Corn Rootworm Control in South Dakota with Notes on Wireworm and Cutworm Control

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**Precautions**

Insecticides are poisonous; handle and store them with care. Be sure to read the label and follow the directions. Keep children and pets out of the area where chemicals are stored, mixed, or used.

Do not contaminate feed, feed containers, or water troughs. Carefully clean all contaminated planting equipment. Destroy all emptied containers so they cannot be used for any purpose.

Use of trade name does not imply endorsement of one brand over another.
Corn Rootworm Control in South Dakota
with Notes on Wireworm and Cutworm Control

Resistant strains of the western corn rootworm have caused a serious insect problem in South Dakota. The western, northern, and southern species have been present for a number of years. However, the first evidence of resistant strains of western corn rootworms in South Dakota was observed in 1962.

Treatment failures using aldrin and heptachlor, later checked by laboratory tests on adult beetles, indicated that the western corn rootworm population in Lincoln County was becoming resistant. Populations became well established during the 1963 growing season so that the southern and western areas of the state are now infested with resistant strains (see figure 4). 

Adult specimens of the western corn rootworm have been collected as far north as the North Dakota border, but populations in the more northern counties are at low levels at present.

LIFE CYCLE OF THE CORN ROOTWORM

Adult 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 the eggs during late summer and fall. Most eggs are found in the first 6 inches of soil, though they have been found from one-half to 15 inches deep. The life cycle of the western corn rootworm is shown in (figure 3).

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 (see figure 1).

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

Following pupation in the soil, the western corn rootworm adults start 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.
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 the spring. There may be several generations of this insect a year. This species has been found to attack sorghum in Nebraska. Serious economic populations of southern corn rootworm have not been encountered on sorghum in South Dakota.

**LARVAL DAMAGE**

Root injury results from larval feeding, with the smaller roots often completely consumed and the larger roots severely tunneled (see figure 2.). Disease organisms often follow injury by rootworm larvae causing further destruction of the root system. The most severe injury usually occurs during the latter part of June and the first 3 weeks in July. Often the entire root system is destroyed.

Losses resulting from a rootworm infestation may range from a light yield reduction to the total loss of the crop, depending on a number of factors. Among these factors are the 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 lacking during the period of maximum worm feeding. Under these conditions it is hard for the plants to grow new roots. Infested fields often become severely lodged, making mechanical harvesting operations difficult.

**POLLINATION AFFECTED BY ADULT BEETLES**

Adult beetles, upon emergence from the soil, prefer to feed on corn silks, however, they also feed on leaves and pollen of corn. When large numbers of beetles are present during the pollination period, poorly filled ears often result. Fields with late silking plants are usually 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. Do not apply insecticide control for this purpose until the bulk of the plants in the field are in silk.

**CONTROL MEASURES FOR LARVAL POPULATIONS**

Cultural practices that promote good root systems will help reduce yield loss and lodging. Plant as early as feasible, as 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. Thus, 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. If corn is not planted the following year in these fields the larvae will perish after hatching.

Although the western corn rootworm has not been successfully controlled by crop rotation in areas where western adult populations are at a high level, evidence indicates that this practice will reduce western corn rootworm numbers. This reduction in turn will aid in obtaining a better degree of control with the chemical treatments applied properly and at the right time.

There is not sufficient data available on the effect of fall tillage versus spring tillage, diskling versus plowing, etc. and their subsequent effects on rootworm infestations. However any tillage methods which improve the seed bed and promote good root development are recommended. Do not drag treated fields crosswise or diagonally as this will displace the chemicals in the treatment band.
CONTROL OF RESISTANT LARVAL POPULATIONS

On the basis of performance, in research experiments in South Dakota State University test plots, the insecticides recommended in 1966 for control of resistant rootworms are thimet (phorate), stabilized ethyl parathion (Niran, Stathion) and diazinon.\(^1\)

In areas where populations are mixed with northern corn rootworms being susceptible to aldrin and heptachlor and the resistant western species, or in fields which have a history of other soil insect problems, such as cutworm and wireworm, combination products are recommended. Two combinations currently registered for use are aldrin plus ethyl parathion (aldrex) and heptachlor plus ethyl-parathion (para-hep). These combination treatments should be applied using at least one pound actual of each insecticide as a band treatment.

Other experimental organic phosphate and carbamates have been tested in South Dakota by the experiment station. It is possible that several of these formulations may be registered for use in 1966. Check with your extension entomologist or county agent on the efficacy data of new materials.

\(^1\)The only stabilized parathion that has been tested against the western corn rootworm in South Dakota research plots were Niran 10G and Stathion 10G.

