

Florida Department of Agriculture and Consumer Services Division of Plant Industry

Pallidus beetle, *Delphastus pallidus* LeConte (Insecta: Coleoptera: Coccinellidae), a native predatory beetle of whitefly species in Florida

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INTRODUCTION: Genus *Delphastus* Casey are small whitefly-specific predatory ladybird beetles belonging to the coccinellid tribe Serangiini. They feed on all immature stages of whitefly and are reared and sold commercially all over the world for this purpose. Many of these beetles are compatible with the application of parasitoids since their larvae and adults avoid feeding on parasitized whitefly nymphs (Cloyd 2001). Within this genus, there are species which are well-known biocontrol agents of multiple whitefly species such as *Delphastus catalinae* (Horn) [formerly known as *D. pusillus* (LeConte)], *D. davidsoni* (Gordon) and *D. pallidus* (LeConte).

However, for the last six decades, there has been little information published on *D. pallidus* (LeConte), a native species to Florida (Gordon 1970; Muma 1955). In the past, its population has been low in Florida agro-ecosystem. However, it has recently been found consistently in relatively high populations on ficus hedges infested by ficus whitefly, *Singhiella simplex* (Singh), at different locations in Miami-Dade County, Florida (Ahmed et al. unpublished data) (Figs. 1–2).

In a recent survey to assess the host range of *D. pallidus*, it was found feeding on silverleaf whitefly, *Bemisia tabaci* Gennadius (also known as B biotype/MEAM1); solanum or pepper whitefly, *Aleurotrachelus trachoides* Back; bondar's nesting whitefly, *Paraleyrodes bondari* Peracchi; and cloudy-winged whitefly, *Dialeurodes citrifolii* Morgan (Figs. 1–2). Survey results indicated that *D. pallidus* could potentially be used for controlling multiple whitefly pests of horticultural importance in the region (Fig. 1).

DISTRIBUTION: The earliest prey records of *D. pallidus* in Florida were in the early 1950s when it was reported feeding on citrus whitefly, *Dialeurodes citri* (Ashmead), in Vero Beach and the Mims area in 1951, and in the Indian Rocks and Lake Alfred areas in 1953 (Muma 1955). Later it was recorded in Sand Point (Gordon 1970). Natural abundance of this predatory beetle has been reported from at least six counties in southern Florida including Brevard, Broward, Charlotte, Miami-Dade, Palm Beach, Sarasota, Martin, Monroe and Palm Beach (Peck and Thomas 1998; FDACS-DPI-Entomology sample database query, 2016). *Delphastus pallidus* has also been found in Ecuador and several Caribbean countries including the Bahamas, Cuba, Dominican Republic and the Virgin Islands (Gordon 1970).

DESCRIPTION: Genus *Delphastus* generally contains small-sized predatory beetles in the range of 0.90 to 1.60 mm in length and 0.7 to 1.25 mm in width (Fig. 6). The size of *D. pallidus* is 0.9 to 1.05 mm in length and 0.70 to 0.80 mm in width. It is comparatively smaller than other commonly known species in the genus like *D. catalinae* (1.40 to 1.50 mm in length and 1.10 to 1.18 mm in width) and *D. pusillus* (1.40 to 1.60 mm in length and 1.10 to 1.20 mm width) (Figs. 6–7). Body color is a pale reddish-brown with reddish-yellow legs. Several identification pictures of *D. pallidus* are provided (Figs. 1–5, 9–12).

Delphastus species can be placed in three broad groups based on external physical characteristics. One group contains two small, pale species, *D. nebulosus* and *D. pallidus*. The remaining species are all dark and may be divided into those with distinctly punctate elytra (*D. collaris*, *D. minutus*, *D. abditus*, *D. anthracinus*, *D. chapini*, *D. dubitalis*) and those with the elytra impunctate, or nearly so (*D. catalinae*, *D. diversipes*, *D. pusillus*, *D. argentinicus*).



It is difficult to distinguish between male and female *D. pallidus* from dorsal and ventral views. Adult beetle genitalia must be dissected and examined to determine gender. Male: genitalia with apex of basal lobe abruptly bent, asymmetrical parameres reduced and apparently absent bearing a few short setae of varying length present on basal lobe, and siphon with apex straight and blunt (Fig. 8). Female: receptaculum seminis forked, with bulbous structure on one side. The structure of the female receptaculum seminis is a characteristic for the genus, and does not differ between species (Fig. 8).

