

5 - Major Insect Pests of Field Corn in Arkansas and Their Management

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Field corn production in Arkansas has been relatively minor until recent years. Because of this, the majority of information available for managing insects on field corn in Arkansas has been based on data developed in the 1950s in Arkansas and on more recent data from other states. However, with the formation of the Arkansas Corn and Grain Sorghum Promotion Board in 1998, funding became available for research on field corn insects, and substantial progress has been made. Surveys have now been completed on insects and their impact on field corn throughout the state. Major insect pests have been identified, and their distribution within the state has been established. Much has been learned on the biology of major insect pests, and this information has enabled the improvement of insect management on field corn.

Although only four years of research have been completed and numerous additional studies are needed, substantial knowledge has been gained. The next step in the process is to provide the corn producers of Arkansas with this information in a usable production manual. The objective of this manual section is to provide the producer with the most current information on identification, biology and management of insect pests of field corn in Arkansas.

Emphasis has been placed on the major insect pests and their management. Additional insects, now considered to be minor pests, may pose greater threats in future years. Also, new species may migrate into the state. Thus, continual research is needed to identify these changes and develop management strategies. As these findings become available, updates to the production manual will be made. Additional information can be found on websites maintained by the University of Arkansas Department of Entomology (<http://comp.uark.edu/%7Epjmcleod/>) and the Cooperative Extension Service (<http://www.aragriculture.org/pestmanagement/insects/corn>).

From a producer's perspective, the major insect pests of Arkansas field corn can be divided into two groups; i.e., those attacking seed and seedlings early in the season, and those attacking later. Early season pests include a diverse group of insects. Among the most damaging are chinch bugs, cutworms and wireworms. Rootworms, a major pest of field corn in the Midwest, have not caused significant damage in recent years in Arkansas. The most destructive insect pest of later season field corn in Arkansas is the corn borer complex, including the southwestern and European corn borers. Also, included in this group are the corn earworm, fall armyworm and aphids. Discussions of the major pests follow.

Early season insect pests	Mid and late season insect pests
Chinch bug Corn flea beetle Corn thrips Cutworms Seed corn maggot Sugarcane beetle White grubs Wireworms	Aphids Corn earworm European corn borer Southwestern corn borer Fall armyworm

Chinch Bug, *Blissus leucopterus leucopterus*, Heteroptera: Lygaeidae

Description

Chinch bug adults are true bugs; i.e., the front half of the fore wing is hardened while the rear portion is membranous. Color is generally black, but the light-colored wings give the appearance of a white band across the midsection (Photo 5-1). Adults are only about 3/16 inch long. Immatures vary greatly in appearance. Newly hatched nymphs appear as minute reddish/orange specs on corn stalks and foliage. As nymphs develop, color

changes from orange to dark grey or black (Photo 5-2). All nymphs are wingless.

Distribution, Damage and Impact

In Arkansas, chinch bug population has varied greatly during the past four years. Few were detected during 1999 and 2000 except for Lafayette County in extreme southwest Arkansas. Surveys during the last two years, however, have detected chinch bugs throughout the state. Also, very high numbers (20 adults per three-leaf plant) have been found in the White River Delta near Des Arc, the Arkansas River Valley near Clarksville and Alma and near Dumas in southeast Arkansas. Outside of Arkansas, chinch bug occurs in all states east of the Rocky Mountains and into southern Canada. Its impact on field corn in more northern states is minimal. On seedling corn, adult chinch bugs can be found either on the ground or on stems near the ground, often under leaf sheaths. Here they insert their stylet mouth parts into the plant and remove plant fluids. Infested plants often become yellow and distortion of seedlings is common (Photo 5-3). Impact in Arkansas from chinch bug has been substantial. Where chinch bugs have been controlled, yields have been increased up to 25 bushels per acre over areas not managed.

Life History

Generally, adult chinch bugs migrate from overwintering grasses into seedling corn. Once in corn they mate and begin egg laying. When orange nymphs emerge, large numbers of nymphs can often be detected by peeling back the lower leaves on corn seedlings. Nymphs develop for a few weeks before becoming the winged adult form. This process continues throughout the growing season. Mature corn may harbor many chinch bugs in all developmental stages. In Arkansas, about three generations of chinch bug can develop each season.

Management

Successful chinch bug management can be accomplished with four approaches. First, **early planting** may avoid high chinch bug populations. Also, chinch bug damage is generally greater under dry conditions. Plants with **sufficient moisture** are more able to out grow the damage. Thus, irrigation during periods of drought may reduce the impact of

chinch bugs on field corn. Irrigation also may aid the uptake of insecticides applied to the seed or soil. In areas with a history of chinch bug problems, it may be beneficial to use seed treated with insecticide or apply a soil insecticide at planting. However, chinch bug populations may experience great fluctuations between years, and preventative soil or seed insecticides may not always be justified. In areas with a history of chinch bug problems and where **treated seed or soil insecticides** are used, it is suggested that a small portion of the field be left untreated and periodically checked for chinch bug. The final approach to chinch bug management is with the use of **insecticide sprays** applied to the foliage of seedling corn. The chinch bug threshold is variable and depends on the rate of plant growth and size. Slow growing smaller plants are most susceptible to severe damage. A general threshold for chinch bug has been established on seedlings less than 6 inches in height. Foliar treatments should be justified when 20 percent or more of the sampled plants harbor a minimum of 5 chinch bugs per plant. Fields should be sampled in several areas due to the variability in chinch bug distribution. Because the chinch bug is often found between the leaf sheath and stem, spray coverage is critical. Foliar insecticides must be applied in a minimum of 20 gpa and directed at the top of the seedling. Also, surfactants will likely increase effectiveness.

