

Corn silk Fly (suggested common name), *Euxesta stigmatias* Loew (Insecta: Diptera: Otitidae)¹

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Introduction

'Corn silk flies' are attractive, medium to dark metallic green to black colored flies with distinctive wing patterns and wing flapping behavior. They are commonly found throughout Florida's agricultural communities. Their normally saprophytic life style belies their destructive nature when it comes to their preference for sweet corn ears. Entire fields may have to be passed up for harvest if they go untreated for these destructive pests, or if individual treatments were missed due to weather, time or other constraints. Ears produced for seed and silage corn are also vulnerable to attack, but damage to these field corns often goes unnoticed due to less frequent scouting. Four species of 'corn silk flies' are known to attack corn in Florida: *Chaetopsis massyla* (Walker), *Euxesta annonae* (Fabricius), *Euxesta eluta* Loew, and *Euxesta stigmatias* Loew.

Distribution

'Corn silk flies' are found in tropical and subtropical areas of the western hemisphere. They occur throughout Florida, Puerto Rico and the Caribbean Islands, Mexico, Central and South America south to Argentina and Chile. Historically they have been pests of sweet corn in southern Texas and California, but modern reports of damage by 'corn silk flies' in the United States are restricted to Florida, Georgia and Puerto Rico. *Chaetopsis massyla* is found on corn throughout Florida and north into South Carolina,



Figure 1. *Chaetopsis massyla* on corn leaf.
 Credits: Gregg Nuessly, University of Florida.

Georgia, Alabama and Louisiana. *Euxesta eluta* is found throughout Florida and extends north only into Alabama and Georgia. *Euxesta annonae* and *Euxesta stigmatias* are found in Florida corn from Orlando south to the end of the peninsula (Goyal et al. 2011a). *Euxesta annonae* and *Euxesta stigmatias* are found in the Hawaiian Islands, but there is no record of them attacking corn there.

The genus *Euxesta* is represented by 36 species in North America north of Mexico and 69 species in the Americas south of the United States (Steyskal 1965 and 1968). At least three additional *Euxesta* species are known as corn pests in Central and South America, including *Euxesta major* Wulp, *Euxesta mazorca* Steyskal, and *Euxesta sororcula*

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(Weidemann) (Branco et al. 1994, Evans and Zambrano 1991, Frias 1981, Painter 1955, Steyskal 1968 and 1974).

The genus *Chaetopsis* is represented by seven species in North America and ten species in the Americas south of the United States with four species common to both (Steyskal 1965 and 1968). *Chaetopsis aenea* (Wiedeman) and *Chaetopsis fulvifrons* (Macquart) have also been found on corn in the United States, but only in association with stem damage caused by other insects.

Life Cycle and Description

Adults can be found throughout the year in south-central through southern Florida. The adults are adept at finding both adult and larval food sources. *Chaetopsis massyla* and *Euxesta stigmatias* complete development on sweet corn in the field in 17 (May) to 34 (Dec) days and adults live 36 to 52 days, respectively. *Euxesta eluta* completes development on sweet corn in the field in 19 (May) to 36 (Dec) days and adults live an average of 86 days. Therefore, many overlapping generations are possible each year. Tolerance to freezing conditions is unknown, but air temperatures < 3.5 °C (40 °F) forces late instar larvae to leave corn ears and seek shelter at or below the soil surface. Larvae and pupae can only be identified to species using minute structures visible with a microscope. However, adults are readily identified using several characters visible with the naked eye or a hand lens. Biology is described by App (1938), Seal and Jansson (1989, 1993), Seal et al. (1995, 1996), Hentz and Nuessly (2004) and Goyal et al. (2010a and b, 2011b, 2012a and b).

Eggs

Females cannot penetrate intact plant tissue with their ovipositor. In most cases, they deposit eggs into damaged, cracked, or decomposing plant tissue. In corn, eggs are deposited principally at the tip of the ear, within the silk, at the point of emergence from the ear (**Figure 2**). Eggs are less commonly deposited between the husk leaves and around feeding holes in the husk caused by larval fall armyworm, *Spodoptera frugiperda*, and corn earworm, *Helicoverpa zea*. Adults will deposit eggs in ears with green and browning silk; therefore, sweet corn ears are susceptible to infestation by the flies to within a few days of harvest. In the absence of ears, all four species may deposit eggs at the base of leaves, in whorls infested with fall armyworm, or in the tassel, but survival rates are much lower than when they are deposited in ears. Eggs measure about 0.85 mm in length and 0.16 mm in width. They are white in color and cylindrical in shape, with ends that taper to a broadly



Figure 2. *Euxesta stigmatias* eggs in cornsilk.

