



A new species of *Bracon* (Braconidae: Braconinae) from central Mexico, probable parasitoid of a weevil that feeds on roots of *Argemone ochroleuca* Sweet (Papaveraceae)

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Abstract

A new species of the braconine genus *Bracon* (subgenus *Bracon*), *B. hidalguensis* sp. nov., is described from the locality of Tasquillo in the state of Hidalgo, central Mexico. The new species was reared from roots of *Argemone ochroleuca* Sweet (Papaveraceae), where specimens of the weevil species *Conotrachelus leucophaeus* (Champion) (Curculionidae) were also obtained and thus probably it represents its host. The new *Bracon* species was characterised molecularly with DNA barcoding (COI) and a fragment of the variable D2–3 region of the nuclear ribosomal 28S gene.

Key words: scrub, Papaveraceae, roots, weevil-specialist, Braconinae

Introduction

Braconinae is one of most species-rich braconid subfamilies, currently containing 192 valid genera and more than 3,000 described species worldwide (Yu *et al.*, 2016). With over 900 recognised species currently grouped in 15 subgenera, *Bracon* Fabricius is by far the largest braconine genus (Yu *et al.*, 2016). The taxonomy of *Bracon* is problematic especially in the Neotropics, where many species were described more than a century ago without precise locality data nor with a detailed morphological description or identification keys to species. Moreover, both morphological and molecular evidence revealed that this genus is not monophyletic (Belshaw *et al.*, 2001).

Species of *Bracon* are mainly idiobiont ectoparasitoids of Coleoptera larvae, though some species attack Diptera, Hymenoptera and Lepidoptera larvae that usually feed on plant tissues (Shaw & Huddleston, 1991; Quicke, 1997). Various species of this genus have in particular been reported to be parasitoids of curculionid larvae. For instance, the weevil *Anthonomus grandis* Boheman, which feeds on *Gossypium thurberi* Tod. and *Datura stramonium* L., is known to be attacked by some species of *Bracon*, including *B. mellitor* (Tillman *et al.*, 1989), *B. thurberipage* (Rojas *et al.*, 1995), and *B. vulgaris* (Ramalho *et al.*, 2009).

Currently, only 19 described species of *Bracon* have been reported to occur in Mexico, and none recorded for the central part of the country (Rodríguez- Sánchez *et al.*, 2022). Here we describe a new species, *B. hidalguensis* sp. nov., from an arid scrub region in Tasquillo, state of Hidalgo, in central México. This new species was reared from roots of the Mexican poppy plant *Argemone ochroleuca* Sweet (Papaveraceae), from which the specialist weevil *Conotrachelus leucophaeus* Champion (Curculionidae) was feeding. Our observations suggest that the new

species described here probably develops as idiobiont ectoparasitoid of this weevil species. We also molecularly characterised this new species with the DNA barcoding of the COI mitochondrial gene and a fragment of the nuclear ribosomal 28S gene to assist in the recognition of both previous and newly described species of the genus.

Material and methods

Examined specimens

Specimen rearing

Specimens of the new species of *Bracon* described here were collected in Tasquillo, state of Hidalgo, in central Mexico, as part of an ongoing study that investigates insect interactions with the Mexican poppy *A. ochroleuca* (Fig. 1A) We collected complete specimens of this plant during their fruiting stage (about 15 specimens per locality) in 12 different localities in the states of Hidalgo, Puebla, Morelos, State of Mexico, Michoacán, and Tlaxcala. Of these, we only reared the new species of *Bracon* on plants collected in the locality of Tasquillo, Hidalgo.