Insecticide Recommendations for Chinch Bug on Field Corn

See Tables 5-1 (page 41) and 5-2 (page 42) for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Corn Flea Beetle, *Chaetocnema pulicaria*, Coleoptera: Chrysomelidae

Description

The corn flea beetle is a very small (1/16 inch long) black beetle found on the foliage of grasses and field corn (Photo 5-4). As the adult beetle is approached, its common defensive behavior is to use its enlarged hind femurs to jump; hence the name flea beetle.

Distribution, Damage and Impact

Little is known about the corn flea beetle in Arkansas. Surveys have detected low numbers on field corn at Marianna and Des Arc; however, it likely occurs throughout the state. Adults damage field corn by feeding on the epidermis of the leaf. Damaged foliage has light-colored streaks that may give the corn a silver appearance. In addition to foliar damage, the corn flea beetle is capable of transmitting Stewart's wilt disease.

Life History

In Arkansas, the corn flea beetle adult overwinters on grasses including weeds and grass crops like wheat. With warm temperatures in late winter, adults begin to feed, mate and lay eggs in the soil near grasses and corn seedlings. Larvae develop on roots and stems within the soil, pupate and adults emerge to begin the process again. Multiple generations occur each year. Flea beetle problems are greatest following mild winters.

Management

The threshold for corn flea beetle is not clearly defined, but more than two adults per seedling (5-leaf or smaller) may warrant **foliar insecticide** application. In fields with soil-applied **insecticides at planting**, it is unlikely that high numbers of flea beetles will develop. Many of the current field corn hybrids possess some resistance to Stewart's wilt.

Insecticide Recommendations for Corn Flea Beetle on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Corn Thrips, *Frankliniella* spp., Thysanoptera: Thripidae

Description

Corn thrips are minute insects found on the leaf surfaces of field corn. Adults are black and about

1/16 inch long (Photo 5-5). Two pairs of wings are present and long hairs occur on the edges of the wings. Immature thrips are smaller and lighter in color.

Distribution, Damage and Impact

Thrips occur throughout Arkansas and may be abundant on seedling corn adjacent to maturing wheat. Adults and immature stages "rasp" the leaf surface with their mouthparts and feed on the exuding plant sap. The impact of thrips on field corn is not well documented, but large populations of thrips can cause yellowing of foliage and stunting of seedling field corn.

Life History

Overwintering adult thrips migrate from maturing weeds and wheat into field corn in spring and early summer. Mating occurs and females insert eggs into the corn tissue. Larvae emerge and feed by scraping the plant surface and ingesting plant sap. Maturity is reached in less than one week and pupation occurs in soil. Adults emerge in about four days and the cycle is repeated. Several generations occur annually in Arkansas.

Management

Because of the sporadic occurrence of thrips on field corn, their impact is not fully understood and management decisions are difficult. **Foliar insecticides** directed at the top of corn seedlings and applied in large volumes of water can be used to reduce the number of thrips. Economic benefits of these applications are not well established, however. **Field location** may play a major role in thrips management as large thrips populations may move from maturing wheat into adjacent crops.

Insecticide Recommendations for Corn Thrips on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Cutworms Including the Black Cutworm, *Agrotis ipsilon*, Lepidoptera: Noctuidae

Description

Cutworm larvae are dark grey to black caterpillars that can generally be found just below the soil surface feeding on seedling field corn. Although larvae are minute, less than 1/8 inch long at hatching, they are not likely to be detected until they are at least 1/2 inch long. At maturity larvae are almost 1.5 inch in length (Photo 5-6). The caterpillars have three pair of true legs on the thorax and five pair of fleshy “prolegs” on the abdomen.

Distribution, Damage and Impact

Cutworms occur throughout the U.S. and throughout Arkansas. Recent surveys have detected large populations near Stuttgart and Des Arc. Larvae feed on emerging seedlings and often cut off the plant near or below the soil surface (Photo 5-7). Several adjacent plants within the drill line can be killed by a single cutworm. During 2002, damage was severe in field corn near Des Arc, and several fields required replanting. Also, rough or cloddy soil appears to harbor larger cutworm populations.

Life History

Cutworms generally are capable of overwintering as pupae in soil in Arkansas, especially in southern counties. In addition to adults emerging in late winter from the overwintered pupae, adult moths fly into Arkansas from more southern states. Moths lay eggs on many weed hosts and crops, including field corn. Newly hatched larvae can produce “shot holes” in corn foliage. Larger larvae often cut the seedling and feed below the soil surface. Where damage occurs, larvae can be detected by removing the upper layer of soil near a damaged plant. The number of generations per year varies from one to three depending on cutworm species.

Management

The first step in cutworm management is proper **crop rotation**. Corn that follows corn or corn planted in recently turned pastures tends to have more damage from cutworms. Also, adults are attracted to fields with weeds on which eggs are laid. Thus, **early seedbed preparation** prior to planting reduces the likelihood of cutworm damage.

