Soil Fertility Treatments for Improved Corn Production in Eastern Oklahoma

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This Experiment

Corn production in Oklahoma has been on a decrease since shortly after the turn of the century. Depletion in soil productivity has been a basic factor for the reduced corn production in the state.

This study was made to determine soil fertility needs of soils used for corn production in central and eastern Oklahoma. Various kinds and rates of fertilizers, particularly nitrogen, were found essential for increased corn yields. Experiments reported in the study ran from 1946 through 1955 and included soil types and locations representative of the corn producing areas.

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Corn production in Oklahoma has declined steadily since 1906. The annual state production at that time was some 313 million bushels. Today it is less than 10 million bushels. Harvested acres of corn have decreased from a high of 5,939,000 acres in 1909 to 321,000 acres in 1954 (Figure 1). Acreages used for corn production have, in general, changed from statewide distribution to areas of productive soils located in central and eastern Oklahoma (Figures 2 and 3).

A principal factor contributing to the decline of corn as a major cash crop has been the failure to produce profitable yields consistently throughout most of Oklahoma. The central and eastern parts of the

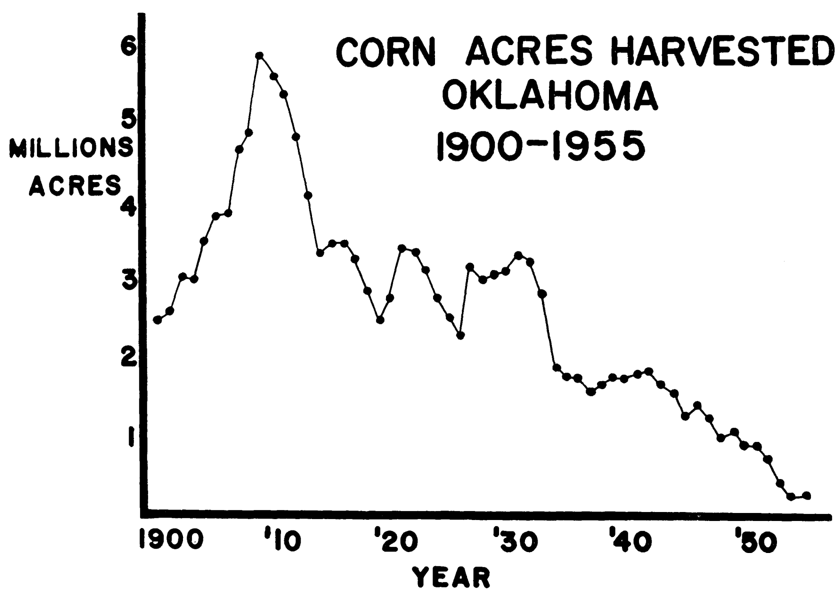

Fig. 1 Acres of corn harvested in Oklahoma have declined from a high of 5,939,000 acres in 1909 to a low of 321,000 acres in 1954. Decreasing soil productivity of land used for production of this crop has contributed much to reduction in corn acreage.

[1] This study was supported in part by a research grant from the Spencer Chemical Company, Kansas City, Missouri. The authors gratefully acknowledge the many contributions of land, labor and materials received from the farmer cooperators for this work.

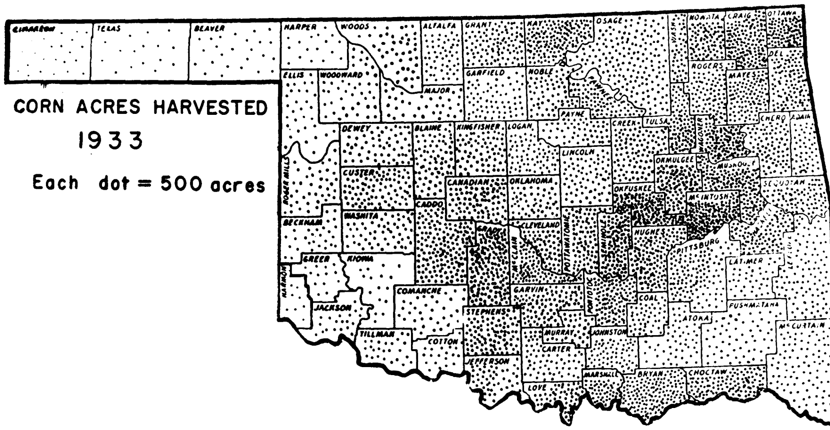

Fig. 2 Corn was planted generally throughout the state as late as 1933 with 2,861,000 acres harvested that year. Acres planted to corn decreased steadily from that year.

state have been affected by this trend even during years of favorable climate for corn production. Soil physical and chemical characteristics are governing factors in determining growth and yield of this crop in favorable and unfavorable years.

This study was undertaken to determine the response of corn to various rates and kinds of fertilizer with particular emphasis on nitrogen fertilization. Field experiments were established on soil types typical of those presently used for corn production in the state and were located on farms in representative areas throughout central and eastern Oklahoma.

