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NEW REPORT OF *CHAETOPSIS MASSYLA* (DIPTERA: ULIDIIDAE) AS A PRIMARY PEST OF CORN IN FLORIDA

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ABSTRACT

The picture-winged fly *Euxesta stigmatias* Loew (Diptera: Ulidiidae) has been a serious pest of sweet corn in Florida since the 1930s and had been considered the only fly infesting Florida corn. In a sweet corn variety trial to evaluate *E. stigmatias* resistance in 2007, adult *Chaetopsis massyla* (Walker) (Diptera: Ulidiidae) was reared from the ears. Choice and no-choice trials were conducted in 2007 and 2008 to determine the pest nature of *C. massyla* on corn. In no choice tests, *C. massyla* pairs were caged on uninfested corn ears in green house and field trials. In choice tests, field collected corn ears were held for fly emergence. No choice tests showed that *C. massyla* could infest and complete development in ears that had no previous damage. *Chaetopsis massyla* emerged from corn ears with and without prior infestation by other insect species in choice tests. Subsequently, *C. massyla* were reared from corn ears collected from locations throughout the major sweet corn growing region of southern Florida. Therefore, we present what we believe to be the first report of *C. massyla* as a primary pest of corn ears in Florida and in the United States of America.

Key Words: corn, *Chaetopsis massyla*, *Euxesta stigmatias*

RESUMEN

La mosca *Euxesta stigmatias* Loew (Diptera: Ulidiidae) ha sido una plaga seria del maíz dulce en la Florida desde los años 1930 y ha sido considerada como la única mosca que infesta el maiz en la Florida. En una prueba para evaluar la resistencia de variedades de maíz dulce hacia *E. stigmatias* en el 2007, adultos de *Chaetopsis massyla* (Walker) (Diptera: Ulidiidae) fueron criados sobre mazorcas. Se realizaron pruebas de opción y sin opción durante 2007 y 2008 para determinar la naturaleza de la plaga *C. massyla* sobre maíz. En las pruebas sin opción, parejas de *C. massyla* fueron puestas en jaulas con mazorcas no infestadas en pruebas en hechas en un invernadero y en el campo. En las pruebas con opción, mazorcas recolectadas en el campo fueron guardadas para la emergencia de moscas. Las pruebas sin opción mostraron que *C. massyla* pueden infestar y desarrollar completemente en mazorcas que no fueron dañadas anteriormente. *Chaetopsis massyla* emergió de mazorcas con o sin infestaciones anteriores de otras especies de insectos en las pruebas con opción. Posteriormente, *C. massyla* fueron criadas de mazorcas recolectadas en sitios por toda la regióon principal donde se siembra el maíz dulce en el sur de la Florida. Por lo tanto, presentamos lo que creemos es el primer informe de *C. massyla* como una plaga primaria de la mazorca en la Florida y en los Estados Unidos.

The picture-winged fly *Euxesta stigmatias* Loew (Diptera: Ulidiidae) is a serious pest of sweet corn (Mossler 1999; Nuessly & Hentz 2004) causing up to 100% damage to untreated crops (Van Zwaluvenberg 1917). It was first described as a sweet corn pest in Florida in 1938 (Barber 1939). Fly larvae emerge from eggs deposited primarily on corn silks (styles) and feed on silks, kernels, and cobs. Economic losses can occur even in fields where insecticides are frequently applied (Seal & Jansson 1994; Seal 1996; Nuessly & Hentz 2004). While additional *Euxesta* spp. have been reported damaging corn ears in Central and South America (Painter 1955; Frias-L 1978; Diaz 1982), no other ulidiid has been reported attacking corn in Florida. However, during the course of

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a sweet corn variety trial in 2007 conducted at Belle Glade, FL, we sweep netted and reared from infested ears what appeared to be a second species. Gary J. Steck (Division of Plant Industry, Florida Department of Agricultural and Consumer Services, Gainesville, FL) identified adults collected and reared from the field as *E. stigmatias* Loew and *Chaetopsis massyla* (Walker) (Diptera: Ulidiidae).