Providing a minimum of two weeks of host free time prior to planting should reduce the attractiveness of the field to cutworm adults. Reduced or no-till fields are more susceptible to economic losses from cutworms. Also, seed beds prepared during wet conditions are often cloddy. These may later harbor increased numbers of cutworms. Bed knockers or flat rolling beds can reduce the chances of developing damaging cutworm populations. In areas with histories of cutworm problems, **treated seed or soil insecticides** applied at planting may be justified. **Foliar insecticide sprays** may be used to reduce cutworm populations, but early scouting for damage is critical. Foliar insecticide sprays should only be used when the damage levels exceed the threshold of 6 to 8 percent of the seedlings with cutworm damage above the surface of the ground or 2 to 4 percent of the plants cut below the surface. Finally, insecticide success may be reduced when late stage larvae are targeted as most of their time is spent underground.

Insecticide Recommendations for Cutworms on Field Corn

See Tables 5-1 and 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Seedcorn Maggot, *Delia platura*, Diptera: Anthomyiidae

Description

Adult seedcorn maggots resemble house flies but the body is somewhat slimmer and, at rest, wings are held more backward directly over the abdomen. The damaging form is the larval stage. Larvae can be found attacking germinating seed. At maturity, they are creamy white and about 1/4 inch long (Photo 5-8). A distinct head and legs are lacking.

Distribution, Damage and Impact

Seedcorn maggots occur worldwide and throughout Arkansas. Many crops are attacked, including field corn. Most problems in field corn

occur in fields high in organic matter content. Freshly plowed fields with decaying grass and weeds are especially attractive to adult flies which lay eggs near the decaying plant material. When corn is seeded into this ground, the developing maggots often move to the corn seed and can reduce germination, seedling vigor and stand.

Life History

In northern states, the seedcorn maggot overwinters as a pupa within the soil. All stages can be found during mild winters in Arkansas. As spring nears, adults seek decaying organic matter for egg deposition. After hatching, larvae feed for one to three weeks and pupate within the soil. Adults emerge and renew the cycle. Multiple generations occur each year in Arkansas.

Management

Planting in soils with fully **decomposed plant material** should reduce the attractiveness of the field to adult flies. Damage also is more severe in fields where seed are slow to germinate and where seedling growth is retarded. Thus, **delaying planting** until soil is warmer will reduce the impact of the seedcorn maggot. **Treated seed and soil insecticides** applied at planting are effective tactics. Use of insecticide sprays after maggot problems are detected on germinating seed or seedlings is of no benefit.

Insecticide Recommendations for Seedcorn Maggot on Field Corn

See Table 5-1 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Sugarcane Beetle, *Euetheola humilis regiceps*, Coleoptera: Scarabaeidae

Description

Adult sugarcane beetles are hard, shiny black scarab beetles found in seedling corn at or just below the soil level (Photo 5-9). Larvae can be found in mid-season corn through late summer. Larvae are cream colored grubs also found in the soil.

Distribution, Damage and Impact

Surveys have detected adult sugarcane beetles in southern Arkansas near Pine Bluff and Arkadelphia. The adult produces the major damage. Seedling corn is burrowed into at the base of stems generally at the soil line (Photo 5-10). Plants are weakened and may not fully develop. The greatest threat is in fields recently converted from pastures to corn and in reduced tillage systems with substantial grasses. In Arkansas, impact of sugarcane beetle on field corn has been minimal during the last four seasons.

Life History

Adult beetles overwinter in soil, particularly in grassy areas. With warm spring temperatures, adults are attracted to emerging corn seedlings and begin to cut a small chamber in the stem near or just below the soil level. Eggs are laid in soil in corn fields, and developing larvae feed on corn roots but cause little damage. Larvae pupate in late summer and adults emerge and seek overwintering sites. One generation occurs each year.

Management

In south Arkansas **avoidance of recently plowed grassy fields**, including pastures, will reduce the attractiveness of the field to adult sugarcane beetles. Damage also is more severe in fields where seed are slow to germinate and where seedling growth is retarded. Thus, **delaying planting** until soil is warmer will reduce the impact of the sugarcane beetles. **Treated seed and soil insecticides** applied at planting also are effective tactics.

White Grub, *Phyllophaga* spp., Coleoptera: Scarabaeidae

Description

White grub is generally a term given to the larvae stage of a group of over 200 species of scarab beetles. Adult descriptions vary greatly, but the most common is referred to as the May beetle. These adults are commonly found at lights during late spring and summer nights. May beetles are about 1 inch long and tan to dark brown in color. Larvae are cream colored scarabs with a tan head capsule and dark internal markings on the end of the abdomen (Photo 5-11). Six true legs are easily seen on the thorax.

Distribution, Damage and Impact

White grubs occur in the soil of corn fields throughout Arkansas. Damage may occur when the grubs feed on underground roots. However, in recent surveys the impact of white grub has been minimal. Fields recently converted from pastures are most susceptible.

Life History

The biology of white grubs varies greatly due to the many different species. In general, adults emerge in the spring, mate and deposit eggs in a cell below the soil line. Larvae hatch and can complete their development through the summer and fall or may take two or more years to mature. Pupation occurs in the soil.

Management

In south Arkansas **avoidance of recently plowed grassy fields**, including pastures, will reduce the attractiveness of the field to adult beetles. **Rotation** of corn with broadleaf crops, especially soybean, will reduce the likelihood of damage. Use of **treated seed or soil insecticides** applied at planting may reduce larval populations but is not likely to be economically effective if directed only at the white grub.

