

Scientific Note

Preliminary Evaluation of *Delphastus catalinae* (Coleoptera: Coccinellidae) as a Predator of the Ficus Whitefly, *Singhiella simplex* (Singh) (Hemiptera: Aleyrodidae)

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The predatory lady beetle *Delphastus catalinae* (Horn) (Coleoptera: Coccinellidae) is an important whitefly predator, often confused in the literature with *D. pusillus* (LeConte) (Hoelmer and Pickett 2003). This beetle species is sold as a commercial biological control agent against several species of whiteflies, including the greenhouse whitefly, *Trialeurodes vaporariorum* (Westwood) (Aleyrodidae) (Lucas et al. 2004) and the Biotype "B" of the sweetpotato whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae) (Liu and Stansly 1999). The immature development and reproductive life history of *D. catalinae* feeding on *B. tabaci* have been studied at 22, 26 and 30 °C (Legaspi et al. 2008). Immature development required ~300 degree-days. As temperature was increased from 22 to 26 °C, the intrinsic rate of increase (*r*) rose from 0.048 to 0.082 and doubling time decreased from 14.4 to 8.4 d. When presented with immature *B. tabaci* (= *argentifolii* Bellows and Perring) on different host plants, predation by adult *D. catalinae* over 24 h was highest on cotton *Gossypium hirsutum* L.), followed in rank order by collards (*Brassica oleracea* var. *acephala* DC), cowpea (*Vigna unguiculata* [L.], Walpers ssp. *unguiculata*), tomato (*Lycopersicon esculentum* Miller), and hibiscus (*Hibiscus rosa-sinensis* L.) (Legaspi et al. 2006).

The ficus whitefly, *Singhiella simplex* (Singh) (Hemiptera: Aleyrodidae), is an economic pest of *Ficus* plant species in India, Burma and China, first reported in the United States in August 2007 (Hodges 2007). From initial records in Miami, Florida, its geographic range has increased to include most of southern Florida, as well as along both coasts up to central

Florida (Legaspi et al. 2013). Total duration of whitefly immature stages varied from 97.1 d at 15°C to 25.2 d at 30°C, and lifetime fecundity per female averaged 37.9 and 46.2 at 25 and 27°C, respectively (Legaspi et al. 2011). In Ft. Pierce, Florida, endemic mortality of the ficus whitefly on *Ficus benjamina* L. was attributed predominantly to entomopathogenic fungi and predation, with only about 10% due to parasitoids such as *Encarsia* spp. (Avery et al. 2011). Here, we evaluated *D. catalinae* as a potential biological control agent against the ficus whitefly.

A colony of *S. simplex* maintained at the USDA-ARS-CMAVE Center for Biological Control in Tallahassee, Florida was used in this study. The colony was started with *S. simplex* collected from ornamental ficus in Homestead, Florida in July of 2010. The colony was continuously reared on potted *Ficus benjamina* plants (~ 50 cm in height) and kept in 61 cm cubic cages which had been screened with ultrafine mesh. Cages were housed inside a laboratory at a temperature of 25 -27°C. Cages were held near a window and kept under natural light supplemented by fluorescent lamps (Sylvania Gro-Lux, Sylvania Ltd. Mississauga, ON, Canada) attached to a timer that maintained a 14:10 photoperiod. *Delphastus catalinae* were obtained from Rincon-Vitova Insectaries (Ventura, CA, USA) and were kept in a colony for ~ 15 subsequent generations. They were maintained on a constant diet of *Bemisia argentifolii* which were reared on potted collard and tomato plants. Beetles were kept in 61 cm cubic cages and were maintained at a temperature of 25-27°C with a 14:10 photoperiod.

Ficus leaves were placed in plastic petri dishes

(90 mm diam. x 15 mm depth). The dishes were positioned vertically and placed on top of plastic tubes (82 mm height x 30 mm diam.) containing water. One leaf was placed in each dish. A hole was cut into the side of the dish to allow the leaf petiole to pass into the water tube and modeling clay was used to seal the dish enclosure to the water container. Two 10 mm holes were cut in the lid of each enclosure. One hole was covered with ultra-fine screen mesh to provide ventilation. The other hole was plugged with the cut top from a plastic microcentrifuge tube which served as an access opening for the introduction of test insects. The dish enclosures were sealed with parafilm to prevent the insects from escaping.

Individual 5 cm ficus leaves were infested with *S. simplex*. Approximately ten male and ten female newly eclosed adult whiteflies were placed in each dish and allowed to mate and oviposit on the leaf surface for ~48 h. After oviposition the leaves were kept at ~26°C until the insects had reached the appropriate age for the predation trials. Tests of predation were conducted on whitefly immatures at each of three levels of development: eggs, small nymphs (2nd -3rd instars), and large nymphs (4th instar).

Once immature *S. simplex* were at the proper stage, numbers of whiteflies were counted and extra insects were removed. We tested 200 eggs, 100 2nd – 3rd instars, and 10 fourth instars per replicate trial. Adult *D. catalinae* females were starved for 24 h, then introduced into the leaf enclosure and allowed to feed for 24 h. One adult *D. catalinae* was placed inside each petri dish enclosure. The petri dish enclosures containing the ficus leaf, immature whiteflies and adult *D. catalinae* were maintained at ~26° C. After the predation period, the numbers of remaining immature whiteflies were recorded. Similar tests were also conducted using 3rd instar immature *D. catalinae*, which had been starved for one hour, as the predator. To standardize, females were used to represent the adult stage of *D. catalinae* and 3rd instar larvae were used to represent the immature stage of *D. catalinae*. Each treatment was replicated 10 times.

Immature larvae of *Delphastus catalinae* consumed 76.2 ± 5.0 eggs, 35.5 ± 7.2 2nd and 3rd instars and 3.7 ± 0.8 4th instars of the ficus whitefly. Adult *D. catalinae* consumed 147.3 ± 9.8 eggs, 39.4 ± 6.7 2nd and 3rd instars and 1.2 ± 0.6 4th instar ficus whiteflies. Similar experimental protocol was used in an earlier study on predation by *D. catalinae* on *Bemisia argentifolii* (Legaspi et al. 2006). Over a 24-h predation period, *D. catalinae* adults presented with 200 prey items of each life stage consumed on average 174 ± 9.7 whitefly eggs (mean \pm SE), 58.7 ± 9.0 small nymphs and 33.9 ± 4.8 large nymphs (Legaspi et al. 2006). A statistical analysis (t-test) was used to compare the two

whitefly species (the ficus whitefly from the current test) and the silverleaf whitefly, *B. argentifolii* from a previous test (Legaspi et al. 2006). When comparing predation between the two species of whitefly prey, adult *D. catalinae* consumed approximately equal numbers of eggs ($t = 1.94$; $df = 17.9$; $P = 0.07$) and small larvae ($t = 1.72$, $df = 17.0$, $P = 0.10$). However, significantly more large nymphs of *B. argentifolii* were eaten compared to the ficus whitefly ($t = 6.8$; $df = 9.3$; $P < 0.01$). These results suggest that *D. catalinae* is a promising biological control agent against the ficus whitefly.

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