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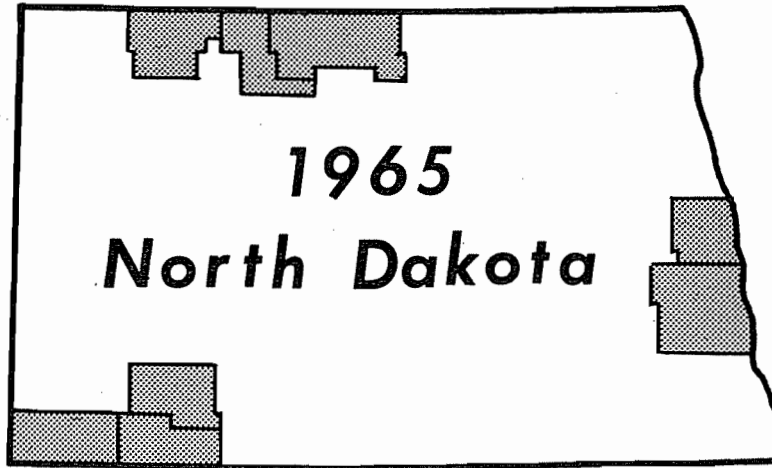
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TVA Fertilizer Test-Demonstration Program

DEPARTMENT OF AGRICULTURAL ECONOMICS
AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA STATE UNIVERSITY
OF AGRICULTURE AND APPLIED SCIENCE
FARGO, NORTH DAKOTA

FOREWORD

This publication is the ninth annual report of fertilizer test-demonstration work in North Dakota. This work has been made possible by cooperation of the Tennessee Valley Authority. They provide a grant to the North Dakota Agricultural Experiment Station to help support this work and also to make experimental fertilizer materials available at a reduced price for educational and demonstrational work. Names and addresses of farm cooperators in this project during 1965 are shown below.

<u>Cooperator</u>	<u>Address</u>	<u>Cooperator</u>	<u>Address</u>
Anderson Brothers	Hillsboro	Kermit Kjonaas	Maxbass
Daryl Anderson	Reeder	J. P. Lorenzen	Mohall
Howard Anderson	Willow City	Earl Nelson	Gascoyne
Harold Bergman	Bottineau	C. L. O'Keeffe	Lansford
Harry Benshoof	Flaxton	George Ott	Reeder
Donald Brown	Scranton	Ralph Peterson	Harwood
Floyd Bryan, Jr.	Bowbells	Randolph Brothers	Lansford
Henry Busch	Portal	Lorry Rotvold	Halstad, Minn.
Morten Clausen	Norma	Marce Schaefer	Glenburn
Gene Davison	Haynes	Henry Schlichtmann	Hillsboro
Leo DeWit	Regent	Delmer Schulz	Davenport
Alvin Dill	Regent	Donald Schumacher	Scranton
Fred Ehlers	Hettinger	Walter Stzegura	Gascoyne
Arnold Funk	Bowbells	Lawrence Thomas	Reeder
Art Grove	Hillsboro	Dave Witteman	Mohall
Orlin Gunderson	Buxton	George Witteman Co.	Mohall
Roy Kern	Scranton	Raymond Wothe	Reeder

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THE TVA FERTILIZER TEST-DEMONSTRATION PROGRAM
IN NORTH DAKOTA FOR 1965

L. W. Schaffner¹ and Virgil Weiser²

Introduction

The Tennessee Valley Authority and the North Dakota State University of Agriculture and Applied Science cooperate in conducting a fertilizer 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 farmers' acceptance of these fertilizer materials.
3. To demonstrate and test the effects of recommended fertilizer treatments on individual crop yields and overall farm income.
4. To promote agricultural development in North Dakota through improved use of fertilizer in combination with other recommended farming practices.

The North Dakota Agricultural Experiment Station and the North Dakota Extension Service cooperate in conducting and demonstrating this program within the state. The Department of Agricultural Economics was responsible for the development and conduct of the program and for the analysis of the results. The Cooperative Extension Service provided the soils agent who developed the crop and fertilizer plans on each of the cooperating farms, ordered the fertilizer materials, supervised the fertilizer application, and helped in obtaining fertilizer yield results. County agents in the counties cooperating in the program selected the farmers to cooperate in the program and helped in carrying out the program within their respective counties. The Tennessee Valley Authority furnished the fertilizer materials used in the program and provided funds to cover some of the costs of the program.

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Four-Year Summary

An average of 38 farmers cooperated in the farm test-demonstration program for the past four years, 1962-1965. The number of farmers ranged from 34 to 41. Seventy-nine per cent of the farmers cooperated in the program throughout this period. Location of the counties and farms which were in the program in 1965 is shown in Figure 1.

Three factors must be considered when analyzing the profitability of fertilizer use. These factors include:

1. The yield response to fertilizer.
2. Cost of the fertilizer.
3. Price or value of the crop produced.

Yield Response

Knowledge of the yield response to fertilizer is important to farmers as well as individuals working in the fertilizer industry. The yield response data are necessary to calculate the profitability of fertilizer use. Table 1 shows the average pounds of fertilizer used and the average bushel increase in yield by crops and cropping systems for three areas of the state for the four-year period, 1962-1965. When 1965 prices were used, the average yield increases were large enough to more than cover the cost of fertilizer in all cases except four. Barley on fallow in the North Central area and durum on fallow using a nitrogen and phosphate fertilizer and durum on nonfallow in the Valley area gave a negative return to the investment in fertilizer.

The data in Table 1 indicate that, in come cases, a straight phosphate fertilizer on fallow land would be more profitable than a nitrogen and phosphate fertilizer. This was true in six of the eight situations in Table 1 where this analysis was made.

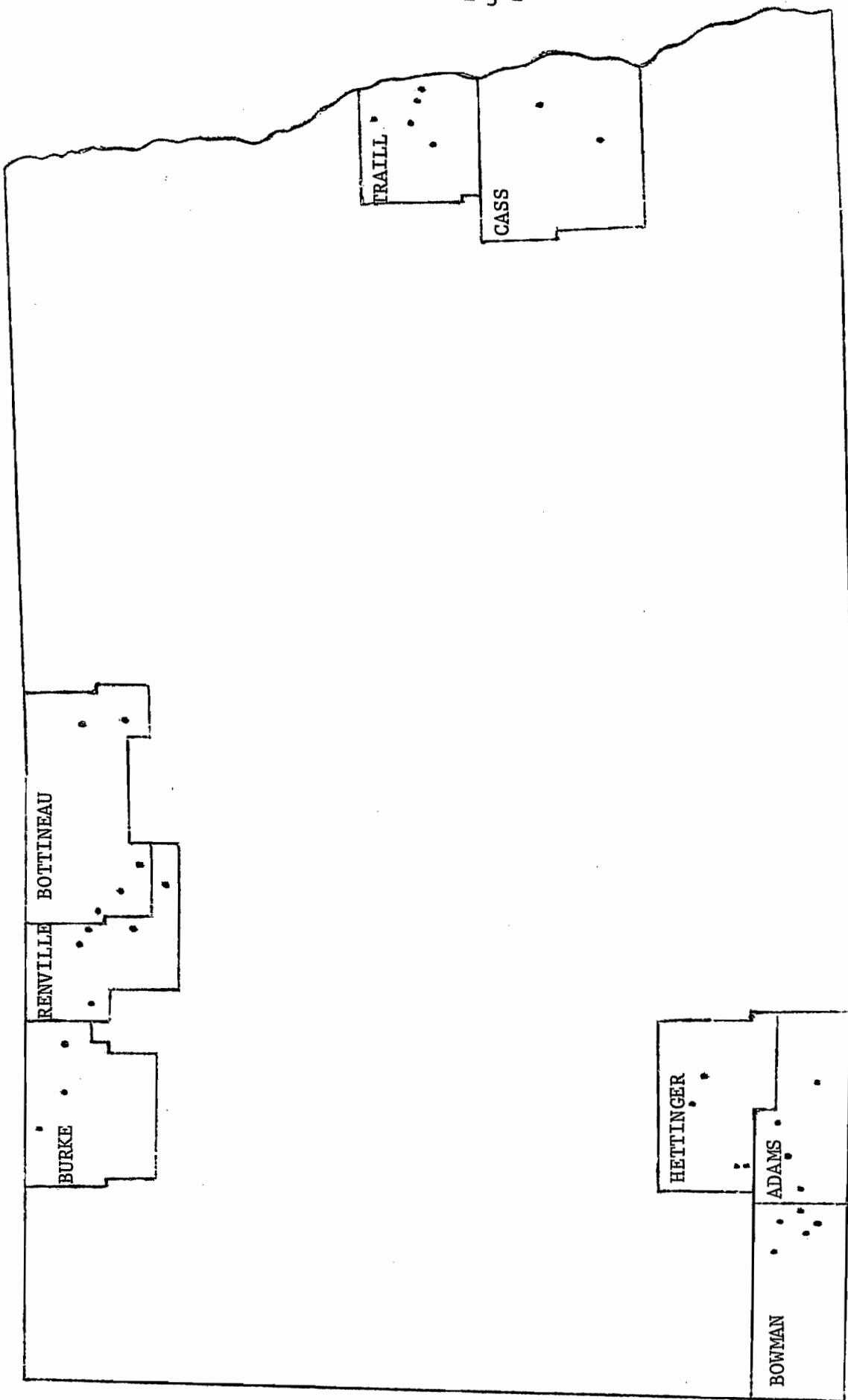


Figure 1. Location of Test-Demonstration Farms, by Counties, 1965.

TABLE 1. AVERAGE BUSHEL INCREASE PER ACRE FROM FERTILIZER FOR HRS WHEAT, DURUM, AND BARLEY, BY CROPPING PRACTICES AND BY AREAS, FOR THE FOUR-YEAR PERIOD, 1962-1965

Crop and Cropping Practice	Number of Fields	Average Fertilizer Treatment ^a	Yield Increase in Bushels
<u>Southwest Area^b</u>			
HRS Wheat			
Fallow	89	0+26+0	3.9
Fallow	66	10+25+0	4.1
Nonfallow	73	11+25+0	3.3
Durum			
Fallow	3	0+21+0	2.1
Fallow	15	8+21+0	4.0
Barley			
Fallow	7	0+26+0	7.5
Fallow	9	9+22+0	6.7
Nonfallow	30	10+23+0	7.3
<u>North Central Area^c</u>			
HRS Wheat			
Fallow	67	0+24+0	2.2
Fallow	36	8+18+0	2.6
Durum			
Fallow	56	0+22+0	2.8
Fallow	42	8+20+0	3.6
Barley			
Fallow	17	0+24+0	2.3
Fallow	7	9+24+0	2.6
Nonfallow	36	9+18+0	3.9
<u>Valley Area^d</u>			
HRS Wheat			
Fallow	2	0+28+0	2.2
Fallow	21	13+29+0	4.4
Nonfallow	19	36+25+0	6.0
Durum			
Fallow	2	0+30+0	4.4
Fallow	8	10+26+0	3.1
Nonfallow	39	26+19+0	4.3
Barley			
Nonfallow	81	29+23+0	6.8

^aAverage pounds of available nutrient. These are averages of all trials which involve several different fertilizer analyses.

^bIncludes Adams, Bowman, and Hettinger counties.

^cIncludes Bottineau, Burke, and Renville counties.

^dIncludes Cass and Traill counties.

The percentage distribution of yield responses as a result of fertilizer by four yield response groups is shown in Table 2. The number of yield comparisons for the various crops was relatively small, so a breakdown into smaller response groups was not possible.

Data in Table 2 show that in southwestern North Dakota 32 per cent of the fields of wheat on fallow land and 39 per cent of the fields of wheat on nonfallow land had yield responses of less than 2.5 bushels. The modal group was 2.5 to 4.9 bushels for both of these groups.

Table 2 shows that for the North Central area a higher proportion of the yield increases fell in the 2.4 bushel or less category. Sixty per cent of the HRS wheat trials that were on fallow land and 49 per cent of the durum trials on fallow land had yield increases of 2.4 bushels or less. One reason for a larger percentage of the yield increases falling into the low category was a higher proportion of the soils which tested medium and high in phosphate. The yield responses to fertilizer are not as great on these soils. Fifty-eight per cent of the barley trials on fallow land and 47 per cent of the barley trials on nonfallow land did not produce yield increases great enough to cover the fertilizer costs.

Heavier rates of fertilizer were used in the Valley area, and higher yield responses are necessary to cover the fertilizer cost. Forty-eight per cent of the barley trials on nonfallow land gave a yield response of 7.5 bushels or more. Forty-seven per cent of the durum trials on nonfallow land gave a yield response of 5.0 bushels or more (Table 2).

