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1968 Tests

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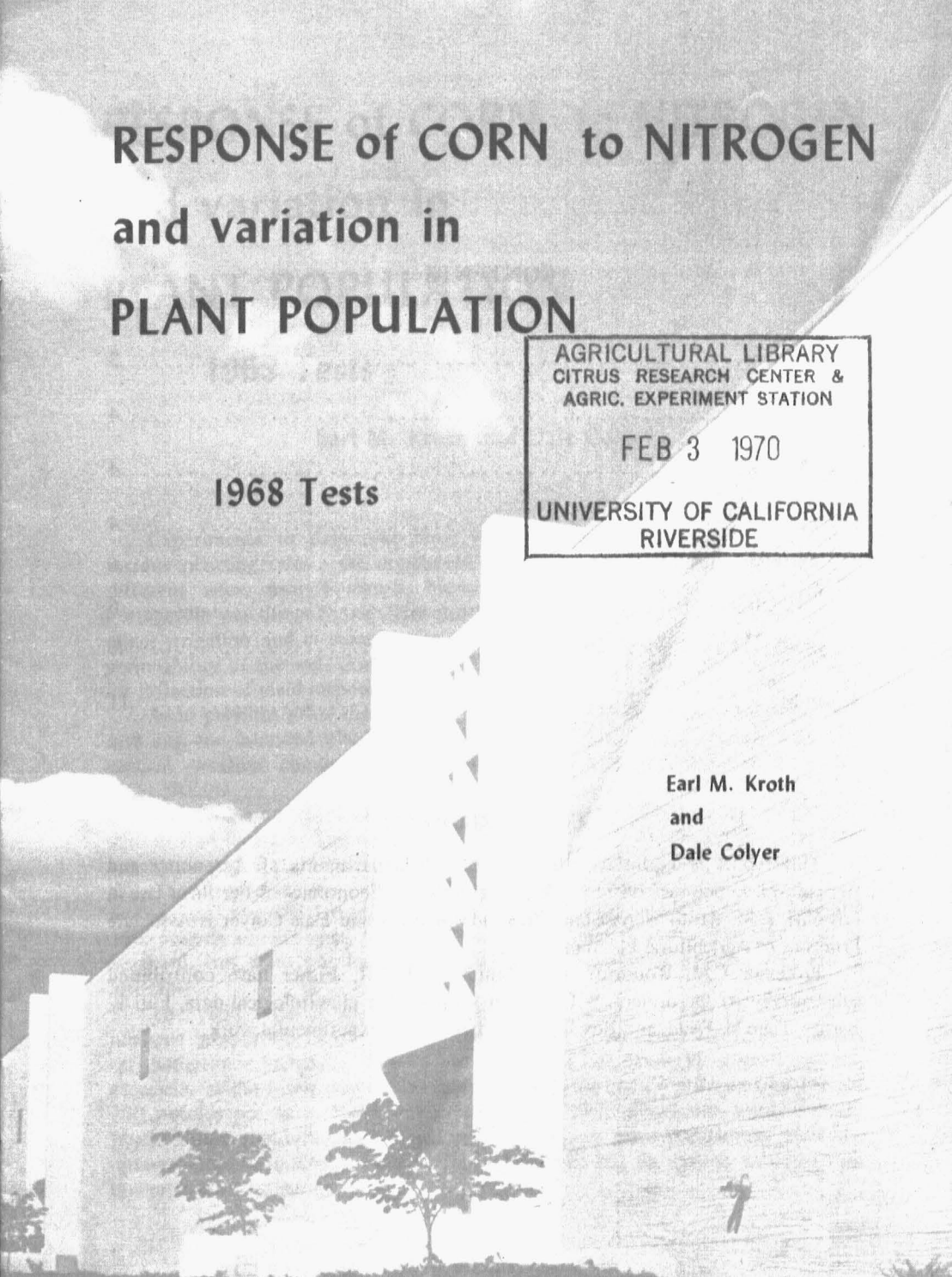

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AGRICULTURAL EXPERIMENT STATION

CONTENTS

ACKNOWLEDGMENTS

This report is a joint contribution of the Departments of Agronomy and Agricultural Economics on research project 455, the Economics of Fertilizer Use in Missouri. E.M. Kroth is Assistant Professor of Soils and Dale Colyer is Associate Professor of Agricultural Economics.

