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

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Abstract
A three-year 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, this 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.

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Introduction

A three-year 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, this 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 3 years (Site 1). A second trial was established in 2007 and was evaluated for 2 years (Site 2). The predominant soil was Taintor and there were minor areas of Mahaska. Initial soil-test K was Very High at Site 1 (269 ppm, although it varied from Optimum to Very High) and Optimum at Site 2 (163 ppm). Treatments were two corn hybrids and five K fertilizer rates, which were replicated four times. One hybrid was resistant to glyphosate and corn borer and the other was an isoline with the addition of rootworm resistance. In 2006 the hybrids were DKC63-74 (YGPL) and DKC63-81 (YGCB). In 2007 and 2008 hybrids were DKC63-42 VT3 (RR2-YGRW/YGCB) and DKC63-46 RR2/YGCB. The K rates ranged from 0 to 180 lb K_2O/acre. No soil insecticide was applied. Measurements for all plots were grain yield and the nutrient concentration of ear leaves at the silking stage and of harvested grain. Rootworm injury, plant weights, and plant nutrient concentrations were also measured in plots of three K fertilizer treatments at the silking stage. Rootworm injury was rated at the silking growth stage following the Iowa State University node injury scale (NIS). Corn was planted in rows spaced 30 in. apart. Fertilizer N and P were applied across all plots as needed.

Results and Discussion

Data summarized at this time include grain yield, rootworm injury ratings for all years, and the leaf K concentration for 2006 and 2007. Chemical analyses of whole plants sampled at the silking stage have not been completed. Therefore, results and conclusions should be considered preliminary until all data are summarized, which will include a third year of Site 2 in 2009.

Rootworm injury ratings (Table 1) showed light feeding for the rootworm resistant corn hybrids and ranged from 0.05 to 0.38 in the 0 to 3 scale. Root injury was moderate to heavy for the susceptible hybrid, and ranged from 0.62 to 2.50. Potassium fertilizer did not affect rootworm incidence consistently.

The grain yield data and statistics indicated no response to K fertilization in any year of Site 1 regardless of the hybrid used (which tested Very High). There was a yield response from both hybrids in both years of Site 2 (which tested Optimum), but there were inconsistent and no statistically significant differences between the K fertilizer rates. Therefore, yield data in Table 2 are only for the control and the average of all K rates.

The rootworm resistant (RW) corn hybrid yielded more than the susceptible hybrid at

both sites with the only exception in 2007, when they did not differ. The average grain yield advantage was 4 bushels/acre but ranged from 3 to 11 bushels/acre across the yield responsive years. The two hybrids showed small and inconsistent differences concerning yield response to K fertilization in the two years of the responsive Site 2. On average, the yield data across both years of Site 2 showed an identical yield response over the control for both hybrids (9%).

Data in Table 3 indicated that K fertilization increased the K concentration of ear leaves in both sites. This result reveals luxury K uptake because increases also occurred at the site with no grain yield increase. The leaf K concentrations were approximately similar for both hybrids. However, the response to added K was greater for the susceptible hybrid in all years of both sites. The leaf K concentration increase was 14 and 21% for the RW and susceptible hybrid, respectively. These leaf K results are difficult to explain because the root feeding observed at each site should have resulted in lower leaf K concentration in the susceptible hybrids without K fertilization, but this was not the case. Pending analyses of K concentration and whole-plant responses at the silking stage might help explain the results because we will be able to study plant K concentration or dilution resulting from plant dry matter responses to rootworm feeding and K fertilization.

Conclusions

If similar hybrid genetics other than rootworm resistance are assumed, results from both sites suggest that the rootworm resistance trait increased grain yield in most years but did not affect the yield response to K consistently. Work on this project will continue for one more year by harvesting the third crop at one site and completing study of K uptake responses.

Acknowledgements

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

		RW resistant		RW suscep.	
Site	Year	No K	+ K	No K	+ K
		---------- Feeding rating* ---------			
1	2006	0.38	0.15	2.50	2.31
1	2007	0.11	0.18	0.98	0.90
1	2008	0.05	0.05	1.18	0.94
1	Avg	0.18	0.12	1.55	1.38
2	2007	0.14	0.12	1.77	1.85
2	2008	0.05	0.05	0.62	0.99
2	Avg	0.09	0.08	1.19	1.42
Overall avg		0.14	0.11	1.41	1.40

*ISU node injury rating from 0 to 3 assessed at the silking stage.

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

		RW resistant		RW suscep.	
Site	Year	No K	+ K	No K	+ K
		---------- bushels/acre ----------			
1	2006	216	219	213	204
1	2007	184	193	192	187
1	2008	160	165	153	166
1	Avg	187	192	186	186
2	2007	186	199	190	195
2	2008	136	153	121	146
2	Avg	161	176	156	170
Overall avg		176	186	174	180

Table 3. Effects of rootworm resistance and K fertilization on the K concentration of corn ear leaves at silking.

		RW resistant		RW suscep.	
Site	Year	No K	+ K	No K	+ K
		---------- % ----------			
1	2006	1.76	2.08	1.73	2.14
1	2007	2.05	2.30	2.08	2.45
1	Avg.	1.91	2.19	1.90	2.30
2	2007	1.49	1.69	1.45	1.75
Overall avg		1.77	2.02	1.75	2.11