Insecticide Recommendations for White Grub on Field Corn

See Table 5-1 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Wireworm, Coleoptera: Elateridae

Description

Several species of wireworms occur in Arkansas, and descriptions of the different species vary. In general, wireworm adults, also known as click beetles, are dark brown hard-bodied beetles. The term “click” comes from the ability to snap the hinge between the thorax and abdomen, resulting in

a flip that rights the upturned insect. Size varies but adult wireworms in field corn are about 1.25 inch long. Larvae occur in the soil. Although the larvae of some species are white, the most common in Arkansas is tan and at maturity about 3/4 inch in length (Photo 5-12). True legs are evident and the head is somewhat flattened.

Distribution, Damage and Impact

Wireworms occur throughout the state, but the major damage resulting from their feeding has been observed in Clay County in northeast Arkansas and near Paris in Logan County. Larvae feed on newly planted seed, emerging seedlings and can be found infesting the lower stems of larger corn plants (Photo 5-13). Damage in some fields has been substantial, and at times fields have been replanted due to stand loss.

Life History

The biology of wireworms is also quite variable. Some species complete two generations per year while some require up to 5 years for a single generation. In general, adults emerge from overwintering larvae in the spring and search for grassy fields. Eggs are laid in the soil, usually where grasses are available for the larvae to feed. When corn is planted, the seed and emerging seedlings are burrowed into. Seedlings can be weakened and killed. Wireworm larvae can be found by carefully digging up weak seedlings and searching the soil. In dry conditions, wireworm larvae move deep into the soil and are difficult to detect.

Management

In Arkansas, **avoidance of recently plowed grassy fields**, including pastures, will reduce the likelihood of damage from wireworms. **Crop rotations**, i.e., corn following a broadleaf like soybean, will reduce damage, but with wireworms that require multiple years for development, damage may be substantial. Damage also is more severe in fields where seed are slow to germinate and where seedling growth is retarded. Thus, **delaying planting** until soil is warmer may reduce the impact of the wireworms. Although the use of treated seed and soil insecticides applied at planting may provide some control, wireworm problems persist in Clay County despite insecticide application. Foliar insecticide application to seedlings is of no benefit.

Insecticide Recommendations for Wireworms on Field Corn

See Table 5-1 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Aphids, including the Corn Leaf and Bird Cherry-Oat Aphids, *Rhopalosiphum* spp., Aphididae: Homoptera

Description

Aphids found on Arkansas field corn are minute (less than 1/8 inch long) blueish-green insects (Photo 5-14). Clear membranous wings may be present, but wingless forms are more common. Aphids occur in colonies which contain different size nymphs and adults. As the newly born nymphs increase in size, molting occurs and the white exoskeleton is left on the leaf surface.

Distribution, Damage and Impact

Aphid species that attack field corn occur throughout the state and are often found in the whorl of the plant during mid to late summer. Late planted corn is generally more susceptible to damage from aphid feeding. Aphids feed by inserting their stylet or beak into the plant tissue and removing plant sap. Large amounts of sap are removed and the partially digested contents are excreted onto the plant surface in the form of a clear sticky honeydew. A dark grey mold may later form on the honeydew. The level of injury in Arkansas field corn appears to be minimal and generally does not require management. Aphids also transmit viral diseases, but aphid control is not effective in viral disease management.

Life History

Aphids are capable of overwintering on alternate host plants in Arkansas. Also, winged aphids are carried into the state each spring on winds coming from more southern areas. Adults colonize grassy hosts and field corn seedlings, and reproduce asexually through the summer. Development of

nymphs is rapid, and many generations occur each season. As temperatures peak during mid to late summer, reproduction rate declines. Thus, early planted corn that matures in August generally is less susceptible to aphid population increase. Later planted corn, however, may experience large aphid populations in early fall. Also, foliar insecticides applied for corn borer management in mid to late summer may reduce beneficial insect populations, and result in aphid population increase.

Management

Early planted corn rarely harbors large aphid populations. In late planted corn, aphid populations may be very high, but when this population buildup occurs on maturing corn, aphid management will likely have little economic benefit. Excessive aphid populations on actively growing corn may be managed with **foliar insecticides**, but the benefits may be very limited. Numerous **beneficial organisms** affect aphids, including naturally occurring insect pathogens, parasites and predators, and insecticide use may reduce their effectiveness. Some corn hybrids possess some level of **resistance** to the aphid.

Insecticide Recommendations for Aphids on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Corn Earworm, *Helicoverpa zea*, Lepidoptera: Noctuidae

Description

Adults of the corn earworm, also known as the cotton bollworm, are light tan in color and are about 1.25 inch long. Moths generally have green eyes. Eggs are near white when laid but darken just prior to larvae emergence. Larvae are initially minute, about 1/16 inch, but at maturity can reach 1.75 inch in length. Three pair of true legs occur on the thorax and four pair plus an anal pair are found on the abdomen (Photo 5-15). Color of larvae varies

greatly. Mature larvae that have developed on foliage are mostly green while those developing on ears are reddish brown with longitudinal lines. The pupal stage occurs in soil, and color ranges from light tan shortly after pupation to dark brown just prior to moth emergence.

Distribution, Damage and Impact

All stages of the corn earworm can be found throughout Arkansas, and resulting damage may be severe. This damage occurs in several forms, including foliar damage to young corn, damage to tassels and silks and direct damage to kernels (Photo 5-16). The corn earworm also plays a role in occurrence of aflatoxin. Damage to corn ears may serve as an entrance for the fungi responsible for producing aflatoxin.