Procedure

During the period 1946 through 1955, field experiments (non-irrigated) were established on soil types and at locations representative of important corn producing areas of central and eastern Oklahoma. These experiments were carried out with the cooperation of a large number of farmer operators who generously contributed the land and frequently much of the labor, farm machinery and seed. Only a representative portion of results from some forty-six field experiments are used as illustrations in this publication. A detailed report of experimental results are presented elsewhere.[2]

There were essentially four basic experimental plans used: (1) Rates of nitrogen applied as sidedressing as an early cultivation of an established stand were used with common and differential fertilizer treatment at seeding. (2) Rates and kinds of nitrogen and ammonium phos-

[2] Effects of various Soil Fertility Treatments on Corn Yields in eastern Oklahoma. Oliver Henry Brensing. M. S. Thesis. Oklahoma State University. 1958.

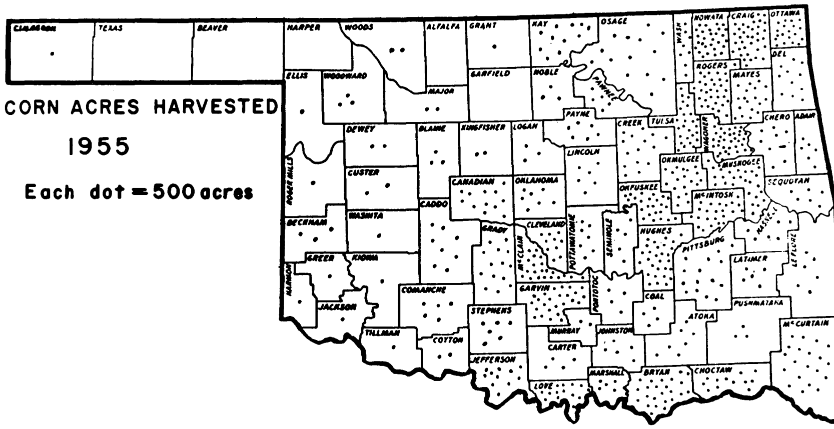

Fig. 3 Corn acreages in recent years are principally located in the eastern prairie and productive bottomland soil areas. Only 338,000 acres of corn were harvested in 1955.

phate fertilizers were applied as a sidedressing at an early cultivation with common and differential fertilizer treatment at seeding. (3) Time of sidedressing was compared with different rates of nitrogen fertilizers with common starter fertilizer applied at planting. (4) Rates of nitrogen, phosphorus and potassium were compared in various combinations to obtain a yield response as a function of a single plant nutrient when other plant nutrients were not limiting.

Fertilizer applied at planting was placed below and to one side of the seed. Nitrogen fertilizers used in sidedressing an established stand were applied with a cultivation operation when the corn plants were 12 to 18 inches in height. Stands were planted to obtain populations of 9 to 11 thousand corn plants per acre. The seed variety used was, in general, that used by the farmer-cooperator and was a high yielding variety of good quality seed recommended for that particular part of the state.

Results and Discussion

It is commonly assumed that a direct relationship exists between corn yields and rainfall during the growing season. This may be shown as a positive correlation between state average corn yields and average rainfall recorded for the first seven months of corresponding years during the period 1933-1955, as shown in Figure 4.

This apparent relationship can be used only for a broad general interpretation because of the many factors that influence growth and yield of corn in Oklahoma. Examples of these factors include the distribution and intensity of rainfall, the occurrence of hot, dry winds during the flowering period of the corn plant along with soil productivity factors, including soil moisture relationships and fertility level.

These field experiments were undertaken with the premise that improvement of soil factors, particularly fertility level, may improve corn yields during seasons considered both favorable and unfavorable for corn production.

Soils in central and eastern Oklahoma, generally used for corn production, were grouped into four categories based on response to fertilizer treatment.

Group I Soils

These deep, permeable, medium and heavy textured soils are located on first and second bottomlands. Soil fertility levels are usually high and soil moisture conditions are favorable during most years. These soils have high crop production potential when properly managed. Judicious use of fertilizers generally increases corn yields except under extreme drought conditions. Soil series in this group include Port, Verdigris, Telier, Reinach and Mason.

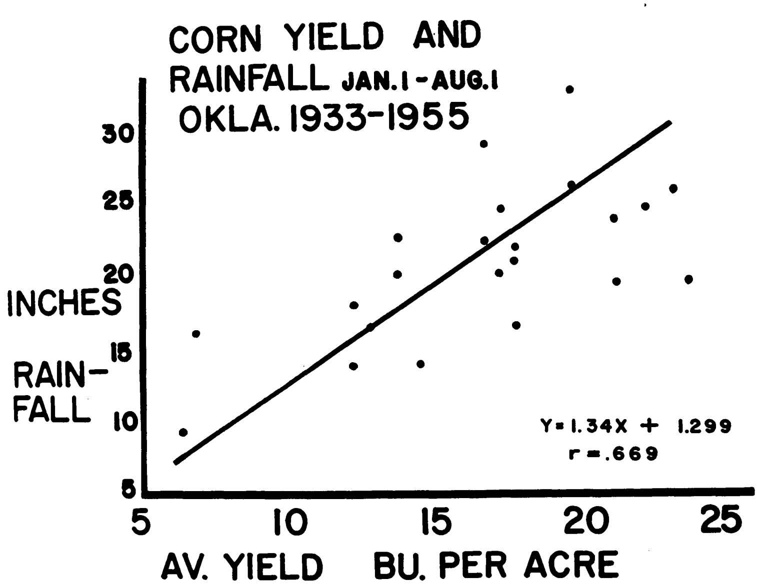

Fig. 4 There appears to be a relationship between the average corn yield and average rainfall during the seven month period, January 1st to August 1st. Rainfall distribution and soil productivity factors greatly influence this relationship. Well managed soils provide means for increasing efficiency in soil moisture utilization.

