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Early Season Pests of Field Corn

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Pest Biology and Host Injury of Early Season Pests

The early season pest complex of corn includes a number of insect pest species that impact stand establishment, which is often directly correlated to grain yield if nutrient and moisture inputs are not significantly altered by an adverse climate during the growing season. Early season pests commonly found in Ohio corn are presented inTable 1.

Seedcorn Maggot

The seedcom maggot, *Delia platura*, is an anthomyiid fly which overwinters in the pupal stage. In the spring, adult flies emerge and lay their eggs on recently tilled fields having high

Larvae and pupae of seedcom maggot next to damaged seed.

Table 1. Stand Injury and Risk Variables Associated With Early Season Pests of Corn.

Early Season Pest	Insect Order	Stand Injury	Risk Variable
Seedcorn Maggot	Diptera	Seed injury and destruction	Tillage of high organic matter and cool / wet growing conditions
Black Cutworm	Lepidoptera	Seedling loss and stalk injury	Migrant moths attracted to weedy pre-planted habitats
Stalk Borer	Lepidoptera	Stalk injury and plant deformation	Incidence linked to established weed hosts
Armyworm	Lepidoptera	Early stand defoliation	No-tillage into grass or forage cover crop
Wireworms	Coleoptera	Seed injury and stalk injury	Linked to sod or small grain rotation in plain habitats
Scarab Grubs	Coleoptera	Root system pruning	Linked to sod rotation or abundant Japanese beetle in soybean
Flea Beetles	Coleoptera	Foliar injury and disease vectoring	Mild winters increase Stewart's wilt disease transmission

levels of decaying organic matter. Within a few days, eggs hatch into maggots (legless larval stage), which feed on decaying organic matter and germinating seeds in the soil.

Maggots transform into pupae from which adult flies emerge. Two to three generations may occur in the spring until temperatures above 75°F lead to dormancy of the maggot in the pupal stage throughout the remainder of the year.

Seedcorn maggot injury is enhanced under cool growing conditions that delay seedling emergence and prolong exposure of germinating seed to seedcom maggot feeding.

Where seedcom maggots are a problem, seedling emergence will be reduced, legless maggots will be found in deteriorating seeds, and small brown fly pupae will be easily detected in the seed furrow.

Black Cutworm

Adult moths of the black cutworm (BCW), *Agrotis ipsilon,* overwinter in the south and migrate north with the prevailing spring weather fronts. The intensity and distribution of the migratory BCW flight may differ from year to year. Some regions such as the Ohio River valley often exhibit higher levels of BCW activity than other regions such as the areas bordering the Great Lakes.

Within a region, migrating BCW moths tend to be attracted to fields having a significant ground cover of winter annuals such as chickweed at the time of peak migratory flights. Since the accumulation of winter annuals is often associated with reduced tillage or no-tillage systems, the incidence of BCW infestations tends to be linked to tillage practices. However, it should be noted that late tillage prior to corn planting may not reduce BCW infestations if significant weed cover was present at the time of peak egg laying by migratory BCW moths. Thus, reduced tillage or no-tillage corn may be equally susceptible to BCW infestation if the corn crop follows a no-tillage corn or soybean crop that enabled development of a significant stand of winter annuals which are attractive sources for egg laying by migratory BCW moths.

BCW larvae pass through seven instar stages. Early first-, second-, and third-instar BCW larvae are rarely detected in the field, although such early instars may cause some foliar feeding. Above-ground cutting of corn seedlings or below-ground tunneling of corn is generally linked to BCW larvae in the fourth- and later instar stages, which range in length from 1 /2 to 2 inches. Stand loss of corn is generally associated with below-ground feeding injury which occurs below the growing point. Plants cut off above the growing point tend to recover.