BIOLOGY: The life cycle of *D. pallidus* is influenced by the prey species. The average longevity of an adult is about 63 ± 10 , 56 ± 10 , and 27 ± 5 days when reared on pepper whitefly, bondar's nesting whitefly, and ficus whitefly, respectively at $\sim 25^\circ\text{C}$ (Ahmed et al. unpublished data). Immature development time ranges between 17 to 22 days (egg emergence = 5–7 d; larval period = 8–11 d; pupal period = 5–7 d) on the three whitefly hosts. On average, female beetles live for approximately two months, during which they lay 3–4 eggs per day. The longevity and development time of males and females are almost the same.

HOST PREFERENCE AND PREDATION POTENTIAL: Adults and larvae feed by piercing the insect with their mouthparts and alternately sucking and regurgitating the internal contents to digest and consume it (Fig. 11). All larval stages and adults of *Delphastus* sp. have potential to prey on all immature stages of whiteflies. Larvae and adults of *D. pallidus* prefer the initial development stages of whitefly including eggs, and 1st and 2nd nymphal instars. The average 24-hour predation rate of adult *D. pallidus* was 86.5 ± 5 , 68 ± 4 , 41 ± 4 eggs when fed pepper whitefly, bondar's nesting whitefly or ficus whitefly, respectively. Predation rates of adult *D. pallidus* on 1st instars over 24 hours were 46 ± 5 , 21 ± 3 and 46 ± 8 when fed on pepper whitefly, bondar's nesting whitefly or ficus whitefly, respectively.

Delphastus pallidus was observed, in both the lab and the field, feeding on at least five whitefly species with the ranking from high to low preference in initial results of host choice experiments; bondar's nesting whitefly > silverleaf whitefly > pepper whitefly > ficus whitefly > rugose spiraling whitefly.

[Video 1](#). Predatory beetle, *D. pallidus* feeding on solanum whitefly, *Aleurotrachelus trachoides*, eggs and immatures. [Video 2](#). The 2nd instar of predatory beetle, *D. pallidus* feeding on Ficus whitefly eggs and adults. [Video 3](#). The 4th instar of predatory beetle, *D. pallidus* feeding on Ficus whitefly eggs. Videos credit: M.Z. Ahmed

MAINTAINING POPULATION IN THE FIELD: Adult females prefer to feed on eggs and first instars compared to later whitefly stages. Female beetles are capable of consuming over 200 eggs per day to complete egg production. Therefore, *D. pallidus* may be of limited benefit where whitefly populations are low. However, this beetle species is able to survive on whitefly honeydew in the absence of hosts. Additionally, they are strong fliers that can search and locate plants containing high densities of whiteflies.

In order to support existing population of the beetle in the field, it is important to carefully monitor population levels by searching for beetle eggs, larvae, adults or their exuviae before any pesticides are applied. Natural enemies, including predators, may encounter pesticides directly from foliar sprays or residues on plant surfaces, but may also be exposed indirectly through ingestion or exposure to pesticide-treated hosts (prey). Some insecticides can be severely detrimental to *D. pallidus*. Therefore, the presence of an untreated refuge, such as banker plants can allow natural enemies to escape pesticide exposure, and help their establishment and persistence in the agro-ecosystem. Insecticide applications can also be manipulated by adjusting timing, placement or method to minimize exposure to predators.

