1976

Corn Rootworm Control in South Dakota: 1977

Cooperative Extension South Dakota State University

FS 491
(Revised for 1977)

Corn Rootworm Control in South Dakota

1977

Corn rootworms: western, top; northern, center; southern, bottom.

Cooperative Extension Service
South Dakota State University, Brookings
U. S. Department of Agriculture

Corn Rootworm Control in South Dakota

By
B. H. Kantack, Extension entomologist; **David Walgenbach,** entomologist, Agricultural Experiment Station; and **W. L. Berndt,** Extension pesticide specialist.

Corn rootworms are the most serious insect problem in South Dakota. The western, northern and southern species have been present for a number of years. Farmers can expect damaging corn rootworm infestations in fields where corn is grown continuously. Less predictable rootworm damage has also occurred in corn following small grains and flax. General observations have shown that volunteer small grain and a number of weed species are attractive as feeding sites for the adults and that egg laying also occurs in these areas. The severity of first year corn rootworm problems has also been associated with condition of the corn during August and September as influenced by drought and frost.

Life Cycle

Adult corn rootworm beetles lay eggs in the soil of corn fields and to a lesser extent in other fields where weeds and flowering plants are present. They deposit eggs during late summer and fall. Most eggs are found in the first six inches of soil, although they also have been found to depths up to 15 inches.

The life cycle of the western corn rootworm is shown in Figure 1. This insect passes the winter in the egg stage, and hatching begins in June. It requires several weeks for all eggs to hatch, so larvae of all sizes can be found during late June and early July (Figure 2).

Larvae feed on the root system, eating smaller roots and tunneling into larger ones. Even the base of the stalk below the soil surface often is severely damaged. When the larvae are full grown they change into an inactive stage called pupae.

Following pupation in the soil, the western corn rootworm adults begin to emerge in early July and continue to emerge until early September.

The northern corn rootworm's life cycle is similar to that of the western species, but usually the eggs hatch and the adult beetles emerge a little later in the season.

The southern corn rootworm-commonly known as the spotted cucumber beetle-overwinters as an adult in southern states and deposits eggs in the corn fields in spring. There may be several generations of this insect in a year. This species has been found to attack sorghum in Nebraska. Serious economic populations of southern corn rootworm have not been encountered on South Dakota sorghum.

Larval Damage

Root injury results from larval feeding; smaller roots often are consumed completely, and larger roots are tunneled severely (Figure 3). Disease organisms often follow injury by rootworm larvae, causing further destruction of the root system. Most severe damage usually occurs during the latter part of June and the first three weeks in July. The entire root system often is destroyed.

Losses resulting from a rootworm infestation may range from a light yield reduction to total loss of the crop, depending on a number of factors: number of larvae per plant, time of planting, moisture conditions during and following rootworm attack, and general growing conditions.

Yield losses are considerably greater when moisture is deficient during the period of maximum larval feeding. Under these conditions root regrowth is minimal. Infested fields often become severely lodged, making mechanical harvesting operations difficult and inefficient.

Future Control Problems

The future direction and problems in corn rootworm control include several pathways. All are contained in the genetic potential and diversity of western and northern corn rootworms. The emergence of these genetically different populations will cause changes in control techniques and chemicals that are associated with selective mortality pressures. Some of these changes will be due to widespread use of given insecticides creating tolerant or resistant populations. Other changes in rootworm reaction to control measures will be caused by environmental selection; a selective mortality due to weather and soil conditions at critical stages in the rootworm life cycle. Farmers also have a role in these population changes as differential mortality can be expected from fall or spring plowing; subsequent tillage operations; and late vs. early planting dates. These factors interact and change from field to field and certainly change on an annual basis.

Information has been obtained on the various stages in the rootworm life cycle that shows a wide range of adaptability. It is possible that as the rootworm population shifts because of environmental pressures, changes also occur in their susceptibility to insecticides. Some of the physiological variations that have been observed include a segment of the rootworm population that lays eggs that begin development within a short period after being deposited and do not go through diapause. At the other extreme, some eggs do not hatch for almost two years after being laid. In the laboratory, the majority of eggs hatch over a 30-day period when treated in a similar manner. A differential hatching rate can be obtained depending on the length and intensity of the cold treatment. The cold treatment is necessary to break the diapause in the majority of eggs. We are not certain of the situation in the field. Scattered observations indicated that when insecticide failures occurred, root damage was noted early in the season.