Figures 5 and 6[3] illustrate the highly significant increases in corn yields obtained with increased rates of nitrogen fertilization applied as sidedressing on these soils. The magnitude of response generally increased when climatic conditions were favorable for corn production.

There was a usual, but not always consistent, response to N-P-K fertilization at planting on these soil types. Examples of experimental results are shown in Table 1. Significant increases in corn yield averaging over 14 bushels per acre were obtained from three of the six experiments shown, one in each of the years 1949, 1950 and 1951. Significant response to starter fertilization was obtained in two of three years at the J. L. Smith farm on Teller fine sandy loam in Johnston County. No response was obtained in the Pawnee County experiment where corn followed alfalfa that had been heavily fertilized. Response to N-P-K fertilization was generally obtained on these Group I soils when the field had been in continuous corn or other cultivated crop with no fertilization during years immediately preceeding the experiments.

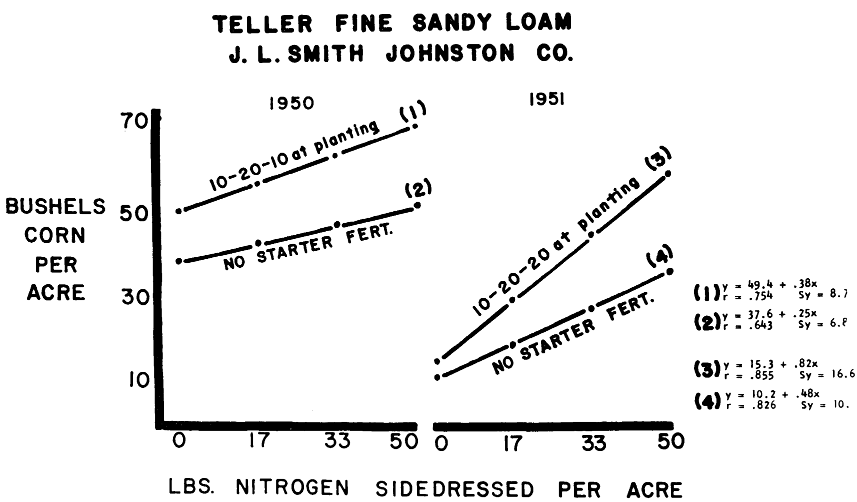

Fig. 5 A usual, but not always consistent yield response to complete fertilization at planting was obtained with Group I soils as Teller Fine Sandy Loam. The average Johnston County corn yield in 1950 was 27.0 bushels per acre. 25.62 inches of rainfall were recorded from April 1 to August 1 of that year. The average county yield in 1951 was 22.5 bushels per acre with 17.59 inches of rainfall received between April 1 and August 1.

[3] Explanatory note for figures and tables: The trend in corn yield is shown with a "line of best fit." The equation shown is the calculated formula for the line shown. r is the correlation coefficient for the data: r = 1.0 is the maximum relationship possible. Sy is the standard deviation of corn yields from the average yield of the experiment.

Successive years' data from experiments with Verdigris fine sandy loam on the Tom Hill farm in Seminole County are shown in Table 2. This data indicated an increase in corn yield when N was added up to 100 lbs. N per acre when P and K were applied at high rates. Increases in yield with increased P applications were obtained when N and K were applied at high rates. No apparent yield response was obtained with increased K additions when N and P were applied at high rates on this Group I soil.

Group II Soils

This second soil grouping also occurs on first and second bottomlands. These well drained, medium to coarse textured soils have been deposited by recent stream overflows. Hazards from the cutting action of wind-blown sand particles are frequently of great importance on these soils. Fertility is generally low and soil productivity for corn production more limited than with the Group I soils. These soils have good moisture relationships although generally low in organic matter. Soil series in this group include Yahola, Cleora and Pulaski.

