

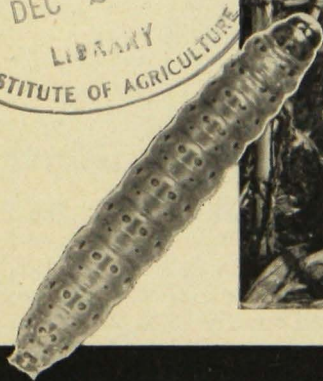
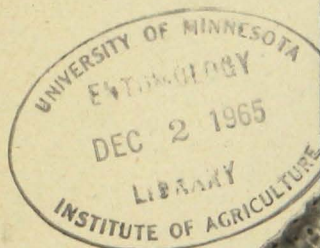
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Fighting the **EUROPEAN CORN BORER IN MINNESOTA**

H. E. Milliron

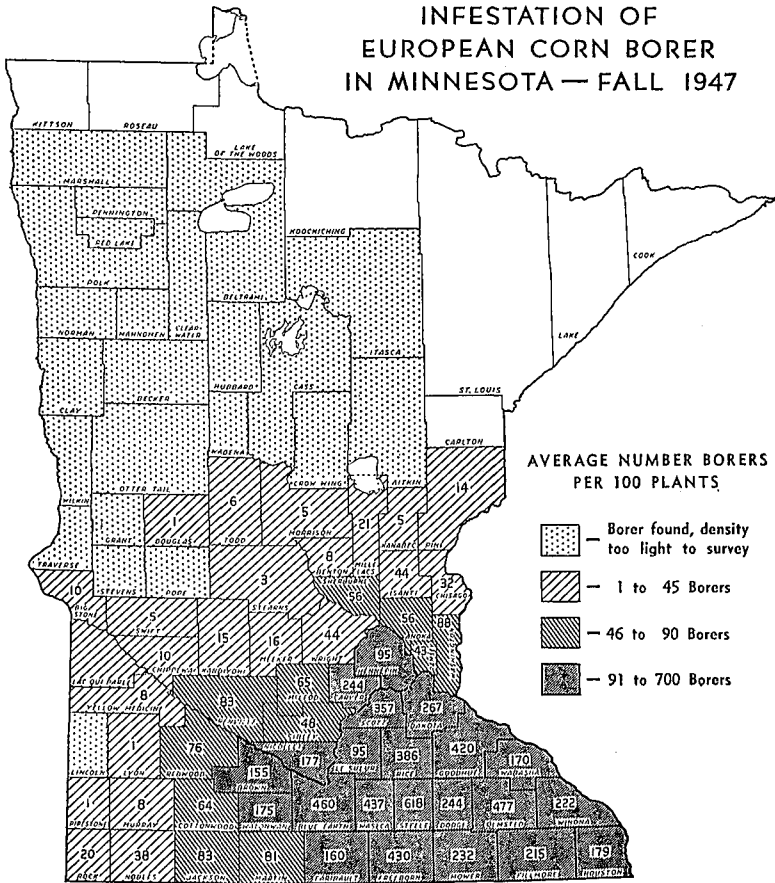
A. W. Buzicky



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UNIVERSITY OF MINNESOTA
Agricultural Extension Service
U. S. DEPARTMENT OF AGRICULTURE

INFESTATION OF EUROPEAN CORN BORER IN MINNESOTA — FALL 1947



When Is There Danger of Damage?

In areas where borers average more than 100 per 100 stalks, the infestation may be very severe. In areas where they average from 10 to 100 per 100 stalks, infestation is liable to be severe. Counties with less than 10 borers per 100 stalks may have some damage. The corn borer moth can fly 25 to 50 miles, so an area adjacent to a heavy infestation could be heavily infested in another year.

Fighting the European Corn Borer in Minnesota

by H. E. Milliron¹ and A. W. Buzicky²

A FEW YEARS ago the European corn borer was nothing more than a curiosity in Minnesota. Today it is a great menace facing corn production. First found in Houston County only five years ago, in 1943, it has now spread to every corn-growing area in the state.

