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For Check Out Only!

Agricultural Economics
Report No. 18

Agricultural Economics
STAFF CONFERENCE ROOM

the **1960 REPORT** ★

ON TEST DEMONSTRATION FARMS IN NORTH DAKOTA

BARLEY
8.5
Bushels

**APPLIED
FERTILIZER
GAVE THESE
INCREASES
IN ACRE
YIELDS**

WHEAT
5.2
Bushels

OATS
17.7
Bushels

APRIL 1, 1961

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

THE 1960 REPORT ON THE TEST-DEMONSTRATION
PROGRAM IN NORTH DAKOTA

Marvin T. Nordbo¹ and Virgil Weiser²

The test-demonstration program was initiated in North Dakota in 1957. This is a cooperative project between the North Dakota State University of Agriculture and Applied Science and the Tennessee Valley Authority. The broad objectives of the 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 the conduct of this program within the state. The Agricultural Economics Department has a state project (S-3-5) devoted to an economic evaluation of a recommended and balanced fertilizer program as it applies to the over-all farm. The project supervisor is an agricultural economist who assumes responsibility for general development and conduct of the program. He is responsible for supervision of all farm records and accounts needed and for

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making analyses of results obtained. An Extension Service soils agent helps to develop crop and fertilizer use plans for each cooperating farm, requisitions required fertilizer materials, supervises fertilizer applications, and assists in obtaining yield results from fertilizer use by establishing and checking check strips. Extension agents in the participating counties assist the project supervisors in carrying out the program within their respective counties. Other research and extension personnel are available for counsel and advice as needed.

This test-demonstration program has been active in Barnes, Ramsey, Morton and Stark counties for four cropping seasons. McLean and Williams counties have participated for three cropping seasons. These counties were selected because of their location within the three major soils associations in the state. Barnes and Ramsey counties are in the Aastad-Hamerly-Barnes Soils Association; Morton and Stark counties are in the Morton-Bainville Soils Association; McLean and Williams counties are in the Williams-Zahl Soils Association. Twenty-five farmers located within these counties were active cooperators during the 1960 cropping season. Twenty-three of these are dryland farmers. Irrigation proposals and developments within the state prompted the inclusion of two irrigation farmers as cooperators. Their farms are located on the Buford-Trenton Irrigation Project in Williams county.

Active Test Demonstration Farms in North Dakota

Farm cooperators have been retained from year to year where possible. All active cooperators in 1960 were retained from the previous season. One dropped out of the program, because the farm was placed in the soil bank. The distribution of farm cooperators by counties is shown in table 1.

TABLE 1. NUMBER OF TEST DEMONSTRATION FARMS BY COUNTIES, 1960

County	Active Cooperators January 1, 1960	Cooperators Dropped Out During Year	Active Cooperators December 31, 1960
Barnes	3	0	3
Ramsey	6	0	6
Morton	4	0	4
Stark	4	0	4
McLean	5	0	5
Williams	4	1	3
Total	26	1	25

The location of participating counties and relative location of individual farm cooperators are shown in Figure 1.

Size, Type and Tenure of Farm Cooperators

The size of cooperating farms ranged from 320 to 2,800 acres. The average farm size was 1,232 acres. Distribution of farms by size is shown in table 2. The two smallest farms in Williams county were the irrigated farms.

TABLE 2. SIZE OF TEST-DEMONSTRATION FARMS, 1960

County	Total Acreage				Total
	Under-640	641-960	961-1280	1281-over	
Barnes	1	-	1	1	3
Ramsey	4	-	2	-	6
Morton	-	1	-	3	4
Stark	-	1	1	2	4
McLean	1	1	2	1	5
Williams	2	-	-	1	3
Total	8	3	6	8	25
Average size of farm within each group	478.5	876.0	1119.	2202.5	1232