Professor C.M. Woodruff, G.E. Smith, and T.R. Fisher have contributed substantially to the project. W.L. Decker supplied the climatological data. Earl L. Barnes, Theo M. Dean, and Rex Williams directed the experimental work.

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Experiments to determine corn yield response to nitrogen fertilization at various planting rates were conducted for the eighth consecutive year at three different sites, near Spickard, Marshall, and Columbia. The experiment at Portageville was discontinued. The experiment at this location had been conducted under irrigation and in recent years problems were encountered in relation to the permeability of the soil. Consequently this did not result in the desired conditions for reflection of yield response under irrigation.

As in previous years the nitrogen application varied from 0 to 200 pounds per acre and the intended plant population from 9,000 to 21,000 plants per acre. In general, weather conditions were good and were especially favorable at the Columbia site.

The maximum yields obtained at Columbia were higher than for any previous year at that location. The highest single plot yield was 179.8 bushels per acre from a plot planted at the 21,000 plant population rate and treated at a rate of 100 pounds of nitrogen per acre while the highest average treatment yield (three replications) was 164.1 bushels per acre from the 21,000 plant population plot and 150 pounds of nitrogen per acre. Yields also tended to be relatively high at Spickard, but were not high at Marshall where weather conditions were not as favorable.

The yield rates at all locations tended to increase rapidly up to levels of nitrogen application of 75 to 100 pounds per acre. At higher rates yields leveled off, sometimes increasing slightly but sometimes decreasing by a small amount, especially at the lower population rates and with the highest nitrogen treatment of 200 pounds per acre. Yield differences due to plant population were relatively small. Larger yields were obtained with the higher plant populations when the nitrogen applications also were at the higher levels but the reverse prevailed with low nitrogen treatments.

PROCEDURES

The experiment was conducted for the eighth successive year on the same plots at Spickard, Marshall, and Columbia. A split plot design is used with the four plant populations as whole-plot treatments and the seven nitrogen application rates as subplots within each population plot.*

Applications of potassium and phosphorus were made on the basis of soil tests the first year of the experiment and maintenance quantities have been applied since then. Starter fertilizer has been used to apply potassium and phosphorus and the first 25 pounds of nitrogen. The remainder of the nitrogen is plowed down in the spring. All plots are planted at high plant population rates and are thinned after emergence to obtain the desired stands. The plots are harvested by hand and dropped ears are included in yield calculations which are computed as shelled corn equivalents at a 15.5 percent moisture level.

STATISTICAL METHODS USED

Statistical measures are included in this publication to aid in the interpretation of the results. All experiments are subject to error because of uncontrollable factors such as variation in soil, seed, or fertilizer and because of measurement problems. The experiment was designed so that these uncontrollable or "chance" errors in yield variance could be measured. When yield variations between the test plots sufficiently exceed those that are caused by chance, the variations are said to be due to the treatment (nitrogen or plant population). One statistical measure used is the least significant difference (LSD) which is listed under the yield tables for each site. In addition, analysis of variance tables are given in the Appendix.

The LSD gives the minimum difference which must exist between two treatment plot yields for them to be considered significantly different—or, in other words, for the difference to be considered as caused by the treatment rather than by chance or error. The *probability levels* indicate the percentage of times a variation of the size indicated would occur by chance alone. For example, the footnote of Table 2 lists the LSD for nitrogen treatments as 2.2 bushels per acre at the 0.05 (5 percent) probability level. This means that for two plots where nitrogen treatments are being compared, if yields differ by *more than* 2.2 bushels per acre there is only a 5 percent probability that the difference was caused by uncontrolled factors and a 95 percent probability that it was caused by the nitrogen treatment.