Losses from the borer threaten to be large unless control steps are taken immediately. In 1947, the total cost to Minnesota farmers was about \$14,000,000 or about 3 per cent for the state as a whole. In many counties the loss was small, but in some it amounted to \$500 per farm. In the future this figure may mount unless control measures are adopted.

The borer damages corn in four ways.

1. Newly hatched larvae feed on the young leaves, causing a shot-hole condition.

2. Young larvae tunnel or burrow through the stalk. This tunneling prevents the plant from getting all the food needed for growth and eventually the plant may be so weakened that it breaks over easily. Small circular holes beneath which a sawdust-like material or frass is deposited is a sign that the borer has been working in the stalk. The burrowing often results in nubbins and light, chaffy ears.

3. Larvae may attack the ears themselves.

4. The larvae in burrowing into and through the stalk and ears open avenues of entrance for molds which may cause as much or more damage than the borer itself.

Where borers average three to a plant, field corn yields have been cut 10 per cent. Heavier infestations of 10

to 20 borers per plant have caused complete loss.

Before control can be considered, the borer's habits must be known. It is important, too, to be able to identify the borer in its four stages—egg, larva or borer, pupa or resting, and adult or moth. The larva damages corn leaves, stalks, and ears.

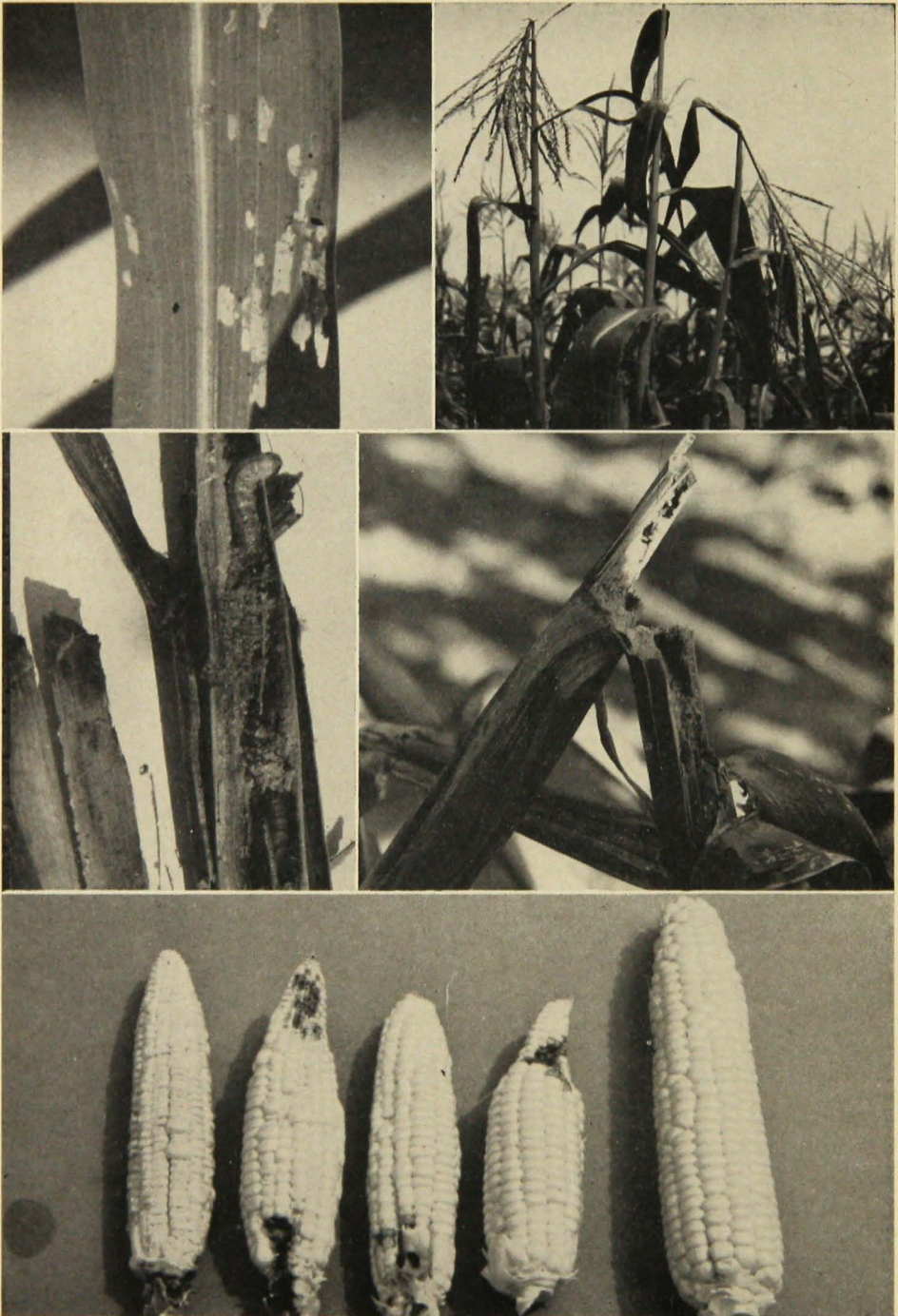
Larva.—The full-grown corn borer larva is about an inch long and about 3/16-inch thick. Its head is a dark brown or black, with the rest of the body usually dirty gray, although it may range from pinkish to light brown. It has rows of small brown spots down its back but no stripes. The borer goes through the winter in this stage.