Previously referred to as Otitidae, Ulidiidae is the family name currently accepted by dipterists and used in the BioSystematic Database of World Diptera (Thompson 2006). This family is reported to have 671 species worldwide (Anonymous 2008a), including 285 in the Americas south of the United States (Steyskal 1968). Ulidiidae is divided into 2 subfamilies, Otitinae and Ulidiinae, based on aedeagus differences (Hennig 1939). Both *Euxesta* and *Chaetopsis* belong to the subfamily Ulidiinae. The genus *Chaetopsis* is represented by 7 species in North America (Steyskal 1965) and 10 species in the Americas south of the United States with 4 species common to both (Steyskal 1968). Most species of this family have saprophagous feeding habits, although some are primarily phytophagous (Allen & Foote 1992). Genera that are considered to be phytophagous include *Chaetopsis*, *Eumetopiella*, *Euxesta, Tetanops*, and *Tritoxa*.

The literature indicates that *C. massyla* has been reared from several other monocots, but these finds have been associated with prior or concurrent insect or fungal infestations. *Chaetopsis massyla* has been reared from onions, *Allium cepa* L. (Liliales: Liliaceae) (Merrill 1951), decaying *Narcissus* bulbs (Liliales: Liliaceae) (Blanton 1938), and cattail, *Typha latifolia* L. (Typhales: Typhaceae) (Keiper et al. 2000). Allen & Foote (1992) collected *C. massyla* larvae from decomposing cattail stems previously damaged by Noctuidae (Lepidoptera) larvae and from *Carex lacustris* Willd. (Cyperales: Cyperaceae) stems previously damaged by *Epichlorops exilis* (Coquillett) (Diptera: Chloropidae) larvae. The objective of this study was to determine the pest nature of *C. massyla* on corn.

Materials and Methods

No-choice trials on sweet corn (Seminis 'Obsession') were conducted in Dec 2007 in a greenhouse and again in May 2008 in a field at the Everglades Research and Education Center (EREC), Belle Glade, FL. Pre-silking ears were protected from infestation by other ulidiids or Lepidoptera by 50-mesh cloth bags secured with rubber bands. Seven days after the start of silking, *C. massyla* male-female pairs were added to the cages and provided with 50% honey solution on cotton balls. Each ear was caged with five, 8-14 d-old pairs in the 2007 trials and one 5-15 d-old pair in the 2008 trials. As part of a larger experiment designed to evaluate fly development on uninfested ears, 8 ears and 9 ears were caged solely with *C. massyla* flies in 2007 and 2008, respectively. All ears were collected 14 d later and placed individually in 0.93 L plastic bags with paper towels in a room maintained at 26.0 ± 1°C and photoperiod of L14:D10 h. Pupae were collected from the bags and held for adult emergence on moist filter paper within parafilm-sealed Petri plates. Emerged adults were preserved in 70% ethyl alcohol.

To evaluate *C. massyla* infestation of ears in full choice tests, ears naturally infested by ulidiids were collected from 2 additional field trials conducted in 2008 at the EREC. Ears were selected randomly from the fields at harvest (21-d-old ears). Seventy-five ears were collected in May from a *Bt*-enhanced sweet corn field (Syngenta 'GSS 0966'), and 360 ears were collected in December from a standard sweet corn field ('Obsession') and examined for fly larvae within silk channels. To remove the possibility of *C. massyla* attacking only ears damaged previously by other insects, ears with fly larvae and the presence of or previous damage by Lepidoptera larvae, either *Helicoverpa zea* (Boddie) or *Spodoptera frugiperda* L. (J. E. Smith) (Lepidoptera: Noctuidae), were discarded from the samples. Ears infested only with fly larvae were held for pupal development and adult emergence as described above.

Results

No choice trials resulted in 100% infestation by *Chaetopsis massyla* with no other insects emerging from caged ears. A mean (±SEM) of 13 ± 4 (range 6 to 40) adults emerged from each ear in the Dec 2007 greenhouse trial, while 13 ± 6 (range 4 to 20) per ear emerged in the May 2008 field trail. These tests indicated that *C. massyla* could successfully colonize and develop in sweet corn ears not previously or concurrently infested with other insects.

