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## Scientific Note

# First report of *Engytatus varians* (Distant, 1884) (Heteroptera: Miridae: Dicyphini) in Eastern Uruguay and preliminary test on its feeding habits

**Juan P. Burla[1], Diego L. Carpintero[2], Enrique Castiglioni[1]**

*[1]Laboratorio de Entomología. Departamento de Sistemas Agrarios y Paisajes Culturales. Centro Universitario Regional del Este (CURE), Universidad de la República. Uruguay. [2]División Entomología, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Ciudad Autónoma de Buenos Aires, Argentina.*
*Corresponding author: jburla@cure.edu.uy*

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**Abstract.** The aim of this work is to report the unprecedented presence in Uruguay of *Engytatus varians* (Distant, 1884), a predator of several pests of Solanaceae, to present its main morphological features and some facts of its biology, and to provide a key for the identification of the Dicyphini species registered in the country. The presence of this predator in our region is of great interest for the development of future research works related to biological pest control and the potential interaction thereof with other predaceous mirids.

**Keywords:** Dicyphini, Biological Control, Distribution, Neotropics.

The mirids of the tribe Dicyphini are being evaluated with growing interest in the context of applied biological control programs in various regions of the world (McGregor et al. 1999; Bouagga et al. 2018). These insects generally have a zoophytophagous feeding habit, that is, they feed on sap, pollen and a great diversity of species of soft-bodied insects (Calvo et al. 2009; Castañé et al. 2011). They are considered generalist predators and the following species stand out among their preys: *Trialeurodes vaporariorum* (Westwood, 1856) (Hemiptera: Aleyrodidade), *Bemisia tabaci* (Gennadius, 1889) (Hemiptera: Aleyrodidade), *Myzus persicae* (Sulzer, 1776) (Hemiptera: Aphididae), *Aphis gossypii* Glover, 1877 (Hemiptera: Aphididae), *Frankliniella occidentalis* (Pergande, 1895) (Thysanoptera: Thripidae), and *Tuta absoluta* (Meyrick, 1917) (Lepidoptera: Gelechidae), which affect commercial tomato crops globally (Fauvel et al. 1987; McGregor et al. 1999; Alomar et al. 2006).

*Engytatus varians* (Distant, 1884) has been recorded for the southern US, Mexico, Puerto Rico, Ecuador, Antillas, Surinam, Colombia, Nicaragua, Cuba, Guatemala, Brazil, Argentina (Blanchard 1945; Carvalho 1947; Castineiras 1995; Schuh 1995; Hernández & Henry 2010; Martínez et al. 2014) and now in Uruguay.

Bueno et al. (2012), in Minas Gerais, verified the presence of *Engytatus* sp and *Macrolophus* sp on tobacco plants and succeeded in artificially rearing them on tomato plants. In laboratory, the authors assessed their diet on different stages of *Tuta absoluta*, recording daily consumptions greater than 60 eggs and 5 larvae. In tomato crops, *E. varians* was registered preying nymphs of the tomato psyllid *Bactericera cockerelli* (Sulc, 1909) (Hemiptera: Triozidae) under greenhouse conditions. When offering 10 to 20 *B. cockerelli* third instar nymphs to *E. varians* fourth instar nymphs, 46% predation was recorded within a 24-hour period (Martínez et al. 2014).

Hernández & Henry (2010) mention eight species of host plants for *E. varians*: *Amaranthus* sp (Amaranthaceae), *Helianthus annuus* (Asteraceae), *Clidemia eggersii* (Melastomataceae), *Solanum lycopersicum* (Solanaceae), *Martynia annua* (Martyniaceae), *Mentha requienii* (Lamiaceae), *Nicotiana tabacum* (Solanaceae) and *Selinum* sp (Umbelliferae). Tomato crops and in particular tobacco are reported as hosts for various Dicyphini mirids (Cassis 1984; Ferreira & Henry 2011; Bueno et al. 2012; Nogueira et al. 2019). In Cuba, this species is mentioned among the whitefly *Bemisia tabaci* predators (Castineiras 1995).