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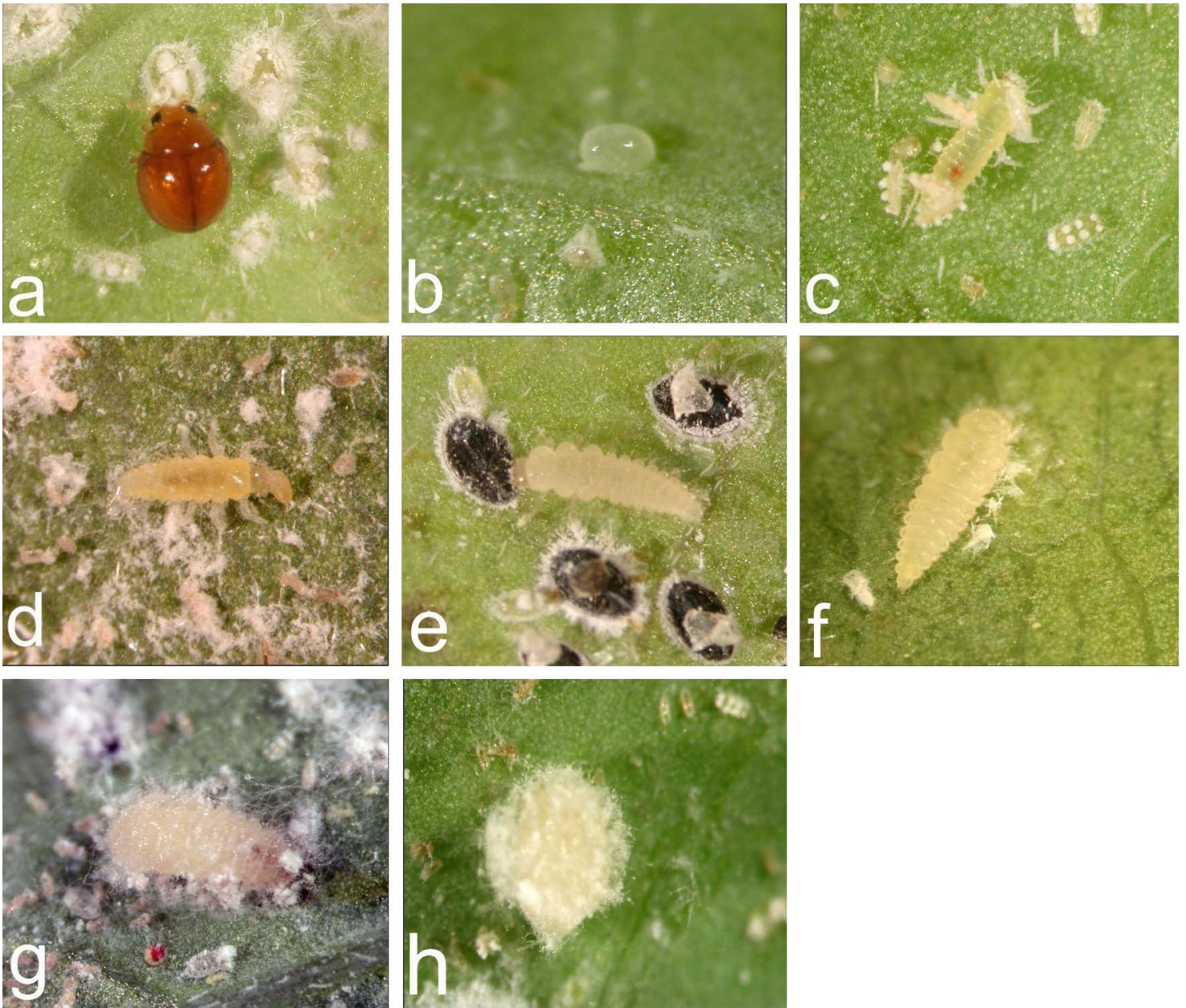


Fig. 1. Life stages of the predatory beetle, *D. pallidus* after feeding on pepper whitefly: (a) adult, (b) egg, (c) 1st instar, (d) 2nd instar, (e) 3rd instar, (f) 4th instar, (g) prepupa, and (h) pupa. Photo credit: M.Z. Ahmed and Y.V. Hernandez

Disclaimer: the visual sizes in the pictures are not corresponding to the actual physical sizes of stages. The pictures were taken at different times and with different zoom and magnification settings.