When significant infestations of BCW occur, fourth- and fifth- instar larvae can readily be found before a stand of corn has completed emergence. By the time corn development reaches the third- or fourth-leaf stage, sixth- and seventh-instar stages of BCW larvae are likely to be detected. Since significant infestations of BCW tend to coincide with corn emergence and development, a BCW larva may eliminate three to five corn plants as

6th instar black cutworm larvae

it develops. As a result, a gap of two or more missing plants in a row will often be found next to a BCW injured plant with a late-instar BCW larva in the soil below.

In summary, there are two basic types of visible BCW injury, namely below-ground feeding injury and above-ground feeding injury. The below-ground injury generally occurs below the growing point and causes the death of the plant.

Below-ground feeding on small corn plants in the two- to three-leaf stage often results in the total disappearance of the plant. Below-ground feeding on corn plants having four or more leaves often leads to wilted plants or dead whorls, and a tunnel will be found near the base of the plant.

Below-ground cutworm tunneling of corn

Above-ground injury by BCW is very visible but seldom results in the elimination of the plant, since the injury often occurs above the growing point, and the plant will recover.

During the initial stages of a cutworm outbreak, above-ground feeding injury may be greater than below-ground injury. However, as plants and BCW larvae develop, below-ground injury will become the dominant form of visible injury.

The most significant field symptom associated with a cutworm infestation is missing plants, which represent the loss of small corn plants to early below-ground cutworm-feeding activity. In general, the ratio of missing stand to visible cutworm-

Above ground cutworm cutting of corn.

injured stand is about 4:1 by the time a stand of corn is in the four-leaf stage of development.

The black cutworm life cycle includes multiple generations per year, but only the first generation is regarded as a problem on corn. Subsequent generations tend to be a problem on late-planted crops and grass habitats such as lawns and golf courses.

Stalk Borer

The stalk borer, *Papaipema nebris, is* a common pest of grasses and broadleaf weeds like giant ragweed. When the borer outgrows the natural host plant or the weed host is injured by mowing or chemical treatment, the borer will move to an alternate host such as corn. As a result, stalk borer infestations of corn are commonly near field borders or associated with conservation-tillage fields having well-established weed populations.

The stalk borer overwinters in the egg stage, which was deposited on host grasses or broadleaf weeds during the previous fall season. The eggs hatch in the early spring and initially feed on their native hosts. Crossover infestation of corn may occur anytime following formation of an initial stalk during the 2nd or 3rd leaf stage of corn development. Stalk-borer larvae enter the corn plant near ground level and tunnel into the low stalk. Small corn plants infested by stalk borer exhibit a dead central whorl, which is the same symptom expressed by corn plants in which the growing point has been hit by black cutworm below-ground feeding activity.

In a stalk-borer-infested corn plant, a small striped larvae can usually be found in the stalk. If a stalk-borer infestation of corn occurs during early stages of corn-plant development, the stalk-borer larva may move from one plant to another if it kills the host plant. If a corn plant recovers from the initial infestation of stalk borer, the central whorl will exhibit deformed foliar growth during the early-whorl stages of development. In heavy stalk-borer infestations, stalk-borer larvae may be found feeding on the corn foliage.

Stalk-borer development includes seven or more instars, and the life cycle is limited to one generation per year. Stalk-borer larval activity may extend into the early summer. The final-instar stage will lack the lined markings of the earlier instar stages. Stalk borer larvae pass the summer in the pupae stage, and adults emerge in the fall season.

Stalk borer larva.

Armyworm

The armyworm, *Pseudaletia unipuncta,* is a common pest of field corn, but severe infestations are generally limited to no-tillage corn planted into grassy habitats such as a rye cover crop or an old stand of alfalfa. Armyworms overwinter in the pupae stage and pass through two or three generations per year. Injury to corn is caused by the first generation, which results from the spring flight of moths that are attracted to rye cover crops and other grassy habitats to deposit their eggs.