Life History

Adults that are active in late winter arise from two sources – overwintering pupae and flights of moths from southern areas. Adults are attracted to many host plants, but flowering plants are favored. Eggs are deposited on foliage of seedling corn and larvae consume large amounts of foliage. When accurate counts are made, however, the percentage of seedling corn plants infested with corn earworm is generally very low and control is not feasible. Later generations deposit eggs on silks and emerging larvae chew down the silk channel to the developing ears. Again, use of foliar insecticides to reduce damage on ears is not economically effective on Arkansas field corn. Regardless of host plant structure on which the larvae develop, mature larvae move to the ground and pupate within the upper 6 inches of soil. In Arkansas three or four generations occur each year.

Management

Foliar insecticides are not practical for corn earworm management on field corn, and their use may ultimately increase the problem. Numerous **beneficial organisms** affect corn earworm, including naturally occurring insect pathogens, parasites and predators, and insecticide use may reduce their effectiveness. Soil insecticides may have some effect on larvae attacking seedling corn but are not practical if directed only at the corn earworm. Some corn hybrids possess some level of **resistance** to the corn earworm. Finally, the use of **transgenic Bt**

corn likely has some impact of reducing damage to foliage and ears. Future transgenic lines may possess much stronger toxicity to the corn earworm.

Insecticide Recommendations for Corn Earworm on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

European Corn Borer, *Ostrinia nubilalis*, Crambidae: Lepidoptera

Description

Corn borers, including the European and southwestern corn borers, are the two most destructive insect pests of field corn in Arkansas. European corn borer adults are small, about 3/4 inch in length, and fragile moths. At rest the wings are held back over the abdomen but with a more pronounced “V” shape than wings of the southwestern corn borer. Wings are yellow and brown and exhibit a zigzag pattern (Photo 5-17). Males are slightly smaller and darker than females. In Arkansas, European corn borer adults may be confused with adults of the garden webworm, *Achyra rantalis* (Guenee), a much more common but slightly smaller moth. European corn borer eggs are laid in masses of up to about 25 cream colored eggs in an overlapping fish scale arrangement. Upon hatching, European corn borer larvae are about 1/16 inch in length and resemble newly hatched southwestern corn borer larvae. Their abdomens, however, lack the reddish tint on newly hatched southwestern corn borers. As larvae mature, they become more easily distinguished (Photo 5-18). The tubercles of the European corn borer larvae are less pronounced than on southwestern corn borer larvae, and the upper integument is darker than the lower integument.

Distribution, Damage and Impact

The European corn borer is more widely distributed in Arkansas than the southwestern corn borer. European corn borers can be found

throughout the Arkansas River Valley, north central, northeastern and eastern Arkansas. None have been found in southwestern or southeastern Arkansas during recent surveys. Impact of European corn borer larvae on Arkansas field corn is severe. Shortly after hatching, first generation larvae wander over the leaf surface and begin to feed on unfolding leaves. This feeding removes most of the leaf surface, leaving only a thin layer of the upper or lower epidermis. Damage often appears as elongated “window panes” parallel to the leaf veins. Young larvae also feed completely through leaves still rolled in the whorl. As these leaves unfold, a “shot-hole” appearance may be observed (Photo 5-19). Second generation larvae attack most structures on the corn plant. Ear shank tunneling results in ear loss at harvest and stalk tunneling reduces kernel size and yield. Additionally, European corn borer larvae are likely to feed directly on ears. Although ear feeding likely has little adverse impact on yield, this feeding may serve to introduce pathogens that increase losses.

Life History

Mature European corn borer larvae overwinter in corn stubble and other host plant material in Arkansas. In April and May, European corn borer adults begin to emerge from overwintering sites and mate. Egg laying begins about two days after emergence and continues for about one week. Most eggs, however, are deposited during the first two nights. Eggs are very small, less than 1/32 inch in diameter and, like the southwestern corn borer, are overlaid in a mass resembling fish scales. Egg masses generally consist of about 25 eggs. The entire egg mass is only about 1/4 inch in diameter. Eggs are laid primarily on the top and bottom of fully expanded leaves and when ears are present, second generation eggs are most often found on leaves within three nodes above or below the ear. Egg development also resembles that for the southwestern corn borer. With warmer temperatures, larvae hatch in about five days while requiring six or seven days in early season when temperatures are lower. European corn borer larval behavior is also similar to the southwestern corn borer larvae. First generation larvae feed on the outer leaf layers for about 10 days and later tunnel into the whorl and stalk. Damage consists primarily of “shot holes.” Second and later generation larvae damage ears, ear shanks and stalks. European corn borer larvae are also capable of tunneling within the upper stalk just below the

tassel. This often results in tassel breakage. In 1998, numerous corn fields in eastern Arkansas experienced complete tassel loss due to European corn borer.

Management

Management tactics follow the description of the southwestern corn borer.

Southwestern Corn Borer, *Diatraea grandiosella*, Crambidae: Lepidoptera

Description

Adults are inconspicuous white moths about 3/4 inch in length and have no obvious patterns on the wings (Photo 5-20). Females are slightly larger than males. At rest, adults fold wings almost parallel to the abdomen. Newly hatched larvae are less than 1/8 inch long and have a black head capsule and reddish tint on the abdomen. At maturity, larvae are about 1.25 inch in length, have a reddish head capsule and possess numerous black tubercles on their integument (Photo 5-21). These spots and the consistency of off white color of the integument on both the dorsal and ventral sides of the larvae are the most obvious distinguishing characteristics of southwestern corn borer larvae. In contrast, the spots are reduced and the dorsal integument is darker on European corn borer larvae.