Table 1. Summary Recommendations for Selecting Insecticide Formulations to Fit Cropping Conditions

<table>
<thead>
<tr>
<th>Cropping history</th>
<th>Insect condition</th>
<th>Insecticide recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn after corn</td>
<td>No history of cutworm or wireworm injury or</td>
<td>Organic phosphate insecticide only. 1.0 lb.</td>
</tr>
<tr>
<td></td>
<td>other soil insects</td>
<td>actual or 10 lbs. 10% granules</td>
</tr>
<tr>
<td>Corn after corn</td>
<td>Cutworm or wireworm history or mixed</td>
<td>Organic phosphate insecticide plus aldrin or</td>
</tr>
<tr>
<td></td>
<td>rootworm population of northern and</td>
<td>heptachlor. Use at least 1.0 actual of each</td>
</tr>
<tr>
<td></td>
<td>western species</td>
<td>insecticide. 10 lbs. of a 10-10 formulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>as a band or 2.0 lbs. broadcast prior to</td>
</tr>
<tr>
<td></td>
<td></td>
<td>planting.</td>
</tr>
<tr>
<td>Corn, following legume,</td>
<td>Cutworm and wireworms expected</td>
<td>Broadcast treatment of aldrin or heptachlor</td>
</tr>
<tr>
<td>sod, soilbank or others</td>
<td></td>
<td>at 2.0 pounds actual insecticide per acre</td>
</tr>
<tr>
<td>diverted acres</td>
<td></td>
<td>disked into the soil before planting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>followed by an organic phosphate insecticide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>application at planting time.</td>
</tr>
</tbody>
</table>

Where wireworm or cutworm control is desired a broadcast treatment of either 2.0 lbs. of aldrin or heptachlor per acre applied prior to planting time and disked into the soil, probably will be more effective than a band treatment at planting time.
Di-Syston is a federally labelled product that is available on the retail market; carbaryl (Sevin) may also be registered for corn rootworm control by the spring of 1966. Neither of these two mentioned products are being recommended for corn rootworm control in South Dakota because sufficient research efficacy data are lacking in South Dakota.

Organic phosphate insecticides mixed with fertilizers are on the market, but are not recommended under any circumstances for rootworm control in South Dakota.

Performance data obtained in South Dakota using recommended materials will be available to farmers at the local county agent's office or through the office of the extension entomologist.

Use of aldrin or heptachlor for corn rootworm control is no longer recommended in areas shaded in Figure 1. In the remainder of the counties western populations are not as well established and the northern corn rootworm species is predominate. Aldrin and heptachlor treatments in this area are still recommended for 1966. There may be a few fields in the unshaded area (figure 1), where resistant western corn rootworm were noted in 1965. In that case, use the organic phosphate insecticides or aldrin or heptachlor combined with an organic phosphate insecticide.

**APPLICATION**

Western corn rootworm has seriously infested first year corn on fields previously planted in small grain, legumes, sorghum etc. in South Dakota. Thus, it is recommended that in areas where western corn rootworm populations are high that first year corn be treated with an organic phosphate insecticide.

### Organic Phosphates

The three organic phosphates are suggested for application in granular form only and are to be applied with one of the granular applicators. Apply in 4- to 7-inch bands over the rows (not with the seed) at planting time and incorporate the insecticide into the upper one-half inch of the soil. This can be accomplished by making the granule application in front of the press wheels, covering disks, or by dragging chains behind the planter.

It is of extreme importance that at least 1 pound of active ingredient (10 pounds of 10% granules or 7 pounds of 14% granules) be applied in this manner per acre of field. Take care not to exceed this dosage, as this increases the expense of the treatments. Therefore, carefully calibrate the application equipment to obtain the right dosage.

These insecticides can also be applied as side-dressing treatments at first or second cultivation. Special attachments for the cultivator can be purchased or constructed. Use 1 pound active ingredient per acre. Apply at the base of the plants and cultivate immediately to incorporate the insecticide into the soil.

Emergency treatments have also been applied at lay-by time using high clearance machines to place the insecticide at the base of the plants; disk hillers can be used on a cultivator to incorporate the insecticide into the soil.

Rootworms will still be present in treated fields, particularly outside the treatment band, as none of the insecticides will provide 100% control. Ineffective control may also be encountered when extremely dry conditions prevail during late June and early July. Treatments applied at planting time may be more effective than later treatments under very dry conditions. Also, timing of later treatments is very critical. Control with organic phosphates may also be reduced in spots where water remains standing for periods in a field.

Recommended applications are based on 40-inch row spacings and narrower spacings require a proportionately higher rate. Basically, apply 10 pounds of 10% granules for every 13,080 linear feet of row.