Cost of Fertilizer

The cost used for fertilizer in each of the four years of the study was 14 cents per pound of nitrogen and 10 cents per pound of phosphate. These costs

TABLE 2. PERCENTAGE DISTRIBUTION OF YIELD RESPONSES, BY CROPS AND BY AREAS, 1962-1965

Yield Increase in Bushels/Acre	Crop by Cropping Practice					
	Wheat- Fallow	Wheat- Nonfallow	Durum- Fallow	Durum- Nonfallow	Barley- Fallow	Barley- Nonfallow
<u>Southwest Area</u>						
Less than 2.4	32.0	38.9				
2.5 - 4.9	38.0	40.3				
5.0 - 7.4	19.3	11.1				
7.5 and over	<u>10.7</u>	<u>9.7</u>				
	100.0	100.0				
<u>North Central Area</u>						
Less than 2.4	61.1		48.5		46.2	35.3
2.5 - 4.9	24.3		22.2		26.9	26.5
5.0 - 7.4	10.7		16.2		19.2	8.8
7.5 and over	<u>3.9</u>		<u>13.1</u>		<u>7.7</u>	<u>29.4</u>
	100.0		100.0		100.0	100.0
<u>Valley Area</u>						
Less than 2.4			40.6			31.2
2.5 - 4.9			12.5			11.7
5.0 - 7.4			18.8			9.1
7.5 and over			<u>28.1</u>			<u>48.0</u>
			100.0			100.0

were calculated to include the cost of the fertilizer materials as well as a charge for the extra time in handling the fertilizer and for repair and depreciation of the fertilizer attachment.

Product Prices

One of the factors affecting the profitability of fertilizer is the price received for the product. The prices used for most of the crops in the analysis of fertilizer responses on the TVA test-demonstration farms are the mid-October prices. Table 3 shows the prices used in each of the four years for the main crops. Since 1962 durum and HRS wheat prices have declined, while barley prices have increased. Between 1963 and 1965 durum and HRS wheat prices fell by 39 and 29 per cent, respectively. With this trend in prices received for these commodities, the profits would have been lower even if the cost of the fertilizer treatment and the yield increases remained the same as in 1963.

TABLE 3. AVERAGE MID-OCTOBER CASH GRAIN PRICES FOR NORTH DAKOTA FOR THE YEARS 1962-1965

Crop	Year			
	1962	1963	1964	1965
	(price per bushel)			
Durum	\$2.23	\$2.09	\$1.36	\$1.28
HRS Wheat	2.10	2.03	1.45	1.44
Barley	.78	.77	.83	.94
Oats	.49	.49	.50	.48
Corn	.95	.97	.98	1.02

SOURCE: U. S. Department of Agriculture, Statistical Reporting Service.

Returns to Fertilizer

The average annual per cent return to fertilizer for all test-demonstration farms during the four years was 62 per cent (Table 4). For each dollar invested in fertilizer an average return of \$1.62 was realized. This

annual per cent profit to fertilizer ranged from 40 to 117 per cent during the four-year period. Table 4 shows the per cent return for each dollar invested in fertilizer for all crops on test-demonstration farms in North Dakota. The returns to fertilizer increased from east to west across the state. In general the moisture conditions were favorable for small grains, except in 1962 when the Valley area had excess precipitation. In 1965 some of the areas were delayed in seeding because of the cool wet spring, and harvest was delayed as much as six weeks because of wet weather.

TABLE 4. AVERAGE PROFITABILITY OF FERTILIZER FOR ALL CROPS ON TVA TEST-DEMONSTRATION FARMS IN NORTH DAKOTA, BY AREAS OF THE STATE, 1962-1965

Year	Area			State
	Southwest	North Central	Valley	
	(per cent profit)			
1962	300	114	22	117
1963	82	37	- 6	40
1964	67	57	35	49
1965	50	45	38	43
4-Year Ave.	125	63	22	62

Table 4 shows that there was a variation in returns to fertilizer over the four-year period in each of the areas. There was also a wide variation between fields on the same farm in the same year. For example, the range in returns to fertilizer for wheat grown on fallow land on one farm in Bowman County in 1965 ranged from a minus 20 per cent to a plus 212 per cent. On another farm in the same county the range was a minus 77 per cent to a plus 140 per cent return to fertilizer for wheat grown on fallow land. The cause of the wide variation in yield response to fertilizer on a farm is hard to explain. Some of it may be due to the time of planting, stage of growth when days of high temperature occur, soil type, and maybe difference in tillage practices and weed control.

Table 5 shows selected fertilizer data for three crops by cropping practices for the four-year period, 1962-1965. On the average, the crops grown on fertilized fallow land gave a higher return per dollar invested in fertilizer than the crops grown on fertilized nonfallow land. The average yield increases were greater on nonfallow land, but the cost of the extra nitrogen more than offset the gain in the yield increase.

Durum gave the highest return of the three crops compared in Table 5 on fallow land, and HRS wheat gave the highest return on nonfallow land. The per cent profit for the various crops has varied in the four years, 1962-1965. Table 5 indicates that durum and HRS wheat on fallow land consistently returned a profit. Wheat and durum yields during this four-year period showed less variation than barley yields (Table 5). The yields of wheat and durum are generally less affected by climatic conditions than barley.

The four-year summary of average fertilizer treatment, average yield increase, and per cent profit for the Southwest, North Central, and Valley areas is shown in Tables 6, 7, and 8, respectively. Returns to fertilizer investment were greater in all three areas for crops grown on fallow land than for crops grown on nonfallow land. Negative returns to fertilizer investment were more prevalent in the crops grown on nonfallow land. Some factors which may contribute to a higher proportion of low returns to fertilizer on nonfallow land are:

1. Fertilizer investment is higher on nonfallow land to supply adequate nitrogen. A greater crop yield increase is needed to break even with the fertilizer investment.
2. There is less stored moisture on nonfallow land. Crops are more often subjected to moisture stress resulting in reduced yield response to fertilizer.
3. While stored soil moisture at seeding time has been found to be one of the best guides to profitable nitrogen rates, determining field treatments in January, in administering this program, does not allow for the best use of this guide in determining the nitrogen rates.

TABLE 5. SELECTED FERTILIZER DATA FOR NORTH DAKOTA,^a BY CROPS AND CROPPING PRACTICES, 1962-1965^b

		Year			
		1962	1963	1964	1965
<u>Crops on Fallow Land</u>					
Durum	Ave. Fertilizer Treatment	2+22+0	7+21+0	4+23+0	4+21+0
	Ave. Fert. Yield/Acre-bu.	45	35	36	40
	Ave. Yield Increase/Acre-bu.	4.4	2.7	3.1	3.6
	Per Cent Profit	292%	77%	45%	77%
HRS Wheat	Ave. Fertilizer Treatment	3+24+0	6+26+0	3+25+0	3+24+0
	Ave. Fert. Yield/Acre-bu.	35	28	27	28
	Ave. Yield Increase/Acre-bu.	3.1	3.3	3.1	3.7
	Per Cent Profit	142%	99%	56%	60%
Barley	Ave. Fertilizer Treatment	0+24+0	6+27+0	0+24+0	6+26+0
	Ave. Fert. Yield/Acre-bu.	73	44	56	55
	Ave. Yield Increase/Acre-bu.	2.7	3.3	2.9	5.6
	Per Cent Profit	-19%	-27%	1%	59%
<u>Crops on Nonfallow Land</u>					
Durum	Ave. Fertilizer Treatment	15+26+0	15+20+0	28+16+0	34+14+0
	Ave. Fert. Yield/Acre-bu.	37	31	34	39
	Ave. Yield Increase/Acre-bu.	8.1	.8	3.9	5.4
	Per Cent Profit	283%	-66%	-5%	12%
HRS Wheat	Ave. Fertilizer Treatment	19+24+0	23+28+0	18+19+0	20+24+0
	Ave. Fert. Yield/Acre-bu.	32	21	23	28
	Ave. Yield Increase/Acre-bu.	5.1	3.0	3.9	6.4
	Per Cent Profit	110%	-3%	30%	93%
Barley	Ave. Fertilizer Treatment	18+25+0	23+22+0	25+20+0	21+23+0
	Ave. Fert. Yield/Acre-bu.	45	46	53	56
	Ave. Yield Increase/Acre-bu.	5.5	6.0	9.3	6.1
	Per Cent Profit	-13%	-16%	40%	7%

^aIncludes Adams, Bowman, Hettinger, Burke, Renville, Bottineau, Cass, and Traill counties.

^bPrice assumptions are those included in Table 3. Cost assumptions are 14 cents per pound for nitrogen and 10 cents per pound for phosphate.

TABLE 6. SELECTED FERTILIZER DATA FOR THE SOUTHWEST AREA,^a BY CROPS AND CROPPING PRACTICE, 1962-1965^b

		Year			
		1962	1963	1964	1965
<u>Crops on Fallow Land</u>					
Durum	Ave. Fertilizer Treatment	7+21+0	8+20+0	6+23+0	None
	Ave. Fert. Yield/Acre-bu.	33	32	27	
	Ave. Yield Increase/Acre-bu.	4.3	4.8	2.3	
	Per Cent Profit	210%	220%	-1%	
HRS Wheat	Ave. Fertilizer Treatment	3+19+0	6+27+0	4+27+0	4+26+0
	Ave. Fert. Yield/Acre-bu.	30	27	20	19
	Ave. Yield Increase/Acre-bu.	4.7	4.6	3.5	3.1
	Per Cent Profit	329%	162%	55%	41%
Barley	Ave. Fertilizer Treatment	0+21+0 ^c	5+22+0	0+32+0 ^d	8+24+0
	Ave. Fert. Yield/Acre-bu.	47	45	53	41
	Ave. Yield Increase/Acre-bu.	6.7	3.2	17.5	7.8
	Per Cent Profit	149%	-12%	319%	118%
<u>Crops on Nonfallow Land</u>					
Durum	Ave. Fertilizer Treatment	8+21+0	None	None	None
	Ave. Fert. Yield/Acre-bu.	27			
	Ave. Yield Increase/Acre-bu.	5.7			
	Per Cent Profit	295%			
HRS Wheat	Ave. Fertilizer Treatment	8+22+0	14+30+0	9+16+0	9+24+0
	Ave. Fert. Yield/Acre-bu.	37	18	15	19
	Ave. Yield Increase/Acre-bu.	7.3	2.5	2.3	3.6
	Per Cent Profit	366%	0%	15%	39%
Barley	Ave. Fertilizer Treatment	8+21+0	16+29+0	9+23+0	6+25+0
	Ave. Fert. Yield/Acre-bu.	48	45	29	29
	Ave. Yield Increase/Acre-bu.	12.3	8.2	4.4	4.4
	Per Cent Profit	205%	21%	5%	18%

^aIncludes Adams, Bowman, and Hettinger counties.

^bPrice assumptions are those included in Table 3. Cost assumptions are 14 cents per pound for nitrogen and 10 cents per pound for phosphate.

^cOnly 10 acres checked.

^dOnly eight acres checked.

TABLE 7. SELECTED FERTILIZER DATA FOR THE NORTH CENTRAL AREA,^a BY CROPS AND CROPPING PRACTICE, 1962-1965^b

		Year			
		1962	1963	1964	1965
<u>Crops on Fallow Land</u>					
Durum	Ave. Fertilizer Treatment	1+21+0	6+21+0	3+22+0	4+21+0
	Ave. Fert. Yield/Acre-bu.	45	35	40	40
	Ave. Yield Increase/Acre-bu.	3.9	2.6	3.4	3.6
	Per Cent Profit	268%	85%	72%	77%
HRS Wheat	Ave. Fertilizer Treatment	2+25+0	3+21+0	2+22+0	2+21+0
	Ave. Fert. Yield/Acre-bu.	39	29	35	34
	Ave. Yield Increase/Acre-bu.	2.3	1.8	3.0	4.2
	Per Cent Profit	77%	51%	83%	87%
Barley	Ave. Fertilizer Treatment	2+23+0	4+25+0	0+20+0	0+27+0 ^c
	Ave. Fert. Yield/Acre-bu.	76	43	59	75
	Ave. Yield Increase/Acre-bu.	2.1	1.6	2.6	3.5
	Per Cent Profit	-37%	-59%	8%	22%
<u>Crops on Nonfallow Land</u>					
Durum	Ave. Fertilizer Treatment	None	13+12+0	11+11+0	11+15+0
	Ave. Fert. Yield/Acre-bu.		28	35	32
	Ave. Yield Increase/Acre-bu.		--	4.4	-1.5
	Per Cent Profit		-100%	121%	-162%
HRS Wheat	Ave. Fertilizer Treatment	0+26+0 ^c	None	None	9+22+0
	Ave. Fert. Yield/Acre-bu.	38			27
	Ave. Yield Increase/Acre-bu.	2.8			4.9
	Per Cent Profit	126%			104%
Barley	Ave. Fertilizer Treatment	9+22+0	13+16+0	10+21+0	5+20+0
	Ave. Fert. Yield/Acre-bu.	53	43	47	58
	Ave. Yield Increase/Acre-bu.	3.9	5.3	5.0	1.1
	Per Cent Profit	-9%	24%	15%	-62%

^aIncludes Burke, Renville, and Bottineau counties.

