MORPHOLOGY AND BIOLOGY OF DIOMUS TERMINATUS (COLEOPTERA: COCCINELLIDAE), A PREDATOR OF SIPHA FLAVA (HOMOPTERA: APHIDAE)

Authors: Hentz, Matthew G., and Nuessly, Gregg S.

Source: Florida Entomologist, 85(1) : 276-278

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2002)085[0276:MABODT]2.0.CO;2

MORPHOLOGY AND BIOLOGY OF *DIOMUS TERMINATUS* (COLEOPTERA: COCCINELLIDAE), A PREDATOR OF *SIPHA FLAVA* (HOMOPTERA: APHIDAE)

MATTHEW G. HENTZ AND GREGG S. NUESSLY
University of Florida, IFAS, Everglades Research and Education Center
3200 East Palm Beach Rd., Belle Glade, FL 33430

Sugarcane is an important crop in several counties around Lake Okeechobee in south Florida (Hall & Bennett 1994). It has been a commercial staple since the 1920s, and in the year 2000, 450,000 acres were planted (Dovell 1947, FASS 2000). There is a diverse pest complex associated with sugarcane which includes insects from a broad spectrum of Orders such as Lepidoptera, Homoptera, Coleoptera, Hemiptera, and Acarina (Hall 1988, Hall & Bennett 1994). One of the pest species that can cause severe plant damage is the yellow sugarcane aphid, *Sipha flava* (Forbes). This aphid has been a resident and important pest of sugarcane for many years (Ingram et al. 1938, Ingram et al. 1951, Hall & Bennett 1994). It feeds mostly on the underside of leaves. After several days of feeding the leaves can exhibit red discoloration followed by chlorosis and necrosis (Ingram 1951). Prolonged feeding can result in plant stunting and death (Nuessly and Hentz, pers. obs.). Effective insecticides are available, and recently these have been used during the spring to reduce damage to the young plants. As a result, mid- to late- season aphid populations can rebound to damaging levels. Therefore, sugarcane growers also rely on abiotic and biotic control measures such as weather, disease, and natural enemies to reduce yellow sugarcane aphid populations.

One natural enemy with potential to control yellow sugarcane aphid is the small coccinellid, *Diomus terminatus* (Say) (Hall & Bennett 1994). Previously named *Scymnus terminatus* Say, it is a generalist aphid predator belonging to the tribe Scymnini (Thompson 1928, Gordon 1976). Its range is large and encompasses most of the eastern and southeastern United States (Gordon 1976). Gordon (1976) has provided a good description of the adult, but little descriptive information is available on its other life stages (Chittenden 1906, Watson 1926). Hall (2001) provided some information on the biology of *D. terminatus*. The purpose of this study was to present a general description of some of the life stages and basic biology of *D. terminatus*.

Adults of *D. terminatus* were collected from sugarcane fields in Pahokee, Florida. Five groups of 10 beetles of mixed sexes were placed in separate petri dishes (150 × 15 mm) and held at 27.5°C ± 1°C, 16:8 L:D photoperiod. Yellow sugarcane aphid—infested Sorghum—Sudan hybrid (Var. 'Kow Chow') leaves were placed in the petri dishes daily. The aphids served as a food source. A moist filter paper was placed in the bottom of each petri dish to maintain a humid environment. Female beetles began to oviposit after several days. Eggs of a similar age were collected and held until larvae emerged. Fifty neonate larvae were separated and housed in individual petri plates and observed once per day until their death. Observations on the development and morphology were recorded and summarized.

Four measurements for each larva were recorded: head length (anterior most to visible posterior end), head width (distance between simple eyes), body width (width of third thoracic segment), and body length. Figure 1 is provided to aid in the recognition of some of the life stages.

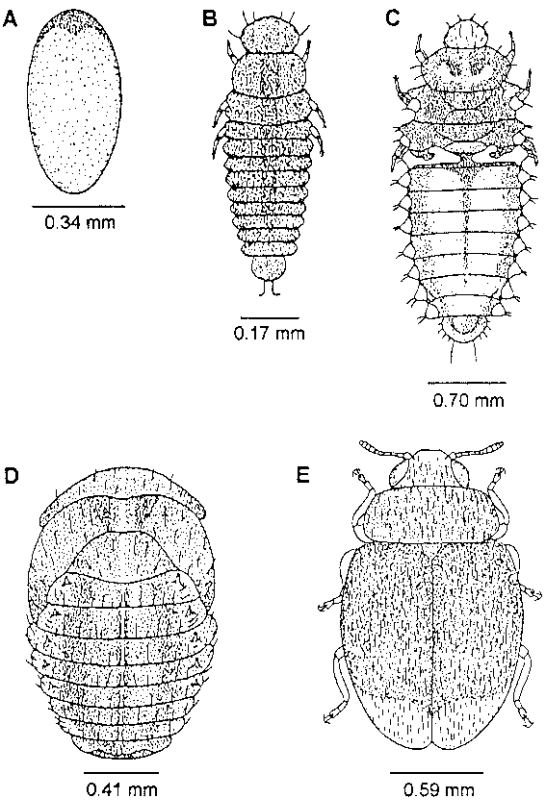

Fig. 1. Different life stages of *Diomus terminatus*. A) Egg, B) First Instar, C) Fourth Instar, D) Pupa, E) Adult.