Hernández-Quintero et al. (2017) used immature forms of *B. cockerelli* and eggs of *Sitotroga cerealella* (Olivier, 1789) (Lepidoptera: Gelechiihae) for rearing *E. varians* in the laboratory on tomato plants and it was found that they feed on first instar larvae of *Spodoptera exigua* (Hübner, 1808) (Lepidoptera: Noctuidae). Palma-Castillo et al. (2019) were able to increase growth, longevity and fertility values by incorporating a 5% sugar solution into the base diet of immature forms of *B. cockerelli* and eggs of *S. cerealella.*

The great diversity of preys consumed by the Dicyphini presents good prospects for the management and conservation of said species (Pérez-Hedo & Urbaneja 2015). Sanchez et al. (2003) used *Verbascum thapsus* (Scrophulariaceae) plants to facilitate an early establishment of *Dicyphus hesperus* Knight, 1943 (Miridae: Dicyphini) in protected tomato crops. Messelink et al. (2014) mention the use of banker plants for the release and conservation of omnivorous predators.

The aim of this work is to report the presence of *E. varians*, predator of aphids, eggs and larvae of lepidopterans, found in a conservation management program carried out in the East of Uruguay, to present a preliminary assessment of its predatory activity on *M. persicae nicotianae* Blackman, 1987 (Hemiptera: Aphididae), its main taxonomic characters and a key for the identification of the Dicyphini registered in the country.

In the context of said program for survey and conservation of natural enemies of insects associated with horticultural crops, specimens of the Miridae family were collected. The insects were captured with a manual aspirator and preserved in 70° alcohol for the subsequent identification thereof. The collections were carried out during one hour of weekly observation from September 2019 to March 2020, on companion plants previously installed near the protected tomato crop. The main plant species used were *Nicotiana tabacum*, *Calendula officinalis* (Asteraceae), *Petunia hybrida* (Solanaceae) and *Polymnia connata* (Asteraceae) located in Rocha department, 4.5 km away from the city of Castillos 34°10'17"S, 53°52'52"W. Sixteen specimens (4♀ and 12 ♂) of *E. varians* were collected, on tobacco and tomato plants, which were used for the identification of the species. Part of the specimens were remained *in vivo* in order to install a laboratory rearing colony to preliminarily assess their predatory activity.

For the identification of the Miridae, the genitalia of the males

were dissected, placing the last four abdominal segments in 3 mL of a 10% KOH solution for one hour at 75°C. Subsequently, the right and left parameres, the aedeagus and the projections of the pygophore were dissected (Carvalho 1947; Carvalho & Becker 1958; Cassis 1984; Ferreira & Henry 2011; Pineda et al. 2016). The collected specimens were mounted and deposited in the collection of Uruguayan Institutions *Centro Universitario Regional del Este (CURE)*, *Museo Nacional de Historia Natural (MNHN)* and *Unidad de Entomología de Facultad de Agronomía, Universidad de la República (FAGRO, UDELAR)*.

To conduct a preliminary assessment of the feeding habits, a small rearing colony was established, based on alternative food: pre-frozen larvae of *Galleria mellonella* (Linnaeus, 1758) (Lepidotera: Pyralidae) and *Phoracantha semipunctata* (Fabricius, 1775) (Coleoptera: Cerambycidae), and cysts of *Artemia salina* (Linnaeus, 1758) (Anostraca: Artemiidae) (Vandekerkhove et al. 2008), among other food resources used for rearing Dicyphini mirids at CURE. Ten females and ten males of *E. varians* were obtained from this rearing. Forty-eight hours after emerging, the adults were individually placed in Petri dishes (9x1.5 cm). We offered six *M. persicae nicotianae* nymphs for each predator on a piece of tobacco leaf (3x2cm), recording the rate of preyed aphids within 24 and 72 hours. To avoid dehydration of the material, a moistened filter paper was added to the base of each dish. The experiment was carried out in a growth chamber (Meditry SMP-250) at a temperature of 24±2°C and a 12:12 photoperiod, light: dark. For aphid consumption of both sexes at 24 and 72 hours, linear models were adjusted, taking the proportion of consumed aphids as the response variable and sex as the explanatory variable, using the Statistical Software R version 3.6.1.