Pupa.—In late May the larva changes to the pupa. This resting stage lasts about 10 to 14 days. During this time the borer is about one-half to three-quarters inch long, spindle shaped, and a light to dark reddish brown.

Moth.—In late June the moth comes out of its pupal case. Usually tan, the moth may range from light brown to pale yellow. There are zigzag dark

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← DAMAGE DONE BY THE BORER

Upper left: shot-hole condition caused by feeding on leaves; upper right: broken tassels resulting from borer feeding within stalk; center left: tunneling or burrowing within stalk; center right: broken stalk caused by tunneling; bottom: ears attacked directly and nubbins and light, chaffy ears resulting from borer stopping normal development (right ear came from uninfested field).

lines on the outer half of the front wing. It is seldom seen during the day, usually remaining hidden in weeds or grass or, more rarely, on the underside of corn leaves. Ordinarily the moths leave the corn fields at dawn and return after twilight.

Eggs.—The moths mate and lay eggs within two to five days after leaving their pupal case. They lay their eggs at night, usually along the midrib on the underside of the corn leaf, in clusters of 5 to 50 overlapping like fish scales. Each female lays about 400 eggs. The eggs are laid in early July on the most advanced corn in any area.

At first the eggs are milky white. After four to seven days and just before hatching, a black spot develops on each egg. This spot is the head of the young larva showing through.

A single-generation strain of the corn borer is present in Minnesota in small numbers. However, most corn borers in this state produce two generations during the summer and are

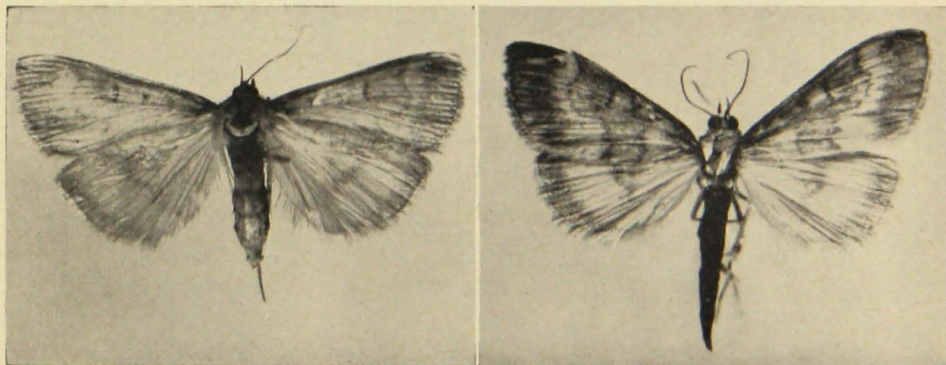
known as the two-generation strain. The majority of the borers produced by moths appearing in June or early July represent the first generation and those developing from moths appearing late in August or early September, the second generation.