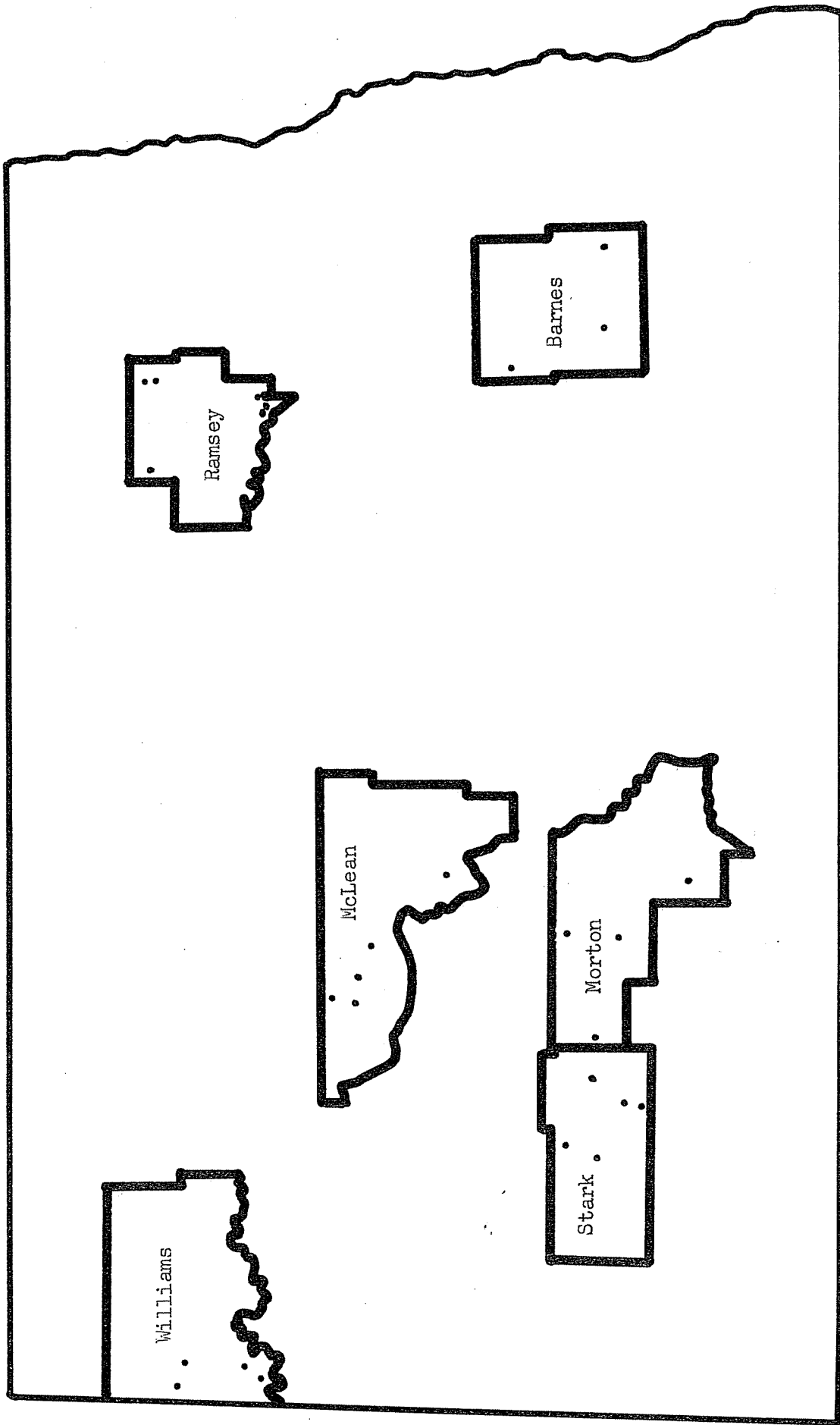


Figure 1. Location of Test - Demonstration Farms.

Eleven of the 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 most cooperators also included livestock enterprises in their farm operations. Only three cooperators were strictly cash-grain farmers.

The 25 cooperators in the test-demonstration program operated a total of 30,510 acres of farm land. Approximately 61 per cent of this average was tillable, as indicated in Table 3.

TABLE 3. PROPORTION OF LAND OWNED AND RENTED, AND TILLABLE ACREAGE ON TEST DEMONSTRATION FARMS, 1960

	Acres	Per cent of Total Farmland
Farmland Owned	19,705	64.6%
Farmland Rented	10,805	35.4%
Total Farmland	30,510	
Tillable Acreage	18,594	60.9%

Wheat was the leading cash crop on the test-demonstration farms. Twenty-nine per cent of the total cropland was devoted to wheat production in 1960 (table 4). Research and farmer experience have proven that wheat gives the highest net returns from fertilizer investments in North Dakota. Measuring crop yield responses on the test-demonstration farms during the past four seasons has resulted in average net returns as follows: all wheat, 107 per cent; all barley, 25 per cent; and all oats, 9 per cent. These results indicate the optimum sequence for investing fertilizer dollars on small grains in North Dakota. The profitability of fertilizer investments on low valued crops such as oats is rather questionable in many areas of the state. Consequently, wheat

TABLE 4. DISTRIBUTION OF CROP ACREAGES AND USE OF FERTILIZER ON TEST-DEMONSTRATION FARMS IN 1960

Crop	Acreage Grown	Percentage of Total Cropland	Acreage Fertilized	Percentage of Crop Fertilized
Wheat	5374	28.9	4969	92.5
Barley	2754	14.8	2058	74.7
Corn	1458	7.8	198	13.6
Oats	1229	6.6	246	20.0
Flax	412	2.2	---	---
Alfalfa	880	4.7	65	7.4
Pasture and Grass	1089	5.9	---	---
Rye	182	1.0	121	66.5
Sugar Beets	86	.4	86	100.0
Millet	65	.3	---	---
All Crops	13,529	72.8	7743	57.2
Summer Fallow	3,792	20.4	0	---
Soil Bank	1,273	6.8	0	---
Total Cropland	18,594	100.0	7743	41.7

has received the major emphasis in the fertilization program on these test-demonstration farms. Table 4 shows that 4,969 acres or 92.5 per cent of all wheat acreage on these farms was fertilized in 1960.

Amount of Fertilizer Material Used

A total of 225.16 tons of Tennessee Valley Authority fertilizer material was used in the North Dakota test-demonstration program during the 1960 cropping season. About 31 tons of ammonium phosphate nitrate (30-10-0) was shipped into Ramsey county during the fall of 1959 and used for fall applications of nitrogen. The balance of the fertilizer materials was shipped in and applied during the spring planting season. The distribution of Tennessee Valley Authority fertilizer materials by type and counties is shown in table 5.

TABLE 5. AMOUNT OF TVA FERTILIZER MATERIALS USED ON TEST-DEMONSTRATION FARMS IN 1960

	Tons of 0-63-0	Tons of 20-52-0	Tons of 30-10-0	Tons of 20-20-0	Total Tons of All Material
Barnes	---	34.56	15.80	---	50.36
Ramsey	1.08	36.40	38.86*	4.46	80.80
Morton	---	23.36	9.50	---	32.86
Stark	---	21.36	8.25	---	29.61
McLean	---	---	---	---	---
Williams	5.52	10.88	14.05	1.08	31.53
Total	6.60	126.56	86.46	5.54	225.16

* Includes material which was purchased and applied in fall of 1959.

Concentrated super phosphate (0-54-0) was available to cooperators, but no cooperator was willing to try it in 1960 because of the poor condition of this material in 1959 and the problems encountered during that season. Consequently, diammonium phosphate (20-52-0) was used in many instances where normally a straight phosphate would have been recommended. Also, many cooperators purchased phosphate materials locally.

McLean county cooperators did not use any Tennessee Valley Authority test-demonstration fertilizer materials in 1960. A large proportion of their fertilizer needs was phosphate and they purchased their materials locally. They cooperated in the test-demonstration program by leaving check strips and making harvest checks. Their results are included in this report. A summary of fertilizer materials and amounts purchased of each type is presented in table 6. About 76 tons of material were purchased locally to supplement fertilizers purchased from the Tennessee Valley Authority.

