Controlling CORN BORERS in FIELD CORN with Insecticides

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To Get Both Good and Profitable Control

- Time treatments right. Timing is the most important feature of successful use of insecticides. For first-generation control, make treatments when the tassel ratio is between 30 and 50 (see pages 2-4) if 75 percent or more of the plants show fresh feeding in the whorls.
- Make ground applications of 12 pounds of 5-percent DDT granules to the acre or spray with 1½ pounds of DDT to the acre. Make airplane applications of 20 pounds of DDT granules. Applications of granules from the air give as good control as ground treatments.
- Treat fields for second-generation borers if there are one or more egg masses per plant.

CIRCULAR 768

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EUROPEAN CORN BORER, which first appeared in Illinois in 1939, has become one of the most important insects attacking field corn. Although this pest is found in all parts of the state, it is most destructive in the northern half. Up to the present, however, it has never completely ruined a planting of field corn in this state, but the extent to which it reduces yields can be measured every year.

This circular tells how to control borers with insecticides and tells of farmers' results with insecticides during a five-year period. Control by means of insecticides, however, is only one of several control measures in a well-rounded borer-control program. (For more detailed information concerning other control measures and the life history of corn borers, see Illinois Circular 637.) A well-rounded program includes disposing of old stalks properly, using adapted hybrids, and observing adjusted planting dates.

Insecticides will not eliminate borers in a field, but they do provide practical control. Use them only when it appears that the savings in yield will more than pay for cost of the chemical and application.

TREATING FIELD CORN FOR BORERS PAYS

For five years, farmers made $3 for every $1 they spent for borer control. Treatments saved an average of a little over 7 bushels of corn an acre, or almost 7½ percent of their total yields. These are the findings of a team of entomologists who kept careful records on a total of 83 farmer's fields in the northern half of the state. The records were for 1947-1950 and 1956.

Borer counts showed that the average number of borers in the untreated parts of the fields was three times that in the treated parts. For this five-year period, the treatments gave an average control of more than 68 percent. Each year counts were made, the percentage of farm control increased. The reason for this increase is farmers are timing treatments better. As an example, in 1956 a random sampling of 15 fields showed that overall control averaged 81 percent, but counts made in 13 fields on which treatments were properly timed showed control averaged 90 percent. Thus farmers can do a still better job, and some are.

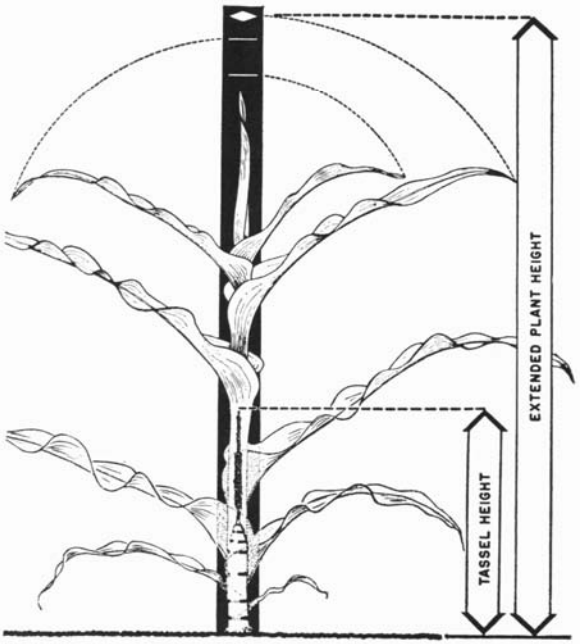
WHEN TO TREAT

The mortality rate of borers hatched out on small, young corn plants is very high. The closer the stalk is to coming into tassel, the higher the number of borers that live. The reason for this difference in mortality is due to morphological and chemical changes within the corn plant. For practical purposes, therefore, newly hatched bor-

ers on young corn can be ignored. But in later stages of plant development, every egg mass on a plant is important. Farmers will need to consider these facts when evaluating the need for control.

To help farmers decide what fields to treat and when to time the treatment, Illinois entomologists developed a simple and accurate method of measuring the development of the corn plant in relation to survival of borers. This method is based on the growth of the tassel and is called the tassel-ratio index.

This ratio compares the height of the developing tassel inside the plant to the extended height of the plant. To get the ratio, cut the stalk off at the base where the main roots join the stalk. Measure the stalk from the base to the tip of the longest leaf when it is extended upward. (See Fig.) Then slit the plant lengthwise to expose the developing tassel and measure from the base of the stalk to the very tip of the tassel. Now divide the height of the tassel by the height of the plant and multiply by 100. The answer is the tassel ratio. For



Broken line (*top*) **shows height of plant when longest leaf is pulled upward. To get plant height, measure from base of stalk to tip of longest leaf when pulled upward. Broken line** (*bottom*) **shows tassel height. To get this height, slit the stalk lengthwise and measure as shown.**

example, suppose the height of the plant is 50 inches and the height of the tassel is 15 inches. Fifteen divided by 50 is .3 and when multiplied by 100 gives a tassel ratio of 30.