How important this life cycle is, especially in chemical control, will be shown later in this bulletin.

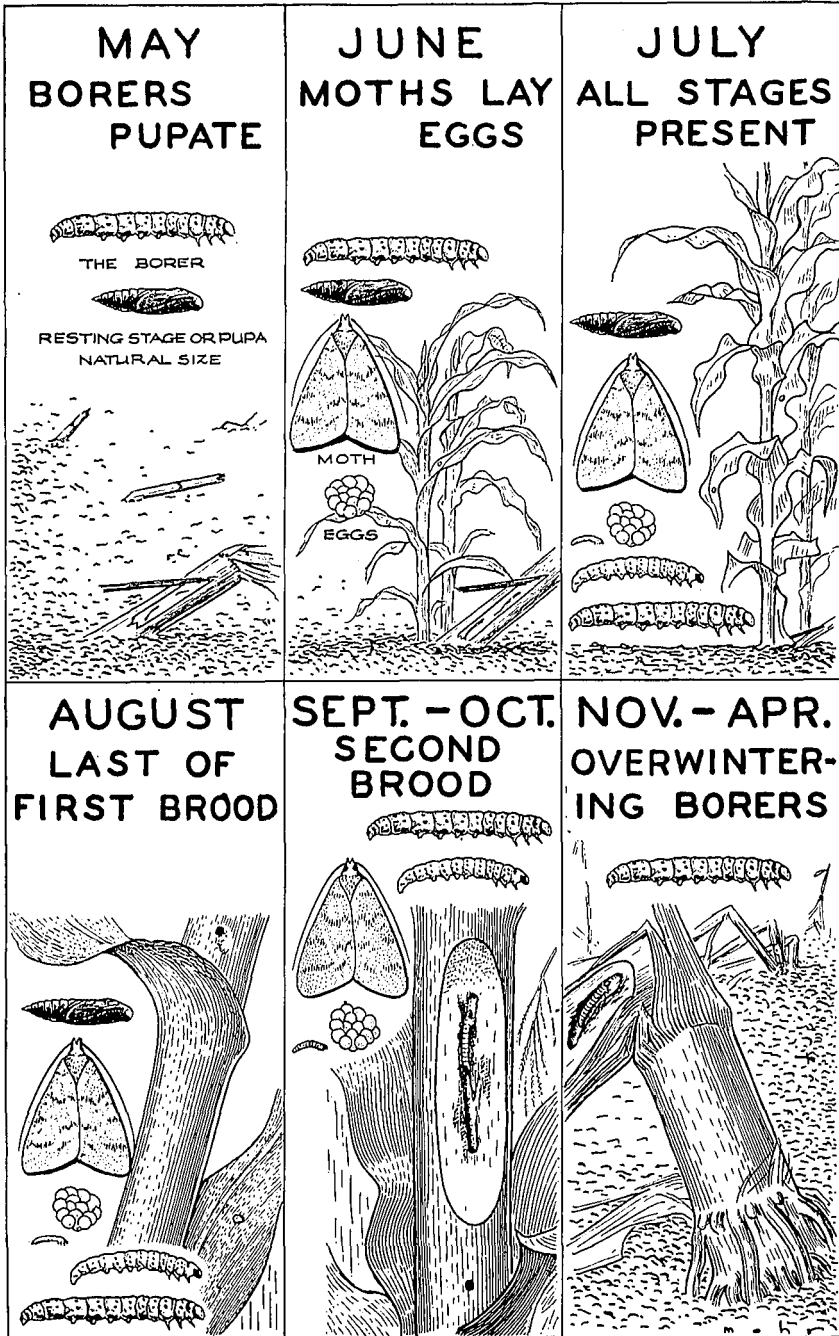
Methods of Control

Controlling the corn borer is not an easy job. The corn borer is here to stay. Laxity in control at any time might mean disastrous losses. On the other hand, a heavy infestation does not necessarily mean that the corn borer will prevent profitable corn production.

In general, there are four control measures and all will have to be used in a complete control program. They include cultural, mechanical, biological, and chemical methods.

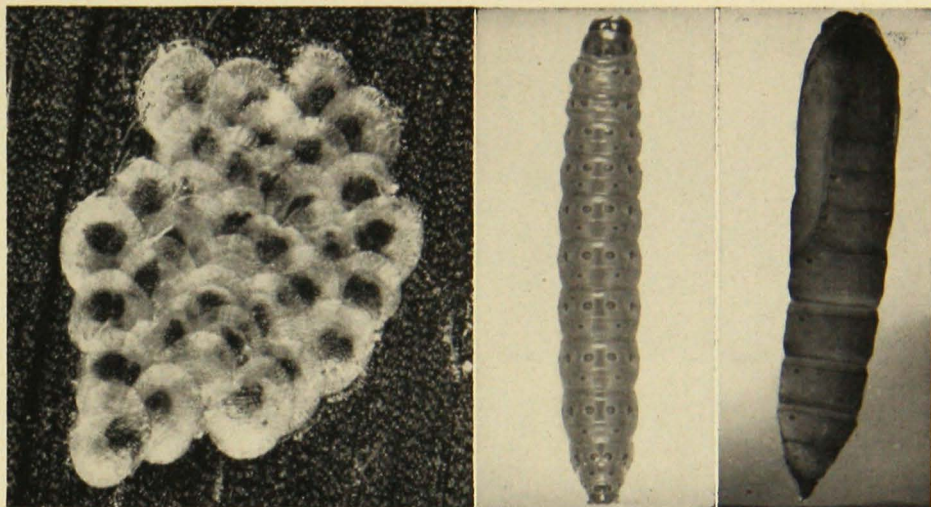


The female, left, and the male moth, right (magnified about twice), have marks distinguishing them from each other and from other moths. Note that the male is darker and has darker zigzag lines.



LIFE HISTORY OF THE EUROPEAN CORN BORER

Modified for Minnesota conditions from Illinois Natural History Survey Publication.



