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1987

G87-839 Corn Rootworm Control

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Peters, Leroy L.; Meinke, Lance J.; and Witkowski, J. F., "G87-839 Corn Rootworm Control" (1987).
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Corn Rootworm¹ Control

Corn rootworms -- damage they cause, and how to control them.

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Three kinds of rootworms attack corn in Nebraska -- the western, the northern, and the southern. The western is the most common and most damaging and can be found over the entire state. The northern is found mainly in the northeastern counties. The southern can be found over the entire state.

Life History

Female western and northern rootworm beetles lay 300 to 400 eggs in the upper 2 to 8 inches of soil during later summer and early fall. Western corn rootworm eggs hatch the next spring in late May and early June. The start of hatching depends to some extent on soil temperatures and continues for several weeks.

Some (as many as 30-40%) of the northern corn rootworm eggs may not hatch until the second spring due to "extended diapause." Diapause is a resting period during which the insect does not develop. Extended diapause is associated with northern corn rootworms where eggs remain in the soil for two winters rather than hatching in the spring following the first winter. This phenomena has been identified in Iowa, Minnesota, and South Dakota where corn/soybean rotation has been used for several years. Some of the northern corn rootworm population has adjusted to every-other-year corn planting in those areas. The incidence of extended diapause in Nebraska has not been identified, and at this time very few fields appear to be affected.

Southern corn rootworm (spotted cucumber beetle) adults probably do not overwinter in Nebraska but migrate to Nebraska from the south each year and deposit eggs in corn fields in the spring. The southern corn rootworm does enter diapause during the fall in Nebraska. However, overwintering survival is probably minimal and would be most likely to occur in southeast Nebraska. More than one generation of southern corn

rootworms occur each year, but these cause little damage to corn.

After hatching, rootworms feed on the underground root systems of corn plants, causing varying degrees of damage ranging from none to complete root destruction. After larvae finish feeding, they change to the pupal stage in which the "worms" change into the adult, or beetle stage. Western corn rootworm beetles usually begin to emerge from the soil in late June, and continue to emerge until September. They may be active in fields until frost. Northern corn rootworm beetle emergence is usually somewhat later in the season.

Damage by Larvae

Larvae feed on roots and can cause direct grain losses by reducing both plant stand and vigor. Root pruning can also cause plant lodging which may further reduce yields due to harvest losses.

Usually, peak rootworm feeding occurs from late June to mid-July, when all corn roots may be destroyed. The resulting loss of grain may vary widely depending upon the number of larvae per plant, time of planting, available moisture, soil fertility, wind, and general climatic conditions during and immediately following peak injury.

Western and northern corn rootworms feed on the roots of corn and certain grasses. They have not been found to damage sorghums or other agricultural crops. Southern corn rootworm larvae will feed on the roots of many plant species, including corn, soybeans, sorghum, wheat, cucumbers, and other vegetables, and many legumes, but the feeding damage is not serious on corn.

Damage by Adults

The preferred food of the adults (beetles) is corn silks and pollen. However, early emerging western corn rootworm beetles may feed on corn leaves, producing a parchment-like appearance if pollen isn't present. If adults are numerous during the pollination period and silks are chewed into the husks, poorly filled ears may result. Under these conditions, it may be profitable to control adults to protect silks. Depending upon growing conditions, 10-20 beetles per silk mass are usually required to seriously affect pollination. Late planted corn is more likely to be damaged by adults. Most fields are pollinated before enough beetles are present to reduce fertilization and controls are rarely justified.

Corn rootworm adults may occasionally interfere with pollination if there is enough feeding to keep silks chewed into the husks during the pollen-shed period. Severe silk feeding at 25 to 50% pollen shed may indicate a possible need to apply insecticide. **When pollination is complete, silks are wilted or turning brown, then silk feeding is no longer of concern.**

Rootworm Management

Crop Rotation

Adult western and northern corn rootworm beetles are attracted to and feed on the pollen of corn, sorghum, some legumes, grasses, and weeds common to our cultivated land. Eggs are usually deposited in fields where the adults feed.

With a few exceptions corn rootworms are only damaging in continuous corn. In some instances, however, economic corn rootworm injury has occurred on corn following small grains (primarily oats), or weedy soybeans, in northeastern Nebraska. Only in rare instances has damage followed in a corn rotation with the other major crops grown in Nebraska. Therefore, simply rotating corn annually with another crop will largely prevent serious rootworm damage. Soybeans, grain sorghums, forage sorghums and sudans, small grains, and legumes such as alfalfa, sweet clover, and red clover could be used in rotations. Larvae hatching from eggs

laid in these fields will perish.

