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Agricultural Economics
Report No. 12

The 1958 report on Test-Demonstration Farms in North Dakota

April 1, 1959

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

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THE 1958 REPORT ON THE TEST-DEMONSTRATION PROGRAM IN NORTH DAKOTA

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INTRODUCTION

A cooperative Tennessee Valley Authority and North Dakota Agricultural College fertilizer test-demonstration project was organized in 1957. This program was expanded during the 1958 cropping season. The objectives of the program are:

(1) To introduce TVA experimental fertilizers in farm fertilizer programs in in the state,

(2) To determine cooperating farmers' 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 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 from the Agricultural Economics Department assumes responsibility for the general development and conduct of the program. He is responsible for supervision of all farm records and accounts needed and finally making the analysis of results obtained. The Extension Soils Agent helps develop crop and fertilizer use plans for each cooperating farm, requisitioning required fertilizer, supervising fertilizer applications, and in obtaining yield results of fertilizer use by establishing check strips. The extension agents in the participating counties assist the project supervisors in carrying out the program

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within their respective counties. Other station and extension personnel are available for counsel and advice as needed.

This program was expanded to include two additional counties and nine additional farm cooperators for the 1958 cropping season. Twenty-seven farmers located in six different counties were active cooperators throughout the year. The participating counties were selected on the basis of location within the three major soils association areas in the state. Barnes and Ramsey counties are in the Aastad-Hamerly-Barnes Soil Association, Morton and Stark counties are in the Morton-Bainville Soils Association, and McLean and Williams are in the Williams-Zahl Soils Association. Irrigation proposals and developments within the state prompted the inclusion of two irrigation farmers as cooperators in this study. These farms are located on the Buford-Trenton Irrigation Project in Williams County. Remaining cooperators are located in dryland farm areas.

The success of this project demands contributions and cooperation from many individuals. The project supervisors are very grateful for the fine cooperation received from everyone involved. The test-demonstration farmers have been very cooperative in applying the fertilizers in accordance with recommendations, leaving check strips and making harvest yield checks, and providing all the records requested from them. The county extension agents have cooperated in supporting the program within their counties. The Agricultural Experiment Station and State Extension Service personnel have been helpful in supporting the program and contributing council and services. Assistance provided by the Tennessee Valley Authority has been very essential to the conduct of this program. The very helpful council and services of Mr. Hunter Stone are especially appreciated.

LOCATION AND NUMBER OF TEST-DEMONSTRATION FARMS IN NORTH DAKOTA

Barnes, Ramsey, Morton and Stark counties were active in the test-demonstration program in 1957 and 1958. McLean and Williams counties became active cooperators during the 1958 season. The location of these counties and the farm cooperators within each county are shown in figure 1. Barnes County had one new cooperator replacing one who dropped out, and two cooperators carried over from the previous year. Ramsey County had six cooperators, all of them were cooperators carried over from the previous year. Morton County had three cooperators carried over from the previous year and one new cooperator as a replacement for one drop-out from the previous year. Four cooperators in Stark County were carried over from the 1957 season and one replacement was added. McLean and Williams counties had five and four new cooperators respectively. A total of twenty-seven cooperators were active throughout the 1958 season. All of these cooperators are desirous of continuing in the project for the 1959 season. Table 1 indicates the number of cooperators within each of the counties included in the program.

TABLE 1. NUMBER OF TEST-DEMONSTRATION FARMS BY COUNTIES, 1958

County	Cooperators During 1957	Cooperators Dropping Out After 1957	New Cooperators Added for 1958	Cooperators Active During 1958
Barnes	3	1	1	3
Ramsey	6	0	0	6
Morton	4	1	1	4
Stark	5	1	1	5
McLean	0	0	5	5
Williams	0	0	4	4
Total	18	3	12	27

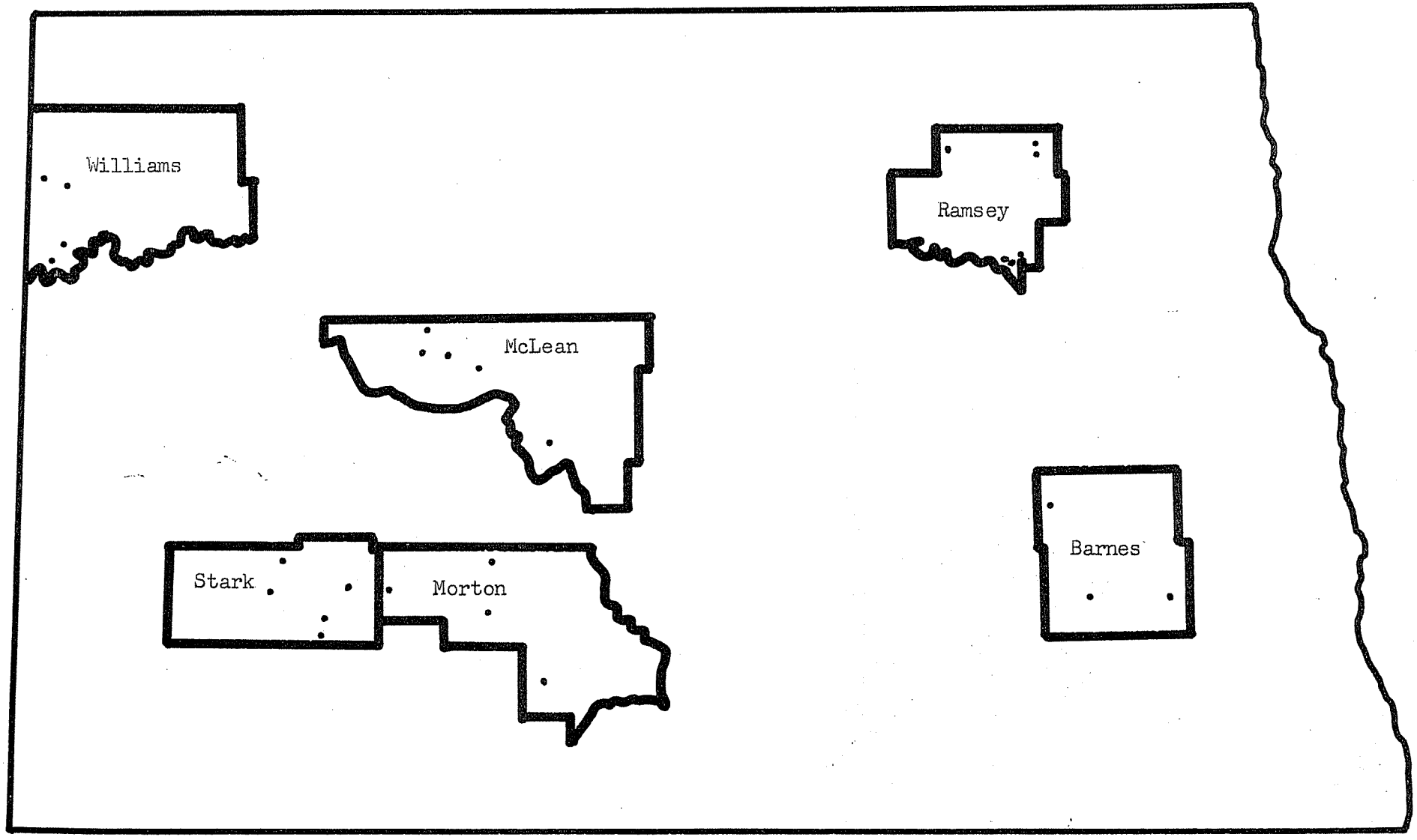


Figure 1. Location of Test - Demonstration Farms.