^bPrice assumptions are those included in Table 3. Cost assumptions are 14 cents per pound for nitrogen and 10 cents per pound for phosphate.

^cOnly one field checked.

TABLE 8. SELECTED FERTILIZER DATA FOR THE VALLEY AREA,^a BY CROPS AND CROPPING PRACTICE, 1962-1965^b

		Year			
		1962	1963	1964	1965
<u>Crops on Fallow Land</u>					
Durum	Ave. Fertilizer Treatment	4+26+0	9+23+0	9+31+0	None
	Ave. Fert. Yield/Acre-bu.	35	37	35	
	Ave. Yield Increase/Acre-bu.	8.1	2.2	1.9	
	Per Cent Profit	468%	26%	-41%	
HRS Wheat	Ave. Fertilizer Treatment	9+27+0	13+35+0	7+30+0	17+33+0
	Ave. Fert. Yield/Acre-bu.	35	30	24	42
	Ave. Yield Increase/Acre-bu.	3.5	4.4	2.3	6.0
	Per Cent Profit	86%	66%	-18%	53%
Barley	Ave. Fertilizer Treatment	None	22+41+0	0+28+0 ^c	5+30+0
	Ave. Fert. Yield/Acre-bu.		53	52	56
	Ave. Yield Increase/Acre-bu.		15.6	.7	1.4
	Per Cent Profit		67%	-79%	-64%
<u>Crops on Nonfallow Land</u>					
Durum	Ave. Fertilizer Treatment	18+28+0	15+21+0	36+19+0	42+13+0
	Ave. Fert. Yield/Acre-bu.	41	31	33	41
	Ave. Yield Increase/Acre-bu.	9.0	.9	3.7	7.9
	Per Cent Profit	281%	-62%	-28%	39%
HRS Wheat	Ave. Fertilizer Treatment	26+28+0	44+25+0	33+23+0	41+22+0
	Ave. Fert. Yield/Acre-bu.	25	27	38	42
	Ave. Yield Increase/Acre-bu.	3.5	4.0	6.8	13.3
	Per Cent Profit	16%	-6%	42%	140%
Barley	Ave. Fertilizer Treatment	26+27+0	27+23+0	31+20+0	36+24+0
	Ave. Fert. Yield/Acre-bu.	38	48	57	62
	Ave. Yield Increase/Acre-bu.	4.1	5.8	11.2	9.7
	Per Cent Profit	-47%	-28%	46%	22%

^aIncludes Cass and Traill counties.

^bPrice assumptions are those included in Table 3. Cost assumptions are 14 cents per pound for nitrogen and 10 cents per pound for phosphate.

^cOnly one field checked.

Active Test-Demonstration Farms
in North Dakota in 1965

The number of active test-demonstration cooperators in 1965 is shown in Table 9. At the beginning of the year 31 cooperators were active in the program. Three cooperators dropped out during the year giving a total of 31 at the close of the 1965 season. In Hettinger County there were two new cooperators to replace two who dropped out at the close of the 1964 season.

TABLE 9. NUMBER OF ACTIVE TEST-DEMONSTRATION COOPERATORS, BY COUNTIES, 1965

County	Cooperators Active January 1, 1965	Number Dropped During Year	Cooperators Active At End of Year
Adams	4	-	4
Bottineau	5	-	5
Bowman	5	-	5
Burke	4	2	2
Cass	2	1	1
Hettinger ^a	4	-	4
Renville	5	-	5
Traill	5	-	5
All Counties	34	3	31

^aThere were two new cooperators added in 1965 to replace two who dropped out at the end of 1964.

Moisture Situation in 1965

The moisture conditions at planting time in the Southwest, North Central, and Valley areas varied from adequate to excess moisture. In general, the spring planting was later than normal. Some wheat was not planted until the latter part of May. In some areas there was about a week in the latter part of April in which the field conditions were ideal for seeding. About May 1 the rains started, and seeding conditions were not ideal because of the wet soils. The temperature in May, June, and July was cool which made it ideal for the growth of small grains. The weather and temperature were not ideal for weed control. It was difficult to find days that were suited to spraying of weeds.

Figure 2 shows the precipitation for the four-year period 1962-1965 and for the long-term period 1931-1960 by crop reporting districts. In all of the crop reporting districts the 1965 annual rainfall was above the long-term average 1931-1960. In the western half of the state the annual precipitation in each of the four years was above the long-term average.

In 1965 the precipitation was greater than the long-term average for five months in the Southwest area, for four months in the North Central area, and for five months in the East Central area (Table 10). The total annual precipitation was about three inches above the long-term average in the Southwest and North Central areas and about seven inches above the long-term average in the East Central area.

TABLE 10. PRECIPITATION IN INCHES FOR 1965 AND THE 1931-1960 AVERAGE, BY MONTHS, FOR THREE CROP REPORTING DISTRICTS

Month	Crop Reporting District					
	Southwest		North Central		East Central	
	1965	1931-1960	1965	1931-1960	1965	1931-1960
	(inches)					
January	.40	.47	.28	.52	.16	.48
February	.23	.46	.01	.40	.13	.48
March	.38	.77	.18	.73	.62	.71
April	2.28	1.24	1.11	1.03	3.37	1.38
May	4.57	1.94	3.80	1.97	3.74	2.42
June	3.10	3.78	2.18	3.59	3.14	3.51
July	2.77	2.13	5.17	2.47	5.21	2.75
August	1.99	1.73	2.13	2.34	3.01	2.63
September	1.71	1.18	3.77	1.34	4.22	1.69
October	Tr.	.81	.13	.84	1.23	1.23
November	.31	.55	.44	.61	.55	.75
December	.15	.31	.37	.44	.82	.50
Annual Average	18.21	15.37	19.50	16.28	25.90	18.53

SOURCE: U. S. Department of Agriculture, Statistical Reporting Service, Fargo, North Dakota.

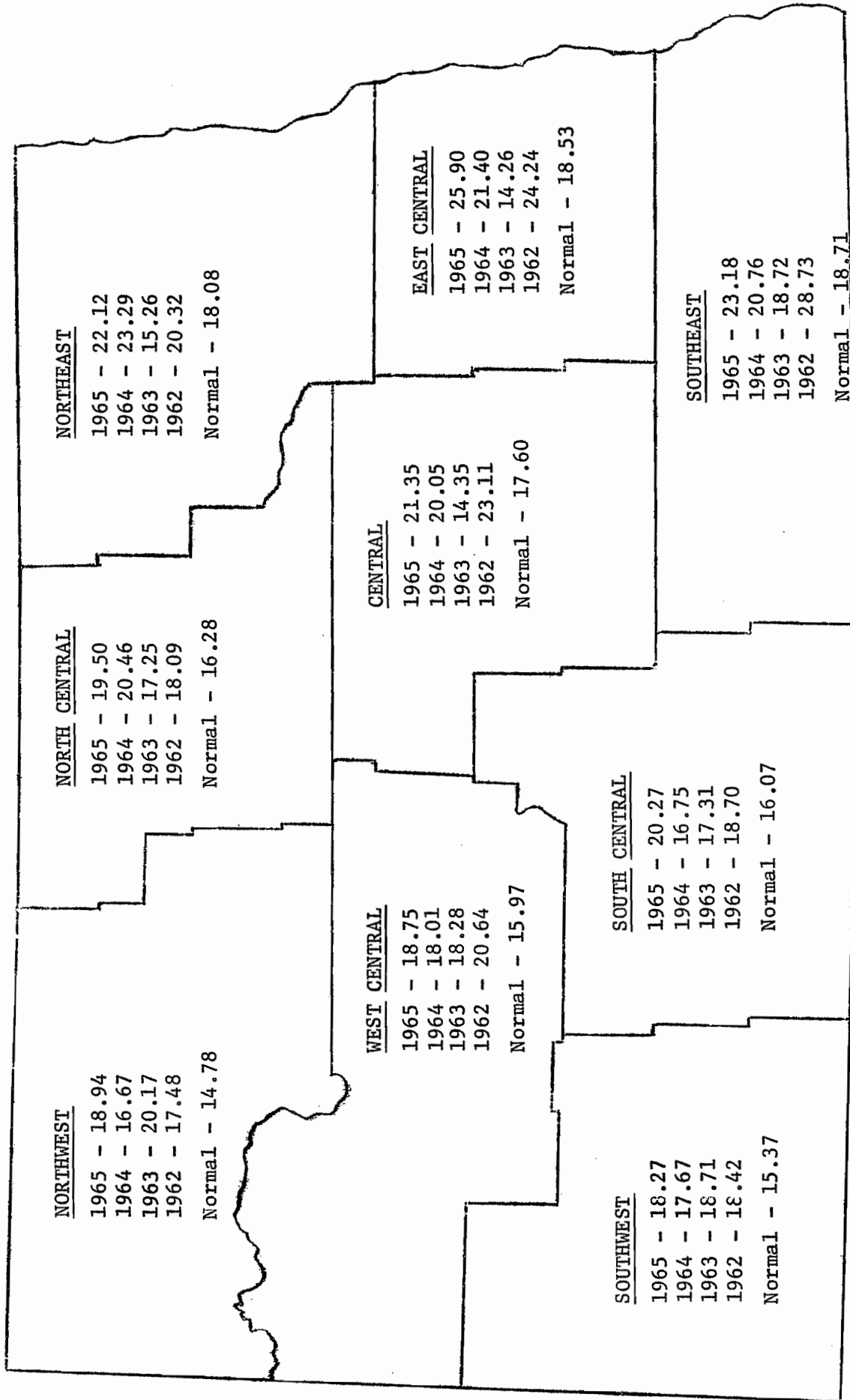


Figure 2. Average Annual Precipitation in North Dakota, by Crop Reporting Districts for 1962, 1963, 1964, 1965, and 1931-1960 Average.

SOURCE: USDA Statistical Reporting Service, Agricultural Statistician, Fargo, North Dakota.

The precipitation during the harvest period made it difficult for the farmers, particularly in the North Central and East Central areas, to get the crops harvested. Some of the grain laid in the swath for about six weeks before it could be combined. For most of the state there were only one or two days that were fit for harvesting during the six-week period of August 23 to about October 1. This also presented problems for some of the test-demonstration cooperators to obtain accurate field checks. Some of the field checks were lost because of the prolonged wet spell.

Crops Fertilized

Test-demonstration farmers fertilized 17,004 acres in 1965. Table 11 shows the acreage fertilized by crops and areas for the four-year period, 1962-1965. The number of acres fertilized in 1965 was down from 1963 and 1964 mainly because the number of farmers cooperating in 1965 was less than in the previous two years. Oats and hay and pasture were two crops which showed an increase in the acreage fertilized in 1965 over the previous years. This is probably the result of the ample supply of moisture at seeding time and some shifting of the crop acreage because of wet fields. On a per farm basis, there has been an upward trend in the acreage fertilized during the four-year period. In 1962 fertilizer was applied to 328 acres per farm, and in 1965 the acreage fertilized per farm was 549 acres. The trend in North Dakota has been to increase the use of fertilizer. In the last five year period, 1961-1965, the annual tonnage of fertilizer used in North Dakota increased 46 per cent. This increase has been due in part to:

1. Past results of fertilizer use by farmers.
2. Intensifying production of cash crops because of acreage allotments.
3. Reducing per unit costs of production.
4. Increasing farm size.

TABLE 11. ACREAGE FERTILIZED IN 1962, 1963, 1964, AND 1965 ON TEST-DEMONSTRATION FARMS, BY AREAS OF THE STATE

Crop	Year	Area			All Areas
		Valley	Southwest	North Central	
					(acres)
Wheat	1962	1,180	3,782	4,442	9,404
	1963	1,756	5,539	4,050	11,345
	1964	1,665	6,316	5,051	13,032
	1965	994	5,660	5,269	11,923
Barley	1962	1,102	493	986	2,581
	1963	1,636	578	1,762	3,976
	1964	1,535	359	946	2,840
	1965	868	830	959	2,657
Oats	1962	147	186	150	483
	1963	356	275	314	945
	1964	216	322	284	822
	1965	154	547	690	1,391
Rye	1962	-	-	-	-
	1963	-	-	99	99
	1964	-	11	145	156
	1965	-	67	40	107
Flax	1962	-	-	-	-
	1963	95	-	30	125
	1964	25	-	203	228
	1965	92	-	46	138
Corn	1962	306	116	-	422
	1963	417	190	-	607
	1964	321	32	60	413
	1965	70	80	65	215
Specialty Crops ^a	1962	237	-	-	237
	1963	454	-	-	454
	1964	462	-	-	462
	1965	421	-	40	461
Hay and Pasture ^b	1962	-	-	10	10
	1963	70	-	30	100
	1964	10	-	43	53
	1965	55	17	40	112
All Crops	1962	2,972	4,577	5,588	13,137
	1963	4,784	6,582	6,285	17,651
	1964	4,234	7,040	6,732	18,006
	1965	2,654	7,201	7,149	17,004

^aIncludes sugar beets, soybeans, sunflowers, peas, buckwheat, and canary grass.