TABLE 6. COMMERCIAL FERTILIZER MATERIALS PURCHASED LOCALLY BY TEST-DEMONSTRATION FARMS IN 1960

Fertilizer Material	Tons Purchased
82-0-0	1.85
33.5-0-0	13.48
27-14-0	.60
24-20-0	1.91
23-23-0	.87
16-20-0	20.88
11-48-0	5.25
0-46-0	31.04
Total	75.88

RECORDS REQUIRED AND ANALYTICAL STUDIES

Every test-demonstration cooperator leaves unfertilized check strips in a representative number of the fertilized fields. These check strips demonstrate the effects of proper fertilization on the crop. The cooperators harvest these check strips separately. They weigh and test the grain to determine yield and quality differences on fertilized versus unfertilized portions of the field.

Complete farm records are kept by each cooperator. These records are made available to the project supervisor, who analyzes the economic effects of fertilizer use as it applies to the farm business. These records also reflect other efficiencies and/or inefficiencies within the various farm units.

A review of the 1959 farm records indicated that about 10 per cent of the net income on the cooperators' farms could be attributed to crop yield increases due to fertilizer applications. However, severe drought plus some hail in Morton, Stark and Williams counties caused an actual decrease in net income from fertilized fields on some of the cooperating farms. Barnes county, on the other hand, had favorable weather conditions during the 1959 season and fertilizer responses increased cooperating farmers' net farm income by about 34 per cent.

FERTILIZER RESPONSES IN 1960

The test-demonstration farm cooperators fertilized 7,273 acres of small grains (wheat, barley and oats) in 1960. Harvest yields were measured on fertilized and unfertilized portions of 3,610 acres to determine crop yield responses due to fertilizer applications. The net returns to the fertilizer investment averaged 48 per cent on all non-irrigated land in 1960 as compared with 40 per cent in 1959. The returns on the irrigated acreage averaged 180 per cent (table 7).

TABLE 7. COSTS, TOTAL RETURNS AND PROFITS FROM FERTILIZER INVESTMENTS OF 3,610 ACRES OF SMALL GRAIN CROPS, 1960

County	Acres Checked	Fertilizer Cost Per Acre (\$)	Total Added Return/Acre (\$)	Profit (%)
Results Obtained on Non-irrigated Land				
Barnes	953	6.94	12.39	79
Ramsey	1,194	5.59	8.10	45
Morton	498	4.55	3.21	-29
Stark	542	5.01	6.41	28
McLean	241	3.38	7.37	118
Average	3,428	5.57	8.26	48
Results Obtained on Irrigated Land				
Williams	182	6.44	18.05	180
Average Results (Irrigated and Non-irrigated)				
State Average	3,610	5.61	8.75	56

The results varied greatly from county to county and even among cooperators within each county.

McLean county reflects the highest average returns to fertilizer investments during 1960 on non-irrigated land, with an average of 118 per cent net return. There are several factors to consider when drawing this conclusion. Fertilizer

response history in North Dakota indicates that the largest fertilizer profits are obtained from putting phosphate on fallowed land, and wheat has been the most consistent and highest profit producer in response to fertilizer application. The results obtained in McLean county in 1960 are based on 68 per cent of the checks being made on land which was fallowed in 1959. Wheat made up 78 per cent of the acreage checked. In contrast, Barnes county had a 79 per cent profit, but only 12 per cent of the acreage was on fallowed land, with 46 per cent of that acreage checked devoted to wheat. The responses in McLean county also were obtained from a relatively small acreage. Another factor which had an influence on the favorable return in McLean county was that the fertilizer investment per acre on fallowed land was lower, due to use of straight super phosphate materials rather than adding nitrogen with the phosphate treatment. Nitrogen is normally not recommended when fertilizing fallowed land in this area. However, 20-52-0 was the only suitable test-demonstration fertilizer material available to substitute for 0-54-0, which had caused many problems in the previous season. Consequently, many cooperators applied 20-52-0 on their fallowed land.

Rainfall and moisture supplies also influenced fertilizer responses during the 1960 season. Morton county suffered most in this regard. Spring moisture supplies were very low and rainfall during the growing season was inadequate. Consequently, a 29 per cent loss in the fertilizer investment was experienced in this county.

The fertilizer results thus far have been discussed in terms of dollar gains and losses. They also may be stated in terms of bushel increases. Tables 8 and 9 show the average yields and average yield increases resulting from fertilizer treatments. These averages for all test-demonstration farms are simple averages of the different harvest yield checks. The crop yields and yield responses on the individual fields and individual cooperators are listed by counties in appendix tables 1 through 6.

TABLE 8. YIELD RESPONSES TO FERTILIZER TREATMENTS ON FALLOWED LAND ON TEST-DEMONSTRATION FARMS, 1960^a

Crop	Number of Samples	Fertilized Yield Bushels/Acre	Check Yield Bushels/Acre	Increase Bushels/Acre
Wheat and Durum	31	23.3	19.1	4.2
Barley	2	36.2	23.7	12.5

^aAverage fertilizer treatment was 8 pounds of nitrogen and 27 pounds of P₂O₅ per acre.

TABLE 9. YIELD RESPONSES TO FERTILIZER TREATMENTS ON NONFALLOWED LAND ON TEST-DEMONSTRATION FARMS, 1960^a

Crop	Number of Samples	Fertilized Yield Bushels/Acre	Check Yield Bushels/Acre	Increase Bushels/Acre
Wheat and Durum	29	22.1	17.4	4.7
Barley	28	29.8	22.2	7.6
Oats	4	75.2	56.2	19.0

^aAverage fertilizer treatment was 23 pounds of nitrogen and 26 pounds of P₂O₅ per acre.

FOUR YEARS OF EXPERIENCE

This project has been conducted throughout four cropping seasons in the state. During this period, 25,990 acres of small grains have been fertilized on the cooperating farms and about 55 per cent of this acreage has had unfertilized check strips left through the fields, facilitating harvest yield comparisons. Crop yield responses have been checked on 14,120 acres. The fertilizer responses on these acres have produced an averaged additional net return of \$3.19 per acre.

In addition to the small grains, 2,043 acres of other crops such as corn, sugar beets, alfalfa, rye, speltz, etc., have been fertilized. Some of these crops have responded very well. An example, is sugar beets on irrigated land which have given about a 4.5 ton per acre yield increase due to fertilizer treatments. However, these are minor crops in this area and sufficient yield

comparisons are not available to make a valid evaluation of fertilizer responses.

