

Corn rootworms

J. L. WEDBERG

Common names

Northern corn rootworm
Western corn rootworm
Southern corn rootworm

Scientific names

Diabrotica barberi
Diabrotica virgifera virgifera
Diabrotica undecimpunctata howardi

Appearance

Rootworms—fully grown larvae—are slender, white worms, approximately ½ inch long with brown to black heads and a dark plate on the top side of the rear segment.

Northern corn rootworm beetles are pale yellow to tan when they first emerge from the soil but soon darken to light green. They are about ¼ inch long.

Western corn rootworm beetles have alternating black and yellow stripes running lengthwise on the wing covers; these black stripes converge to various degrees on the males. The adult western corn rootworm beetle is about ¼ inch long.

The southern corn rootworm beetle—also known as the 12-spotted cucumber beetle—has 12 conspicuous black spots on its wing covers. It is

yellow to green in color and about the same size as the northern and western corn rootworm beetles. This species does not overwinter in Wisconsin, and is not a threat to corn produced in the state because it arrives too late in the summer to cause damage.

Life cycle

Northern and western corn rootworm beetles lay very small (less than 0.1 mm long), white eggs that are shaped like a football. Eggs overwinter in the top 6 inches of soil, although some have been found 10 to 12 inches below the surface. In hilly fields, the highest concentrations of eggs are often found on west-facing

slopes. Hilltops tend to be a less-favored egg-laying site.

Eggs begin to develop when spring soil temperatures reach 50° to 52°F. Larvae emerge and begin invading corn roots by mid-June, with the largest number of larvae usually found in early to mid-July. Corn rootworms go through three larval stages (instars) and can move as much as 20 inches through the soil during this time.

Newly hatched larvae (first instar) feed on the smaller, branching corn roots. Later instars invade the inner root tissues that transport water and needed mineral elements to the plant. In most instances, larvae migrate to feed on the newest root growth.



Western corn rootworm beetle



Northern corn rootworm beetle



Corn rootworm larva



Lodged corn plants resulting from corn rootworm damage.



These pruned corn silks are the result of beetle feeding.

Different-sized (instars) larvae can be found at any given time. This is probably due to eggs hatching over a long period of time and larvae growing at different rates. In fact, larvae, pupae, and adults can be found simultaneously in July and August.

After feeding for about 3 weeks, the larva leaves the roots, forms a small earthen cell, and transforms to the pupal stage. Transformation to the adult takes 1 to 2 days. Pupae are white, delicate, resemble the beetle and are often found next to the plant base but have been recovered as far as 25 inches away from the plant and 9 inches deep in the soil. This suggests that some adults must move a great distance before reaching the soil surface.

Northern and western corn rootworm beetles feed on corn pollen and many other types of pollen, as well as corn silks. Occasionally, this pollen-foraging habit results in corn rootworm problems in residential flower and vegetable gardens. In addition to pollen, the western corn rootworm beetle feeds on corn leaves.

Northern and western corn rootworm beetles first appear in Wisconsin between July 16 and 24, according to a 3-year study at the University of Wisconsin's Arlington research farm. The population peak for western corn rootworm male beetles occurs before the female beetle peak. And the population peak for the western corn rootworm beetle occurs before that of the northern corn rootworm beetle.

Adults reach sexual maturity slowly. Female corn rootworm beetles do not begin laying eggs until at least 2 weeks after mating. Although some egg-laying occurs in late July and early August in Wisconsin, most of the eggs are laid after August 15. While a female corn rootworm beetle is capable of laying more than 1,000 eggs, she usually lays 300 to 500 eggs over a period of several weeks. Most of these eggs are in a diapause ("rest") condition and must go through winter chilling before the embryo will develop in spring.

Soil moisture influences both the number of eggs laid and where the eggs are laid. Corn rootworm beetles will lay more eggs in moist soil than dry soil. And high soil moisture content may induce the female beetles to lay their eggs near the soil surface. Research suggests that eggs near the surface need moisture to survive the winter or they will probably die. However, low soil temperatures due to little snow cover may also contribute to egg mortality.