Credits: Megha Kalsi, University of Florida.

rounded point. Eggs are usually deposited in small groups of 10 to 25 upwards to 40. Many females may deposit eggs within individual ears resulting in hundreds of eggs in each ear. Duration of the egg stage is 28 to 42 hours at 26.5 °C (80 °F).

Larvae

Larvae are elongate and cylindrical in shape, with a blunt, broadly rounded posterior that tapers to a pointed head that is equipped with a pair of mouth hooks (**Figure 3**). Two peg-like, black spiracles are clearly visible on the blunt end of their abdomen. The ventral surface bears ridges and coarse spines. Larvae complete development in 10 to 16 days, passing through three instars. Mature larvae range in size from (length × width) 6.2 × 0.9 mm (*Euxesta stigmatias*) to 8.2 × 1.2 mm (*Chaetopsis massyla*). Larvae are whitish in color during the first two instars and become pale yellow during the final third instar. Larvae feed on cornsilk, cob and pre-black layer stage kernels in ears, but can also be found feeding on fall armyworm-damaged leaves and tassels within the corn whorls.



Figure 3. Last instar larvae of the cornsilk fly, *Euxesta stigmatias*.

Credits: Matthew Hentz, USDA, ARS, Ft. Pierce, Florida.

Pupae

The majority of larvae leave the ear to pupate within the top 2 cm of the soil surface. Some pupation occurs on the corn silks within or outside of the silk channel. Larvae propel themselves from the corn ears by first grabbing the end of their abdomen with their mouth hooks and then quickly flexing their muscles to flip into the air to the soil. The puparia are elongate, cylindrical, slightly flattened with the anterior end tapered to a blunt point (**Figure 4**). Pupae can be separated to genus by the shape of the posterior plate. Pupae measure (length × width) 3.9 × 1.4 mm (*Euxesta stigmatias*) to 5.0 × 1.6 mm (*Chaetopsis massyla*). *Euxesta stigmatia* pupae are light brown, while *Euxesta eluta* and *Chaetopsis massyla* pupae are redish brown in color. Puparia darken at maturity due to dark body and wing colors of the developing adult structures. ‘Corn silk flies’ complete pupal development in five to seven days in May and six to eight days in December.

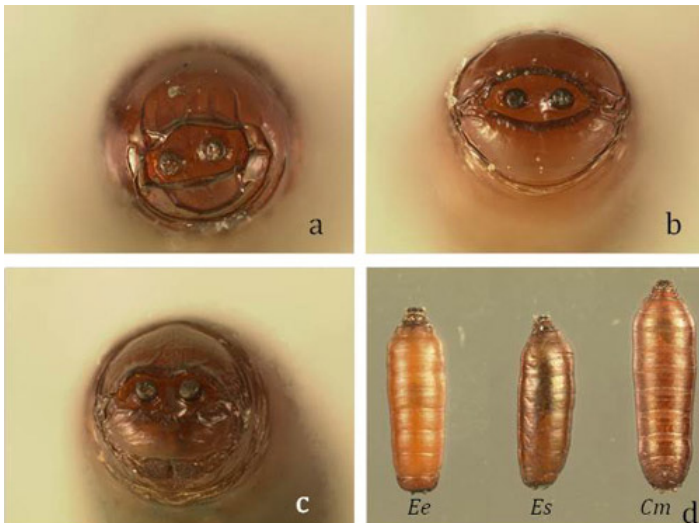


Figure 4. Pupae of ‘corn silk flies’: Posterior views of *Chaetopsis massyla* (a), *Euxesta eluta* (b), *Euxesta stigmatias* (c); view of three species; Ee, *Euxesta eluta*, Es, *Euxesta stigmatias*, Cm, *Chaetopsis massyla*. Credits: Gaurav Goyal, Monsanto Corporation.

