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Effect of Potassium Fertilization and New Corn Hybrids on Yield and Potassium Uptake in Continuous Corn

Abstract

A study was conducted to evaluate the effects of potassium (K) fertilization and new corn hybrids resistant to rootworm on grain yield and K uptake in continuous corn. New corn hybrids may increase yield and change K uptake or fertilization needs through improved traits that increase yield and root efficiency. Therefore, the study was planned to test this hypothesis by comparing continuous corn yield and response to K fertilization of hybrids with and without the rootworm resistant trait.

Keywords

RFR A10109, Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

Effect of Potassium Fertilization and New Corn Hybrids on Yield and Potassium Uptake in Continuous Corn

RFR-A10109

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Introduction

A study was conducted to evaluate the effects of potassium (K) fertilization and new corn hybrids resistant to rootworm on grain yield and K uptake in continuous corn. New corn hybrids may increase yield and change K uptake or fertilization needs through improved traits that increase yield and root efficiency. Therefore, the study was planned to test this hypothesis by comparing continuous corn yield and response to K fertilization of hybrids with and without the rootworm resistant trait.

Materials and Methods

One trial was established in 2006 and was evaluated for three years (Site 1). A second trial was established in 2007 and was evaluated for two years (Site 2). The predominant soil was Floyd loam at Site 1 and Kenyon loam at Site 2. Initial soil-test K was borderline between Low and Optimum at both sites (123 and 130 ppm). The treatments were two corn hybrids and five K fertilizer rates (0 to 180 lb K₂O/acre), which were replicated four times. One hybrid was resistant to glyphosate and corn borer, and the other was an isolate with the addition of rootworm resistance. In 2006, the first year at Site 1, the hybrids were DKC 51-39 (YGPL) and DKC 50-20 (RR2/YGCB). From 2007 to 2009 the hybrids planted at both sites were DKC 52-59 (VT3) and DKC 52-63 (RR2/YGCB). Corn was planted in rows spaced 30 in. The K rates ranged from 0 to 180 lb K₂O/acre. Fertilizer N and P were applied across all plots as needed. No soil insecticide was applied.

Measurements for all plots were the nutrient concentration (N, P, and K) of ear leaves at the silking stage, grain yield, and grain nutrient concentration at harvest. Rootworm injury and aboveground plant weight, nutrient concentration, and nutrient uptake were also measured in plots of three contrasting K fertilizer treatments at the R1 growth stage. Rootworm injury was rated according to the Iowa State University node injury scale (NIS). In this report we summarize rootworm injury ratings, aboveground plant K uptake at the R1 growth stage, and grain yields.

Results and Discussion

Rootworm injury ratings (Table 1) were consistently lower for the rootworm resistant corn hybrid, and were very low with the exception of 2007 at Site 2. For the susceptible hybrid root injury ranged from light to moderate. Potassium fertilization did not affect rootworm incidence consistently.

The grain yield data indicated no increase due to K fertilization at any year of Site 1 or the first two years of Site 2. There was a clear yield response to K the last year of Site 2, but no difference between the K rates used. Therefore, Table 2 shows yield data for the control receiving no K fertilizer and the average of all K rates. In 2009 (the last year of Site 2), K fertilization increased yield of the resistant hybrid from 177 to 187 bushels/acre (a 5.7% increase) and yield of the susceptible hybrid from 160 to 175 bushels/acre (a 9.4% increase). The yield levels were higher for the resistant hybrid, and a K deficiency hurt the susceptible hybrid more than the resistant hybrid. Therefore, the resistant hybrid was more efficient when K was limiting.

In 2006, 2008, and 2009, the rootworm resistant corn hybrid yielded more than the susceptible hybrid, while in 2007 there were no clear yield differences between hybrids at any site. The yield differences were not well related to the rootworm injury ratings observed for the hybrids, sites, or years. On average across all site-years, the resistant hybrid yielded about 10 bushels/acre more than the susceptible hybrid. Grain K concentrations and K removal (not shown) indicated no K concentration differences between hybrids but higher K removal by the resistant hybrid due to higher yield.

Data in Table 3 indicate that at Site 1, K fertilization increased the plant K uptake by the susceptible hybrid but not K uptake by the resistant hybrid, and that uptake without K fertilization was higher for the resistant hybrid. At Site 2, K fertilization increased K uptake by both hybrids. Although trends were not consistent for all years and sites, the average results indicate a higher K use efficiency of the resistant hybrid with limiting K and a higher uptake response for the susceptible hybrid. This result is in agreement with the higher K efficiency of the resistant hybrid to produce grain yield with limited K in the last year of Site 2.

Results and Discussion

The results indicated that the rootworm resistance more often increased grain yield than not. The resistant hybrid showed a higher capacity for K uptake than the susceptible hybrid in soil not fertilized with K. There was an infrequent grain yield response to K at this farm, but the responses in one year at one site also showed a higher capacity of the resistant hybrid to produce grain yield when soil K was limiting. Furthermore, the K fertilizer rate that maximized yield was the same for both hybrids, even though on average the yield level was higher for the resistant hybrid.

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Table 1. Rootworm injury ratings as affected by the corn hybrid and K fertilization.

Site	Year	RW resistant		RW suscep.	
		No K	+ K	No K	+ K
----- injury rating* -----					
1	2006	0.01	0.02	0.78	1.02
1	2007	0.11	0.10	1.20	1.36
1	2008	0.05	0.05	0.62	0.61
1	avg.	0.05	0.05	0.87	0.99
2	2007	0.51	0.39	0.65	0.45
2	2008	0.05	0.06	0.23	0.25
2	2009	0.15	0.11	0.89	0.90
2	avg.	0.24	0.18	0.59	0.53
Overall avg.		0.15	0.12	0.73	0.76

*ISU node injury rating (0 to 3) assessed at the R 1 growth stage.

Table 2. Effects of rootworm resistance and K fertilization on corn grain yield.

Site	Year	RW resistant		RW suscep.	
		No K	+ K	No K	+ K
----- bu/acre -----					
1	2006	180	176	168	163
1	2007	180	184	177	180
1	2008	147	149	130	135
1	avg.	169	170	159	159
2	2007	175	178	176	183
2	2008	162	166	156	157
2	2009	177	187	160	175
2	avg.	172	177	164	171
Overall avg.		170	173	161	165

Table 3. Effects of rootworm resistance and K fertilization on aboveground plant K uptake at the R1 growth stage.

Site	Year	RW resistant		RW suscep.	
		No K	+ K	No K	+ K
----- g K ₂ O/plant -----					
1	2006	1.57	1.37	1.25	1.55
1	2007	1.56	1.64	1.39	1.79
1	2008	1.44	1.41	1.17	1.44
1	avg.	1.53	1.47	1.27	1.59
2	2007	1.39	1.70	1.48	1.82
2	2008	1.61	1.81	1.63	1.89
2	2009	1.33	1.47	1.24	1.42
2	avg.	1.44	1.66	1.45	1.71
Overall avg.		1.48	1.57	1.36	1.65