Damage

Rootworms cause economic losses mainly in the southern two-thirds of the state. The corn rootworm beetles prefer loam soils for egg-laying and usually are not a problem in peat, muck, and non-irrigated sandy soils.

As mentioned previously, rootworms tunnel in corn roots. This damage can consist of brown, elongated scars on the root surface, tunneling within the roots, or varying degrees of root pruning.

Plants with pruned roots usually lodge after storms accompanied by heavy rains and high winds. Slight to moderate lodging can result in reduced ear weight—the affected plants will have a goose-necked appearance up to harvest. With severe lodging the corn roots will pull completely out of the soil, and stalks will fall flat. In this case, the ear often fails to develop. Or, if severe lodging occurs, the ear may be difficult to pick up with harvest equipment.

Although lodging is one indicator of rootworm damage, lodging usually occurs because of other factors. Some corn varieties lodge just because of wind and rain—without any rootworm activity at all. This seems to be particularly true for very tall corn before the brace roots are totally developed.

Besides feeding on corn roots, rootworm beetles feed on green corn silks and thereby reduce pollination. However, most field corn is pollinated before peak beetle populations occur, so beetles present around mid-August or later have little impact on that corn.

The western corn rootworm beetle also feeds on leaves, and this can slow plant growth and on rare

occasions kill plants of some corn varieties. Late-planted field corn and sweet corn—such as corn planted after early peas or first-crop alfalfa—are most likely to suffer from adult feeding activity.

If you see lodging in your fields during July or August, dig several lodged and unlodged plants along with a 6-inch core of soil. Shake off the soil, thoroughly wash the roots, and look for rootworm feeding—the root tips may be brown, or appear tunneled and pruned back to the plant base. You may find larvae in the plant crown.

Do not wait until fall to check lodged plants, because normal root decay present in fall usually makes it impossible to accurately assess rootworm damage.

Scouting suggestions

Determining immediate adult rootworm damage

Corn rootworm beetles can interfere with pollination by pruning silks during this critical period; this is one reason you should scout your fields. Check for corn rootworms before 70 percent of the plants are in the process of silking. Waiting until later may result in yield losses before you have a chance to apply insecticides. Beetles do not reduce yields once pollination is over and silks are brown.

First, count the number of beetles on 10 random plants in five separate areas (a total of 50 plants). Do this for each planting date and each variety in the field. Record the number of beetles per plant and the number of plants with silks pruned back to $\frac{1}{4}$ inch or less. Also record the number of plants that haven't silked, the number with fresh silk, and the number with brown silk. In addition, determine if pollen is still being shed.

Predicting potential rootworm damage

Another reason to scout for corn rootworm beetles is to predict the potential for rootworm damage the following year. During some years, soil insecticides are applied to 90 percent of the continuous corn acreage in the rootworm area of Wisconsin, yet only 40 to 50 percent of these fields have rootworm populations that justify such applications.

While this proportion will vary from year to year depending on natural fluctuations in the corn rootworm population, it still indicates that many farmers could save money with prudent insecticide use. By scouting cornfields during August and evaluating corn rootworm beetle population levels, you can determine if an insecticide will be necessary if you plant corn in the same field next year.

Beginning in late July, make three scoutings at 7- to 10-day intervals through late August. Occasionally, beetle numbers are so dense (such as in late-planted fields) that they literally are "all over the place." In these instances, detailed counts aren't necessary—the odds are good that the field will have a corn rootworm infestation that can cause substantial corn losses next year.

For lesser populations count the number of western and northern corn rootworm beetles on 50 plants each time you sample. Examine 10 plants selected at random in each of five areas in the field.

Make sure you move quietly as you approach a plant so you don't disturb the beetles. Count the beetles on the entire plant—including the tassel, ear tip, leaf surface, and behind leaf axils. Pull the leaves away from the stalk to examine leaf axils.

When you check the ear, grasp the ear tip tightly, enclosing the silks in the palm of your hand and count all other areas of the plant first. The silks often have the most beetles on the plant, so a tight hold on the ear tip keeps beetles from dropping. Examine the ear tip by cutting it off with a knife, cutting only the silks. Open your hand slowly and count the beetles that come out of the silks.