Small grain yield responses to fertilizer treatments have varied greatly during the four year period. Some fields have not responded to fertilizer treatments, whereas other fields have had very substantial yield increases. The average results for each county are enumerated in appendix tables 7 through 13.

The four year summaries in table 10 reflect the comparative profitability of using fertilizer on various crops. Wheat seeded on fallowed land and fertilized with recommended levels of phosphate has yielded the highest net returns to fertilizer, averaging 169 per cent profit on 4,872 acres checked. These four year results indicate that the fertilizer program for small grains would give the greatest returns by the following sequence of investment:

1. Fertilizing wheat on fallowed land
2. Fertilizing barley on fallowed land
3. Fertilizing wheat on nonfallowed land
4. Fertilizing barley on nonfallowed land
5. Fertilizing oats on nonfallowed land

On the basis of these results the first fertilizer dollars should be invested in fertilizing wheat seeded on fallowed land.

Barley seeded on fallowed land would be the next alternative for investing fertilizer. Wheat seeded on nonfallowed land has been the third most profitable investment, followed by barley on nonfallow and oats on nonfallow, in that order. A closer look at table 10 shows that on an acre basis, wheat on nonfallow produced almost as large a net income due to fertilizer response as barley seeded on fallowed land - \$3.69 per acre as compared with \$3.93 per acre. However, the average investment per acre for fertilizing wheat on nonfallow was \$5.88, compared with \$2.52 for barley fertilized on fallowed land. This indicates a good possibility for increasing the net income per acre when acreage is a limiting production factor. Even though the percentage returns to fertilizer weren't as high on nonfallow as fallowed land, the returns per acre were quite comparable in the above example.

TABLE 10. FERTILIZER RESPONSES, AVERAGE COST AND RETURNS ON TEST-DEMONSTRATION FARMS¹

Crop	Year	Acreage	Bushel Increase Per Acre ²	Fertilizer Cost Per Acre	Net Return Per Acre	Per Cent Profit
Wheat and Durum on Fallow	1960	853	4.5	\$ 3.99	\$4.34	109 %
	4 yr. ³	4,872	4.2	2.89	4.90	169 %
Barley on Fallow	1960	30	12.2	2.42	6.16	255 %
	4 yr. ³	399	8.1	2.52	3.93	156 %
Wheat and Durum on Nonfallow	1960	1,268	5.7	6.02	4.40	73 %
	4 yr. ³	3,888	5.1	5.88	3.69	63 %
Barley on Nonfallow	1960	1,154	8.4	6.18	-.31	-5 %
	4 yr. ³	4,509	9.0	5.84	1.15	20 %
Oats on Nonfallow	1960	123	17.7	6.87	.90	13 %
	4 yr. ³	489	15.5	6.37	.67	11 %
All Crops	1960	3,428	---	5.57	2.69	48 %
	4 yr. ³	14,120	---	4.77	3.19	67 %

¹This summary includes only the results obtained on nonirrigated land.

²The yield response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

³Four year period includes the years 1957, 1958, 1959 and 1960.

The average net return on 14,120 acres of small grains checked from 1957 to 1960 was \$3.19 per acre on an average fertilizer investment of \$4.77 per acre. This was a profit of 67 per cent. In other words, for every \$100 invested in fertilizer an average of \$167 was returned in the fall. Multiplying these costs and returns by the number of acres (14,120) which have been checked during this four year period indicates that \$67,352.40 have been invested in fertilizer and \$45,042.80 of additional net income has been realized from this investment.

PROBLEMS ENCOUNTERED WHILE APPLYING TEST-
DEMONSTRATION FERTILIZER MATERIALS

Relatively few problems were encountered by test-demonstration cooperators in applying the fertilizer materials received in 1960. The physical condition of all materials received was generally good and all material arrived in good condition. Four different materials were used: Calcium metaphosphate (0-63-0), diammonium phosphate (20-52-0), ammonium phosphate nitrate (30-10-0), and leach zone fertilizer (20-20-0). No concentrated super phosphate (0-54-0) was ordered in 1960 because all cooperators who tried it in 1959 had so much trouble with it that they were unwilling to try it again.

The cooperators were not requested to complete appraisal forms on the diammonium phosphate in 1960. Some cooperators found little bits of paper mixed in this material which tended to lodge and plug the tubes of the fertilizer attachments. Others complained about the uneven particle size of this material and the large amount of very fine material in it, which created irregular application rates.

Another frequent criticism during the spring season was the size of the paper bags in which this material was packaged. The bags were so large that 80 pounds of material did not fill them. The result is a very limp package which is difficult to handle. They would prefer a much firmer package which would not tend to bend in the middle when picked up.

One cooperator who used 20-20-0 has a fertilizer attachment with a star wheel feeding mechanism. In this case, material built up under the star wheels and caused trouble. The other materials did not cause this trouble and, consequently, this farmer did not desire to use any more 20-20-0.

No other problems were encountered in the use of the test-demonstration fertilizer materials. The farmer appraisals of ammonium phosphate nitrate and 20-20-0 indicated that these materials were generally very satisfactory.

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

In 1960 239 different fields had fertilizer applied on the 25 test-demonstration farms. About 55 per cent of these fields had unfertilized check strips left in them and 105 fields had harvest yield comparisons made of the fertilized and unfertilized portions.

Many local farmers, elevator men and fertilizer dealers stopped to examine the fertilized fields and check strips demonstrations on these farms throughout the growing season. Local fertilizer dealers often took farmers out to observe the growth responses in these demonstrations. Others inquired about the actual yield results obtained on these fields. County extension agents included the test-demonstration farms as stops in county farm tours. Results obtained on these farms have been used extensively 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 1960 follows:

<u>Kind of Fertilizer Demonstration</u>	<u>Number of Demonstrations</u>
Small grains grown on fallow	53
Small grains grown on nonfallow	74
Corn	3
Alfalfa	2
Sugar Beets	2

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

Number of people who visited fertilizer demonstrations (Including tour groups and individual visits)	<u>700</u>
Number of tour groups who saw fertilizer demonstrations	<u>6</u>
Number of news articles mentioning one or more of these demonstrations and/or results from these demonstrations	<u>35</u>
Number of radio and television programs in which reference was made to these demonstrations and results obtained.	<u>39</u>

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. One article, "There's Profit in Fertilizer", summarizing the results obtained in the test-demonstration program was published in the North Dakota Farm Research Bulletin. This bimonthly publication has a circulation of about 10,000. Reprints were also made of this article for wider distribution. Results published in the annual reports are used as references and fertilizer response information in many activities. One hundred fifty copies of last year's report have been distributed.

