Summary Report . . .

WHEAT FERTILIZATION EXPERIMENTS

in the Columbia Basin

1953-57

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This report includes a summary of the effects of fertilizers, particularly nitrogen, on the yield and quality of wheat in five wheat-growing counties of the Columbia Basin in Oregon.

Results reported here represent experimental work on 173 farms selected in Wasco, Sherman, Gilliam, Morrow, and Umatilla Counties. Exprimental sites were deliberately chosen to provide information from major soil types under varying climatic conditions.

Informaton in this report may be used as a basis for general fertilizer recommendations where soil and climatic conditions for a particular farm can be related to one or more of the experimental sites on which fertilizer experiments were conducted. Soil type, soil depth, and climatic conditions varied widely between farms and between areas. Results varied from year to year due to moisture and management differences.

Information presented in this report may be helpful to farmers in evaluating benefits to be expected from the use of fertilizers. This report can serve a further purpose as a basis for estimating the overall fertilizer needs of wheat in the entire Columbia Basin Area.

The Research Program

An extensive fertility research program was conducted in the Columbia Basin wheat area of Oregon during the four years 1953 to 1957 on 173 experimental sites. This study was conducted to determine relationships between levels of soil nitrogen, soil moisture, and yield of wheat to nitrogen fertilization. Effect of nitrogen on test weight and protein content of wheat was obtained. Fall and spring applications of nitrogen fertilizer were compared.

Data from the first two years of this study were published in Oregon Agricultural Experiment Station Circular of Information 570 entitled, "Progress Report . . . Wheat Fertilizer Experiments in the Columbia Basin, 1953-55." The present report gives a general summary of the data obtained during the 4-year period and detailed information on the response to fertilizers obtained during the last two years (see Summary).

Description of the Area

The Columbia Basin dryland wheat area of Oregon refers to all the nonirrigated wheatlands of Umatilla, Morrow, Gilliam, Sherman, and Wasco Counties. This area which is roughly 150 miles long and 60 miles wide, extends from the Cascade Mountains on the west to the Blue Mountains on the east and northeast, and lies south of the Columbia River. It contains approximately 1½ million acres of cropland. In Figure 1 approximate boundaries of principal soils and distribution and approximate location of the 173 experimental sites are indicated.

Wide variations in elevation, soil depth, and precipitation occur. Elevations range from about 600 feet just south of the river to nearly 3,000 feet close to the mountains. In general, soil depth decreases with distance from the river. Average annual precipitation ranges from a little less than 10 to more than 20 inches. Heavier rainfall occurs relatively close to the two mountain ranges, and most precipitation occurs during the winter and early spring. Figure 2 shows the approximate average annual precipitation boundaries for the area studied.

The term "low-rainfall area" as used in this report refers to areas where rainfall is less than 15 inches per year and farmers follow a wheat-fallow farming system. "High-rainfall area" refers to a narrow belt of soils lying along footslopes of the mountains in eastern Umatilla and western Wasco Counties where annual rainfall averages around 15 inches or more. In eastern Umatilla County land is cropped annually, often alternately with wheat and canning peas.

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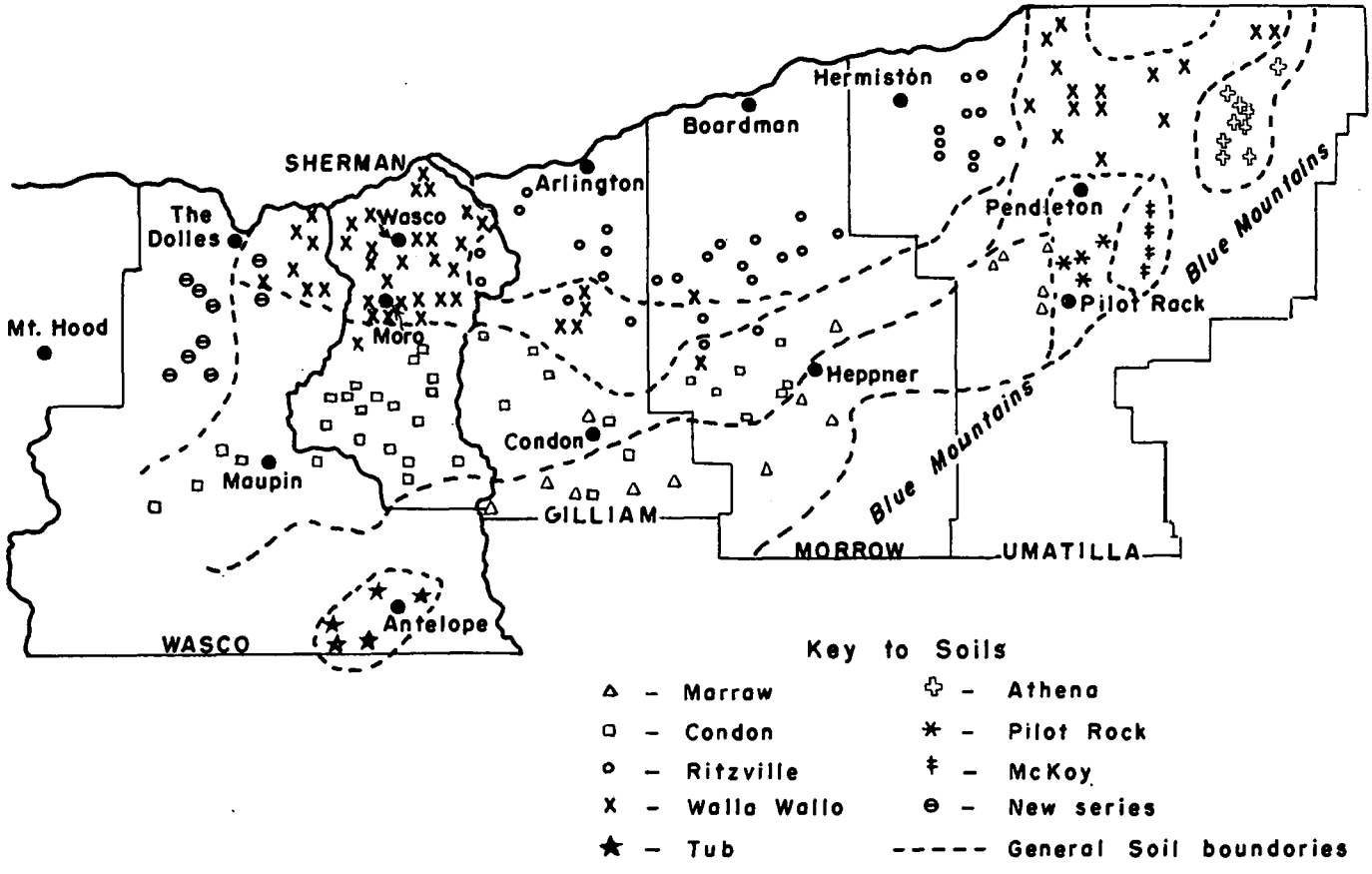
County Extension Agents Victor W. Johnson, Norton Taylor, N. C. Anderson, Ernest J. Kirsch, Thomas W. Thompson, E. M. Nelson, and John Frizzell participated actively in this study. Soil Scientists Elmar Hill, Robert Mitchell, Douglas Price, Burrell Lovell, and J. Leo Paul examined the experimental sites and classified the soil as to type. Lyle D. Calvin and Roger Petersen, statisticians, directed the statistical analyses.

Figure 1. Approximate location of experimental sites.



Experimental Procedures

This study was conducted on 173 experimental sites. Selection of specific sites was made on the basis of apparent uniformity of soil, past management, degree of slope, and proximity to roads. In general, slopes greater than about 15 percent were avoided. In almost all cases plots were 8 feet wide and 50 feet long. On each site, 15 fertilizer treatments were repeated 4 times. The 60 plots on each farm occupied about half an acre. Table 1 shows the number of experiments in each of the Columbia Basin Counties during the 4 years.

In all cases the farmer selected as a cooperator, prepared seedbeds, planted wheat, sprayed weeds, and performed other necessary field operations on the experimental sites in accordance with his own schedule except for application of fertilizer treatments and harvest of plots.

Fertilizer treatments varied somewhat with area and with years. Nitrogen rates employed in the lower rainfall areas varied by 20-pound increments from 0 to 80 pounds

Table 1. Number of Experiments in Each County for Each Year in Both Low (below 15 inches) and High (15 inches and over) Rainfall Areas

County	Number of Experiments				
	1953-54	1954-55	1955-56	1956-57	Total
Umatilla					
Low rainfall	11	12	8	5	36
High rainfall	5	5	3	2	15
Morrow*	9	7	5	5	26
Gilliam					
Low rainfall	6	7	7	4	24
High rainfall	1	....	....	....	1
Sherman*	10	10	10	11	41
Wasco					
Low rainfall	4	5	9	7	25
High rainfall	3	2	....	....	5
Total	49	48	42	34	173

* All sites in Morrow and Sherman Counties were in low rainfall area.

of N per acre in 1953-54 and from 0 to 100 pounds in the other three years. In the higher rainfall areas rates of nitrogen were 50 percent higher. The same rates of nitrogen were applied to separate plots at fall seeding time (September or October) and in spring shortly after growth started (March or early April).

