Corn rootworm larvae

Western corn rootworm adult

Northern corn rootworm adult

European corn borer (all stages)

Extension
UNIVERSITY OF WISCONSIN-MADISON

Managing Corn Insects When Growing Non-Bt Hybrids

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Introduction

Using Bt-hybrids to control European corn borers and corn rootworm has been a key management practice used by Wisconsin farmers since 1996 and 2003, respectively. With low corn prices and low populations of both insects, some producers have elected to grow non-Bt hybrids to reduce seed costs. In addition, some growers are planting conventional hybrids because they have markets that are paying them a premium for conventional grain. **This summary was developed to provide insect pest management information to growers who are growing non-Bt hybrids this year.**

What are "Bt hybrids"

The term "Bt hybrid" is a general term used to describe a protein bio-engineered into a corn hybrid. There are approximately 9 different proteins available for use in corn that can be separated into two categories. Those which control corn rootworms are considered **below-ground Bt traits** and the **above-ground Bt traits** control an insect complex, which may include one or more of the following insects: European corn borer, western bean cutworm, black cutworm, stalk borer and true armyworm. The above-ground Bt traits can be very specific regarding the insects they control. No single trait will control all the above ground insects.

Field Scouting

Field scouting is extremely important when growing non-Bt corn hybrids. It provides updates on pest populations in your fields so that rescue treatments, if needed, can be made in a timely manner. Essentially, scouting serves as a substitute for Bt hybrids.

Field scouting is not difficult but does take some time. To make time spent in the field as productive and efficient as possible it is important to know what to look for. Information on insect identification, life cycles, economic thresholds and scouting methods can be found in the **Field Crop Scout Training Manual**. Becoming familiar with these techniques will help you understand the process and improve time use efficiency. If time to scout is limited, consider hiring a crop consultant to do the field scouting for you. Contact your local county extension agent for individuals who offer this service in your area.

Although our focus is insects, the value of field scouting goes far beyond and will provide additional information for diseases, weeds, nutrient deficiencies as well as anything else that may be going wrong (or right!) with your crop.

The following electronic newsletters are published weekly during the growing season and will provide scouting and pest management assistance. The **Wisconsin Pest Bulletin**, issued by the Wisconsin Department of Agriculture, Trade and Consumer Protection, is an excellent newsletter that emphasizes current and trending pest populations. The University of Wisconsin-Madison, Division of Extension publishes the **Wisconsin Crop Manager**, which provides both management and pest alert information. Subscriptions to both electronic newsletters are free.

Insect management recommendations for non-Bt corn hybrids

In addition to knowing field scouting techniques, it is helpful to become familiar with management practices and recommendations. Specific insecticide recommendations and economic thresholds are available in **A3646, Pest Management in Wisconsin Field Crops**. This publication is updated annually. For further interpretation of these management practices, consult with your local county extension agent.

Corn Rootworms

According to the Wisconsin Pest Bulletin, corn rootworm populations have been at historic lows during the 2017 and 2018 growing seasons. Although this field scouting data is limited in scope (200-250 fields/year) their data accurately predicts population trends over time. Rootworm is different from the other insect pests in that there is no rescue treatment. Rootworm management decisions are based off beetle populations in corn fields the previous year. By establishing the level of adult infestation, you can determine whether preventative treatments, or even which preventive treatments, will best serve as cost effective replacements for the below-ground Bt hybrids.

Monitoring beetle populations at weekly intervals during the egg laying period (mid-August to early September) will determine the potential for corn rootworm feeding in your corn fields the following year. Count the number of adult western and northern corn rootworm on five non-consecutive corn plants in each of 10 random areas of the field (50 total plants). Pay close attention to beetles that may be feeding on silks and/or kernels. If weekly beetle populations remain below a 0.75/plant average, you will not have to manage rootworms in that corn field next year. If populations are over a field average of 0.75 beetles/plant at any one of the weekly scouting visits one of the following control practices will be needed.