According to Pineda et al. (2016), adult males and females are generally yellowish-green (while alive) with more greyish corium and cuneus (Fig. 1A). The head is pale, with the frons and vertex between the eyes, the clypeus, and the narrow area at the base (neck) behind the eyes dark brown (Fig. 1E). The eyes are dark red and prominent. The labium extends to the base of the metacoxa or a little beyond when at rest. The antennae are dark brown, with segment I pale at the base and the apex (Fig. 1E) and segment II variably pale apically or mostly pale darkened only at the base. The combined lengths of the antennal segments (I - IV) are equal to the length of the body. The pronotum is yellowish-green to grayish, with the area around the callus dark brown colored; the scutellum is pale with a brown median line. The hemelytra are yellowish-green to greyish, with the corium and cuneus narrowly dark brown apically; the membrane is hyaline and grey-tinged. The legs are pale yellow to green, with the bases of the trochanters, spots at the bases of each tibia and numerous, small, spots on the outer surface of the hind femora dark brown. The lower surface of the thoracic segments is brown; the abdomen is pale to greenish and the sides often become browner. The length and width of the male are 3.2 mm (3.1-3.3) × 0.9 mm (0.8-1.0), while in the female the measurements are 3.4 mm (3.1-3.6) × 0.9 mm (0.8-1.0).

Males and females are similar in general coloration and markings, but the females are noticeably more broadly rounded, especially the abdomen, which carries the subgenital plate on segments VIII and IX and a median groove from segments VIII to IX to receive the ovipositor. In males, the genital capsule has a bifid sclerotized process caudally, one arm of the process is straight, with a short, laterally directed, apical spine and the other is elbowed at the middle (Fig. 1B); the left paramere is C-shaped, with the basal lobe stout and the apical lobe flattened and elongate-oval; the reduced right paramere is straight, slender, and pointed apically (Carvalho 1947), which was verified by the examination of the genitalia (Fig. 1C). *Engytatus varians* may be distinguished by the extensive dark marks in the head, pronotum, and especially, in the apex of corium and cuneus. In *Engytatus modestus* (Distant, 1893) (Miridae: Dicyphini) the head and the hemelytron are mostly pale, without the dark brown areas in the frons, neck and pronotum, and the apical marks in the corium and cuneus. The genital capsule and parameres are similar in both species and do not easily separate them (Pineda et al. 2016).

Twenty-four hours after the start of the feeding experiment, a consumption of 2.4±1.95 (38.2%) and 1.5±1.9 (27.9%) of *M. persicae nicotianae* specimens was observed by *E. varians* females and males, respectively. After 72 hrs, the consumption of *M. persicae nicotianae* individuals reached 4.7±1.9 (72.3%) and 3.6±2 (66.9%) by *E. varians* adult females and males, respectively (Fig. 2).

