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

Antonio P. Mallarino, professor
Matthew W. Clover, postdoctoral associate
Department of Agronomy
David Rueber, farm superintendent

Introduction

A three-year study was conducted at this farm 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.

Procedures

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 soils were Canisteo at Site 1, and Canisteo and Nicollet at Site 2. Initial soil-test K was borderline between Optimum and High at Site 1 (167 ppm) and High at Site 2 (191 ppm). The 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. The hybrids were DKC51-39 (RR2/YGPL) and DKC50-20 (RR2/YGCB) in 2006. In 2007 and 2008 hybrids were DKC52-59 VT3 (RR2-YGRW/YGCB) and DKC52-63 (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 also were 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 injury for the rootworm resistant corn hybrids and ranged from 0.01 to 0.10 on the 0 to 3 scale. Root injury was light to heavy for the susceptible hybrid, and ranged from 0.11 to 2.22. Potassium fertilizer did not affect rootworm incidence consistently.

The grain yield data and statistics indicated no response to K fertilization at any site or year regardless of the hybrid used. Therefore, yield data in Table 2 are only for the control and the average of all K rates. Data for Site 1 in 2006 indicate a response to K mainly by the resistant hybrid (16 bushels/acre) than for the susceptible hybrid (3 bushels/acre). This result could be reasonable because soil at this site tested Optimum and the yield level with K was higher than for the susceptible hybrid, but a lack of statistical significance and no response in the next two years suggest this apparent response was just random variation.

The rootworm resistant (RW) corn hybrid yielded more than the susceptible hybrid at both sites regardless of the year. The average grain yield advantage was 12 bushels/acre but ranged from 1 to 24 bushels/acre across years.

Data in Table 3 indicate that K fertilization increased the K concentration of ear leaves in both sites. This result reveals luxury K uptake because increases occurred even with no grain yield increase. The leaf K concentration was approximately similar for both hybrids, but the response to added K was greater for the susceptible hybrid in all sites and years. The K concentration increase was 16 and 19 % for the RW and susceptible hybrid, respectively. These leaf K results are difficult to explain because the observed root injury should have resulted in lower leaf K concentration in the susceptible hybrid without K fertilization, but this was not the case. Pending analyses of K concentration and whole-plant K uptake at the silking stage might help explain the results better. These data will allow for study of plant K concentration or dilution resulting from possible plant dry matter responses to rootworm injury 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. 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

This research was possible with partial support from Monsanto and the International Plant Nutrition Institute.

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

		RW Resistant		RW Suscep.	
Site	Year	No K	+ K	No K	+ K
		---------- Injury rating* ----------			
1	2006	0.04	0.01	0.65	0.71
1	2007	0.10	0.10	1.79	1.83
1	2008	0.04	0.04	0.11	0.26
1	Avg.	0.06	0.05	0.85	0.93
2	2007	0.08	0.09	2.04	2.22
2	2008	0.05	0.07	0.45	0.68
2	Avg.	0.06	0.08	1.24	1.45
Overall avg		0.06	0.06	1.01	1.14

*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	178	194	183	186
1	2007	174	164	153	137
1	2008	169	167	161	158
1	Avg.	173	175	166	161
2	2007	169	166	147	151
2	2008	180	180	169	174
2	Avg.	174	173	158	162
Overall avg		174	174	162	161

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	1.03	1.19	0.98	1.21
1	2007	0.84	1.08	0.86	1.10
1	Avg.	0.93	1.14	0.92	1.15
2	2007	1.30	1.39	1.22	1.33
Overall avg		1.05	1.22	1.02	1.21