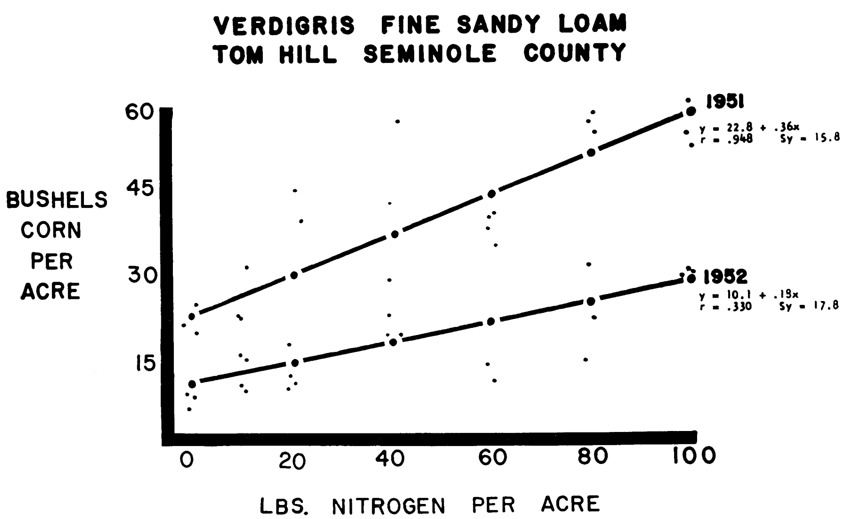

Fig. 6 Highly significant yield increases were obtained with increased rates of N applied as a sidedressing on Group I soils. All treatments shown above received 60 lbs. P_2O_5 and 60 lbs. K_2O per acre except the check which received no treatment. Ten pounds of N per acre was applied at planting on all N treated plots with the remaining N applied as sidedressing. The average Seminole County corn yield in 1951 was 18.5 bushels per acre with 12.59 inches of rainfall received between April 1 and August 1 of that year. The average county yield in 1952 was 12 bushels per acre with 16.64 inches of rainfall during the four months period April 1 to August 1.

These soils, in general, gave highly significant yield increases from N-P-K fertilization applied at planting and with increased rates of nitrogen applied as a sidedressing (Figure 7).

The consistent yield response of these soils to starter fertilization, shown in Table 3, reflects the lower soil fertility level normally encountered in the soil grouping as compared to the Group I soils.

The importance of timeliness in application of nitrogen fertilizers as sidedressing is shown in Table 4. Yields decreased steadily with lateness of application in these experiments. Recommended time of application is when the corn plants are 12 to 18 inches in height and is ordinarily at the time of the last cultivation of the corn crop.

Group III Soils

These medium textured soils are productive upland and terrace soils of moderate depth. They are usually moderate in fertility and generally respond well to fertilization, particularly to both nitrogen and phosphate. Erosion is often a factor and soil management practices must include provision for minimizing erosion loss with production of cultivated crops. Soil series in this group include Bethany, Choteau, Dennis, Bates, Parsons and Vanoss.

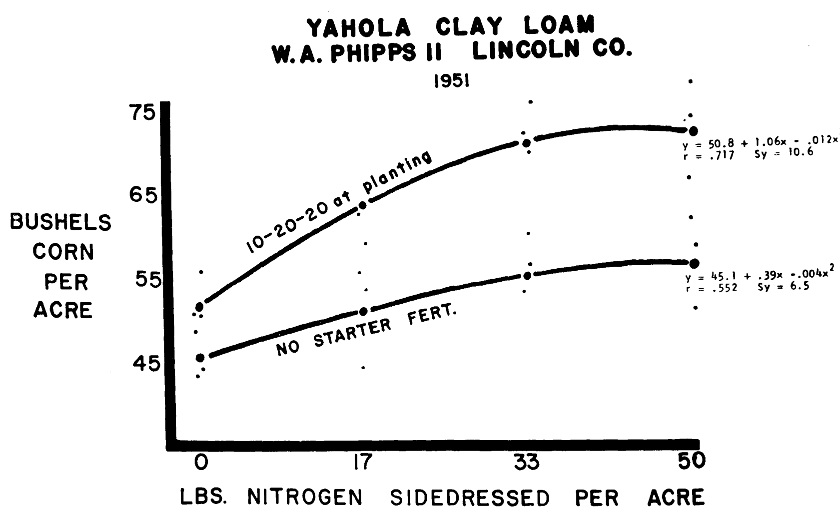

Fig. 7 The general need for complete fertilization of corn at planting on Group II soils is shown here. Yield increases are limited with increased rates of N applied when P and K are not available to the crop in adequate amounts. The average corn yield in Lincoln County was 19.5 bushels per acre in 1951. 16.10 inches of rainfall were recorded for the period April 1 to August 1 of that year.

Experimental results in Table 5 are representative of the usual significant yield increase obtained with N-P-K fertilization when applied at planting. Corn yields on Vanoss fine sandy loam, Johnston County, 1949, 1950 and 1951 illustrate the significant yield increases obtained with increased rates of nitrogen applied as sidedressing on these soils. Response from sidedressed nitrogen was markedly increased when complete fertilization was applied at planting (Figure 8).

The corn crop on Dennis silt loam, Pawnee County, followed heavily fertilized alfalfa. This resulted in a limited response from N-P-K fertilization at planting in that experiment.

The influence of nitrogen fertilization when combined with a favorable nutrient balance for increasing corn yields is shown in Figure 9. A linear type yield increase was obtained on this Choteau silt loam, McIntosh County, with increased rates of nitrogen when combined with high levels of P and K.