No significant differences were found between the consumption

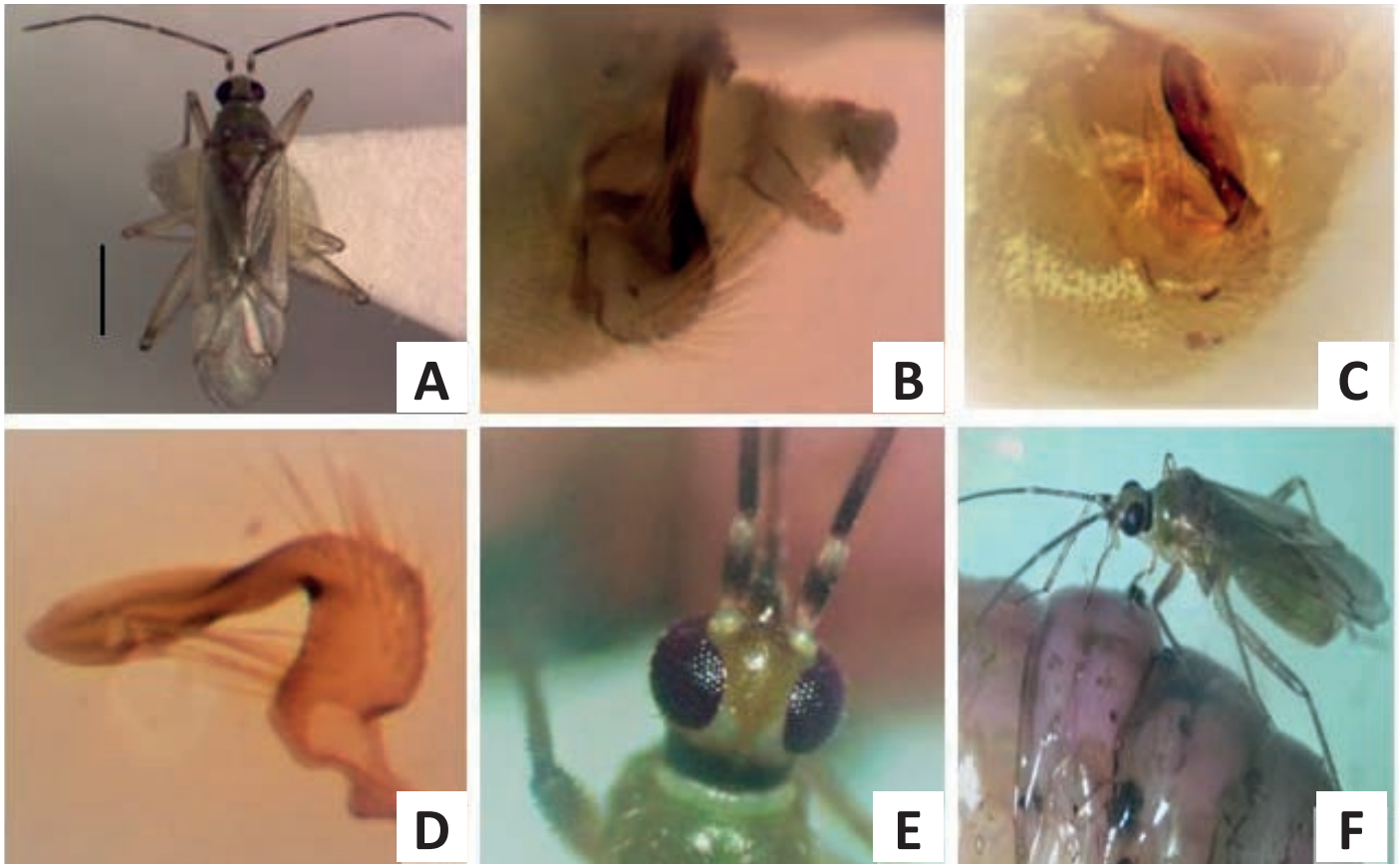


**Figure 1.** (A) Dorsal view of adult *Engytatus varians.* (B) Angled projections of the pygophore. (C) and (D) Detail of the paramere with flattened and oval-widened apical lobe. (E) Adult head. (F) Adult feeding on *Diaphania* sp (Lepidoptera: Crambidae) larvae.