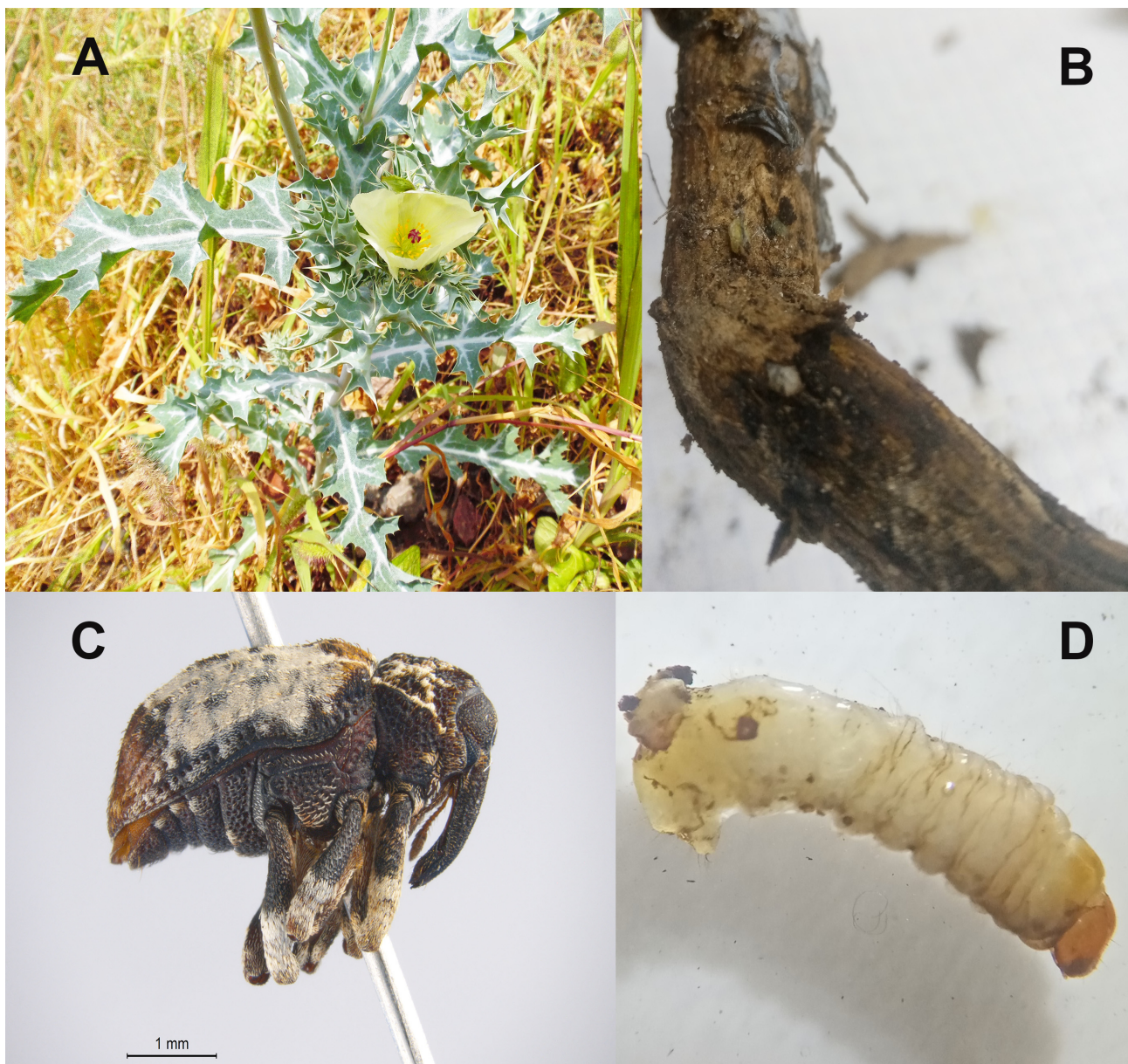


FIGURE 1. A) *Argemone ochroleuca* (Papaveraceae); B) larva of *C. leucophaeus* boring the epidermis of roots of *A. ochroleuca*. C) Adult of *C. leucophaeus*; D) larva of *C. leucophaeus* with an undetermined ectoparasitic larva.

