COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT, LEXINGTON, KY 40546

Corn Rootworm Resistance Management with Bt Corn

Ric Bessin, Extension Specialist

Entfact-147

The potential for the development of resistance to Bt-rootworm corn is considered to be so high that all growers who use the technology must follow an approved, resistance management plan. EPA approval for Bt-rootworm corn requires all growers who purchase seed to sign contracts stating that they will comply. Currently there are three different types of approved resistance management plans based on the type of Bt corn being grown. These are the 20% structured refuge, a reduced 5% structured refuge, and refuge in the bag strategy. A refuge refers to corn that does not contain the Bt-toxin and allows the pest to complete its development. Resistance management for rootworms is similar to one in place for corn borer (Entfacts 128 and 140) but has some distinct differences in the locations of refuges.

20% structured refuge:

- The creation of a non-Bt-rootworm corn refuge with the planting of any acreage of Bt-rootworm corn.
- The refuge must be at least equal to 20% of the acreage of the Bt-rootworm corn.
- The refuge must be in blocks adjacent to the Bt-rootworm corn or planted as in-field strips.
- If an adjacent field is used, then the refuge field should have a similar rotational history as the Bt-rootworm field.
- When planting the refuge as in-field strips, the strips must be at least 6 rows wide, preferably 12 consecutive rows wide.
- The grower may apply insecticide treatments for control of corn rootworm larvae with the refuge corn.
- Applications of insecticides to control the adult corn rootworm beetles are NOT permitted in the refuge unless the Bt-rootworm corn is treated in a similar manner.

5% structured refuge:

- Same as the 20% refuge except that this only requires 5% refuge corn.

Refuge in the Bag:

- With refuge in the bag (RIB), a small amount of non-Bt seed (10% for example) is preblended with the Bt seed.

With EPA-approved plans, non-Bt-rootworm corn acreage on each farm serves as a refuge, allowing corn rootworms to survive without exposure to Bt corn. If a rare resistant corn rootworm were able to survive on a Bt-corn plant, it would most likely mate with a susceptible corn rootworm. Corn rootworms produced from this mating would only be partially resistant, and should not be able to survive if they feed on Bt-rootworm corn. This strategy tries to prevent mating between resistant corn rootworm beetles. If mating occurs between resistant beetles, then rootworms produced may be fully resistant to the Bt-rootworm corn.

Corn Borer and Rootworm Refuges

While corn borer and corn rootworm structured refuges are similar in size, the maximum distance that they may be planted from the Bt corn is different. This accounts for differences in the biology of the insects. Corn borer moths move considerably farther than rootworm beetles before mating. So a refuge planted 1/4 of a mile from the Bt-corn borer corn is close enough to ensure >random= mating of the moths. Corn rootworm beetles mate soon after leaving the soil, so the Bt-rootworm refuge must be either within or adjacent to the Bt-rootworm corn.

Stacked Hybrids

Additionally, many Bt-rootworm corn hybrids may have stacked genes for both corn borer control and rootworm control. Growers using these hybrids are required to comply with resistance management for both corn borers and corn rootworms. There must be a refuge for both groups of pests adjacent to or

within the Bt-corn field. A common option is to use a common refuge for both corn borers and corn rootworms. This minimum refuge would be either within or adjacent to the Bt-corn field. The corn planted in the refuge would not have either the Bt-corn borer or Bt-rootworm traits.

Resistance and Corn Rootworms

This responsibility must not be taken lightly. Development of resistance by corn rootworms to this type of corn is a real threat. The Western and Northern corn rootworms have demonstrated the ability to develop resistance to some insecticides and adapt to various crop rotation practices. In the Western corn belt, Western corn rootworm has developed resistance to several insecticides. In parts of Illinois, Indiana, and Ohio, the Western corn rootworm developed a soybean biotype that leaves corn fields to lay its eggs in other crops, rendering crop rotation ineffective. In parts of Iowa and South Dakota, the Northern corn rootworm has developed delayed diapause, a condition where only a portion of its eggs hatch the following year. The remaining eggs hatch two, three, four, and even five years later. In these later examples, first-year corn can sustain severe corn rootworm injury. Fortunately for Kentucky corn growers, we do not have the soybean biotype of the Western corn rootworm or delayed diapause with the Northern corn rootworm.

Revised: 11/19