^bIncludes alfalfa, millet, brome and clover hay, and pastures.

The acreage fertilized in 1965 by crops, by cropping practice, and by area is shown in Table 12. Durum and HRS wheat accounted for about 70 per cent of the acreage fertilized. About 66 per cent of the acreage fertilized was on crops grown on fallow land. Eighty per cent of the wheat, 27 per cent of the barley, 40 per cent of the oats, 87 per cent of the rye, and all of the sugar beets that were fertilized were grown on fallow land.

Table 13 contains the fertilized acreage checked for yield response. The number of acres checked was less than the total acres fertilized because of weather conditions, custom combiners not leaving the check strips, and check strips that were left near ditches or shelterbelts which were not typical yield responses for the field. About 6,561 acres of the total of 17,004 acres fertilized, or 39 per cent, were checked at harvest time.

Amount of Fertilizer Material Used

In 1965 the use of TVA fertilizer decreased about 3 per cent on the test-demonstration farms as compared to 1964. About 432 tons of TVA fertilizer were used in 1965 compared to 444 tons in 1964. The decline in the amount of fertilizer used was primarily due to a total of 34 farmers' obtaining fertilizer in 1965 compared to about 38 farmers in 1964. When the total fertilizer use--TVA and commercial fertilizer--is considered, the total consumption of fertilizer in 1965 was greater than in 1964. In 1965 the total fertilizer consumption on test-demonstration farms was about 598 tons compared to 562 tons in 1964. On a per farm basis, each farm used 17.6 tons of fertilizer in 1965 compared to 14.8 tons in 1964, or about a 6 per cent increase. This increase is primarily the result of more acreage per farm being fertilized. The rates per acre were basically the same in 1964 and 1965.

Table 14 indicates the analysis and amount of TVA fertilizer used in each county cooperating in the program. Concentrated superphosphate (0-54-0)

TABLE 12. ACREAGE FERTILIZED IN 1965, BY CROPS, CROPPING PRACTICES, AND AREAS OF THE STATE

Crop and Cropping Practice	Area			All Areas
	Valley	Southwest	North Central	
	(acres)			
Wheat on Fallow	278	4,397	4,875	9,550
Wheat on Nonfallow	<u>716</u>	<u>1,263</u>	<u>394</u>	<u>2,373</u>
All Wheat	994	5,660	5,269	11,923
Barley on Fallow	84	422	215	721
Barley on Nonfallow	<u>784</u>	<u>408</u>	<u>744</u>	<u>1,936</u>
All Barley	868	830	959	2,657
Oats on Fallow	-	237	321	558
Oats on Nonfallow	<u>154</u>	<u>310</u>	<u>369</u>	<u>833</u>
All Oats	154	547	690	1,391
Rye on Fallow	-	53	40	93
Rye on Nonfallow	<u>-</u>	<u>14</u>	<u>-</u>	<u>14</u>
All Rye	-	67	40	107
Flax	92	-	46	138
Buckwheat	-	-	40	40
Millet	25	-	-	25
Corn	70	80	65	215
Sunflowers	78	-	-	78
Sugar Beets	343	-	-	343
Alfalfa	30	-	-	30
Tame Pasture	-	17	20	37
Native Pasture	-	-	20	20
All Crops	2,654	7,201	7,149	17,004

TABLE 13. FERTILIZED ACREAGE CHECKED AT HARVEST TIME, BY CROPS, CROPPING PRACTICES, AND AREAS OF THE STATE

Crop and Cropping Practice	Area			All Areas
	Valley	Southwest	North Central	
	(acres)			
HRS Wheat on Fallow	82	1,261	1,218	2,561
Durum on Fallow	-	-	857	857
HRS Wheat on Nonfallow	136	280	100	516
Durum on Nonfallow	468	-	169	637
All Wheat	686	1,541	2,344	4,571
Barley on Fallow	74	186	50	310
Barley on Nonfallow	655	171	425	1,251
All Barley	729	357	475	1,561
Oats on Fallow	-	-	38	38
Oats on Nonfallow	143	85	45	273
All Oats	143	85	83	311
Corn on Nonfallow	40	-	-	40
Sunflowers on Nonfallow	78	-	-	78
All Crops	1,676	1,983	2,902	6,561

and diammonium phosphate (21-53-0) were the materials in greatest demand by farmers. About 66 per cent of the acreage fertilized was crops grown on fallow land. The fertilizer analysis used for these crops was 0-54-0 and 21-53-0. In many nonfallow situations where stored moisture outlook was low, 21-53-0 supplied adequate nitrogen. The fertilizer analyses 25-25-0 and 30-10-0 were used only where adequate moisture warranted these ratios. Where stored moisture warranted broadcast of nitrogen in addition to drill application, straight nitrogen was purchased locally by cooperators and applied.

TABLE 14. ANALYSIS AND TONNAGE OF FERTILIZER PURCHASED FROM TVA IN 1965, BY COUNTIES^a

County	Fertilizer Analysis				All Analyses
	0-54-0	21-53-0	30-10-0	25-25-0	
	(tons)				
Adams	40.6	25.7	-	-	66.3
Bottineau	27.3	15.9	3.4	9.5	56.1
Bowman	9.4	41.6	-	2.3	53.3
Burke	31.7	12.0	3.2	2.4	49.3
Cass	6.3	18.7	13.6	-	38.6
Hettinger	17.7	23.4	-	1.5	42.6
Renville	23.3	16.8	8.7	2.1	50.9
Traill	23.9	15.4	17.3	18.5	75.1
All Counties	180.2	169.5	46.2	36.3	432.2

^aThirty-four farms received TVA fertilizer.

Additional fertilizer was purchased from local dealers to supplement the TVA materials. The amounts and analyses of fertilizer purchased from local dealers are shown in Table 15. Ammonium nitrate accounted for about 28 per cent of the fertilizer purchased. Most of the ammonium nitrate is bulk spread on nonfallow fields in Traill County.

TABLE 15. COMMERCIAL FERTILIZER PURCHASED FOR 1965 BY TVA COOPERATORS, BY ANALYSIS AND COUNTIES^a

Analysis of Fertilizer	County						All Counties
	Adams	Bottineau	Bowman	Burke	Cass	Traill	
				(tons)			
0-46-0		2.0		5.0	2.0	26.3	35.3
0-45-0	1.5						1.5
5-45-5							
8-24-12		1.0					1.0
11-48-0	.9		6.0		7.2		14.1
12-36-12		1.0					1.0
15-25-5		1.0					1.0
16-20-5		1.0					1.0
16-20-0				3.0			3.0
16-48-0					1.3		1.3
18-36-0					6.0		6.0
18-48-0			2.5				2.5
23-23-0					4.7		4.7
24-20-0					22.9		22.9
27-14-0					8.5		8.5
33-0-0		4.0	1.0			43.2	48.2
30-10-0		2.0					2.0
Total	2.4	12.0	9.5	8.0	52.6	81.5	166.0

^aThirty-four farmers reporting.

Handling, Storing, and Spreading Characteristics
of Test-Demonstration Fertilizer Materials

The quality of the fertilizer bags was good, and the fertilizer materials were transported and stored on the farm without any deterioration. The fertilizer was stored about six to eight weeks on the farm. The moisture conditions were higher than normal because of the wet spring, but no problems were encountered in maintaining the fertilizer quality during storage. In the Southwest area nails in the railroad car broke a number of bags.

Comments on the various fertilizer materials are as follows:

0-54-0

Some difficulty was encountered in getting an even distribution of this material on the whole field because of the uneven size of the particles. The particles would tend to pulverize when the fertilizer went through the attachment. The color of the fertilizer would vary from sack to sack. In one railroad car there were some sacks which contained red rock and when analyzed had a lower analysis of phosphate and contained some nitrogen and potash.

21-53-0

The main comment on this fertilizer material was the uneven particle size. It was dusty and it absorbed moisture.

25-25-0 and 30-10-0

These fertilizer materials absorbed moisture easily and had uneven particle size.

Educational Uses Made of
Test-Demonstration Farm Results

The primary objective of the test-demonstration program in North Dakota is to determine the economic effects of a recommended fertilizer program. Encouragement was given the farm cooperators to take soil samples which were analyzed for phosphate content by the Soil Testing Laboratory, Soils Department, North Dakota State University. Generally, soils testing very low in phosphate

require about 30 to 35 pounds of phosphate per acre; low testing soils, about 25 pounds; medium testing soils, about 15 pounds; and high testing soils generally require no additional phosphate. The nitrogen rate is determined by the cropping history and amount of soil moisture at planting time.³

The crop yield comparisons on the fertilized and unfertilized portions of the fields were used to demonstrate the physical and economic effects of recommended fertilizer treatment on individual fields and crops. Extension service and research people use the results obtained on the test-demonstration farms in farm meetings, news stories, radio and television programs, and in research activities. About 1,697 people attended meetings during 1965 where the results of the test-demonstration farms were discussed (Table 16). About 682 people visited the farms during the growing season to view the fields which had fertilized and unfertilized strips. The results obtained in the test-demonstration program are generally included as a part of other extension programs, so it is difficult to estimate how extensively these data are used.

TABLE 16. EDUCATIONAL USES MADE OF TEST-DEMONSTRATION FARMS AND THE RESULTS OF THESE DEMONSTRATIONS, 1965^a

Educational Use	Number
Number of people who visited fertilizer demonstrations (including tour groups and individual visits).	682
Number of tour groups who saw fertilizer demonstrations.	10
Number of news articles mentioning one or more of these demonstrations and/or results of these demonstrations.	43
Number of radio and television programs in which reference was made to these demonstrations and results obtained.	19
Number of people attending meetings where results of these demonstrations were discussed.	1,697

^aBased on reports from the eight counties in which the test-demonstration farms were located.

³North Dakota Fertilizer Guide, Circular A-350, Extension Service, North Dakota State University of Agriculture and Applied Science, April, 1963.

Quality of Harvested Small Grain Samples

The grain samples from the fertilized and the check strips were tested for test weight per bushel, and the barley samples were also tested for per cent plump and per cent thin kernels. The samples from the fertilized strips tested to be on the average equal or slightly heavier in test weight per bushel than the average of the samples from the check or nonfertilized strips (Table 17).

The average for 37 fields of barley showed the fertilized samples to be 75.6 per cent plump and 3.8 per cent thin compared to 73.5 per cent plump and 4.9 per cent thin for the check samples.

TABLE 17. AVERAGE TEST WEIGHT PER BUSHEL FOR FERTILIZED AND NONFERTILIZED HARVESTED SAMPLES, 1965

Crop	No. of Samples	Unit	Test Weight	
			Fertilized	Check
HRS Wheat	88	lbs.	57.8	57.5
Durum	41	lbs.	58.3	58.1
Barley	44	lbs.	47.3	47.0
Oats	8	lbs.	37.1	36.5

Fertilizer Responses in 1965

The average per cent profit to the investment in fertilizer in 1965 was about 43 per cent for the state, 6 per cent below 1964 (Table 18). The decrease came in the crops grown on nonfallow land. The fertilizer cost per acre was up, and the net return was down from the previous year. The return to fertilizer investment for crops grown on fallow land was the same for 1964 and 1965. The average rate of fertilizer use per acre was about the same for crops grown on fallow and a little higher for crops grown on nonfallow land in 1965 compared to 1964.

The data in Tables 18, 19, 20, and 21 give a breakdown for some of the crops grown on fallow land using a straight phosphate fertilizer only and using a fertilizer that has both nitrogen and phosphate nutrients. Table 18 shows that for HRS wheat the phosphate fertilizer gave the highest returns per dollar invested in fertilizer. For durum and barley the use of a nitrogen and phosphate fertilizer gave the higher returns. The number of field trials was too small to give an accurate trend, but it does point out there may be a savings to farmers in some areas by using a straight phosphate fertilizer. The data in this report did not have enough field trials by the various crops in each of the areas to obtain information as to differences by areas of the state.

The fertilization ratio, yield responses, fertilizer costs, and net returns for each of the farms cooperating in the fertilizer test-demonstration program in 1965 for all areas is found in Appendices A and B.

Southwest Area

The return to investment in fertilizer was the lowest in 1965 when the results of the four-year period, 1962-1965, are compared (Table 4). In 1965 the average return to fertilizer investment for all crops was 50 per cent compared to 67 per cent in 1964, 82 per cent in 1963, and 300 per cent in 1962. The year 1962 was a good small grain year with the crops planted on schedule and adequate rainfall during the growing season. Also, the price for wheat, which comprised 82 per cent of the fertilized acreage, was the highest of the four-year period. The combination of good yields and good prices made the 1962 returns to fertilizer the best of the four years compared. The cash price of wheat dropped from \$2.10 in 1962 to \$1.44 in 1965. If the yield increase had remained the same, the returns in 1965 would have been below the returns for 1962 because of this factor alone. Because of price and weather factors, the returns to fertilizer in 1965 were lower than in the three previous years.