Early larvae activity of the first generation is generally detected on corn during the pre-whorl or early-whorl stages of corn development. Armyworm feeding is initially focused on the leaf margins (see photo) which is a primary indicator of foliar injury caused by armyworm presence. During mid-day the armyworm larvae armyworm can be found seeking shelter in the central whorl or under the ground residue.

The detection of moderate feeding activity by small or mid-size armyworms on early corn in the early-whorl stage may be an indication of a forthcoming problem since defoliation may inten-

Foliar injury caused by armyworm.

sify as armyworm larvae feed and mature to full-grown larvae that are about 1.5 inches in length. In addition, armyworms tend to migrate in large numbers and defoliation may intensify within a brief period of time.

When a severe infestation of armyworm occurs, the injury to a field of corn can be devastating. Larvae may be abundant to the point that every plant is infested and exhibiting foliar injury. In some cases, entire stands of corn may be defoliated so that only mid-ribs remain on waist-high corn. In some areas of a field, corn may be reduced to stubble.

Intensive defoliation of a whorl by armyworms.

Wireworms

Wireworms include a complex of pest species within the Elaterid family of beetles. Their name is based on the slender and rather firm body of the larvae. Wireworm adults are often called click beetles. Life cycles of wireworm species range from one to five years. Since the life cycle of a wireworm may span a few years, a population may become established in a habitat of sod pasture or small grain crop and be a problem a year or two later when the site is planted to corn.

Wireworm larvae cause injury to corn primarily by feeding on the germinating seeds and emerging seedlings, causing losses in stand. In addition, wireworm larvae may tunnel into established corn stalks.

In the case of corn seedling damage, wireworm feeding at the base of the emerging seedling will damage the growing point and cause a dead whorl symptom that is very similar to that observed in corn seedlings damaged by stalk borer or cutworms.

Wireworm injury to base of corn seedling.

Grubs of Scarab Beetles

The term grubs is applied to larvae of scarab beetles, which include a complex of species commonly referred to as true white grubs belonging to the genus *Phyllophaga*. In addition, the scarab family includes the Japanese beetle, *Popillia japonica,* which is a pest of corn and soybeans.

True white grubs feed on corn root systems and strip off the root hairs causing plants to wilt and die. However, grub infestations in fields tend to be rather patchy due to effects of neighboring forest habitats that influence grub population establishment. Similar to the situation of wireworms, white grubs tend to be a problem in corn following sod, since some grub species have a long life cycle, and grub populations tend to become established in sod pastures.

Information on the effects of Japanese beetle grubs on corn is limited, but questions have been raised about the potential for grub injury in corn following heavy infestations of Japanese beetles in the preceding soybean crop.

A white grub

During the past decade, the abundance of Japanese beetles in soybeans in western Ohio has intensified, and increases in grub activity in corn following soybeans have been observed. Since the Japanese beetle has a one-year life cycle, it has been assumed that a potential risk of grub injury may exist in corn that follows a soybean crop exhibiting high levels of adult activity.

Corn Flea Beetles

The corn flea beetle, *Chaetocnema pulicaria*, occasionally is found in abundance on corn. The flea beetle is a leaf beetle and may cause significant foliar injury when abundant on emerging seedlings. Foliar injury by the flea beetle is in the form of small linear streaks parallel to the leaf veins. When concentrated, the feeding scars take on an appearance of windowpane patches. However, it is questionable whether intensive foliar injury by flea beetle has any effect on corn yield since corn plants tend to outgrow the injury when growing conditions are favorable.

The primary concern of flea-beetle-feeding activity is the potential for transmittal of Stewart's wilt disease to susceptible

corn varieties. Stewart's wilt is caused by the bacterium, *Erwinia stewartii*, which is transmitted by the corn flea beetle. Although most field-corn hybrids have traditionally been resistant to Stewart's wilt, the incidence of the disease in field corn has increased in recent years. The annual incidence of Stewart's wilt is very dependent on the winter survival of *E. stewartii* in the flea beetles, soil, and plant residue. Thus, the potential for Stewart's wilt transmittal is high following mild winters and low following cold winters.

