

Protecting Corn From Corn Rootworms

By Robert F. Ruppel,
Department of Entomology

The western and northern corn rootworms are the most damaging of all field and forage crop insects in Michigan. They are closely related to the striped and spotted cucumber beetles (the latter is also called the southern corn rootworm) and the bean leaf beetle that attack a variety of crops.

By far the greatest damage done is to the roots of corn by the young (larvae) rootworms that can feed only on corn. The adults of the western and northern feed heavily on flowers and leaves of many plants growing near heavily infested corn fields. Rootworms are pests where corn follows corn. Thus rotation of corn with any other crop is the best means of avoiding corn rootworm problems, and is strongly recommended wherever it is economically sound.

Biology and Description

Rootworms overwinter as oval, yellowish eggs in the soil. The eggs hatch in the first part of June. The young larvae are slender, cylindrical worms with a white body, a tan head, and have six small legs just behind the head (Fig. 1). They are about ½ inches long when fully grown.

The rootworm larvae can feed only on corn roots and not on any other crop. They prune and tunnel the roots of the corn. Their feeding reduces the vigor of plants and can weaken the roots to the point that plants lodge and pull out of the ground at harvest. Lodging caused by the rootworms typically starts at soil level and the plants gradually curve up ("goose-neck") from their bases (Fig. 2). Larvae finish feeding in late June and July. They then make a small cell in the soil and transform to a quiet stage, the pupa, in the cell.

Adults emerge from the pupal cases and leave the soil in mid-to-late-July. The adults are hard shelled beetles about ¼ inch long. Unlike most other beetles found in flowering corn, the adult rootworms: 1) have long antennae (feelers) (Fig. 3); and 2) will rapidly run, jump, or fly when disturbed. The other common beetles in corn have short antennae and move slowly or tumble to the ground when disturbed.

The northern corn rootworm adult is pale green or yellow without markings. The western corn rootworm adult is yellow or red with black stripes down its wings; the stripes vary from little more than thin streaks to nearly covering the whole wing.

The adult rootworms feed on corn silks and tassels. The western adults also feed on the leaves of the plants.



Fig. 1. Larva of the corn rootworm.



Fig. 2. Typical "goose-neck" lodging caused by corn rootworm larvae.

The feeding of the adults on the silks can reduce grain set if the adults are abundant during pollinating time.

Females lay eggs in the soil, usually in cracks close to the crowns of the corn plants. These eggs do not hatch until the following spring and there is only one generation of the rootworms per year.

The adults move out of the corn as the corn matures. They are attracted to a variety of flowers and to lush plant growth but can still cause damage in late August and September by feeding on the silks of late planted sweet corn and the leaves of soybeans, dry beans, vegetables and even alfalfa in fields near heavily infested corn fields. They do lay eggs in the soil under these other crops and, while rare, can lay enough eggs to cause damage to first year corn planted in that field the following year. The adult rootworms are long-lived and some survive until the first heavy frost.

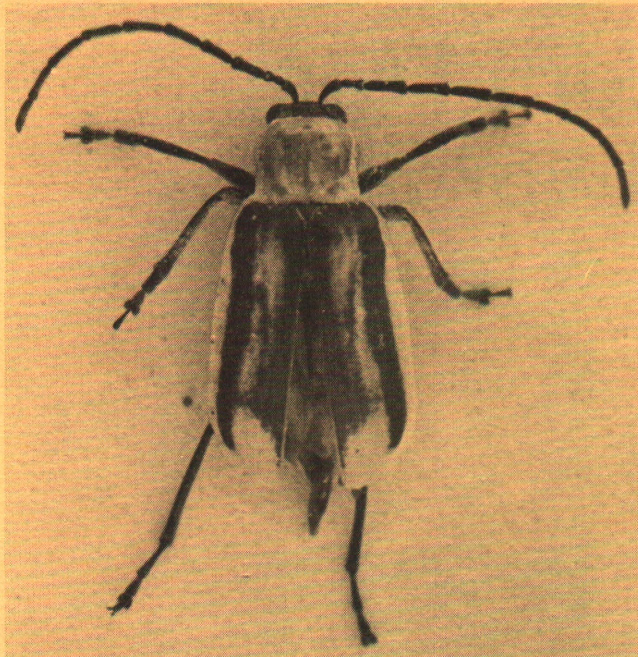


Fig. 3. Adult western corn rootworm; the northern corn rootworm is pale yellow or green without markings.