Stages in the borer's life: left, egg; center, larva; and right, pupa.

Clean Plowing Destroys Borer

CLEAN PLOWING is one of the most important measures in corn borer control. The reason that clean plowing is so important lies in the corn borer's life cycle.

The corn borer larva overwinters in corn stalks, stubble, and, to some extent, in coarse-stemmed weeds. Plowing these down cleanly and completely will kill most larvae.

If clean plowing is to be completely effective, every farmer in the community must cooperate. Corn borer moths can fly 25 miles and reinfest cleaned-up areas. Clean plowing, however, will reduce the numbers of corn borers in even a small local area.

Cover Stalks Completely

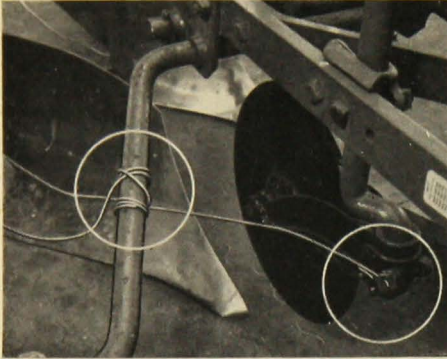
All stalks must be completely covered with soil. Some borers will work themselves up to the top of the ground

and if they have no uncovered stalks to bore into for protection their natural enemies will kill them or they will die from exposure.

