STARTER FERTILIZER INTERACTIONS WITH CORN HYBRIDS

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ABSTRACT

The objective of this study was to evaluate the response of corn hybrids grown in a dryland, no-tillage production system on a soil high in available phosphorus to starter fertilizer. Treatments were corn hybrids (5 in 1993 and 6 in 1994) grown with or without starter fertilizer. Starter fertilizer (30 lb N and 30 lb P_2O_5) was applied 2 inches to the side and 2 inches below the seed at planting. Nitrogen was balanced on all plots to give a total of 180 lb/A. Bray-1 P level in the experimental area was 43 ppm. Starter fertilizer improved growth of all hybrids at both the V6 and V10 stage of growth. V6 stage whole plant N and P uptake were also improved by the use of starter fertilizer. Leaf N and P concentrations at silking were higher in all hybrids with starter fertilizer. Starter fertilizer improved grain yield, improved total P uptake (grain plus stover), and reduced the number of days from emergence to mid-silk in some hybrids but not others. Starter fertilizer increased the 2-year average grain yield of Pioneer 3346 and Dekalb 636 by 15 bu/A, respectively, but the yields of ICI 8599 and Pioneer 3563 were not affected by the application of starter fertilizer.

Introduction

Dryland corn in central Kansas is normally planted as early in the spring as possible so pollination occurs in June when temperatures are more moderate and moisture conditions are more favorable than in July when conditions are normally hot and dry. Early corn growth is often poorer in conservation tillage systems than in conventionally tilled systems. This can be a serious problem with dryland corn planted in early April when soil temperature is less than optimum for plant growth. Cool soil temperatures at planting time can reduce N and P uptake of corn. Slow plant growth at low soil temperature may be due to limited root growth and reduced nutrient availability. Placing fertilizer in close proximity to the seed at planting has been shown to alleviate the detrimental effects of cool soil temperature on corn growth and development. Corn hybrids may differ in rooting characteristics and ability to extract and utilize nutrients. This study evaluated the effects of starter fertilizer on corn hybrids with maturities ranging from 2530 to 2850 growing degree units (GDU) grown under no-tillage, dryland conditions.

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Methods

This field experiment was conducted at the North Central Kansas Experiment Field near Belleville on a Crete silt loam soil starting in the spring of 1993. Analysis by the KSU Soil Test Lab showed that initial soil pH (April 1993) was 6.1, organic matter content 2.4%, Bray-1 P 43 ppm, and exchangeable K 380 ppm in the surface 6 in. The site had been in no-tillage grain sorghum for two years prior to the establishment of this study. The study was a split-plot design with hybrids as the main plots. The corn hybrids ICI 8599 (2530 GDU), Pioneer 3563 (2600 GDU), Pioneer 3346 (2850 GDU), Dekalb 636 (2830 GDU), Dekalb 591 (2590 GDU), and Pioneer 3394 (2690 GDU, tested in 1994, but not 1993) were grown with or without starter fertilizer. Starter fertilizer (30 lb N and 30 lb P_2O_5/A) was applied 2 inches to the side and 2 inches below the seed at planting. Liquid ammonium polyphosphate (10-34-0) and urea-ammonium nitrate solution (28% UAN) were used as the starter fertilizer sources. Nitrogen as anhydrous ammonia was knifed applied immediately after planting to bring all plots to a total of 180 lb/A. Corn was planted on 26 April, 1993 and 19 April, 1994 at the rate of 24,000 seed/A into crop residue without tillage.

Results

Temperatures in April and May in both 1993 and 1994 were much below normal. Starter fertilizer x hybrid interactions for yield, days to mid-silk and total P uptake were significant in both 1993 and 1994 (Table 1). Starter fertilizer improved yields of some hybrids but not others. Pioneer 3346 and Dekalb 636 yielded 12 and 13 bu/A higher in 1993 and 19 and 18 bu/A higher in 1994 with than without starter, respectively. Starter fertilizer had no significant effect on yields of ICI 8599 and Pioneer 3563 both years. Hybrids responded similarly to starter for the two years suggesting that hybrids could be screened for responsiveness, perhaps using company descriptions of hybrid early season vigor. Pioneer 3394 was added to the experiment in 1994 because of company description of outstanding early-season growth characteristics under cool soil temperature conditions. However, yields of Pioneer 3394 in 1994 were 15 bu/A higher with starter fertilizer than without.

For dryland corn production, it is important to have the crop pollinate before the hot, dry period that usually occurs in early July. Number of days from emergence to mid-silk were reduced in all hybrids except for ICI 8599. When averaged over all hybrids, the number of days from emergence to mid-silk was reduced by 5 days (Table 1). Starter fertilizer improved total P uptake (grain plus stover) in some hybrids but not in others.