Chaetopsis massyla emerged from ears collected in both choice field trials. In the *Bt*-enhanced sweet corn trial, *C. massyla* were found in 19 of the 30 ears infested only with fly larvae. Three of these ears were infested solely by *C. massyla* while 16 also held *E. stigmatias*. Mean *C. massyla* adult emergence per ear was 25 ± 6 (range 7 to 61) when infested only by *C. massyla* and 16 ± 3 (range 2 to 43) when infested by both fly species. Of the 50 standard sweet corn ears found infested solely by fly larvae, 42 contained *C. massyla*. Half of these were infested by only *C. massyla*, whereas the others were also infested by *E. stigmatias*. Mean *C. massyla* emergence per standard sweet corn ear was 7 ± 2 (range 2 to 21) when infested only by *C. massyla* and 6 ± 2 (range 1 to 13) when infested by both fly species. *Chaetopsis massyla* was subsequently reared from fly-

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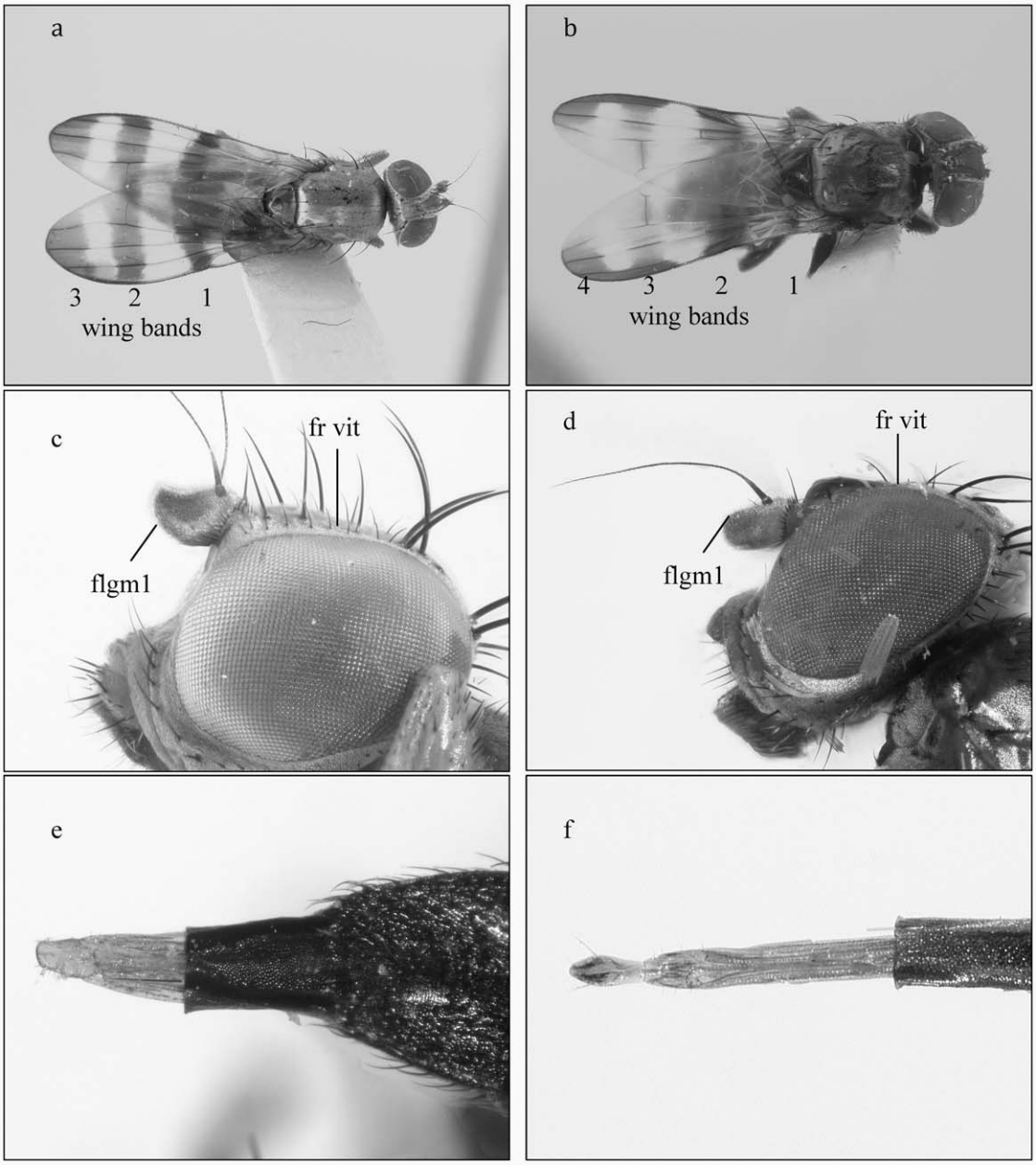


