First record and redescription of *Binodoxys brevicornis* (Hymenoptera: Braconidae: Aphidiinae) from Argentina

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ABSTRACT. *Binodoxys brevicornis* (Haliday) is reported for the first time for Argentina. This aphidiine was found parasitizing the aphid *Hyadaphis foeniculi* (Passerini) feeding on *Foeniculum vulgare* (Miller), a non-crop plant species commonly occurring near alfalfa crops. *Binodoxys brevicornis* is redescribed and illustrated.


RESUMEN. *Binodoxys brevicornis* (Haliday) se cita por primera vez en Argentina. Este afidiino se encontró parasitando al pulgón *Hyadaphis foeniculi* (Passerini) en *Foeniculum vulgare* (Miller), una especie vegetal de crecimiento espontáneo, comúnmente asociada a los bordes de cultivos de alfalfa. *Binodoxys brevicornis* se redescribe e ilustra.


INTRODUCTION

The genus *Binodoxys* (Mackauer) is closely related to *Trioxys* (Haliday) and *Acanthocaudus* (Smith). Previously, *Binodoxys* was classified as *Trioxys* or *Trioxys* (*Binodoxys*). It can be distinguished from these related genera by the following combination of characteristics: tergite 1 (petiole) with primary and secondary tubercles; accessory prongs of female hypopygium absent; and fifth, sixth, and seventh terga of female without subapical row of pegs or spiny bristles (Stary, 1995; Sharkey & Wharton, 1997; Sampaio et al., 2003). This taxonomic group is, collectively, one of the most diverse in the subfamily Aphidiinae (Tomanovic & Kavallieratos, 2002). Certain species of the group are important natural enemies of *Rhopalosiphum padi* (L.) (bird cherry-oat aphid), *Myzus persicae* (Sulzer) (green peach aphid), *Theroaphis trifolii,* et al., 2003). This taxonomic group is, collectively, one of the most diverse in the subfamily Aphidiinae (Tomanovic & Kavallieratos, 2002). Certain species of the group are important natural enemies of *Rhopalosiphum padi* (L.) (bird cherry-oat aphid), *Myzus persicae* (Sulzer) (green peach aphid), *Theroaphis trifolii,*
(Monell) (yellow clover aphid) and other aphid species associated with plants in the genera Medicago and Trifolium (Stary, 1978). In Argentina, only one species of Binodoxys has been previously recorded: B. tucumanus (Stary) (originally described as Trioxys (Binodoxys)), a native species known only from Tucumán Province reared from M. persicae on potato (Stary & Delfino, 1986). Years after its release in Argentina, this parasitoid was observed in association with M. persicae (Stary et al., 2007).

Alfalfa is one of the most well-known and widely used perennial leguminous crops, with Argentina being the second largest producer of alfalfa in the world, where this crop constitutes one of the most relevant forage resources for cattle (Basigalup & Ustarroz, 2007). Among the most important pest insects in alfalfa are aphids (Hemiptera: Aphididae), such as T. trifolii, Acyrthosiphon pisum, (Harris) and A. kondoi (Shinji). To control aphids, parasitoids of the subfamily Aphidiinae (Hymenoptera: Braconidae) are the most widely used biological agents. Considering that parasitoids may occur in different host aphids in both crop and non-crop plant species, moving from one site to another during the year (Stary & Cermeli, 1989), a careful exploration of the parasitoid species in fields and borders of alfalfa in Santa Fe Province, Argentina was started in 2009. The aims of this paper are to inform the occurrence of B. brevicornis in Argentina, to provide a redescription for adults of this species and also to supply information about its associations with aphids and plants in alfalfa crop fields.

MATERIAL AND METHODS

Sampled fields were located at INTA (Instituto Nacional de Tecnología Agropecuaria, Rafaela Experiment Station, 31°11’S; 61°29’W), in the west of Santa Fe Province, Argentine Pampa region. The zone is characterized by plains and extended landscapes. The annual average rainfall is 1050 mm (variation WE = 125 mm), distributed with an isohigro regime, with 70% of the rainfall in spring–summer, 23% during autumn and just 7% in winter. The annual mean temperature is 18.0 °C (variation NS = 1.0 °C), with 26.0 °C and 12.7 °C being the means in January and July, respectively, at the hottest and coldest months of the year and with an average thermal amplitude of 13.3 °C (Panigatti, 1980; Panigatti & Mosconi, 1982). The traditional management practice used in the study site depended on the growth stage of the alfalfa: grazing (rotary strip up to a total density of 1.5 total cows per ha) on flowering buds, or being cut for hay or silage when 10–20% of flowering was reached (recommended practice for dairy cows) (Comeron & Romero, 2007). No insecticides were sprayed on alfalfa plants during the sampling period.