RESULTS

The 1968 experimental results and statistical analyses are given in the following pages. A table of yield means (averages) per treatment, a chart showing trends in yields as nitrogen treatments are increased at each planting rate, and a brief description of the experiment are given for each site. Table 1 reports the weather conditions as recorded at weather stations closest to the experimental plots. A table with the analysis of variance for the experiment at each location is included in the Appendix.

***The experiment was designed as a complete factorial imposed on a randomized block split-plot with three replications.**

TABLE 1

CLIMATOLOGICAL DATA FROM WEATHER RECORDING STATIONS NEAREST THE EXPERIMENTAL SITES, 1968

Station	Inches of rainfall[a]	Departure	Days with rain					Dry periods[b]	Avg. temp.	Departure	No. of days 90° or more		days 100° or more
			May	June	July	Aug	Sept				1968	Avg	
Spickard	16.09	-3.24	12	5	8	8	1	6/25-7/15 8/31-9/15	70.2°	-0.7°	25	44	0
Marshall[c]	14.69	-4.69	10	6	11	7	0	6/15-7/9 8/11-8/29 8/31-9/16	72.8°	1.1°	48	39	0
Columbia	19.46	1.29	11	8	12	7	2	7/2-7/17 8/9-8/29	71.2°	-0.1°	23	39	0

[a] May 1 to September 15.

[b] Dry Period: At least 15 consecutive days with less than 0.25 inches of precipitation.

[c] Rainfall data is for the experimental site eight miles west of the weather station.

North Missouri Research Center

The experimental plots at the North Missouri Research Center near Spickard in Grundy County are located on Seymour silt loam. Pioneer 3306 hybrid seed corn was planted May 2, 1968, and harvested October 11, 1968. Rainfall at the site was 3.24 inches below normal during the growing season and there were dry periods in July and September. Due to management error the stalk counts were lower than in previous years and final stalk counts were not made.

The highest single plot yield was 171.3 bushels per acre obtained from a nitrogen treatment rate of 200 pounds per acre on the 15,000 plants per acre whole plot. The greatest yield from three replications was 159.2 bushels per acre from 150 pounds of N at an intended population of 18,000 plants per acre. Although the higher yields were obtained at the two highest fertilization rates, 150 and 200 pounds per acre, the responses were relatively small at rates over 75 to 100 pounds per acre. At fertilization rates of 75 pounds or greater the largest yields were obtained from the plots with the two highest planting rates, 15,000 and 18,000 plants per acre. Yield differences due to nitrogen treatments, population, and nitrogen-population interaction were all highly significant statistically (Appendix Table 1). The yield data for average nitrogen treatments are shown in Figure 1 and Table 2.

A.H. Orr Farm

Growing conditions at the Marshall site were less favorable than at the other two locations and consequently yield responses were somewhat smaller. The plots at this site are on Marshall silt loam, a soil of relatively good natural fertility. Rainfall during the growing season, however, was 4.69 inches below normal and there were three dry periods during parts of June-July, August, and September.

The highest single treatment yield was 131.2 bushels per acre from a subplot with a per acre application rate of 150 pounds of nitrogen on a 21,000-plant population. The largest production per acre from three replications of a nitrogen treatment was 126.2 bushels from an application of 150 pounds of N and an intended population of 17,000 (average actual population at harvest time for the three subplots was 16,933 plants per acre). At all except the lowest population rate the yields increased sharply up to application rates of 50-75 pounds of nitrogen, with smaller increases at heavier fertilization rates and in some instances small declines in yield responses from one rate to another. At the high nitrogen applications largest yields resulted from the two highest populations, although yields were substantially lower only with the lowest planting rate.

Yield differences due to nitrogen treatments, planting rates, and nitrogen-population interaction were statistically significant. Average yields for nitrogen treatments are shown in Table 3 and Figure 2.