SIZE, TYPE AND TENURE OF FARM COOPERATORS

The size of cooperating farms ranged from 160 to 2800 acres. The distribution of farms by size is indicated in table 2. The two small farms in Williams County are irrigated units. Fourteen of the cooperators own all of their farm land, eight are part-owners and part-renters, and five cooperators rent all of their farm land. Small grain and livestock is the most popular enterprise combination on these farms, 21 of them have such a combination. Three of the cooperators have a small-grain and dairy enterprise combination and three are strictly cash-grain farmers.

TABLE 2. SIZE OF TEST-DEMONSTRATION FARMS, 1958

County	Total Acreage				Total
	160-640	641-960	961-1280	1281-over	
Barnes	1	1	1	0	3
Ramsey	4	0	2	0	6
Morton	1	0	1	2	4
Stark	0	1	2	2	5
McLean	1	1	2	1	5
Williams	2	0	0	2	4
Total	9	3	8	7	27

The 27 cooperators in the test-demonstration program operated a total of 31,204 acres of farm land. Approximately sixty-three percent of this acreage was tillable as indicated in table 3.

TABLE 3. PROPORTION OF LAND OWNED, RENTED, AND TILLABLE ACREAGE ON TEST-DEMONSTRATION FARMS, 1958.

Farmland owned	20,549 acres	65.9% of total farmland
Farmland rented	10,655 acres	34.1% of total farmland
Tillable farmland	19,567 acres	62.7% of total farmland
Total farmland	31,204 acres	

DISTRIBUTION OF CROPS AND FERTILIZER USEAGE ON TEST-DEMONSTRATION FARMS

North Dakota has a favorable climate for production of small grains, however, the growing season is relatively short and annual precipitation is limited to an average of 17.16 inches. This climate is most suitable for crops such as hard red spring wheat, durum wheat, barley, oats and flax. Many other crops are grown successfully but are not as common throughout the state. Table 4 shows the distribution of crops grown on the test-demonstration farms in 1958 and this cropping pattern is generally characteristic of most farms throughout the state. Several other more specialized crops such as potatoes, soybeans and sunflowers are grown, particularly in the Red River Valley.

The lack of intertilled crops and limited rainfall has encourage extensive use of fallow. This practice involves leaving a portion of cropland idle but under cultivation throughout one cropping season. The main purposes of fallow are to control weeds and conserve moisture for the next season's crop. Technological advancements in agriculture tend to reduce the need for fallow, however, it still remains a popular farm practice throughout the state.

TABLE 4. DISTRIBUTION OF CROP ACREAGES AND USE OF FERTILIZER ON TEST-DEMONSTRATION FARMS, 1958

Crop	Acreage Grown	Percentage of Total Cropland	Acreage Fertilized	Percentage of Crop Fertilized
Wheat and Durum	6,091	31.1%	5,431	89.2%
Barley	2,843	14.5	1,891	66.5
Corn	1,463	7.5	351	24.0
Oats	1,086	5.5	322	29.7
Alfalfa	1,070	5.5	50	4.7
Flax	946	4.9	0	0
Pasture and Grass	872	4.5	15	1.7
Rye	465	2.4	89	19.1
Alfalfa and Brome Mix	334	1.7	0	0
Speltz	135	.7	55	40.7
Sugar Beets	79	.4	79	100.0
Saflower	51	.3	0	0
Mellet	35	.2	0	0
Sweet Clover	30	.1	0	0
Sudan Grass	30	.1	0	0
Sorghum	26	.1	0	0
Total Crop	15,556	79.5%	8,268	53.1%
Fallow	4,011	20.5	0	0
Total Cropland	19,567	100.0%	8,268	42.3%

AMOUNT OF TVA FERTILIZER MATERIAL USED

A total of 281.72 tons of TVA fertilizer materials were used in the North Dakota test demonstration program during the 1958 crop season. One carload containing 31.42 ton of fertilizer was shipped into Ramsey and Williams Counties in the fall of 1957 for fall application. The balance was shipped in and applied in the spring at planting time. The distribution of fertilizer by type and by counties is shown in table 5.

TABLE 5. TONS OF TVA FERTILIZER MATERIALS USED ON TEST-DEMONSTRATION FARMS IN 1958

County	No. of Farms	Tons of TVA Fertilizer Material Used				Total of All Material
		0-63-0	0-54-0	20-52-0	30-10-0	
				(Tons)		
Barnes	3	3.52	5.64	23.68	21.1	53.94
Ramsey	6	0	5.68	34.6	25.15	65.43
Morton	4	0	11.84	11.00	7.00	29.84
Stark	5	0	7.8	14.52	11.95	34.27
McLean	5	0	27.64	7.08	11.6	46.32
Williams	4	7.72	18.60	10.80	14.8	51.92
Total	27	11.24	77.2	101.68	91.6	281.72

The test-demonstration farmers purchased about 40 tons of commercial fertilizer materials in addition to the materials purchased from TVA. About 18 tons of this fertilizer was super phosphate material, 6 tons was 1-4-0 ratio material, 8 tons of a 4-5-0 ratio, and 7½ tons of nitrogen materials. Some of this commercial material was purchased for fall application in 1957. Several cooperators purchased commercial fertilizer materials to replace the 0-54-0 obtained from TVA because of its poor physical condition, and in some cases additional fertilizer was needed.

SELECTION OF COOPERATORS

The success of this project demands good farm cooperators. They must have sufficient managerial ability and willingness to employ good cultural practices as well as fertilizing crops in accordance with college recommendations. Farm and field records are required for analytical studies of these farms. Adequate and suitable equipment for applying fertilizers at uniform and accurate rates is essential.

The six participating counties are scattered throughout the state in such a manner that the fertilizer materials have to be ordered and shipped into each

county separately. This geographic distribution within the state creates the need of four to six cooperators within a county who can utilizer a carload of fertilizer.

Each farm cooperator may participate in the program for a period of five years. In 1958, 15 of the cooperators were retained from the previous year and 12 new cooperators were added. All of these cooperators had employed fertilizer useage on their farms prior to becoming a test-demonstration farmer. Generally, however, they had not applied sufficient rates of nitrogen on their nonfallowed land. Their phosphate treatments were more in line with the rates recommended by the Experiment Station and Extension Service.

RECORDS REQUIRED AND ANALYTICAL STUDIES

Every test-demonstration cooperator leaves unfertilized check strips in a representative number of the fields which are fertilized. These check strips serve to demonstrate the effects of fertilizer on the crop. The cooperators harvest a portion of these check strips separately and weigh the grain to determine yield differences.