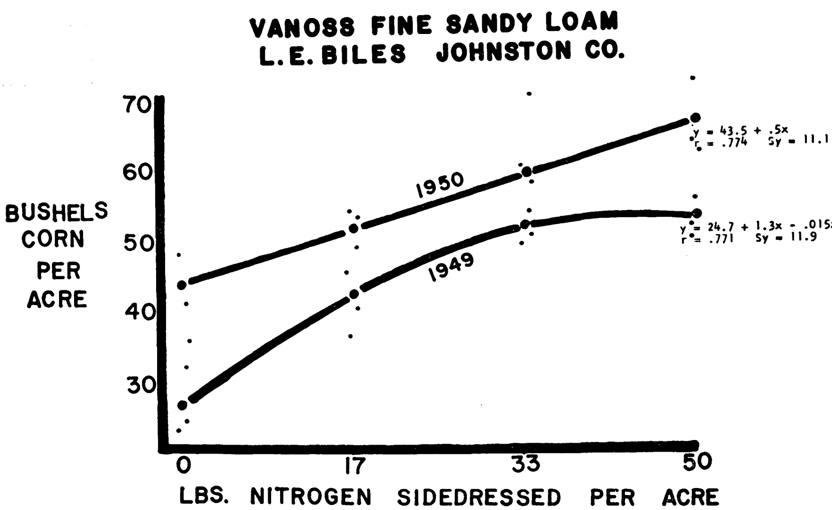

Fig. 8 Profitable increases in corn yield with increased rates of nitrogen fertilization were obtained on these soils when adequate phosphorus and potassium fertilizers were used. The response is apparent in both favorable and less favorable years for corn production.

The 1949 crop shown above received a complete fertilizer consisting of 14 lbs. of N, 34 lbs. of P_2O_5 and 28 lbs. of K_2O per acre at planting in addition to the N sidedressing. The 1950 crop received 10 lbs. of N, 20 lbs. P_2O_5, 20 lbs. K_2O per acre at planting in addition to the sidedressing of N. The Johnston County average corn yield in 1949 was 20.0 bushels with 13.46 inches of rainfall recorded from April 1 to August 1. The 1950 county average was 27 bushels per acre with 25.62 inches of rainfall recorded in the period April 1 to August 1.

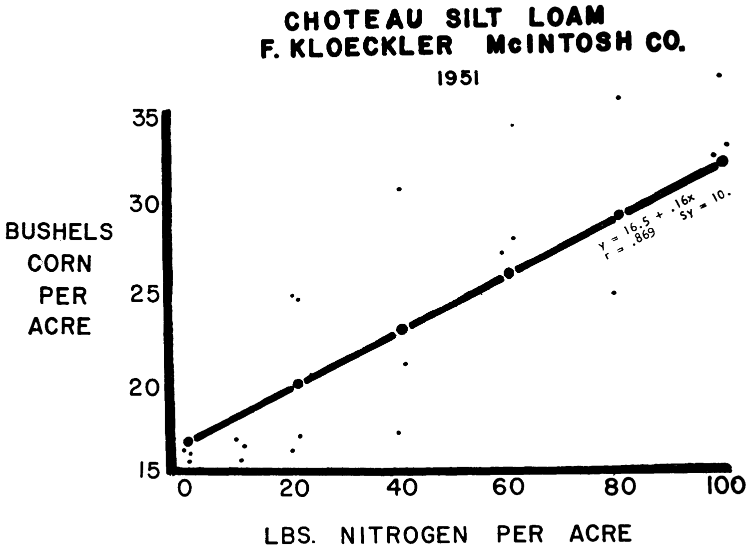

Fig. 9 Highly significant increases in corn yield with increased nitrogen fertilization were obtained on these soils when favorable plant nutrient balance was attained with proper fertilization. The corn crop shown above was fertilized with 60 lbs. P_2O_5 and 60 lbs. K_2O per acre. Ten pounds N was applied at planting on all N treated plots with the remaining N applied as sidedressing.

Group IV Soils

These coarse textured soils are located on sandy upland and sandy terraces. They are usually considered as having low productive potential. These soils are generally low in inherent fertility, strongly acid in reaction and low in organic matter. Proper fertilization usually requires lime with high rates of nitrogen, phosphorus and potassium. Soil moisture relationships are usually good during most seasons, even in those periods of limited rainfall considered drouthy for the other three soil groupings. Soil series in this group include Bowie, Stidham, Dougherty and Stephenville.

There was generally a consistent response to complete N-P-K fertilization at planting. Also highly significant linear-type increases in yield were obtained with increased rates of nitrogen applied as sidedressing up to 50 pounds per acre. Results shown in Table 6 are representative of these yield responses obtained during the years 1948, 1949, 1951 and 1952 on Group IV soils.

Water soluble fertilizers have possibilities for improving yields when applied to established crops which are deficient in plant nutrients. Significant yield increases with sidedressing of ammonium phosphate fertilizers were obtained on Dougherty fine sandy loam, Table 7. These soils are normally deficient in phosphorus and availability of this plant nutrient frequently limits response to increased rates of nitrogen application (Figure 10).

Three years data with comprehensive soil fertility treatments on Bowie fine sandy loam, Atoka County, Table 8, illustrates the yield increases consistently obtained with increased N rates when P and K were applied at high levels, Figure 11. The response to P fertilization is shown with linear increases in yield with increased P rates applied at high N and K levels. Yields were also increased with increased rates of K fertilization when N and P were not limiting.