Other Cultural Practices

All cultural practices that encourage rapid plant growth help reduce the effects of rootworm damage. Select a variety or varieties adapted to your area and noted for strong root development. Good seedbed preparation, fertilizing according to soil test, and timely irrigation help promote rapid growth.

Early planting often maximizes yield and allows silks to develop before peak rootworm beetle feeding. Good weed control not only aids early growth and development of corn plants, but also makes fields less attractive to rootworm beetles. Hilling at lay-by time helps brace roots to become more firmly established, thereby reducing the severity of lodging and promoting rapid root regeneration.

First Year Corn

First year corn is unlikely to benefit from soil insecticide applications. Crop rotation is still our best recommendation for corn rootworm prevention. The only exceptions might be first year corn following soybeans or other crops in northeast and eastern Nebraska. In a very small percentage of fields following soybeans or other rotations, northern corn rootworm larvae may damage first year corn because of extended diapause. Presently, these fields cannot be identified. In most cases, preventive treatment with soil insecticide is unnecessary, even in these situations. Insecticides are recommended where losses in yield due to insect damage are likely to exceed control costs. When applied as "insurance" treatments, the use of soil insecticides is wasteful and will lead to higher production costs, greater environmental risks, and a shortening of the useful life of important pesticide products. We recommend treatment of first year corn only if corn follows weedy soybeans, oat stubble, soybean fields heavily infested with volunteer corn, or following pasture or sod and a problem with rootworms has existed in the past.

Summer Management

Corn following other crops may be damaged by rootworm larvae if adult populations in adjacent corn fields were numerous the previous August. When beetles emerge they tend to remain in corn fields if plants remain green, succulent, and attractive. Otherwise they may fly to flowering legumes, sorghum, and weeds, where they feed on pollen and deposit eggs. Western corn rootworm beetles are more likely to move from field to field than northern corn rootworm beetles.

Adult Control -- For Larval Control the Following Year

Spraying corn rootworm beetles one year to reduce the following year's larval populations gives inconsistent control and is not recommended. One major problem is the proper timing of applications. egg laying begins in July and can continue until frost. The use of soil insecticides on the current year's crop is still the most reliable control method.

Controlling rootworm adults (beetles) to reduce the number of larvae the next season may not be as reliable as soil insecticides because precise timing of control is essential. If this method is used, it should be under the supervision of trained pest management personnel. To have a reasonable chance of success, begin weekly scouting in early July. Apply control when there is an average of 3 rootworm beetles per 4 plants (0.75 beetles per plant or 18,000 beetles per acre based on a plant population of 24,000 plants per acre) and 10% of the females have mature eggs. Note that strict use of calendar dates in timing of treatment is not recommended since there may be as much as 3 weeks variation in optimum treatment timing from year to year. When beetle numbers first reach or exceed the above threshold, apply a residual insecticide. Residual activity is reduced by overhead irrigation or rainfall after application. If beetles reinfest the field, make a second application when population levels reach one beetle per two plants. The cost of two treatments will exceed that of a single soil treatment applied at planting or first cultivation the following spring. In continuous corn, if you do not have

scouting data from the previous season for the full beetle activity period, consider a soil insecticide application at cultivation or planting as a precautionary measure. Many fields never develop a rootworm problem. Using both adult control the previous year plus soil insecticide the current year is not recommended.

Spring Management

Granular insecticides can be applied with commercially available granular applicators at planting, cultivation, or layby (for rescue treatments). Insecticides applied too early may break down or lose effectiveness before rootworm eggs hatch, resulting in poor control.

Therefore, apply the soil insecticide as close to hatching time (late May or early June) as possible. Generally, this is at cultivation time. Avoid planting time applications before mid-May. Do not reduce the rate and don't split it, i.e. half at planting and half at cultivation. The application should be according to label instructions, either directed at the base of the plants or over the row. Incorporate with 1 to 2 inches of soil in either case. Some moisture is needed for chemical activation. If excessive moisture conditions persist, aerial application is an alternative. However, when incorporation is not possible, control effectiveness may be decreased. Applications after mid-June become progressively less effective because damage by the growing larvae increases. Even with "good control," surviving larvae may be found in the field and adults may emerge later in the season.

If insecticide is applied at planting time, apply the granules as a band about 7 inches wide directly over the row or in the seed furrow, depending upon grower preference and insecticide label restrictions. Some chemicals may cause reduced stands if they come in direct contact with the seed. Therefore, do not use in-furrow or T-band applications with these insecticides. Work the insecticide into the upper 1/2 inch of soil with packing wheels, covering disks, or by dragging chains or spring teeth behind the planter. Do not use loop chains. If listing, apply insecticide at cultivation.