TABLE 18. AVERAGE COSTS AND RETURNS TO FERTILIZER USE BY CROPS FOR ALL TEST-DEMONSTRATION FARMS, 1965^a

Crop	Acres Checked	Average Per Acre				
		Fertilizer Treatment	Yield Increase	Fertilizer Cost ^b	Net Return ^c	Per Cent Profit
<u>Crops Grown on Fallow Land</u>						
HRS Wheat	1,596	0+23+0	2.7	\$2.15	\$1.83	85
HRS Wheat	965	10+24+0	3.4	3.74	1.10	29
Durum	446	0+20+0	1.9	2.02	.39	19
Durum	411	8+21+0	5.4	3.19	3.71	116
Barley	118	0+18+0	3.5	2.85	.42	15
Barley	192	10+24+0	6.8	3.80	2.64	69
Oats	38	0+22+0	8.1	2.20	1.69	77
All Crops	3,766	3+23+0	---	\$2.85	\$1.80	63
<u>Crops Grown on Nonfallow Land</u>						
HRS Wheat	516	17+23+0	6.4	\$4.75	\$4.40	93
Durum	637	34+14+0	5.4	6.18	.75	12
Barley	1,251	21+23+0	6.1	5.35	.37	7
Oats	273	14+21+0	17.4	4.07	4.29	105
Corn	40	22+43+0	-1.3	7.38	-8.69	-118
Sunflowers	78	15+35+0	209#	5.52	3.22	58
All Crops	2,795	23+21+0	---	\$5.34	\$1.54	29
Total of All Crops	6,561	12+23+0	---	\$3.91	\$1.68	43

^aWeighted averages based on number of acres checked at harvest.

^bCost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cNet returns from fertilizer based on the grain prices for October, 1965:

HRS Wheat	= \$1.44	Oats	= \$.48
Durum	= 1.28	Corn	= 1.02
Barley	= .94	Sunflowers	= .047/lb.

Table 19 shows the average yield increase, fertilizer cost, and net return by crops and cropping practices for 1965. The moisture condition was good during the growing season. The planting of the crop was later than normal because of the moisture in April and May. The yield responses in 1965 compared to 1964 were lower for the crops grown on fallow and higher for the crops grown on nonfallow land (Table 6).

The fertilizer rate for crops grown on fallow land was about the same as in 1964, with the same amount of phosphate and one pound more of nitrogen used. The average fertilizer rate per acre for crops grown on nonfallow land in 1965 was eight pounds of nitrogen and 24 pounds of phosphate. This was one pound less of nitrogen and seven pounds more of phosphate than was used in 1964. The slight change in rates was due in part to the type of season, and also there were two new farms in the group that did not have a soil test made at the time the rates were determined. Their rates were based on the area average for similar soils. The cost of the fertilizer was about 14 per cent higher for all crops in 1965 than it was in 1964. This is due to the change in the fertilizer rates used.

The return to HRS wheat on fallow land to phosphate fertilizer was \$1.54 for each \$1.00 invested in fertilizer, and for the nitrogen and phosphate fertilizer it was \$1.29 for each dollar invested. For barley the return was \$1.91 for each \$1.00 invested in the phosphate fertilizer and \$2.09 for each \$1.00 invested in the nitrogen and phosphate fertilizer.

The average return to fertilizer investment for all crops in the past four years for the Southwest area was 125 per cent. That is, each \$1.00 invested in fertilizer returned \$2.25.

North Central Area

The growing season had a mixture of factors which make it difficult to

TABLE 19. AVERAGE COSTS AND RETURNS TO FERTILIZER USE BY CROPS IN SOUTHWESTERN NORTH DAKOTA, 1965^a

Crop	Acres Checked	Average Per Acre				
		Fertilizer Treatment	Yield Increase	Fertilizer Cost ^b	Net Return ^c	Per Cent Profit
<u>Crops Grown on Fallow Land</u>						
HRS Wheat	718	0+31+0	2.8	\$2.74	\$1.47	54
HRS Wheat	543	10+25+0	3.4	3.81	1.11	29
Barley	29	0+26+0	5.4	2.64	2.40	91
Barley	<u>157</u>	<u>9+24+0</u>	<u>8.2</u>	<u>3.70</u>	<u>4.04</u>	<u>109</u>
All Crops	1,447	5+26+0	---	\$3.24	\$1.68	52
<u>Crops Grown on Nonfallow Land</u>						
HRS Wheat	280	9+24+0	3.6	\$3.67	\$1.44	39
Barley	171	6+25+0	4.4	3.47	.64	18
Oats	<u>85</u>	<u>8+22+0</u>	<u>16.3</u>	<u>3.43</u>	<u>4.40</u>	<u>128</u>
All Crops	536	9+24+0	---	\$3.57	\$1.66	50
<hr/>						
Total of						
All Crops	1,983	5+25+0	---	\$3.33	\$1.67	50

^aWeighted averages based on number of acres checked at harvest. Includes Adams, Bowman, and Hettinger counties.

^bCost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cNet returns from fertilizer based on the grain prices for October, 1965:

HRS Wheat = \$1.44
 Barley = .94
 Oats = .48

appraise yield responses to fertilizer. There was an ample supply of moisture at planting time which made the season later than normal. It became dry in August with several hot days which, in some cases, caught the crop at a critical stage of maturity. When the crops were ready to be harvested, the rains began and lasted for about a six-week period.

The average return to fertilizer investment for all crops was 45 per cent in 1965 compared to 57 per cent in 1964 and 63 per cent for the average of the last four years (Table 4). Table 20 shows the average fertilizer rates, yield responses, and returns to fertilizer by crops for 1965. In the North Central area the return to HRS wheat on fallow land for a phosphate fertilizer was 119 per cent, and for the nitrogen and phosphate fertilizer it was 19 per cent. The results were just the reverse for durum--19 per cent for the phosphate fertilizer and 116 per cent for the nitrogen and phosphate fertilizer.

The yield increases in 1965 compared to 1964 were generally higher for crops grown on fallow and lower for crops grown on nonfallow land. The fertilizer rates and costs were about the same for both years for crops on fallow land. The fertilizer treatment for crops grown on nonfallow land in 1965 had about two pounds less nitrogen and four pounds more phosphate than in 1964. Some negative returns to fertilizer were encountered for durum and barley grown on nonfallow land (Table 20).

Valley Area

The average return to fertilizer investment in 1965 was the highest for the four years that data are available. The per cent return to the investment in fertilizer was 38 for 1965 compared to 35 per cent for 1964 and 22 per cent for the average of the four-year period, 1962-1965 (Table 4). Moisture and climatic factors were more ideal during the growing season in 1965 than they were in 1962, 1963, and 1964.

TABLE 20. AVERAGE COSTS AND RETURNS TO FERTILIZER USE BY CROPS IN NORTH CENTRAL NORTH DAKOTA, 1965^a

Crop	Acres Checked	Average Per Acre				
		Fertilizer Treatment	Yield Increase	Fertilizer Cost ^b	Net Return ^c	Per Cent Profit
<u>Crops Grown on Fallow Land</u>						
HRS Wheat	878	0+21+0	3.3	\$2.14	\$2.55	119
HRS Wheat	340	8+20+0	2.6	3.18	.61	19
Durum	446	0+20+0	1.9	2.02	.39	19
Durum	411	8+21+0	5.4	3.19	3.71	116
Barley	50	0+27+0	3.5	2.70	.59	22
Oats	<u>38</u>	<u>0+22+0</u>	<u>8.1</u>	<u>2.20</u>	<u>1.69</u>	<u>77</u>
All Crops	2,163	3+21+0	---	\$2.44	\$1.97	81
<u>Crops Grown on Nonfallow Land</u>						
HRS Wheat	100	9+22+0	4.9	\$3.43	\$3.56	104
Durum	169	11+15+0	-1.5	3.10	-5.01	-162
Barley	425	5+20+0	1.1	2.79	-1.72	-62
Oats	<u>45</u>	<u>15+ 5+0</u>	<u>20.5</u>	<u>2.60</u>	<u>7.23</u>	<u>278</u>
All Crops	739	8+18+0	---	\$2.94	-\$1.22	-41
Total of All Crops	2,901	4+20+0	---	\$2.57	\$1.16	45

^aWeighted averages based on number of acres checked at harvest. Includes Bottineau, Burke, and Renville counties.

^bCost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cNet returns from fertilizer based on the grain prices for October, 1965:

HRS Wheat = \$1.44
 Durum = 1.28
 Barley = .94
 Oats = .48

There were some negative returns to the fertilizer investment in 1965 (Table 21). Barley grown on fallow land showed a negative return as well as corn grown on nonfallow land. The negative returns may be due in part to the fact that the farms reporting had soils that tested medium to high in phosphate. There probably was little response to the amount of phosphate applied to these crops.

In general, the rates of fertilizer application were higher in 1965 than in 1964. The rate of fertilization for crops grown on fallow land was increased by four pounds of nitrogen and two pounds of phosphate over the 1964 rate. On nonfallow land the rate in 1965 was increased by five pounds of nitrogen and one pound of phosphate. The average cost per acre for fertilizer for all crops and cropping practices was \$6.91 in 1965 compared to \$5.95 in 1964.

TABLE 21. AVERAGE COSTS AND RETURNS TO FERTILIZER USE BY CROPS IN THE VALLEY AREA, 1965^a

Crop	Acres Checked	Average Per Acre				
		Fertilizer Treatment	Yield Increase	Fertilizer Cost ^b	Net Return ^c	Per Cent Profit
<u>Crops Grown on Fallow Land</u>						
HRS Wheat	82	17+32+0	6.0	\$5.67	\$3.02	53
Barley	39	0+32+0	2.1	3.20	-1.24	-39
Barley	35	11+27+0	.6	4.24	-3.65	-86
All Crops	156	11+32+0	---	\$4.73	\$.46	10
<u>Crops Grown on Nonfallow Land</u>						
HRS Wheat	136	41+22+0	13.3	\$7.96	\$11.11	140
Durum	468	42+13+0	7.9	7.29	2.83	39
Barley	655	36+24+0	9.7	7.50	1.66	22
Oats	143	17+25+0	17.1	4.92	3.30	67
Corn	40	22+43+0	-1.3	7.38	-8.69	-118
Sunflowers	78	15+35+0	209#	5.52	3.22	58
All Crops	1,520	35+22+0	---	\$7.13	\$2.83	40
Total of All Crops	1,676	33+22+0	---	\$6.91	\$2.61	38

^aWeighted averages based on number of acres checked at harvest. Includes Cass and Traill counties.

^bCost of fertilizer = 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cNet returns from fertilizer based on the grain prices for October, 1965:

HRS Wheat	= \$1.44	Oats	= \$.48
Durum	= 1.28	Corn	= 1.02
Barley	= .94	Sunflowers	= .047/lb.