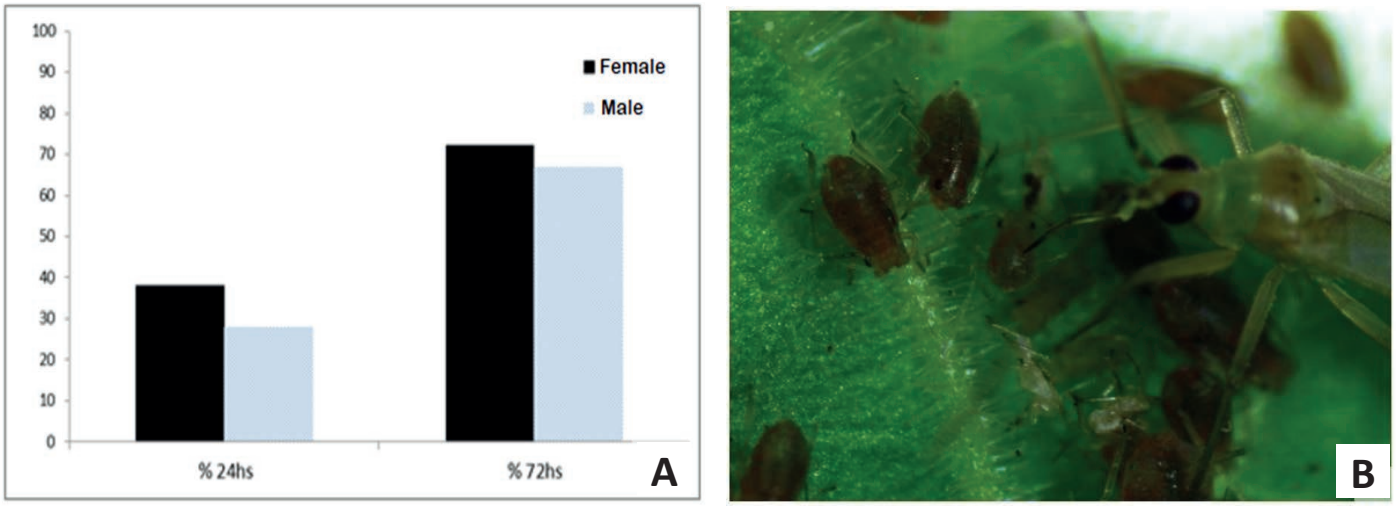


**Figure 2.** (A) *Myzus persicae nicotianae* consumed by *Engytatus varians* at 24 and 72h, as a percentage of the offered preys. (B) Adult of *E. varians* predating.

by males and females ($p$ = 0.3608 and 0.4276, for 24 and 72 hs, respectively), in contrast to the results obtained by Martínez et al. (2014), who found significant differences in the predation of *E. varians* males and females when offered *B. cockerelli* as prey. The experiment conducted demonstrates the predatory activity of *E. varians* as well as its potential importance for the natural control of *M. persicae nicotianae*. The relationship between tobacco plants and aphids could be valued as a niche for the conservation of the mirid predator, as proposed by Sanchez et al. (2003) who worked with other species.

The presence of predator *E. varians* in the country is of great interest for the development of future research works related to biological pest control and the study of the possible interaction thereof with other predaceous mirids, as evaluated by Lucas & Alomar (2002) on two species present in the Mediterranean region. The effect of these mirids on the biological control of whitefly and tomato moth could be evaluated as Bouagga et al. (2018) in their work comparing the control of three species of mirids on sweet pepper. *Engytatus varians* is incorporated into the list of Miridae: Dyciphini already detected in Uruguay as potential predators of tomato crop pests and an identification key below is adapted for the species registered for Uruguay.

**Identification key for Dicyphini species registered for Uruguay [Adapted from Ferreira & Henry (2011) and Carvalho (1947)]**

1 Head with lateral margins behind the eyes somewhat parallel, not convergent; with a dark stripe behind each eye ..... ..... *Macrolophus basicornis* (Stål, 1860)
1' Head with lateral margin behind the eyes somewhat convergent; without a dark stripe behind each eye ..... 2
2 Genital capsule with a bifurcated process on anterior margin. Head yellowish green, with frons, clypeus, neck dark brown or black; apex of cuneus dark brown; hind femora with numerous brown spots (Fig. 1A-E) ..... *Engytatus varians* (Distant, 1884)
2' Genital capsule without a bifurcate process ..... 3
3 Vesica partially covered with spinose patches ..... ..... *Campyloneuropsis cincticornis* (Stål, 1860)
3' Vesica without spinose patches (*Tupiocoris*) ..... 4
4 Hemelytra uniformly pale; head, pronotum and scutellum black ..... ..... *T. chlorogaster* (Berg, 1878)
4' Hemelytra pale dull green, sometimes tinged with red on apical areas of corium and clavus; head, pronotum and scutellum never comple ... ..... *T. cucurbitaceus* (Spinola, 1852)

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## Authors' Contributions

BJP reared *E. varians*, designed the method of rearing and establishment of *E. varians*, conducted the experiment, and drafted this paper. CDL confirmed the identification of *E. varians*, reviewed and corrected this paper. CE drafted and corrected the paper.

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