Stalks must be buried deep enough, if possible four to six inches, so that they won't be dragged to the surface in disking, seeding, or other field operations.

Fall plowing is most effective, but if impossible because of conservation practices or because crops cannot be harvested in the fall, spring plowing is satisfactory. **Plowing must be finished by the last week in May.**

In hand-picked corn fields it is possible to plow in either direction without previous disking or leveling. In machine-picked fields, plow in the same direction as the picker was driven. Double disking these machine-picked fields before plowing will help cover stalks better.



Attaching a 10- or 12-foot length of No. 9 wire to front of plow and allowing the wire to drag in the furrow helps guide stalks into the furrow.

Moldboard Plow Best

A moldboard plow with a 14- or 16-inch bottom covers trash and stalks the best. A large 16- or 18-inch rolling coulter, either smooth or notched, helps materially in cutting trash and preventing clogging. Jointers of either the moldboard or disk type are essential in good coverage.

A simple, home-made device at-

tached to the coulter shank will help cover the trash and stalks completely. Attach a 10- or 12-foot length of No. 9 wire to front of plow. Allow the other end to drag free in the furrow. The free end is covered and held down by the furrow and guides the stalks down into the furrow. In very trashy fields attach two wires to the shank for each bottom.

Don't Depend on Disking Alone

Disking corn stubble before planting small grains does not destroy the borers within the corn stubble. If winter grains must be sown on unplowed corn land, cutting the corn close to the ground and ensiling the crop or feeding the stalks to livestock in a small yard in such a way that the residue will be thoroughly tramped will help.

Growing a crop after corn that may yield well even though not planted early should be considered. Soybeans is one crop that might be grown on soils not subject to erosion. Special care in packing and firming spring-plowed land will pay well.



A poor job of plowing like this tends to increase the borer population.

Spraying and Dusting Kills Larvae

DURING THE past three years insecticides have definitely proved themselves in corn borer control. DDT sprays and dusts can be applied for \$3.50 to \$5 per acre on a custom basis. With your own equipment this cost may be reduced. Correctly timed, these applications have saved 5 to 15 bushels or more per acre in heavily infested fields.

Proper Timing Essential

Proper timing is essential in chemical control of the borer. Young corn borer larvae are most susceptible to insecticides just after they are hatched and before they have gone into the leaf whorl or into the stalks. Once in the stalks the borer is relatively safe from insecticides.

Larger larvae do leave the stalk for other parts of the plant occasionally, but they are more difficult to kill than in earlier stages. For best control there should be a layer of insecticide on the leaves while the larvae are hatching and before they reach the protective leaf sheath. It is not necessary to direct the spray or dust to the underside of the leaves.

When to Count Egg Masses

The height of the corn indicates when a count of egg masses should be made.

Start checking for the egg masses when the corn is from 15 to 18 inches high (normal, not extended leaf height). The grower himself must make these observations. In addition, state entomologists, county agents, and other agencies will watch the situation care-

fully and make recommendations when to spray.

Apply spray or dust if there are 50 egg masses per 100 plants (25 for sweet corn) at the beginning of the egg-laying period. The application should be made when the black spots, explained earlier, appear on the eggs.

It is recommended that one or two applications be made on field corn and from one to four on sweet corn and hybrid seed corn. The added applications for sweet corn may be required because more complete control is necessary.

The number of applications depends on the period of time over which hatching is spread. If it extends over only a short time, 10 days or two weeks, a single application may do the job. If egg hatching extends over several weeks, however, more than one treatment is necessary. Growth of new leaves and the effect of weather and sun reduce the efficiency of the layer of insecticide and make new applications necessary at approximately weekly intervals.

Insecticides are applied in late June and early July to control the first-generation borer in corn. Second-generation borers are not as big a problem except in sweet corn.