Summary

The failure to produce profitable corn yields consistently has been a principal factor contributing to the decline from 5,939,000 harvested acres in 1909 to 321,000 acres in 1954. This study was originated to determine yield response of corn to various rates and kinds of fertilizer with emphasis on nitrogen fertilization.

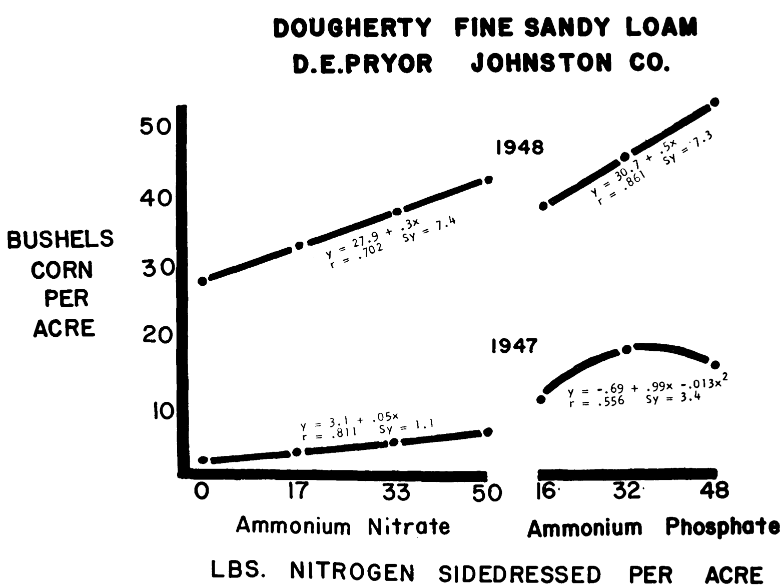

Fig. 10 Ammonium phosphate, a water soluble phosphate fertilizer applied as 16-20-0 analysis, increased yields over corresponding N rates of fertilization where no phosphorus was applied in these sidedressed fertilizer treatments. No fertilizer was applied at planting in these experiments.

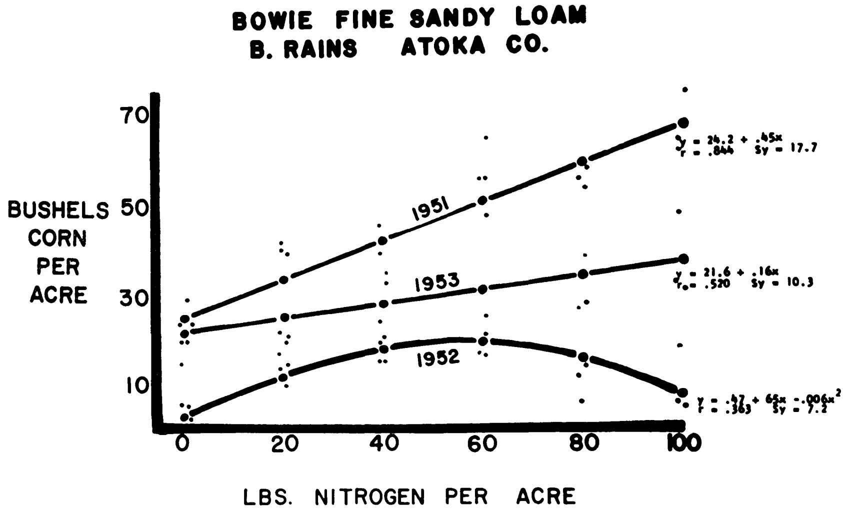

Fig. 11 Increases in corn yield with increased rates of N application were obtained when P and K were not limiting. All treatments shown above received 60 lbs. P_2O_5 and 60 lbs. K_2O per acre at planting. Ten pounds N was applied at planting on the N treated plots with the remaining N applied as sidedressing. The average per acre corn yields and the amount of rainfall recorded from April 1 to August 1 for Atoka County were as follows: 1951, 18.5 bushels and 16.88 inches rainfall; 1952, 9.5 bushels and 18.00 inches rainfall; 1953, 14.0 bushels and 29.18 inches rainfall.

Soils of eastern and central Oklahoma were grouped into four categories:

Group I: Deep, permeable, highly permeable, highly productive heavy textured bottomland soils indicated (a) a usual, but not always consistent, yield increase with N-P-K fertilization at planting, (b) highly significant yield increase with increased rates of N sidedressed, (c) yields increased lineally with N additions combined with high P and K treatments. High rates of P increased yields when combined with high rates of N and K.

Group II: Well drained, normally less productive medium to coarse textured bottomland and terrace soils indicated (a) highly significant yield increases to N-P-K fertilization at planting with increased rates of N sidedressed (b) date of N application was of great importance at all rates.

Group III: Medium textured upland soils of moderate depth indicated (a) a generally significant yield increase with N-P-K fertilization applied at planting, (b) highly significant yield increases from rates of

N applied as sidedressing, (c) N additions gave a linear type yield increase when combined with high levels of P and K fertilization.

Group IV: Coarse textured upland and terrace soils, usually considered of limited productive potential, indicated generally (a) consistent response to complete N-P-K fertilization at planting with highly significant response from N applied as sidedressing, (b) high significant response from P applied as ammonium phosphate when no starter fertilizer was used, (c) with high levels of fertilization, N and P rates gave a linear yield increase and K addition increased yields.

