RESEARCH SUMMARY - WESTERN CORN BELT - MANAGING CORN ROOTWORM

WHAT YOU'LL LEARN

- Best management practices (BMP) such as crop rotation and planting corn products with multiple modes of action can help manage high corn rootworm pressure in fields.
- It is important to use a soil-applied insecticide when planting corn products with a single trait protecting against corn rootworm feeding in order to add an additional mode of action.
- Crop rotation continues to be the most effective best management practice 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 2014 to compare the use of dual mode of action (MOA) seed products for corn rootworm (CRW) with single MOA products. Research trials were also conducted in 2013 and 2014 to compare the efficacy of soil-applied insecticides (SAI) for protecting corn from CRW larval feeding. In both studies, roots were scored using the Iowa State University Node-Injury Scale (NIS).[1] 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 eight trials were conducted to compare dual MOA corn seed products with single MOA products. These trials were located in Howard and Platte (2 locations) counties in Nebraska; Sherman, Sheridan, and Thomas counties in Kansas; and Yuma and Kit Carson counties in Colorado. All test sites were multi-year, irrigated corn-on-corn. All corn products were planted with and without a SAI. Seed products in the trials included:

- Genuity® VT Triple PRO® RIB Complete® corn blend, a single MOA (Cry3Bb1) product for CRW control.
- Optimum® AcreMax® 1, a single MOA (Cry34/35Ab1) product for CRW control.
- Genuity® SmartStax® RIB Complete® corn blend, a dual MOA (Cry3Bb1 and Cry34/35Ab1) product for CRW control.
- A corn product without *Bt* protein insect protection as a check.

The average NIS rating for the non-*Bt* check was 2.00 (Figure 1). Genuity SmartStax RIB Complete corn blend had an average NIS rating of 0.22 (without a SAI) and provided the most effective and consistent control of CRW compared to the other corn products. Use of a SAI improved NIS scores for all corn products tested.

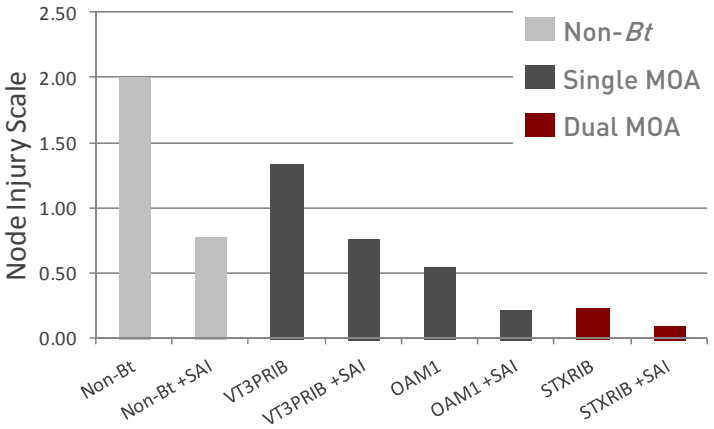

Figure 1. Average node injury scale ratings for different corn products with and without soil-applied insecticides (SAI). VT3PRIB = Genuity® VT Triple PRO® RIB Complete®; OAM1 = Optimum® AcreMax® 1; STXRIB = Genuity® SmartStax® RIB Complete®.

Insecticide Trials

Research trials were conducted in Polk County in Nebraska, Logan County in Colorado, and Sherman County in Kansas in 2013; and in Howard and Platte counties in Nebraska, Yuma and Logan counties in Colorado, and Sherman County in Kansas in 2014. All test sites were irrigated with multi-year corn-on-corn rotations. At each site, a Genuity® VT Double PRO® RIB Complete® corn blend product (a corn product that does not contain a CRW protection trait) was planted with one of the following soil-applied insecticides:

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

The average NIS rating for the check with no SAI was 2.39 (Figure 2), indicating high CRW pressure. The average NIS rating decreased with the use of a SAI. The lowest rating of 0.79 occurred when Force 3G was used. There were no significant differences between insecticides for CRW control (F=1.76).