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**Figure 4. Corn Rootworm outlook for 1966.**

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**AREAS WHERE ORGANIC PHOSPHATE INSECTICIDES ARE RECOMMENDED FOR CONTROL OF CORN ROOTWORM IN '66**
Chlorinated Hydrocarbons

(Northern corn rootworm), apply aldrin or heptachlor as a soil treatment in the nonresistant areas when preparing the soil for planting operations. Two general methods of applying the insecticides are broadcast or a row treatment. No special equipment is required for broadcast treatments since a sprayer or fertilizer spreader can be used. Row treatments require only one-half the insecticide needed for broadcast applications. This is a decided advantage where large acreages are involved. Row applications call for a granular attachment to the planter or a planter mounted sprayer.

Broadcast Treatment (Northern Corn Rootworm)

For the broadcast method, use a pound of actual insecticide per acre, either aldrin or heptachlor—5 pounds of 20% granules per acre, or one-half gallon of an emulsifiable concentrate containing 2 pounds of ingredient per gallon with sufficient amount of water. For cutworm or wireworm control this dosage should be doubled (2.0 lbs. actual per acre).

For best results, work broadcast application into the soil by disking rather than plowing, due to the danger of embedding the insecticide too deep. However, granular formations have been plowed under and fair control was obtained. Work broadcast applications, especially sprays, into the soil as soon as possible, otherwise the effectiveness of the chemical is reduced.

Broadcast applications are not recommended for listed corn.

Row Treatments

On row treatments apply one-half pound of actual aldrin or heptachlor per acre (2½ pounds of 20% granules per acre or 1 quart of the 2-pound-per-gallon emulsion with sufficient water per acre). In areas where wireworm or cutworm control is desired this dosage should be doubled (1.0 lb. actual per acre). Row treatments of aldrin or heptachlor will probably not be as effective as broadcast treatments for cutworm and wireworm control.

When using the sprayer on the planter for row treatments, place the spray nozzle in each planter shoe to spray a band on the soil as it falls over the seed. In the case of listed corn, spray this band behind the moldboard, but ahead of the packing wheels. It should be at least 2 to 4 inches wide.

Granular fertilizer-insecticide mixtures are not recommended for row treatments where placement is at one side and below the level of the seed. For best results, the insecticide needs to be slightly above the seed.

Calibrate the granular applicator with calibrating devices provided by the machine manufacturer or by catching and weighing the granules delivered over a measured distance of the field. Remember that the right amount properly applied is just as important as the insecticide being used. Keep tubes that deliver the granules from the hoppers as straight as possible to avoid hindering the flow of granules.

ADULT BEETLE CONTROL

As the adult beetles emerge they seek attractive plants on which to feed. With corn silks and pollen among their favorite diets, feeding damage on the silks sometimes interferes with proper pollination. Adult control measures are suggested only where interference with pollination appears likely, as they are not considered practical for reducing the following year’s infestation. Take control measures before the silks are damaged (to where less than one-half an inch of the silk is protruding from the tip of the ear, and while viable pollen is available in the field.)

Insecticides available for farmer use for control of adults are malathion, 1 pound active ingredient per acre; diazinon, 8 ounces active ingredient per acre; and Sevin, 1 pound active ingredient per acre. Fields treated with any of these materials can be ensiled or pastured as long as the intervals between treatment and feeding to livestock are observed. These intervals are clearly stated on the insecticide label. Low-volume malathion concentrate at the rate of 4 ounces per acre, is recommended for adult control by aerial applicators equipped for low-volume application. Follow label instructions with this material.

Experienced aerial applicators may use more toxic materials such as liquid sprays of ethyl parathion or methyl parathion. Farmers should never use these toxic liquid sprays.

CAUTION—POISON

All of these insecticides used for rootworm control are poisonous to both man and insects. This is especially true of the organic phosphate insecticides suggested in this fact sheet. They are safe to use in liquid form when all safety precautions prescribed on the labels are strictly followed.

Thimet, parathion, and Di-Syston are extremely toxic, while diazinon is somewhat less toxic. All of these materials are extremely 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 completely understood. Secondly, follow to the letter the manufacturer’s directions on safety precautions.

Wear protective equipment when opening containers and filling insecticide hoppers—rubber gloves, long-sleeved shirt or coveralls, goggles, hat, and a proper respirator when working in the wind.
Remove protective clothing as soon as possible after use. If any insecticide is accidentally spilled on clothing or parts of the body, remove such contaminated 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. Never haul containers in your automobile as fumes are often inhaled. Store all insecticides or contaminated equipment away from children or pets. Be sure to burn containers immediately after they are emptied and bury unused or spilled granules. Never attempt to sift or break up lumpy granular insecticides. The personal hazard is to great! If you find lumps or excessive amounts of very fine powder in the granular formulation you purchased, return it to your dealer and ask for a refund of the purchase price or replacement with a quality product.

If there is any chance that you may have been accidentally poisoned, consult your local doctor. These insecticides can gain entry into a human body in a number of ways—absorption through the skin, inhalation of vapors, breathing fumes or dust, smoking while hands or face are contaminated with dust, entrance into the eyes. Take all precautions to avoid accidental poisoning.