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BIOLOGICAL NOTES ON *MELANAGROMYZA RUELLIAE* (DIPTERA: AGROMYZIDAE), A SEED FEEDER ON THE INVASIVE MEXICAN PETUNIA, *RUELLIA TWEEDIANA* (ACANTHACEAE)

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The dipteran leafminer family Agromyzidae in Florida includes 21 species of the genus *Melanagromyza* Hendel (Spencer & Stegmaier 1973). Members of this genus typically are stem borers or seed feeders rather than leafminers, and numerous plant families serve as hosts. Knowledge of the Florida species, including the subject of this paper, *Melanagromyza ruelliae* Spencer, is summarized in Spencer & Stegmaier (1973). They reported collections made during the 1960s in Dade County during the months of Apr, May, Aug, Sep, Nov, and Dec. They also reported four host plants: *Ruellia tweediana* Grisbach (as *Ruellia brittoniana* Leonard), *Ruellia caroliniensis* (J.F. Gmel.) Steud., *Blechum pyramidatum* (Lam.) Urb., and "*Stroebilanthes*" sp. [presumably *Strobilanthes* Blume], in which the larvae fed and pupated in the seed heads. All are members of the Acanthaceae. Spencer and Stegmaier (1973) noted also the presence of *M. ruelliae* in the Bahamas, and Thompson (2005) added Texas to its known range. *A eurytomid* (Hymenoptera) parasitoid that Stegmaier reared from *M. ruelliae* (Dade County, 1972 and 1973) was described by Bugbee (1975). These sources provide the only distribution records of *M. ruelliae* and the extent of our biological knowledge of it.

The genus *Ruellia* L. comprises about 150 species native to tropical and temperate North and South America (Hammer 2002). Of the 8 species occurring in Florida, 3 are non-natives that have escaped cultivation and become naturalized (Wunderlin 1998). *Ruellia tweediana* (Mexican petunia), native to central Mexico, has been cultivated for ornamental purposes since the 1940s and has become naturalized in 28 Florida counties (Wunderlin & Hansen 2004). In addition to Florida, *R. tweediana* occurs in six other southeastern states from South Carolina to Texas (Godfrey & Wooten 1981). *Ruellia tweediana* is considered by the Florida Exotic Pest Plant Council to be an invasive species that is altering native plant communities (Category I, Florida Exotic Pest Plant Council, 2006). Consequently, it is not recommended for use in north and central Florida by the IFAS Assessment of the Status of Non-Native Plants in Florida's Natural Areas (Fox et al. 2003, 2005). Of the four known host plants of *M. ruelliae* noted above, only *R. caroliniensis* is native to Florida.

Here we report the occurrence of *M. ruelliae* in Alachua, Brevard, Broward, Collier, Hillsborough, and Seminole Counties, Florida, and further details of its biology on *R. tweediana*. While conducting an ecological study of the invasive weed *R. tweediana* at Paynes Prairie Preserve State Park (Alachua Co.), a high percentage of undeveloped seed capsules was observed. These were infested with larvae and pupae of *M. ruelliae* (Fig. 1A). To examine the relationship between *M. ruelliae* and *R. tweediana*, seed capsules were collected from the Paynes Prairie site and an additional site along Hogtown Creek (Gainesville, Alachua Co.). During 6 visits to Paynes Prairie between Oct 28, 2005 and Feb 10, 2006, a total of 2,994 seed capsules was collected. Overall, 87% of seed capsules showed evidence of infestation (SD = 10.80, range 73-98%). Typically, 1 or 2 fly puparia were found in each capsule. The larvae not only destroyed seeds by direct feeding (usually <25% seeds per capsule remained viable), they also caused the capsule to desiccate which impeded seed dispersal. Normal seed capsules of *R. tweediana* (Fig. 1B) dehisce explosively (Witztum & Schulgasser, 1995), while infested capsules do not dehisce at all. In total, 235 adult flies were reared from these seed capsules. The sex ratio of a subset of preserved specimens was approximately 1.2 females : 1.0 males (n = 106). A single parasitoid, *Heteroschema* sp. (Hymenoptera: Pteromalidae) was reared from the Paynes Prairie collections. A collection of about 33 seed capsules taken at Hogtown Creek on 9 Feb 2006 yielded only a single fly, plus 10 *Heteroschema* sp. (different from the species at Paynes Prairie) and 1 *Aprostocetus* (*Aprostocetus*) sp. (Hymenoptera: Eulophidae).

Additional seed capsule collections of *R. tweediana* in September 2006 from Alachua and other counties of Florida have corroborated these findings of frequent high *M. ruelliae* infestation rates. Data for the following sites are given as: Date; Site; Number of capsules collected/Number infested with *M. ruelliae*/Number infested with an unidentified lepidopteran larva.