Distribution, Damage and Impact

The center of southwestern corn borer activity in Arkansas is likely near West Memphis. Recent surveys have detected almost 100 percent of non-Bt field corn plants near Marianna and Marion infested with southwestern corn borers. As distance from West Memphis increases, frequency of southwestern corn borer generally decreases. However, damage is severe into Clay, Monroe and Woodruff Counties. Damage is similar to that caused by the European corn borer as described above. Loss of foliage by first generation southwestern corn borer larvae is generally minimal and has little direct effect on corn plants in Arkansas. However, some larvae may tunnel down through the whorl to the growing point of the plant. Leaf tissue above the point of feeding can turn white, a condition called “white heart.” If feeding is extensive the plant may be stunted or killed. This condition is called “dead heart” (Photo 5-22).

When the southwestern corn borer first invaded Arkansas during the 1950s, entire fields were lost to “dead heart.” Recent surveys of field corn in eastern Arkansas detected only low numbers of plants with “dead heart.” In these fields, non-infested plants adjacent to plants with “dead heart” appeared to compensate for the lost plants and thereby limit yield loss. Stalk tunneling is often severe, and as much as 50 percent of the entire length of stalk can be damaged. Yield losses are difficult to assess, but use of the highly effective Bt corn has resulted in yield increases of up to 80 bushels per acre. Tunneling by southwestern corn borer in stalks may weaken them to the point of breaking and falling across the rows. This is called “lodging” (Photo 5-23). In Arkansas, lodging from southwestern corn borer has been common in the eastern and northeastern portions of the state. In 1998, lodging in some corn fields was about 30 percent of the total number of stalks. Lodged stalks slow harvest operations, and yield can be significantly reduced.

Second and third generation southwestern corn borer larvae also feed on the ear shanks – the stem connecting the ear to the stalk. Near harvest, affected ears droop instead of pointing upward like non-infested ears. In a field located at Marianna, 46 percent of the ear shanks were infested by corn borers in 1999. Although many of the infested ears are still harvested, many fall to the ground before or during harvest, which significantly reduces yield.

Yet another way in which the southwestern corn borer affects corn yield is by reducing the size of kernels. Preliminary studies conducted during 1999 sought to correlate the extent of tunneling in stalks below the ear with kernel size. Although the effect was limited, kernel size was negatively correlated with increase in tunneling in stalks below the ear. Tunneling may reduce water and nutrient movement within stalks, thereby limiting kernel development.

Life History

The southwestern corn borer overwinters as a mature cream colored larvae just below the soil line in the stem/root mass of field corn. Adults emerge from corn stubble in spring (May). Mating begins within one night from emergence, and moths generally initiate egg laying or oviposition on the second night after emerging. Eggs are off white in color when laid, and may occur singly or in a small group

(Photo 5-24). Individual eggs are very small; i.e., less than 1/16 inch across, elliptical and flattened on the leaf surface. Female moths may lay more than 300 eggs. However, under field conditions it is uncommon to find more than four southwestern corn borer eggs in a group.

The eggs laid by overwintering corn borers represent the first generation of the year. Common plant locations to find first generation eggs are upper and lower leaf surfaces of young corn plants. Although eggs from subsequent generations may be detected on much of the plant, most will occur on leaves within the area located two or three nodes above or below the ear. About one day after being laid, each southwestern corn borer egg develops three reddish orange bars (Photo 5-25). Tiny black spots, which are the head capsules of the developing larvae become visible after three or four days. Larvae within these eggs will emerge within about one additional day. The duration of the egg stage is dependent on temperature. Rolston (1955) reported that most southwestern corn borers hatched six or seven days after being laid in early July, when temperature averaged 71°F. With average temperatures of 80° to 83°F, most eggs hatched in four to five days, respectively.

First generation larvae that complete development, pupate within corn stalks, and second generation moths emerge in mid summer. These moths behave similarly to those of the first generation by mating and ovipositing. By the time oviposition of the second generation occurs, the corn plant is decidedly different in structure. At this time ears are often present. Second generation southwestern corn borer moths exhibit a strong preference for depositing eggs on foliage near the ear. About 80 percent of the second generation eggs can be found within three nodes above or below the ear. When these second generation larvae hatch, the corn plant offers much more structure for the young larvae to penetrate and hide within. The outer layers of ear shuck are often penetrated by young southwestern corn borer larvae. By searching for brown spots on the shuck and carefully removing the outer layer, young larvae may be detected.

Second generation larvae can develop within the ear, particularly the ear shank, but more commonly develop by feeding within corn stalks. Second generation southwestern corn borer larvae affect

corn plants in several ways. Most commonly, larvae form extensive tunnels within stalks. When stalks are infested with multiple larvae, the tunnels can run from the soil line up through about 15 plant nodes. Just prior to pupation, larvae can terminate a tunnel just below the stalk surface. They leave only the outermost layer of stalk, which soon turns brown. This forms an exit hole. After larvae pupate within the tunnel, the adult moth pushes out through the exit hole and leaves the stalk to again mate and begin egg laying.

Management – Southwestern/European Corn Borer

Both the southwestern and European corn borers are managed with four methods.

