

## Corn Rootworm Best Management Practices—Western Corn Belt

- Best management practices (BMP) such as crop rotation and planting corn products with multiple modes of action can help manage fields with high corn rootworm (CRW) pressure.
- When planting corn products with a single trait protecting against CRW feeding, it is important to consider the use of soil-applied insecticides to help ensure success.
- Crop rotation continues to be the most effective BMP in the Western Corn Belt because the rotation resistant variant western corn rootworm has not been documented in the area.

Monsanto research trials were conducted in 2013 to compare use of dual mode of action (MOA) seed products for CRW with single MOA products. Research trials were also conducted to compare efficacy of soil-applied insecticides (SAI) for protecting corn from CRW larval feeding. Roots were scored using the Iowa State University Node-Injury Scale (NIS).<sup>1</sup> Scores range from 0.00 for roots with no CRW feeding to 3.00 for severely damaged roots with three or more root nodes consumed.

### Comparison of Best Management Practices

A total of seven trials were conducted to compare dual MOA corn seed products with single MOA products. These trials were located in Polk (2 locations), Colfax, and Knox Counties in Nebraska; Sheridan and Sherman Counties in Kansas; and Logan County in Colorado. All test sites were multi-year corn on corn and all but the Knox County site were irrigated. All corn products were planted with and without a soil-applied insecticide (SAI). Seed products in the trials included:

- Genuity® VT Triple PRO® RIB Complete® corn blend (Cry3Bb1)
- Optimum® AcreMax® 1 (Cry34/35Ab1)
- Agrisure® 3122 E-Z Refuge™ Trait Stack (mCry3A and Cry34/35Ab1)
- Genuity® SmartStax® RIB Complete® corn blend, a dual MOA (Cry3Bb1 and Cry34/35Ab1) product for CRW control
- A Roundup Ready® Corn 2 product without Bt protein insect protection as a check

The average NIS rating for the non-Bt check was 1.92 (Figure 1). Genuity® SmartStax® RIB Complete® corn blend had an average NIS rating of 0.14 (without a SAI) and provided the most effective and consistent control of CRW compared to the other traits. Use of a SAI significantly improved NIS scores for single MOA corn products, but did not significantly improve NIS scores for dual MOA corn products.

### Insecticide Trials

Research trials were conducted in Polk County, Nebraska, Logan County, Colorado, and Sherman County, Kansas. All test sites were irrigated fields with multi-year corn on corn rotations. A Genuity® VT Double PRO® corn product was planted with the following soil-applied insecticides:

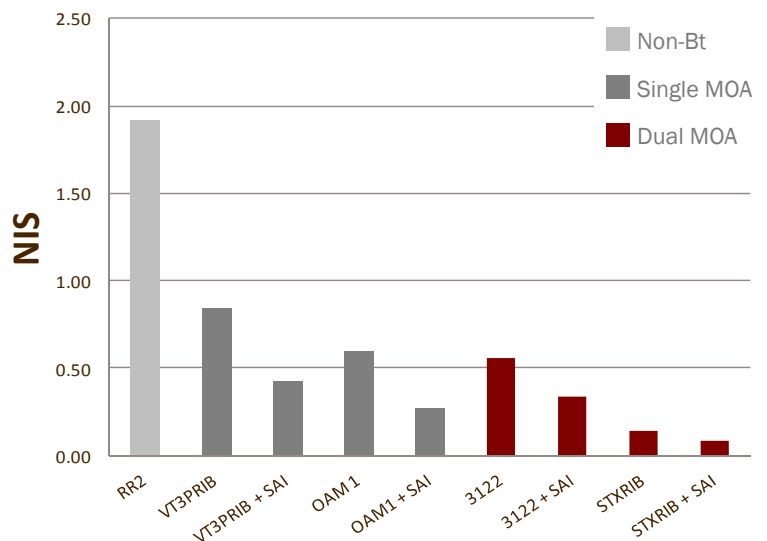


Figure 1. Average Node Injury Scale ratings for different corn products with and without soil-applied insecticides. RR2 = Roundup Ready® Corn 2; VT3PRIB = Genuity® VT Triple PRO® RIB Complete®; OAM1 = Optimum® AcreMax® 1; 3122 = Agrisure® 3122 E-Z Refuge™; STXRIB = Genuity® SmartStax® RIB Complete®.

- Counter® 20G
- Aztec® 4.67 G
- Brigade® 2EC
- Capture® LFR®
- Force® CS
- Force® 3G

The average NIS rating for the check with no SAI was 2.78 (Figure 2), indicating high CRW pressure. The average NIS rating decreased with the use of SAI. The lowest rating of 0.84 occurring when Force CS was used. There were no significant differences between insecticides for CRW control ( $F=1.80$ ). This was a single-year study and additional insecticide trials are planned for 2014.