Sep 7; Blackwater Creek (Hillsborough Co.); 27/20/5

Sep 8; Lake Jesup (Seminole Co.); 19/4/15

Sep 20; Fakahatchee Strand State Preserve (Collier Co.); 45/34/0

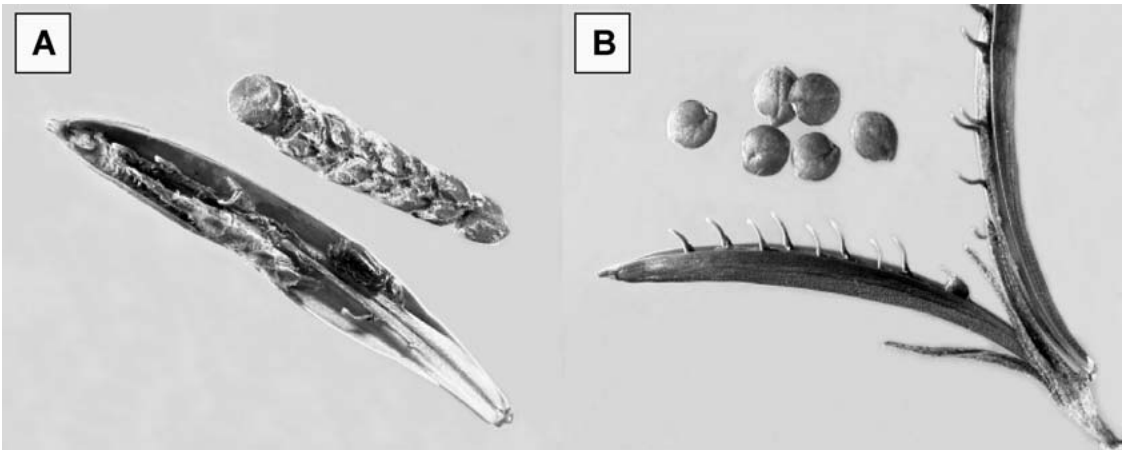

Fig. 1. A. Seed capsule of *R. tweediana* with *M. ruelliae* puparium. Some seeds are damaged, others remain clumped and do not disperse. B. Normally dehisced seed capsule and seeds of *R. tweediana*.

Sep 18; Hogtown Creek; 30/25/0

Sep 27; Paynes Prairie; 24/19/0

Also, in searching the Agromyzidae holdings of the Florida State Collection of Arthropods, we found a single female specimen apparently identical to *M. ruelliae* with label data: Brevard Co., Palm Bay, 4-XII-1992, ex *Ruellia brittoniana*.

We have not observed flies in the field and do not know at what stage of fruiting the earliest oviposition may be. Damaged seeds have been found in nearly mature, greenish seed capsules. When pupae were removed from mature capsules, adult flies emerged over a period of about 1 week.

A collection of approximately 100 seed capsules of *R. caroliniensis* in Gainesville in Jun 2004 showed no indications of damage from *M. ruelliae*. *Blechum pyramidatum* also is naturalized in Alachua County (Wunderlin & Hansen 2004), but was not examined during this study. *Strobilanthes* apparently does not occur outside of cultivation in Florida (USDA-NRCS, 2007).

Both *R. tweediana* and *R. caroliniensis* are known to produce both chasmogamous (outcrossed) and cleistogamous (small, self-fertilized) flowers (Long & Uttal 1962; Long & Lakela 1978). *Ruellia caroliniensis* produces chasmogamous flowers in the spring which rarely set fruit, while the cleistogamous flowers in the summer and early autumn produce abundant seeds (Long & Uttal 1962). Cultivated *R. tweediana* plants in Florida produce flowers and seeds year-round in controlled conditions (Wilson & Mecca 2003). In the field, *R. tweediana* plants have been observed to produce chasmogamous flowers from Jun to Sep, and cleistogamous flowers as early as Jan and as late as Nov (Huey, personal observation). Other *Ruellia* species have been found to produce cleistogamous flowers from late Jun to the first frost. It is interesting to note that the collection period for this study, Sep-Feb, coincides with the cleistogamous flowering period. Future capsule collections may be useful to compare oviposition by *M. ruelliae* in capsules from cleistogamous versus chasmogamous flowers.

Based on its long flight times in both Alachua and Dade Counties, *M. ruelliae* apparently is multivoltine. In north Florida, it is not yet known whether multiple host plant species are used or whether specific habitats might be required. The fly probably is widespread in Florida, considering the broad distribution of its known host plants.

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Summary

We report the first collections of *Melanagromyza ruelliae* (Diptera: Agromyzidae) in Florida since the 1960s, in Alachua, Brevard, Broward, Collier, Hillsborough, and Seminole Counties, the first Florida records outside of Dade County. Larvae are seed feeders of the invasive weed, Mexican petunia (Acanthaceae: *Ruellia tweediana*). Seed capsule infestation rates ranged from 73% to 98% in Alachua County. Infested seed capsules produced <25% viable seeds compared to uninfested

capsules and dispersion of seeds by explosive dehiscence was prevented due to larval feeding. Flies are multivoltine in north Florida with a flight time from at least Sep to Feb. Two parasitic species of *Heteroschema* (Hymenoptera: Pteromalidae) and an *Aprostocetus* (*Aprostocetus*) sp. (Hymenoptera: Eulophidae) were reared from fly puparia.

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