$$\frac{15 \text{ inches}}{50 \text{ inches}} = .3 \qquad .3 \times 100 = 30$$

All the plants in a field will not have the same tassel ratio at the same time. However, taking the average of 5 to 10 representative plants gives a very accurate index.[1]

A corn plant does not have a measurable tassel for the first 30 days of growth. After this time, the tassel begins to grow and increases in length as it moves up the center of the plant. Very few borers hatching from eggs laid on corn with a tassel ratio of 0 to 20 will live. The number that survive increases from ratio 20 to 60 when most of the borers are feeding in the whorl of the plant. Fifty egg masses per 100 plants on corn with a ratio of 30 will produce many more borers than 500 egg masses per 100 plants on corn with a ratio of 3. Depending on the variety and soil fertility, tassels begin to emerge in field corn at ratio 60 to 75. By this time many of the borers are large and have already left the whorl to feed in the stalk. This is why treatments applied before a tassel ratio of 20 or after 60 are comparatively ineffective in Illinois.

Field corn needs to be treated only once for first-generation borers if the application is properly timed. Apply the insecticide sometime between tassel ratio 30 and 50. If tractor-mounted pull-type units are used, delay treatment as long as possible. Many tractors can operate without serious damage in fields having ratios up to 35. Treatment by airplane or hi-clearance equipment can be made any time during the period the tassel ratio is 30 to 50. To get the very best control, make applications when the ratio is 40 to 50.

WHAT FIELDS TO TREAT

For first-generation borers. Shortly after first-generation moths appear in the community, begin regular examination of the tallest, most advanced fields. When a field reaches a tassel ratio of 20 or more, examine the plants carefully for leaf feeding. In any field with a tassel ratio of 30 or more, treatment will be justified if 75 percent or more of the plants show fresh leaf feeding in the whorl.

For second-generation borers. Two generations of borers are usually produced each year in Illinois. However, the numbers of the second-generation vary from year to year and depend on the population of the first-generation and the weather. When second-generation borers are abundant, ear droppage can be severe.

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[1] Illinois entomologists are working on an even easier method of timing the application of insecticides based on only one measurement, the developing tassel. As with the tassel-ratio method, split the plant lengthwise, but measure only the length of the developing tassel from its base to its tip. In field corn, a tassel length of 3 to 10 inches is equal to a tassel ratio of 30 to 50. Although this method is not ready for recommendation, some farmers may want to use it.

The tassel ratio cannot be used to time treatments for second-generation borers. The fields most likely to be damaged by second-generation borers are those that are in the pre-tassel through the pollination stages of development at the time the moths are laying eggs. If a field has one or more egg masses per plant, make one application when the first eggs are found hatching.

WHAT INSECTICIDES TO USE

DDT has been more widely used for controlling corn borers than any other insecticide. It is highly effective, easy to get, and relatively inexpensive. It can be applied as a spray, a dust, or as granules. There is little difference between the effectiveness of ground applications of DDT sprays and granules and airplane applications of DDT granules. Air applications of DDT sprays and dusts are less effective than other methods.

Granules, a recent development in the manufacture and formulation of insecticides, look like small grains of sand. They are heavy enough to roll down the corn leaves into the whorl and leaf axils where many of the borers are. Although granular insecticides are attached to many inert materials, clays are the most common carriers. Mixtures of two or more types of clays in the same formulation are not recommended. For airplane and ground application, clay granules have received more testing than other types of granular formulations and appear to be the best types for corn borer control. Particles that will pass through a 30-mesh screen and be held by a 60-mesh have been most widely used.

Recommended DDT formulations and rates of application per acre are given below.

	Application rate of diluted DDT per acre	
	Ground Application	Air Application
Spray, 25 percent emulsion concentrate	3 quarts in 10 to 50 gallons of water	3 quarts in 2 to 3 gallons of water
Granules, 5 percent on clay	12 pounds	20 pounds
Dust, 5 percent	30 pounds	30 pounds

WARNING: Do not use DDT on ensilage corn to be fed to dairy cattle or any livestock being fattened for slaughter. Serious infestations of borers on ensilage corn can be treated with parathion but only by professional applicators with experience in handling parathion. The rate of application is ½ pound to the acre. If para-

thion is used, the tassel ratio should be 40 to 50 when the treatment is made.

Dieldrin at ½ pound, endrin at ⅕ pound, heptachlor at 1 pound, and toxaphene at 2 pounds to the acre, in granular formulation only, give control equal to that of DDT. When the label on the container shows that the above chemicals can be used for corn borer control they may be substituted for DDT.

WHAT KIND OF EQUIPMENT TO USE

For spraying for first-generation borers, standard pull-type, tractor-mounted, or hi-clearance sprayers are effective units. The machine must be equipped with a boom, have three nozzles per row, and be capable of maintaining constant pressure. The pressure used will vary depending on the type of nozzles, the gallons of liquid applied per acre, and the speed of the sprayer, but pressures of 50 to 100 pounds per square inch are satisfactory. Adjust all three nozzles to spray into the whorl and onto the upper third of the corn plant. For best results, operate sprayers at not more than 4 miles an hour.