Plant organs (roots, leaves, and capsules) were collected in Tasquillo on the 26th of September 2018, and they were immediately transported to the laboratory of Interacciones y Procesos Ecológicos at the Faculty of Sciences, Universidad Nacional Autónoma de México (UNAM). All plant organs were placed in 500 mL plastic containers, covered with a fine mesh and then placed in a growth chamber with a 12-hr light/12-hr dark cycle. We collected all emerging adult insects and registered their emergence date over three months. After this time, we dissected the roots to collect any remaining immature insect specimens (Fig. 1B). We obtained 165 larvae (Fig. 1D) and reared two adults of a weevil species that was identified as *C. leucophaeus* (Fig. 1C), as well as nine adult specimens (three females, six males) of the new *Bracon* species, which emerged from roots 12 to 15 days after plant collection.

Species description

The terminology used for morphological characters and surface sculpturing follows Sharkey and Wharton (1997) and Harris (1979), respectively. Digital colour multifocal images were taken with a ZEISS AXIO Zoom V16 stereoscopic microscope connected to an Axio Cam MRc5 camera and the ZEN 2012 software. We compared the external morphological features of the specimens of the new species with those mentioned in the original descriptions of species of *Bracon* which have been recorded to occur in Mexico and Central America (Ashmead, 1895; Cameron, 1886, 1905; Cresson, 1872; Dalla Torre, 1898; Say, 1836; Shenefelt, 1978; Wharton, 1983; Wharton and Quicke, 1988). The subgenus assignment of the new species was established using the key to subgenera of *Bracon* provided by Li *et al.* (2020). The type material is deposited in the Colección Nacional de Insectos (CNIN) of the Instituto de Biología, UNAM (IBUNAM).

Barcoding characterisation

We molecularly characterised the new species of *Bracon* generating DNA sequences belonging to two different gene fragments. We sequenced the animal barcoding locus (658 bp of the cytochrome oxidase I mitochondrial DNA gene, *cox1*; Hebert *et al.* 2003), and a 620 bp fragment of D2–3 region of the nuclear ribosomal (r) RNA gene of one and two paratype specimens, respectively (DNA voucher nos CNIN 4744–45, GenBank accession nos OR453535 and OR4522866–67, respectively). We extracted genomic DNA and carried out amplification and sequencing of the above gene fragments using the primers and protocols described in Cecarelli and Zaldívar-Riverón (2013). We assessed the genetic similarity of the two gene markers obtained from the newly described species with those generated from other species of the genus with BLAST in GenBank.

Results

The new species of *Bracon* described here belongs to the nominal subgenus based on the following external morphological features: (Li *et al.* 2020): vein 1-SR of fore wing medium-sized; fore wing vein 3-SR always more than $1.6 \times$ longer than vein r, usually more than $1.9 \times$ longer; mesosoma mostly smooth, lacking granulate sculpture; maximum length of mesosoma less than $1.6 \times$ its maximum height; second submarginal fore wing cell distinctly longer than wide; scutellum lacking punctate depression; all metasomal tergites sculptured, mostly coriaceous; ovipositor relatively long, projecting well beyond metasomal apex; all tergites in both male and female similarly pubescent and sculptured; antenna filiform or weakly setiform, usually with less than 40-antennomeres, flagellomeres often longer than wide; malar space below without a hook-like process in lateral view; second to sixth tergites without foveola-like punctures; tergites entirely sculptured; ovipositor sheath as long as or slightly longer than metasoma; apical segment of hind tarsi not longer than second segment; antenna shorter than body, not thickened; first submarginal cell of fore wing reaching or almost reaching wing apex.

The closest published COI and 28S sequences of the newly described species are with specimens assigned to two undetermined species of *Bracon*, one from Canada (COI: 93.75%; GenBank accession no. JN300500) and the other from U.S.A. (28S: 99.68%; GenBank accession no. AJ296035).

Taxonomy

Bracon hidalguensis sp. nov.

Figs 2 & 3

Material examined. *Holotype* (CNIN IBUNAM): Female. México: Hidalgo, Tasquillo, 19°50'135'' N, 99°16'326'' W, 28-IX-2018, reared from roots of *Argemone ochroleuca*, J. Solis de la Rosa col. *Paratypes* (CNIN-IBUNAM): 9 specimens 3 females, 6 males. Same data as holotype.

