Stalk borer ecology and pest management options in corn and soybeans

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Stalk borers in corn have always challenged farmers, but during recent years, management has seemed especially troublesome. The stalk borer is not normally considered to be a major pest, as are corn rootworms or European corn borers, but problems do occur. Stalk borers can heavily infest corn rows that are adjacent to grass terraces, fence lines, or grass waterways and cornfields where grass control was poor the previous summer. Fieldwide stand losses are possible.

Early-stage larva.

Historical perspective

The stalk borer is a native insect that ranges from the Atlantic Coast to the Rocky Mountains. The first corn infestation recorded in Iowa was near Keokuk in 1890. During the 1920s, the stalk borer was unusually destructive in all parts of Iowa. There were many reports of serious damage; sometimes as much as 80 percent of the stand was destroyed. Stalk borers have been collected in every Iowa county for many years. More than sixty years ago, George Decker, an entomologist at Iowa State University, speculated that stalk borers could probably be found on every farm in the state.

Recent problems

Increases in conservation tillage and perennial grass populations and the construction of more grass terraces and grassed waterways have favored the stalk borer, resulting in increased stalk borer damage to corn. In recent years, farmers in western Iowa have reported infestations of 75 to 100 percent of

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young corn plants in no-tilled fields that had previous foxtail or woolly cupgrass problems.

Late-stage larva.

Large, fieldwide infestations are the result of moths laying their eggs on grass throughout the field during late summer. When corn is planted again in grassy-weed problem fields the following spring, stalk borer problems are possible. Herbicides that are sprayed to kill the grasses during May force the larvae to move from the dead grass to the corn. In cultivated fields where grassy weeds are kept under control, most stalk borer damage is confined to the first four rows adjacent to grass ditches, terraces, fence lines, and grass waterways.

Life cycle

The stalk borer life cycle begins when moths lay eggs during late summer. Moth flight begins August 10 to 21, peaks September 8 to 14, and ends October 5 to 19.

Moths are attracted to leaves and stems of grasses and some broadleaf weeds to lay their eggs. Grass terraces, ditches, fence lines, grass waterways, and weed patches are preferred egg-laying sites. Eggs hatch the following spring from late April through the first three weeks of May. The number of larval stages varies from 7 to 16, but most borers complete their development in 7 to 9 larval stages. Development from hatch to pupation takes 60 to 130 days. There is a single generation per year.

The larvae bore into the first suitable plant they find. If they grow too large for a stem, they leave the plant and seek a different host with a larger diameter. Stalk borers are rather indiscriminate feeders. They have been collected from 176 plant species, including green foxtail, quackgrass, orchardgrass, bromegrass, bluegrass, wirestem muhly, woolly cupgrass, smartweed, lambsquarter, pigweed, alfalfa, sweet clover, hemp dogbane, giant ragweed, cocklebur, goldenrod, and yarrow. Stalk borers commonly infest corn growing near areas that contain these plants.

Stalk borer tunneling into cornstalk.

The stalk borer larva is white with brownish-purple stripes extending the length of the body. Directly behind the true legs on both sides of the body is a large, purple spot or band. This spot, called the purple heart, fades as the larva grows older. The orange head has a black stripe along either side that can be used to distinguish stalk borers from all other caterpillars that feed on corn in Iowa.

Leaf injury from stalk borer feeding in whorl.

Crop injury to corn

Larvae may attack anytime after corn emerges, and they produce two kinds of injury: **leaf feeding** and **stalk tunneling.**

Stunted corn plant caused by stalk borer tunneling. Note dead whorl and small ears.

Leaf feeding is probably the more commonly observed injury. Larvae crawl into the whorl and feed on the newly-developing leaves. Feeding causes ragged holes to appear in the leaves as they unfold. Leaf feeding by larvae does not reduce grain yields.

The other injury, **stalk tunneling,** is much more severe. It occurs when larvae tunnel through the plant and destroy the growing point, causing what is known as dead heart. Stalk tunneling results in upper leaves being cut off within the heart of the plant, which then wilts and dies. The outer leaves remain green and apparently healthy. Plants that survive often grow tillers, are delayed in development, and do not produce normal-sized ears.

Plants with dead heart have barren rates of 25 to 63 percent.

Wilted soybean seedling infested with stalk borer.

Grain yields are only about 30 to 40 percent of the amount produced by undamaged plants. A barren plant that survives is basically a weed; it competes with neighboring plants for moisture, nutrients, light, and space, but produces no grain. Because of this competition, the uninfested, adjacent plants do not compensate for the yield that is lost from the barren plant, unless the infested plant dies.