### Crop Rotation for the Western Corn Belt

Crop rotation to soybean or other non-host crop breaks the corn rootworm life-cycle and can be a consistent and economical BMP to lower CRW pressure in a field.<sup>2</sup> Corn rootworm females lay their eggs in existing corn fields during August and September. If fields that were in corn are rotated to a non-host

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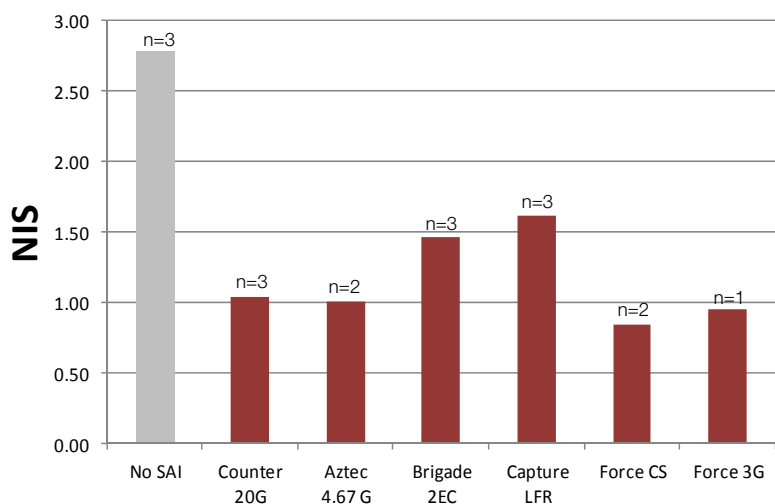


Figure 2. Average Node Injury Scale ratings for Genuity® VT Double PRO® corn products with different soil applied insecticide treatments; n = number of locations.

crop such as soybean, corn rootworm eggs hatch and die due to starvation. In some areas of the Midwest, some northern corn rootworms and western corn rootworms exist that are able to resist the effects of crop rotation. A variant of the western corn rootworm survives crop rotation by laying eggs in soybean fields rather than corn fields. These larvae then emerge in first-year corn fields the following summer. Northern corn rootworms with extended diapause are able to survive a traditional corn-soybean rotation because they lay dormant in the soil for an additional year (i.e. they have a 2-year life cycle).<sup>3</sup> Currently, there is no evidence that either of these rotation-resistant CRW variants exist in Colorado or Kansas.<sup>2,4</sup> In Nebraska, the western CRW variant has not been identified; however, the extended diapause northern CRW variant is present in the far eastern portion of the state.<sup>5,6</sup> Sorghum, wheat, summer fallow, and several other crops are good rotation options, especially where water may be a limiting factor.

## In Summary

Corn rootworm beetles and larvae can be difficult to control pests. In high pressure fields, farmers should use multiple modes of action against CRW, including quality Genuity® corn products with Bt traits along with soil-applied insecticides. Results from this trial show that under high CRW pressure, the dual modes of action of Genuity® SmartStax® RIB Complete® corn blend products provide the most consistent control of CRW compared to other control options (Figure 1). Genuity® VT Triple PRO® products or Genuity® VT Triple PRO® RIB Complete® corn blend products should be reserved for fields with light CRW pressure and be combined with an insecticide to improve performance against CRW. SAI can be a helpful tool (Figure 2); however, their efficacy can be highly dependent on environmental conditions. In general, granular SAI are more

effective than liquid formulations. SAI should not be relied upon as the sole management tactic when high CRW pressure exists.

To further improve success against CRW, farmers should rotate SAI modes of action each year to limit development of resistance to the insecticide. Fields should be scouted for CRW larvae after they hatch; this provides an opportunity to potentially reduce larval numbers with a chemigation treatment. Chemigation for larval control can be effective; however, it should be reserved for a rescue treatment should the in-furrow application not provide acceptable control and significant larval activity is observed. Use of foliar application(s) to control adult beetles and reduce egg laying and subsequent CRW pressure the following year may be another approach to achieve management with multiple modes of action.

## Sources:

<sup>1</sup> Oleson, J. D. et al. Interactive node-injury scale. Iowa State University. <http://www.ent.iastate.edu> (verified 10/21/2013); <sup>2</sup> Peairs, F.B. and Pilcher, S.D. 2013. Western corn rootworm. Fact sheet no. 5.570. Colorado State University Extension. <http://www.ext.colostate.edu> (verified 11/5/13); <sup>3</sup> Prasifka, P.L. et al. 2006. Rotation-resistant corn rootworms in Iowa. Integrated Crop Management. Iowa State University. <http://www.ipm.iastate.edu> (verified 10/17/13); <sup>4</sup> Michaud, J.P. 2013. Corn insects—western corn rootworms and northern corn rootworms. Kansas State University. <http://entomology.k-state.edu> (verified 11/5/13); <sup>5</sup> Wright, B. and Meinke, L. 2011. Corn rootworm update. CropWatch 9/22/11. University of Nebraska-Lincoln. <http://cropwatch.unl.edu>; <sup>6</sup> Geisert, R.W. and Meinke, L.J. 2013. Frequency and distribution of extended diapauses in Nebraska populations of *Diabrotica barberi* (Coleoptera: Chrysomelidae). Journal of Economic Entomology. 106 (4):1619-1627. <http://www.bioone.org> (verified 1/17/14).

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