Crop Rotation

Crop rotation continues to be a viable management alternative for all fields over the 0.75 beetles/plant threshold. Rootworms overwinter as eggs and corn is the only crop larvae will survive on. If these eggs hatch in any other crop the larvae will starve soon after hatching.

A two-year crop rotation continues to be a feasible management alternative for corn rootworms in Wisconsin. However, it must be mentioned that in the south and southeast sections of Wisconsin, western corn rootworm beetles have adapted to a corn/soybean rotation by laying eggs in soybean fields. This phenomenon was first detected in Wisconsin during the 2002 growing season. However, after only a few years of damage to first year corn it has not been detected at significant levels within the past 10 years.

To verify its presence/absence in your fields, consider digging and washing corn roots during late July or early August and look for root feeding on first year corn. This method will not predict the potential for first year corn damage but will help answer questions of its presence or absence on your farm.

Seed Treatments

Seed treatments containing the active ingredients clothianidin and thiamethoxam can provide effective rootworm control when rootworm populations are in the low to moderate range. Efficacy of these products can be questionable when rootworm populations are high. These seed treatments are applied by the seed supplier and available in either a low, medium or high rate. The highest rate (1250 mg/kg seed) is the only rate labeled for corn rootworm control. If you have scouting data from the previous year that indicates low to moderate beetle pressure (at or slightly above 0.75 beetles/plant) these seed treatment should provide economical control.

At-Plant, Soil Applied Insecticides

Several liquid and granular insecticides are available for use at planting time to control rootworm larvae. Most will provide acceptable control at high rootworm populations as a stand-alone program. This approach can provide significant savings when compared to using below-ground Bt hybrids. Read each insecticide label carefully. Some insecticides may suggest that an additional method of control (seed treatments or a below-ground Bt hybrid) should be used to achieve control when rootworm populations are high. In this situation, choose an insecticide which doesn't restrict its use under high populations.

Calibration is important for both liquid and granular insecticides. Settings on the granular insecticide bag (label) should only be used as a reference point for initial calibration. Proper calibration should include collection of insecticide output over a known area from each row to insure uniformity of application and performance. There may be use restrictions (pounds of product/acre) on row spacings narrower than 30 inches. Furthermore, reading and following label restrictions is important because some products have specific use constraints that include set back restrictions and/or buffer strips near aquatic habitat.

These two modes of action are available for at-plant, soil applied insecticides. Although resistance to currently labeled insecticides has not been detected, rootworm have demonstrated the ability to become resistance to several management practices including insecticides. Annual rotation of insecticide mode of action is an extremely important management tool that will help delay resistance.

Interactions between organophosphate foliar applied and/or soil applied insecticides and ALS herbicides have known to occur. Read labels for these restrictions.

Recently purchased planters may not be equipped with boxes to apply granular insecticides. After market insecticide boxes may be purchased or planters can be plumbed for liquids insecticides. Manufacturer incentives may be available for purchase of planter mounted granular or liquid application equipment. However, these incentives may only be cost effective if long term purchases are made.

Validating Rootworm Management Decisions

A certain level of apprehension may exist when adopting new control methods. To lessen this anxiety and improve your comfort level, consider verifying performance by digging and washing corn roots to inspect for feeding injury. Corn rootworm damage can be cryptic and easily overlooked or misidentified. Corn does not have to be lodged to suffer economic injury. Furthermore, not all lodged corn is a result of rootworm feeding. By evaluating the roots for damage you should, hopefully, gain confidence with your management decision.

Dig several roots from each field during late July through August when rootworm larvae have finished feeding. Wash each root with a power washer and observe the root for injury. Regardless of the management practice used, some injury is possible and light feeding is economically acceptable. To determine extent of the damage, rate each root using the **0-3 Nodal Injury Scale** developed by research entomologists at Iowa State University. This rating system is based on a decimal system. The number to the left of the decimal indicates the number (or equivalent number) of root nodes pruned back to within 1½ inch of the corn stalk. The number to the right of the decimal indicates percentage of the next node of roots pruned to within 1½ inch of the stalk. For example, a root rating of 1.20 indicates the equivalent of one complete node of roots is pruned and 20% of the next node of roots.