Fig. 1. Adult females of *Chaetopsis massyla* (a) and *Euxesta stigmatias* (b); heads of *C. massyla* (c) and *E. stigmatias* (d); ovipositors of *C. massyla* (e) and *E. stigmatias* (f); flgm1, first flagellomere; fr vit, frontal vitta.

infested corn ears collected from commercial sweet corn fields throughout Palm Beach County. This county is the major sweet corn producing county in Florida (Anonymous 2008b; A. Kirstein, Palm Beach Co. Coop. Ext. Economist, personal communication).

Discussion

In choice and no-choice trials, *C. massyla* successfully infested and developed in ears without prior infestation by other insect species. This is the first known report of *C. massyla* as a primary

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pest of corn ears. However, in Nov 2009, examinations of Ulidiidae specimens at the California Department of Food and Agriculture collection by S. D. Gaimari (CDFA Dipterist, personal communication) and at the Smithsonian National Museum of Natural History by G. S. Nuessly (in collaboration with Dipterist A. Norbaum) revealed *C. massyla* adults were reared from sweet corn tassels in Orange County, CA in 1942 and from corn ears in Riverside County, CA in 1996, respectively. The later specimens were collected from ears also infested with *E. stigmatias*. Labels on *C. massyla* specimens at the Smithsonian indicate they have been collected from across the continental United States.

Two other *Chaetopsi*s species are reported to feed on corn and other plants as larvae. *Chaetopsis aenea* (Wiedemann) were reared from damaged corn stems in Ohio (Gossard 1919) and decayed and smut-infected onions in Michigan (Severin & Severin 1915). Larvae of *Chaetopsis fulvifrons* (Macquart) were found in tunnels of *Ostrinia nubilalis* (Hübner) (Lepidoptera: Crambidae) within corn stalks in Texas (Knutson 1987), and from barnyard grass, *Echinochloa crus-galli* (L.) P. Beauv (Cyperales: Poaceae) damaged by *Eumetopiella rufipes* (Macquart) (Diptera: Ulidiidae) (Valley et al. 1969).

Chaetopsis massyla can be distinguished from other pestiferous ulidiids occurring in Florida corn by several characters. Wings of *C. massyla* have 3 dark bands (Fig. 1a), while *Euxesta* spp. attacking corn have a fourth band near the wing base (Fig 1b). The legs of *C. massyla* are yellow, whereas the legs of other species attacking corn are brown to black in color. The upper apex of the first antennal flagellomere is angulate or pointed in *Chaetopsis* (Fig. 1c), but is rounded in *Euxesta* spp. (Fig. 1d) (Steyskal 1987). The frontal vitta of *C. massyla* usually is bare (Fig. 1c), while it has several scattered setae or cruciate bristles in *Euxesta* spp. (Fig. 1d) (Steyskal 1987). The ovipositor is broad, depressed, thin and laminar apically in *Chaetopsis* (Fig. 1e) compared with *Euxesta* spp. where the ovipositor is narrow, soft and not laminar apically (Fig. 1f) (Steyskal 1987).

In conclusion, the results from field surveys and artificial infestation studies indicate that *C. massyla* can attack and develop within corn ears with or without prior infestation by other insect species. Larval feeding by *C. massyla* renders the ears unmarketable. Therefore, we report *C. massyla* as a pest of corn and also confirm its primary nature of attack on corn ears in contrast to reports by Allen & Foote (1992) that suggested the species was limited to scavenging or secondary invasion of plant tissues. Cooperative studies are in progress to determine the geographical distribution of corn-infesting populations of *C. massyla* throughout the southeastern United States.

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