During a three year period (2009-2011), aphid colonies were fortnightly collected in both, alfalfa and non-crop vegetation in the borders, along one linear transect of 100 m on each habitat. Plant samples bearing both, live and mummified aphids, were collected. Aphididae samples were placed in plastic vials (~3 cm diameter x 10 cm in height) containing 95% ethanol for later identification using keys by Blackman & Eastop (2006a, 2006b). Mummified aphids were individually placed in plastic vials with cotton-top (~2 ml) until the adult parasitoid emergence. Adults were preserved in 95% ethanol, with representative specimens from rearings cleared and slide mounted whole or dissected following standard methods (see Fulbright et al., 2007), and identified to species using keys, by Smith (1944), Pike et al. (2000), and by comparison with paratypes and species vouchers from Washington State University (WSU) holdings. Also, representative specimens identified as Binodoxys brevicornis (Haliday) from Argentina were examined and confirmed by European Aphidiine specialist Dr. P. Stary (Institute of Entomology, Acad. Sci. Czech Republic, Ceske Budejovice, Czech Republic). Illustrations of parasitoids were drawn from images taken with a DEC13MTM digital eyepiece camera through a Zeiss AxiolabTM compound microscope; morphological measurements (in mm) and
character ratios were derived from image-measuring software by D. Allison (Pike et al., 2005). Descriptive morphology follows Sharkey & Wharton (1997), and Huber & Sharkey (1993). Voucher specimens are deposited in INTA and WSU collections.

RESULTS

Binodoxys brevicornis is recorded for the first time from Santa Fe, Argentina, parasitizing the aphid Hyadaphis foeniculi (Passerini) (honesuckle aphid) in Foeniculum vulgare (Miller) (Apiaceae = Umbelliferae). Like the other Aphidiinae, B. brevicornis is a primary solitary koinobiont endoparasitoid of aphids (H. foeniculi, Dysaphis apiifolia (Theobald), Aphis spiraecola (Patch), A. fabae (Scopoli) and Cavariella aegopodii (Scopoli)). Adults are free-living and feed on honeydew, nectar, pollen and other plant secretions. Availability of these feeding resources can increase their longevity, oviposition potential and attack (Hoffmann & Frodsham, 1993; Jervis & Kidd, 1995; Lee et al., 2004; Michelena et al., 2004; Wackers, 2005; Bianchi & Wacker, 2008).

Adult description

Descriptions.  
FEMALE (n = 11)
Head (Fig. 1): Eyes averaging 150 µm in length range: 112-176 µm. Malar space equal to 1/5 of eye length. Antenna (Fig. 2, Table I) 10 segmented. Flagellomere 1 (= F₁), averaging 2.4 times as long as wide, with 1 to 5 placoids; (F₂) approximately equal to slightly greater than F₁ with 2 to 4 placoids, (F₅) averaging 1.8 as long as wide, with 3 to 4 placoids, preapical segment approximately equal to F₅, apical segments averaging nearly 4.0 time as long as wide, with 8 placoids.

Mesosoma: according to Tremblay (1975) and Stary (1979) this parasitoid has mesoscutum with 17-25 pleural setae (Fig. 3). Propodeum: smooth or with two longitudinal carinae (Fig. 6) with 8-10 anterior propodeal setae. Forewing (Fig. 4, Table I): stigma triangular tapering into R₁, averaging 3.0 times as long as wide. R₁ vein (=mesocarpus) equal to about half stigma length. Radial sector 2.8 times as long as stigma width.

Metasoma: petiole (Fig. 5) 1.7 times width at spiracles; secondary tubercles not pronounced and not far spaced from spiracular tubercles. Genitalia, ovipositor sheath length slightly < 3 times sheath width at midpoint of narrower distal region of sheath (Fig. 7). The prongs are paired, straight to upwards arcuate, narrowed to the apex, with 3-4 dorsal setae.

Body length: about 2 mm.

Coloration: according to Mescheloff & Rosen (1993) this parasitoid has: head dark brown; mouthparts light: the clypeus and mandibles are light brown and remaining parts are yellowish. Antenna light brown, except scape, pedicel and narrow base of F₁ yellowish. Mesosoma blackish brown to brown; wing venations light brown. Metasoma light brown with areas yellowish. Legs brown to light brown, tarsi blackish. Ovipositor sheaths and prongs brown to light brown.

Known host aphids in Argentina: Hyadaphis foeniculi.  
Distribution in Argentina: known currently only from Rafaela, Santa Fe.  

MALE (n = 6): Antennae 12 segmented. Coloration similar to that of the female, except for the antennae, which are entirely brown with the yellowish base of F₁ (see Table 1 for full range of character measurements).