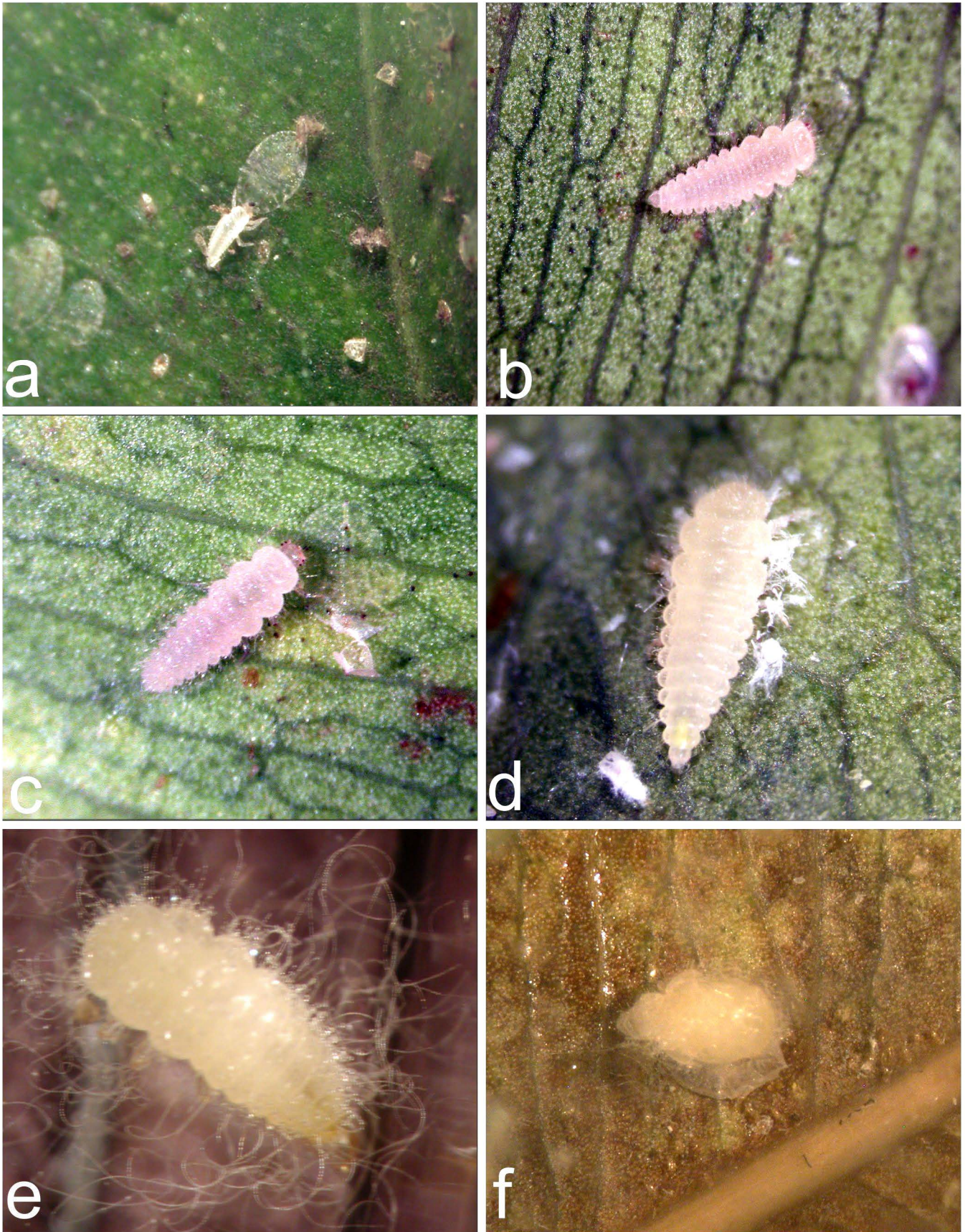


Fig. 2. Life stages of the predatory beetle, *D. pallidus* after feeding on ficus whitefly: (a) 1st instar, (b) 2nd instar, (c) 3rd instar, (d) 4th instar, (e) prepupa, and (f) pupa. Photo credit: M.Z. Ahmed and Y.V. Hernandez



a



b



c



d

Fig. 3. Adult of predatory beetle, *D. pallidus*: (a) naked eye view, (b) microscopic dorsal view, (c) microscopic ventral view, and (d) microscopic lateral view (with 20X magnification). Photo credit: M.Z. Ahmed and Y.V. Hernandez



b

Fig. 4. The naked eye view of larvae and adult of predatory beetle, *D. pallidus*: (a) on ficus whitefly infested ficus leaf, and (b) on pepper whitefly infested *Duranta* sp. leaf. Photo credit: M.Z. Ahmed and Y.V. Hernandez