Tubes that deliver granules from hoppers should be as straight as possible. Curves in the tubes hinder the flow of granules and can result in uneven distribution.

Treatments at cultivation time are sometimes delayed in wet fields, allowing severe root damage to occur before insecticides can be applied. The delay may extend beyond the time that effective soil treatments could be applied.

Granular formulations of insecticides are usually preferred over liquid formulations for controlling rootworm larvae, because of their better effectiveness and safety.

Factors Affecting Chemical Control When Applied at Planting

Many factors will reduce control of larvae, especially if the insecticide is applied at planting before May 15. Those factors are:

- Excessive moisture may enhance rapid breakdown of the insecticide.
- Prolonged dry conditions of soil may limit chemical release.
- Alkaline soils cause insecticides to deteriorate faster than neutral or slightly acid soils.
- High populations of microorganisms may accelerate breakdown of some insecticides in certain soils.
- High rootworm numbers can result in root damage even when control (percent reduction) of larvae is moderate to high.
- High soil organic matter content may reduce efficacy.
- Control with most insecticides will be reduced if they are applied in narrow bands, if granules are not covered with soil, or if wind blows granules off the rows.
- Application is less than the labeled or suggested rates.

All of these factors are of greater importance with early planted corn. The longer granules remain in the soil before rootworm eggs hatch, the less effective the insecticide will be in controlling the larvae.

Rates of Application

Nebraska corn rootworm soil insecticide dosage rates are given in ounces per 1,000 feet of row. As the row width decreases, the total amount of insecticide needed per acre increases; however, the amount applied per unit of row length stays the same. **Be sure that each applicator is carefully calibrated!** Refer to *Table I* for the amount of insecticide formulation needed per acre using various row spacings.

Table I. Amounts of formulated insecticide needed per acre at various row spacings, based on the recommended rate of ozs/1,000 ft of row for four different percentage formulations of granular rootworm insecticides.

Recommended amount of formulated insecticide per 1,000 feet of row	Pounds of formulated insecticide needed to cover one acre					
	40-inch rows	38-inch rows	36-inch rows	34-inch rows	32-inch rows	30-inch rows
10% Granules-12.24 oz	10.00	10.51	11.11	11.77	12.48	13.33
14% Granules- 8.75 oz	7.15	7.51	7.94	8.42	8.92	9.53
15% Granules- 8.16 oz	6.67	7.01	7.41	7.85	8.32	8.88
20% Granules- 6.12 oz	5.00	5.26	5.55	5.89	6.24	6.66

Chemical Rotations

Evaluate soil insecticide performance annually by comparing corn root ratings in treated and untreated areas. Use of the same corn rootworm soil insecticide in continuous corn over several consecutive years in the same field has generally been successful in Nebraska. In a few fields, however, erratic control has occurred. While some of these failures can be attributed to application problems, planting dates, calibration errors, or environmental factors, some have resulted from the continuous use of the same soil insecticide for several years. If problems have occurred with planting time applications, consider using a cultivation application or rotating to another crop. When there is no alternative to planting time application in continuous corn, consider these suggestions:

1. If rootworm control has been poor after use of a carbamate insecticide, switch to an organophosphate the following season.
2. If poor performance has resulted after use of an organophosphate insecticide, consider switching to a carbamate or another organophosphate insecticide.

These two suggestions are offered as precautionary measures. The extent of the problem associated with continuous use of the same insecticide remains unclear. Just how many years it takes a soil to develop a problem or to "recover" is unknown.

For results of annual rootworm insecticide evaluations conducted by entomologists at the University of Nebraska-Lincoln, refer to the Insect Newsletter or contact your local Cooperative Extension Service office.

Cautions

All insecticides are poisonous. Safety precautions are printed on the container label. **Read and follow** all

precautions on the label to assure safety of the applicator, and to prevent damage to the crop and the environment.

Additional Information

For current insecticide recommendations see the current year's edition of:

- *G83-774, Corn Rootworm Soil Insecticide Treatment Decisions Based on Beetle Numbers*

The Department of Entomology's

- *Managing Corn Rootworm Adults*
- *<Nebraska Insecticide Recommendations*
- *Managing Corn Rootworm Larvae*
- *Nebraska Insecticide Recommendations*

These are available at your Cooperative Extension Service office.

¹Order -Coleoptera

Family -Chrysomelidae

Species Western - *Diabrotica virgifera virgifera*

Northern - *D. barber*

Southern - *D. undecimpunctata howardi*

File G839 under: INSECTS AND PESTS

C-13, Field Crops

Issued June 1987; 10,000, printed.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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