Crop Rotation for the Western Corn Belt

Crop rotation to a non-host crop such as soybean, sorghum, or wheat breaks the CRW life cycle and can be a consistent and economical BMP to lower CRW pressure in a field.[2] Corn rootworm females lay their eggs in existing corn fields during August and September. If fields that were planted to corn are rotated to a

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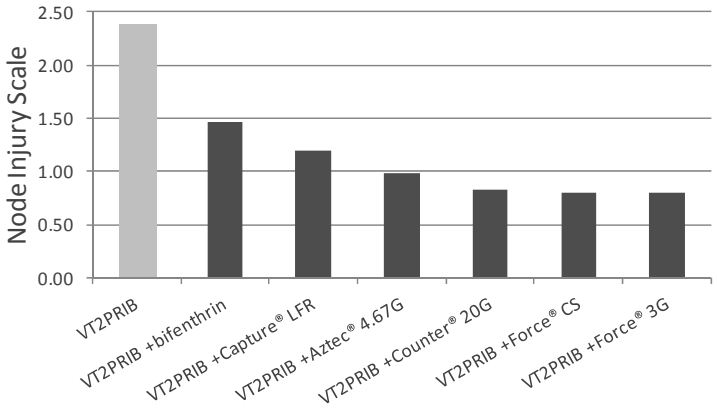

Figure 2. Average node injury scale ratings for Genuity® VT Double PRO® RIB Complete® corn blend (VT2PRIB) (check with no CRW trait) with different SAI treatments.

non-host crop, CRW eggs hatch and die due to starvation. In some areas of the Midwest, some northern CRW and western CRW variants exist that are able to resist the effects of crop rotation. A variant of the western CRW 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 CRW with extended diapause are able to survive a traditional corn-soybean rotation because they remain dormant in the soil for an additional year (i.e. they have a 2-year life cycle), allowing them to emerge when corn is planted again.[3] Currently, there is no evidence that either of these rotation-resistant CRW variants exist in Colorado or Kansas.[2,4] In Nebraska, the western CRW variant has not been identified; however, the extended diapause northern CRW variant is present in some portions of the state.[5,6]

Insect Resistance Management

Farmers are encouraged to follow recommended Integrated Pest Management (IPM) practices, including cultural control tactics, scouting, and the appropriate use of pest thresholds and sampling.

- The first management option for fields that have experienced CRW damage should be rotating the field to a non-host crop such as soybeans.
- The use of Genuity® SmartStax® RIB Complete® corn blend products provide a dual MOA and deliver excellent protection under high CRW pressure.
- For fields with light CRW pressure, use Genuity® VT Triple PRO® or Genuity® VT Triple PRO® RIB Complete® with a SAI.
- The use of foliar insecticides is recommended if beetle populations reach threshold levels. In general, potential for yield loss next year could occur when adult beetle populations exceed $^{3}/_{4}$ to 1 beetle per plant.
- Farmers should rotate SAI and foliar insecticide MOA each year. Repeated use of the same insecticide will reduce its efficacy and can lead to the development of resistance.

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 an in-furrow application not provide acceptable control and significant larval activity is observed.

In Summary

Results from this trial show that under high CRW pressure, the dual MOA of Genuity SmartStax RIB Complete corn blend products provided the highest level of protection from CRW compared to other corn products tested. This protection is further enhanced when used in combination with a SAI (Figure 1). 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.

Sources:
[1] Oleson, J.D. et al. Interactive node-injury scale. Iowa State University; [2] Peairs, F.B. and S.D. Pilcher. 2014. Western corn rootworm. Fact sheet no. 5.570. Colorado State University Extension; [3] Prasifka, P.L. et al. 2006. Rotation-resistant corn rootworms in Iowa. Integrated Crop Management. Iowa State University; [4] Michaud, J.P. 2013. Corn insects—western corn rootworms and northern corn rootworms. Kansas State University; [5] Wright, B. and L. Meinke. 2011. Corn rootworm update. CropWatch 9/22/11. University of Nebraska -Lincoln; [6] Geisert, R.W. and L.J. Meinke. 2013. Frequency and distribution of extended diapauses in Nebraska populations of *Diabortica barberi* (Coleoptera: Chrysomelidae). Journal of Economic Entomology. 106 (4):1619-1627. All sources verified 10/8/14.