

Corn Rootworm Management

Ronald B. Hammond, Andy Michel, and James B. Easley
 Department of Entomology
 The Ohio State University

Crop: Field Corn
Crop Development: Pre-Plant (larvae) and Tassel or Silk Stage (adults)
Scientific Name: *Diabrotica virgifera virgifera* (WCR)
Diabrotica barberi (NCR)

The western corn rootworm (WCR) (fig. 1) and the northern corn rootworm (NCR) (fig. 2) are leaf beetles that feed predominantly on corn. Adult WCR are gold in color with a black head and three black stripes on wing covers. In the case of male WCR, the black stripes often merge to the point that the entire wing cover appears black. Adult NCR are pale to dark green in color. Rootworms overwinter as eggs that were deposited by adult females in the soil during the late summer months of the previous growing season. Egg hatch generally occurs from late May

to mid-June, about the time that corn is in the four-leaf stage of development. The phenology of rootworm egg hatch often coincides with sightings of the adult firefly beetle. The eggs hatch into larvae, which feed on corn root systems for a period of 3 to 4 weeks during June and early July, at which time they pass through three growth stages commonly referred to as the first, second, and third instars. A mature third-instar is about 1/2 inch in length and has a dark brown head and anal plate. At maturity, the third instar transforms into a pupa, which is inactive for a week or two. The pupae then turn into adult beetles, which emerge from the soil and start feeding on corn foliage, pollen, and silks around mid-July. The adults are active for about 10 to 12 weeks throughout August, during which time they feed, mate, and deposit their eggs, which become the overwintering stage of the life cycle.



Figure 1. Western corn rootworm adult



Figure 2. Northern corn rootworm adult

Rootworm Injury to Corn

The rootworm larvae cause the most significant damage through feeding injury to the corn root (fig. 3). Where rootworms are active, the injury may range from a few feeding scars and tip injury on a root system to elimination of entire nodes of a root system (fig 4). As root injury becomes severe, lodging occurs (fig. 5) and yields are reduced. Secondly, rootworm adults may cause significant foliar injury (fig. 6) and interfere with pollination by excessive feeding on the silks, which is called silk clipping (fig. 7).



Figure 3. Close up of root injury



Figure 5. Lodged corn showing goose necking



Figure 6. Corn with significant adult leaf feeding



Figure 4. Corn rootworm larval root injury



Figure 7. Silk clipping

Rootworm Variants

Historically, rootworm tended to be only a problem on corn following corn. If corn is planted following corn, the larvae can feed on the corn root system causing corn to lodge and reducing grain yield. However, in the late 1980s, cases of rootworm injury on first-year corn by the WCR were identified in northeastern Illinois and soon thereafter in northwestern Indiana. In this case, adult rootworms were depositing eggs in soybean fields, rather than corn; the eggs then hatched the following year in corn planted after soybeans. This new egg-laying behavior enabled populations of WCR to thrive under a system of intense two-year rotations of corn and soybeans. This new variant of the WCR spread throughout Illinois and Indiana during the 1990s, especially in an eastward direction towards the Indiana-Ohio border. By 1996, Ohio State University Extension entomologists had confirmed that the new variant of WCR had become established in Ohio counties bordering Indiana. More recent observations indicate that it has become a more common occurrence in western Ohio, and is now present in the central part of the state.

Also in the 1980s, a NCR rootworm problem in first-year corn developed in the northwestern region of the Corn Belt, which was attributed to the extended-diapause variant. In this situation, a portion of the eggs deposited in corn one year remains dormant for more than one year, resulting in a hatch in corn the following year when corn follows soybeans in a two-year rotation system. Research has demonstrated that extended diapause is a common trait of the NCR throughout the Corn Belt and may be the cause of isolated incidents of rootworm injury in first-year corn in Ohio.

Symptoms, Assessment, and Scouting

The potential for rootworm injury on corn following corn can be predicted by periodic monitoring of adult activity during July and August of the previous season. Peak counts greater than 1 adult beetle per corn plant in corn following corn or 0.7 beetle per plant in 1st year corn indicate potential levels of economic rootworm activity if corn is planted again in the field being monitored.