Rootworm Habits Need More Study

The movement of adults from field to field, their habits and patterns of migration have not been closely studied. No population marker has been identified in the present population, hence beetle migration has not been studied since the migration of the western corn rootworm. The adult males emerge 3-5 days prior to the females. Mating has been observed shortly after female emergence, and oviposition begins 14 to 21 days later. The eggs are found in the soil, however oviposition has not been observed in the field. Beetle migration and selection of ovipositional sites are not understood although observations indicate general adult migration from fields severely damaged by larvae. Plant attractiveness had been associated with the availability of fresh silks and tassels hence late plantings or "trap crops" have been used for insecticide evaluation plots the succeeding year.

A large number of chemicals have been evaluated for rootworm control the past several years. The new chemicals perform similar to the older compounds and no exciting new breakthroughs are foreseen in corn rootworm control. Methods of applying soil insecticides for rootworm control have been investigated, including broadcast application, subsurface placement and combination liquid insecticide, herbicide and fertilizer treatments. None have given better rootworm control than the conventional seven-inch band applied over the covered seed furrow in front of the presswheel. Post-planting application of insecticides has not generally improved rootworm control under South Dakota conditions. The reason for this situation

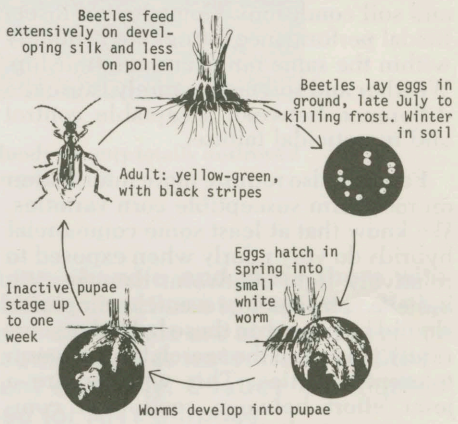

Figure 1. Western corn rootworm life cycle.

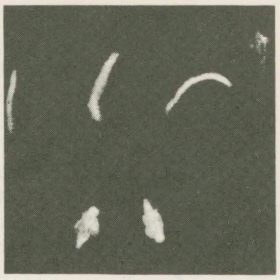

Figure 2. Western corn rootworm larvae (top); inactive pupae stage (bottom).

appears to be associated with both timing of the application in relation to rootworm hatch and frequency and amount of rainfall after application of the insecticides.

Causes Of Insecticide Field Failures

A number of human-related factors are the first target of determining why insecticides fail:

(1) Calibration of the applicators for the recommended rate of insecticide. In South Dakota the rate is 1 lb. A/A based on 40-inch row spacings.

(2) Formulation and/or manufacturing problems causing the product to be under-formulated or degraded prior to application. With some compounds, a few instances of poor formulation occur every year. Present laws on container disposal make this situation harder to evaluate.

(3) Abnormal weather conditions can influence activity of insecticides but generally not enough to cause failure of insecticides applied at planting. Wet weather and soil conditions have been more often associated with poor insecticidal performance, however, when the same compounds are used in dryland and irrigated corn, and from the western cornbelt to higher rainfall areas in the eastern states, deviation in local weather patterns seem less important.

Considerable emphasis has been given to these variables as the major cause of poor insecticidal performance, *seldom is the transformation heard.* Registered compounds are evaluated across the cornbelt under a variety of rainfall and soil conditions. Comparative insecticidal performance ratings are generally within the same range and relationship. Weather and soil factors rarely cause the difference between acceptable control and insecticidal failure.

Farmers also require more information on rootworm susceptible corn varieties. We know that at least some commercial hybrids do very poorly when exposed to relatively light rootworm damage. We believe as much research emphasis should be placed on these hybrids as currently placed on the search for rootworm tolerant varieties. This will require a joint effort between seed corn companies, agricultural experiment stations and the ARS, USDA. As we look to poorer insecticide performance this information will become more valuable.

Pollination Affected By Adult Beetles

Adult beetles, upon emergence from the soil, prefer to feed on corn silks, but also are attracted by leaves and pollen. When large numbers of beetles are present during the pollination period, the damage to silks often results in poorly filled ears. Fields with late-silking plants usually are most severely affected. When populations of beetles are high during the pollination period, it may be necessary to practice adult control measures to protect the silks.

CONTROL MEASURES

Cultural Control of Larval Populations

Cultural practices that promote good root systems will help reduce yield loss and lodging. Plant as early as feasible. Experience in the rootworm areas shows that late-planted corn is often more severely damaged than early-planted corn.

Adult beetles disperse from the corn fields as the season progresses and move into adjoining fields where flowering legumes, sorghums, and weeds are present. If high adult populations were present in such fields during August and September of the preceding year, corn planted in these fields may be heavily infested the following year.