For spraying for second-generation borers, use hi-clearance sprayers. Direct the nozzles to spray the upper half of the plant including the ear zone. Practically all the eggs that produce second-generation borers are laid on the topmost five to seven leaves.

For applying granules for first-generation borers, pull-type granular applicators, tractor-mounted applicators, and applicators mounted on hi-clearance equipment are suitable.

On single-outlet applicators, adjust the outlet directly over the row. On multi-outlet applicators, plug all the outlets except the two or three directly over each row. The extra outlets can be easily plugged with masking tape. To get the best results, release the granules 8 to 10 inches above the whorl of the plant and don't travel more than 4 miles an hour. Caution: Do not use conventional row-crop dusters for applying granules. They are not suitable.

For applying granules for second-generation borers, units mounted on hi-clearance equipment, such as detasselers, are necessary. With either single or multi-outlet applicators, release the granules directly over the row.

Airplanes appear to be particularly well adapted for applying granules. Aerial application of granules has proved just as effective as ground applications of granules or sprays. Air-seeding devices apply granules better than crop-dusting equipment. However, most conventional crop dusters when equipped with seeder-type gates give

good distribution. Aircraft should fly 35 to 50 feet above the ground. At this height, good coverage can be expected on 11 to 15 rows of corn, depending on the equipment.

When spraying or dusting by airplane, the width of the swath may vary with the kind of equipment used, but it should not be wider than the wing span. Planes should fly 4 to 6 feet above the corn.

FACTS AND FIGURES ON FARMERS' RESULTS

In the 83 farmers' fields mentioned earlier in the circular, the farmer himself decided when and how to treat and made the treatment. Each of the 83 fields was planted to only one hybrid and on one day. All of every field was made up of similar soil type and received the same fertilizer applications. Part of each field was treated and part was not. Late in July and early in August, entomologists took counts of first-generation borers and at harvest time took the yield records.

The number of first-generation borers in the untreated parts of the 83 fields averaged 254 per 100 stalks (Table 1). In the treated parts of the fields, they averaged 80. Thus treatment destroyed an average of 174 borers per 100 stalks. Control averaged 68 percent. These are five-year averages.

Table 1. — Average Control in Farmers' Fields and Effects on Yields, 1947-1950 and 1956

Year	Number of fields	Number of borers per 100 stalks			Borer control	Corn yields per acre, No. 2 shelled			Yield saved
		Untreated area	Treated area	Difference		Untreated area	Treated area	Difference	
					perct.	*bu.*	*bu.*	*bu.*	*perct.*
1947...	14	272	132	140	52	81.6	89.8	8.2	9.1
1948...	13	259	89	170	66	104.4	110.7	6.3	5.7
1949...	19	268	92	176	66	83.7	92.0	8.3	9.0
1950...	22	252	72	180	71	83.8	89.3	5.5	6.2
1956...	15	231	44	187	81	104.6	111.4	6.8	6.1
Average		254	80	174	68	90.3	97.4	7.1	7.3

Control was poorest in 1947, the first year, averaging only 52 percent. Farmers made most of the treatments a week too early and applied only one pound of actual DDT to the acre. The next year, average control was considerably better, 66 percent. Fields were sprayed by plane, timing was improved, and 1 to 1½ pounds of DDT was used to the acre. By 1950, control averaged 71 percent. Most of the fields were treated by ground sprayers putting on 1½ pounds

of DDT to the acre and timing was much better. In 1956, control averaged 81.0 percent. In general, farmers timed their treatments more accurately, though some made treatments too early. In the fields in which treatments were properly timed, control averaged 90 percent. Using either DDT sprays or granules gave farmers almost identical results.

Average savings in yield ranged from 5.5 to 8.3 bushels per acre of No. 2 shelled corn. Possibly other insects present were controlled and may account for some of this difference.

The entomologists used the borer counts and yield records collected in these five years to find out what effect the individual borer has on yield. Their object was to determine how many borers there must be per stalk to make the use of insecticides profitable. They found that the greater the number of borers the greater the net return from a single treatment. They also found that the more borers there are in a field the less each individual borer reduces yield. In fields in which mature borers averaged one per stalk, each borer reduced yield 5½ percent, but where there were five per stalk, each reduced yield 2.7 percent. (Table 2). This means that fields contain-

Table 2. — Effect on Yield of Varying Numbers of Corn Borers in Farmers' Fields, Five-year Average

Number of fields	Number of borers per 100 stalks			Corn yield per acre, No. 2 shelled			Yield saved	Reduction in yield per borer per stalk
	Untreated area	Treated area	Difference	Untreated area	Treated area	Difference		
				bu.	*bu.*	*bu.*	*perct.*	*perct.*
22.....	107	24	83	93.1	97.6	4.5	4.6	5.5
21.....	197	48	149	93.8	100.7	6.9	6.9	4.6
15.....	311	70	241	85.8	93.3	7.5	8.0	3.3
12.....	518	126	392	91.1	101.9	10.8	10.6	2.7

ing relatively fewer borers can be treated profitably, a fact which many farmers may want to consider when they have to decide whether to treat a field. That the greatest yield reduction occurred in the fields with the highest borer populations is still the more important fact to be considered.

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