1. Early planting – Corn planted early in the season may reach maturity before the second generation corn borer larvae can negatively impact yields. Planting dates vary with location, weather and ground preparation. In eastern Arkansas corn planted before April 15 can often avoid much of the damage caused by the second generation of corn borers.

2. Stalk destruction following harvest – Both the southwestern and European corn borers overwinter as larvae within old stalks. With environmental changes associated with spring, the larvae initiate pupation and emerging adults begin the cycle of egg laying. Research has consistently shown that stalk destruction can reduce overwintering corn borer populations by greater than 80 percent. From the insect management view, the most effective method of stalk destruction is to mow and disc stalks shortly after harvest in late summer or early fall. This leaves the overwintering larvae on or near the soil surface where the effects of low temperatures and rainfall have their greatest effect on producing larvae mortality. Natural enemies, including beneficial insects, rodents and birds, also contribute to larvae mortality in stalks left on soil surfaces. In late winter, prior to corn borer pupation, the stalk residue should be turned under as much soil as possible. This makes it more difficult for the emerging moths to make their way out of the soil.

3. Soil and foliar insecticides – Much of the corn acreage in Arkansas receives a soil insecticide at planting. This may be directed at chinch bugs,

rootworms, cutworms or nematodes. The impact of currently registered soil insecticides on corn borers is not clearly understood. At present, it is doubtful that currently registered soil insecticides directed only at corn borers provide economically acceptable returns. Additional research is currently underway to more clearly define the benefits of these insecticides.

Corn borers are susceptible to several insecticides applied to corn foliage. Difficulties with foliar insecticide effectiveness are associated with corn borer biology. First generation corn borers penetrate corn structures within about 10 days of hatching and second generation within about 7 days. After entering the plant, corn borers are very difficult to target. Thus, foliar applications must be timed precisely to be effective. While the most effective method of timing insecticides is by scouting for corn borer eggs, it is a very difficult task. Use of pheromone trap collections may provide a good indication of when to initiate scouting.

Another method of monitoring adult flight is to search for infested corn stalks. By visually inspecting the ground for insect frass and the lower portion of corn stalks for damage, corn borer larvae can be easily detected. Once found, the stalk can be cut with use of a large knife and carefully split. Both larvae and pupae can be detected. When pupae color changes from tan to dark brown, the moth will emerge within a day or two. Mating and egg laying begins one or two days after moth emergence and eggs will hatch in about five days. Thus, foliar sprays should be applied approximately seven days from first detection of dark corn borer pupae.

If scouting is attempted, one method is to cut 20 plants from each of five locations in a field. Plants should be removed from the field and foliage searched. Applications should be initiated if greater than 25 percent of the plants are infested. For first generation corn borers, granular insecticides are often chosen. Granules likely drop into the whorl better than water based sprays. Granular insecticides are not effective against second generation corn borer. For second generation larvae, sprays are the preferred choice. Spray volume is very important. In 1999, correctly timed foliar sprays provided acceptable levels of corn borer management when applied in 20 gpa. Another method of foliar insecticide application that should be successful is through center pivot irrigation where available.

4. Use of genetically modified corn hybrids –

Although field corn has been bred for many years to resist attack by corn borers, the recent development of field corn with the gene that codes for the *Bacillus thuringiensis* (Bt) toxin has met with phenomenal success. Research in eastern Arkansas and numerous other states in recent years has demonstrated that Bt corn is highly effective against both the southwestern and European corn borers. With current populations of corn borers, planting of Bt field corn will likely reduce corn borer impact to more than acceptable levels. Critical in use of Bt corn is managing its use to delay the development of resistance in corn borers to Bt. Insects have a well documented resistance to foliar applications of Bt. As highly effective as Bt corn is against corn borers, selection pressure is very high. Thus, the corn producer is faced with insects that have developed resistance to similar Bt strains and are now placing substantial selection pressure on the same insect populations. Resistance development is only a matter of time. Currently, the accepted method of delaying resistance development is to maintain a susceptible corn borer population through the planting of a portion of land with non-Bt corn. In addition to resistance development, the other major problem with use of Bt corn is with the public's acceptance of genetically modified organisms (GMO's).

Insecticide Recommendations for Corn Borers on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

Fall Armyworm, *Spodoptera fugiperda*, Lepidoptera: Noctuidae

Description

Fall armyworm adults are large bodied moths with dark grey forewings that have lighter banding. A light spot occurs near the apex of the forewings. Mature larvae are up to 1.5 inch long, and are dark brown in color with numerous black spots (Photo 5-26). The head capsule has a distinct light colored inverted "Y."

Distribution, Damage and Impact

Fall armyworm occurs throughout Arkansas and its impact on field corn is similar to that of the corn earworm. This impact occurs in several forms including foliar damage to young corn, damage to tassels and silks and direct damage to kernels. The fall armyworm also plays a role in occurrence of aflatoxin. Damage to corn ears may serve as an entrance for the fungi responsible for producing aflatoxin.

Life History

In early spring, adults migrate into Arkansas from more southern states, mate and seek suitable host plants for egg laying. Eggs are laid in masses that contain up to a few hundred eggs. Emerging larvae feed for two to three weeks and then pupate just below the soil surface. Multiple generations occur each year.

Management

Foliar insecticides are not practical for fall armyworm management on field corn, and their use may ultimately increase the problem. Numerous **beneficial organisms** affect larvae, including naturally occurring insect pathogens, parasites and predators, and insecticide use may reduce their effectiveness. The use of **transgenic Bt corn** likely has some impact of reducing damage to foliage and ears. Future transgenic lines may possess much stronger toxicity to the fall armyworm.