Diagnosis. This new species belongs to the nominal subgenus (*Bracon*). Currently, 19 species of this genus have been recorded from México, with three of them being associated with weevil larvae: *Bracon compressitarsus* Wharton, *B. mellitor* Say, and *B. nuperus* Cresson. The new species can be distinguished from the described species from Mexico by the following combination of characters: head, pronotum and mesonotal lobes largely dark brown to black (entire body piceous yellow in *B. mellitor*; Figs 2A–D; 3A,B); propodeum rugose-coriaceous (largely smooth in *B. compressitarsus* and *B. nuperus*); and second metasomal tegum rugulose-coriaceous medially (largely smooth with a median anterior carina in *B. compressitarsus*) (Fig. 2F). One North American species, *B. tortriciae* Ashmead is known to attack the weevil species *Conotrachelus nenuphar* (Yu *et al.* 2016); however, *B. hidalguensis* sp. nov. can be distinguished by the latter species by its sculptured propodeum (smooth in *B. tortriciae*) and colour pattern (metasoma with extensive dark patterns in *B. tortriciae*).

Description. *Holotype female.* Body length 3.0 mm (Fig. 2B); fore wing 3.2 mm (Fig. 2H). Ovipositor 0.9 × longer than metasoma. *Colour:* head, pronotum and mesoscutal lobes dark brown to black; propleuron, scutellum, propodeum and mesopleuron dark brown to honey yellow; median area of mesoscutum, scutellar disc, metasoma and legs honey yellow, last tarsal segment and claws black; eyes silverish black, anterior and posterior area surrounding eye honey yellow; mandibles honey yellow, black at tip; clypeus, malar space and maxillary and labial palpi honey; antennae dark brown. Wings hyaline, veins and pterostigma brown. Ovipositor sheaths dark brown to black, ovipositor honey yellow.

Head: Width 1.6 × its median length (dorsal view). Transverse diameter of eye 1.6 × wider than temple (dorsal view), 1.4 × as high as broad (lateral view). Vertex and temple smooth and polished, frons smooth-slightly coriaceous; face slightly rugose-coriaceous, sparsely setose medially, densely setose laterally. Clypeus granulated, with long dense hairs at the base. Malar space 0.3 × height of eye. Antenna with 25 flagellomeres (one antenna broken); scape and pedicel smooth and sparsely setose; segments broad, cylindrical, terminal flagellomere acuminate.

Mesosoma: Length 1.5 × its maximum height, mostly smooth and polished. Propleuron coriaceous. Lateral mesoscutal lobes slightly coriaceous near notauli. Notauli distinct, narrow and smooth, not joining. Median area of mesoscutum smooth. Scutellar disc smooth, with long, dense setae. Scutellar sulcus deep and narrow, with seven transversal carinae. Propodeum strongly rugose-coriaceous, longitudinal median carina short, about one fourth length of propodeum. Metapleuron slightly rugose-coriaceous, with long, sparse setae.

Wings: Fore wing length 3.0 × its maximum width. Pterostigma 2.8 × longer than width. Vein R1 1.7 × longer than pterostigma. Vein 3RSa 2.1 × longer than vein r, 0.8 × as long as vein 3RSb, 1.8 × longer than vein 2RS. First submarginal cell 1.3 × longer than wide, as long as first discal cell. Hind wing about 6.3 × longer than wide. Vein M+CU 0.5 × as long as vein 1M.

Legs: Coxae, femora and tibiae smooth-acinose, with sparse setae. Tarsal claws with basal lobe. Basitarsus of hind tarsus as long as second to fifth tarsomeres combined. Hind coxa 1.8 × longer than its maximum width.

Metasoma: Metasoma as long as head and mesosoma combined. First tergite short, 0.6 × as long as its maximum width, with a pentagonal-like shaped area surrounded by two lateral carinae. Second tergite coriaceous to rugulose coriaceous medially, striate in “V-like” shape medio-basally, suture between second and third terga slightly sinuous, remaining terga coriaceous. Ovipositor 0.9 × longer than metasoma; dorsal valve with a single nodus, ventral valves apically with three serrations.