If the field average is lower than 0.50 it is assumed that there isn't enough rootworm feeding to cause economic loss. If the field average is greater than 0.75 one should assume there will be economic yield loss. For field averages between 0.50 and 0.75 economic loss may depend on other plant stresses that include, fertility, disease, compaction, environment, etc.

European Corn Borer

Like corn rootworms, European corn borer populations have been at historic lows. Unlike corn rootworms, European corn borer populations have been at remarkably low levels for several years running. Although numerous factors may have contributed to this low population trend, widespread use of corn hybrids with the above-ground Bt insect traits have undoubtedly been a major factor. It should be recognized that occasional pockets of high European corn borer activity may exist. While there may be no clear-cut reasons for these hot-spots they may be more common in areas with low adoption of above-ground Bt hybrids or in areas with significant acreage of a non-bio-engineered host crops like sweet corn. Timely scouting will provide advanced warning of economic damage and offer a suitable application period for first generation. Second generation may be difficult to time with a single application because of the long adult flight and egg laying period. However, field corn is a less attractive host to the second generation and economic populations less common than in the first generation.

Field scouting provides the basic information needed to make in-season European

1st Generation European Corn Borer Management Worksheet

☐ % of 100 plants infested x ☐ average # of borers/plant[A] = ☐ average borers/plant

☐ average borers/plant x 5% yield loss per borer = ☐ % yield loss

☐ % yield loss x ☐ expected yield (bu/A) = ☐ bu/A loss

☐ bu/A loss x ☐ $ expected selling price/bu = ☐ $ loss/A

☐ $ loss/A x ☐ % control[B] = ☐ $ preventable loss/A

☐ $ preventable loss/A - ☐ $ cost of control/A = ☐ $ gain (+) or loss (-) /A if treated

[A] Determined by checking whorls from 20 plants.

[B] Assume 80% control for most products: assume 50% control for Asana, Furadan and Lorsban sprays.

2nd Generation European Corn Borer Management Worksheet

☐ # of egg masses /plant[A] x 2 borers/egg mass[B] = ☐ borers/plant

☐ borers/plant x 4% yield loss per borer[C] = ☐ % yield loss

☐ % yield loss x ☐ expected yield (bu/A) = ☐ bu/A loss

☐ bu/A loss x ☐ $ expected selling price/bu = ☐ $ loss/A

☐ $ loss/A x 75 % control = ☐ $ preventable loss/A

☐ $ preventable loss/A - ☐ $ cost of control/A = ☐ $ gain (+) or loss (-) /A if treated

[A] Use cumulative counts, taken seven days apart.

[B] Assumes survival rate of two borers per egg mass.

[C] Use 3% loss/borer if infestation occurs after silks are brown. The potential economic benefits of treatment decline rapidly if infestations occur after corn reaches the blister stage.

corn borer control decisions. As with corn rootworm scouting, become familiar with this process to make sure you understand the process and make efficient use of your time. Detailed scouting information, damage symptoms and economic threshold calculations can be found in the **Field Crop Scout Training Manual (page FC-28)**.

Use accumulated degree days which are published in the Pest Bulletin to time field scouting activities. For 1st generation, initiate scouting prior to the best treatment period (800 – 1000_{DD} (Base 50° F)). European corn borer larvae do not survive well on field corn less that is less than 18 inches extended leaf height. Therefore, the earliest planted fields may be more attractive for egg laying. Once corn reaches 18 inches extended leaf height, examine 10 consecutive plants in 10 areas of the field for leaf feeding. Pull the whorl leaves from two infested plants in each area and unroll the leaves to look for borers. Calculate the percentage of plants with leaf feeding and average number of European corn borer larvae/ infested plant. Consult the **First-Generation European Corn Borer Management Worksheet** to determine the potential for economic loss.