Phosphorus and sulfur were applied with all rates of nitrogen in 1953-54. In succeeding years they were applied only in certain treatments designated to provide qualitative information on the need for these elements. A micronutrient mixture (boron, copper, manganese, zinc) was added in one treatment each year to test the need for these nutrients. All fertilizers were applied by means of a belt-type applicator, slightly below or on the soil surface, in bands 12 inches apart. Ammonium nitrate, TVA concentrated superphosphate, gypsum, borax, and the sulphates of copper, manganese, and zinc were fertilizer sources.

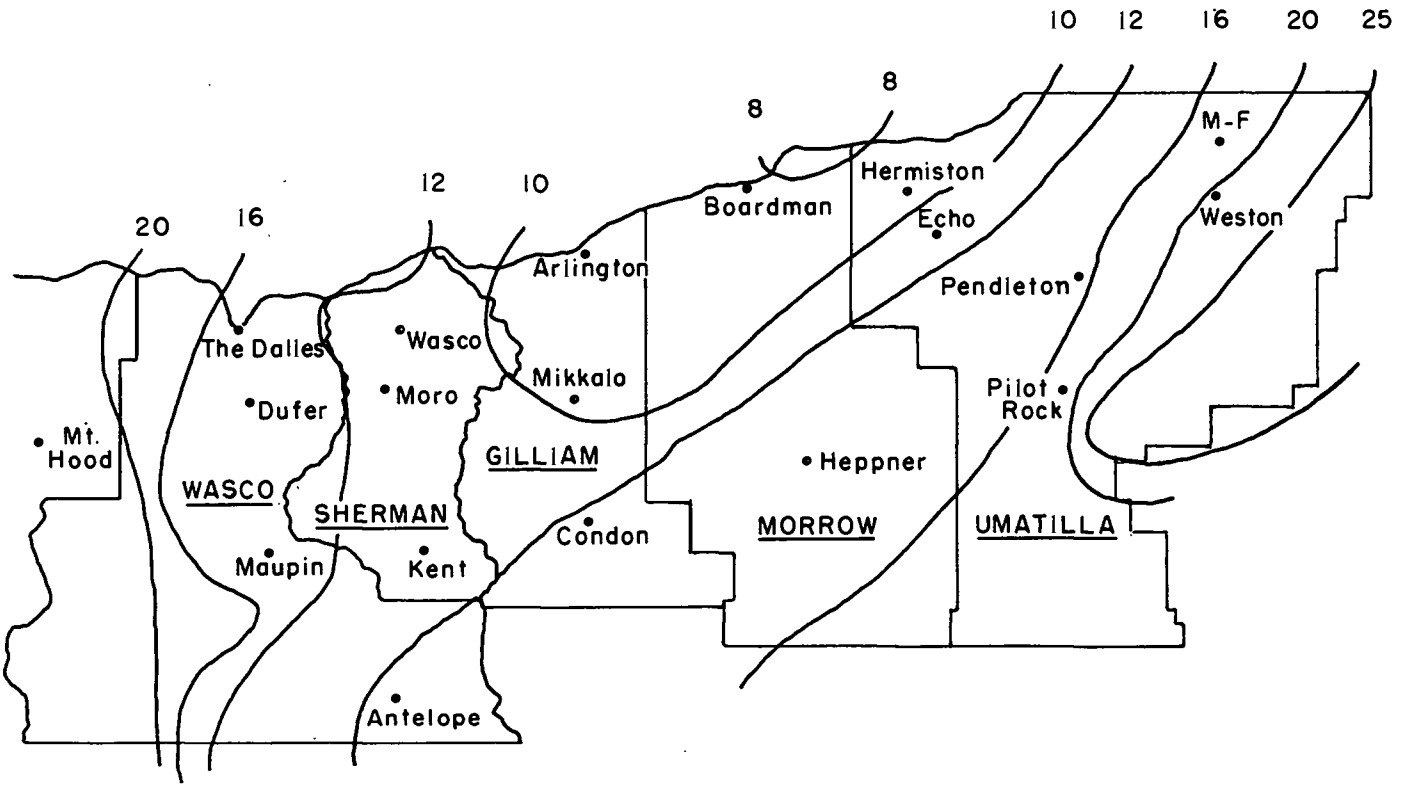
At the time of fertilizer applications in fall and spring, soil samples to 6 feet were taken from all experimental sites by 1-foot increments of depth, or to bedrock or restricting layer where the soil depth was less than 6 feet. Content of available soil moisture and several forms of nitrogen were determined. Efforts to correlate these data with yield responses to fertilizer are discussed in Oregon Agricultural Experiment Station Technical Bulletin 57.

Each year several cooperators in Morrow, Gilliam, Sherman, and Wasco Counties were supplied with rain gauges for measurement of precipitation at points as near the experimental sites as feasible for servicing by the cooperator. Precipitation for Umatilla County was obtained from approximately 15 rain gauges located throughout the county and serviced by the Pendleton Grain Growers, Inc. Records from official Weather Bureau observation stations in the area were also used.

Self-propelled, portable plot combines were used to harvest a strip 40 inches wide and 40 feet long from each plot. Wheat from individual plots was recleaned and yields were then calculated to 60-pound bushels per acre. Test weight and protein content determinations were made on samples of wheat from all plots.

Soil types and varieties of wheat grown at each experimental site are indicated in Appendix Tables 1 through 12.

Figure 2. Approximate average precipitation boundaries, inches per year.



Results

Yield Response from Added Nitrogen

Yield responses to nitrogen fertilizer on individual farms and averages for counties for the first two years of this study were presented in Oregon Agricultural Experiment Station Circular of Information 570. Listed in Appendix Tables 1 to 12 of this bulletin, for each of the 76 experimental sites for 1955-56 and 1956-57, are found the name of the farmer who cooperated, community in which each experimental site was located, fertilizer treatments employed, wheat yields obtained from each fertilizer treatment, average yields from fall and spring applications of the same rates of nitrogen, soil depth, series and type, date of fertilizer application, and variety of wheat grown. The farms are grouped according to county and year. Average yields for all farms in each county are included.

Addition of nitrogen to the wheat crop resulted in three types of yield responses: (1) significant increase, (2) significant decrease, or (3) no appreciable effect. Most data for yields, test weight, and protein content have been related to these types of response.

There were significant yield responses to sulfur on one site in 1953-54 and on two sites in 1954-55. For the same two years there were two and five sites which gave a response with phosphorus. In 1955-56 there were four significant yield responses to the combination of sulfur, phosphorus, and the micro nutrients. The nutrient responsible could not be identified but sulfur was suspected.

Considering both fall- and spring-applied nitrogen for all 173 experimental sites over the 4-year period, approximately 75 percent showed yield increases, 15 percent showed yield decreases, and 10 percent showed neither an increase nor a decrease. The highest average yields for the period of the investigation were obtained in Sherman County—the lowest in Morrow County.

Low rainfall area

Figure 3 shows effect of added nitrogen on the type of response and yield of wheat for the 152 sites in the low rainfall area. Type of response to added nitrogen was almost the same for fall-applied as for spring-applied nitrogen. Where the addition of nitrogen increased or had no effect on yield there was very little difference in actual yield between fall-applied or spring-applied nitrogen. On the other hand, fall-applied nitrogen resulted in larger yield decreases than did spring-applied nitrogen. No yield depressions from the use of nitrogen fertilizer were observed in the 1955-56 crop.

For those sites where one or more rates of added nitrogen resulted in a significant yield increase, rates of 20, 40, 60, 80, and 100 pounds gave increases over the check plot of 5.7, 9.5, 11.7, 12.1, and 12.5 bushels per acre, respectively.

Figure 3. Effect of nitrogen on response and yield of wheat, low rainfall area.