Bradford Experimental Farm

The plots at the Bradford Experimental Farm, Columbia, are on Mexico Silt Loam. Planting was on April 26, 1968, and harvest on September 27, 1968. The season was very favorable, with adequate rainfall (1.29 inches above normal) well distributed throughout the season, but with dry periods in early July and late August. Yield responses were the best in eight years at this site and the maximum

TABLE 2
AVERAGE CORN YIELDS FOR NITROGEN TREATMENTS AT FOUR PLANTING RATES
NORTH MISSOURI AGRICULTURAL RESEARCH CENTER, SPICKARD, 1968
(Bushels per Acre)

No. of Plants per Acre	Pounds of Nitrogen per Acre						
	0	25	50	75	100	150	200
9,000	83.2	91.5	104.5	113.4	118.1	119.7	119.3
13,000	84.3	103.0	123.9	125.9	137.5	139.8	137.1
17,000	78.7	101.3	118.9	140.1	147.5	152.2	157.2
21,000	76.3	94.4	118.8	146.1	154.6	159.2	156.9

LSD for plant population (0.05 probability level): 2.1 bushels per acre.
LSD for nitrogen treatments (0.05 probability level): 2.2 bushels per acre.

TABLE 3
AVERAGE CORN YIELDS FOR NITROGEN TREATMENTS AT FOUR PLANTING RATES
A. H. ORR FARM, MARSHALL, 1968
(Bushels per Acre)

No. of Plants per Acre	Pounds of Nitrogen per Acre						
	0	25	50	75	100	150	200
9,000	74.3	85.1	88.5	91.2	89.1	87.1	87.8
13,394	73.1	95.0	105.3	113.0	115.2	113.4	110.4
17,015	63.4	80.2	106.5	115.8	120.8	126.2	118.8
20,666	61.6	76.2	99.6	117.9	118.6	123.4	124.4

LSD for plant population (0.05 probability level): 2.1 bushels per acre.
LSD for nitrogen treatments (0.05 probability level): 2.3 bushels per acre.

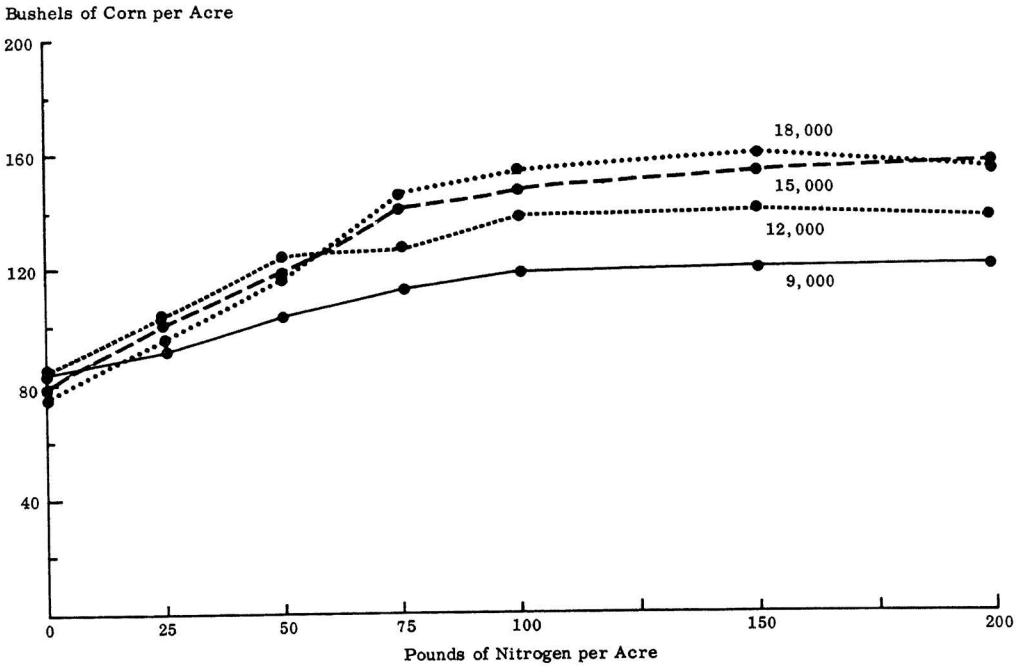

Fig. 1. Response of Corn Yield to Nitrogen Applications at Four Planting Rates, North Missouri Research Center, Spickard, 1968.