Complete farm records are kept by each cooperator and these are made available to the project supervisor for purposes of analyzing the farm business and determining economic effects of fertilizer use as it applies to the farm business. When analyzing these records, the following factors are considered: (1) the overall effects of applying fertilizers to the whole farm in accordance with fertilizer recommendations of the North Dakota Agricultural College, (2) the comparative efficiencies of enterprises within the farm unit, (3) comparative efficiencies that result from different practices between farm units and (4) methods of improving efficiencies within a farm unit.

Records of management and yield on individual fields are also kept by the test-demonstration cooperators. These records will help provide the research workers with basic input-output information for the various crops under various types of management.

Preliminary analytical work has been done on the 1957 records. However, some problems arise in using the phosphate responses obtained in 1957 due to the type of fertilizer material used and the relatively low fertilizer responses obtained. Calcium metaphosphate was used and it is a slow releasing form of phosphate which deprives the young seedling plants of the early fertilizer stimulation needed under our growing conditions and our method of applying fertilizers. In addition to the type of material used, 1957 was a relatively poor phosphate response year in this area so the results obtained were much poorer than the long time experience within the state.

An analysis based on these results tends to keep the returns to fertilizer lower than they actually are. By applying commercial costs to the fertilizer treatments used in 1957 the average net return to fertilizer on all treatments was 33 percent. In 1958 the net returns to fertilizer increased to 99 percent. However, in some cases the results were very favorable, in instances where very little calcium metaphosphate was used and conditions were favorable, individual operators experienced as much as 130 percent net return on their fertilizer investment. After analyzing the farm records it was also of interest to note that during 1957 the fertilizer net returns accounted for about nine percent of the total net farm income on these farms. Four cooperators did not have sufficient yield responses to cover the commercial cost of the fertilizer but in one instance 56 percent of the total net farm income could be attributed to fertilizer profits. The farm records point out comparative efficiencies between farms, machinery costs per crop acre and livestock returns per hundred dollars worth of feed. Intentions are to release parts of this information within the next year.

YIELD RESPONSES TO FERTILIZER-1958

Unfertilized check strips were left in a representative number of fertilized fields. These check strips were of sufficient size to allow yield determinations by the combine harvest method.[3] A total of 151 fields were checked for yield comparisons in fertilized and unfertilized protions of the field.

The yield responses varied greatly, in some instances there was no yield increase and in some instances the yield was approximately doubled by addition of fertilizer. The responses for the major crops are summarized in tables 6 and 7. Table 6 gives the average responses on fallowed land and table 7 shows the responses on nonfallowed land.

TABLE 6. YIELD RESPONSES TO FERTILIZER ON FALLOWED LAND ON TEST-DEMONSTRATION FARMS, 1958[a]

Crop	Number of Samples	Fertilized Yield	Check Yield	Increase
Wheat and Durum	68	32.9	28.5	4.4
Barley	4	59.3	53.7	5.6

[a]Average fertilizer treatment was 2 pounds nitrogen and 27 pounds phosphate per acre.

TABLE 7. YIELD RESPONSES TO FERTILIZER ON NONFALLOWED LAND ON TEST-DEMONSTRATION FARMS, 1958[a]

Crop	Number of Samples	Fertilized Yield	Check Yield	Increase
Wheat and Durum	32	31.1	26.1	5.0
Barley	31	48.5	37.8	10.7
Oats	7	73.7	59.7	14.0

[a]Average fertilizer treatment was 23 pounds of nitrogen and 30 pounds of phosphate per acre.

[3]This method of making comparisons is explained in North Dakota Extension Circular AE-66, April 1958, "Checking Crop Yields by Combine Method" by L. A. Jensen, Extension Agronomist and S. L. Vogel, Extension Agricultural Engineer.

The average yield responses as indicated in the above tables are quite comparable to the long time average bushel increases obtained in North Dakota with wheat, oats, and barley grown on fallow and nonfallow land. The long time average yield responses obtained in North Dakota are shown in table 8.

TABLE 8. LONG TIME AVERAGE YIELD RESPONSES OBTAINED FROM FERTILIZER USE IN NORTH DAKOTA[a]

Crop	Fallow or Nonfallow	Average Fertilizer Treatment Pounds Per Acre $N+P_2O_5+K_2O$	Average Yield Increase Bushels Per Acre
Wheat	Fallow	0+25+0	4.8
Barley	Fallow	0+25+0	8.0
Wheat	Nonfallow	30+25+0	5.5
Barley	Nonfallow	30+25+0	10.0
Oats	Nonfallow	30+25+0	15.0

[a]This data is obtained from North Dakota Extension Fact Sheet No. 33, Soils January 1958.

The fertilizer responses from the two irrigation units in Williams County are not included in the summaries in tables 6 and 7. Seven wheat fields on this units were checked for yield comparisons. The average fertilizer treatment was 22 pounds of nitrogen and 33 pounds of phosphate per acre. The unfertilized check strips averaged 49.7 bushels per acre and the fertilized portions averaged 58.7 or an average yield increase of nine bushels due to the fertilizer. An unfertilized check strip was also left in a sugar beet field and yield determinations made. This field received a total of 75 pounds of nitrogen and 94 pounds of phosphate per acre. The fertilized portion yielded 19.97 tons of beets per acre, the unfertilized portion yielded 15.83 or a difference of 4.14 tons per acre.

The fertilizer responses and returns on the test-demonstration farms were higher in 1958 than in 1957. The responses in 1958 produced an overall net return equal to 99 percent of the fertilizer cost (about $2 return for every dollar

invested in fertilizer) and in 1957 this return was 33 percent of the fertilizer cost. Tables 9, 10, and 11 show the distribution of net returns for the major crops which had enough harvest samples to allow such a break-down. Wheat on fallowed land produced the most profitable fertilizer responses averaging 194 percent net return. Fertilizing grains seeded on nonfallowed land involves higher fertilizer costs because nitrogen has to be added along with the phosphate. On nonfallow the wheat responses showed an average net return of 52 percent and barley responses produced a 51 percent net return.

TABLE 9. DISTRIBUTION OF NET RETURNS TO FERTILIZER, GROWING WHEAT ON FALLOWED LAND ON TEST-DEMONSTRATION FARMS IN 1958

Net Returns	Number of Fields	Percentage
Lost Money	13	19.2
0-99%	12	17.6
100-199%	12	17.6
200-299%	14	20.6
300 and over	17	25.0
Total	68	100.0

TABLE 10. DISTRIBUTION OF NET RETURNS TO FERTILIZER, GROWING WHEAT ON NONFALLOWED LAND ON TEST-DEMONSTRATION FARMS IN 1958.

Net Returns	Number of Fields	Percentage
Lost Money	7	21.9
0-99%	17	53.1
100-199%	6	18.7
200-299%	2	6.3
Total	32	100.0

TABLE 11. DISTRIBUTION OF NET RETURNS TO FERTILIZER, GROWING BARLEY ON NONFALLOWED LAND.

Net Returns	No. of Fields	Percentage
Lost Money	7	22.6
0-99%	16	51.6
100-199%	5	16.1
200-299%	2	6.5
300% and over	1	3.2
Total	31	100.0

The data in tables 9, 10 and 11 indicate that about 20 percent of the fields did not have sufficient responses to cover the cost of the fertilizer applications, however, these non-paying response fields were distributed among the cooperators so that every farm had an overall fertilizer profit.

