# Corn Grain Yield and Potassium Uptake and Recycling as affected by Rootworm Resistance and Potassium Fertilization

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## Introduction

New corn hybrids increase yield and may change potassium (K) uptake or fertilization needs through improved traits that increase yield and root efficiency. Hybrids, soil conditions, and rainfall may affect the rate at which K in cornstalks is released to the soil and becomes available to plant uptake. Therefore, a study was conducted from 2006 through 2009 at the Agronomy and Agricultural Engineering Research Farm to evaluate the effects of K fertilization and rootworm resistance on grain yield, K uptake, and K recycling with residue.

## Materials and Methods

A trial was established in 2007 and was evaluated for three years. The soil was Clarion loam, and initial soil-test K was between Very Low and Low (91 ppm). Treatments were two corn hybrids and five K fertilizer rates (0 to 180 lb $K_2O$/acre) replicated four times. One hybrid was resistant to glyphosate and corn borer (DKC 61-73 RR2/YGCB) and the other was an isoline with added rootworm resistance (DKC61-69 (VT3). No soil insecticide was applied. Measurements summarized for the three years of the study were rootworm root injury, aboveground plant K uptake at the silking growth stage, and grain yield. In the last two years, we also measured plant K uptake at the black layer growth stage, grain K removal, and K remaining in the cornstalks from the time of grain harvest until the following spring.

## Results and Discussion

Rootworm injury ratings (Table 1) were much lower for the rootworm resistant hybrid. For the susceptible hybrid, root injury ranged from light to moderate. Potassium fertilization had no consistent effect on rootworm incidence.

The rootworm resistant hybrid yielded more than the susceptible hybrid in 2007 and 2009, but there was no yield difference in 2008. The yield differences were not well related to the rootworm injury ratings observed for the hybrids or years. On average across K rates and years, yield for the resistant hybrid was 11 bushels/acre higher. Grain K concentrations and K removal (not shown) indicated no difference in K concentrations but higher K removal for the resistant hybrid due to higher yield.

Corn yield responded to K fertilization in 2007 and 2009, but there were no clear differences between K rates. Table 2 shows yields for the control receiving no K and the average of the two highest-yielding fertilized treatments. In 2007, the response to K was 3.3 percent for the resistant hybrid and 6.3 percent for the susceptible hybrid. In 2009, the response to K was 8.9 percent and 12.5 percent, respectively. On average across the three years, the response to K was 3.7 percent and 6.1 percent for the resistant and susceptible hybrid, respectively. Yield often was higher for the resistant hybrid and a K deficiency hurt the susceptible hybrid more, which indicated higher K use efficiency by the resistant hybrid when K was limiting.

Potassium fertilization increased plant K uptake proportionally more for the susceptible hybrid than for the resistant hybrid, and K uptake without K fertilization was higher for the resistant hybrid (Table 3). On average across the three years, the K uptake response was 6.8 and 20.4 for the resistant and susceptible hybrid, respectively. Therefore, the resistant hybrid had a higher K use efficiency with limiting K, there was a higher uptake response for the susceptible hybrid, and there were similar K uptake for both hybrid types with a high K fertilization rate.

## Potassium Uptake and Recycling

Figure 1 shows summary results for amounts of K in plant parts (except grain) from the black layer growth stage until spring. The data shown are averages across years, corn hybrids, and K rates because these factors determined no clear differences in the proportion of K remaining in plant parts over time. There was a very sharp decrease in the amount of K remaining in vegetative tissue from the black layer stage until harvest. This sharp plant K decrease can be explained by some K remaining in partially decomposed leaves on the ground that were not collected and K leaching from standing biomass. There was a moderate decrease during late fall, little change during winter and a clear decrease from late winter until spring.

## Conclusions

The rootworm resistant hybrid often increased yield compared with a susceptible hybrid. The resistant hybrid showed a higher K use efficiency, which was shown by higher K uptake and yield with limiting soil K. There was significant K leaching from corn plants and residue over time, which may explain high temporal variability in soil-test K.

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**Table 1. Rootworm injury ratings.**

| | RW resistant | | RW suscep. | |
|---|---|---|---|---|
| Year | No K | + K | No K | + K |
| | ---------- Injury rating* ---------- | | | |
| 2007 | 0.09 | 0.28 | 0.58 | 0.63 |
| 2008 | 0.08 | 0.08 | 0.14 | 0.26 |
| 2009 | 0.08 | 0.15 | 1.02 | 0.70 |
| Avg. | 0.05 | 0.05 | 0.58 | 0.53 |

*ISU node injury rating (0 to 3) at the silking growth stage.

**Table 2. Corn grain yields.**

| | RW resistant | | RW susceptible | |
|---|---|---|---|---|
| Year | No K | + K | No K | + K |
| | ---------- bushels/acre ---------- | | | |
| 2006 | 169 | 175 | 159 | 169 |
| 2007 | 193 | 192 | 191 | 193 |
| 2008 | 176 | 192 | 150 | 169 |
| Avg. | 179 | 186 | 167 | 177 |

**Table 3. Above ground plant K uptake at the silking growth stage.**

| | RW resistant | | RW suscep. | |
|---|---|---|---|---|
| Year | No K | + K | No K | + K |
| | ---------- g $K_2O$/plant ---------- | | | |
| 2007 | 0.99 | 1.01 | 0.90 | 1.07 |
| 2008 | 1.53 | 1.69 | 1.40 | 1.70 |
| 2009 | 1.02 | 1.08 | 0.90 | 1.08 |
| Avg. | 1.18 | 1.26 | 1.06 | 1.28 |

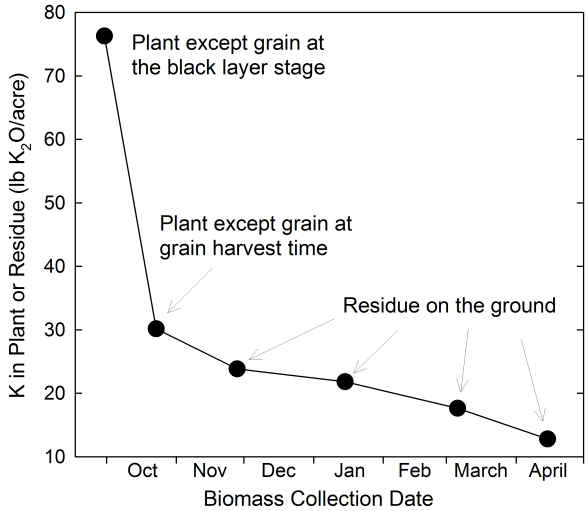


**Figure 1. Potassium in corn biomass except grain from physiological maturity until spring.**