83
	Per Acre		2.73	2.28	83
McLean County	1958	1,514	6,030.55	8,595.50	143
	1959	1,740	6,136.59	2,513.51	41
	1960	1,700	5,285.13	4,394.92	83
	1961	1,499	4,130.43	-323.72	-8
	Total	6,453	21,582.70	15,180.21	70
	Per Acre		3.34	2.35	70

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns additional to fertilizer cost.

APPENDIX TABLE C-7. ESTIMATED RESULTS OF TOTAL SMALL GRAIN ACREAGE FERTILIZED ON TEST-DEMONSTRATION FARMS IN WILLIAMS COUNTY, 1958-1961[1]

Cooperator	Year	Acres Fertilized	Commercial Cost of Fertilizer ($)	Fertilizer Return[2] ($)	Per Cent Return
U2-3 (Dryland)	1958	530	1,727.80	1,038.80	60
	1959	100	270.00	29.00	11
	1960	230	972.90	209.40	42
	1961	70	189.00	-74.90	-40
	Total	930	3,159.70	1,402.30	44
	Per Acre		3.40	1.51	44
U2-4 (Dryland)	1958	616	2,053.94	1,111.60	54
	1959	443	1,804.01	-1,664.35	-92
	Total	1,059	3,857.95	-552.75	-14
	Per Acre		3.64	-.52	-14
Williams County (Dryland)	1958	1,146	3,781.74	2,150.40	57
	1959	543	2,074.00	-1,664.35	-79
	1960	230	972.90	409.40	42
	1961	70	189.00	-74.90	-40
	Total	1,989	7,017.65	849.55	12
	Per Acre		3.53	.43	12
U2-1 (Irrigated)	1958	162	920.96	1,574.32	171
	1959	198	1,150.08	102.81	9
	1960	174	1,120.56	1,810.66	162
	1961	139	1,007.48	1,428.78	142
	Total	673	4,199.08	4,916.57	117
	Per Acre		6.24	7.31	117
U2-2 (Irrigated)	1958	77	419.65	1,274.39	304
	1959	44	176.00	487.29	277
	1960	106	682.64	1,385.89	203
	1961	62	471.20	2,428.54	515
	Total	289	1,749.49	5,576.11	319
	Per Acre		6.05	19.29	319
Williams County (Irrigated)	1958	239	1,340.61	2,848.71	212
	1959	242	1,326.08	590.10	44
	1960	280	1,803.20	3,196.55	177
	1961	201	1,478.68	3,857.32	261
	Total	958	5,948.57	10,492.68	176
	Per Acre		6.21	10.95	176

[1]Small grains included are wheat, barley and oats. Fertilizer responses are based on yield difference obtained at harvest time, crop losses and abandonments on fertilized fields are included. Cost of fertilizer = 14 cents per pound of nitrogen, and 10 cents per pound of P_2O_5. Annual mid-October grain prices were used to establish value of yield increase.

[2]Returns additional to fertilizer cost.