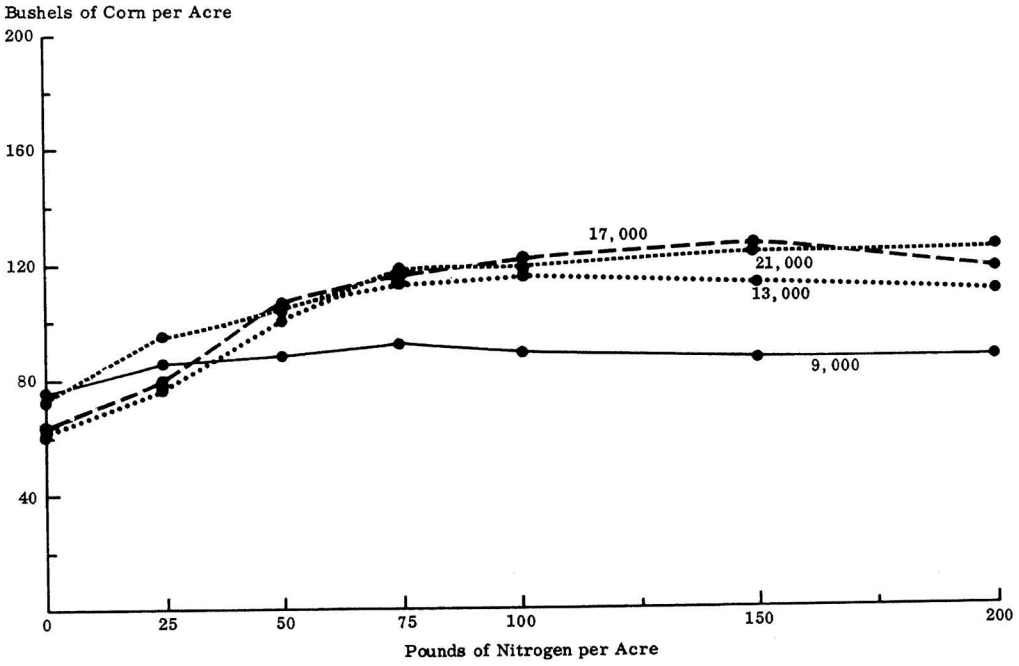

Fig. 2. Response of Corn Yields to Nitrogen Applications at Four Planting Rates, A. H. Orr Farm, Marshall, 1968.

yields were larger than for any other site for this year. Because of management error the final stalk count was not taken at harvest time.

The maximum subplot yield was 179.8 bushels per acre from a fertilization rate of 100 pounds of N and the 21,000 plants per acre population rate. The largest average treatment yield (3 replications) was 164.1 bushels of corn per acre from the 150 pound treatment and also from the whole plot with the highest planting rate. Yields responded with each nitrogen application up to about 100 pounds per acre but tended to decline slightly with larger treatments except at the highest population rate where the maximum yield was obtained from 150 pounds of N. At nitrogen rates of 100 pounds or greater the larger yields were obtained from the higher planting rates. There was relatively little response to nitrogen at the lowest planting rate.

Yield differences were statistically significant at the 5 percent level for population and the 1 percent level for nitrogen and population–nitrogen interaction. Average nitrogen treatment yields for this location are shown in Table 4 and Figure 3.