Record both the number of western corn rootworm beetles per plant and the number of northern corn rootworm beetles.

Control

Chemical control

Although a soil insecticide will not kill all corn rootworms in a field, it controls them sufficiently to prevent economic damage. However, situations such as extremely high populations of larvae, heavy rains, and improper calibration of insecticide application equipment can result in poor control.

Depending on their label, insecticides can be banded ahead of the planter presswheel, broadcast before planting or at early postemergence (before mid-June), or applied side-dress during cultivation. The preferred method is to apply a 7-inch band of granular insecticide ahead of the planter presswheel at planting.

While it is possible to plant corn so late that most of the rootworm larvae starve before corn roots are available, dent corn yields from such late plantings are too low to make this practical. If there are enough rootworm eggs present to cause substantial corn losses in a field, use a corn rootworm insecticide whenever corn is planted before mid-June.

Extension publication *Field Crops Pest Management in Wisconsin* (A3646)

contains detailed information on selecting and using corn rootworm insecticides and provides information on treatment thresholds. It is revised annually because treatment thresholds and insecticide suggestions may change each year. This publication is available from your county Extension agent.

Non-chemical control

Crop rotation. Growing corn in the same field two years in a row gives rootworms a chance to greatly damage corn the second year, so a soil insecticide is often needed at planting time where rootworms are a problem.

Late-planted corn fields are especially attractive to rootworm beetles. Their green silks and pollen can attract large numbers of beetles from more mature corn in surrounding fields, resulting in massive numbers of eggs being deposited in the soil. Since soil insecticides do not control 100 percent of the rootworm larvae, an unacceptable amount of root feeding could still occur in these fields. In these cases, crop rotation appears to be the most appropriate control choice.

Crop rotation is an excellent method of controlling corn rootworms. Larvae perish soon after hatching if a crop other than corn is planted in the field they inhabit.

Crop rotation is also a good management option because it reduces the possibility of corn rootworms developing resistance to a particular insecticide. Insecticide resistance is possible whenever an insect population is continually subjected to selection pressure from insecticide use.

Corn can be planted after soybeans without using a soil insecticide as long as there was not an abundance of volunteer corn or weeds present in the soybean field. Weed or volunteer corn pollen may attract sufficient corn rootworm beetles and result in enough eggs deposited to produce substantial corn losses. Good weed control will help eliminate this problem.

Corn rootworms occasionally are a problem in fields planted to corn after alfalfa. Adults attracted by alfalfa or weed blossoms during the summer egg-laying period may lay enough eggs to result in a problem level of larval feeding the following summer.

You can plant corn after most vegetables, except lima beans, without using an insecticide at planting time. Lima beans blossom over a long period of time and may attract corn rootworm beetles. In fact, some canners report corn rootworm damage when sweet corn follows lima beans in rotation.

Although there may be some damage to first-year corn planted after soybeans, alfalfa, small grains and other crops, it seldom is great enough to warrant insecticide treatment for corn rootworms. Thus, annual crop rotation is an excellent method of corn rootworm control.

Resistant varieties. There are no commercially available dent or sweet corn varieties resistant to corn rootworms. However, there are varieties that are rootworm tolerant—they have the ability to outgrow rootworm damage and regenerate roots better than other varieties. Planting these varieties will not eliminate the need for soil insecticide use, but used with an insecticide they will help prevent serious economic damage to your crop, as well as lodging. Contact your area seed dealers for additional information about tolerant varieties.

Natural control. Nature also helps control insect pests. While adult and larval corn rootworms are essentially free of parasites, ground beetles and predacious mites in the soil help control corn rootworms to some extent by feeding on rootworm eggs, larvae and pupae.

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Author: J.L. Wedberg is professor of entomology, College of Agricultural and Life Sciences, University of Wisconsin-Madison and University of Wisconsin-Extension, Cooperative Extension. Produced by Cooperative Extension Publications, University of Wisconsin-Extension.

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