Adults

Chaetopsis massyla adult flies have a medium metallic green body, yellowish legs, and three black dark bands on the front wings (**Figures 4 and 5**). Adults of *Euxesta* spp. attacking corn in Florida are dark metallic green to black, with brown to black legs, and four pale to dark brown bands on the front wings. The arista is attached to a pointed first antennal segment in *Chaetopsis massyla* (**Figure 6**) while a rounded one in the three *Euxesta* spp. (**Figure 7**). The wing patterns of *Euxesta annonae* (**Figure 8**) and *Euxesta stigmatias* (**Figures 9 and 10**) are the most similar of the four species, but the pattern of *Euxesta stigmatias* is

paler than *Euxesta annonae* and fades from the front to the rear wing margin. The banding pattern in *Euxesta eluta* is offset slightly between the 3rd and 4th bands resulting in a clear round to oval spot near the front wing margin that is visible no matter the wing position (**Figures 11 and 12**). Males are shorter than females in all four species. Male *Euxesta annonae* and *Euxesta stigmatias* measure about 3.8 mm in length, females about 4.2 mm. *Euxesta eluta* are slightly longer than the other two *Euxesta* spp., while *Chaetopsis massyla* are 2 to 2.5 mm longer than *Euxesta eluta*. The terminal end of the male abdomen is rounded, while that of the female ends in a trapezoid-shaped segment. The flies move their wings and walk in specific patterns in response to presence of other adults of their species, but also at other times when they are walking individually on plants. Adults are frequently observed sunning themselves early in the day, but quickly move into the shadows as sunlight grows more intense. Mating occurs principally at dusk and dawn.

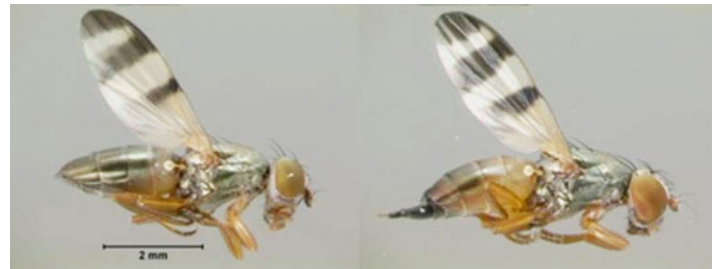


Figure 5. *Chaetopsis massyla* male (left) and female (right). Credits: Gaurav Goyal, University of Florida.

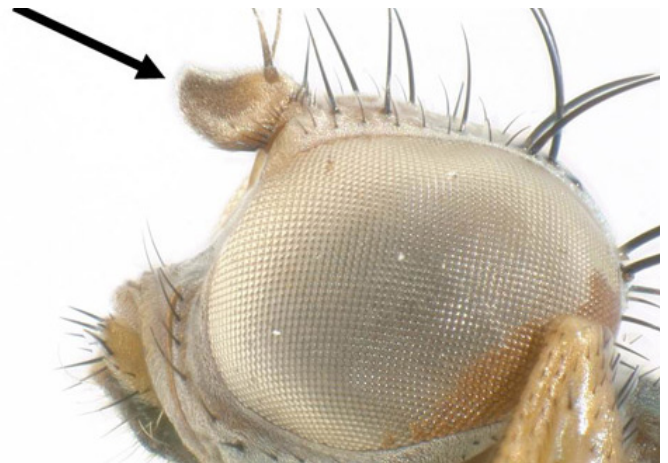


Figure 6. *Chaetopsis massyla* head showing edge of 1st antennal segment. Credits: Gaurav Goyal, University of Florida.

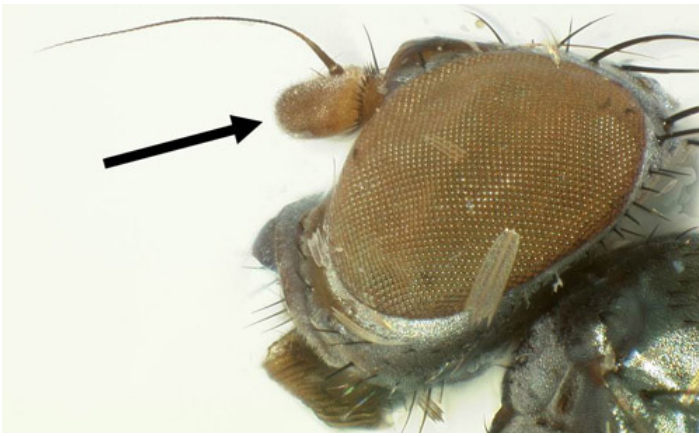


Figure 7. *Euxesta* spp. head showing rounded edge of 1st antennal segment. Credits: Gaurav Goyal, University of Florida. .



Figure 11. *Euxesta eluta* in colony. Credits: Gregg Nuessly, University of Florida.



Figure 8. *Euxesta annonae* male (left) and female (right). Credits: Gaurav Goyal, University of Florida.



Figure 12. *Euxesta eluta* male (left) and female (right). Credits: Gaurav Goyal, University of Florida.