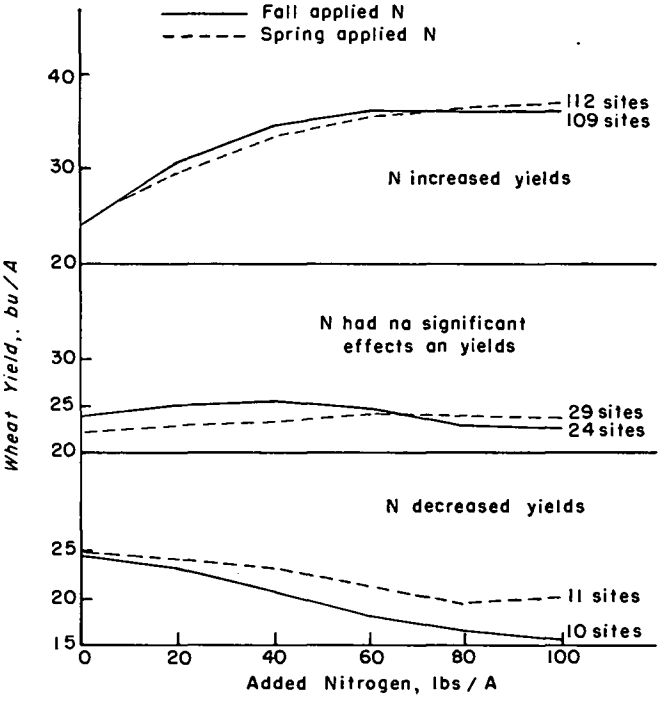
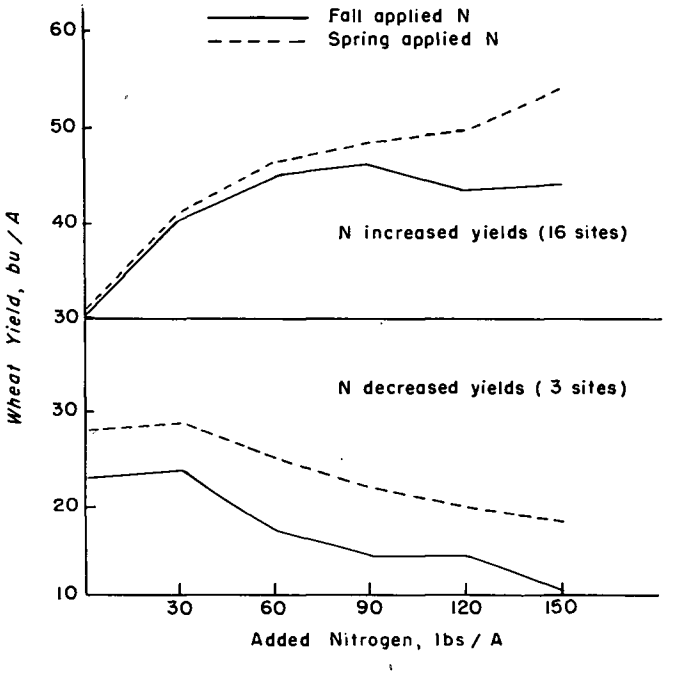


Figure 4. Effect of nitrogen on response and yield of wheat, high rainfall area.



High rainfall area

Average yields obtained with added nitrogen in the high rainfall area are presented in Figure 4. Data are grouped according to type of response. For both fall- and spring-applied nitrogen, yields were increased on 16 sites but decreased on 3. Spring-applied nitrogen appears to be superior to that applied in the fall, regardless of response obtained. It is of considerable importance that yield decreases occurred only for the 1955 crop.

Nitrogen Required to Produce One Bushel of Wheat

Amount of fertilizer required to produce an increase of one unit of crop yield is an important consideration in use of fertilizer, particularly when costs are considered. Average number of pounds of fall- and spring-applied nitrogen required to increase wheat yield by one bushel per acre for the four major soil series is given in Table 2. These data are from experimental sites where nitrogen produced significant yield increases.

The greatest efficiency for fall-applied nitrogen was obtained on the Walla Walla and Condon soils where approximately 3 pounds of nitrogen were required per bushel of wheat increase over the check plot. Fifty percent more nitrogen was required for the Ritzville and Morrow soils. It should be pointed out that data for Condon soils were from sites deeper than 3 feet. Practically all of the yield responses on Morrow soils were in 1955-56.

There was much less efficiency where nitrogen was applied in the spring for all but Morrow soils. Ritzville soil was the least efficient and required about 6 pounds of nitrogen to increase wheat yield by 1 bushel per acre.

For all 109 sites in the low rainfall area where a significant yield response was obtained from added nitrogen, the amount required to increase wheat yield by one bushel per acre was 3.7 pounds for fall-applied, and 4.1 pounds for spring-applied nitrogen. This is almost identical with the 3.5 and 4.3 pounds required by the four major soils for fall- and spring-applied nitrogen, respectively.

Effect of Nitrogen on Test Weight

A summary of effects of nitrogen application on test weights of wheat is given in Figure 5 for 156 experiments on which test weight data were obtained. (Test weight data were not obtained for the 1955-56 crop on 16 experiments in Umatilla and Morrow Counties.)

Effects of nitrogen fertilizer on test weights tended to parallel effects on yield. On sites where yields were increased by nitrogen, test weights were also increased. Where no significant effects on yields were produced, test weights declined slightly with increasing rates of nitrogen. Largest decreases occurred where added nitrogen significantly reduced yields. In these cases reduced yields often resulted from "burning" of the foliage and shriveling of the grain from too early exhaustion of the moisture supply.

In general, average test weights were lower than the 60 pounds accepted as the standard weight of a bushel of wheat. Where yields increased with added nitrogen there was very little difference in test weight between fall or spring applications. On the other hand, where there was no effect or a decrease in yield, fall application of nitrogen gave slightly higher test weights than spring application. Test weights were slightly higher for 1953-54 than for any of the other years.

Table 2. Average Pounds of Applied Nitrogen Required to Increase Wheat Yield by One Bushel per Acre on Four Major Soil Types in the Low Rainfall Area

(Data are summarized for fall- and spring- applied nitrogen where significant yield increases were obtained)

Soil series	No. of sites	Added N required for max. yield	Yield			Pounds N per bushel increase
			Check	Maximum	Increase	
		Lbs./acre	Bushels per acre			
		Fall-Applied Nitrogen				
Walla Walla	40	45.0	27.4	41.8	14.4	3.1
Ritzville	25	40.0	20.2	29.1	8.9	4.5
Condon[1]	19	30.0	29.4	38.7	9.3	3.2
Morrow[2]	5	45.0	21.3	31.5	10.2	4.4
All 4 soils	89	40.0	25.5	37.0	11.5	3.5
		Spring-Applied Nitrogen				
Walla Walla	38	55.0	28.6	40.7	12.5	4.4
Ritzville	28	40.0	19.6	26.5	6.9	5.8
Condon[1]	20	45.0	27.2	38.5	11.3	4.0
Morrow[2]	6	35.0	22.1	34.5	12.4	2.9
All 4 soils	92	45.0	25.0	35.5	10.5	4.3

[1] From Condon soils over 3 feet deep.
[2] Yield increases from added nitrogen were almost entirely for 1955-56 crop year.

Figure 5. Effect of rate and time of application of nitrogen on test weight of wheat, low rainfall area.

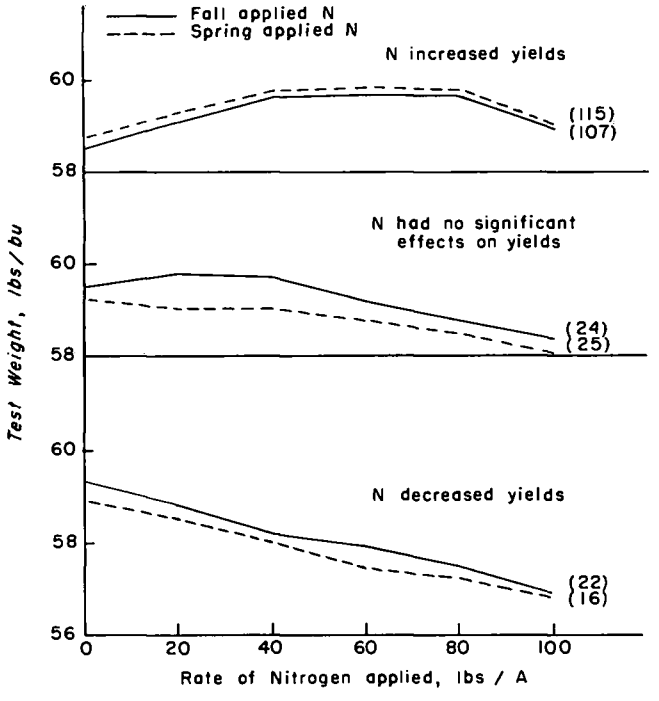
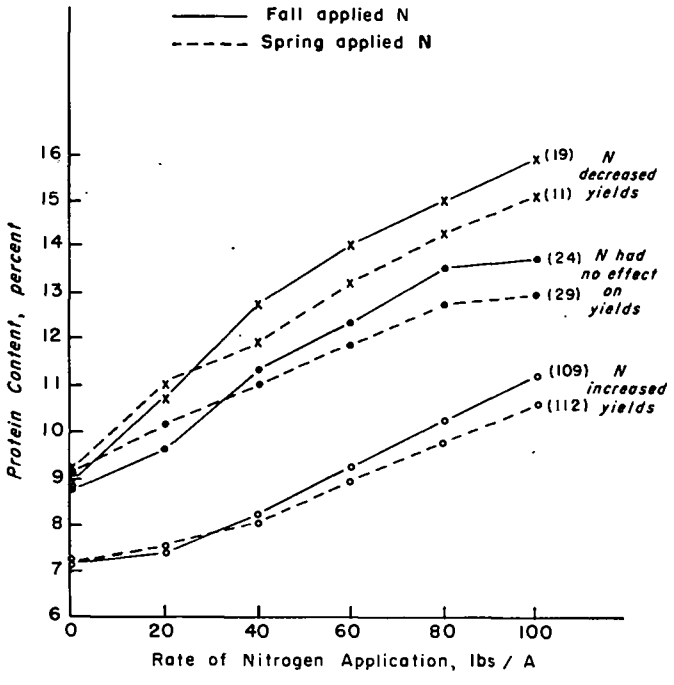


Figure 6. Effect of rate of nitrogen on protein content of wheat, low rainfall area.