APPENDIX A

CROP YIELD RESULTS FOR FARMS IN THE TVA
TEST-DEMONSTRATION PROGRAM, 1965

APPENDIX TABLE A-1. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN ADAMS COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-Bushels/Acre		
					Fert.	Check	Diff.
Daryl Anderson	6-9	Fallow	HRS Wheat	0+27+0	22.30	19.90	2.40
	5-14	Fallow	HRS Wheat	0+27+0	25.00	20.13	4.87
	12-6	Fallow	HRS Wheat	0+27+0	34.00	27.00	7.00
	12-23	Fallow	HRS Wheat	0+27+0	28.00	24.57	3.43
	18-2 ^a	Corn	HRS Wheat	11+27+0	7.27	7.00	.27
	10-7	Fallow	Barley	11+27+0	70.40	64.98	5.42
Gene Davison	B-4	Fallow	HRS Wheat	0+27+0	23.22	22.55	.67
	C-3	Fallow	HRS Wheat	0+27+0	30.48	24.20	6.28
	J-6	Fallow	HRS Wheat	0+27+0	21.13	14.22	6.91
	L-3	Fallow	HRS Wheat	0+32+0	20.75	16.50	4.25
	N-8	Fallow	HRS Wheat	0+27+0	20.88	17.52	3.36
	M-5	Corn	HRS Wheat	11+27+0	26.07	24.40	1.67
	P-1	Corn	HRS Wheat	11+27+0	30.73	28.82	1.91
	U-1 ^b	Corn	HRS Wheat	11+27+0	23.06	18.68	4.38
	S-2	Corn	HRS Wheat	8+21+0	23.57	15.72	7.85
S-9	Corn	HRS Wheat	11+27+0	44.16	40.33	3.83	
Fred Ehlers	13-I	Fallow	HRS Wheat	0+27+0	26.00	22.67	3.33
	26-0	Fallow	HRS Wheat	0+27+0	28.66	27.33	1.33
	24-U	Fallow	HRS Wheat	0+27+0	28.00	25.33	2.67
	25-0	Fallow	HRS Wheat	0+27+0	29.33	28.00	1.33
	3-U	Fallow	HRS Wheat	0+27+0	28.67	26.67	2.00
	3-M	Fallow	HRS Wheat	0+27+0	28.00	25.33	2.67
	14-E	Corn	HRS Wheat	11+27+0	26.67	24.00	2.67
	26-S	Corn	HRS Wheat	11+27+0	31.33	29.33	2.00
	24-X-3	Fallow	Barley	11+27+0	70.00	65.83	4.17
3-G	Fallow	Barley	0+27+0	60.00	50.83	9.17	
Raymond Wothe	2-G ^b	Fallow	HRS Wheat	0+35+0	28.00	29.33	-1.33
	1-G ^b	Fallow	HRS Wheat	0+35+0	28.00	30.67	-2.67
	3-E ^c	Fallow	HRS Wheat	0+35+0	29.33	26.67	2.66
	3-E ^d	Fallow	HRS Wheat	0+35+0	20.00	16.00	4.00
	3-L ^c	Wheat	HRS Wheat	12+29+0	26.67	26.67	0.00
	3-L ^d	Wheat	HRS Wheat	12+29+0	13.33	13.33	0.00
	7-C ^e	Corn	HRS Wheat	12+29+0	16.00	13.33	2.67
	6-B	Corn	HRS Wheat	12+29+0	20.00	17.33	2.67
	6-L	Corn	HRS Wheat	12+29+0	20.00	16.00	4.00
	5-A	Corn	HRS Wheat	12+29+0	22.67	20.00	2.67
Adams County	Ave.	Fallow	HRS Wheat	0+28+0	25.58	22.78	2.80
		Fallow	Barley	9+27+0	68.57	63.41	5.16
		Nonfallow	HRS Wheat	11+27+0	21.75	18.58	3.17

(continued)

APPENDIX TABLE A-1. (continued)

^aLee wheat which had severe rust damage.

^bWindblown swaths.

^cHeavy soil.

^dSandy soil.

^eForx wheat which had rust damage.

APPENDIX TABLE A-2. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BOWMAN COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Donald Brown	E-2	Fallow	HRS Wheat	8+21+0	26.81	25.02	1.79
	C-1	Fallow	HRS Wheat	13+32+0	42.76	31.90	10.86
	B-1 ^a	Fallow	HRS Wheat	8+21+0	12.37	10.31	2.06
	A-2 ^b	Fallow	HRS Wheat	19+49+0	36.03	28.88	7.15
Roy Kern	1	Fallow	HRS Wheat	11+27+0	26.81	22.00	4.81
Earl Nelson	34-A+C	Corn	HRS Wheat	8+21+0	25.93	21.61	4.32
	26-A+B	Fallow	Barley	9+24+0	39.61	28.81	10.80
	26-C	Winter Wheat	Oats	9+24+0	64.82	48.62	16.20
Donald Schumacher		Fallow	HRS Wheat	11+27+0	17.33	13.33	4.00
		Fallow	HRS Wheat	11+27+0	13.33	12.66	.67
		Fallow	HRS Wheat	11+27+0	18.66	17.33	1.33
		Fallow	HRS Wheat	0+32+0	14.66	9.33	5.33
Walter Stzegura	30-C	Fallow	HRS Wheat	8+21+0	24.24	16.00	8.24
	30-M	Fallow	HRS Wheat	8+21+0	28.32	18.80	9.52
	31-D	Fallow	HRS Wheat	8+21+0	27.76	24.00	3.76
	31-J	Fallow	HRS Wheat	8+21+0	27.04	20.48	6.56
	25-R	Fallow	HRS Wheat	8+21+0	18.24	16.00	2.24
	25-J	Fallow	HRS Wheat	8+21+0	17.12	11.20	5.92
	26-Z	Fallow	HRS Wheat	8+21+0	16.00	11.20	4.80
	29-J	Corn	Barley	10+10+0	50.56	43.20	7.36
	29-V	Corn	Barley	10+10+0	35.52	33.60	1.92
19-I	Corn	Barley	10+10+0	33.60	27.04	6.56	
Bowman County	Ave.	Fallow	HRS Wheat	8+27+0	20.30	16.39	3.91
		Fallow	Barley	9+24+0	39.61	28.81	10.80
		Nonfallow	HRS Wheat	8+21+0	25.93	21.61	4.32
		Nonfallow	Barley	10+10+0	40.79	35.70	5.10
		Nonfallow	Oats	9+24+0	64.82	48.62	16.20

^aMidia wheat which was heavily infested with rust.

^bWinter wheat planted in fall and fertilized. Plowed in spring, and planted to spring wheat which was fertilized.

APPENDIX TABLE A-3. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN HETTINGER COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Leo DeWit	H	Fallow	HRS Wheat	9+24+0	16.00	14.00	2.00
	T	Fallow	HRS Wheat	8+21+0	28.00	25.00	3.00
	5	Fallow	HRS Wheat	8+21+0	34.00	28.50	5.50
	7	Fallow	HRS Wheat	8+21+0	33.00	30.50	2.50
	35	Fallow	HRS Wheat	8+21+0	27.00	20.50	6.50
	40	Fallow	HRS Wheat	6+16+0	29.00	27.00	2.00
	Q	Fallow	Barley	8+21+0	48.00	40.50	7.50
	19	Fallow	Barley	10+10+0	57.00	51.00	6.00
	9	Wheat	Barley	7+19+0	48.00	41.00	7.00
	21	Corn	Barley	18+18+0	39.00	32.00	7.00
	Alvin Dill	16-A	Fallow	HRS Wheat	0+22+0	26.67	22.67
16-C		Fallow	HRS Wheat	0+22+0	28.80	24.13	4.67
2-H		Fallow	HRS Wheat	0+22+0	19.20	17.60	1.60
16-E		Sudan Grass	HRS Wheat	8+21+0	27.06	22.13	4.93
16-G		Sudan Grass	HRS Wheat	8+21+0	25.47	22.67	2.80
34-H		Corn S. Grain	Wheat	8+21+0	18.40	14.67	3.73
34-B		Corn	Oats	8+21+0	46.00	37.50	8.50
34-E		Corn	Oats	8+21+0	72.50	55.50	17.00
34-G		Sudan Grass	Oats	8+21+0	71.00	47.00	24.00
George Ott		2	Fallow	HRS Wheat	0+27+0	15.96	12.13
	6	Fallow	HRS Wheat	0+27+0	19.15	17.23	1.92
	15	Fallow	HRS Wheat	0+27+0	14.84	13.62	1.22
	SW ⁴ -8	Fallow	HRS Wheat	0+27+0	16.12	11.97	4.15
	21	Corn	Barley	13+32+0	28.72	22.66	6.06
	9	Corn	Barley	11+27+0	20.74	17.55	3.19
Lawrence Thomas	21-A	Fallow	HRS Wheat	11+27+0	29.33	27.20	2.13
	21-D	Fallow	HRS Wheat	13+32+0	28.80	25.87	2.93
	21-I	Fallow	HRS Wheat	11+27+0	21.33	18.13	3.20
	25-K	Fallow	HRS Wheat	0+32+0	25.60	23.73	1.87
	25-I	Fallow	HRS Wheat	0+27+0	25.07	23.10	1.87
	6-B	Fallow	HRS Wheat	11+27+0	30.40	28.13	2.27
	6-F	Fallow	HRS Wheat	11+27+0	35.20	30.40	4.80
	6-I	Fallow	HRS Wheat	11+27+0	33.87	30.40	3.47
	22-C	Fallow	HRS Wheat	7+17+0	27.20	24.53	2.67
	22-G	Fallow	HRS Wheat	11+28+0	30.13	26.13	4.00
	25-B	Fallow	Barley	0+22+0	43.33	36.66	6.67
	25-G	Fallow	Barley	0+27+0	34.67	30.67	4.00

(continued)

APPENDIX TABLE A-3. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN HETTINGER COUNTY, 1965 (continued)

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Lawrence Thomas	25-N	Fallow	Barley	0+27+0	16.67	16.67	0.00
	21-H	Wheat	Barley	0+22+0	16.00	12.68	3.32
	25-E	Grain	Barley	11+27+0	32.67	30.67	2.00
	6-A	Grain	Barley	0+27+0	48.00	40.00	8.00
	6-D	Grain	Barley	0+27+0	42.00	39.50	2.50
	6-I	Grain	Barley	0+27+0	39.33	36.66	2.67
Hettinger County	Ave.	Fallow	HRS Wheat	3+25+0	22.19	19.40	2.79
		Fallow	Barley	5+22+0	43.54	37.66	5.88
		Nonfallow	Wheat	8+21+0	22.43	18.70	3.73
		Nonfallow	Barley	6+27+0	32.70	28.42	4.28
		Nonfallow	Oats	8+21+0	61.59	45.19	16.40

APPENDIX TABLE A-4. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BOTTINEAU COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Howard Anderson	2-S	Fallow	HRS Wheat	11+27+0	35.87	30.27	5.60
	2-A	Fallow	HRS Wheat	9+ 3+0	28.00	24.13	3.87
	2-Y	Fallow	HRS Wheat	10+25+0	32.13	23.87	8.26
	27-I+C	Fallow	Durum	10+26+0	44.80	37.07	7.73
	3-R	Fallow	Durum	6+16+0	26.27	24.27	2.00
	2-T	Grain	Barley	11+27+0	67.67	61.17	6.50
	27-E	Grain	Barley	13+13+0	57.33	57.66	-.33
Harold Bergman	16-G+H	Fallow	Durum	8+21+0	35.34	34.51	.83
	16-H	Corn	Durum	15+15+0	32.72	32.31	.41
	15-D	Wheat	Barley	0+22+0	65.14	64.80	.34
	15-A	Barley	Barley	0+22+0	46.92	36.61	10.31
	15-C+B	Durum	Barley	0+27+0	46.75	52.25	-5.50
	16-I	Durum	Barley	0+22+0	69.95	71.33	-1.38
C. L. O'Keefe	24-C+D	Fallow	HRS Wheat	0+23+0	38.40	37.20	1.20
	24-I	Fallow	HRS Wheat	0+22+0	32.80	32.40	.40
	24-K	Fallow	HRS Wheat	0+18+0	31.20	25.47	5.73
	25-H	Fallow	HRS Wheat	0+23+0	39.47	33.87	5.60
	25-K+L	Fallow	HRS Wheat	0+22+0	40.00	34.40	5.60
	35-A	Fallow	HRS Wheat	0+23+0	37.33	34.66	2.67
	23-B	Fallow	Durum	0+22+0	32.00	36.00	-4.00
	24-G	Fallow	Durum	0+27+0	21.87	28.00	13.87
	35-I	Fallow	Durum	0+21+0	38.13	36.80	1.33
	35-K	Fallow	Durum	0+22+0	36.27	39.60	-3.33
	23-C	Wheat	Barley	6+16+0	73.33	65.16	8.17
	24-F	Wheat	Barley	7+16+0	42.83	49.83	-7.00
	Kermit Kjonaas	32-D+E ^a	Fallow	HRS Wheat	0+24+0	30.00	28.00
33-D ^{ab}		Fallow	HRS Wheat	8+21+0	28.00	28.00	0.00
4-D ^a		Fallow	HRS Wheat	0+16+0	24.93	24.93	0.00
3-C ^a		Fallow	HRS Wheat	0+22+0	28.00	26.93	1.07
3-E ^b		Fallow	HRS Wheat	0+14+0	26.67	26.67	0.00
3-K ^b		Fallow	HRS Wheat	0+22+0	26.67	26.67	0.00
5-A		Fallow	HRS Wheat	0+16+0	30.93	24.93	6.00
33-A		Fallow	Durum	0+16+0	37.33	33.33	4.00
33-D ^{ab}		Fallow	Durum	0+16+0	32.93	32.93	0.00
3-H+I ^a		Fallow	Durum	8+21+0	34.93	32.00	2.93
33-B ^a		Fallow	Durum	7+19+0	30.93	28.93	2.00
George Witteaman	20-10	Fallow	Durum	8+14+3	49.30	39.90	9.40
	20-12	Fallow	Durum	9+11+3	43.30	40.90	2.40
	G-11	Flax	Durum	9+15+3	42.20	37.70	4.50
	G-11	Flax	Durum	10+12+3	40.20	37.10	3.10
	G-11	Flax	Durum	15+15+0	31.30	37.10	-5.80

(continued)

APPENDIX TABLE A-4. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BOTTINEAU COUNTY, 1965 (continued)

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Bottineau County	Ave.	Fallow	HRS Wheat	1+20+0	31.79	26.57	5.22
		Fallow	Durum	4+20+0	38.15	34.58	3.57
		Nonfallow	Durum	15+15+0	32.73	34.24	-1.51
		Nonfallow	Barley	3+22+0	56.42	57.34	-.92

^aDamaged by rain.