Potential Risk of Early Season Pest Problems on Field Corn

In general, the risk of having significant early season pest problems in rotated corn systems with minimal weed problems is very low. The potential for seedcom maggot, black cutworm and stalk borer problems is dependent in part on tillage practices and effective weed control. The potential for armyworm problems is limited to a specific combination of no-tillage and rotation practices which can be avoided. The potential for significant wireworm and grub problems is usually limited to corn following forage or sod. The potential of flea beetle transmittal of Stewart's wilt is limited to planting of wilt susceptible corn hybrids. In summary, the typical corn field rotated with soybeans is unlikely to have a significant early-season pest problem.

For the typical corn-soybean production systems using a combination of conservation tillage practices, the most common early-season pest problem is the risk of experiencing a low level of stand loss to a combination of seedcorn maggot, black cutworm, and stalk borer. This situation may or may not warrant investment in preventive treatments to optimize stand establishment and prevent exceptional cases of yield losses to early-season pest problems.

Pest Management Strategies for Prevention of Stand Losses

Multiple management strategies exist for preventing stand losses associated with early-season pests of corn. The primary strategy for preventing early-season pest problems should include a combination of rotation, tillage, and weed-control practices that minimize the incidence of early-season pest activity that may impact stand establishment.

Chemical treatment strategies (see Table 2) may be integrated into a production system to minimize the risk of early-season pest problems. The chemical treatment strategies include preventive treatments of using seed treatments, soil insecticides applied at planting, or use of a broadcast treatment applied as tank mixes with pre-emergence herbicide treatments. In contrast, post-emergence chemical treatments for early-season pests may be applied as rescue treatments when field scouting indicates a need for chemical intervention. However, the relative efficacy of treatment strategies may differ from one early-season pest problem to another.

In general, the selection of an optimal strategy for management of early-season pest problems depends on an awareness of early-season pest incidence associated with a given corn production system. Such an awareness can only be developed by conducting periodic field observations of corn-stand injury and relating such assessments to yield data over time.

If possible, early-season pest and stand-loss observations should be linked to on-farm trials in which treated and untreated strips are compared to evaluate the site-specific impact of early-season pests on stand establishment. Such on-farm trials may be implemented to evaluate the benefit of the use of seed treatments, planting time treatments, or pre-emergence treatments.

Table 2. Chemical Treatment Strategies Applicable to Management of Early-Season Pests.

Early Season Pest	Chemical Treatment Strategies			
	Seed Coating	Soil Insecticide at Planting	Pre-Emergence Broadcast	Post-Emergence Rescue
Seedcorn maggot	xxx	xx	x	n.a.
Black cutworm	xx	xxx	xxx	xx
Stalk borer	x	xx	xxx	xx
Armyworm	n.a.	n.a.	xx	xxx
Wireworms	xx	xxx	n.a.	n.a.
Scarab grubs	n.a.	xxx	n.a.	n.a.
Corn flea beetle	xx	x	x	xxx

xxx = Labeled treatments available having high level of treatment efficacy.
xx = Labeled treatments available. Control efficacy depends on timely application.

Where on-farm trials are not conducted, periodic sampling and observation of untreated field sites will provide relevant information on the incidence of early season pest activity, especially if significant incidents of pest infestations are periodically detected. However, if treated sites or strips are not available for comparison, evaluation of marginal differences in stand establishment and yield may not be feasible.

Pest Management Procedures Applicable to Rescue Treatment

When a significant pest problem occurs in the field, corrective action may be taken with the application of a rescue treatment if the problem is detected in time to prevent additional losses and if effective treatment options exist. In the case of seed maggot, wireworms, and grubs, the problem may be prevented by a seed- or soil-insecticide treatment, but a rescue option is not available. In the case of black cutworm, stalk borer, armyworm, and flea beetles, corrective action can be implemented by application of a rescue treatment. However, application of a rescue treatment should be justified on the basis that the value achieved by preventing additional losses is greater than the cost of the rescue treatment. To achieve an effective rescue treatment of a pest problem, timely detection of the problem is essential, impact of present and forthcoming losses must be evaluated, and the efficacy of the rescue treatment should be considered.