Number of Applications

Field corn—If 50 egg masses are found on 100 plants of field corn (25 for sweet corn), the applications should be considered.

If you feel that you can afford only one application, it should be made 7 to 10 days after first hatch. Ordinarily

this is when the corn is 24-30 inches high. Actually, when the egg hatch is concentrated over a short period, this is all that is needed. If, however, the hatch is not concentrated, one application will still give fair to good control.

If more complete control is desired, make the first application 3-5 days after the first hatch. This usually is when the corn is 22-26 inches tall. Make a second application 7-8 days later.

On sweet corn and hybrid seed corn, three or four applications may be necessary to secure satisfactory control. The first should be made 1-3 days after the first hatch and then applications should be repeated at 5-7 day intervals.

What to Apply

DDT and Ryania are the best and most economical insecticides to use in corn borer control at the present time. They can be applied either as dusts or as sprays, depending on available equipment. The various applications include:

5 per cent DDT dust—This is the easiest to apply and the most widely used insecticide. Apply 35 pounds per acre for each application.

37 per cent Ryania—Apply 40 pounds per acre.

25 per cent DDT emulsion—Apply 2 quarts per acre. Dilute this DDT emulsion with water. The amount of water used will depend on the capacity of the sprayer. If a low-gallonage weed sprayer is used, regulate it to put out as much water as possible up to 50 or 75 gallons per acre.

If the 25 per cent DDT emulsion is to be applied with a converted weed sprayer, be sure to get assurance from the dealer that the solvent used in the emulsion is nontoxic and will not injure plants if applied in strengths over 5 per cent.

50 per cent DDT wettable powder—Apply 3 pounds per 100 gallons of water per acre for best results. Using this dilute spray at about 100 pounds per square inch pressure has proved the most satisfactory way of applying the wettable powder.

Never use wettable powders in a sprayer that does not have an agitation device. Fine-spray nozzles may also clog frequently if the material is not thoroughly broken up and agitated.

Pure ground Ryania—Apply 4 pounds per 100 gallons of water per acre.

How to Apply

In general, ground-spray machines give best results. Ground dusters rank second and airplanes third. However, the differences are so slight that equipment most readily available should be used.

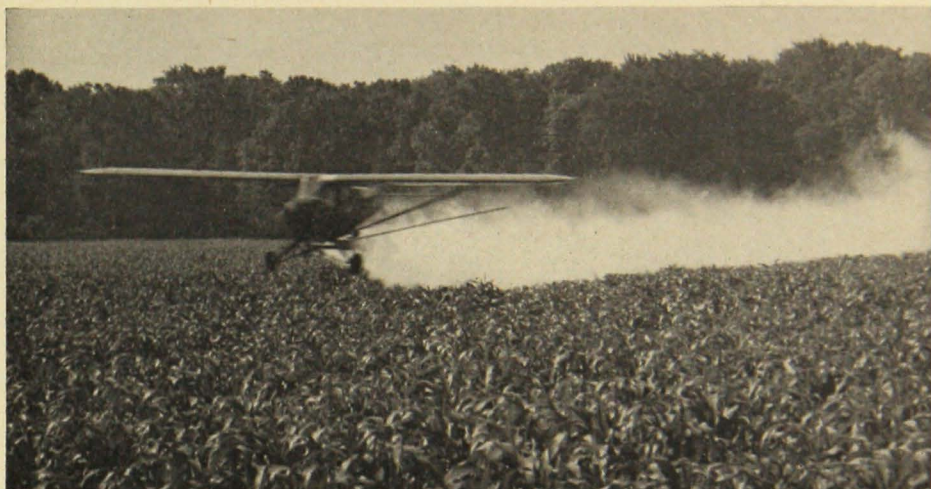
Spray machines for corn borer control should have a boom with two or three solid cone nozzles per row. Adjust these so that a drenching application can be made to the upper leafy portions of the plants.