Table 1.—Effects of Sidedressed Nitrogen Application With and Without Starter Fertilization on Corn Yields, Group I Soils, 1949-1951

County, Soil Cooperator Type and Year	Fertilizer Starter Lbs./Acre	Pounds Per Acre Nitrogen Sidedressed 0	17	33	50	Av.	of Number Reps.	F Values[1] N Rate	Starter
		Bushels Per Acre							
J. L. Smith	None	38·6	45.5	44.5	34.6	40.8	3	4.32*	4.15
Johnston Co·	12-30 24	39.3	46.7	45.8	45.5	44.3			n. s.
Teller find									
sandy loam									
1949									
Jim Little	None	49.1	67.6	69.3	66.5	63.1	3	6.08**	31.46**
Garvin Co.	12-30-12	72.3	78.7	79.9	78.9	77.5			
Reinach									
silty clay									
1949									
J. L. Smith	None	39.4	42.4	42.4	51.8	44.0	3	11.20**	60.14**
Johnston Co.	10-20-20	48.7	55.8	64·9	66.8	59.1			
Teller fine									
sandy loam									
1950									
O.H. Brensing	None	33.0	40.4	57.2	61.7	48.1	3	122·83**	2.23
Pawnee Co.	10-20-10	23.8	39.8	52.1	60.8	44.1			n. s.
Port very	6-12-0	21.4	43.3	53·2	60.4	44.6			
fine sandy	8-16-16	25.8	44.0	57.5	64.9	48.1			
loam, 1950									
J. L. Smith	None	11.7	16.8	27.1	34.2	22.5	3	41.83**	59.66**
Johnston Co.	10-20-20	20·3	30.4	45.0	53.8	37.4			
Teller fine									
sandy loam									
1951									
D. Pryor	None	12.6	16.6	19.2	24.8	18.3	2	5.57*	1.48
Johnston Co.	10-20-20	13·4	21.2	23.8	25.3	20.9			n. s.
Teller fine									
sandy loam									
1951									

** Indicates statistical significance at the 1% level
* Indicates statistical significance at the 5% level
n.s. Indicates non-significant statistical differences.

Table 2.—Corn Yields as Affected by Various Soil Fertility Treatments Verdigris Fine Sandy Loam, Tom Hill, Seminole County

	Fertilizer Treatment Pounds Per Acre			Average Yield, Bushel Per Acre	
	N	P_2O_5	K_2O	1951	1952
Check	0	0	0	20.3	9.3
$N_1P_3K_3$	10	60	60	23.7	12.9
$N_2P_3K_3$	20	60	60	35.2	13.3
$N_3P_3K_3$	40	60	60	42.4	18.7
$N_4P_3K_3$	60	60	60	41.2	20.1
$N_5P_3K_3$	80	60	60	56.4	22.9
$N_6P_3K_3$	100	60	60	56.8	28.2
$N_6P_0K_3$	100	0	60	40.4	22.3
$N_6P_1K_3$	100	20	60	44.1	33.1
$N_6P_2K_3$	100	40	60	46.1	22.8
$N_6P_3K_0$	100	60	0	64.6	22.6
$N_6P_3K_1$	100	60	20	55.8	37.1
$N_6P_3K_2$	100	60	40	65.7	22.9
Treatment F value				11.24**	4.19**

Yields shown above are the average of three replications. Ten pounds N per acre wa applied at planting on all N treated plots with the remaining N applied as sidedressing

Table 3.—Corn Yield as Affected by Various Soil Fertility Treatments, Group II Soils, 1951-1952.

Cooperator, Soil Type, County and Year	Starter Fertilizer Lbs./A.	Sidedressed Fertilizer Treatment Pounds Per Acre					Number of Replications	F Value
		None	16-0-0	33-0-0	49-0-0			
W. A. Phipps, Yahola clay loam Lincoln Co., 1951				Bushels Per Acre		Av.		
	no starter	45.9	49.1	55.6	55.5	51.50	2	5.85**
	10-20-10	52.9	62.4	75.2	73.2	65.92		
		None	67-0-0	133-0-0	200-0-0			
Glen Goble, Yahola very fine sandy loam, Lincoln Co., 1951				Bushels Per Acre		Av.		
	no starter	21.5	25.4	31·1	27.4	26.35	3	3.19**
	10-20-10	35.8	41.8	31.2	33.8	35.65		
		None	17-0-0	33-0-0	50-0-0			
Glen Goble, Yahola very fine sandy loam, Lincoln Co., 1952				Bushels Per Acre		Av.		
	no starter	50.8		68.3		59.55	3	3.42**
	6-14-0	53.4	64.1	69.4	74·7	65.42		

Table 4.—Corn Yields as Affected by Rates and Time of Nitrogen Application, Yahola Very Fine Sandy Loam, Muskogee County, 1947