APPENDIX TABLE 1. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BARNES COUNTY, 1960

Cooperator	Field No.			Soils Test ¹	Nutrients Per Acre	Yield Bu/Acre		
						Fert.	Check	Difference
Lyle Guscette	29-4	Fallow	Wheat		13+34+0	41.3	28.0	13.3
	21-2	Corn	Wheat	VL	30+37+0	45.3	30.7	14.6
	24-4	Bly.+Wht	Barley		31+40+0	20.3	1.0	19.3
	28-1	Corn	Oats	L	25+31+0	115.5	82.5	33.0
Ray Stangler	15	Flax	Wheat		36+31+0	32.0	18.9	13.1
	8	Corn	Wheat	L	30+37+0	26.3	20.3	6.0
	6	Corn	Wheat	L	30+37+0	24.0	14.7	9.3
	13	Wheat	Barley	VL	36+31+0	51.0	37.3	13.7
	9	Wheat	Barley	L	36+31+0	36.0	34.5	1.5
	1	Flax	Barley		36+31+0	20.5	17.2	3.3
	10	Oats	Oats	L	36+31+0	58.8	46.5	12.3
Note: Fields 1 and 9 had considerable wind damage just prior to harvest, this cut both yields and fertilizer responses.								
Riedman Brothers	19	Fallow	Wheat	VL	13+34+0	38.0	29.2	8.8
	5	Corn	Wheat	M	22+23+0	30.4	23.2	7.2
	4	Wheat	Barley	L-M	22+23+0	34.1	18.4	15.7
	9	Corn	Barley	VL	21+34+0	53.2	41.1	12.1
	13	Barley	Barley	H	21+7+0	32.1	19.2	12.9
	18	Wheat	Barley	VL	21+24+0	35.3	32.3	3.0

¹VL - Soil tested very low in phosphate.

L - Soil tested low in phosphate.

M - Soil tested medium in phosphate.

H - Soil tested high in phosphate.

LM - Soil tested low to medium in phosphate.

APPENDIX TABLE 2. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN RAMSEY COUNTY, 1960

Cooperator	Field No.	1959 Crop	1960 Crop	Soils Test ¹	Nutrients Per Acre	Yield Bu./Acre		
						Fert.	Check	Difference
E.B. & Don Calderwood	2	Barley	Durum	L	28+32+0	20.8	15.3	5.5
	15	Barley	Durum	M	35+21+0	26.1	12.8	13.3
	13	Barley	Barley	M	35+21+0	20.7	18.0	2.7
	14	Wheat	Barley	H	36+12+0	22.2	17.0	5.2
	16	Barley	Barley	M	32+29+0	25.9	18.7	7.2
Willis Calderwood	6	Barley	Durum		28+32+0	23.1	19.5	3.6
	1	Wheat	Barley	H	30+10+0	21.3	17.5	3.8
	2	Barley	Barley	L	28+32+0	18.7	12.2	6.5
L.B. Currie	14	Alf-Fallow	Durum	VL	10+26+0	13.3	13.3	0*
	4	Fallow	Wheat	VL-L	12+31+0	18.7	18.7	0*
	2	Fallow	Wheat	M	8+21+0	21.3	18.6	2.7*
	5+6	Fallow	Wheat	M-L	8+21+0	37.3	24.0	13.3
*Fields 2, 4, and 14 were badly damaged by hail.								
Orville Larson	7	Barley	Durum	L-M	27+31+0	28.0	22.7	5.3
	9	Fallow	Durum	M	7+31+0	36.8	29.3	7.5
	9A	Durum	Durum	L-M H	27+17+0	27.2	19.2	8.0
	3	Barley	Barley	M-H	25+31+0	32.7	16.0	16.7
	11	Durum	Barley	L L-M	27+17+0	28.4	20.2	8.2
	12	Dur.+Flx.	Barley	M	12+12+0	25.8	22.0	3.8
Lawrence Stensland	4	Durum	Oats	H	27+29+0	50.0	30.0	20.0
	1	Fallow	Durum	L H	10+26+0	24.6	22.7	1.9
	10	Fallow	Durum	VL	10+26+0	22.9	19.9	3.0
	13	Wheat	Barley	M	20+25+0	26.3	15.8	10.5
3	Wheat	Barley	M	16+16+0	28.3	15.8	12.5	
LeRoy Stensland	5+7	Durum	Barley		20+25+0	32.0	24.8	7.2
	5	Barley	Barley		20+25+0	33.4	27.7	5.7

¹VL - 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 3. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN MORTON COUNTY, 1960

Cooperator	Field No.	1959 Crop	1960 Crop	Soils Test ¹	Nutrients Per Acre	Yield Bu./Acre		
						Fert.	Check	Difference
Alfred	1	Fallow	Wheat	VL	12+31+0	11.3	9.7	1.6
Underdahl	9	Fallow	Wheat	VL	12+31+0	10.0	10.1	-.1
	25L	Fallow	Wheat	L	12+31+0	23.3	19.3	4.0
	28	Fallow	Wheat	L	12+31+0	25.6	20.4	5.2
	43	Fallow	Wheat	L	6+16+0	28.0	21.3	6.7
	58	Fallow	Barley	VL M	6+16+0	36.7	23.3	13.4
Ole Wang	3	Fallow	Wheat	VL	10+26+0	11.7	10.6	1.1
	14	Corn	Wheat	VL	20+25+0	5.3	4.4	.9
<p>Field #3 had 13 percent hail damage, Field #14 had 50 per cent damage. The above two fields were the only ones that could be checked due to hail and drought.</p>								
Erich	13	Corn	Wheat		15+23+0	29.3	26.7	2.6
Wilkins	14	Corn	Wheat		15+23+0	23.6	19.6	4.0
	26	Oats	Wheat		15+23+0	23.5	20.3	3.2
	22	Wheat	Oats		15+23+0	76.3	65.8	10.5
Sig	3	Corn	Wheat		15+23+0	25.3	22.3	3.0
Peterson	18	Corn	Wheat		15+23+0	13.6	12.3	1.3
	24	Corn	Wheat		15+23+0	11.5	15.0	-3.5
	16	Wheat	Wheat		15+23+0	13.7	12.0	1.7
	6	Barley	Wheat		15+23+0	17.3	14.1	3.2
	10	Barley	Wheat		15+23+0	17.5	18.0	-.5

¹VL - Soil tested very low in phosphate.