Black Cutworm

Timely detection of cutworm infestations requires periodic inspection of a field starting with the first emergence of the corn stand. If an economic infestation of cutworm is present, stand losses will accumulate daily until cutworms reach maturity or corn growth approaches the 6th leaf stage of development. Stand loss by cutworms is most severe when mid-size larvae are feeding below ground on corn in the seedling and pre-whorl stages of corn development. In general, detection of cutworm injury on 3% or more of a stand is an indicator that a rescue treatment is needed. As cutworm infestation develops, injury will shift from above ground cutting to below ground feeding, and the ratio of missing stand to visible cutworm injury will increase. If substantial stand loss has already occurred and late-instar larvae are feeding on corn approaching the 5th or 6th leaf stage, prevention of additional stand losses by a rescue treatment is unlikely.

Stalk Borer

Timely detection of significant stalk-borer infestation is essential for effective rescue treatment, since early stalk-borer larvae are more likely to be on the foliage and susceptible to treatment. In a severe outbreak, stalk borers may be found both on the foliage and within the stalks. Stalk-borer infestations tend to be concentrated in areas of weedy habitats such as near patches of quack grass or giant ragweed, or along field borders. Thus, spot treatment or perimeter treatment of field infestations may be warranted in contrast to a total field treatment.

Armyworm

No-tillage corn planted in rye cover crops or old hay fields must be monitored closely to achieve timely detection of armyworm outbreaks. Detection of foliar feeding on 5% to 20% of a stand indicates a need for close surveillance (2 times per week), especially if armyworm larvae are in the early stages of development. If stand infestation ranges from 20% to 50% on early-whorl corn, rescue treatment should be considered if more than one larvae are found per plant or defoliation of infested plants exceeds 50%. If stand infestation exceeds 50% and larvae are not yet mature, rescue treatment is needed immediately.

Corn Flea Beetle

Treatment of field-corn hybrids that are resistant to Stewart's wilt is generally not warranted. However, treatment of wilt-susceptible hybrids may be warranted if flea beetles are abundant.

Sampling and Assessment of Corn-Stand Injury by Early-Season Pests

Sampling of stand injury and stand losses to evaluate the marginal benefits that may or may not be gained from preventive insecticide treatments requires a level of accuracy that will detect stand differences ranging from 2 to 5%. To achieve such accuracy, stand counts should be conducted on a minimum sample of 50 row ft. and preferably 100 row ft. Use of a traditional agronomic sample of 17.4 row ft. (1,000th of an acre) is not sufficient to detect low levels of stand injury and stand losses.

In Ohio State University Extension entomology trials, plastic chains with large eye screws at each end are used to delineate the section of row to be sampled. A 25-ft. chain is used in small plot trials, and a 50-ft. chain is used in large plot trials. The chain is laid between two rows, and plants in both adjoining rows are counted. Using the 50-ft. chain provides a sample of 100 row ft. Flags are

Stand count of corn rows adjacent to white plastic chain.

posted at the ends of the chain if an additional count is to be taken later to detect changes in stand emergence, injury, or recovery.

A stand count generally includes a count of the total number of plants present and the number of plants per type of pest injury. The most common types of injury include black cutworm (noting above- and below-ground injury), stalk borer, armyworm, and herbicide symptoms, if present. Recording the date of sampling, stage of corn-plant development, and site of sampling (plot reference or equivalent site notation) are standard procedures which must be routinely implemented.

The number of stand count samples taken will depend on treatments and replication of plots established. If there is only one treatment to be evaluated at a field site, then a minimum of three locations should be sampled to obtain information on variability of stand within the field.

For Additional Information

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