Detection and Treatment Guidelines

ROTATION. Almost all rootworm eggs are laid in corn fields. The larvae that hatch from those eggs can feed only on corn. Therefore, rotation of corn with any other crop will almost eliminate the risk of rootworm damage. The feasibility of rotation should be critically evaluated if rootworms become a problem in a field. *Rotate the corn whenever it is economically sound.*

FIRST YEAR CORN. Corn planted the first year following another crop is rarely damaged by corn rootworms. In the few cases where damage to first year corn has occurred it has been in fields that had a lush growth of soybeans, dry beans, alfalfa or weeds immediately adjacent to heavily infested corn fields during late August and September of the previous year.

Information from other states and some limited observation in Michigan show that fields of any crop that have large numbers of volunteer corn plants may also have enough rootworm eggs to damage first year corn. There are no reliable guidelines to the actual risk such fields pose for rootworm damage the following year. The number of fields of first year corn damaged by rootworm is so low that the risk is negligible and I do not generally recommend treating them for rootworms. The exception to this is fields fitting the noted criteria or where the grower had checked the previous September and found adult rootworms heavily feeding.

LARVAL DETECTION. Small corn that is injured by rootworms will grow slowly and wilt quickly during dry

spells beginning in mid-June. Dig up the roots of several plants in the infested area and check them for tunnels and for feeding signs. Look for rootworm larvae on the roots or in the soil around the plant. Once again, there are no reliable guidelines, but I recommend that a lay-by application of soil insecticide, noted later, be applied *if* rootworm larvae are found in most of the plants examined *and if* the treatment is made before July 1.

GRAIN SET. Corn is pollinated within a week or 10 days after the first silks appear. This is usually before many rootworm adults are present. Late planted or retarded corn may especially need protection from the silk feeding of the adults during that critical pollination period. Apply a spray of one of the insecticides, (noted later), to protect grain set *if* there are five or more adults per ear in grain or silage corn or three or more adults per ear in seed corn *and* it is not later than 10 days after the first silks appear. Later feeding on the silks by the adults will not affect the corn.

General Recommendations

The insecticides recommended for control of the rootworm adults are:

Carbaryl (Savit or Sevin) at one lb. active per acre. Minimum 0 days between application and harvest.

Take precautions to keep honey bees out of the field for one week following application.

Imidan at 0.25 lb. active per acre. Minimum 14 days between application and harvest.

M & M (a mixture of malathion and methoxychlor) at two quarts of the formulation per acre. Minimum seven days between application and harvest.

Di-Syston at 0.5 lb. active per acre. Minimum 28 days between application and harvest.

Malathion at 1 lb. active per acre. Minimum five days between application and harvest.

Other Insecticides (Restricted Use Pesticides or special formulations).

Parathion at 0.38 lb. active per acre. Minimum 15 days between application and harvest.

Methyl parathion at 0.25 lb. active per acre. Minimum 12 days between application and harvest.

PennCap-M (an encapsulated formulation of methyl parathion) at two pints of the formulation per acre. Minimum 12 days between application and harvest.

Do not apply if honey bees are working in the field.

ULV malathion at four fl. oz. of the concentrate per acre. Minimum five days between application and harvest.

LATE SEASON DETECTION. Rootworm damage may not be found until the adults appear in the field or until lodging or pulled plants cause problems at harvest. Check for root pruning and tunneling if adults or lodging is common in the field. It will be too late to protect the crop, but it will be a warning to rotate that field to another crop or to use a soil insecticide, (noted later), the next season if corn will be planted in that field.

Predicting Rootworm Problems

A count of adults in a field for one year can be used to estimate the risk of the corn rootworm damage in that field the next year. Growers are strongly urged to make this count whenever they plan to follow corn with corn. This will warn them of a rootworm problem or assure them that no control will be needed the next year. They will save either way, by protecting yield when needed, or saving the cost of an unneeded insecticide application. Check each field separately (or part of a field if there were differences in planting date, weed control, or other major factors). There can be great differences in rootworm infestations even between adjacent fields.