L - Soil tested low in phosphate.

M - Soil tested medium in phosphate.

APPENDIX TABLE 4. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN STARK COUNTY, 1960

Cooperator	Field No.	1959 Crop	1960 Crop	Soils Test ¹	Nutrients Per Acre	Yield Bu./Acre		
						Fert.	Check	Difference
Joseph Lind	15	Safflower	Wheat	VL L	10+26+0	18.8	15.1	3.7
	16	Wheat	Wheat	VL L	19+29+0	12.9	10.5	2.4
	15A	Wheat	Durum	VL L	10+31+0	24.5	19.2	5.3
	24	Fallow	Wheat		12+31+0	26.7	14.7	12.0
	31	Fallow	Wheat		12+31+0	26.4	18.8	7.6
	21	Fallow	Wheat		12+31+0	12.0	8.5	3.5
	25	Fallow	Wheat		12+31+0	17.7	14.0	3.7
	28	Fallow	Wheat		12+31+0	20.4	18.0	2.4
	2	Corn	Barley	VL	19+29+0	29.1	18.3	10.8
	17	Wheat	Barley	VL	19+29+0	39.3	33.6	5.7
	27	Wheat	Barley		19+29+0	37.2	28.4	8.8
Clarence + Daniel Wahlers	21	Fallow	Wheat	L	12+31+0	17.9	13.6	4.3
	23	Fallow	Wheat	L	12+31+0	12.7	13.5	-.8
	18	Corn	Wheat		23+35+0	18.2	14.7	3.5
	26	Oat Hay	Wheat	L	12+31+0	17.6	13.3	4.3
Richard Dohrmann	2	Fallow	Wheat		10+26+0	16.4	16.1	.3
	12	Fallow	Wheat		10+26+0	22.7	21.6	1.1
	15	Corn	Wheat		23+26+0	26.8	17.7	9.1
	32	Corn	Wheat		10+26+0	18.7	17.1	1.6
	34	Corn	Wheat		22+30+0	22.7	21.9	.8

¹VL - Soil tested very low in phosphate.

L - Soil tested low in phosphate.

APPENDIX TABLE 5. CROP YIELD RESULTS ON TMA TEST-DEMONSTRATION FARMS IN MCLEAN COUNTY, 1960

Cooperator	Field No.	1959 Crop	1960 Crop	Soils Test ¹	Nutrients Per Acre	Yield Bu./Acre		
						Fert.	Check	Difference
Melvin	1-B	Fallow	Wheat	VL	0+23+0	23.7	19.2	4.5
Bjornholt	1-G	Fallow	Wheat		0+23+0	24.0	19.1	4.9
	7-F	Fallow	Durum	M	0+23+0	29.3	26.0	3.3
	7-J	Fallow	Durum	M	0+23+0	26.0	23.2	2.8
	6-B	Fallow	Barley	VL	0+28+0	35.8	24.2	11.6
	6-D	Corn	Durum	VL	24+30+0	20.7	16.0	4.7
	11-B	Corn	Durum	VL	24+30+0	25.9	20.1	5.8
	1-L	Sudan Grass	Barley	M	24+30+0	24.7	16.2	8.5
	Alfred	10	Fallow	Durum		0+23+0	32.8	25.6
Cole	11	Wheat	Barley		12+10+0	29.2	30.7	-1.5
	13	Wheat	Barley		19+16+0	28.8	24.3	4.5
Norlan Rue	16C	Fallow	Durum	VL	4+19+0	24.0	20.0	4.0
Karl Vangsness	19	Fallow	Wheat		4+19+0	26.4	24.1	2.3

¹VL - Soil tested very low in phosphate.

M - Soil tested medium in phosphate.

APPENDIX TABLE 6. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION IRRIGATION FARMS IN WILLIAMS COUNTY, 1960

Cooperator	Field No.	1959 Crop	1960 Crop	Soils Test	Nutrients Per Acre	Yield Bu./Acre		
						Fert.	Check	Difference
Paul Motzko	5	Corn	Oats		16+42+0	96.1	82.7	13.4
	1	Winter Wheat	Barley		16+42+0	60.0	34.7	25.3
		10	Barley	Winter Wheat		16+42+0	37.6	27.6
	2	Durum + Corn	Durum		16+42+0	28.3	22.3	6.0
		3	Barley	Durum		16+42+0	54.6	46.4
	4	Sugar Beets	Durum		16+42+0	71.1	56.1	15.0

The Durum yield on field number 4. from the portion of field which was fertilized but the sugar beets from the previous year were not harvested = 71.5 bushels per acre.

SUGAR BEET RESULTS:

Sample #1. Fall plowed stuble + manure + 75 lb. N. + 89 lb.

P₂O₅ = yield -13.46 tons per acre.

Sample #2. Spring worked, no fertilizer, ground on which the 1959 sugar crop was not harvested. Yield -8.15 tons per acre.

Sample #3. Spring worked ground on which the 1959 sugar crop was not harvested + 75 lb. N. + 89 lb. P₂O₅ yield -10.96 tons per acre.