Row-crop sprayers developing pressures from 35 to 100 pounds per square inch give the best results. They drive the spray into crevices where the borer likes to hide.

Low-gallonage weed sprayers can be adapted for corn borer control. Replace the boom with nozzles arranged for row-crop spraying. Replace the weedicide nozzles with a cone-shaped nozzle giving a coarser spray.

Use only a 25 per cent DDT emulsion in this low-gallonage type of sprayer.

Crop dusters, especially row-crop dusters, can be easily adapted with two dust nozzles per row so as to cover corn plants thoroughly. The machine should have a gauge so that the dust output of the apparatus can be adjusted.



Airplane dusting aids in the control of the borer.

Tractor-drawn or mounted dusting and spraying machinery can be used up to the time the corn is 30 to 35 inches high. This equipment ordinarily will not break down the corn, especially if application is made on a warm evening.

Airplanes are most effective where large areas have to be covered in a short time or during wet seasons. They are also effective for late August application to control the second-generation borer in sweet corn.

Sweet Corn Control Different

Because two generations of borers are present in Minnesota, sweet corn presents a slightly different problem than field corn. Because of differences in application dates and growth rates between sweet and field corn, applications of insecticides must be repeated every five or six days rather than seven to 10 as for field corn.

In addition, sweet corn must be treated late in the season because of the heavy damage from second-generation borers. Here the airplane is effective in avoiding breakage. Timing of this application is governed by egg-mass counts and condition of eggs. The applications are the same as for field corn.

Warning: The University of Minnesota Agricultural Experiment Station recommends that stalks treated with DDT not be fed dairy and beef cattle. DDT accumulates in the fatty tissues of the animal and in the butterfat of milk. How much DDT in butterfat is necessary to make a hazard to humans is not yet known. Until further research answers this question it can be only recommended that DDT-treated crop residues not be fed to beef or dairy stock.



Other Control Measures

MECHANICAL CONTROL

There are several mechanical devices that will help in controlling the borer.

Stalk choppers are useful in chopping up long corn stalks to make clean plowing easier. Many borers are killed directly by the revolving blades.

Crushing devices attached to the corn picker are on the market. These crush stalks after the corn has been picked and destroy up to 99 per cent of the worms.

Field ensilage harvesters and hammer and roughage mills are important in corn borer control. The few borers that escape the cutter blades and the hammers perish when the fodder is stored.

Feed Lots Source of Infestation

Feed lots become sources of corn borer infestation if stalks are not disposed of in some way. If the stalks have not been completely trampled into the mud or manure, gather and destroy them before moths emerge. Haul the stalks into the field and plow completely under before the last week of May.

Burning corn borer stalks destroys valuable organic matter that should be returned to the soil. Burning should be used only as a last resort to destroy small amounts of stalks and weeds.

Several pictures have been published by courtesy of the U.S.D.A. Bureau of Entomology and Plant Quarantine, European Corn Borer Research Laboratory, Toledo, Ohio.

OTHER MEASURES

There are other controls that do not rest in the farmer's hands. The State Department of Agriculture, United States Department of Agriculture, and University of Minnesota Agricultural Experiment Station are working on two of these controls:

1. **Introduction of parasites** that are the natural enemy of the borer. Some have already been released in Minnesota, but further studies are needed to find the most effective parasite. However, introduction of parasites will only give partial control. Even when completely developed, cultural, mechanical, and chemical measures must also be relied upon.
2. **Development of hybrid varieties** tolerant to the borer. Extensive experiments are now being made by the University of Minnesota Agricultural Experiment Station and the United States Department of Agriculture, and a number of lines have been developed which show tolerance to the borer. However, it will take several years to develop these to a point where they can be released to growers.

Hybrid corn, in general, stands up better to corn borer attack than open-pollinated field corn. Hybrid varieties which are well adapted in maturity, which possess desirable stalk characteristics, and which are best suited to each grower's locality should be used.

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