Delayed silking is the primary physiological basis for yield reductions in plants with dead heart. The silks do not catch sufficient pollen to pollinate all the kernels. Younger plants are more susceptible to damage, therefore, yield losses caused by stalk borers decline if the plant is attacked later in development. Once the plant reaches the 6-leaf stage, the plant's ability to tolerate stalk borer injury greatly increases. Larvae also can tunnel into corn stalks below the growing point, but this does not kill the plant. As many as four larvae per corn stalk have been found in silking-stage corn.

In conventionally-tilled fields without a grassy-weed problem, most damage occurs in the four rows next to permanently grassy areas. When the first or second corn rows are shorter than the inside rows, stalk borers are usually the cause of the problem. A common misconception is that rows are stunted because of competition for moisture from the neighboring grass or weeds. An examination of the stalks, however, should reveal stalk borers inside the plants.

Crop injury to soybean

Yield losses or significant stand reductions in soybeans have not been reported. Larvae have been found tunneling in soybeans shortly after the plants emerge (unifoliolate stage) and later in the season when the plant is beginning to develop pods (R5 stage). Infested plants usually have wilted terminals. It is easy to overlook stalk borer injury in soybeans, because noninfested plants quickly outgrow and overshadow infested seedlings. The infested plant wilts and dies, unnoticed.

Entrance holes in soybean stem.

Managing stalk borers in soybeans is not practical. Because soybeans are planted at rates from 100,000 to 250,000 plants per acre, stalk borers are unlikely to reduce the plant stand to levels that show a yield reduction. Also, healthy neighboring plants adjacent to infested plants compensate for insect damage.

Biological and environmental influences

Heavy rainfall during the egg-hatching period plays a significant role in reducing stalk borer populations. But as the small larvae (the first three stages) tunnel into grass stems, they are well protected from both adverse climatic conditions and predators. Later, when the fourth-, fifth-, and sixth-stage larvae migrate in search of larger-diameter hosts, predation by ants, ground beetles, and spiders causes their populations to decline significantly. Parasites account for less than 5 percent of stalk borer mortality. All of these factors contribute to larval mortality, but they cannot be relied upon to prevent yield losses.

Management options

Cultural management: Planting date. Plants that are attacked at earlier developmental stages tend to produce fewer and smaller ears than do plants attacked at later developmental stages. Early-planted fields may escape some stalk borer damage, but this varies from year to year, depending on when the eggs begin to hatch. Fields that are planted late and have grass terraces or grass waterways and yearly grass problems are at highest risk for stalk borer damage.

Stalk borer tunneling in soybean stem.

Cultural management: Burning. Burning grass and weeds in egg-laying sites is another way to reduce crop damage. Decker reported that stalk borer populations could be reduced by 82 to 97 percent by burning fence lines between November 1 and May 1.

Recent burning experiments in Iowa resulted in yield increases of up to 68 percent in corn adjacent to grass terraces. However, burning sometimes results in no yield difference between burned and unburned areas. Eggs that are laid in grasses between corn rows may not be eliminated if grassy weeds in the rows are flattened by winter snows and are not dense enough to burn. Therefore, to benefit from burning terraces and grass waterways, grass in the corn must be eliminated. Successful reduction of stalk borer populations is best attained by burning grassy areas and controlling grassy weeds in the cornfield.

Egg-laying sites should be burned during March for three reasons. First, burning terraces during early spring

Burning ditch in spring to kill stalk borer eggs.

briefly exposes the soil to erosion, while burning during the fall exposes the soil all winter. Second, burning in the early spring before grass greens up does not hinder regrowth. Third, birds usually don't nest in grassy areas during March.

Chemical management. Corn is infested by newly hatched larvae tunneling into young corn plants (such as in a no-till field), or by partially grown larvae crawling from grass in search of larger diameter plants. Chemical control is difficult to achieve, because larvae are exposed for very short periods of time; they cannot be killed after they tunnel into a plant.

Farmers should time an insecticide application with long residual action to coincide either with egg hatch or with movement from grass to corn.

One approach is to target the hatching larvae. This works best in fields that have a history of fieldwide infestations. An application of permethrin (Ambush, Pounce), timed to coincide with egg hatch, has been found to reduce stalk borer populations in terraces by 50 to 85 percent, resulting in a 50 to 75 percent reduction in damaged corn plants. Timing is critical. Apply permethrin when between 575 and 750 F degree days have occurred, using a base threshold of 41°F beginning January 1. Degree day information is published in the *Integrated Crop Management* newsletter, which is available from county extension offices. Hatching will occur between the last week of April and the first three weeks of May. Unfortunately, this approach doesn't consider the size of the stalk borer population, so an insecticide may be sprayed on a population that is not economically damaging.