The fertilizer returns were greatest on the irrigation units as indicated in figure 2. Wheat on dryland fallow followed closely with a 194 percent net return to fertilizer. Wheat on nonfallow had a 52 percent net return and barley on nonfallow had a 51 percent net return. Barley on fallowed land produced a 58 percent profit. These cooperators are not encouraged to fertilize oats because it has a relatively low bushel value and thereby making it difficult to obtain profitable yield responses. A few cooperators did, however, fertilize their oats. Seven oat fields received an average fertilizer treatment of 24+31+0 and produced an average yield increase of 14 bushels per acre. If the price of oats is 41 cents, this yield increase was not quite sufficient to pay for the cost of the fertilizer. Three of these fields did produce profitable responses to fertilizer but four of them did not pay for the fertilizer application.

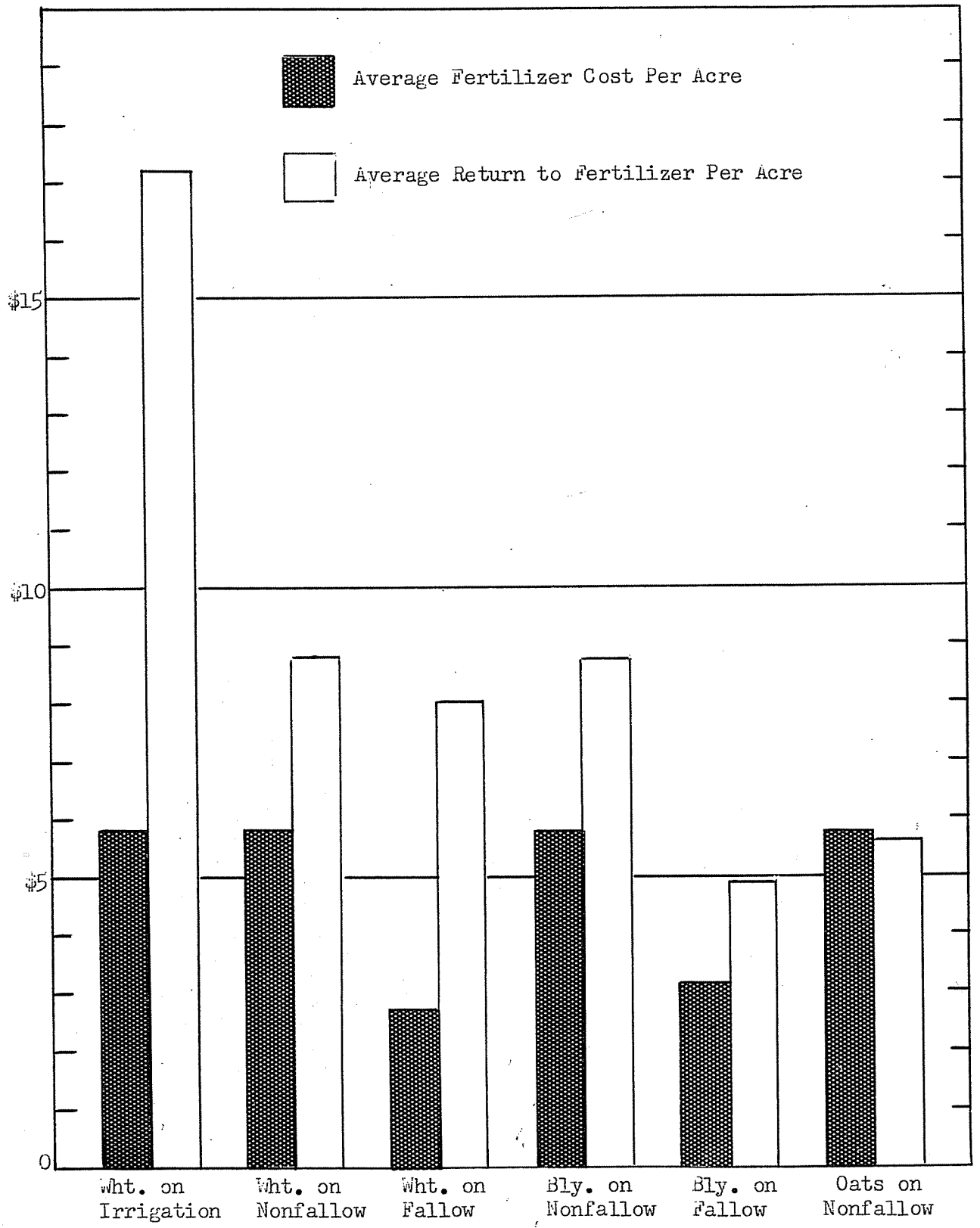


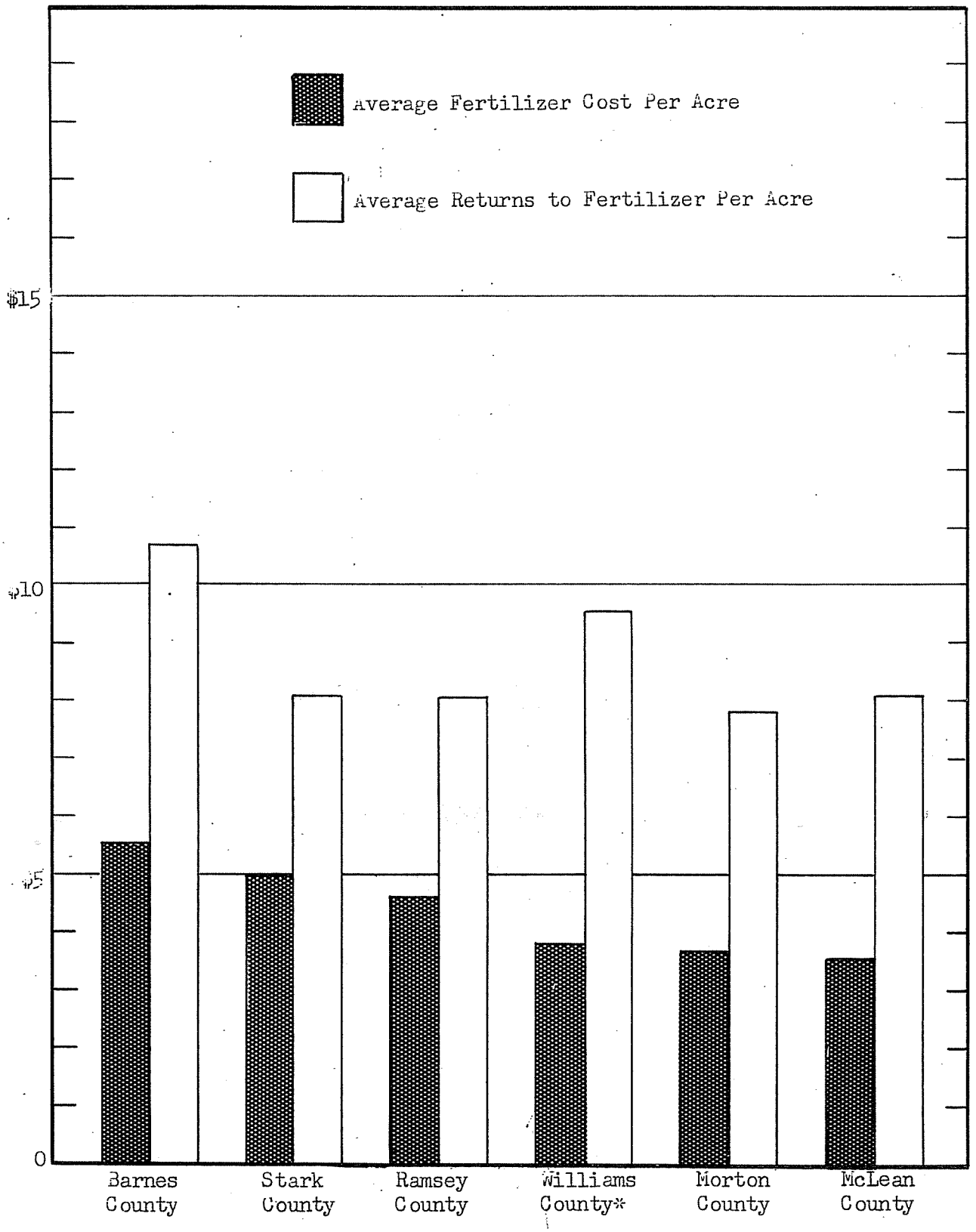
Figure 2. Average Costs and Returns to Fertilizer Per Acre on Test - Demonstration Farms, 1958