Effect of Nitrogen on Protein Content of Wheat

With the exception of Turkey Red, all wheat grown in these experiments was of soft white varieties used chiefly for pastries. Since the quality of pastry wheat is impaired if protein content rises to levels of around 10 percent or above, it is desirable to regulate the supply of nitrogen so that optimum yields are obtained without greatly exceeding that level.

Protein content of wheat is affected by rate of added nitrogen. Type of response from experiments on 152 farms in the low rainfall area is presented in Figure 6. (Responses of protein content to nitrogen in the high rainfall area were essentially the same.)

Lowest average protein content was obtained on those sites on which addition of nitrogen resulted in a significant yield increase. For these same sites, the average protein content exceeded 10 percent only at the highest rate of added nitrogen. Where no nitrogen was applied the average protein content of wheat was only slightly above 7 percent. Nitrogen applied in the spring resulted in only slightly lower protein contents than similar rates applied in the fall.

Highest protein content of wheat was obtained on those sites where addition of nitrogen decreased yields significantly. Where no nitrogen was applied to these sites, the protein content of wheat was slightly above 9 percent and increased markedly with each increment of nitrogen. Similar effects were noted where addition of nitrogen did not have any significant effect on yield.

These data show that, on the average, whenever the wheat in a field in this area contains less than 8 percent protein, increased yield could have been obtained by application of more nitrogen. On the other hand, whenever protein content is 9 percent or more, additional nitrogen probably would not have increased yield.

Since several factors affect the results obtained with nitrogen fertilizer, these must be considered in applying the information presented. The large number of widely distributed sites suggests that the summary averages give a good overall view of the kind of results to be expected in the area. But results on individual locations and in different years varied widely.

Variation in soil type, soil depth, available moisture, available nitrogen, and past management differed widely. Also variations in climatic conditions from year to year and place to place affected results. The tables of results of individual sites (Appendix) provide information of more value to a specific farm or location.

Summary

This circular presents a summary of effects of nitrogen fertilizer on yields of wheat in 173 cooperative experiments on farms in the Columbia Basin of Oregon. This research was conducted during the four crop years 1953-54 to 1956-57. Effects on test weight and protein content also were obtained. Fall and spring applications of nitrogen were compared.

Use of nitrogen fertilizer in the low rainfall area significantly increased wheat yields on approximately 75 percent of the sites. There was no significant effect on yield on 15 percent and a significant decrease in yield on 10 percent of the sites where nitrogen was applied. Relatively little difference existed between fall- and spring-applied nitrogen where yields were increased. For the high rainfall area, 16 out of 19 sites produced yield increases with added nitrogen.

There was a little difference in the efficiency of added nitrogen to produce an increase of one bushel of wheat per acre for the four major soil types. The biggest difference can be seen by comparing fall- and spring-applied nitrogen, where the latter was the least efficient for all but Morrow soil.

Test weight of wheat increased with added nitrogen where yields were increased but showed no change where yields were not increased.

Protein content increased with increments of nitrogen regardless of effect of nitrogen on yield. However, protein content was much higher in wheat where the yield was not affected or was decreased by added nitrogen.

Appendix

Appendix Table 1. Columbia Basin Wheat Fertilization Experiments in Umatilla County, Lower Rainfall Area, 1955-56

Treatment No.	Treatment N-P_2O_5-S	John Blanchet (Coombs Canyon)	Ralph Hutchinson (Pilot Rock)	R. H. Leisinger (Helix)	Leonard Lorenszen (West Pendleton)	Peter Meyers (Echo)	Marshall Patton (South Reservation)	Clyde Preston (Myrick)	Stockman-Swearingen (Juniper)	Mean 8 farms
	Lbs./acre				*Bushels per acre*					
					Fertilizer Applied in Fall					
1	0-0-0	24.1	19.5	23.7	28.0	22.3	13.4	29.9	25.4	23.3
2	20-0-0	28.1	24.9	36.3	37.1	28.8	17.5	39.9	28.8	30.2
3	40-0-0	29.5	25.0	45.0	43.4	35.9	21.4	45.8	30.3	34.5
4	60-0-0	31.1	30.6	50.1	45.0	34.9	27.6	45.4	33.5	37.3
5	80-0-0	29.0	25.8	55.0	43.4	38.1	29.9	47.9	33.0	37.8
6	100-0-0	29.6	27.9	58.2	42.9	36.6	31.9	46.2	36.5	38.7
LSD[1], Trs. 1-6		2.7	5.0	3.6	3.2	4.5	7.2	5.1	5.8	
3	40-0-0	29.5	25.0	45.0	43.4	35.9	21.4	45.8	30.3	34.5
7	40=50=50=MN[2]	32.1	30.5	46.7	44.7	35.5	25.7	43.7	33.3	36.5
					Fertilizer Applied in Spring					
1	0-0-0	24.1	19.5	23.7	28.0	22.3	13.4	29.9	25.4	23.3
8	20-0-0	28.9	26.1	37.6	33.8	26.6	18.8	40.0	26.1	29.7
9	40-0-0	29.8	26.9	45.7	39.9	26.0	22.0	40.1	27.7	32.3
10	60-0-0	29.7	22.8	50.2	41.5	30.6	30.8	44.1	38.7	34.8
11	80-0-0	30.3	23.1	52.7	41.4	29.3	30.1	45.9	26.1	34.9
12	100-0-0	28.9	25.2	54.1	41.4	32.8	32.6	43.9	30.2	36.1
LSD, Trs. 1, 8-12		2.7	NS	3.6	3.2	4.5	7.2	5.1	NS	
					Means of Fall-and Spring-Applied Nitrogen					
Fall N		28.6	25.6	44.7	40.0	32.8	23.6	42.5	31.3	33.6
Spring N		28.6	23.9	44.0	37.7	27.9	24.6	40.7	27.4	31.9
Sig. of diff.[3]		NS	NS	NS	Sig.	Sig.	NS	NS	Sig.	
Soil depth, feet		2	2	6	6	5	2½	6	6	
Soil type		Morrow silt loam	Morrow silt loam	Walla Walla silt loam	Ritzville very fine sandy loam	Ritzville silt loam	McKay silt loam	Walla Walla silt loam (lt. text.)	Walla Walla silt loam (lt. text.)	
Date of fertilizer application										
Fall		10/7/55	10/6/55	10/3/55	9/29/55	9/28/55		9/30/55	10/7/55	
Spring		4/4/56	4/4/56	3/29/56	3/28/56	3/27/56		3/29/56	3/29/56	
Wheat variety		Elmar	40-Fold	Elmar	Elmar	Brevor	Elmar	Elmar	Elgin	

[1] LSD = "Least significant difference between treatment means" (P = 0.05).
[2] MN = 25 lbs. each of borax and sulfates of Cu, Mn, and 50 lbs. of zinc sulfate per acre.
[3] Significant difference at P = 0.01; NS = Not significant.