A second approach is to target an insecticide application, based on degree days, to coincide with migration of the larvae from the grass to the corn. This option is best for controlling larvae that are migrating from grassy areas to adjacent corn. Approximately 10 to 50 percent of the larvae will move out of the grass by 1,400 F to 1,700 F (base 41) degree days. A calendar cannot be used to predict movement because migration is also affected by weather. Movement of 50 percent of the larvae from grass to corn can fluctuate by as much as two weeks from one year to the next. For

example, 50 percent movement occurred on June 9 in 1985 and on June 24 in 1984.

When 1,300 to 1,400 F degree days have accumulated, scout corn to verify that stalk borers are present in grass (look for dead stems and larvae inside) or to determine if they are moving into the field. Table 1 lists economic injury levels that can help in deciding whether or not to apply an insecticide to the border rows. Make the decision about applying an insecticide between 1,400 to 1,700 F degree days.

To determine the percentage of infested plants, inspect the two outer border rows. Count 25 consecutive plants at four or more evenly-spaced locations. Divide the number of infested plants by the total number of plants you observed, then multiply by 100. Use this number to decide whether or not to apply an insecticide, according to the economic injury levels given in Table 1. The economic injury level for stalk borer depends on the corn-leaf stage and the percent of infested plants. Economic injury levels have been calculated for corn in the 1- to 7-leaf stages as a percentage of injured plants in the first two rows.

Younger plants are more susceptible to yield losses from stalk borers, so the insecticide should be sprayed during the early phase of movement. Stalk borers do not migrate very far from grassy areas, so treat only the first four corn rows next to terraces, fence lines, or waterways.

A third option is necessary for historical, fieldwide problems, if an insecticide was not sprayed against the hatching larvae. In-furrow treatments or banded over-the-row applications of a granular insecticide at planting do not reduce the damage, but rescue applications of a liquid pyrethroid can result in significantly fewer injured plants. Even pre-emergence treatments of a pyrethroid can reduce the number of injured plants. The most effective

Table 1. Economic injury levels (expressed as a percentage of infested plants) for corn in border rows attacked by stalk borers.

Leaf stage	Percent of plants infested
1 leaf	15%
2 leaf	18%
3 leaf	23%
4 leaf	25%
5 leaf	25%
6 leaf	50%
7 leaf	100%

This chart is for corn valued at $2 per bushel, management costs of $10 per acre, and 50 percent control with an insecticide.

Outside rows of corn damaged by stalk borers.

approach is a burndown herbicide-insecticide combination, either tank mixed or in a split application, rather than an insecticide used alone. The herbicide kills the grass, forcing the larvae out of the plant to search for another host.

Insecticides can be tank mixed with fast-acting herbicides, such as paraquat, or applied 7 to 10 days after a slow-acting herbicide, such as Roundup. Ambush 2E (6.4 to 12.8 ounces per acre), Asana XL (5.8 to 9.6 ounces), Lorsban 4E (2 to 3 pints), or Pounce 3.2EC (4 to 8 ounces) are recommended for stalk borer control, but Lorsban should not be tank mixed with the herbicide. Long-term management of fieldwide infestations requires grass control so that eggs will not be laid across the field during late summer. If the grass isn't controlled, the problem can repeat itself the following year.

An Integrated Pest Management Approach

The best way to manage stalk borers in corn is to integrate strategies that fit an individual field situation. The following are options.

1. Determine which fields have a history of or potential for stalk borer problems because of grassy weeds. Consider planting these fields early.
2. In fields without grassy-weed problems, burn grass terraces, ditches, and waterways in early spring, before grass begins to green up.
3. If grass areas are not burned, either spray egg-laying sites with a pyrethroid at 575 to 750 F (base 41) degree days or scout the first two corn rows for migrating larvae and leaf injury between 1,400 F and 1,700 F degree days. Use the economic injury level table to determine if an insecticide application is justified.
4. Treat fields that have historically had fieldwide stalk borer infestations with an insecticide timed to coincide with egg hatch. If this is not done, tank mix an insecticide with a fast-acting, burndown herbicide later, or apply the insecticide 7 to 10 days after applying a slow-acting herbicide.
5. Eliminate grass problems in the field before egg laying begins in August to reduce problems next year.

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