Cooperator Date N Applied	Nitrogen Sidedressed, Pounds Per Acre 0	17	33	50	99	Av.	F Value N Rate	Time
F. Vann								
May 28	14.6	22.3	32.2	30.2	34.1	26.7	18.07**	41.27**
June 13		14.7	17.6	23.3	26.6	20.6		
July 5		10.6	12.7	14.2	16.6	13.5		
Jim Short								
May 28	10.8	35.4	29.2	28.9	30.4	26.8	16.36**	262.04**
June 13		5.0	7.5	8.3	9.8	7.6		
July 5		2.3	3.4	2.7	4.0	3.1		

Table 5.—Effects of Sidedressed Nitrogen Application With and Without Starter Fertilization on Corn Yields, Group III Soils, 1949-1951

Cooperator County, Soil Type and Year	Starter Fertilizer Lbs./A. $N\text{-}P_2O_5\text{-}K_2O$	Nitrogen Sidedressed Pounds Per Acre 0	17	33	50	Av.	Number of Reps.	F Values N Rate	Starter
		Bushels Per Acre							
L. E. Biles Johnston Co. Vanoss fine sandy loam, 1949	None	22.9	42.2	43.2	46.1	38.6	3	105.5**	15.72**
	14-34-28	26.1	41.9	51.7	52.1	42.9			
Gus Shi Garvin Co. Bethany silt loam, 1950	None	43.0	50.7	53.8	53.7	50.3	2	11.2**	54.3 **
	18-36-18	54.6	64.3	61.4	72.4	63.2			
L. E. Biles Johnston Co. Vanoss fine sandy loam, 1950	None	36.0	56.5	57.1	58.5	52.2	3	15.8**	3.7
	10-20-20	43.0	51.8	62.5	66.9	56.1			n. s.
Henry Brensing Pawnee, Dennis silt loam, 1950	None	52.5	57.8	68.8	63.3	60.6	3	4.4*	.1
	6-12-6	53.0	57.7	64.2	70.7	61.4			n. s.
L. E. Biles Johnston Co. Vanoss fine sandy loam, 1951	5-10-10	43.9	55.3	63.9	65.1	57.1	3	6.2*	

Table 6.—Effects of Sidedressed Nitrogen Application With and Without Starter Fertilization on Corn Yields, Group IV Soils, 1948-1952

Cooperator County, Soil Type and Year	$N-P_2O_5-K_2O$ Starter Fertilizer Lbs./Acre	Nitrogen Sidedressed Pounds Per Acre 0	17	33	50	Av.	Number of Reps.	F Values N Rate	Starter
		Bushels Per Acre							
W.H. Hathaway Johnston Co. Bowie fine sandy loam, 1948	5-15-5	7.5	18.1	30.8	35.9	23.1	3	30.64**	
W.H. Hathaway Johnston Co. Bowie fine sandy loam, 1949	None	22.7	33.7	38.4	43.1	34.5	3	8.44**	
	12-30-24	40.4	45.7	47.5	47.9	45.4			27.3**
W.H. Hathaway Johnston Co. Bowie fine sandy loam, 1948	12-24-12	30.1	40.8	53.5	56.5	45.2	3	21.29**	
C. Faulkenstein Lincoln Co. Stephenville fine sandy loam, 1952	19-48-19	8.0	12.1	17.4	20.0	14.4	5	9.76**	

Table 7.—Corn Yields as Affected by Various Soil Fertility Treatments, Dougherty Fine Sandy Loam, D. E. Pryor, Johnston County

Year	Fertilizer Sidedressed Pounds Per Acre None	17-0-0	33-0-0	50-0-0	16-20-0	32-40-0	48-60	Av.	Number of Replications	Treatment F Value
	Bushels Per Acre									
1947	4.4	3.6	5.1	5.6	11.7	17.9	16.8	9.3	2	48.96**
1948	24.8	36.2	37.4	42.5	38.2	47.3	54.5	40.1	3	26.84**

No starter fertilizer was applied at planting.

Table 8.—Corn Yields as Affected by Various Soil Fertility Treatments, Bowie Fine Sandy Loam, B. Rains, Atoka County

	Fertilizer Treatment Pounds Per Acre			Average Yield, Bushels Per Acre		
	N	P_2O_5	K_2O	1951	1952	1953
Check	No Fertilizer			16.6	5.0	19.4
P_3K_3	0	60	60	24.9	1.2	22.7
$N_1P_3K_3$	20	60	60	32.1	16.6	25.1
$N_2P_3K_3$	40	60	60	39.3	18.0	27·1
$N_3P_3K_3$	60	60	60	59.1	18.2	36.7
$N_4P_3K_3$	80	60	60	57.3	11.2	31.8
$N_5P_3K_3$	100	60	60	68.8	12.0	38.1
N_5 K_3	100	0	60	35.3	6.8	33.2
$N_5P_1K_3$	100	20	60	52·0	8.3	37.4
$N_5P_2K_3$	100	40	60	44.8	11.2	36.1
N_5P_3	100	60	0	54.7	8.8	29.8
$N_5P_3K_1$	100	60	20	50.5	13.2	32.6
$N_5P_3K_2$	100	60	40	60.0	12.9	35.7
	Treatment F Value			8.87**	2.03 n.s.	1.23 n.s.

Yield figures are the average from three replications. Ten pounds N was applied at planting on all N treated plots with the remaining N applied as sidedressing.