Appendix Table 2. Columbia Basin Wheat Experiments, Umatilla County, Higher Rainfall Area, 1955-56

No.	Fertilizer Treatment N-P_2O_5-S	John Adams	Dale Erickson	Reser Bros.	Mean 3 farms
	Lbs./acre	*Bushels per acre*			
		Fertilizer Applied in Fall			
1	0-0-0	48.0	22.8	23.5	31.4
2	30-0-0	56.9	30.8	41.8	43.2
3	60-0-0	64.5	41.5	43.6	49.9
4	90-0-0	60.0	54.0	48.8	54.3
5	120-0-0	51.0	50.6	51.2	50.9
6	150-0-0	47.8	58.1	50.5	52.1
	LSD[1], Trs. 1-6	12.3	11.1	7.6	
7	90-50-50	58.6	48.1	54.3	53.7
8	90-0-10	64.2	47.6	50.6	54.1
9	90-50-10	62.7	48.8	47.3	53.0
10	90-50-10-MN[2]	67.6	55.9	52.8	58.8
		Fertilizer Applied in Spring			
1	0-0-0	48.0	22.8	23.5	31.4
11	30-0-0	58.0	35.6	33.5	42.4
12	60-0-0	63.4	47.9	41.0	50.8
13	90-0-0	63.9	47.2	54.6	55.2
14	120-0-0	64.1	51.7	54.6	56.8
15	150-0-0	61.6	55.2	53.8	56.9
	LSD,Trs.1,11-15	12.3	11.1	7.6	
		Means of Fall-and Spring-Applied Nitrogen			
	Fall N	54.7	43.0	43.2	47.0
	Spring N	59.8	43.4	43.5	48.9
	Sig of diff.[3]	Sig.	NS		
	Soil depth, feet	6			
	Soil series and type	Athena silt loam	Waha Palouse silt loam	Walla Walla silt loam	
	Date of fertilizer application				
	Fall	10/3/55	10/3/55	10/6/55	
	Spring	4/10/56	4/9/56	4/9/56	
	Wheat variety	Elmar	Elmar	Elmar	

For footnotes see Appendix Table 1.

Appendix Table 3. Columbia Basin Wheat Experiments, Morrow County, 1955-56

Treatment No.	N-P_2O_5-S	Harold Beach (North Lexington)	Lawrence Becket (8-Mile)	John Eubanks (West Ione)	Harold Evans (Clark Canyon)	Kenneth Peck (Clark Canyon)	Mean 5 farms
	Lbs./acre			*Bushels per acre*			
				Fertilizer Applied in Fall			
1	0-0-0	17.4	29.4	19.3	24.6	16.2	21.4
2	20-0-0	18.7	39.9	24.8	30.9	25.8	28.0
3	40-0-0	20.8	51.4	27.9	33.1	26.6	32.0
4	60-0-0	21.7	57.5	27.0	32.4	30.1	33.7
5	80-0-0	20.7	62.4	28.8	26.7	33.9	34.5
6	100-0-0	21.1	63.0	28.6	32.8	39.1	36.9
LSD[1], Trs. 1-6		2.5	5.6	2.8	5.8	4.0	
3	40-0-0	20.8	51.4	27.9	33.1	26.6	32.0
7	40-50-50-MN[2]	19.6	51.7	29.0	31.4	29.5	32.2
				Fertilizer Applied in Spring			
1	0-0-0	17.4	29.4	19.3	24.6	16.2	21.4
8	20-0-0	19.8	40.8	25.1	30.2	22.1	27.6
9	40-0-0	21.1	54.6	24.4	31.0	25.5	31.3
10	60-0-0	21.8	58.6	26.3	32.3	29.2	33.7
11	80-0-0	21.1	59.3	27.1	31.9	29.6	33.8
12	100-0-0	21.5	66.8	27.9	34.6	32.0	36.6
LSD, Trs. 1, 7-12		2.5	5.6	2.8	5.8	4.0	
				Means of Fall- and Spring-Applied Nitrogen			
Fall N		20.1	50.6	26.1	30.1	28.6	31.1
Spring N		20.5	51.6	25.0	30.8	25.8	30.7
Sig. of diff.[3]		NS	NS	Sig.	NS	Sig.	
Soil depth, feet		3½	3	6	2½	3½	
Soil type		Ritzville silt loam	Condon silt loam	Ritzville very fine sandy loam	Condon silt loam	Ritzville silt loam	
Date of fertilizer applications							
Fall		10/20/55	10/19/55	10/19/55	10/18/56	10/18/55	
Spring		4/2/56	4/3/56	4/2/56	4/3/56	5/3/56	
Wheat variety		Ruqua	Elmar	Orfed	Elmar	Brevor	

For footnotes see Appendix Table 1.

Appendix Table 4. Columbia Basin Wheat Experiments, Gilliam County, 1955-56
(Yield, bushels per acre—means of 4 replications)

Treatment No.	N-P_2O_5-S	Earl Gentry (Mayville)	Lester Harrison (Trail Fork)	Robert Patching (Ajax)	Lee Pettyjohn (8 Mile Flat)	Rudolph Steinke (Shutler Flat)	Clark Van Gaasbeck (Blalock)	Bill Wise (Mikkalo)	Mean 7 farms
	Lbs./acre			Fertilizer Applied in Fall					
1	0-0-0	18.2	19.8	27.1	17.4	18.3	9.0	17.2	18.1
2	20-0-0	28.0	27.2	29.8	21.8	28.0	11.8	16.7	23.3
3	40-0-0	34.8	29.7	28.0	25.4	32.2	14.2	16.5	25.8
4	60-0-0	37.8	32.6	29.2	28.8	34.1	14.6	17.0	27.7
5	80-0-0	41.0	37.3	28.2	29.5	33.0	12.8	15.1	28.1
6	100-0-0	45.9	39.5	30.6	27.7	33.5	15.1	17.6	30.0
LSD[1], Trs. 1-6		5.0	10.0	NS	4.8	2.7	3.1	NS	
3	40-0-0	34.8	29.7	28.0	25.4	32.2	14.2	16.5	25.8
7	40-50-50-MN[2]	35.4	28.3	30.6	29.6	31.9	16.3	19.6	27.4
				Fertilizer Applied in Spring					
1	0-0-0	18.2	19.8	27.1	17.4	18.3	9.0	17.2	18.1
8	20-0-0	29.7	33.4	24.8	19.3	23.6	10.6	17.6	22.7
9	40-0-0	33.9	37.9	24.3	21.2	25.3	11.7	15.9	24.3
10	60-0-0	43.3	47.1	26.3	23.2	26.7	12.6	18.0	28.2
11	80-0-0	43.9	47.3	27.5	25.3	27.4	12.4	16.2	28.6
12	100-0-0	46.4	43.0	26.9	25.2	31.1	14.8	17.8	29.3
LSD, Trs. 1, 8-12		5.0	10.0	NS	4.8	2.7	3.1	NS	
				Means of Fall- and Spring-Applied Nitrogen					
Fall N		34.3	31.0	28.8	25.1	29.9	12.9	16.7	25.5
Spring N		35.9	38.1	26.2	21.9	25.4	11.9	17.1	25.2
Sig. of diff.[3]		NS	Sig.	Sig.	Sig.	Sig.	NS	NS	
Soil depth, feet		2⅛	2⅛	3	3½	5¼	6	2½	
Soil type		Morrow silt loam	Morrow silt loam	Condon silt loam	Ritzville very fine sandy loam	Ritzville very fine sandy loam	Ritzville very fine sandy loam	Ritzville silt loam	
Date of fertilizer applications									
Fall		9/12/55	9/12/55	10/21/55	9/13/55	9/13/55	10/21/55	10/21/55	
Spring		3/22/56	4/19/56	3/22/56	3/21/56	3/21/56	3/21/56	3/22/56	
Wheat variety		Golden	Golden	Rex	Rex	Golden	Federation (spring)	Early Boart (spring)	

For footnotes see Appendix Table 1.

Appendix Table 5. Columbia Basin Wheat Experiments, Sherman County, 1955-56
(Yield, bushels per acre—means of 4 replications)