South Dakota State University Entomologists strongly recommend insecticide treatments for corn rootworm control on all first year corn following small grains, flax and sorghum. Corn rootworm infestations in corn following small grain and flax were quite common over eastern South Dakota during the 1975 growing season. The predominant species involved was the northern corn rootworm. In addition where corn rootworm beetle populations are very high, farmers should consider treating corn following soybeans particularly where complete weed control was not achieved.

There is not sufficient data available on the effect of fall tillage versus spring tillage, disking versus plowing, etc., and their subsequent effects on rootworm infestations. However, any tillage methods which improve the seedbed and promote good root development are recommended.

LARVAL CHEMICAL CONTROL

Rotate Corn Rootworm Insecticides

Field observations for the past seven years on insecticide performance against corn rootworm show that almost all problems of poor rootworm control were encountered in fields where the same insecticide had been used for several years. This evidence indicates that some changes are taking place, either in the insect or in some environmental factors in these fields, which cause poor insecticide performance. By implementing a rotation or change of insecticides each year, problems of poor performance or insecticide failures may be eliminated. Thus, it is recommended that growers never use the same corn rootworm insecticide on the same field two years in a row.

Application of Granular Insecticides

Planting time — The insecticides recommended for larval control are suggested for application in the granular form only and are to be applied with a granular applicator. Apply in 4 to 7-inch bands over the rows (not with the seed) at planting time, and incorporate the insecticide into the upper ½ inch of the soil. Make the granule application in front of press wheels, covering disks, or by dragging chains behind the planter. To avoid granule drift off the row when treatments are made during windy weather, provide plastic guards on each side of the banders. Adequate control of corn rootworm will not be obtained if excessive drift of insecticide from the row is allowed during application.

Carefully calibrate the application equipment to obtain the correct dosage. Recommended applications are based on 40-inch row spacings; narrower row spacings require a proportionately higher rate. Basically, apply 10 pounds of 10 percent granules per every 13,080 linear feet of row. It is important that the recommended amount of active ingredient be applied in the correct manner and in the proper place when using row treatments. *Do not drag treated fields crosswise or diagonally - this will displace the chemicals in the treatment band.*

Table 1. Insecticides recommended for control of corn rootworm larvae

Insecticide Formulations	Amount Formulation/ 1,000 ft. of row	Formulation and Amount/ Acre of Row
	ounces	pounds
Catagory A		
Furadan 10G	12	10
Counter 15G	8	6.7
Category B		
Dyfonate 20G	6	5
Dyfonate 10G	12	10
Category C		
Thimet 15G	8	6.7
Mocap 10G	12	10
Lorsban 15G	8	6.7

These corn rootworm insecticides are ranked according to the degree of root protection provided by planting-time treatments during 1974, 1975, and 1976, in South Dakota State University's Agricultural Experiment Station Trials.

It is recommended that South Dakota corn growers *rotate their corn rootworm chemicals each year* using the better performing insecticides listed in Category A. Growers should ROTATE corn rootworm insecticides, switching from a carbamate (Furdan) to an organic phosphate (Counter) each year (or vice versa). Where insecticide availability is a problem, then the grower should select from the next best performing category. Short term studies have shown better performance of the insecticides when phosphates follow carbamates or vice versa.

Post-planting time—Although SDSU entomologists are not recommending cultivation treatments, some of the recommended insecticides are registered for side-dressing treatments at first or second cultivation. Special attachments for the cultivator can be purchased or constructed for this purpose. Apply treatments at the base of the plants and incorporate into the soil immediately. When post-planting applications are made, incorporate the insecticide by using a rotary hoe or by covering with the cultivator shovels. If the corn is small, applications can be made over the row or as a band on each side of the row. Emergency treatments also have been applied at lay-by time using high clearance machines to place the insecticide at the base of the plants and disk hillers on a cultivator to incorporate the insecticide into the soil.

Rootworms still will be present in treated fields, particularly ouside the treatment band, since none of the insecticides will provide 100 percent control. Ineffective control also may be encountered when extremely dry conditions prevailing during late June and early July prevent local dispersion of the insecticide. Control with insecticides also may be reduced in spots where water remains standing in a field for extended periods of time.

Control of Adult Beetles

South Dakota State University **DOES NOT** recommend spraying cornfields each year to reduce corn rootworm adults in an attempt to reduce or eliminate next year's larval infestations for a number of reasons: (1) it is ecologically unsound from the standpoint of killing beneficial insects and thus will trigger the development of other insect problems, (2) it adds insecticidal hazard to our honeybee and honey industry and interferes with the proper pollination of our seed crops by killing pollinators, (3) it may lead to development of resistance in our crop-injuring insects to currently used insecticides, and (4) methods for adult corn rootworm surveillance have not been perfected regarding counting techniques and timing of the spray application. Beetle populations must be kept at one beetle per plant or less during the summer and fall.