For the WCR variant, assessing the population in soybeans is the best way to determine the potential for problems the following year. Monitoring for the first-year WCR variant is done using Pherocon AM yellow sticky traps (fig. 8). Six traps are placed into a soybean field at least 100 feet from the edge and apart from one another during the third week in July. These traps are sampled every 7 days by counting the number of adult WCR on



Figure 8. Yellow sticky trap

the trap. The traps should remain in the field for 6 weeks and be changed every week when adults are counted. The average number of beetles collected per trap per day over each sampling period provides an index of adult rootworm beetle activity. Any time the number of beetles reaches the threshold of 5 adult beetles per single trap per day during a sampling period, it suggests a high potential for problems the following spring if corn is planted. In those cases, taking preventive action is warranted. See OSU Extension fact sheet FC-ENT-1-09 (available at <http://ohioline.osu.edu>) for more details on monitoring for first-year WCR in soybeans.

When rootworm injury in corn is detected, an assessment of the injury should be conducted to determine the severity of the problem, and whether the management tactic that was used performed adequately. Rootworm injury on corn root systems is commonly rated on the 0–3 Node Injury Scale, where 1 represents a complete node destroyed, 2 represents two nodes destroyed, and 3 is for three nodes destroyed. For ratings less than 1, a rating of 0.1 is for a single root on a node eaten to within an inch and a half of the main root, while 0.5 is for half the roots on one node being consumed within an inch and a half of the main stem.

Management

Where first-year corn rootworm is not considered a problem, annual rotation of corn with an alternative crop

will eliminate rootworm problems. If the first-year corn rootworm problem is present, corn following soybeans may be susceptible to rootworm injury. Where a significant potential for rootworm injury is anticipated in corn following corn or first-year corn following soybeans, preventive management tactics are warranted.

Management of rootworm larvae has changed significantly over the past few years, shifting to the use of transgenic *Bt*-corn hybrids, which provide excellent protection against WCR and NCR larval infestation. These products are used as preventive measures against these insects similar to soil insecticides. Transgenic corn hybrids are available containing a *Bt* gene that offers rootworm larval control alone, or in combination as a stacked hybrid with a *Bt* gene for control of European corn borer feeding. Currently, there are three transgenic families from different companies with different *Bt*-rootworm genes, Agrisure, Herculex and YieldGard, either with the rootworm gene alone or in combination with other *Bt* genes. These products provide economic control of WCR and NCR larvae. When using any of these transgenic corn hybrids whether with the transgenic RW trait alone or in combination, growers need to follow certain EPA regulations that include the use of a 20% refuge. Growers should also be aware that all transgenic RW hybrids are treated with the low rate of one of the commercially applied seed treatments, Cruiser or Poncho, for control of secondary soil pests. Growers should see their seed dealers for all the requirements and guidelines to follow when planting transgenic hybrids.

The second option is the use of a soil insecticide, which remains an acceptable choice for protection against

rootworm larval feeding. These soil insecticides will also control many secondary soil-based pests, depending on the treatment selected.

A third option is the application of one of the commercially applied seed treatments, Cruiser or Poncho. These seed treatments are labeled for rootworm larval control at their higher rates (seed treatments on corn have both a low and high rate depending on the pest to be controlled). They also are labeled to provide control against certain soil-based and early season pests. However, in our experience, the high rate of the seed treatments will often not provide acceptable control against rootworm larvae if the density is high and the injury potential is severe, nor do they appear to always provide acceptable control against some of the other soil-based pests, most notably black cutworm.

For control of WCR and NCR adult feeding on silks, rescue treatment with a foliar insecticide is warranted when there are 5 or more adults per plant and pollination has not yet occurred. Prior to applying a foliar insecticide against adult feeding, growers should remove an ear from the corn and carefully roll back the shucks. Hold the ear horizontally, and shake it gently. If most of the silks fall off, the kernels are pollinated and adult rootworm control may not be warranted. If they stay attached, pollination has not yet occurred and adult rootworm control may be warranted.

See Ohio State University Extension Bulletin 545, *Control of Insect Pests of Field Crops*, for those insecticides labeled for corn rootworms, or for all insecticides labeled on corn. Bulletin 545 can be accessed at <http://entomology.osu.edu/ag/>.

This publication refers to pesticide recommendations in Bulletin 545 that are subject to change at anytime. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The authors, Ohio State University Extension, and the Ohio Agricultural Research and Development Center assume no liability resulting from the use of these recommendations.

Additional information is available from your local Extension office or The Ohio State University Entomology Agronomic Crops Insects web site (<http://entomology.osu.edu/ag/>).

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Keith L. Smith, Ph.D., Associate Vice President for Agricultural Administration and Director, Ohio State University Extension

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