Variation. Body length 2.7–3.0 mm; fore wing 2.7–3.2 mm. Median area of mesoscutum honey yellow top black dorsally; metasoma, tibiae and tarsi honey yellow to brown. Ovipositor, 0.7–0.9 × longer than metasoma. Scutellar disc honey yellow to brown

Males. Body length 2.2–2.4 mm (Fig. 3A); forewing 2.0–2.2 mm. Antennae with 23–24 flagellomeres. Anterior and posterior area surrounding eye brown and less distinctive. Scutellar disc and metasoma honey yellow to brown.

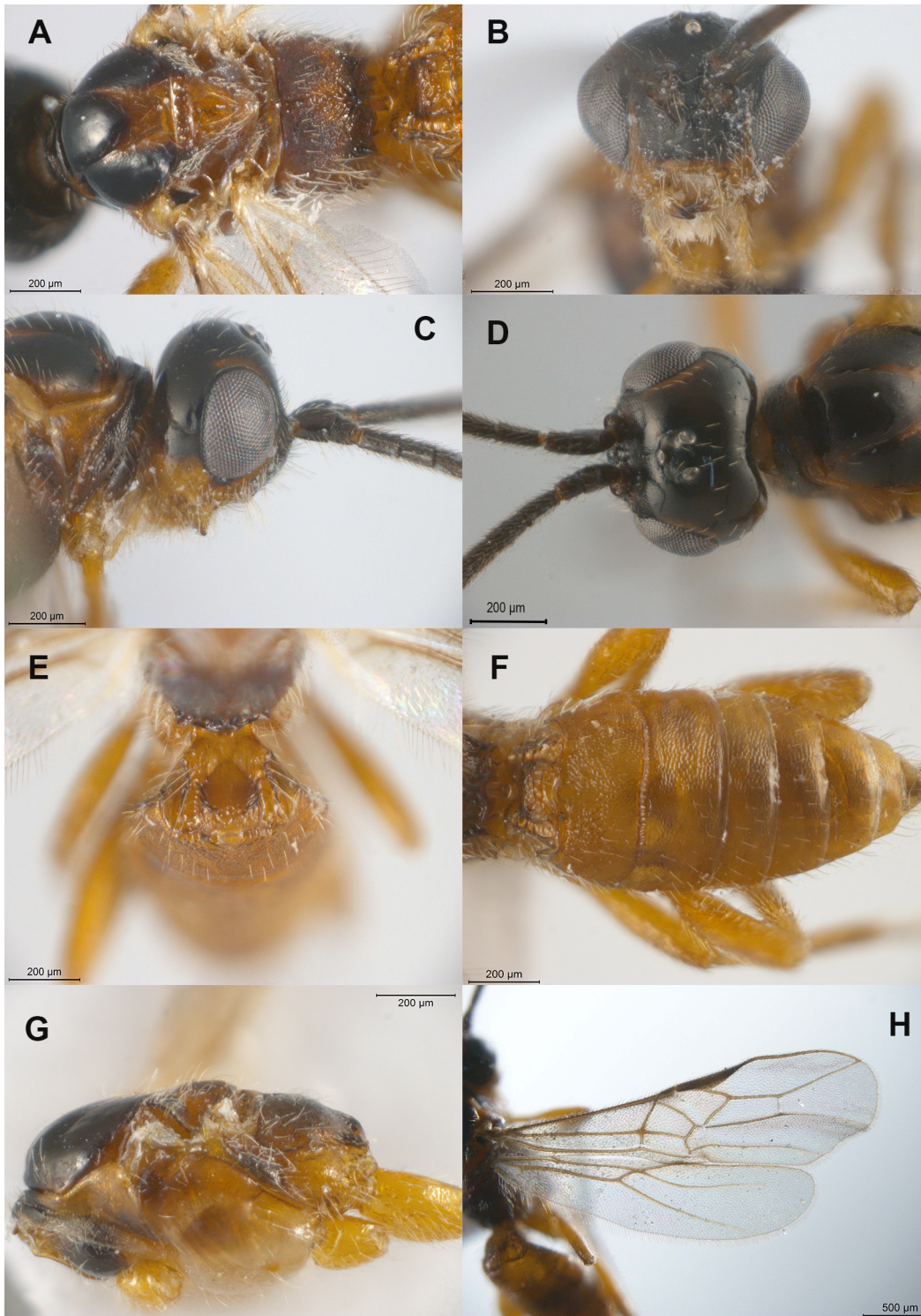


FIGURE 2. *Bracon hidalgensis* **sp. nov.**, holotype female, except G paratype male. A) mesoscutum, dorsal view; B) head, frontal view; C) head and mesosoma, lateral view; D) head and mesosoma, dorsal view; E) first metasomal tergite, dorsal view; F) second and third metasomal tergites, dorsal view; G) mesosoma, lateral view; H) fore and hind wings.