Insecticide Recommendations for Fall Armyworm on Field Corn

See Table 5-2 for insecticide recommendations current at time of publishing. Current updated recommendations can be found in the Cooperative Extension Service publication MP-144 and on the world wide web at www.cdms.net/manuf/default.asp. Always follow instructions on pesticide labels.

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Acknowledgments

Much of the original knowledge about southwestern corn borers was developed by Dr. L. H. Rolston, Department of Entomology, University of Arkansas, in the early 1950s shortly after the insect invaded Arkansas. Dr. Rolston studied the basic biology of this new corn pest and used the informa-

tion to devise successful management programs. This information was reported in *The Southwestern Corn Borer in Arkansas*, June 1955, University of Arkansas Bulletin 553. Today, information reported in the bulletin continues to serve as the basis for corn borer management.

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Table 5-1. 2002 Recommendations for Insecticides Applied to Soil at Field Corn Planting

Insecticide	Amount of product per 1000 row ft.	Armyworm	Chinch Bug	Cutworm	Seed Corn Maggot	Corn Rootworm	Corn Thrips	White Grub	Wireworm
Ambush	.5 fl. oz.	X		X					
Aztec 2.1G	6.7 fl. oz.			X	X	X		X	X
Capture 1.15G	6.4 - 8.0 oz.			X	X	X		X	X
Capture 2EC	.15 - .3 fl. oz.			X	X	X		X	X
Counter 15G	8 oz.		X	X	X	X		X	X
Force 3G	3 - 5 oz.		X	X	X	X		X	X
Furadan 4F	2.5 oz.				X	X			X
Fury	.16 oz.			X					
Pounce 3.2EC	.3 oz.			X	X				X
Regent 4SC	.24 oz.		X	X	X	X		X	X
Cruiser 5FS*	1.28 - 9 oz./100 lb. Seed		X	X	X	X		X	X
Gaucho*	1.34 mg AI/kernel		X		X	X	X	X	X
Prescribe*	1.34 mg AI/kernel		X		X	X	X	X	X
*Seed treatment									

Table 5-2. 2002 Recommendations for Insecticides Applied to Field Corn Foliage

Insecticide	Amount per acre	Armyworm	Aphids	Chinch Bug	Corn Earworm	Cutworms	European Corn Borer	Fall Army-worm	Flea Beetles	Grasshoppers	Southwestern Corn Borer	Stink Bugs
Ambush	6.4 - 12.8 fl. oz.	X			X	X	X	X	X		X	
Asana XL	5.8 - 9.6 fl. oz.	X	X	X	X	X			X	X	X	
Capture 2EC	2.1 - 6.4 fl. oz.	X	X	X	X	X	X	X	X	X	X	X
Fury	1.4 - 2.9 fl. oz.		X			X	X		X	X	X	
Lannate LV	.75 - 1.5 pts.	X	X		X			X	X			
Lorsban 15G	5 - 5.6 lbs.						X				X	
Pounce 3.2EC	4 - 8 fl. oz.	X				X	X	X	X		X	
Sevin XLR	1 - 2 qts.	X		X	X			X	X			
SpinTor 2SC	1.5 - 6 fl. oz.	X			X		X	X			X	
Warrior T	1.92 - 3.84 fl. oz.	X	X	X	X	X	X	X	X	X	X	X

Photo Descriptions

The following descriptions correspond to the numbered photographs on the next pages.

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|------|---|------|---|
| 5-1 | Adult chinch bug on field corn foliage. | 5-15 | Mature corn earworm larvae that has developed on field corn. |
| 5-2 | Chinch bug nymph. | 5-16 | Corn earworm damage to the whorl of field corn. |
| 5-3 | Field corn seedling damaged by chinch bug and showing distortion, yellowing and delayed leaf unfolding. | 5-17 | Adult European corn borer. |
| 5-4 | Adult corn flea beetle and foliar damage. | 5-18 | Mature European corn borer larvae with dorsal integument darker than ventral integument. |
| 5-5 | Adult thrips on field corn foliage and resulting damage. | 5-19 | Shot holes produced by corn borer larvae on seedling field corn. |
| 5-6 | Mature black cutworm larvae. | 5-20 | Adult southwestern corn borer. |
| 5-7 | Cutworm damage to seedling field corn. | 5-21 | Mature southwestern corn borer larvae within corn stalk. |
| 5-8 | Seed corn maggot larvae and associated damage on seedling field corn. | 5-22 | Dead heart of field corn produced by corn borer larvae feeding into the growing point of the whorl. |
| 5-9 | Adult sugarcane beetle. | 5-23 | Lodging of field corn resulting from corn borer feeding damage in the lower portion of the stalks. |
| 5-10 | Gouged out feeding damage from an adult sugarcane beetle on seedling field corn. | 5-24 | Newly laid southwestern corn borer eggs. |
| 5-11 | Mature white grub larvae. | 5-25 | Southwestern corn borer eggs after two days of development. |
| 5-12 | Mature wireworm larvae. | 5-26 | Mature fall armyworm larvae feeding on kernels of corn. |
| 5-13 | Wireworm feeding damage in seed and newly emerging corn seedlings. | | |
| 5-14 | Immature and mature aphids on field corn foliage. | | |

Photographs are referenced throughout Section 5 - Major Insect Pests of Field Corn in Arkansas and Their Management