The average returns to fertilizer varied between counties as shown in figure 3. The average per acre fertilizer costs varied from county to county in accordance with the amount of fallowed land. Williams County shows the highest percent of net return because the irrigation units are included in the county average. Stark County showed the second highest average per acre fertilizer cost but had the lowest average percent net return, 62% ($3.08 net return per acre).

PROBLEMS ENCOUNTERED IN APPLYING TVA FERTILIZER MATERIALS

A large proportion of the cultivated crop acreage in North Dakota Dakota is taken up by the small grain crops of wheat, barley, oats and rye. As a consequence the major part of the fertilizer used in the state is for these crops. Fertilizer grades and condition of the materials that fit the need of these crops and recommended methods of application are of prime importance.

North Dakota research results have shown that straight phosphate material (0:1:0 ratio) or low nitrogen high phosphate material (about 1:4:0 ratio) are well suited for small grains sown on fallow. The phosphate should have a relatively high water solubility and should be applied in the row with the seed by drill attachment for most efficient use of the phosphate. Best rates of phosphate for various soil test levels vary from 15 to 20 pounds on medium testing soils to 35 pounds or more for very low testing soils. These rates call for 35 to 80 pounds per acre of a concentrated superphosphate such as 0-45-0. In order to meter out and evenly distribute such small rates the material has to be in condition to flow freely. Granulated and pelleted materials are best suited to the drill attachment equipment and rates used on most farms.



*Includes responses obtained on irrigation.

Figure 3. Average Costs and Returns to Fertilizer Per Acre for Small Grain Crops on Test - Demonstration Farms in 1958.

Of the TVA materials available in 1958, enriched superphosphate (0-54-0) was best suited for small grains on summerfallow from the standpoint of grade or analysis and content of water soluble phosphate. (Calcium metaphosphate 0-63-0 was used on fallow in 1957 on test-demonstration farms with comparatively weak responses. Low solubility or slow availability of this form of phosphate accounted in part for these weak responses.) However, many difficulties were encounted in 1958 with the 0-54-0 material received by test-demonstration cooperators. The chief difficulty seemed to stem from free acid in the fertilizer. Paper bags were brittle. Many broke in shipment and many others broke as they were unloaded from box cars. Still further breakage occurred as the bags were handled for storage and final use. The material was caked and lumpy when received and seemed to become more caked and lumpy in storage on the farms before use. Even though cooperators crushed the lumps and in many cases screened the fertilizer as it was used. It clung together and bridged over or stood up in the box and would not flow freely to the feed mechanisms. Some cooperators assigned an extra man in the seeding operation to ride the drill to keep leveling the material down. Another devised a mechanism that could be operated by a rope from the tractor that would level down the bridging in the fertilizer box on the drill. Some cooperators bought granular material locally to use in the spring seeding rush and took the time to screen and use the 0-54-0 material during more slack seeding periods in later spring and fall. Most operators felt they obtained poor distribution regardless of their efforts. If the 0-54-0 material could be made granulated and free flowing it would be well suited for most situations of small grains sown on summerfallow.

Small grain crops on fallow respond to a small amount of nitrogen (5-10 pounds per acre) with soils that are relatively low in organic matter. Especially for sandy loam soils 1:4:0 ratio materials are recommended instead of 0:1:0. For

soils that test medium or low in phosphate requiring 15 to 25 pounds of available phosphate and up to 10 pounds of nitrogen 20-52-0 can be used and fits within the recommendations.

However, for soils testing very low in phosphate where 35 pounds of phosphate with 5 to 10 pounds of nitrogen are recommended the ratio of nitrogen to phosphate in 20-52-0 is too high. For this situation a few cooperators mixed 0-54-0 and 20-52-0. These cooperators experienced trouble with the mixed material bridging over as when 0-54-0 was used alone. About 50 percent of North Dakota soils test very low in phosphate. A granular free flowing material of about 1:4:0 ratio is needed for many of these soils.

Fertilizer research in the state has shown that considerable nitrogen is needed along with phosphate for smal grains grown on nonfallowed land. Phosphate is recommended at rates varying with soil test levels.

Recommended rates of nitrogen vary with rainfall areas of the state.

Western North Dakota	20-30 lbs. of nitrogen per acre
Central North Dakota	30-40 lbs. of nitrogen per acre
Red River Valley	40-60 lbs. of nitrogen per acre

To meet these recommendations on a large proportion of the soils, 25 to 35 pounds of phosphate and 20 to 35 pounds of nitrogen are required per acre. At these rates, both the nitrogen and phosphorus can be applied in the row with the seed and most operators prefer to apply the materials together as a mixed fertilizer. A fertilizer near to a 1:1:0 ratio is needed.

Test-demonstration cooperators in 1958 mixed 20-52-0 and 30-10-0 to obtain the desired proportions of nitrogen to phosphate. In 1957 they mixed 20-52-0 and 33-0-0 with problems in the ammonium nitrate taking up moisture and reaction between the two materials with release of ammonia.

The problems encountered with 33-0-0 in the mixture were avoided by use of 30-10-0 in 1958. However there is still the need for mixing which most operators would like to avoid. They would prefer to have a 1:1:0 grade that does not require mixing.

In areas of the state where more than 35 pounds of nitrogen is recommended for small grains on nonfallow a broadcast application of part of the nitrogen is recommended. Germination and stand injury has been obtained with 40 or more pounds of nitrogen placed in the row with the seed.

For this situation a straight nitrogen fertilizer is needed for broadcast application in the fall or spring before seeding. At seeding time the balance of the nitrogen plus the phosphate needs are applied in the row by drill attachment. A 1:4:0 ratio material is usually used for this spring application. Four of our test-demonstration cooperators made such split application of materials for small grains in 1958. They broadcast 30-10-0 as their nitrogen application separate from seeding and applied 20-52-0 by drill attachment at seeding time.