DISCUSSION AND CONCLUSION

Binodoxys brevicornis attacked the aphid H. foeniculi feeding on F. vulgare. This plant species spontaneously grows on the margins of alfalfa crops (Zumoffen et al., 2012) and occurs from Salta Province, north of the country to Río Negro in the south of Argentina, being rather common in vacant lots, ditches, roads and railway embankments, fencing and grazing pastures (Marzocca, 1976). Foeniculum vulgare is an erect, aromatic perennial herb, indigenous to the shores of the Mediterranean widely naturalized in many parts of the world. Vegetative growth
begins in autumn, flowers bloom in spring and summer and fruits are produced at the end of summer. Nectar carbohydrates of several Umbelliferae have been mentioned as essential for the fecundity and longevity of hymenopterous insects (Leius, 1961). This plant group has an important role in the interactions between phytophagous insects and their natural enemies, being considered a source of alternative food for predators and parasitoids such as *Cycloneda sanguinea*, *Coccinella ancoralis*, *Eriopis connexa* (all Coleoptera Coccinellidae), *Allograpta exotica* (Diptera: Syrphidae) and *Aphidius colemani* (Hymenoptera: Braconidae), increasing their efficiency in the regulation of pest aphids (Lopez et al., 2003). Studies on *F. vulgare* highlighted its importance as
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Table 1. Feature measurements (µm), counts, and comparisons of female and male *B. brevicornis* (n= 11 female, n= 6 male).