Raymond Russell	6	Sugar Beets	Durum		31+21+0	51.5	43.8	7.7
	7	Sugar Beets	Durum		31+21+0	67.8	50.1	17.7

APPENDIX TABLE 7. FOUR YEAR SUMMARY OF FERTILIZER RESULTS IN BARNES COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response Per Acre ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	114	39.2	10.4	\$ 5.22	\$18.58	\$13.36
1957-60 Ave.	317 ²	41.1	7.7	3.65	14.28	10.63
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	325	32.6	10.0	7.23	17.93	10.70
1957-60 Ave.	1073 ²	32.6	8.0	6.31	14.94	8.63
<u>BARLEY ON FALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	116 ²	53.2	9.8	2.60	7.77	5.17
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	427	33.9	10.4	7.04	7.31	.27
1957-60 Ave.	1606 ²	40.3	11.4	6.05	8.93	2.88
<u>OATS ON NONFALLOWED LAND</u>						
1960	87	78.4	19.5	7.61	8.55	.94
1957-60 Ave.	262 ²	83.6	18.5	6.56	8.44	1.88
<u>ALL SMALL GRAINS CHECKED</u>						
1960	953	---	---	6.94	12.39	5.45
1957-60 Ave.	3374 ²	---	---	5.83	11.27	5.44

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for four year period.

Results for individual years of 1957, 1958 and 1959 may be found in appendix of Ag. Econ. Report #15. "The 1959 Report on Test-Demonstration Farms in North Dakota".

APPENDIX TABLE 8. FOUR YEAR SUMMARY OF FERTILIZER RESULTS IN RAMSEY COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response Per Acre ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	143	26.0	5.4	3.82	9.74	5.92
1957-60 Ave.	639 ²	34.0	3.6	2.67	6.65	3.98
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	255 ²	31.1	6.0	5.90	11.40	5.50
<u>DURUM ON FALLOWED LAND</u>						
1960	134	27.0	3.9	4.03	7.34	3.31
1957-60 Ave.	781 ²	33.3	3.1	2.82	6.26	3.44
<u>DURUM ON NONFALLOWED LAND</u>						
1960	291	24.7	7.3	6.92	13.82	6.90
1957-60 Ave.	674 ²	27.5	5.5	6.26	10.67	4.41
<u>BARLEY ON FALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	20 ²	65.2	8.5	2.53	6.72	4.19
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	615	25.7	7.4	5.69	5.16	-.53
1957-60 Ave.	2080 ²	33.7	8.5	5.83	6.60	.77
<u>OATS ON NONFALLOWED LAND</u>						
1960	11	50.0	20.0	6.68	8.80	2.12
1957-60 Ave.	84 ²	39.5	8.0	6.30	3.95	-2.35
<u>ALL SMALL GRAINS CHECKED</u>						
1960	1194	---	---	5.59	8.10	2.51
1957-60 Ave.	4533 ²	---	---	4.93	7.38	2.45

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for four year period.

Results for individual years of 1957, 1958 and 1959 may be found in appendix of Ag. Econ. Report #15. "The 1959 Report on Test-Demonstration Farms in North Dakota"

APPENDIX TABLE 9. FOUR YEAR SUMMARY OF FERTILIZER RESULTS IN MORTON COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response to Fertilizer ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	100	15.3	2.1	4.30	3.78	-.52
1957-60 Ave.	827 ²	27.4	4.5	3.01	7.51	4.50
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	344	16.9	1.6	4.59	2.92	-1.66
1957-60 Ave.	850 ²	20.2	3.6	5.24	6.84	1.60
<u>BARLEY ON FALLOWED LAND</u>						
1960	11	36.7	13.4	2.44	9.38	6.94
1957-60 Ave.	53 ²	56.4	4.5	2.65	3.39	.74
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	18	20.0	-.3	6.72	-.21	-6.93
1957-60 Ave.	58 ²	38.5	2.1	5.78	1.67	-4.11
<u>OATS ON FALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	40 ²	60.0	5.0	2.70	2.35	-.35
<u>OATS ON NONFALLOWED LAND</u>						
1960	25	76.3	10.5	4.40	4.62	.22
1957-60 Ave.	48 ²	71.6	7.8	5.28	3.48	-1.80
<u>ALL SMALL GRAINS CHECKED</u>						
1960	498	---	---	4.55	3.21	-1.34
1957-60 Ave.	1876 ²	---	---	4.15	6.70	2.55

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for four year period.

Results for individual years of 1957, 1958 and 1959 may be found in appendix of Ag. Econ. Report #15. "The 1959 Report on Test-Demonstration Farms in North Dakota".

APPENDIX TABLE 10. FOUR YEAR SUMMARY OF FERTILIZER RESULTS IN STARK COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response to Fertilizer ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	218	18.9	3.0	4.46	5.39	.93
1957-60 Ave.	747 ²	23.7	4.6	3.23	8.56	5.33
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	264	20.2	3.9	5.41	7.02	1.61
1957-60 Ave.	708 ²	21.9	3.2	5.74	5.97	.23
<u>BARLEY ON FALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	17 ²	34.7	5.2	2.70	4.42	1.72
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	60	35.2	8.4	5.56	5.90	.34
1957-60 Ave.	293 ²	31.6	6.3	5.52	4.83	-.69
<u>OATS ON NONFALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	95 ²	56.9	17.6	6.45	7.70	1.25
<u>ALL SMALL GRAINS CHECKED</u>						
1960	542	---	---	5.01	6.41	1.40
1957-60 Ave.	1813	---	---	4.84	7.06	2.22

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for four year period.

Results for individual years of 1957, 1958 and 1959 may be found in appendix of Ag. Econ. #15. "The 1959 Report on Test-Demonstration Farms in North Dakota".