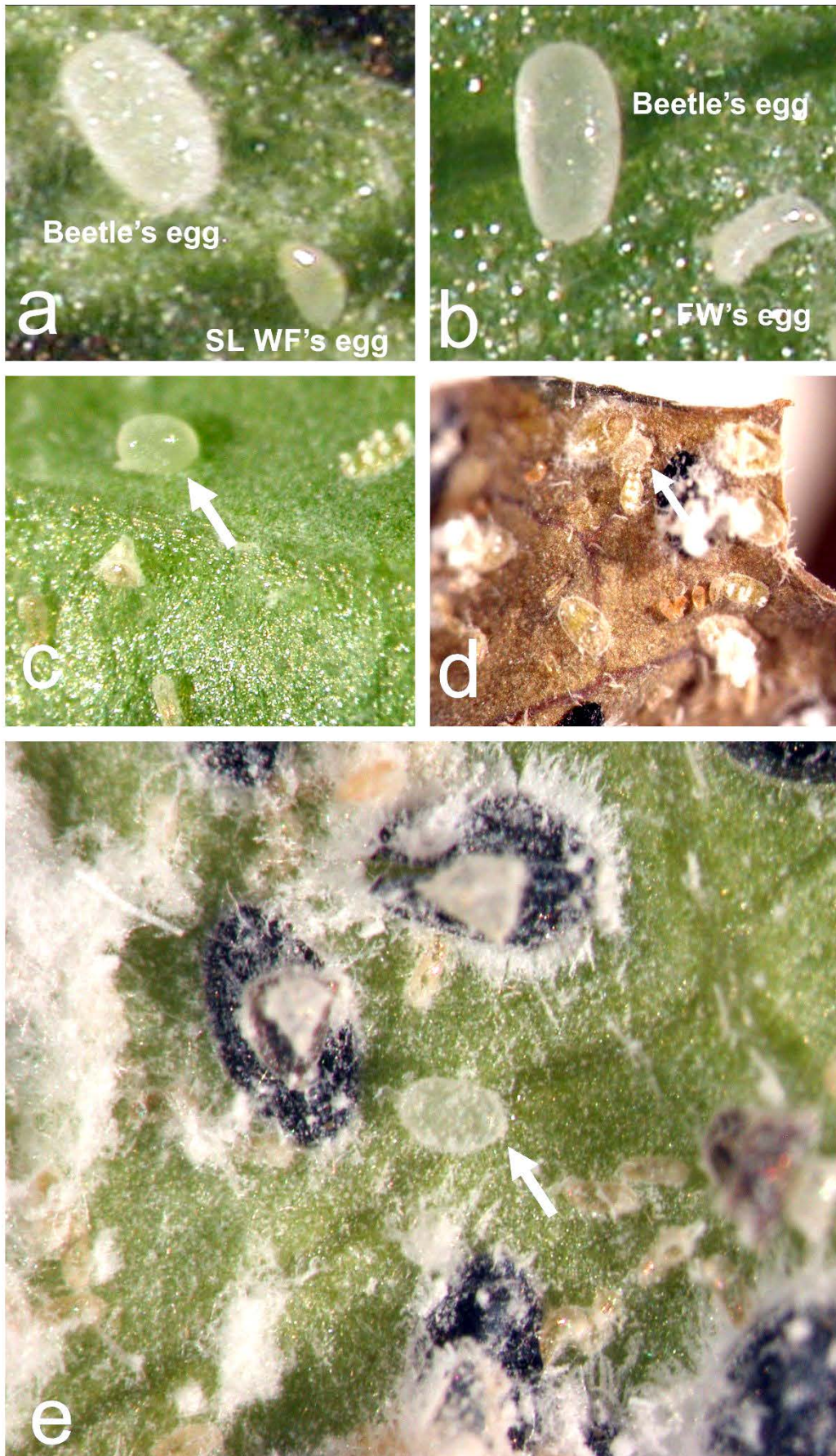


Fig. 5. Whitefly and predatory beetle, *D. pallidus* eggs: (a) beetle egg (upper left) and silverleaf whitefly egg (lower right), (b) beetle egg (upper left) and ficus whitefly egg (lower right), and (c-e) hand lens view of beetle egg on pepper whitefly-infested *Duranta* sp. leaves. Photo credit: M.Z. Ahmed and Y.V. Hernandez



Fig. 6. Size comparisons of different predatory larvae collected from ficus whitefly infested hedges as viewed through the unaided eye: (a, b) larvae of other ladybird beetles, and (c) larvae of predatory beetle, *D. pallidus*. Photo credit: M.Z. Ahmed



Fig. 7. Size comparisons of different species of predatory beetles collected from ficus whitefly infested hedges as viewed through the unaided eye: (a) *D. pallidus*, (b) *Exochomus childreni* Mulsant, (c) *Curinus coeruleus* Mulsant, (d) *Egius platycephalus* Mulsant, and (e) *Harmonia axyridis* Pallas. Photo credit: M.Z. Ahmed