Second generation adults start flying at 1550_{DD} and this flight period may last 3 weeks. Late planted fields are most attractive for egg laying. Scout all fields for egg masses until egg laying ends or a threshold is reached. Due to the extended egg-laying period, several field visits may be required. Egg masses are white when first laid and can found on the undersides of leaves near the midrib. Use the **2nd Generation European Corn Borer Management Worksheet** to determine the potential yield loss. Admittedly, second generation may be difficult to control because of the long egg laying period and because aerial or high clearance application equipment are required.

Occasional insects

Western Bean Cutworm

Western bean cutworms are insects that feed on corn ears but are not controlled by most corn hybrids with above-ground Bt traits. Therefore, they are usually not an additional concern for most growers who are growing non Bt hybrids. However, in localized areas of Wisconsin, western bean cutworms have been a significant pest on sandy soils.

Western bean cutworm populations vary significantly from field to field. Scouting should begin at approximately 1350_{DD} (Base 50° F). Look for egg masses on the top 3-4 leaves. Accumulate egg mass counts over a two-week period and if the field average is 5% of the plants with eggs masses the recommendation is to spray. Continue scouting until egg laying has stopped.

Timing an insecticide application is important. Eggs are not control by foliar insecticides and larvae are only vulnerable from egg hatch until they enter the ear. Furthermore, adults may be actively laying eggs for two weeks. Therefore, to get the best control with a single application, time the insecticide application to when eggs are first starting to hatch. This will provide a lethal concentration of the insecticide on the leaf when the largest percentage of larvae are vulnerable.

True Armyworm

True armyworms do not overwinter in Wisconsin and are an occasional pest on corn. However, their damage can be localized and severe during some growing seasons. Timing of scouting is difficult to predict because adult arrival is weather dependent. Regular scouting (weekly) after emergence is suggested. Concentrate early season efforts on those fields that are attractive for egg-laying, which should include corn following a rye cover crop, those fields that have significant grassy weed growth and or/those fields that are no-tilled into alfalfa.

Foliar applications of an insecticide may be needed if the threshold of 1 caterpillar on 75% of the plants is exceeded, or if 25% of the plants have 2 or more larvae. Larvae should be less than 1 inch long.

Stalk borer

Stalk borers overwinter in Wisconsin as eggs. Larvae will hatch in the spring and feed initially on perennial grasses before migrating to corn. Start scouting in late-May or when corn emerges. Walk field edges next to grassy waterways, fence rows or where perennial grasses were present last year. Insecticides, if required, should be applied after larval migration to corn starts. There is up to a 1½ week window for that application to be effective. Once larvae burrow into the corn stalk they are protected.

Black Cutworms

Black cutworms do not overwinter in Wisconsin but instead migrate into our state each spring on weather fronts. Scouting should start at emergence and continue through V5. Corn after V5 is usually too large for cutworms to cause economic damaged. Black cutworms damage corn by chewing holes in leaves, cutting plants and by burrowing into plants below ground. The damage can be confused with other seedling insect pests. Foliar insecticides should be considered if over 5% of the plants are damaged. Verify if cutworms are present by digging around damaged corn plants.

Summary

Timely field scouting can provide peace of mind and optimize use of insecticides, if needed, when growing non-Bt hybrids. Although scouting and treatment recommendations are discussed briefly, more inform can be found in the references listed below. Scouting is not difficult, and confidence will come with time and experience. Contact your local county extension for questions and more information.

References

Field Crop Scout Training Manual

Generalized Calendar of Events for Corn

Managing Corn Rootworms

Corn Rootworm Root Rating

Corn Rootworm Scouting

A3646, Pest Management in Wisconsin Field Crops

MSU Handy Bt Trait Table

This publication is available from the Nutrient and Pest Management (NPM) Program.
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