KS-23F Long-term nitrogen, phosphorus, and potassium fertilization of irrigated corn and grain sorghum, 1994

Project leader:

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Long-term Kansas research shows that P along with N are essential for optimum yields of irrigated corn and grain sorghum. In this study, N fertilization increased corn yields by 125 bu/A and sorghum yields by 70 bu/A. With adequate N, P fertilization increased corn yields 80 bu/A and sorghum yields 20 bu/A and decreased corn grain moisture content by 10%. Lower grain moisture contibutes to higher crop profits by susbstantial reduction in grain drying costs.

LONG TERM FERTILIZATION OF IRRIGATED CORN AND GRAIN SORGHUM

Alan Schlegel

Summary

Long term research shows that phosphorus and nitrogen fertilizer must be applied for optimum grain yields of irrigated corn and grain sorghum in western Kansas. In this study, N fertilization increased corn yields 125 bu/acre and sorghum yields 70 bu/acre. Although P increases grain yields of corn and sorghum, corn responds much more to P fertilization than sorghum. With adequate N, corn yields are increased 80 bu/acre by P applications compared to 20 bu/acre for sorghum. Fertilizer P at 40 lb P_2O_5/acre appears to be about adequate for producing optimum grain yield of corn. Adequate P fertilization provides for earlier maturity of corn, thereby permitting earlier harvest &/or reducing drying costs.

Procedure

This study was initiated in 1961 to determine responses of continuous corn and grain sorghum grown under flood irrigation to nitrogen, phosphorus, and potassium fertilization. Corn and grain sorghum were grown on Ulysses silt loam in adjacent plot areas. Initial fertilizer treatments were N rates of 0, 40, 80, 120, 160, and 200 lb N $acre^{-1}$ without P and K; with 40 lb P_2O_5 $acre^{-1}$ and zero K; and with 40 lb P_2O_5 $acre^{-1}$ and 40 lb K_2O $acre^{-1}$. In 1992, the treatments for the corn study were changed with the K variable being replaced by a higher rate of P (80 lb P_2O_5 $acre^{-1}$).

All fertilizers were broadcast by hand in the spring prior to planting and incorporated. The corn hybrid was Pioneer 3379 and the sorghum hybrid was Mycogen TE Y-75. Both studies were furrow irrigated as needed during the growing season. The center 2 rows of all plots were machine harvested after physiological maturity. Grain yields were adjusted to 15.5% moisture for corn and 12.5% for sorghum.

Results

Corn yields in 1994 were increased up to 125 bu/acre by N fertilizer (Table 1). Usually 160 lb N/acre is sufficient to maximize corn yields, but there was a slight yield response up to 200 lb N/acre in 1994. Application of P increased yields by about 80 bu/acre when applied with 120 lb N/acre or more. There was no significant yield difference between applying 40 and 80 lb P_2O_5/acre. Grain moisture content at harvest was reduced from 27% to about 18% by P fertilization.

Grain sorghum yields were increased about 70 bu/acre by application of N at 80 lb N/acre or greater (Table 2). Phosphorus increased yields 20 bu/acre or more when applied with N. Potassium has not produced a yield increase for grain sorghum in any year of this study because of inherently high K content of the soil.

Table 1. Effect of of N and P fertilizers on irrigated corn. Tribune, KS, 1994.

N	P_2O_5	Grain		
		Yield	Moist	TW
- -lb/a - -		bu/a	%	lb/bu
0	0	47	21.4	52.5
0	40	43	21.8	52.1
0	80	48	20.6	52.7
40	0	66	22.6	52.2
40	40	104	14.9	56.4
40	80	105	15.0	56.7
80	0	66	30.0	49.7
80	40	129	15.8	56.9
80	80	127	15.3	57.2
120	0	70	31.2	49.6
120	40	147	17.2	56.1
120	80	154	16.2	57.3
160	0	78	29.2	50.2
160	40	162	20.5	54.7
160	80	167	18.0	56.1
200	0	80	29.0	50.2
200	40	171	19.9	55.0
200	80	174	19.5	55.7
ANOVA				
Nitrogen		0.001	0.001	0.001
lin.		0.001	0.001	0.369
quad.		0.001	0.006	0.001
Phosphorus		0.001	0.001	0.001
lin.		0.001	0.001	0.001
quad.		0.001	0.001	0.001
N*P		0.001	0.001	0.001
N_l*P_l		0.001	0.001	0.001
N_l*P_q		0.001	0.009	0.011
N_q*P_l		0.025	0.001	0.001
N_q*P_q		0.133	0.001	0.001

Table 1 (cont).

MAIN EFFECT MEANS

	Grain		
	Yield	Moist	TW
	bu/a	%	lb/bu
Nitrogen (lb/a)			
0	46	21.3	52.4
40	92	17.5	55.1
80	107	20.4	54.6
120	124	21.5	54.3
160	136	22.6	53.7
200	142	22.8	53.6
$LSD_{.05}$	13	1.4	0.6
P_2O_5 (lb/a)			
0	68	27.2	50.7
40	126	18.4	55.2
80	129	17.4	55.9
$LSD_{.05}$	9	1.0	0.4

Table 2. Effect of of N, P, and K fertilization of irrigated grain sorghum on grain yield. Tribune, KS, 1994.

N	P_2O_5	K_2O	Grain	
			Yield	Test weight
- - -lb/a - -			bu/a	lb/bu
0	0	0	64	53.8
0	40	0	82	56.3
0	40	40	78	55.0
40	0	0	76	55.2
40	40	0	113	57.6
40	40	40	112	57.1
80	0	0	96	56.3
80	40	0	123	56.9
80	40	40	131	58.3
120	0	0	91	55.4
120	40	0	131	57.9
120	40	40	133	57.3
160	0	0	105	57.2
160	40	0	137	57.2
160	40	40	125	57.0
200	0	0	114	57.9
200	40	0	133	57.2
200	40	40	130	56.9
ANOVA				
Nitrogen			0.001	0.043
lin.			0.001	0.007
quad.			0.001	0.114
P-K			0.001	0.062
Zero P vs P			0.001	0.021
P vs P-K			0.734	0.658
N*P-K			0.797	0.608
Nl*ZeroP vs P-K			0.860	0.048
Nl*P vs P-K			0.777	0.748
Nq*ZeroP vs P-K			0.060	0.297
Nq*P vs P-K			0.581	0.388

Table 2 (cont).

MAIN EFFECT MEANS

	Grain	
	Yield	Test wt.
	bu/a	lb/bu
Nitrogen (lb/acre)		
0	75	55.0
40	100	56.6
80	117	57.2
120	118	56.9
160	122	57.1
200	126	57.3
LSD.05	14	1.5
P_2O_5-K_2O (lb/a)		
0- 0	91	55.9
40- 0	120	57.2
40-40	118	56.9
LSD.05	10	1.1