Figure 9. *Euxesta stigmatias* on sweet corn ear. Credits: Gregg Nuessly, University of Florida.



Figure 10. *Euxesta stigmatias* male (left) and female (right). Credits: Gaurav Goyal, University of Florida.

Host Plants

Larvae and adults feed on a wide variety of discarded or culled plant matter in abandoned fields or following harvest, including many other vegetables (e.g., cabbage, tomato, and peppers), fruits (e.g., atemoya, banana, guava, avocado, and papaya), and root crops (sweet potato and radish), but they do not infest most other marketable fruits and vegetables in Florida (Goyal et al. 2012a). These flies are known to complete development in field crops (e.g., sorghum and sugarcane), weeds (e.g., spiny amaranth, little hogweed, and Johnson's grass) and native plants (e.g., southern cattail) that have been damaged by other insects [e.g., *Diatraea saccharalis* (Lepidoptera: Crambidae)] or machinery. *Euxesta annonae* has been recorded developing from annona fruit in the state; however, sweet corn and field corn are highly preferred, and the only crops to be economically damaged. Adults feed on pollen, sugary plant exudates, and fluids leaking from plant tissue damaged by their larvae, by other insects or from mechanical damage resulting from field equipment.

Damage

Plant damage is caused by the larval stage. Damage to cornsilk results in poor kernel set and resulting asymmetric kernel size and rows on the cob. The silks turn a bronzed brown color along the path of larval feeding and under heavy infestation all of the silk will be clipped off within the silk channel (**Figure 13**). While low numbers of larvae (<5) do not cause significant damage to cornsilk, larger numbers of larvae result in wet, decomposing cornsilk within the silk channel making the ear unmarketable without trimming to remove the ear tips. Larvae also feed on the tip of the cob resulting in blank tips. Larvae that feed down into the ears cut into developing kernels, where they often hollow out the kernels (**Figure 14**). Larvae may be found feeding along the entire length of the ear. Field corn kernels can also be damaged prior to the R3 stage, but in general the thicker pericarp of field corn results in fewer kernels damaged compared to sweet corn ears. Members of both genera also feed (**Figure 15**) and pupate (**Figure 16**) on developing tassels within the whorl. Yield reductions in sweet corn can reach 100%, with peak levels of damage early in the season in extreme southern Florida following summer vegetable crops (Seal and Jansson 1989, Seal et al. 1996) and at the end of the spring season in the Belle Glade region due to concentration of flies with diminishing sweet corn availability. Significant damage can occur when insecticides have not been properly timed to kill adults before they deposit eggs in ears. At-harvest ear infestations greater than 30% usually result in the field being rejected for fresh market; however, corn with minor tip damage from fly larvae, fall armyworm or corn earworms can be trimmed and marketed in tray packs without loss of quality.

Damage to tassels before they fully emerge and open from the whorl occasionally occurs due to feeding by larval *Euxesta* spp. and *Chaetopsis massyla*.



Figure 13. Damage to sweet corn silk by *Euxesta* spp. and *Chaetopsis massyla* larvae. Credits: Gregg Nuessly, University of Florida.



Figure 14. Damage to sweet corn kernels by *Euxesta* spp. and *Chaetopsis massyla* larvae. Credits: Gregg Nuessly, University of Florida.



Figure 15. Damage by *Chaetopsis massyla* larvae to sweet corn tassel within or just emerging from corn whorl. Credits: Gregg Nuessly, University of Florida.



Figure 16. *Chaetopsis massyla* pupae in sweet corn tassel within whorl. Credits: Gregg Nuessly, University of Florida.

Natural Enemies

Little is known concerning the affect of natural enemies on cornsilk flies in nature. Recent work by Kalsi (2011) provides the first quantitative information on the relative importance of predators in the laboratory. Eggs and larvae are consumed by earwigs (Dermaptera: Forficulidae), mites (Acarina), minute pirate bugs (Hemiptera: Anthocoridae: *Orius* spp.), lacewings (Neuroptera: Chrysopidae: *Chrysoperla* spp.) and rove beetles (Coleoptera: Staphylinidae). Rove beetle adults, lacewing larvae and *Orius insidiosus* adults (Figure 17) consumed 20 eggs and up to 35 1st and 2nd instar *Euxesta* spp. larvae per day in petri dish bioassays. *Orius insidiosus* nymphs also fed on eggs (Figure 18) and small *Euxesta* spp. larvae. Assassin bugs, such as *Zelus longipes* Fabricius (Hemiptera: Reduviidae) and many spider species feed on adults of all four 'cornsilk fly' species. *Zelus longipes* needs 40 to 85 minutes to complete feeding on a *Euxesta* spp. adult depending on the sex of the predator and the fly species (Figure 19). The density of these predators ranges widely in sweet corn produced in Florida depending on the season, location, rate and type of insecticides applied to control fall armyworm, corn earworm and 'cornsilk flies'. Additional work is needed to evaluate predator efficiency on larvae within corn ears and adults on the plant surface before the relative value of these predators in the field can be estimated. No parasitoids have been found associated with these species in Florida, but larval and pupal parasitoids of *Euxesta stigmatias* have been discovered in Sinaloa Mexico, Santa Fe Province Argentina, and Sete Lagos Brazil (Báez et al 2012, Bertolaccini et al. 2010, Valicente 1986).