The recommended system for checking the field is:

1. Check the field for the first adult corn rootworm (be it western or northern) starting in early July or when alerted by the county agricultural extension agent. The first adults usually appear about tasseling time, but could be earlier or later depending on the season. Notify the extension agent when you find the first adult so that neighbors will be informed that the adults are coming out.
2. Count the adults sometime during the period 25 to 35 days after the first adult is seen in the field. This is when the adults should be most abundant. Use the "first find" from neighboring fields if the field itself was not checked for adults.
3. Go into the field beyond the margins and headlands and count the number of western and northern corn rootworm adults (the species is not important) on 60 plants. Count the adults that can be seen on the leaves, tassels, and silks without stripping back leaf sheathes or husks. Repeat this same count in two other places in the field (a total of 180 plants) and add up the number of adults seen in the three areas. Make the counts on sunny days and during mid-day when possible.
4. A decision to rotate the field to another crop or to apply a soil insecticide (noted later) the next season should be based on the total number of adults found on the 180 plants.
 - a. If 180 or more adults are found rotate the field or treat if corn is planted in it the following season.
 - b. No damage from rootworms is expected the following season if less than 180 adults are found.
 - c. Counts close to the 180 index present a problem that is still not resolved. For now, I recommend not treating, even if the count is 179, as there is a level of safety for the lower counts. The upper level is uncertain, however, and a count of 180 must be regarded as a risk.

Soil Insecticides

BAND APPLICATION. Most soil insecticides used for corn rootworm control are applied in six to eight inch bands centered over the row at planting or, less frequently, at lay-by (cultivation or post-emergence application). Special precautions must be taken in planting

time application to keep the insecticides Mocap, Thimet, and Dyfonate out of contact with the seed. This may require placing the granular fan or spray nozzle in back of the press wheel on some equipment.

The insecticides must be covered with some soil as soon as possible to protect them from heat and sun on the soil surface. The planter may cover the insecticide, or special spring tines or dragging a plank or chain may be used for planting time application. A cultivator shoe should be set to throw soil over the insecticide in lay-by applications. Make lay-by applications no later than July 1.

The amounts of insecticide to apply are given as ounces of dry formulation (granules or wettable powders) or fluid ounces of liquid formulation (emulsifiable concentrates or flowables) to be applied *per 1000 row-feet*. The amount needed *per acre* will vary with the row width to be used and can be calculated using the following equations.

Let: A = ounces or fluid ounces recommended per 1000 row feet

R = row width, in inches

F = pounds or quarts of formulation needed per acre.

a. With dry formulation

$$F = (A \div R) \times 32.67$$

For example, 8 oz. of formulation per 1000 row feet is recommended (A = 8) and the row width is 30 inches (R = 30)

$$F = (8 \div 30) \times 32.67 = 8.7120 \text{ lb. formulation per acre.}$$

b. With liquid formulation

$$F = (A \div R) \times 16.335$$

For example, 2.4 fluid ounces of formulation per 1000 row ft. is recommended (A = 2.4) and the row width is 36 inches (R = 36).

$$F = (2.4 \div 36) \times 16.335 = 1.0890 \text{ qt. formulation per acre.}$$

Insecticides

Counter at 8 oz. of the 15% G per 1,000 row ft. at planting or lay-by.

Amaze at 6 oz. of the 20% G or 1.6 fl. oz. of the 6 lb. per gal. EC per 1,000 row ft. at planting or lay-by. The lay-by applications should be applied in three-to-four inch bands at each side of the bases of the plants and not over the plants. Do not use in row widths less than 30 inches. Minimum 75 days between application and harvest. Soybeans may be planted one year after application; other crops may be planted 10 months after application.

Dyfonate at 6 oz. of the 20% G or 10 oz. of the 10% G per 1,000 row ft. at planting or lay-by. Keep the insecticide out of contact with the seed. Minimum 45 days between application and harvest for grain and 30 days for feed.

Dyfonate at 2.4 fl. oz. of the 4 lb. per gal. EC per 1,000 row ft. at planting time only. Keep the insecticide out

of contact with the seed. Minimum 45 days between application and harvest for grain and 30 days for feed.

