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A New Long-term Study: Evaluation of Hybrid, Nitrogen, and Potassium Interactions in Continuous Corn

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Abstract

A long-term experiment was established in 2009 to study continuous corn responses to potassium (K), nitrogen (N), and hybrid rootworm resistance. Previous research suggested a need for this type of study in Southeast Iowa. A long-term trial conducted until 2001 at the Northern Research Farm in a soil testing low in P and K showed that N, P, and K fertilizers greatly increased corn yield but there was an interaction only between N and K. The maximum corn yield level, the relative yield response to N (percent increase for each N addition), and the N rate that maximized yields were highest when K was optimal or higher. In contrast, the relative yield response to N and the N rate that maximized yield were similar for soil-test P levels ranging from very low to very high. Ongoing studies at this research farm and four other farms show that rootworm resistance often increases yield compared with untreated susceptible hybrids. It does not affect the yield response to K consistently, but increases K removal because of the higher yields. Therefore, this new long-term study evaluates possible interactions between corn rootworm resistance, N fertilization, and K fertilization.

Keywords

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Disciplines

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A New Long-term Study: Evaluation of Hybrid, Nitrogen, and Potassium Interactions in Continuous Corn

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Introduction

A long-term experiment was established in 2009 to study continuous corn responses to potassium (K), nitrogen (N), and hybrid rootworm resistance. Previous research suggested a need for this type of study in Southeast Iowa. A long-term trial conducted until 2001 at the Northern Research Farm in a soil testing low in P and K showed that N, P, and K fertilizers greatly increased corn yield but there was an interaction only between N and K. The maximum corn yield level, the relative yield response to N (percent increase for each N addition), and the N rate that maximized yields were highest when K was optimal or higher. In contrast, the relative yield response to N and the N rate that maximized yield were similar for soil-test P levels ranging from very low to very high. Ongoing studies at this research farm and four other farms show that rootworm resistance often increases yield compared with untreated susceptible hybrids. It does not affect the yield response to K consistently, but increases K removal because of the higher yields. Therefore, this new long-term study evaluates possible interactions between corn rootworm resistance, N fertilization, and K fertilization.

Treatments and Procedures

The study was established in 2009 in an area with dominant Mahaska soil. The average

initial soil-test K level of the experimental area was 170 ppm (borderline between the Optimum and High categories). The site was corn in 2008 with light to moderate rootworm infestation. The treatments are two hybrids and the combinations of five N rates and four K rates. In 2009 the hybrids were DKC63-42 VT3 (RR2-YGRW/YGCB) and DKC63-46 RR2/YGCB. The K fertilizer rates were 0, 24, 48, and 72 lb K₂O/acre. The N fertilizer rates were 0, 75, 150, 225, and 300 lb N/acre. The fertilizers used were granulated urea and potassium chloride, which were spring broadcast in chisel-plowed ground and before disking. The corn rows were spaced 30 inches, no rootworm insecticide was applied, and the average harvest plant population was 30,862 plants/acre.

Measurements for all plots were early plant growth, nutrient concentration (V5 to V6 stage), nutrient concentration of ear leaves at the silking stage, and grain yield, nutrient concentration, and nutrient removal. Rootworm root injury ratings, aboveground plant weight, and plant nutrient concentration at the silking stage were measured in plots of both hybrids in plots of four contrasting fertilizer treatments. Rootworm injury was rated following the Iowa State University node injury scale (NIS).

Results and Discussion

This report summarizes the available results from the first year, which include grain yield and rootworm injury ratings. Rootworm injury ratings (Table 1) for the resistant hybrid showed almost no injury for the rootworm resistant hybrid (0.03 to 0.04) in the 0-to-3 scale. Root injury was light to moderate for the susceptible hybrid, and treatment averages ranged from 0.20 to 0.40. The K fertilizer rate

did not affect rootworm incidence. The injury ratings were lower, however, for the highest N rate. This average effect was due mainly to high ratings in very few plots, so results in future years should confirm if this was an N effect or just random variation.

Potassium fertilization did not affect yield this year, probably because initial soil-test K was borderline between Optimum and High. There was no yield difference between the two corn hybrids across the different N and K rates, which may be explained by little rootworm infestation in most plots. A recent study at another location on this farm that evaluated these hybrids response to K fertilization, showed a 4-year average yield advantage for the rootworm resistant hybrid.

Figure 1 summarizes treatment effects of corn yield for the different N rates by showing yield without K fertilizer and average yield for the three K fertilizer rates. The graph symbols clearly show the similar yield for the two hybrids. Therefore, the response curves were fitted to averages of the two hybrids. Maximum estimated yield was 197 and 195 bushels/acre without K and with K, respectively (statistically similar). Nitrogen rates of 244 and 251 lb N/acre maximized corn yield without and with K, respectively (statistically similar). The response to N fertilization agrees with results of other Iowa research.

In contrast to aforementioned results for a study conducted years ago at the ISU Northern Research Farm, Kanawha, there was no interaction between N and K this year in this study. The lack of interaction is explained by soil-test K levels sufficient to maximize corn yield without a need for K fertilization.

Long-term management and climate greatly affect crop yields and rootworm infestation, so conclusions are not possible with just one year

of data. We plan to continue this study as long as funding is available in order to collect crop and soil data over several years.

Table 1. Rootworm injury as affected by the corn hybrid and N or K fertilizer.

Resistant	K Rate	N Rate		
		0	300	Avg.
	0	0.03	0.04	0.04
	72	0.04	0.03	0.03
	Avg.	0.03	0.04	0.03
Susceptible	0	0.59	0.21	0.40
	72	0.73	0.20	0.46
	Avg.	0.66	0.20	0.43

* ISU node injury rating, which ranges from 0 to 3.

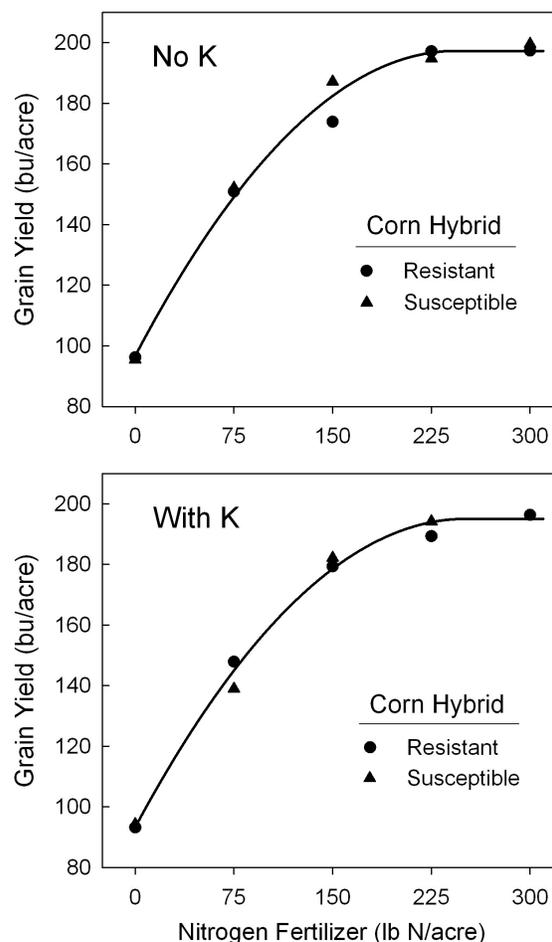


Figure 1. Yield response of rootworm resistant and susceptible corn hybrids to N fertilization for two K fertilizer levels in a high-testing soil.