Where adult beetles are interfering with pollination, begin adult control measures before silks are damaged to the point where less than ½ inch of the silk is protruding from the tip of the ear and while viable pollen is available in the field. Apply insecticides for adult control before 25 percent of the plants in the field are in silk.

Insecticides recommended for adult control to protect silks during pollination are listed in Tables 2 and 3. Aircraft used for application of ultra-low-volume malathion must be properly equipped and calibrated to disperse the insecticide accurately. **Ethyl and methyl parathion, EPN and Di-Syston are recommended for use by experienced aerial applicators only, who have the necessary safety equipment.** Farmers should not use these toxic sprays in ground equipment. Post warning signs on fields treated with these insecticides. Observe label intervals before entering fields treated with ethyl or methyl parathion, EPN or Di-Syston.

Table 2. Adult corn rootworm insecticides for use either by high-clearance ground equipment or aerial applicators.

Insecticide	Actual Insecticide Rate/Acre	Interval Before Harvest or Ensilage
Malathion	1.0 lb (1¾ pints 57% emulsifiable concentrate)	5 days
Carbaryl (Sevin)	1.0 lb (1.25 lbs 80% sprayable)	0 days

Table 3. Insecticides recommended for use by experienced aerial applicators only for adult corn rootworm control.

Insecticide	Actual Insecticide Rate/Acre	Interval Before Harvest or Ensilage
Malathion (ultra-low-volume concentrate)	4 ozs.	5 days
Ethyl parathion	4 ozs.	12 days
Methyl parathion	4 ozs.	12 days
EPN	4 ozs.	14 days
Di-Syston	8 ozs.	28 days

Figure 3. Untreated corn field in Moody County totally destroyed by western corn rootworm, late August 1970.

CAUTION. Insecticides are poisonous—handle and store them with care. Be sure to read the label and follow directions to the letter. Keep children and pets out of the area where chemicals are stored, mixed, or used. Don't contaminate feed, feed containers, or water troughs. Clean all contaminated planting equipment carefully. Destroy all emptied containers so they cannot be reused for ANY purpose.

CAUTION: POISON

All insecticides used for rootworm control are poisonous both to man and animals. This is especially true of most organic phosphate and carbamate formulations. They are safe to use in granular form when all safety precautions prescribed on the labels are followed strictly.

All insecticides recommended for corn rootworm control are toxic and, therefore, dangerous when not handled according to directions.

The first rule in working with any of these materials is to read the label until it is understood completely. Second, follow the manufacturer's safety precautions to the letter.

Wear protective equipment when opening containers and filling insecticide hoppers—rubber gloves, long-sleeved shirt or coveralls, goggles, hat, and a proper respirator if working in the wind.

Remove protective clothing as soon as possible after use. If any insecticide is spilled accidentally on clothing or parts of the body, remove clothing and wash any parts of the body that the insecticide may have contacted.

Always stand upwind and away from the insecticide hoppers when filling. Never breathe dust or fumes. Do not haul containers in your automobile since fumes often are inhaled. Store all insecticides or contaminated equipment away from children and pets. Be sure to burn containers immediately after they are emptied. Bury unused or spilled granules.

Never attempt to sift or break-up lumpy, granular insecticides — the personal hazard is too great! If you find lumps or excessive amounts of fine powder in the granular formulation, return the insecticide to your dealer for replacement or refund.

If there is any chance you may have been poisoned accidentally, consult your doctor. Insecticides can gain entry into a human body in a number of ways—absorption through the skin; inhalation of vapors, fumes, or dust; smoking while hands or face are contaminated with dust; or entry into the eyes.

Take all precautions to avoid accidental poisoning.

In case of ACCIDENTAL POISONING contact:

Sioux Falls: (Treatment and Information)
Poison Control Center
McKennan Hospital
800 East 21st Street
Sioux Falls, S.D. 57101
Phone: 605-336-3894

Aberdeen: (Treatment and Information)
St. Luke's Hospital
305 South State Street
Aberdeen, S.D. 57401
Phone: 605-225-5110

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Hollis D. Hall, Director of Extension Service, South Dakota State University, Brookings. South Dakota Cooperative Extension Service offers educational programs and materials to all people without regard to age, race, color, religion, sex, handicap or national origin, and is an Equal Opportunity Employer. (Male/Female)

File: 9.12—5,000 printed at estimated cost of 8 cents each—fjs—11-76—7105

FS 491
(Revised for 1977)

Corn Rootworm Control in South Dakota

1977

Corn rootworms: western, top; northern, center; southern, bottom.

Cooperative Extension Service
South Dakota State University, Brookings
U. S. Department of Agriculture