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Nitrogen and Phosphorus Fertilization of Irrigated Corn

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Abstract

(Abstract only. Link to: http://newprairiepress.org/kaesrr/vol1/iss3/7/)
Article is nearly identical to Long-Term Nitrogen and Phosphorus Fertilization of Irrigated Corn, previously published in Kansas Fertilizer Research 2015, included in this PDF.

Long-term research shows that phosphorus (P) and nitrogen (N) fertilizer must be applied to optimize production of irrigated corn in western Kansas. In 2014, N applied alone increased yields 58 bu/a, whereas P applied alone increased yields only 12 bu/a. Nitrogen and P applied together increased yields up to 152 bu/a. This is slightly above the 10-year average, when N and P fertilization increased corn yields up to 146 bu/a. Application of 120 lb/a N (with P) produced about 91% of maximum yield in 2014, which was similar to the 10-year average. Application of 80 instead of 40 lb P2O5/a increased average yields 9 bu/a.

Keywords

soil fertility, irrigation, corn, nitrogen fertilization, phosphorus fertilization

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Abstract
Long-term research shows that phosphorus (P) and nitrogen (N) fertilizer must be applied to optimize production of irrigated corn in western Kansas. In 2014, N applied alone increased yields 58 bu/a, whereas P applied alone increased yields only 12 bu/a. Nitrogen and P applied together increased yields up to 152 bu/a. This is slightly above the 10-year average, where N and P fertilization increased corn yields up to 146 bu/a. Application of 120 lb/a N (with P) produced about 91% of maximum yield in 2014, which was similar to the 10-year average. Application of 80 instead of 40 lb P2O5/a increased average yields 9 bu/a.

Keywords
irrigated corn, nitrogen and phosphorus fertilization, southwest Kansas

Long-Term Nitrogen and Phosphorus Fertilization of Irrigated Corn

A. Schlegel and H.D. Bond

Summary

Long-term research shows that phosphorus (P) and nitrogen (N) fertilizer must be applied to optimize production of irrigated corn in western Kansas. In 2014, N applied alone increased yields 58 bu/a, whereas P applied alone increased yields only 12 bu/a. Nitrogen and P applied together increased yields up to 152 bu/a. This is slightly above the 10-year average, where N and P fertilization increased corn yields up to 146 bu/a. Application of 120 lb/a N (with P) produced about 91% of maximum yield in 2014, which was similar to the 10-year average. Application of 80 instead of 40 lb P_2O_5/a increased average yields 9 bu/a.

Introduction

This study was initiated in 1961 to determine responses of continuous corn and grain sorghum grown under flood irrigation to N, P, and potassium (K) fertilization. The study is conducted on a Ulysses silt loam soil with an inherently high K content. No yield benefit to corn from K fertilization was observed in 30 years, and soil K levels remained high, so the K treatment was discontinued in 1992 and replaced with a higher P rate.

Procedures

This field study is conducted at the Tribune Unit of the Southwest Research-Extension Center. Fertilizer treatments initiated in 1961 are N rates of 0, 40, 80, 120, 160, and 200 lb/a without P and K; with 40 lb/a P_2O_5 and zero K; and with 40 lb/a P_2O_5 and 40 lb/a K_2O. The treatments were changed in 1992; the K variable was replaced by a higher rate of P (80 lb/a P_2O_5). All fertilizers were broadcast by hand in the spring and incorporated before planting. The soil is a Ulysses silt loam. The corn hybrids [Pioneer 34N45 (2004 and 2005), Pioneer 34N50 (2006), Pioneer 33B54 (2007), Pioneer 34B99 (2008), DeKalb 61-69 (2009), Pioneer 1173H (2010), Pioneer 1151XR (2011), Pioneer 0832 (2012–2013), and Pioneer 1186AM (2014)] were planted at about 32,000 seeds/a in late April or early May. Hail damaged the 2005 and 2010 crops. The corn is irrigated to minimize water stress. Sprinkler irrigation has been used since 2001. The center two rows of each plot are machine harvested after physiological maturity. Grain yields are adjusted to 15.5% moisture.

Results

Corn yields in 2014 were 17% greater than the 10-year average (Table 1). Nitrogen alone increased yields 58 bu/a, whereas P alone increased yields only 12 bu/a; however, N and P applied together increased corn yields up to 152 bu/a. Although maximum yield was obtained with the highest N and P rate, 160 lb/a N with 80 lb/a P_2O_5 caused less than a 2% yield reduction. Corn yields in 2014 (averaged across all N rates) were 9 bu/a greater with 80 than with 40 lb/a P_2O_5.

Table 1. Effects of nitrogen and phosphorus fertilization on irrigated corn, Tribune, KS, 2005–2014

N	P_2O_5	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Mean
------ lb/a ------		---------- bu/a ----------										
0	0	49	42	49	36	85	20	92	86	70	86	61
0	40	60	68	50	57	110	21	111	85	80	95	74
0	80	51	72	51	52	106	28	105	94	91	98	75
40	0	63	56	77	62	108	23	114	109	97	106	82
40	40	101	129	112	105	148	67	195	138	125	153	127
40	80	100	123	116	104	159	61	194	135	126	149	127
80	0	75	79	107	78	123	34	136	128	112	117	99
80	40	141	162	163	129	179	85	212	197	170	187	162
80	80	147	171	167	139	181	90	220	194	149	179	164
120	0	66	68	106	65	117	28	119	134	114	115	93
120	40	162	176	194	136	202	90	222	213	204	213	181
120	80	170	202	213	151	215	105	225	211	194	216	190
160	0	83	84	132	84	139	49	157	158	122	128	113
160	40	170	180	220	150	210	95	229	227	199	211	189
160	80	172	200	227	146	223	95	226	239	217	233	198
200	0	109	115	159	99	155	65	179	170	139	144	134
200	40	169	181	224	152	207	97	218	225	198	204	188
200	80	191	204	232	157	236	104	231	260	220	238	207
ANOVA (P > F)												
Nitrogen		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Linear		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Quadratic		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Phosphorus		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Linear		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Quadratic		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
N × P		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

continued

Table 1. Effects of nitrogen and phosphorus fertilization on irrigated corn, Tribune, KS, 2005–2014

N	P_2O_5	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Mean
------ lb/a ------		---------- bu/a ----------										
Means												
Nitrogen, lb/a												
0		53	61	50	48	100	23	103	88	80	93	70
40		88	103	102	91	138	50	167	127	116	136	112
80		121	137	146	115	161	70	189	173	143	161	142
120		133	149	171	118	178	74	189	186	171	181	155
160		142	155	193	127	191	80	204	208	179	190	167
200		156	167	205	136	199	89	209	218	186	196	176
$LSD_{(0.05)}$		10	15	11	9	12	9	13	10	10	10	8
P_2O_5, lb/a												
0		74	74	105	71	121	36	133	131	109	116	97
40		134	149	160	122	176	76	198	181	163	177	154
80		139	162	168	125	187	81	200	189	166	186	160
$LSD_{(0.05)}$		7	11	8	6	9	7	9	7	7	7	6

Note: Hail events occurred on August 19, 2005 and July 23, 2010.