

BETWEEN THE ROWS

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WESTERN CORN ROOTWORM RESISTANCE AND CONTROL CONCERNS

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Background

We have learned several important characteristics of western corn rootworm (CRW) control from recent reports of severe rootworm feeding on Bt hybrids. These reports either show some CRW resistance developing (Iowa report) or at least severe root damage present on Bt hybrids that are used to control feeding larva (Illinois report).

The Iowa report was an Iowa State Entomologist study from problem fields in northeastern Iowa that had persistent severe root feeding on Bt corn hybrids. The entomologists collected adult western CRW beetles and demonstrated in the lab that many of the larva from these insects could survive when fed roots of Bt-protected corn hybrids. They described this as incomplete resistance. The Illinois report was an Agronomy Extension report of severe feeding damage on Bt corn hybrids. The fields had exhibited severe root lodging and high numbers of adult beetles present.

A couple of common agronomic factors in the reports are continuous corn production and the same control tactic used for at least 3 years in a row. The reports also indicate the lack of insect refuge as a possible factor in the control failure. The required insect refuge is to provide a large number of susceptible insects that can act to delay the development of resistance. The control tactic identified in the reports utilized Bt hybrids containing the Cry3Bb1 insecticidal protein contained in Monsanto's YieldGard VT Triple® and Genuity® VT Triple PRO™. These reports should cause growers of continuous corn to consider several control options to avoid insect resistance and help ensure long-term effective control with Bt hybrids.

It should be pointed out that Bt CRW control has been shown to be a very effective method of avoiding economic damage from larva feeding. University of Illinois Agronomy Extension Entomologists have demonstrated CRW Bt hybrids as effective and generally superior to an at-planting soil insecticide treatment in controlling feeding from CRW larva. Since introduction in 2003, this technology has been effectively used to economically control corn rootworm larva by thousands of corn growers across the cornbelt.

Bt CRW control will continue to be effective as long as growers follow many of the recommended integrated pest management guidelines and follow the required insect refuge plantings.

Trait Characteristics

The CRW Bt traits as a whole are quite different than the European corn borer (ECB) Bt traits. The Bt protein that controls ECB is a high dose insecticidal protein. Only a small amount of feeding is required to control corn borer larva, so control is relatively consistent and effective.

The CRW Bt protein, on the other hand, is a low dose insecticidal protein. It takes a larger amount of feeding before corn rootworm larva is controlled. Larger instar larva are more difficult to control, and there is some evidence the root concentration of the insecticidal protein is less consistent in the plant.



Western corn rootworm beetle

These core differences make it clear that CRW control is not bullet proof. And with higher levels of root feeding, this technology is obviously under additional pressure.

In both of these reports root lodging was evident and many adult beetles were present, indicating heavy rootworm pressure. This does not mean all western corn rootworm have resistance to that particular trait, but *individual fields or populations* could develop resistance with improper management. Overall, however, a low incidence of performance issues has occurred. The reports of severe feeding are from limited areas with high feeding pressure under specific environmental conditions. These reports involve western corn rootworm. It is not known if northern corn rootworm has the same potential.

Management practices for heavy rootworm pressure

The evidence suggests that CRW can adapt to control measures, particularly when heavy feeding pressure is present and the same control tactic is repeatedly used.

The Iowa State Entomology report and the Illinois Agronomy Extension report of severe feeding damage indicate that a lack of insect refuge may have contributed to the control failure. Growers who ignore refuge requirements are increasing the chance of resistance developing, and losing a convenient, economical means of control on their farm. This can also affect neighbors and others in the immediate area who will be potentially subjected to resistant populations of CRW. Other CRW control options can be more expensive, less convenient and potentially less effective.

In order to manage heavy rootworm pressure with severe rootworm feeding, several management practices can improve chances of economic control.

1. **Monitor insect populations.** Know the insect presence and necessary thresholds to help manage economic levels in your fields. Three to five CRW beetles per plant would indicate severe feeding potential on corn next season. Scouting fields for adult beetles and digging roots to determine feeding pressure is key in determining the success of the current year's control plan and potential damage for next season's corn crop.

2. **Integrated pest management.** Use some combination of tools such as CRW Bt in-plant protection technology, either a dual mode of action product or rotation of control modes. In addition, adult beetle control, at-planting soil applied insecticide, early planting dates, and scouting can help manage high populations.
3. **Hybrid selection.** Use hybrids adapted to your area with strong agronomics, especially root strength.
4. **Weed control.** Weeds (grass) provide alternative hosts for some rootworm feeding. Effective weed control keeps rootworm from surviving on other crops and feeding on corn later.
5. **Reduce plant stress.** Avoid compaction and use recommended plant populations with balanced fertility.

Growers who have low pressure feeding, crop rotation, or have experienced excellent control should continue to be vigilant through scouting, but can continue their agronomic practices and consider more options so the repeated use of the same tactic is avoided. Complying with the required refuge is the best practice to ensure long term effectiveness of Bt technology.