^bLodged.

APPENDIX TABLE A-5. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN BURKE COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Harry Benshoff	I-A	Fallow	HRS Wheat	0+22+0	34.21	32.26	1.95
	I-F-1	Fallow	HRS Wheat	0+22+0	32.57	30.00	2.57
	III-A	Fallow	HRS Wheat	0+32+0	32.98	28.15	4.83
	V-B	Fallow	HRS Wheat	0+22+0	38.42	36.06	2.36
	II-B	Fallow	Oats	0+22+0	105.61	97.50	8.11
Arnold Funk	27-B	Fallow	Durum	5+27+0	45.67	36.73	8.94
	27-F	Wheat	Oats	15+ 5+0	83.75	63.28	20.47
	2-A+B	Grain	Barley	14+14+0	62.06	54.92	7.14
Burke County	Ave.	Fallow	HRS Wheat	0+23+0	35.27	32.66	2.61
		Fallow	Durum	5+27+0	45.67	36.73	8.94
		Fallow	Oats	0+22+0	105.61	97.50	8.11
		Nonfallow	Barley	14+14+0	62.06	54.92	7.14
		Nonfallow	Oats	15+ 5+0	83.75	63.28	20.47

APPENDIX TABLE A-6. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN RENVILLE COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Morten Clausen	34-F	Fallow	Durum	8+21+0	42.66	37.33	5.33
	11-C	Fallow	Durum	7+19+0	49.33	42.67	6.66
	9-E	Fallow	Durum	0+19+0	45.33	45.33	0.00
	34-B	Fallow	HRS Wheat	8+21+0	32.00	32.00	0.00
	9-I	Fallow	HRS Wheat	7+19+0	37.33	37.33	0.00
	4-B	Fallow	HRS Wheat	0+19+0	40.00	20.00	20.00
	2-A	Grain	Wheat	7+19+0	25.33	13.33	12.00
	10-D	Grain	Wheat	7+19+0	24.00	25.33	-1.33
J. P. Lorenzen	3-B	Fallow	HRS Wheat	8+21+0	35.33	33.60	1.73
	34-H	Fallow	HRS Wheat	8+21+0	39.20	36.13	3.07
	34-H	Fallow	HRS Wheat	0+22+0	38.13	36.13	2.00
	35-D	Fallow	Durum	0+22+0	36.27	36.40	-.13
Randolph Brothers	21-M	Fallow	HRS Wheat	8+21+0	31.20	31.20	0.00
	22-F	Fallow	HRS Wheat	8+21+0	33.60	31.20	2.40
	21-J	Corn	HRS Wheat	11+27+0	29.33	28.53	.80
	21-C	Grain	Durum	6+16+0	32.53	38.40	-5.87
	22-B	Grain	Durum	6+16+0	28.93	26.13	2.80
Marce Schaefer	29-0	Fallow	HRS Wheat	0+19+0	31.31	30.63	.68
	31-C	Fallow	HRS Wheat	0+19+0	33.58	31.76	1.82
	32-C	Fallow	Durum	0+19+0	44.47	43.33	1.14
	36-Y	Wheat	Barley	7+19+0	61.26	52.75	8.51
David Witteman	12-E	Fallow	HRS Wheat	0+27+0	42.00	40.73	1.27
	13-J	Fallow	Durum	0+16+0	37.00	36.40	.60
	6-C	Fallow	Durum	0+22+0	38.87	38.00	.87
	12-D	Fallow	Barley	0+27+0	74.67	71.17	3.50
Renville County	Ave.	Fallow	HRS Wheat	5+21+0	36.58	32.79	3.79
		Fallow	Durum	2+20+0	41.59	39.84	1.75
		Fallow	Barley	0+27+0	74.67	71.17	3.50
		Nonfallow	Wheat	9+22+0	26.67	21.81	4.86
		Nonfallow	Durum	6+16+0	30.70	32.16	-1.46
		Nonfallow	Barley	7+19+0	61.26	52.75	8.51

APPENDIX TABLE A-7. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN CASS COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Ralph Peterson	33-4	Corn	Durum	36+12+0	26.40	14.85	11.55
	33-5	Barley	Durum	17+42+0	31.90	28.60	3.30
	7-2+3	Beans	Durum	38+13+0	33.00	28.74	4.26
	12-8	HRS Wheat	Barley	18+36+0	55.00	52.80	2.20
	15-7	Barley & Oats	Barley	30+10+0	45.10	24.20	20.90
	12-6	Grain	Oats	18+36+0	84.70	77.00	7.70
	15-6	Durum	Corn	22+43+0	37.14	38.42	-1.28
Cass County	Ave.	Nonfallow	Durum	33+18+0	29.80	22.45	7.35
		Nonfallow	Barley	24+23+0	50.05	38.50	11.55
		Nonfallow	Oats	18+36+0	84.70	77.00	7.70
		Nonfallow	Corn	22+43+0	37.14	38.42	-1.28

APPENDIX TABLE A-8. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN TRAILL COUNTY, 1965

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Anderson Brothers	A-5 ^a	Barley	Durum	33+ 0+0	40.00	31.33	8.67
				15+15+0	38.33	31.33	7.00
				48+15+0	43.00	31.33	11.67
	A-6	Beets	Barley	33+ 0+0	80.83	77.50	3.33
				11+27+0	72.50	77.50	-5.00
				44+27+0	79.17	77.50	1.67
				33+ 0+0	74.58	72.29	2.29
	A-8	Oats	Barley	11+27+0	76.87	72.29	4.58
				44+27+0	78.12	72.29	5.83
				11+27+0	56.25	55.62	.63
	A-10	Fallow	Barley	11+27+0	56.25	55.62	.63
	A-12	Durum	Barley	33+ 0+0	50.00	45.21	4.79
				11+27+0	48.13	45.21	2.92
				44+27+0	53.96	45.21	8.75
	A-15	Beets	Barley	33+ 0+0	72.71	71.67	1.04
				18+ 6+0	74.58	71.67	2.91
				51+ 6+0	79.38	71.67	7.71
	O-3	Durum	Durum	33+ 0+0	40.17	37.17	3.00
				18+ 6+0	47.67	37.17	10.50
				51+ 6+0	44.17	37.17	7.00
O-4	Beets	Durum	33+ 0+0	55.33	43.33	12.00	
			15+ 5+0	44.00	43.33	.67	
			48+ 5+0	51.66	43.33	8.33	
S-1	Fallow	Barley	0+32+0	55.62	53.54	2.08	
S-2	Barley	Durum	33+ 0+0	46.83	44.00	2.83	
S-6 ^b	Beets	Durum	15+15+0	48.50	46.83	1.67	
			48+15+0	53.50	46.83	6.67	
S-8 ^b	Barley	Durum	18+ 6+0	46.17	40.00	6.17	
			51+ 6+0	47.67	40.00	7.67	
Arthur Grove	16-C	Beets	HRS Wheat	51+ 6+0	40.00	26.67	13.33
	31-N	Wheat	HRS Wheat	25+25+0	41.33	26.00	15.33
	16-D	Wheat	Barley	24+ 8+0	60.00	50.83	9.17
	16-O	Beets	Barley	56+ 8+0	66.67	54.17	12.50
	16-P	Beets	Barley	25+25+0	54.16	45.83	8.33
	30-G+I	Barley	Oats	19+19+0	100.00	68.75	31.25
Orlin Gunderson	C+F	Grain	Sunflowers	15+37+0	1334#	1264#	70#
	E	Grain	Sunflowers	0+43+0	1421#	1156#	265#
	I	Barley	Sunflowers	25+25+0	1361#	1070#	291#
	D	Soybeans	Durum	26+32+0	50.66	45.83	4.83
	K	Durum	Barley	23+23+0	52.79	32.77	20.02
Lorry Rotvold	O	Fallow	HRS Wheat	13+32+0	44.66	32.13	12.53
	H	Beets	HRS Wheat	46+32+0	40.67	29.87	10.80

(continued)

APPENDIX TABLE A-8. CROP YIELD RESULTS ON TVA TEST-DEMONSTRATION FARMS IN TRAILL COUNTY, 1965 (continued)

Cooperator	Field No.	1964 Crop	1965 Crop	Nutrient Per Acre	Yield-bushels/acre		
					Fert.	Check	Diff.
Lorry	K	Beets	HRS Wheat	44+27+0	52.93	37.87	15.06
	I	Wheat	Barley	33+32+0	61.50	46.17	13.33
	B	Beets	Barley	46+32+0	62.00	51.33	10.67
	L	Beets	Barley	44+27+0	52.66	37.83	14.83
Henry Schlichtmann	9-8	Fallow	HRS Wheat	24+24+0	42.67	40.95	1.72
	16-8	Fallow	HRS Wheat	16+41+0	37.23	34.37	2.86
	9-10	Wheat	Barley	48+39+0	48.33	46.54	1.79
	9-3	Grain	Barley	49+39+0	72.49	69.81	2.68
	9-13	Corn	Oats	14+14+0	115.45	106.05	9.40
Traill County	Ave.	Fallow	HRS Wheat	17+33+0	41.67	35.64	6.03
		Fallow	Barley	5+30+0	55.92	54.52	1.40
		Nonfallow	HRS Wheat	41+22+0	41.85	28.60	13.25
		Nonfallow	Durum	48+10+0	47.94	39.71	8.23
		Nonfallow	Barley	40+24+0	65.22	56.06	9.16
		Nonfallow	Oats	17+17+0	105.57	82.19	23.38
		Nonfallow	Sunflowers	15+35+0	1386#	1177#	209#

^aThree rates of fertilizer were checked. The first is for nitrogen applied in the fall. The second is for spring application of nitrogen and phosphate. The third is a combination of fall and spring application of fertilizer.

^bOnly two rates of fertilizer were checked. A spring application and a combination of spring and fall.

APPENDIX B

AVERAGE COST AND RETURNS TO FERTILIZER ON TVA
TEST-DEMONSTRATION FARMS, 1965

APPENDIX TABLE B-1. AVERAGE COST AND RETURNS TO FERTILIZER, ADAMS COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Daryl Anderson	HRS Wheat on Fallow	36.6	\$2.70	\$5.54	\$2.84	105
	HRS Wheat on Nonfallow	10.0	4.24	.39	-3.85	-91
	Barley on Fallow	10.0	4.24	5.09	.85	20
	All Crops	56.6	\$3.25	\$4.55	\$1.30	40
Gene Davison	HRS Wheat on Fallow	71.5	\$2.82	\$5.64	\$2.82	100
	HRS Wheat on Nonfallow	39.0	3.80	7.60	3.80	100
	All Crops	110.5	\$3.16	\$6.33	\$3.17	100
Fred Ehlers	HRS Wheat on Fallow	67.0	\$2.70	\$3.30	\$.60	22
	HRS Wheat on Nonfallow	14.0	4.24	3.50	-.74	-17
	Barley on Fallow	43.0	3.95	4.79	.84	21
	All Crops	124.0	\$3.31	\$3.84	\$.53	16
Raymond Wothe	HRS Wheat on Fallow	28.5	\$3.50	\$-.17	\$-3.67	-105
	HRS Wheat on Nonfallow	58.0	4.58	3.51	-1.07	-23
	All Crops	86.5	\$4.23	\$2.30	\$-1.93	-46
Adams County	HRS Wheat on Fallow	203.6	\$2.86	\$4.04	\$1.18	41
	HRS Wheat on Nonfallow	121.0	4.26	4.57	.31	7
	Barley on Fallow	53.0	4.00	4.84	.84	21
	All Crops	377.6	\$3.47	\$4.32	\$.85	24

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965: HRS Wheat = \$1.44
Barley = .94

APPENDIX TABLE B-2. AVERAGE COST AND RETURNS TO FERTILIZER, BOWMAN COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Donald Brown	HRS Wheat on Fallow	104.0	\$4.12	\$4.71	\$.59	14
Roy Kern	HRS Wheat on Fallow	10.0	4.24	6.93	2.69	63
Earl Nelson	HRS Wheat on Nonfallow	30.0	3.22	6.22	3.00	93
	Barley on Fallow	80.0	3.66	10.15	6.49	177
	Oats on Nonfallow	<u>40.0</u>	<u>3.66</u>	<u>7.78</u>	<u>4.12</u>	<u>113</u>
	All Crops	150.0	\$3.57	\$8.73	\$5.16	145
Don Schumacher	HRS Wheat on Fallow	180.0	\$3.86	\$4.77	\$.91	24
Walter Stzegura	HRS Wheat on Fallow	88.0	\$3.22	\$8.32	\$5.10	158
	Barley on Nonfallow	<u>21.0</u>	<u>2.40</u>	<u>4.79</u>	<u>2.39</u>	<u>100</u>
	All Crops	109.0	\$3.06	\$7.64	\$4.58	150
Bowman County	HRS Wheat on Fallow	382.0	\$3.80	\$5.63	\$1.83	48
	HRS Wheat on Nonfallow	30.0	3.22	6.22	3.00	93
	Barley on Fallow	80.0	3.66	10.15	6.49	177
	Barley on Nonfallow	21.0	2.40	4.79	2.39	100
	Oats on Nonfallow	<u>40.0</u>	<u>3.66</u>	<u>7.76</u>	<u>4.12</u>	<u>113</u>
	All Crops	553.0	\$3.68	\$6.44	\$2.75	75