Adult females preferred to oviposit singly on the under side of the sorghum—sudan leaves near the midrib, although some were also oviposited on the upper surface of the leaves. The egg is slightly convex and elongate with rounded ends (Fig. 1A). The average length and width of the egg is 0.65 ± 0.04 mm (range 0.56-0.75 mm) and 0.34 ± 0.03 mm (range 0.25-0.40 mm) (n = 50), respectively. The average height is 0.17 ± 0.04 mm (range 0.10-0.21 mm) (n = 40). The anterior end is slightly wider than the posterior end. The egg is nearly transparent with a pale white anterior end. About a day before a larva emerges, its dark green body can be seen through the egg chorion.

The larva is campodeiform and hexapodous with a dorso—ventrally flattened body and prognathus head. There are 4 instars, all similar in appearance. Each instar has 13 visible body segments which are sparsely covered with setae, and is olive drab in color with a dark dorsal stripe lengthwise on the abdomen (Figs. 1B, 1C). With each successive instar the segments and lateral tubercles become more defined and the setae are longer. The prothorax and last abdominal segment lack tubercles and the meso- and metathorax have 2 lateral tubercles on each side while the abdominal segments have only 1 on each side in all instars. The armature consists of simple unbranched setae. The 3rd and 4th instars both have 2 yellowish dorsal tubercles on the first abdominal segment. However, these tubercles are more prominent in the 4th instar. In addition, the 4th instar has 3 greenish stripes running lengthwise on the dorsal abdomen (Fig. 1C).

Ranges of larval head length (0.08-0.25 mm), body length (0.62-3.17 mm), and body width (0.24-1.48 mm) were found to overlap in several instances between successive instars (Table 1). However, ranges of head widths (0.16-0.43 mm) were discrete and could be used to determine larval instars. Other developmental and morphological changes were gradual between instars and, therefore, were less reliable indicators of different instars.

The prepupa is similar to the 4th instar except that it is slightly shrunken. The pupa is exarate, dark in color, and is covered with small unbranched setae (Fig. 1D). The mean length and width for the pupae are 1.78 ± 0.12 mm (range 1.50-1.93 mm) and 1.23 ± 0.08 mm (range 1.07-1.43 mm) (n = 28), respectively.

Neonate and older *D. terminatus* larvae fed on nymphal and adult yellow sugarcane aphids, although young aphids seemed to be preferred. During feeding the larva anchored itself to the leaf with a sticky material secreted from a structure on the posterior ventral abdominal segment. This ensured that the beetle larva could not be dragged or dislodged from the leaf if the aphid tried to escape. Aphids were usually attacked on one of their legs. The *D. terminatus* larva would puncture the appendage and remove the liquefied body contents leaving an empty collapsed exoskeleton, which is a typical behavior exhibited by coccinellids (Hagen 1962, Hodek & Honek 1996). Adult beetles simply devoured the whole aphid. In addition to feeding on yellow sugarcane aphid, *D. terminatus* was also observed in the field to feed on and complete its development on *Aphis craccivora* (Koch) feeding on the bean *Lablab purpureus* (L.) and *Rhopalosiphum padi* (L.) and *Rhopalosiphum maidis* (Fitch) feeding on sweet corn (Hentz, personal observation).

The larvae appeared to have two defense mechanisms. In addition to their simple armature, they exhibited "reflex bleeding" in response to bodily threat, a common phenomenon with coccinellids (Hodek & Honek 1996). The larva would release a golden yellow liquid from the dorsum of the abdominal segments when agitated on or near those areas. Usually 2 adjacent drops would appear where the larva was touched.

The preoviposition period lasted about 7 or 8 d. The egg hatched in about 4 d resulting in a neonate ready to feed. The 1st instars fed for approximately 2 d before they molted, while the 2nd, 3rd and 4th instars all fed for approximately 1 d each before they molted. The prepupa, characterized

TABLE 1. MEAN ± SD (MM) AND RANGE OF *DIOMUS TERMINATUS* LARVAL DIMENSIONS.