Both of these materials worked very well and were liked by nearly all cooperators. The 30-10-0 was preferred over ammonium nitrate (used the year before) because of its granulated form and less tendency to sbsorb moisture. One cooperator received a few sacks of 30-10-0 that contained lumps of crushed stone (RR ballast?) that caused trouble in his spreader. The 20-52-0 feeds through the drill attachments very well. There were a few who found that it kept running through when the drill was stopped if the tractor was left running but soon learned how to overcome this minor difficulty. Some have reported trouble on windy days with 20-52-0 blowing out of tops of the seed and fertilizer tubes. They feel there would be less trouble from this if the material was granulated or pelleted.

FARMER APPRAISAL OF TVA FERTILIZER MATERIALS USED IN 1958

	0-63-0	0-54-0	20-52-0	30-10-0
Number of Users	3	20	25	23
Tonnage Used	11.24	77.2	101.68	91.6
Condition of Fertilizer When Received				
Satisfactory	3	0	25	23
Unsatisfactory	0	20	0	0
Length of Storage on Farm				
One month or less	1	13	16	17
Over one month	2	7	9	6
Condition of Fertilizer When Applied				
Satisfactory	3	0	25	23
Unsatisfactory	0	20	0	0
Spreading Characteristics				
Satisfactory	3	0	25	23
Unsatisfactory	0	20	0	0
Spreading Equipment Used				
Grain drill attachment	0	17	25	18
Broadcast spreader	3	3	0	5
Planter attachment	0	0	8	2
Fertilizer Effect on Crop Yield				
Row crops				
Good	2	0	2	2
Fair	0	0	2	0
Poor	1	0	4	1
Small grains				
Good	1	11	15	16
Fair	0	7	9	8
Poor	0	2	1	2
Don't know	0	2	1	0
What Do You Like About the Fertilizer?				
High analysis	3	7	12	1
Easy to spread	2	0	7	5
Didn't take up moisture	0	0	0	4
Granular form	0	0	0	13
What Don't You Like About the Fertilizer?				
Lumpiness	0	18	0	1
Powder form	0	15	8	0
Unable to make it feed	0	14	0	0
Takes up moisture	0	0	0	11
Flows too freely	0	0	2	0

FARMER APPRAISAL OF TVA FERTILIZER MATERIALS USED IN 1958 (Continued)

	0-63-0	0-54-0	20-52-0	30-10-0
Quality of Bags				
Satisfactory	3	0	25	23
Unsatisfactory	0	20	0	0
Bag Size Preferred				
50 pound	0	4	4	3
80 pound	2	15	19	13
100 pound	1	1	2	2

USES MADE OF TEST-DEMONSTRATION FARMS

A study of the effects of recommended fertilizer treatments on over-all farm income is one of the chief objectives of the test-demonstration program in North Dakota. Check strips and yield results obtained from them are used also to demonstrate the effects of recommended fertilizer treatments on individual fields and crops.

Test-demonstration cooperators report many farmers visit their fields with check strips and discuss them with the cooperators. County Extension Agents include test-demonstration farms as stops in county farm tours. Recommended fertilizer treatments are discussed at check strip sites on the test-demonstration farms. County Agents give publicity to the treatments and yield results obtained by cooperators through news stories, television and radio programs.

Following are listed types and numbers of fertilizer check strip demonstrations on the test-demonstration farms in 1958.

Kind of Fertilizer Demonstration	Number of Demonstrations
Small grain sown on fallow	71
Small grain sown on nonfallow	78
Corn	4
Alfalfa	2
Sugar beets	2
Number of people who visited fertilizer check strips (Including tour groups and individual visits)	800
Number of tour groups who saw fertilizer check strips	6
Number of news articles mentioning one or more of these demonstrations	40
Number of radio and TV programs in which reference was made to test-demonstrations	32

Yield results from test-demonstration farms are used also in numerous county and state-wide Extension Service fertilizer meetings.

Fertilizer treatments and yield responses on individual fields are listed by by counties and cooperators on the following pages.

1958 Fertilizer Results on T.V.A. Test-Demonstration Farms

	Field#	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield bu/Acre Fert	Check	Difference
Lyle Guscette	29-1	Fallow	Wheat	VL	0+27+0	53.0	49.0	4.
Lyle Guscette	21-2	Wheat	Barley	VL	25+31+0 [1]	58.0	43.7	14.3
Lyle Guscette	28-1	Flax	Barley	L	26+27+0	86.8	72.3	14.5
Lyle Guscette	24-3	Alfalfa	Barley	VL	0+65+0 [2]	64.7	55.7	9.0
Lyle Guscette	29-2	Wheat	Barley	M	27+23+0	59.5	51.0	8.5
Lyle Guscette	21-2	Wheat	Oats	VL	25+31+0	132.5	101.5	31.0
Lyle Guscette	21-3	Alfalfa	Corn	VL	16+42+0	26.9	20.1	6.8
Lyle Guscette	24-1	Barley	Corn	VL	46+84+0	No Difference [3]		
Ray Stangler	8	Fallow	Wheat	L	0+24+0	54.0	49.3	4.7
Ray Stangler	6	Wheat	Wheat	L	25+31+0	36.0	25.3	10.7
Ray Stangler	5	Barley	Wheat	VL	25+31+0	38.4	27.3	11.1
Ray Stangler	7	Corn	Barley	H-M	25+31+0	50.8	25.0	25.8
Ray Stangler	10	Oats	Barley	L	25+31+0	38.8	29.3	9.5
Ray Stangler	14	Flax	Oats	M	26+27+0	87.5	78.2	9.3
Ray Stangler	9	Flax	Corn		12+31+0			-3.5
Ray Stangler	12	Flax	Alfalfa		0+81+0 [4]			
Riedman Brothers	5	Flax	Wheat	M	25+31+0	26.9	21.5	5.4
Riedman Brothers	9	Barley	Wheat	VL	25+31+0	44.2	33.6	10.6
Riedman Brothers	12	Barley	Wheat	M	25+31+0	47.3	40.0	7.3
Riedman Brothers	3	Corn	Barley	M-VL	25+31+0	51.6	23.3	28.3
Riedman Brothers	10	Corn	Barley	L-M	25+31+0	67.5	63.0	4.5
Riedman Brothers	15	Barley	Barley	L	25+31+0	46.6	33.3	13.3
Riedman Brothers	18	Fallow	Barley	VL	0+23+0	62.5	57.0	5.5
Riedman Brothers	19	Oats	Barley	VL	13+16+0	27.8	22.2	5.6

[1] This field was plowed up and reseeded. All of the fertilizer (25+31+0) was applied at the time of the first seeding.

[2] The phospate was broadcast on this field due to mechanical problems.

[3] This corn was harvested with the combine. The samples were not weighed, but check strips were combined separately and the amount of corn was marked in the combine hopper. No difference in yield was noted.

[4] 150 pounds of 0-54-0 was applied after the first cutting of hay.