Treatment No.	N-P_2O_5-S	Virgil Conlee (Cotton-wood)	Barnett & Fridley (Emigrant Springs)	Harper & Huckin (Wasco)	Paulen Kaesberg (Locust Grove)	Orlow Martin (Moro)	Roy Schilling (Grass Valley)	Robert Schilling (Grass Valley)	Bill Todd (Lone Rock)	Art Watkins (Rufus)	George Wilson (Kent)	Mean 10 farms
	Lbs./acre				Fertilizer Applied in Fall							
1	0-0-0	20.7	24.3	18.6	15.3	23.9	27.1	33.0	17.8	13.7	22.8	21.7
2	20-0-0	25.2	24.7	21.1	20.5	31.6	31.0	37.9	24.1	17.0	28.0	26.1
3	40-0-0	26.7	25.4	25.3	30.3	37.8	34.4	44.9	29.3	19.0	30.6	30.4
4	60-0-0	29.0	24.0	25.0	36.7	37.8	35.2	54.9	32.9	18.1	31.9	32.6
5	80-0-0	27.8	21.4	26.3	42.8	36.5	31.2	60.4	29.9	17.4	29.9	32.4
6	100-0-0	28.1	26.6	27.7	45.2	37.0	32.9	62.9	31.0	24.5	32.5	34.8
LSD,[1] Trs. 1-6		5.0	NS	5.2	4.7	3.3	3.4	7.7	4.8	4.8	3.5	
3	40-0-0	26.7	25.4	25.3	30.3	37.8	34.4	44.9	29.3	19.0	30.6	30.4
7	40-40-40-MN[2]	29.4	31.7	24.7	32.7	39.8	35.7	53.1	26.8	15.8	33.1	31.7
					Fertilizer Applied in Spring							
1	0-0-0	20.7	24.3	18.6	15.3	23.9	27.1	33.0	17.8	13.7	22.8	21.7
8	20-0-0	21.8	24.9	19.7	22.5	30.5	30.1	36.4	24.4	10.5	26.9	24.8
9	40-0-0	23.9	22.3	21.8	26.6	33.7	34.2	45.2	25.7	12.4	33.1	27.9
10	60-0-0	25.5	28.7	23.1	29.7	37.1	34.3	51.0	28.6	12.5	31.2	30.2
11	80-0-0	27.5	21.5	23.8	35.8	38.8	33.7	51.2	25.7	11.8	29.6	29.9
12	100-0-0	27.4	23.9	21.7	38.8	38.8	35.6	60.2	31.8	17.1	30.2	32.6
LSD, Trs. 1, 8-12		5.0	NS	NS	44.7	3.3	3.4	7.7	4.8	NS	3.5	
					Means of Fall- and Spring-Applied Nitrogen							
Fall N.		26.3	24.4	24.0	31.8	34.1	32.0	49.0	27.5	18.3	29.3	29.7
Spring N		24.5	24.3	21.3	28.1	33.8	32.5	46.2	25.7	13.0	29.1	27.9
Sig. of diff.[3]		NS	NS	Sig.	Sig.	NS	NS	NS	NS	Sig.	NS	
Soil depth, feet		6	6	6	6	5¼	3½	4½	3½	6	2½	
Soil type		W. Walla silt loam (dry)	W. Walla silt loam (dry)	W. Walla silt loam (dry)	W. Walla silt loam (lt. tex.)	W. Walla silt loam (dry)	Condon silt loam	Condon silt loam	Condon silt loam	W. Walla coarse silt loam	Shaniko silt loam	
Date of fertilizer applications												
Fall		10/3/55	10/20/55	9/8/55	9/9/55	10/3/55	10/20/55	10/4/55	10/4/55	9/8/55	10/4/55	
Spring		3/19/56	3/20/56	3/20/56	3/21/56	3/21/56	3/28/56	3/28/56	3/21/56	3/20/56	3/27/56	
Wheat variety		Elmar	Elmar	Elmar (Repl.) Federation (spring)	Elmar	Federation (spring)	Federation (spring)	Elmar	Elmar	Elmar	Federation (spring)	

For footnotes see Appendix Table 1.

Appendix Table 6. Columbia Basin Wheat Experiments, Wasco County, 1955-56

(Yield, bushels per acre—means of 4 replications)

Treatment No.	N-P_2O_5-S	Sid Baker (Tygh Ridge)	Eldon Borthwick (Antelope)	Emerson Bros. (Emerson)	Leo Hammel, Jr. (Tygh Ridge)	Robert Holman (Juniper Flat)	Wendell Lindley (Bakeover)	Ken Smith (Friend)	Edra Tidwell (Pleasant Ridge)	C. L. Terry (Boyde)	Mean farms
	Lbs./acre				Fertilizer Applied in Fall						
1	0-0-0	21.6	12.9	15.7	22.1	9.7	17.1	21.2	10.7	18.1	16.6
2	20-0-0	26.4	21.2	21.8	25.8	15.0	15.9	20.6	11.3	23.2	20.1
3	40-0-0	33.3	23.5	26.8	33.9	18.2	24.4	26.0	1.3	25.6	25.2
4	60-0-0	35.1	31.0	29.6	30.4	19.7	24.5	28.6	15.8	31.4	27.3
5	80-0-0	38.0	32.5	29.7	41.7	28.9	22.9	32.8	18.8	29.9	30.6
6	100-0-0	42.7	29.0	32.9	41.8	30.0	24.4	38.4	20.8	34.6	32.7
LSD[1], Trs. 1-6		4.2	7.0	5.7	8.5	5.2	5.5	7.2	4.1	8.1	
3	40-0-0	33.3	23.5	26.8	33.9	18.2	24.4	26.4	14.3	25.6	25.2
7	40-50-50-MN[2]	34.6	27.9	32.0	38.7	24.7	25.4	34.2	13.7	35.0	29.6
					Fertilizer Applied in Spring						
1	0-0-0	21.6	12.9	15.7	22.1	9.7	17.1	21.2	10.7	18.1	16.6
8	20-0-0	28.4	19.5	19.9	26.5	17.1	22.2	22.2	16.5	17.1	21.0
9	40-0-0	36.5	25.5	20.0	31.3	24.9	20.6	35.4	24.4	21.8	26.6
10	60-0-0	42.2	26.3	21.9	40.4	24.9	24.6	37.7	24.9	25.4	29.8
11	80-0-0	43.5	30.1	21.9	44.5	23.8	22.0	39.0	29.6	28.0	31.4
12	100-0-0	49.1	29.4	28.0	46.3	20.9	20.8	46.1	29.3	29.6	33.2
LSD, Trs. 1-12		4.2	7.0	5.7	8.5	5.2	NS	7.2	4.1	8.1	
					Means of Fall- and Spring-Applied Nitrogen						
Fall N		32.9	25.0	26.1	32.6	20.3	21.5	28.0	15.3	27.1	25.4
Spring N		26.9	24.0	21.1	35.2	20.0	21.2	33.5	22.6	23.3	26.4
Sig. of diff.[3]		Sig.	NS	Sig.	NS	NS	NS	Sig.	Sig.	Sig.	
Soil depth, feet		5½	1¾	6	5¼	4	2	4½	4¾	3¾	
Soil type		Condon silt loam	Tub. silt loam	W. Walla coarse silt loam	W. Walla silt loam	New series "A" silt loam	Condon silt loam	New series "E" silt loam	New series "A" silt loam	Dufur silt loam	
Date of fertilizer applications											
Fall		9/21/55	9/23/55	9/14/55	9/15/55	9/15/55	9/22/55	9/20/55	9/21/55	9/15/55	
Spring		3/22/56	3/27/56	3/23/56	3/22/56	3/22/56	3/23/56	4/18/56	3/29/56	3/22/56	
Wheat variety		Elmar	Elmar	Federation (spring)	Elmar	Elmar	Federation (spring)	Elmar	Elmar	Federation (spring)	

For footnotes see Appendix Table 1.

Appendix Table 7. Columbia Basin Wheat Fertilization Experiments in Umatilla County, Lower Rainfall Area, 1956-57

Treatment No.	N-P_2O_5-S	S. E. Brogoitti (Duroc)	Casper Bros. (Cottonwood)	Ed. Hoeft (Pilot Rock)	William Hockensmith (Despain Gulch)	Dale Tucker (Holdman)	Vaughn & Son (Juniper)	Mean 6 farms
	Lbs./acre			*Bushels per acre*				
				Fertilizers Applied in the Fall				
1	0-0-0	43.9	22.2	29.1	23.3	27.0	28.4	30.3
2	20-0-0	49.8	30.4	30.1	31.1	36.3	38.6	37.2
3	40-0-0	51.4	51.8	30.9	38.0	37.5	48.4	41.2
4	60-0-0	52.1	53.0	29.2	40.4	44.3	53.0	43.8
5	80-0-0	47.8	49.3	30.5	39.7	41.4	53.0	42.5
6	100-0-0	48.4	52.8	33.2	42.4	37.9	53.5	43.1
LSD[1], Trs. 1-6		5.2	8.4	NS	3.8	6.5	3.4	
7	40-50-0	52.6	40.4	27.5	38.2	40.6	46.8	41.1
8	40-0-50	49.1	48.6	27.8	38.9	38.6	46.8	40.2
9	40-50-50	50.2	47.2	32.3	40.6	42.5	47.5	42.6
10	40-50-50-MN[2]	51.9	47.0	33.4	38.3	41.8	46.4	42.4
				Nitrogen Applied in the Spring				
1	0-0-0	43.9	22.2	29.1	23.3	27.0	28.4	30.3
11	20-0-0	46.8	46.2	34.6	29.1	31.9	39.3	36.3
12	40-0-0	50.0	51.9	39.6	34.0	36.0	41.0	40.1
13	60-0-0	50.0	65.5	42.1	36.5	38.8	45.4	42.6
14	80-0-0	51.3	63.5	41.8	36.8	40.7	47.7	43.7
15	100-0-0	52.3		43.6	39.4	42.4	50.2	45.6
LSD, Trs. 1, 11-15		5.2	8.4	8.8	3.8	6.5	3.4	
		Means of Fall-(Trs. 1-6) and Spring-(Trs. 11-15) Applied Nitrogen						
Fall N		48.9	43.4	30.5	35.8	37.4	45.8	
Spring N		49.0	41.7	38.5	33.2	36.1	42.0	
Sig. of diff.[3]		NS	Sig.	Sig.	Sig.	NS	Sig.	
Soil depth, feet		6	6	3	6	6	6	
Soil type		Walla Walla silt loam	Walla Walla silt loam	Pilot Rock silt loam	Ritzville silt loam	Ritzville silt loam	Walla Walla silt loam (lt. text.)	
Date of fertilizer application								
Fall		9/20/56	9/18/56	9/25/56	9/26/56	10/1/56	10/1/56	
Spring		4/21/57	4/10/57	4/11/57	3/27/57	4/8/57	4/8/57	
Wheat variety		Elmar	Barley	Golden	Elmar	Elgin	Elmar	

For footnotes see Appendix Table 1.