Figure 17. Adult *Orius insidiosus* feeding on a third instar larva of *Euxesta stigmatias*.

Credits: Megha Kalsi, University of Florida.



Figure 18. First instar *Orius insidiosus* nymph feeding on a *Euxesta* spp. egg.

Credits: Megha Kalsi, University of Florida.



Figure 19. *Zelus longipes* feeding on *Euxesta stigmatias* in sweet corn field.

Credits: Megha Kalsi, University of Florida.

Management

Eggs and larvae of this insect are protected within corn ears, and pupae are sheltered beneath the soil or within the ears. Therefore, current control strategies target the adult stage. Treatment thresholds are poorly developed; however, sampling should commence before tassel push and continue up to harvest to detect adults within sweet corn fields. Adults can be difficult to observe as they are easily disturbed and frequently sit in shaded portions of the plants near the soil surface during the daylight hours. Adults are more easily detected in the early morning and late afternoon or early evening when they rest and interact with each other on the upper stalk and tassel. During silking, the silk channel should be checked for the presence of eggs, paying particular attention to the areas near the tips of the husks. Weed management within and surrounding fields is very important to reduce habitat used by the flies for protection from insecticides applied by air. Growers should

control weeds mechanically and chemically as needed prior to layby to maximize the capacity for insecticidal control of the adults.

Growers in affected areas rely on frequent insecticide applications to maintain a toxic residue on the rapidly developing corn silk. Timing and selection of insecticides is critical to reduce damage in the presence of these pests. Infested fields should be treated with effective insecticides to reduce the population before silks emerge from the ears. These flies can quickly re-enter insecticide-treated fields from surrounding crop reservoirs, particularly surrounding sugarcane and untreated sweet corn fields. Flies entering the fields are first found within 50 rows of field edges (125 ft), but spread throughout fields within 48 hours (Goyal 2010b).

Organophosphate and pyrethroid insecticides were the most effective at killing corn silk flies in bioassays conducted in 2002 (Nuessly and Hentz 2004). However, rates, formulations and pre-harvest intervals of chlorpyrifos have been reduced since that time, resulting in nearly complete reliance on pyrethroids for adult management. Residues of all effective insecticides tested kill less than 40% of flies on plants 24 hours after treatment. Therefore, frequent insecticide application is required to continue to kill new adults entering fields to reduce egg deposition within ears. To prolong the effectiveness of pyrethroids, other insecticide classes should be used to control insects during the vegetative growth, reserving pyrethroids for these flies during the ear stage. New insecticides and alternatives to insecticides are currently being evaluated to try to improve control of these important sweet corn pests. Research has found that cultivars with high levels of maysin in cornsilk have some resistance to ‘cornsilk fly’ larvae (Scully et al. 2000). GMO corn varieties that were developed to control Lepidoptera pests such as fall armyworm, corn earworm, and European corn borer do not provide any protection against these fly pests and should be rigorously scouted throughout the ear stage for these flies.

In very small fields or homeowner situations, covering the ear beginning at initial silk emergence with a homemade mesh bag (e.g., bridal veil material, 20 × 20 to 32 × 32 mesh) held tightly around the middle of the ear with string or rubber bands is an efficient method to greatly reduce egg deposition by the flies without interfering with pollination.

Similar *Euxesta* species are found in maize and vegetables throughout North America, but they are not currently considered to be pests. For example, there are 24 species of Ulidiidae in North America east of the Mississippi River,

but only four of those are considered pests. Therefore, unless you are familiar with the different species in your area, specimens should be properly identified to species by a reliable taxonomist as soon as they appear to determine whether they pose a threat to the corn crop.

For more management information, see:

[Florida Pest Management Guide for Sweet Corn.](#)

[Florida Pest Management Guide for Field Corn.](#)

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