RAMSEY COUNTY

1958 FERTILIZER RESULTS ON T.V.A. TEST-DEMONSTRATION FARMS

	Field No.	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield Bu/Acre Fert.	Check	Difference
E. B. Calderwood	5	Durum	Barley		28+32+0	51.3	34.3	17.0
E. B. Calderwood	16	Wheat	Barley		14+36+0	50.7	35.5	15.2
E. B. Calderwood	12	Wheat	Durum		28+32+0	36.5	32.4	4.1
E. B. Calderwood	8	Corn	Wheat		28+32+0	29.2	25.5	3.7
Willis Calderwood	4	Durum	Durum		28+32+0	32.0	25.9	6.1
Willis Calderwood	6	Wht & Barley	Barley		28+32+0	53.8	34.2	19.6
Willis Calderwood	1	Fallow	Wheat		0+27+0	35.3	33.6	1.7
L. B. Currie	4	Fallow	Wheat	VL-L	0+30+0	46.7	34.7	12.0
L. B. Currie	3	Fallow	Wheat	M	0+22+0	45.3	42.6	2.7
Orville Larson	10	Durum	Barley	VL-VL	22+30+0	49.7	38.7	11.0
Orville Larson	3	Barley	Barley	M-VL	30+26+0	42.0	33.7	8.3
Orville Larson	9	Durum	Barley	VL-VL	5+16+0	38.0	33.8	4.2
Orville Larson	13	Flax	Barley	L-L	25+38+0	38.3	36.1	2.2
Orville Larson	14	Flax	Barley	VL-VL	25+38+0	41.5	33.5	8.0
Orville Larson	7	Wheat	Wheat	M-VL	24+26+0	40.5	35.2	5.3
Orville Larson	4	Durum	Durum		32+40+0	54.7	50.4	4.3
Orville Larson	12	Fallow	Durum	M-M M-H	0+19+0	48.0	48.0	0
Lawrence Stensland	2	Durum	Barley		25+22+0	65.8	35.8	30.0
Lawrence Stensland	4	Alfalfa	Durum		0+24+0	41.6	41.6	0
Lawrence Stensland	10	Wheat	Durum	VL	24+35+0	36.8	32.3	4.5
Lawrence Stensland	14	Fallow	Durum	M	7+18+0	36.0	36.7	-0.7
Lawrence Stensland	14	Fallow	Wheat	M	7+18+0	43.9	43.9	0.
LeRoy Stensland	2	Wheat	Durum		12+31+0	27.1	21.6	5.5
LeRoy Stensland	6	Fallow	Durum		7+18+0	56.8	52.0	4.8
LeRoy Stensland	8	Wheat	Barley		12+31+0	61.0	48.2	12.8
LeRoy Stensland	9	Fallow	Barley		7+18+0	65.2	56.7	8.5

MORTON COUNTY

1958 FERTILIZER RESULTS ON TVA TEST-DEMONSTRATION FARMS

	Field No.	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield-Bu./ Acre Fert.	Check	Difference
Alfred Underdahl	3	Fallow	Wheat		0+35+0	32.0	27.7	4.3
Alfred Underdahl	9	Fallow	Wheat	VL	0+35+0	20.0	18.0	2.0
Alfred Underdahl	14	Fallow	Wheat	VL	0+35+0	39.6	37.3	2.3
Alfred Underdahl	28	Fallow	Wheat		0+27+0	40.3	34.9	5.4
Alfred Underdahl	12	Grass	Barley	VL	13+34+0	38.3	33.3	5.0
Ole Wang	2	Fallow	Wheat	VL	0+32+0	30.5	27.0	3.5
Ole Wang	3	Fallow	Wheat	VL	0+32+0	43.3	39.7	3.6
Ole Wang	11	Fallow	Wheat	VL	0+32+0	29.9	29.3	.6
Ole Wang	14	Corn	Wheat	VL	22+30+0	31.2	23.5	7.7
Ole Wang	16	Fallow	Wheat	L	0+32+0	30.8	28.5	2.3
Ole Wang	19	Fallow	Wheat	VL	0+32+0	35.2	29.9	5.3
Ole Wang	22	Wheat	Wheat	VL	22+30+0	15.9	10.8	5.1
Ole Wang	23	Fallow	Wheat	VL	0+32+0	40.0	36.4	3.6
Ole Wang	41	Fallow	Wheat		10+26+0	36.0	31.2	4.8
Erich Wilkins	27	Fallow	Wheat		10+26+0	27.7	21.6	6.1
Erich Wilkins	22	Wheat	Wheat		23+26+0	25.8	23.5	2.3
Erich Wilkins	23	Oats	Wheat		23+26+0	16.6	15.5	1.1
Erich Wilkins	2	Corn	Wheat		23+26+0	30.1	26.0	4.1
Erich Wilkins	2	Corn	Wheat		23+26+0	28.9	26.0	2.9
Sig Peterson	6	Fallow	Wheat		0+27+0	22.7	18.7	4.0
Sig Peterson	9	Fallow	Wheat		0+27+0	20.0	18.3	1.7
Sig Peterson	10	Fallow	Wheat		10+26+0	21.2	15.1	6.1
Sig Peterson	15	Fallow	Wheat		0+27+0	15.6	12.0	3.6
Sig Peterson	18	Fallow	Wheat		0+27+0	37.3	30.8	6.5
Sig Peterson	3	Corn	Wheat		23+26+0	27.3	20.8	6.5
Sig Peterson	3	Corn	Wheat		18+18+0	26.0	20.8	5.2
Sig Peterson	3	Corn	Wheat		16+41+0	22.0	20.8	1.2
Sig Peterson	3	Corn	Wheat		0+27+0	18.7	20.8	-2.2

STARK COUNTY

1958 FERTILIZER RESULTS ON TVA TEST-DEMONSTRATION FARMS

	Field No.	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield bu/acre Fert.	Check	Difference
Matt Dassinger	43	Fallow	Wheat		10+26+0	28.3	26.8	1.5
Matt Dassinger	7	Fallow	Wheat		8+32+0	36.3	33.3	3.0
Matt Dassinger	54	Corn	Oats		23+25+0	65.0	60.0	5.0
Matt Dassinger	65	Corn	Oats		16+41+0	63.8	62.5	1.3
Matt Dassinger	27	Corn	Speltz		23+26+0	25.2	22.2	3.0
Joseph Link	24	Corn	Wheat		25+31+0	29.6	24.7	4.9
Joseph Link	17	Fallow	Wheat	VL	0+25+0	38.0	33.3	4.7
Joseph Link	17	Fallow	Wheat	VL	0+35+0	39.6	33.3	6.3
Joseph Link	18	Oats	Oats		25+31+0	64.5	42.8	21.7
Joseph Link	9	Fallow	Wheat	VL	0+25+0	36.7	22.0	14.7
Joseph Link	2	Corn	Barley	VL	25+31+0	58.5	47.5	11.0
Joseph Link	31	Oats & Barley	Barley		25+31+0	41.2	33.3	7.9
John Peters	15	Fallow	Wheat		9+21+0	30.0	28.2	1.8
John Peters	20	Corn	Oats		23+26+0	48.0	36.0	12.0
John Peters	33	Corn	Wheat		23+26+0	34.0	30.5	3.5
Clarence and Daniel Wehlers	12	Corn	Wheat		27+36+0	32.7	25.5	7.2
	18	Corn	Wheat		27+36+0	36.0	32.7	3.3
Clarence and Daniel Wehlers	6	Corn	Wheat		27+36+0	31.5	24.9	6.6
	5	Fallow	Wheat	VL	12+31+0	37.7	30.1	7.6
Clarence and Daniel Wehlers	18	Corn	Oats		27+36+0	54.6	36.7	17.9
	17	Rye	Corn		16+42+0	5.15 T.	4.77 T.	0.38 T.
Richard Dohrmann	33	Corn	Wheat		23+26+0	18.7	16.0	2.7
Richard Dohrmann	34	Wheat	Wheat		23+26+0	25.3	16.8	8.5
Richard Dohrmann	36	Corn	Barley		23+26+0	33.7	32.0	1.7
Richard Dohrmann	37	Corn	Wheat		23+26+0	31.3	24.7	6.7
Richard Dohrmann	2	Fallow	Wheat		0+27+0	33.9	25.6	8.3
Richard Dohrmann	14	Barley	Wheat		23+26+0	22.3	21.9	.4