Appendix Table 8. Columbia Basin Wheat Fertilization Experiments in Umatilla County, High Rainfall Area, 1956-57

Treatment No.	N-P_2O_5-S	Crow Pilot Farm (Weston)	Jack Tillman (Athena)	Mean 2 farms
	Lbs./acre	*Bushels per acre*		
		Fertilizer Applied in the Fall		
1	0-0-0	57.8	37.6	47.5
2	30-0-0	68.0	43.0	55.5
3	60-0-0	71.9	40.9	56.4
4	90-0-0	78.6	41.1	59.8
5	120-0-0	76.4	38.4	57.4
6	150-0-0	76.3	39.0	57.6
LSD[1], Trs. 1-6		6.6	3.7	
7	90-50-50	72.4	42.5	57.5
8	90-0-10	75.3	42.9	59.1
9	90-50-10	75.1	42.1	58.6
10	90-50-10-MN[2]	74.6	43.7	59.1
		Nitrogen Applied in the Spring		
1	0-0-0	57.8	37.6	47.7
11	30-0-0	69.4	43.5	56.4
12	60-0-0	74.9	43.2	59.1
13	90-0-0	74.0	39.2	56.6
14	120-0-0	79.7	38.4	59.1
15	150-0-0	78.9	35.0	57.0
LSD, Trs. 1, 11-15		6.6	3.7	
		Means of Fall-(Trs. 1-6) and Spring-(Trs. 11-15) Applied Nitrogen		
Fall N		71.5	40.0	
Spring N		72.4	39.5	
Sig. of diff.[3]		NS	NS	
Soil depth, feet		6	6	
Soil type		Athena silt loam	Walla Walla silt loam	
Date of fertilizer application				
Fall		10/22/56	9/19/56	
Spring		4/10/57	3/28/57	
Wheat variety		Omar	Omar	

For footnotes see Appendix Table 1.

Appendix Table 9. Columbia Basin Wheat Fertilization Experiments in Morrow County, Lower Rainfall Area, 1956-57

Treatment No.	N-P_2O_5-S	Max Barclay (North Lexington)	Harold Evans (Clark Canyon)	Burton Peck (Lexington)	Kenneth Smouse (N. Ione)	Oscar Peterson (Gooseberry)	Stephenie & Son (Ione)	Mean 5 farms
	Lbs./acre			*Bushels per acre*				
				Fertilizer Applied in Fall				
1	0-0-0	20.9	28.7	30.5	30.2	41.2	30.8	28.2
2	20-0-0	19.4	34.8	25.9	35.6	39.9	31.0	29.1
3	40-0-0	17.7	35.8	19.2	35.3	40.4	30.4	27.7
4	60-0-0	19.2	38.0	18.4	34.7	40.5	31.3	28.3
5	80-0-0	19.0	32.7	19.2	34.4	37.0	28.2	26.7
6	100-0-0	19.7	39.7	14.3	35.0	25.6	26.2	27.0
LSD[1], Trs. 1-6		NS	8.6	7.7	2.4	NS	3.4	
7	40-50-0	23.2	34.6	25.4	36.6		30.4	30.0
8	40-0-50	21.1	36.0	23.8	35.9		30.0	29.4
9	40-50-50	19.6	38.2	21.3	35.5		31.8	29.3
10	40-50-50-MN[2]	21.8	40.8	22.4	37.0	41.2	30.2	
				Nitrogen Applied in the Spring				
1	0-0-0	20.9	28.7	30.5	30.2	41.2	30.8	28.2
11	20-0-0	22.6	31.2	27.0	35.4	40.0	30.2	29.3
12	40-0-0	20.6	37.2	23.5	36.6	38.8	29.8	29.5
13	60-0-0	24.5	35.8	21.7	36.9	43.2	31.5	30.1
14	80-0-0	22.2	39.0	23.2	35.5	37.4	29.3	29.8
15	100-0-0	23.0	36.0	21.0	35.4	35.9	26.5	28.4
LSD, Trs. 1, 12-15		3.7	8.6	7.7	2.4	NS	3.4	
				Means of Fall-(Trs. 1-6) and Spring-Applied Nitrogen				
Fall N		19.3	35.0	21.2	34.0	37.4	29.6	
Spring N		22.3	34.6	24.5	35.0	39.4	29.7	
Sig. of diff.[3]		Sig.	NS	Sig.	Sig.	NS	NS	
Siol depth, feet		3½	4	3	6	6	5½	
Soil type		Ritzville very fine sandy loam	Condon silt loam	Condon silt loam	Ritzville silt loam	Walla Walla silt loam (dry)	Walla Walla silt loam (dry)	
Date of fertilizer application								
Fall		10/4/56	10/4/56	10/4/56	10/3/56	10/3/56	10/3/56	
Spring		4/2/57	4/3/57	4/2/57	4/2/57	4/3/57	4/3/57	
Wheat variety		Turkey Red	Elmar	Golden	Burt	Barley (Olympic)	Golden	

For footnotes see Appendix Table 1.

Appendix Table 10. Columbia Basin Wheat Fertilization Experiments in Gilliam County, Lower Rainfall Area, 1956-57

Treatment No.	N-P_2O_5-S	E. & A. Drake (Shutler Flat)	Orva Dyer (Mayville)	Van Rietman (Ajax)	John Weiman, Jr. (Clem)	Mean
	Lbs./acre		*Bushels per acre*			
			Fertilizer Applied in Fall			
1	0-0-0	25.8	40.2	24.6	30.2	30.2
2	20-0-0	30.9	41.5	21.1	36.4	32.5
3	40-0-0	34.1	41.2	14.4	41.0	32.7
4	60-0-0	32.5	39.3	12.9	42.8	31.9
5	80-0-0	32.6	33.4	10.6	38.6	28.8
6	100-0-0	32.4	33.8	10.5	38.0	28.7
LSD[1], Trs. 1-6		2.7	4.0	3.7	2.0	
7	40-50-0	34.3	42.7	13.4	42.0	33.1
8	40-0-50	33.1	41.7	13.6	41.0	32.4
9	40-50-50	32.7	41.3	13.0	41.7	32.2
10	40-50-50-MN[2]	33.8	43.4	15.1	40.7	33.2
			Nitrogen Applied in Spring			
1	0-0-0	25.8	40.2	24.6	30.2	30.2
11	20-0-0	30.3	41.8	19.0	37.5	32.2
12	40-0-0	32.5	42.5	19.5	40.1	33.6
13	60-0-0	33.4	42.4	16.1	43.1	33.8
14	80-0-0	33.0	39.4	14.9	43.5	32.7
15	100-0-0	33.8	37.4	13.5	41.3	31.5
LSD, Trs. 1, 11-15		2.7	4.0	3.7	2.0	
			Means of Fall-(Trs. 1-6) and Spring-(Trs. 1, 11-15) Applied Nitrogen			
Fall N		31.4	38.2	15.7	37.8	
Spring N		31.5	40.6	17.9	39.3	
Sig. of diff.[3]		NS	Sig.	Sig.	Sig.	
Soil depth, feet		6	2½	2¼	3⅞	
Soil type		Ritzville very fine sandy loam	Condon silt loam	Condon silt loam	Walla Walla silt loam (dry)	
Date of fertilizer application						
Fall		10/2/56	10/2/56	10/3/56	10/2/56	
Spring		3/27/57	3/27/57	3/27/57	3/27/57	
Wheat variety		Orfed	Golden	Elmar	Orfed	

For footnotes see Appendix Table 1.