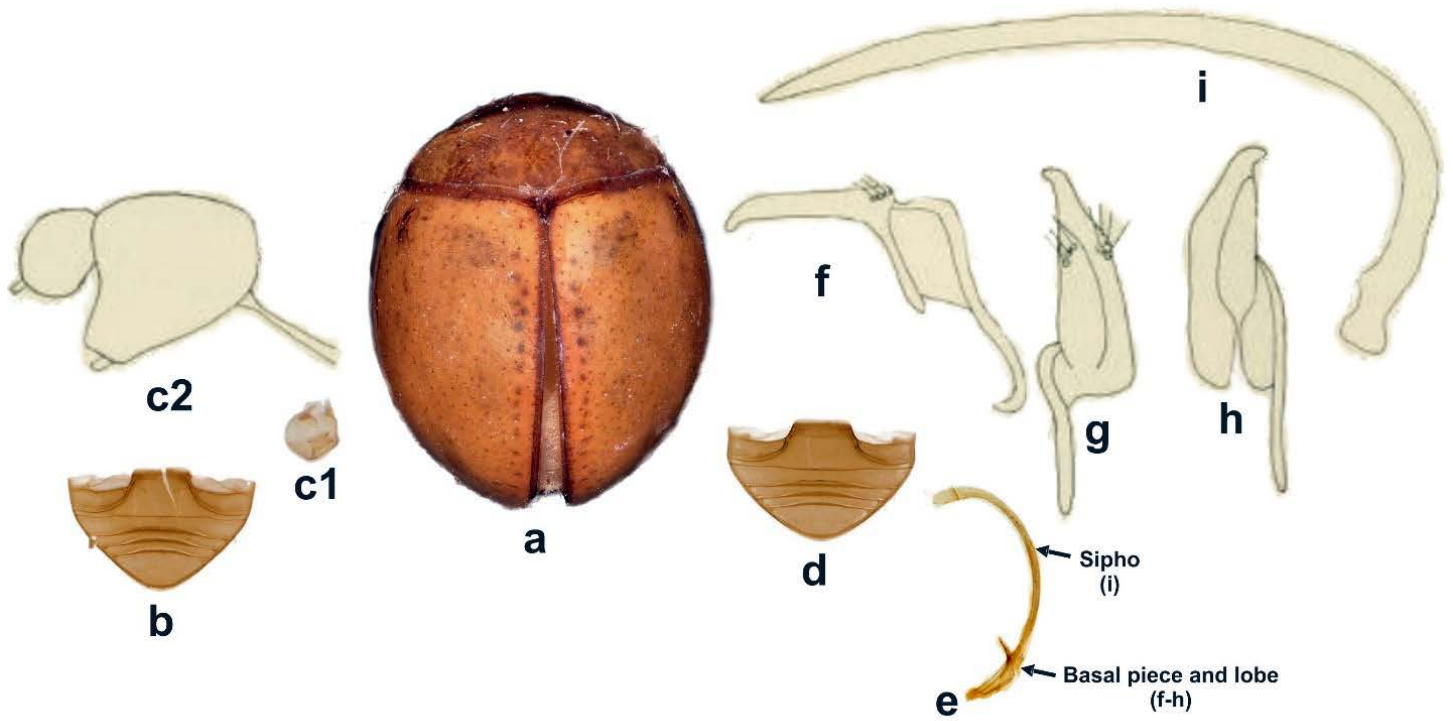


Fig. 8. Male and female identification structure of predatory beetle, *D. pallidus*: (a) typical male and female dorsum; (b) ventral view of posterior female abdomen; (c) typical female genitalia, receptaculum seminis (c1 dissected portion and c2 hand drawing); (d) ventral view of posterior male; (e) dissected male genitalia structure containing siphon, basal piece and lobe; (f-h) hand drawing of male genitalia parts, basal piece and lobe lateral (f), dorsal (g), ventral (h), and siphon lateral (i). Photo credit: M.Z. Ahmed and Y.V. Hernandez and from Gordon (1970), adapted by M.Z. Ahmed