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965: HRS Wheat = \$1.44
 Barley = .94
 Oats = .48

APPENDIX TABLE B-3. AVERAGE COST AND RETURNS TO FERTILIZER, HETTINGER COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Leo DeWit	HRS Wheat on Fallow	95.0	\$2.99	\$4.49	\$1.50	50
	Barley on Fallow	32.0	3.04	6.74	3.70	122
	Barley on Nonfallow	17.0	3.47	6.58	3.11	90
	All Crops	144.0	\$3.06	\$5.24	\$2.18	71
Alvin Dill	HRS Wheat on Fallow	90.5	\$2.20	\$5.58	\$3.38	154
	HRS Wheat on Nonfallow	129.0	3.22	5.36	2.14	66
	Oats on Nonfallow	45.0	3.22	7.87	4.65	144
	All Crops	264.5	\$2.87	\$5.87	\$3.00	105
George Ott	HRS Wheat on Fallow	307.0	\$2.70	\$3.45	\$.75	28
	Barley on Nonfallow	60.0	4.63	4.35	-.28	-6
	All Crops	367.0	\$3.02	\$3.60	\$.58	19
Lawrence Thomas	HRS Wheat on Fallow	183.0	\$3.80	\$4.00	\$.20	5
	Barley on Fallow	20.5	2.61	6.99	4.38	168
	Barley on Nonfallow	73.0	2.82	3.15	.33	12
	All Crops	276.5	\$3.46	\$4.00	\$.54	16
Hettinger County	HRS Wheat on Fallow	675.5	\$2.97	\$4.03	\$1.06	36
	HRS Wheat on Nonfallow	129.0	3.22	5.36	2.14	66
	Barley on Fallow	52.5	2.88	6.84	3.96	138
	Barley on Nonfallow	150.0	3.62	4.02	.40	11
	Oats on Nonfallow	45.0	3.22	7.87	4.65	144
	All Crops	1,052.0	\$3.10	\$4.50	\$1.40	45

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965: HRS Wheat = \$1.44
Barley = .94
Oats = .48

APPENDIX TABLE B-4. AVERAGE COST AND RETURNS TO FERTILIZER, BOTTINEAU COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Howard	HRS Wheat on Fallow	82.0	\$3.08	\$7.95	\$4.87	158
Anderson	Durum on Fallow	80.0	3.61	8.06	4.45	123
	Barley on Nonfallow	46.0	3.78	3.46	-.32	-8
	All Crops	208.0	\$3.44	\$7.00	\$3.56	103
Harold	Durum on Fallow	70.0	\$3.22	\$1.06	\$-2.16	-67
Bergman	Durum on Nonfallow	60.0	3.60	.52	-3.08	-86
	Barley on Nonfallow	200.0	2.41	-1.31	-3.72	-154
	All Crops	330.0	\$2.80	\$-.48	\$-3.28	-117
C. L.	HRS Wheat on Fallow	220.0	\$2.19	\$5.21	\$3.02	138
O'Keeffe	Durum on Fallow	152.0	2.34	4.41	2.07	88
	Barley on Nonfallow	74.0	2.54	-2.34	-4.88	-192
	All Crops	446.0	\$2.30	\$3.68	\$1.38	60
Kermit	HRS Wheat on Fallow	280.0	\$2.07	\$2.14	\$.07	3
Kjonaas	Durum on Fallow	149.0	2.16	2.98	.82	38
	All Crops	429.0	\$2.10	\$2.43	\$.33	16
George	Durum on Fallow	69.0	\$2.63	\$7.88	\$5.25	200
Witteman	Durum on Nonfallow	40.0	3.49	-5.62	-9.11	-261
	All Crops	109.0	\$2.94	\$2.92	\$-.02	-1
Bottineau County	HRS Wheat on Fallow	582.0	\$2.26	\$4.12	\$1.86	82
	Durum on Fallow	520.0	2.64	4.57	1.93	73
	Durum on Nonfallow	100.0	3.55	-1.94	-5.49	-155
	Barley on Nonfallow	320.0	2.64	-.86	-3.50	-133
	All Crops	1,522.0	\$2.55	\$2.83	\$.28	11

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen, 10 cents per pound of phosphate, and 6 cents per pound of potash.

^cBased on prices for October, 1965: HRS Wheat = \$1.44
 Durum = 1.28
 Barley = .94

APPENDIX TABLE B-5. AVERAGE COST AND RETURNS TO FERTILIZER, BURKE COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Harry Benshoff	HRS Wheat on Fallow	272.0	\$2.35	\$3.76	\$1.41	60
	Oats on Fallow	<u>38.0</u>	<u>2.20</u>	<u>3.89</u>	<u>1.69</u>	<u>77</u>
	All Crops	310.0	\$2.33	\$3.78	\$1.45	62
Arnold Funk	Durum on Fallow	85.0	\$3.40	\$11.44	\$8.04	236
	Barley on Nonfallow	85.0	3.36	6.71	3.35	100
	Oats on Nonfallow	<u>45.0</u>	<u>2.60</u>	<u>9.83</u>	<u>7.23</u>	<u>278</u>
	All Crops	215.0	\$3.22	\$9.23	\$6.01	189
Burke County	HRS Wheat on Fallow	272.0	\$2.35	\$ 3.76	\$1.41	60
	Durum on Fallow	85.0	3.40	11.44	8.04	236
	Barley on Nonfallow	85.0	3.36	6.71	3.35	100
	Oats on Fallow	38.0	2.20	4.06	1.86	85
	Oats on Nonfallow	<u>45.0</u>	<u>2.60</u>	<u>9.83</u>	<u>7.23</u>	<u>278</u>
	All Crops	525.0	\$2.69	\$6.01	\$3.32	123

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965:

HRS Wheat	=	\$1.44
Durum	=	1.28
Barley	=	.94
Oats	=	.48

APPENDIX TABLE B-6. AVERAGE COST AND RETURNS TO FERTILIZER, RENVILLE COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Morten	HRS Wheat on Fallow	68.0	\$2.39	\$16.94	\$14.55	609
Clausen	HRS Wheat on Nonfallow	60.0	2.88	10.88	8.00	278
	Durum on Fallow	<u>84.0</u>	<u>2.58</u>	<u>4.93</u>	<u>2.35</u>	<u>91</u>
	All Crops	212.0	\$2.60	\$10.46	\$7.86	302
J. P. Lorenzen	HRS Wheat on Fallow	135.0	\$2.27	\$3.10	\$.83	37
	Durum on Fallow	<u>28.0</u>	<u>2.20</u>	<u>-.17</u>	<u>-2.37</u>	<u>-108</u>
	All Crops	163.0	\$2.26	\$2.54	\$.28	12
Randolph Brothers	HRS Wheat on Fallow	67.6	\$3.22	\$2.57	\$-.65	-20
	HRS Wheat on Nonfallow	40.0	4.24	1.15	-3.09	-73
	Durum on Nonfallow	<u>69.2</u>	<u>2.44</u>	<u>-1.87</u>	<u>-4.31</u>	<u>-177</u>
	All Crops	176.8	\$3.14	\$.51	\$-2.63	-84
Marce Schaefer	HRS Wheat on Fallow	53.0	\$1.90	\$1.54	\$-.36	-19
	Durum on Fallow	35.0	1.90	1.46	-.44	-23
	Barley on Nonfallow	<u>20.0</u>	<u>2.88</u>	<u>8.00</u>	<u>5.12</u>	<u>178</u>
	All Crops	108.0	\$2.08	\$2.71	\$.63	30
David Witteman	HRS Wheat on Fallow	40.0	\$2.70	\$1.83	\$-.87	-32
	Durum on Fallow	105.0	1.97	.98	-.99	-50
	Barley on Fallow	<u>50.0</u>	<u>2.70</u>	<u>3.29</u>	<u>.59</u>	<u>22</u>
	All Crops	195.0	\$2.31	\$1.75	\$-.56	-24
Renville County	HRS Wheat on Fallow	363.6	\$2.46	\$5.22	\$2.76	112
	HRS Wheat on Nonfallow	100.0	3.43	6.99	3.56	104
	Durum on Fallow	252.0	2.19	2.24	.05	2
	Durum on Nonfallow	69.2	2.44	-1.87	-4.31	-177
	Barley on Fallow	50.0	2.70	3.29	.59	22
	Barley on Nonfallow	<u>20.0</u>	<u>2.88</u>	<u>8.00</u>	<u>5.12</u>	<u>178</u>
	All Crops	854.8	\$2.52	\$3.93	\$1.41	56

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965: HRS Wheat = \$1.44
 Durum = 1.28
 Barley = .94

APPENDIX TABLE B-7. AVERAGE COST AND RETURNS TO FERTILIZER, CASS COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Ralph	Durum on Nonfallow	173.0	\$6.44	\$9.41	\$2.97	46
Peterson	Barley on Nonfallow	160.0	5.66	10.86	5.20	92
	Oats on Nonfallow	57.0	6.12	3.70	-2.42	-40
	Corn on Nonfallow	40.0	7.38	-1.31	-8.69	-118
	All Crops	430.0	\$6.19	\$8.19	\$2.00	32

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965: Durum = \$1.28
 Barley = .94
 Oats = .48
 Corn = 1.02

APPENDIX TABLE B-8. AVERAGE COST AND RETURNS TO FERTILIZER, TRAILL COUNTY, 1965^a

Cooperator	Crop	Acres Checked	Ave. Fert. Cost/A. ^b	Ave. Added Return Per Acre ^c	Ave. Net Return Per Acre	Per Cent Profit
Anderson Brothers	Durum on Nonfallow	285.0	\$7.82	\$10.69	\$2.87	37
	Barley on Fallow	74.0	3.69	1.31	-2.38	-64
	Barley on Nonfallow	170.0	8.50	5.58	-2.92	-34
	All Crops	529.0	\$7.46	\$7.74	\$.28	4
Arthur Grove	HRS Wheat on Nonfallow	78.0	\$6.85	\$20.68	\$13.83	202
	Barley on Nonfallow	116.0	6.28	9.41	3.13	50
	Oats on Nonfallow	55.0	4.56	15.00	10.44	229
	All Crops	249.0	\$6.08	\$14.17	\$8.09	133
Orlin Gunderson	Durum on Nonfallow	10.0	\$6.84	\$6.18	\$-.66	-10
	Barley on Nonfallow	33.0	5.52	18.82	13.30	241
	Sunflowers on Nonfallow	78.0	5.52	8.74	3.22	58
	All Crops	121.0	\$5.63	\$11.28	\$5.65	100
Lorry Rotvold	HRS Wheat on Fallow	30.0	\$5.02	\$18.04	\$13.02	259
	HRS Wheat on Nonfallow	58.0	9.47	16.93	7.46	79
	Barley on Nonfallow	116.0	8.73	12.77	4.04	46
	All Crops	204.0	\$8.39	\$14.73	\$6.34	76
Henry Schlichtmann	HRS Wheat on Fallow	52.0	\$6.05	\$3.30	\$-2.75	-45
	Barley on Nonfallow	60.0	10.67	2.00	-8.67	-81
	Oats on Nonfallow	31.0	3.36	4.52	1.16	35
	All Crops	143.0	\$7.41	\$3.02	\$-4.39	-59
Traill County	HRS Wheat on Fallow	82.0	\$5.67	\$8.69	\$3.02	53
	HRS Wheat on Nonfallow	136.0	7.96	19.07	11.11	140
	Durum on Nonfallow	295.0	7.78	10.54	2.76	35
	Barley on Fallow	74.0	3.69	1.31	-2.38	-64
	Barley on Nonfallow	495.0	8.10	8.61	.51	6
	Oats on Nonfallow	86.0	4.13	11.22	7.09	172
	Sunflowers on Nonfallow	78.0	5.52	8.74	3.22	58
	All Crops	1,246.0	\$7.15	\$9.97	\$2.82	39

^aWeighted averages based on number of acres checked at harvest.

^bThe cost of fertilizer was 14 cents per pound of nitrogen and 10 cents per pound of phosphate.

^cBased on prices for October, 1965:

HRS Wheat	= \$1.44
Durum	1.28
Barley	.94
Oats	.48
Sunflowers	.047/lb.