Starter fertilizer improved dry matter production at the V6 growth stage in all hybrids (Table 2). When averaged over all hybrids and years, starter fertilizer increased dry matter production by 358 lb/A. Growth differences to starter fertilizer were still evident at the V10 growth stage.

Starter fertilizer increased N and P uptake at the V6 growth stage in all hybrids (Table 3). When averaged over all hybrids, starter fertilizer nearly doubled N and P uptake in 1993 and almost tripled N and P uptake in 1994. In both 1993 and 1994 earleaf N and P concentrations at silking were improved by the use of starter fertilizer (Table 4).

On this high soil test P soil, starter fertilizer improved early-season growth and nutrient uptake in all hybrids tested. Only for some hybrids did this response translate into an increased grain yield. Hybrids do respond to starter fertilizer differently. When planting early into cool soils under no-tillage conditions, growth and grain yields can be improved with starter fertilizer application even on soils high in available phosphorus.

Table 1. Effect of hybrid and starter fertilizer on grain yield, days to mid-silk, and total P uptake (grain plus stover) of corn, Belleville, KS.

Hybrid	Starter	Yield		Days to Mid-Silk		Total P Uptake	
		1993	1994	1993	1994	1993	1994
		-------bu/A-------				--------lb/A--------	
ICI 8599	With	164	203	63	58	35	40
	Without	163	199	65	60	35	41
Pioneer 3563	With	192	217	63	57	39	42
	Without	190	212	67	62	38	41
Pioneer 3346	With	225	209	65	58	51	44
	Without	213	190	69	64	41	40
Dekalb 626	With	196	196	66	60	44	43
	Without	183	178	72	64	38	37
Dekalb 591	With	191	202	64	58	42	45
	Without	185	193	67	63	37	39
Pioneer 3394	With	---	222	---	58	---	48
	Without	---	207	---	63	---	43
HybridxStarter LSD (0.05)		9	9	0.6	0.8	4	5

Table 2. Effect of hybrid and starter fertilizer on mean corn whole plant dry matter production at two growth stages, Belleville, KS.

	Dry Matter, lb/a			
	V6 Stage		V10 Stage	
Means	1993	1994	1993	1994
Hybrid				
ICI 8599	445	339	3888	4061
Pioneer 3563	690	481	4827	4565
Pioneer 3346	471	520	5283	5514
Dekalb 636	518	365	4638	3719
Dekalb 591	541	445	4858	4236
Pioneer 3394	----	639	----	5261
LSD (0.05)	71	132	NS[1]	NS
Starter				
With	673	683	6069	4036
Without	393	247	3328	5083
LSD (0.05)	105	130	1559	748

Hybrid x Starter interaction not significant (NS)

Table 3. Effect of hybrid and starter fertilizer on V6 stage whole plant P and N uptake of corn, Belleville, KS.

	V6 Whole Plant			
	N	P	N	P
Means	1993		1994	
	lb/A			
Hybrid				
ICI 8599	10.8	1.2	11.7	1.5
Pioneer 3563	16.2	1.9	16.6	1.9
Pioneer 3346	11.3	1.3	19.8	2.2
Dekalb 636	11.2	1.3	13.4	1.6
Dekalb 591	13.6	1.7	16.1	1.9
Pioneer 3394	---	---	22.5	2.6
LSD (0.05)	1.8	0.3	4.1	0.5
Starter				
With	16.5	2.0	24.7	2.9
Without	8.8	1.0	8.6	0.9
LSD (0.05)	2.6	0.3	4.9	0.7

Hybrid x Starter interaction not significant (NS)

Table 4. Effect of hybrid and starter fertilizer on mean earleaf-tissue N and P concentrations of corn at silking, Belleville, KS.

Means	Leaf N		Leaf P	
	1993	1994	1993	1994
	----------%			
Hybrid				
ICI 8599	2.47	2.28	0.28	0.26
Pioneer 3563	2.47	2.47	0.32	0.30
Pioneer 3346	2.79	2.60	0.32	0.28
Dekalb 636	2.74	2.48	0.30	0.28
Dekalb 591	2.81	2.64	0.32	0.29
Pioneer 3394	----	2.41	---	0.27
LSD (0.05)	0.13	0.06	0.01	0.01
Starter				
With	2.75	2.54	0.32	0.29
Without	2.56	2.42	0.30	0.27
LSD (0.05)	0.18	0.04	0.01	0.01

Hybrid x Starter interaction not significant (NS)

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