Furadan at 8 oz. of the 15% G or 12 oz. of the 10% G per 1,000 row ft. at planting or lay-by. Do not rotate to a succeeding crop other than alfalfa, corn, cucurbits, grapes, peppers, potatoes, small grains, sorghum, soybeans, strawberries, or sugar beets. Tomatoes, cabbage, peas, snap (green) beans and dry beans may be planted the following season provided that no more than 1.3 lb. active Furadan was applied per acre.

Furadan at 2.4 fl. oz. of the 4 lb. per gal. flowable per 1,000 row ft. at planting or lay-by. The lay-by application should be applied in 3 to 4 inch bands each side of the plants and not over the plants. Note the rotation restrictions given for the Furadan granules.

Lorsban at 8 oz. of the 15% G per 1,000 row ft. at planting or lay-by.

Thimet at 6 oz. of the 20 G or 8 oz. of the 15% G per 1,000 row ft. at planting or lay-by. Keep the insecticide out of contact with the seed.

Mocap at 12 oz. of the 10% G at planting or lay-by. Keep the insecticide out of contact with the seed.

Mocap at 1.6 fl. oz. of the 6 lb. per gal. EC per 1,000 row ft. at planting only. Keep the insecticide out of contact with the seed.

Diazinon at 8 oz. of the 14% G, 2.4 fl. oz. of the 4 lb. per gal. EC, or 2.5 oz. of the 50% WP per 1,000 row-ft. at lay-by only. The 14% G may be banded over small plants. All diazinon formulations should be applied in a 3-4 inch at each side of the bases of the larger plants.

SPLIT BOOT APPLICATIONS. The 4 lb. per gal. Dyfonate EC, the 4 lb. per gal. Furadan Flowable, and the 6 lb. per gal. Amaze EC at the rates noted earlier can be mixed with some (check their labels) liquid fertilizers and injected in furrows on each side and below the

seed at planting time. The same restrictions on the use of these insecticides given for the band application apply to the split-boot applications. The advantage of split boot over band applications is that the insecticide is applied with the fertilizer without additional application equipment. There has been little use of this method in Michigan and it is suggested for trial only.

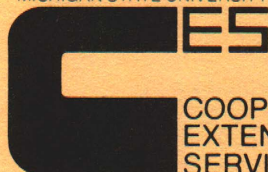
BROADCAST APPLICATIONS. Dyfonate at 1 gal. of the 4 lb. per gal. EC, 20 lb. of the 20% G or 40 lb. of the 10% G per acre can be broadcast and disked into the soil prior to planting. The Dyfonate 4 EC may be mixed for application with some (check the label) herbicides or fertilizers. This is more expensive than band applications, but may be an advantage on some farms.

A Note on the Insecticides

Soil insecticides used against corn rootworms should protect the roots from damage by the rootworm even though they do not kill all of the rootworms in the soil. Adult rootworms, therefore, frequently appear in numbers in treated fields. The success or failure of a treatment should be judged on the protection given the roots and not just by the presence of the adults in the field. Fields where lodging is common or adults are abundant should be checked for root damage.

Use a different type of insecticide than the one that was used if an insecticide, properly applied, fails to protect the roots. Furadan (and continuous use of Furadan in areas of several states, but not as yet in Michigan, has resulted in failures to adequately protect the roots) is currently our only carbamate-type rootworm insecticide; all of the others are phosphate-types. Change to Furadan if one of the others starts to fail; change to one of the others if Furadan starts to fail. A regular rotation of carbamate and phosphate-type insecticides is not recommended. Choose the insecticide that best fits your needs and pocketbook.

MICHIGAN STATE UNIVERSITY



COOPERATIVE
EXTENSION
SERVICE

MSU is an Affirmative Action/Equal Opportunity Institution. Cooperative Extension Service programs are open to all without regard to race, color, national origin, or sex.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by the Cooperative Extension Service or bias against those not mentioned. This bulletin becomes public property upon publication and may be reprinted verbatim as a separate or within another publication with credit to MSU. Reprinting cannot be used to endorse or advertise a commercial product or company.

O-14274

1P-6R-5M-5:83-UP, Price 25 cents, single copy free to Michigan residents.

File 27.321