APPENDIX TABLE 11. THREE YEAR SUMMARY OF FERTILIZER RESULTS IN MCLEAN COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response to Fertilizer ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	55	24.8	3.8	2.15	6.83	4.68
1958-60 Ave.	840 ²	30.2	4.7	2.50	8.72	6.22
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	---	---	---	---	---	---
1958-60 Ave	135 ²	17.7	1.6	5.65	2.94	-2.71
<u>DURUM ON FALLOWED LAND</u>						
1960	89	26.3	4.0	2.21	7.65	5.44
1958-60 Ave.	260 ²	26.0	5.3	2.35	10.63	8.28
<u>DURUM ON NONFALLOWED LAND</u>						
1960	43	23.5	5.3	6.45	9.99	3.54
1958-60 Ave.	193 ²	21.8	2.8	5.77	5.29	-1.48
<u>BARLEY ON FALLOWED LAND</u>						
1960	19	35.8	11.6	2.41	8.12	5.71
1958-60 Ave.	193 ²	42.4	8.5	2.41	6.63	4.22
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	34	26.5	5.4	5.10	3.75	-1.35
1958-60 Ave.	453 ²	31.2	5.3	5.42	4.16	-1.26
<u>ALL SMALL GRAINS CHECKED</u>						
1960	240	---	---	3.38	7.37	3.99
1958-60 Ave.	1991 ²	---	---	3.53	7.15	3.62

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for three year period.

Results for individual years of 1958 and 1959 may be found in appendix of Ag. Econ. Report #15. "The 1959 Report on Test-Demonstration Farms in North Dakota".

APPENDIX TABLE 12. THREE YEAR SUMMARY OF FERTILIZER RESULTS IN WILLIAMS COUNTY

Year	Acres	Fertilized Yield ¹ (Bu.)	Yield Response to Fertilizer ¹ (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre. (\$)
<u>WHEAT ON FALLOWED DRYLAND</u>						
1958-60 Ave.	460 ²	18.3	2.0	3.06	3.52	.46
<u>WHEAT ON NONFALLOWED DRYLAND</u>						
1958-60 Ave.	53 ²	12.8	-2.7	5.86	-5.13	-10.99
<u>BARLEY ON NONFALLOWED DRYLAND</u>						
1958-60 Ave.	19 ²	16.0	2.0	2.53	1.58	-.95
<u>ALL SMALL GRAINS CHECKED ON DRYLAND</u>						
1958-60 Ave.	532 ²	---	---	3.32	2.59	-.73
<u>DURUM ON IRRIGATED NONFALLOW</u>						
1960	112	54.5	10.6	6.44	20.08	13.64
1958-60 Ave.	311 ²	51.9	8.4	5.64	16.60	10.96
<u>WHEAT ON IRRIGATED NONFALLOW</u>						
1960	---	---	---	---	---	---
1958-60 Ave.	106 ²	37.3	4.0	4.20	7.44	3.24
<u>WINTER WHEAT ON IRRIGATED NONFALLOW</u>						
1960	20	37.6	10.0	6.44	17.00	10.56
1958-60 Ave.	74 ²	38.4	5.8	6.01	9.89	3.88
<u>BARLEY ON IRRIGATED NONFALLOW</u>						
1960	34	60.0	25.3	6.44	17.71	11.27
1958-60 Ave.	80 ²	68.4	13.8	6.11	9.97	3.86
<u>OATS ON IRRIGATED NONFALLOW</u>						
1960	16	96.1	13.4	6.44	5.90	-.54
1958-60 Ave.	162	96.1	13.4	6.44	5.90	-.54
<u>ALL SMALL GRAINS CHECKED ON IRRIGATION</u>						
1960	182	---	---	6.44	18.05	11.61
1958-60 Ave.	597 ²	---	---	5.52	12.74	7.22

¹The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

²Total acreage for three year period.

Results for individual years of 1958 and 1959 may be found in appendix of Ag. Econ. Report #15. "The 1959 Report on Test-Demonstration Farms in North Dakota".

APPENDIX TABLE 13. FOUR YEAR SUMMARY OF FERTILIZER RESULTS ON TVA TEST DEMONSTRATION FARMS IN NORTH DAKOTA¹

Year	Acres	Fertilized Yield ² (Bu.)	Yield Response to Fertilizer ² (Bu.)	Cost of Fert./Acre (\$)	Gross Ret. From Fert. Per Acre (\$)	Net Ret. From Fert. Per Acre (\$)
<u>WHEAT ON FALLOWED LAND</u>						
1960	630	24.1	4.8	4.23	8.63	4.40
1957-60 Ave.	3831 ³	28.4	4.4	2.94	7.91	4.97
<u>WHEAT ON NONFALLOWED LAND</u>						
1960	904	23.4	5.2	5.75	9.38	3.63
1957-60 Ave.	3074 ³	25.6	5.1	5.81	9.47	3.66
<u>DURUM ON FALLOWED LAND</u>						
1960	223	26.7	3.9	3.30	7.46	4.16
1957-60 Ave.	1041 ³	31.5	3.5	2.71	7.35	4.64
<u>DURUM ON NONFALLOWED LAND</u>						
1960	364	24.5	6.9	6.69	13.05	6.30
1957-60 Ave.	814 ³	26.7	5.1	6.14	9.92	3.78
<u>BARLEY ON FALLOWED LAND</u>						
1960	30	36.1	12.2	2.42	8.58	6.16
1957-60 Ave.	399 ³	47.8	8.1	2.52	6.45	3.93
<u>BARLEY ON NONFALLOWED LAND</u>						
1960	1154	29.2	8.4	6.18	5.87	-.31
1957-60 Ave.	4509 ³	35.6	9.0	5.84	6.99	1.15
<u>OATS ON FALLOWED LAND</u>						
1960	---	---	---	---	---	---
1957-60 Ave.	40 ³	60.0	5.0	2.70	2.35	-.35
<u>OATS ON NONFALLOWED LAND</u>						
1960	123	75.4	17.7	6.87	7.77	.90
1957-60 Ave.	489 ³	69.7	15.5	6.37	7.04	.67
<u>ALL SMALL GRAINS CHECKED</u>						
1960	3428	---	---	5.57	8.26	2.69
1957-60 Ave.	14,120 ³	---	---	4.77	7.96	3.19

¹This summary includes only the results obtained on nonirrigated land.

²The yield and response obtained from the harvest samples are assumed to be representative of the field in which they were obtained.

³Total acreage for four year period (1957-1960). /Results for individual years on 1957, 1958 and 1959 may be obtained in the appendix of the Ag. Econ. Report No. 15. "The 1959 Report on Test Demonstration Farms in North Dakota".