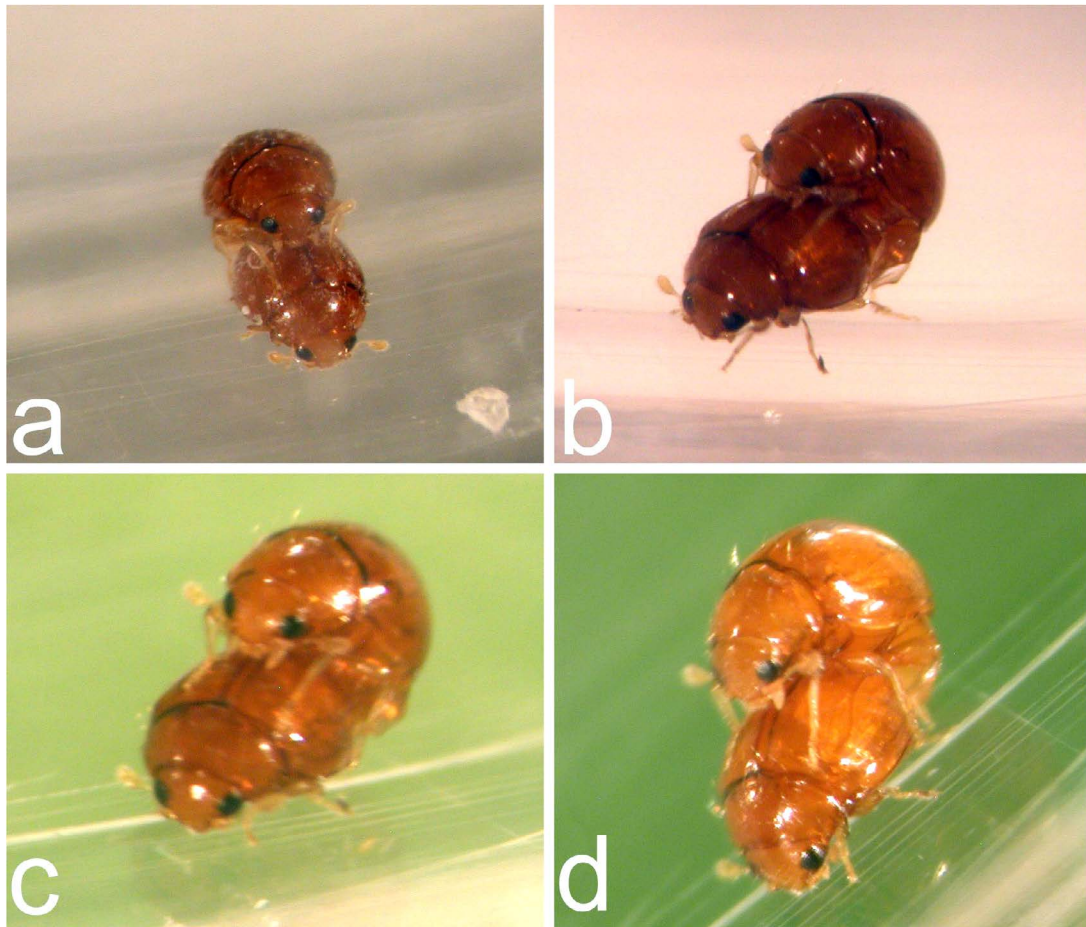


Fig. 9. Mating pair of predatory beetle, *D. pallidus*: (a, b) white background, and (c, d) green background. Photo credit: M.Z. Ahmed and Y.V. Hernandez

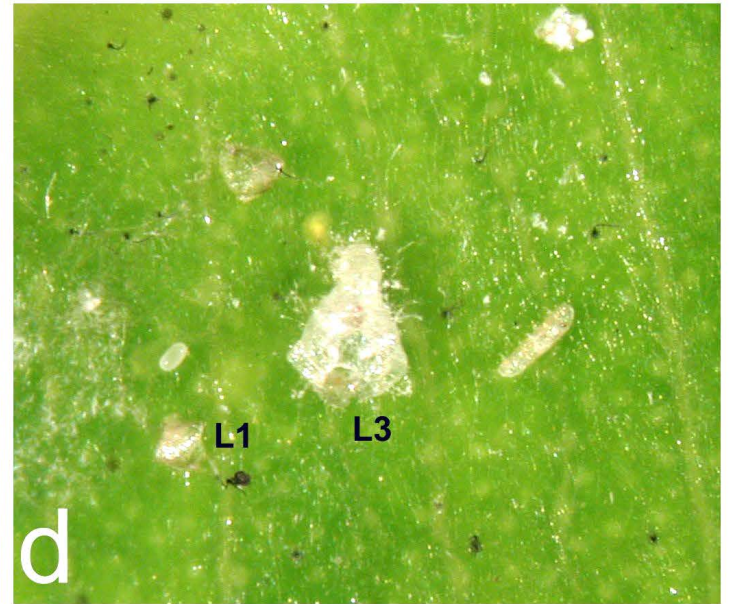


Fig. 10. Exuviae of larval stages (L1-L3) shed during molting by predatory beetle, *D. pallidus*, after feeding on ficus whitefly. Photo credit: M.Z. Ahmed and Y.V. Hernandez