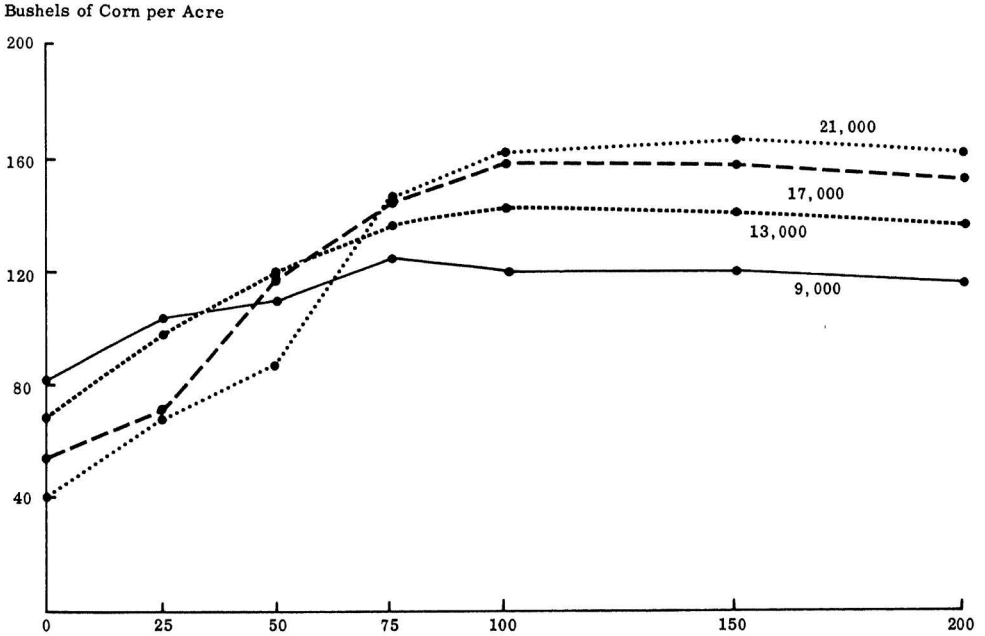

Fig. 3. Response of Corn Yield to Nitrogen Applications at Four Planting Rates, Bradford Experimental Farm, Columbia, 1968.

TABLE 4

AVERAGE CORN YIELDS FOR NITROGEN TREATMENTS AT FOUR PLANTING RATES
BRADFORD EXPERIMENTAL FARM, COLUMBIA, 1968
(Bushels per Acre)

No. of Plants per Acre	Pounds of Nitrogen per Acre						
	0	25	50	75	100	150	200
9,000	80.4	102.6	108.0	123.4	117.9	118.1	114.4
13,000	68.4	97.5	119.1	135.1	141.1	139.2	134.1
17,000	53.6	68.7	115.7	143.3	156.0	155.7	149.7
21,000	40.0	67.5	85.6	144.6	159.8	164.1	158.6

LSD for plant population (0.05 probability level): 2.3 bushels per acre.
LSD for nitrogen treatments (0.05 probability level): 3.8 bushels per acre.

APPENDIX TABLE I
ANALYSES OF VARIANCE FOR THE EXPERIMENT AT THE NORTH MISSOURI AGRICULTURAL RESEARCH CENTER, SPICKARD, 1968

Source	d.f.	Sums of Squares	Means of Squares
Replication	2	132	66
Plant Population	3	6,577	2,192**
Error "a"	6	535	89
Nitrogen Treatments	6	43,017	7,169**
Nitrogen x Population	18	4,338	241**
Error "b"	48	1,531	59
Total	83	56,130	

**Significant at the 0.01 probability level.

APPENDIX TABLE II
ANALYSIS OF VARIANCE FOR THE EXPERIMENT AT THE A. H. ORR FARM, MARSHALL, 1968

Source	d.f.	Sums of Squares	Means of Squares
Replication	2	38	19
Plant Population	3	4,889	1,629**
Error "a"	6	570	95
Nitrogen Treatments	6	20,894	3,482**
Nitrogen x Population	18	5,203	289**
Error "b"	48	1,476	62
Total	83	33,070	

**Significant at the 0.01 probability level.

APPENDIX TABLE III
ANALYSIS OF VARIANCE FOR THE EXPERIMENT AT THE BRADFORD EXPERIMENTAL FARM, COLUMBIA, 1968

Source	d.f.	Sums of Squares	Means of Squares
Replications	2	2,986	1,493
Plant Population	3	1,903	567*
Error "a"	6	688	114
Nitrogen Treatments	6	95,479	15,913**
Nitrogen x Population	18	22,083	1,226**
Error "b"	48	3,420	169
Total	83	126,359	

*Significant at the 0.05 probability level.
**Significant at the 0.01 probability level.