MC LEAN COUNTY

1958 FERTILIZER RESULTS ON T.V.A. TEST-DEMONSTRATION

	Field No.	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield - Bu./acre Fert.	Check	Difference
M. C. Bjornholt	11-A	Fallow	Wheat	V.L.	0+32+0	36.	25.2	10.8
M. C. Bjornholt	13-C	Fallow	Wheat	V.L.	0+32+0	40.9	34.6	6.3
M. C. Bjornholt	6-B	Fallow	Wheat	V.L.	0+32+0	32.9	22.4	10.5
M. C. Bjornholt	6-D	Fallow	Wheat	V.L.	0+32+0	35.5	29.7	5.8
M. C. Bjornholt	1-L	Fallow	Wheat	M	0+19+0	37.6	38.7	- 1.1
M. C. Bjornholt	1-H	Fallow	Wheat	V.L.	0+32+0	44.7	39.3	5.4
M. C. Bjornholt	1-B	Fallow	Wheat	V.L.	0+32+0	42.8	36.4	6.4
M. C. Bjornholt	7-D	Corn	Durum	M.	21+20+0	28.5	28.0	.5
M. C. Bjornholt	7-J	Corn	Durum	M.	21+20+0	25.1	22.1	3.0
M. C. Bjornholt	11-A	Fallow	Barley	V.L.	0+32+0	53.5	49.0	4.5
Alfred Cole	7	Wheat	Barley		23+26+0	49.3	51.2	-1.9
Alfred Cole	12	Fallow	Wheat		0+27+0	35.3	33.6	1.7
Alfred Cole	29	Fallow	Wheat		0+27+0	33.9	32.9	1.0
Alfred Cole	30	Wheat	Barley		23+26+0	40.2	44.1	-3.9
Alfred Cole	35	Fallow	Wheat		0+27+0	35.9	32.3	3.6
Alfred Cole	36	Wheat	Barley		23+26+0	33.5	27.5	6.0
Denver Rosberg	4-D	Rye	Wheat		25+35+0	23.7	19.5	4.2
Denver Rosberg	16-A	Fallow	Wheat		0+35+0	43.2	30.4	12.8
Denver Rosberg	16-D	Wheat	Wheat		25+35+0	23.5	20.9	2.6
Denver Rosberg	21-G	Fallow	Wheat		0+35+0	40.9	32.4	8.5
Denver Rosberg	30-G	Rye	Barley		27+36+0	40.0	30.3	9.7
Denver Rosberg	29-C	Flax	Barley		27+36+0	62.8	46.7	16.1
Norlan Rue	1-B	Fallow	Durum		0+27+0	26.5	18.8	7.7
Norlan Rue	1-E	Fallow	Durum		0+27+0	24.4	19.6	4.8
Norlan Rue	1-F	Durum	Barley		23+26+0	23.3	13.8	9.5
Norlan Rue	6-B	Fallow	Wheat		0+27+0	25.5	17.7	7.8
Norlan Rue	14	Fallow	Wheat		0+27+0	24.3	23.1	1.2
Norlan Rue	15-A	Durum	Barley		23+26+0	37.3	29.5	7.8
Norlan Rue	15-C	Fallow	Durum		0+27+0	37.7	30.4	7.3
Norlan Rue	16-C	Fallow	Wheat		0+27+0	29.6	21.5	8.1
Karl Vangsness	8	Fallow	Barley		0+27+0	56.	52.	4.
Karl Vangsness	28	Fallow	Wheat		0+27+0	29.9	26.8	3.1
Karl Vangsness	21	Fallow	Wheat		0+27+0	32.8	29.1	3.7
Karl Vangsness	19	Fallow	Wheat		0+27+0	42.8	41.5	1.3

WILLIAMS COUNTY

1958 FERTILIZER RESULTS ON T.V.A. TEST-DEMONSTRATION FARMS

	Field No.	1957 Crop	1958 Crop	Soils Test	Fertilizer Treatment	Yield Bu./acre Fert.	Check	Difference
Ardean Aafedt		(Hailed Out)						
Zapara Brothers	1	Fallow	Wheat	VL	6+23+0	26.0	20.7	5.3
Zapara Brothers	1	Fallow	Wheat	VL	5+18+0	21.2	20.7	.5
Zapara Brothers	3	Fallow	Wheat	H	8+29+0	24.8	19.6	5.2
Zapara Brothers	3	Fallow	Wheat	H	5+18+0	24.0	19.6	4.4
Zapara Brothers	8	Fallow	Wheat	VL	7+25+0	23.2	24.1	- .9
Zapara Brothers	12	Fallow	Wheat	L	7+25+0	22.9	20.9	2.0
Zapara Brothers	12	Fallow	Wheat	L	3+12+0	22.7	20.9	1.7
Zapara Brothers	15	Fallow	Wheat	VL-L	6+24+0	24.5	19.6	4.9
Zapara Brothers	20	Fallow	Wheat	VL	6+21+0	14.9	15.1	- .2
Zapara Brothers	23	Fallow	Wheat	VL	7+27+0	18.3	14.7	3.6
Zapara Brothers	23	Fallow	Wheat	VL	5+20+0	21.2	14.7	6.5
Zapara Brothers	26	Fallow	Wheat	L	7+27+0	20.4	17.2	3.2
Zapara Brothers	26	Fallow	Wheat	L	4+17+0	18.8	17.2	1.6
Irrigated Fields								
Paul Motzko	2	Corn	Wheat		14+36+0	43.8	42.9	0.9
Paul Motzko	4	Sgr.Bts	Durum		16+42+0	65.4	56.5	8.9
Paul Motzko	4	Sgr.Bts	Durum		24+62+0	70.4	56.5	13.9
Paul Motzko	10	Durum	W.Wheat		26+38+0	51.3	41.3	10.0
Raymond Russell	1	Sgr.Bts	Durum	VL	20+27+0	73.1	65.2	7.9
Raymond Russell	6	Sgr.Bts	Durum	M	20+27+0	68.6	57.9	10.7
Zapara Brothers	30	Wheat	Wheat		33+0+0	38.5	28.0	10.5
Paul Motzko			Sgr.Bts			19.97 T.	15.83T	4.14T.