Appendix Table 11 (Continued). Columbia Basin Wheat Fertilization Experiments in Sherman County, Lower Rainfall Area, 1956-57

Treatment No.	$N-P_2O_5-S$	Bernard Martin (Rutledge)	B. E. Payne (Buckley)	H. & A. Pinkerton (Gordon Ridge)	Floyd Rathbun (Wasco)	Thompson Bros. (Monkland)	Hildred Zell (Locust Grove)	Means 11 farms
	Lbs./acre			*Bushels per acre*				
				Fertilizer Applied in Fall				
1	0-0-0	36.6	14.4	35.9	36.2	33.5	20.7	30.9
2	20-0-0	37.6	16.2	43.1	40.8	39.8	24.7	35.4
3	40-0-0	41.4	13.4	48.0	41.4	40.6	32.6	37.5
4	60-0-0	39.2	13.2	52.9	37.7	42.0	33.9	37.1
5	80-0-0	35.3	12.6	49.9	36.8	41.6	38.0	35.6
6	100-0-0	36.5	9.6	46.8	34.6	39.8	35.6	33.9
LSD[1], Trs. 1-6		4.3	2.8	6.6	4.3	5.1	5.4	
7	40-50-0	39.7	14.0	52.4	40.2	46.0	32.8	38.1
8	40-0-50	40.6	15.0	50.7	37.7	43.7	38.0	37.3
9	40-50-50	39.8	14.5	52.4	38.2	44.5	32.5	38.0
10	40-50-50-MN[2]	38.6	14.0	54.0	39.7	38.7	29.7	36.44
				Nitrogen Applied in the Spring				
1	0-0-0	36.6	14.4	35.9	36.2	33.5	20.7	30.9
11	20-0-0	40.5	15.9	40.7	38.6	39.2	25.6	34.9
12	40-0-0	40.8	16.1	48.8	43.2	43.0	30.2	37.7
13	60-0-0	39.8	14.5	54.5	42.0	40.8	35.1	38.1
14	80-0-0	41.0	13.4	51.5	38.8	42.5	32.0	37.2
15	100-0-0	38.0	14.3	51.6	40.7	44.8	38.6	37.3
LSD, Trs. 1, 11-15		4.3	NS	6.6	4.3	5.1	5.4	
				Means of Fall-(Trs. 1-6) and Spring-Trs. 1, 11-15) Applied Nitrogen				
Fall N		37.8	13.2	46.1	37.9	39.6	30.9	
Spring N		39.5	14.8	47.2	39.9	40.6	30.4	
Sig. of diff[3]		Sig.	Sig.	NS	Sig.	NS	NS	
Soil depth, feet		4	2	6	6	6	$4\frac{3}{4}$	
Soil type		Condon silt loam	Condon silt loam	Walla Walla silt loam (lt. text.) coarse	Walla Walla coarse silt loam	Walla Walla silt loam (dry)	Walla Walla coarse silt loam	
Dates of fertilizer application								
Fall		9/21/56	9/28/56	9/7/56	9/5/56	9/8/56	9/6/56	
Spring		3/26/57	3/26/57	3/25/57	3/25/57	3/22/57	3/25/57	
Wheat variety		Elmar	Elmar	Omar	Elmar	Omar	Elmar	

For footnotes see Appendix Table 1.

Appendix Table 11. Columbia Basin Wheat Fertilization Experiments in Sherman County, Lower Rainfall Area, 1956-57

(Continued on next page)

Treatment No.	N-P_2O_5-S	F. Cox & S. Alberty (Grass Valley)	Fred Dormaier (Webfoot)	Harold Eakin (Bourbon)	Shelton Fritts (Finnogan)	Joe Heater (Erskine)
	Lbs./acre		*Bushels per acre*			
			Fertilizer Applied in Fall			
1	0-0-0	36.8	22.4	31.3	35.2	37.2
2	20-0-0	48.1	21.4	34.0	41.9	47.9
3	40-0-0	48.1	18.4	36.1	40.4	51.7
4	60-0-0	47.1	16.6	32.6	40.8	52.6
5	80-0-0	42.4	17.1	33.8	39.0	45.6
6	100-0-0	41.3	14.6	29.4	33.9	50.3
LSD[1], Trs. 1-6		6.1	2.9	3.9	5.0	5.0
7	40-50-0	45.2	19.1	35.0	42.0	52.2
8	40-0-50	42.7	16.9	33.2	40.0	52.0
9	40-50-50	48.1	19.0	35.3	41.3	52.7
10	40-50-50-MN[2]	41.7	19.0	33.9	38.8	52.4
			Nitrogen Applied in the Spring			
1	0-0-0	36.8	22.4	31.3	35.2	37.2
11	20-0-0	43.9	24.2	32.0	42.3	40.5
12	40-0-0	45.0	20.9	34.2	41.6	51.4
13	60-0-0	48.2	17.3	33.8	40.6	52.6
14	80-0-0	45.9	17.3	32.0	38.0	56.8
15	100-0-0	44.3	17.2	31.1	35.7	57.2
LSD, Trs. 1, 11-15		6.1	2.9	NS	5.0	5.0
			Means of Fall-(Trs. 1-6) and Spring-(Trs. 1, 11-15) Applied Nitrogen			
Fall N		43.0	18.4	32.7	38.5	47.6
Spring N		43.5	19.9	32.4	38.9	49.3
Sig. of diff.[a]		NS	Sig.	NS	NS	NS
Soil depth, feet		4½	3¼	3½	4	6
Soil type		Condon silt loam	Ritzville very fine sandy loam	Condon silt loam	Condon silt loam	Walla Walla silt loam (light textured)
Date of fertilizer application						
Fall		9/27/56	10/8/56	9/24/56	9/21/56	9/7/56
Spring		3/26/57	3/22/57	3/26/57	3/26/57	3/25/57
Wheat variety		Elmar	Elmar	Elmar	Elmar	Elmar

For footnotes see Appendix Table 1.

Appendix Table 12. Columbia Basin Wheat Fertilization Experiments in Wasco County, Lower Rainfall Area, 1956-57

Treatment No.	N-P_2O_5-S	C. D. Bothwell (Juniper Flat)	Francis Hillgen (Center Ridge)	James Johnson (Columbia)	Arthur Maxwell (Antelope)	Marion McAllister (Dufur)	Clayton Ward (Boyd)	Robert Williams (Columbia)	Mean 7 farms
	Lbs./acre			*Bushels per acre*					
				Fertilizer Applied in Fall					
1	0-0-0	31.2	29.5	30.1	28.4	38.8	33.2	18.5	30.0
2	20-0-0	38.3	34.2	39.3	31.0	38.3	41.1	26.2	35.5
3	40-0-0	44.0	42.0	47.2	38.5	38.5	41.6	31.3	39.6
4	60-0-0	46.8	51.8	51.2	36.5	38.0	41.4	32.3	42.6
5	80-0-0	43.7	47.0	55.0	34.8	37.4	44.0	31.2	41.9
6	100-0-0	43.4	53.0	55.9	31.7	37.2	43.2	32.6	42.4
LSD[1], Trs. 1-6		5.0	7.1	5.1	6.7	NS	5.5	6.7	
7	40-50-0	44.3	45.4	47.2	35.3	36.7	41.3	31.6	40.3
8	40-0-50	44.2	46.6	54.9	32.5	47.3	40.2	26.0	41.7
9	40-40-40	46.4	44.1	49.4	33.7	38.0	43.3	29.2	40.6
10	40-50-50-MN[2]	46.2	48.7	49.4	29.4	36.2	44.9	29.4	40.6
				Nitrogen Applied in the Spring					
1	0-0-0	31.2	29.5	30.1	28.4	38.8	33.2	18.5	30.0
11	20-0-0	38.0	37.4	36.2	29.4	32.3	37.6	28.2	34.2
12	40-0-0	45.3	46.9	42.4	32.8	42.2	42.8	18.7	38.7
13	60-0-0	46.8	54.0	48.8	33.1	38.0	42.1	20.2	40.4
14	80-0-0	50.0	56.2	52.8	34.4	42.9	42.3	19.2	42.5
15	100-0-0	47.8	62.6	55.2	35.4	43.5	42.0	18.8	43.6
LSD, Trs. 1, 11-15		5.0	7.1	5.1	6.7	NS	5.5	6.7	
		Means of Fall (Trs. 1-6) and Spring (Trs. 1, 11-15) Applied Nitrogen							
Fall N		41.2	42.9	46.4	32.5	38.0	40.7	28.7	
Spring N		43.2	47.8	44.2	32.2	39.6	40.0	20.6	
Sig. of diff.[3]		Sig.	Sig.	Sig.	NS	NS	NS	Sig.	
Soil depth, feet		3½	5	6	1½	4	5½	6	
Soil type		Condon silt loam	Dufur silt loam	Walla Walla silt loam (lt. text.)	Tub silty clay loam	Wamic very fine silty loam	Walla Walla coarse silt loam	Walla Walla coarse silt loam	
Date of fertilizer application									
Fall		9/13/56	9/9/56	9/11/56	9/17/56	9/12/56	9/14/56	9/11/56	
Spring		3/28/57	3/28/57	3/28/57	3/28/57	5/21/57	4/23/57	4/23/57	
Wheat variety		Elmar	Elmar	Elmar	Turkey Red	Elmar	Elmar	Elmar	

For footnotes see Appendix Table 1.