Instar	N	Head Width (Range)	Head Length (Range)	Body Length (Range)	Body Width (Range)
1	50	0.17 ± 0.01 (0.16 - 0.19)	0.11 ± 0.01 (0.08 - 0.14)	0.73 ± 0.04 (0.62 - 0.83)	0.26 ± 0.02 (0.24 - 0.33)
2	36	0.25 ± 0.01 (0.23 - 0.28)	0.14 ± 0.03 (0.10 - 0.18)	1.54 ± 0.10 (1.33 - 1.87)	0.67 ± 0.05 (0.55 - 0.75)
3	35	0.33 ± 0.01 (0.32 - 0.35)	0.17 ± 0.03 (0.08 - 0.20)	2.13 ± 0.22 (1.67 - 2.53)	0.97 ± 0.08 (0.77 - 1.10)
4	43	0.41 ± 0.01 (0.38 - 0.43)	0.19[1] ± 0.02 (0.17 - 0.25)	2.80 ± 0.25 (2.07 - 3.17)	1.24 ± 0.11 (1.03 - 1.48)

[1]Head length, N = 20.

by a non-feeding immobile stage, lasted about a day. The pupal stage lasted about 5 d. Larvae were observed to pupate on the undersides of leaves with no apparent protection, such as the silk cocoon produced by *Diomus flavifrons* (Meyerdirk 1983). Pupae were attached to the leaves by a sticky substance secreted by the posterior end of the abdomen. Small setae radiating from the pupa may act as a predator deterrent.

Adult beetles (Fig. 1E) were inactive immediately following eclosion. They became very active after the cuticle had hardened. Several adults were observed to live over 50 d in the laboratory (27.5°C ± 1°C).

Little information is available for comparison with other *Diomus* species. However, information available on larval *Diomus flavifrons* (Blackburn) indicates that they can easily be distinguished from *D. terminatus* larvae by having a light brown appearance with dark spots on the dorsal surface of the thoracic segments (Meyerdirk 1983).

We would like to thank Drs. Ron Cherry (University of Florida) and David Hall (U.S. Sugar Corp.) for their insightful comments on this manuscript. In addition we appreciate all the help our librarian Mrs. Kathy Krawchuk provided. This research was supported by the Florida Agricultural Experiment Station, and approved for publication as Journal Series No. R-07969.

Summary

Diomus terminatus is an adult and larval predator of the yellow sugarcane aphid in south Florida. A description of the immature life stages and some of the basic biology were presented. We found that head capsule widths proved to be the most reliable method for determining larval instars. Further studies on its biology are needed to evaluate its potential as a biological control agent against yellow sugarcane aphid.

References Cited

Chittenden, F. H. 1906. Control of the melon aphis. USDA Farmers Bull. 914: 3-16.

Dovell, J. E. 1947. A history of the everglades of Florida. Ph.D. Dissertation. Univ. North Carolina, Chapel Hill.

Florida Agricultural Statistics Service (FASS). 2000. Florida Field Crops: Crop Production. October 13: 1-2.

Gordon, R. D. 1976. The Scymnini (Coleoptera: Coccinellidae) of the United States and Canada: Key to genera and revision of *Scymnus*, *Nephus* and *Diomus*. Bull. Buffalo Soc. Nat. Sciences. 28: 1-362.

Hagen, K. S. 1962. Biology and ecology of predaceous Coccinellidae. Annu. Rev. Entomol. 7: 289-326.

Hall, D. G. 1988. Insects and mites associated with sugarcane in Florida. Florida Entomol. 71: 138-150.

Hall, D. G. 2001. Notes on the yellow sugarcane aphid *Sipha flava* (Homoptera: Aphididae) and the lady beetle *Diomus terminatus* (Coleoptera: Coccinellidae) in Florida. J. Am. Soc. Sugar Cane Tech. 21: 21-29.

Hall, D. G., and F. Bennett. 1994. Biological control and IPM of sugarcane pests in Florida. *In* Pest Management in the Subtropics, Biological Control-a Florida Perspective. D. Rosen, F. D. Bennett and J. L. Capinera [eds.]. Intercept Ltd., Andover, UK. 737 pp.

Hodek, I., and A. Honek. 1996. Ecology of Coccinellidae. Kluwer Academic Publishers. Dordrecht, The Netherlands. 464 pp.

Ingram, J. W., H. A. Jaynes, and R. N. Lobdell. 1938. Sugarcane pests in Florida. Proc. Internat'l. Soc. Sugar Cane Tech. 6: 89-98.

Ingram, J. W., E. K. Bynum, R. Mathes, W. E. Haley, and L. J. Charpentier. 1951. Pests of sugarcane and their control. USDA Cir. 878. 38 pp.

Meyerdirk, D. E. 1983. Biology of *Diomus flavifrons* (Blackburn) (Coleoptera: Coccinellidae), a citrus mealybug predator. Environ. Entomol. 12: 1275-1277.

Thompson, W. L. 1928. The seasonal and ecological distribution of the common aphid predators of central Florida. Florida Entomol. 11: 49-52.

Watson, J. R. 1926. Citrus insects and their control. Univ. Florida Agr. Exp. Sta. Bull. 183: 289-423.