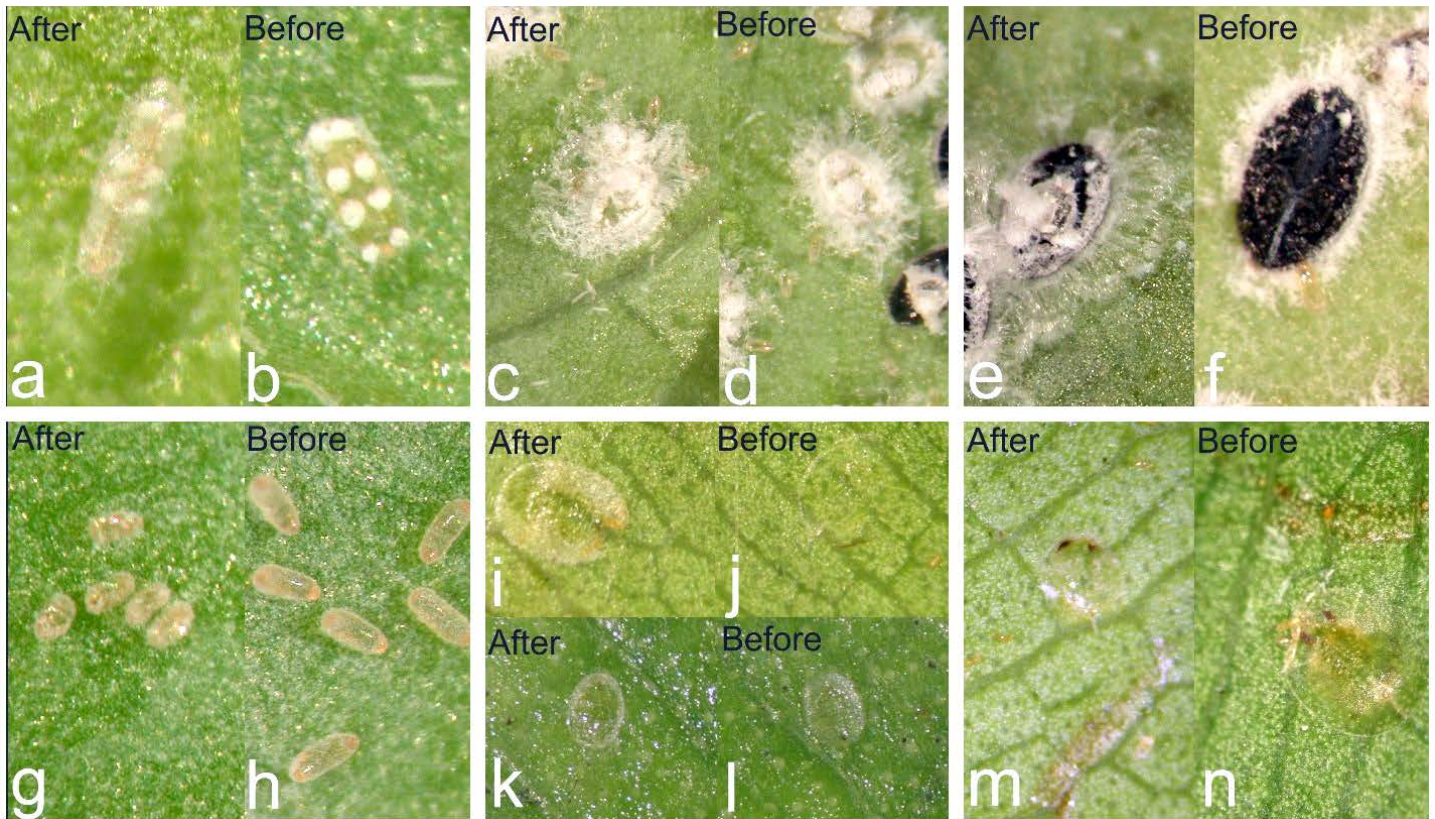


Fig. 11. Whitefly immature stages before and after being fed on by predatory beetle, *D. pallidus*: (a, b) 1st instar of pepper whitefly, (c, d) 2nd instar of pepper whitefly, (e, f) 4th instar of pepper whitefly, (g, h) eggs of ficus whitefly, (i, j) 3rd instar of ficus whitefly, (k, l) 2nd instar of ficus whitefly, and (m, n) 4th instar of ficus whitefly. Photo credit: M.Z. Ahmed and Y.V. Hernandez



Fig. 12. Predatory beetles of *Delphastus* sp.: (a) *D. pallidus* (length 0.9 to 1.05 mm and width 0.70 to 0.80 mm), (b) *D. pusillus* (length 1.40 to 1.60 mm and width 1.10 to 1.20 mm), (c) *D. catalinae* (length 1.40 to 1.50 mm and 1.10 to 1.18 mm width). Photo credit: M.Z. Ahmed, [Hydro-gardens](#) (a), and [Wikimedia](#) (c).

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