<table>
<thead>
<tr>
<th>Feature</th>
<th>Female Avg. (Range)</th>
<th>Male Avg. (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna flagellomeres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_1$ (length)</td>
<td>79 (66-88)</td>
<td>76 (68-83)</td>
</tr>
<tr>
<td>$F_2$ (length)</td>
<td>76 (69-80)</td>
<td>71 (67-77)</td>
</tr>
<tr>
<td>$F_5$ (length)</td>
<td>81 (77-84)</td>
<td>80 (77-83)</td>
</tr>
<tr>
<td>Preapical (length)</td>
<td>83 (80-86)</td>
<td>76 (68-85)</td>
</tr>
<tr>
<td>Apical (length)</td>
<td>181 (173-188)</td>
<td>122 (113-131)</td>
</tr>
<tr>
<td>$F_1$ (width)</td>
<td>32 (28-35)</td>
<td>36 (30-41)</td>
</tr>
<tr>
<td>$F_2$ (width)</td>
<td>36 (32-38)</td>
<td>37 (33-42)</td>
</tr>
<tr>
<td>$F_5$ (width)</td>
<td>44 (41-46)</td>
<td>41 (39-44)</td>
</tr>
<tr>
<td>Preapical (width)</td>
<td>46 (43-49)</td>
<td>39 (38-40)</td>
</tr>
<tr>
<td>Apical (width)</td>
<td>46 (41-49)</td>
<td>43 (40-47)</td>
</tr>
<tr>
<td>Antenna placoids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F_1$ (no.)</td>
<td>2.7 (1.0-5.0)</td>
<td>2.5 (2.0-3.0)</td>
</tr>
<tr>
<td>$F_2$ (no.)</td>
<td>3.0 (2.0-4.0)</td>
<td>3.3 (3.0-4.0)</td>
</tr>
<tr>
<td>$F_5$ (no.)</td>
<td>3.7 (3.0-4.0)</td>
<td>3.7 (3.0-5.0)</td>
</tr>
<tr>
<td>Preapical (no.)</td>
<td>3.6 (3.0-4.0)</td>
<td>5.5 (5.0-6.0)</td>
</tr>
<tr>
<td>Apical (no.)</td>
<td>8.0</td>
<td>6.5 (6.0-7.0)</td>
</tr>
<tr>
<td>Eye (length)</td>
<td>150 (112-176)</td>
<td>118 (93-139)</td>
</tr>
<tr>
<td>Malar space (length)</td>
<td>29 (21-38)</td>
<td>33 (29-40)</td>
</tr>
<tr>
<td>Inter-tentorial distance</td>
<td>89 (83-95)</td>
<td>88 (75-98)</td>
</tr>
<tr>
<td>Tentorio-ocular distance</td>
<td>12 (10-13)</td>
<td>28 (21-34)</td>
</tr>
<tr>
<td><strong>Mesosoma</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesoscutal pleural setae (no.)</td>
<td>21 (17-25)</td>
<td>9.8 (7-13)</td>
</tr>
<tr>
<td>Wing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stigma (length)</td>
<td>287 (227-337)</td>
<td>282 (267-315)</td>
</tr>
<tr>
<td>Stigma (width)</td>
<td>96 (71-118)</td>
<td>97 (79-115)</td>
</tr>
<tr>
<td>R1 (length)</td>
<td>138 (106-175)</td>
<td>198 (144-266)</td>
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<tr>
<td>Radial sector vein</td>
<td>271 (172-325)</td>
<td>291 (255-332)</td>
</tr>
<tr>
<td>Propodeal setae, anterior area</td>
<td>8.3 (8-10)</td>
<td>8 (7-9)</td>
</tr>
<tr>
<td><strong>Metasoma</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Petiole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>177 (124-225)</td>
<td>162 (112-188)</td>
</tr>
<tr>
<td>Width</td>
<td>101 (88-118)</td>
<td>85 (81-88)</td>
</tr>
<tr>
<td>Genitalia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovipositor sheath (length)</td>
<td>150 (115-171)</td>
<td></td>
</tr>
<tr>
<td>Ovipositor sheath (width)</td>
<td>57 (47-65)</td>
<td></td>
</tr>
<tr>
<td>Prong (length)</td>
<td>206 (158-242)</td>
<td></td>
</tr>
<tr>
<td>Prong dorsal setae (no.)</td>
<td>3.4 (3.0-4.0)</td>
<td></td>
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<tr>
<td><strong>Comparisons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malar space/eye</td>
<td>0.2 (0.1-0.3)</td>
<td>0.27 (0.24-0.30)</td>
</tr>
<tr>
<td>$F_1$ (length/width)</td>
<td>2.4 (2.2-2.6)</td>
<td>2.1 (1.8-2.4)</td>
</tr>
<tr>
<td>$F_2$ (length)/$F_1$ (length)</td>
<td>1.0 (1.0-1.1)</td>
<td>1.0 (0.9-1.1)</td>
</tr>
<tr>
<td>$F_5$ (length/width)</td>
<td>2.1 (1.9-2.1)</td>
<td>1.9 (1.8-2.0)</td>
</tr>
<tr>
<td>$F_1$ (length/width)</td>
<td>1.8 (1.7-1.9)</td>
<td>1.9 (1.8-1.9)</td>
</tr>
<tr>
<td>$F_2$ (length)/$F_5$ (length)</td>
<td>1.0 (1.0-1.1)</td>
<td>1.07 (1.07-1.08)</td>
</tr>
<tr>
<td>Petiole (length/width)</td>
<td>1.7 (1.3-2.1)</td>
<td>1.9 (1.2-2.2)</td>
</tr>
<tr>
<td>Stigma (length/width)</td>
<td>3.0 (2.4-4.1)</td>
<td>2.9 (2.7-3.4)</td>
</tr>
<tr>
<td>Stigma (length)/R1 (length)</td>
<td>2.1 (1.6-2.7)</td>
<td>1.5 (1.0-1.9)</td>
</tr>
<tr>
<td>Ovipositor (length/width)</td>
<td>2.7 (2.5-2.9)</td>
<td></td>
</tr>
</tbody>
</table>
a host of natural enemies and innocuous aphid species (H. foeniculi, D. apiifolia, and C. aegopodii) for extensive cropping (Stary & Cermeli, 1989; Beltrame & Salto, 2000). In Spain, B. brevicornis along with Lysiphlebus testaceipes, L. fabarum, and Aphidius salicis are reported to attack H. foeniculi, D. apiifolia, C. aegopodii, A. spiraecola and A. fabae (Michelena et al., 2004). In low densities, A. colemani and Diaeretiella rapae (Mcintosh) were observed parasitizing D. apiifolia and H. foeniculi respectively (López et al., 2003; Manfrino et al., 2011). In 1990, B. brevicornis was imported from Czechoslovakia and released in California to help control the European asparagus aphid (Brachycorynella asparagi Mordv) (Daane et al., 1992). Field performance of this parasitic wasp indicates it has the potentiality to become permanently established in California. It might also prove useful as a parasitoid of C. aegopodii on vegetables (carrots, dill, etc.) (Stary, 1990).

In different regions of Iran, Aphidiinae in the Binodoxys-Trioxys group are known to attack aphid pests of medicinal plants; B. brevicornis is also reported to parasitize C. aegopodii feeding on Salix alba (Salicaceae) (Talebi et al., 2009). In Brazil, B. brevicornis is associated with aphid species, C. aegopodii and H. foeniculi (Sampaio et al., 2003; Stary et al., 2007).

Our data indicates that B. brevicornis was associated with aphids on F. vulgare during mainly the flowering period of the plant (October-February). The crop diversity in small gardens is classified as highly useful for parasitoid survival and effectiveness. Considering that B. brevicornis attacks a non-pest aphid species feeding on F. foeniculi, a host plant usually growing in alfalfa margins, the potential value of this system for a biological control using banker plants should be considered in Argentina.

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LITERATURE CITED