Type locality. Tasquillo, Hidalgo, central Mexico.

Etymology. The new species was named after the state where it was collected, Hidalgo.

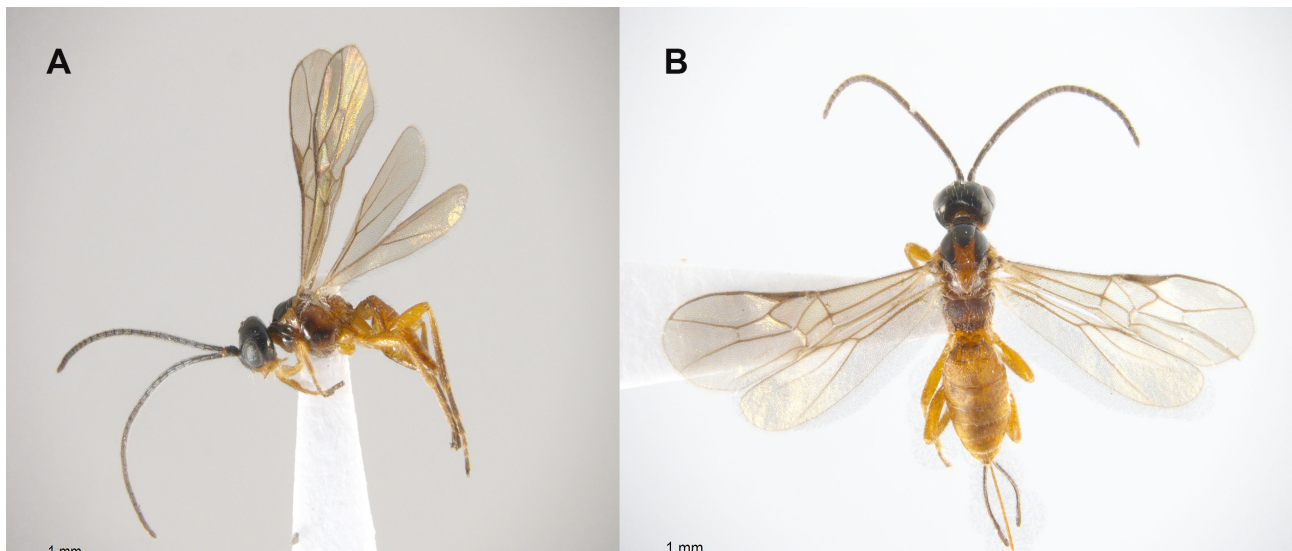


FIGURE 3. Habitus of *B. hidalguensis* sp. nov. A) paratype male, lateral view; B) holotype female, dorsal view.

Discussion

This new species represents the first record of a described species of *Bracon* for central Mexico. This is surprising due to the considerable species diversity of the genus in the region. Our field observations and the molecular characterisation of the new species will serve for future descriptions of *Bracon* species.

Despite their cryptic feeding habits, two *Bracon* species, *B. mellitor* and *B. punctatus* have been previously reported in North America as parasitoids of a weevil species, *Cylas formicarius* (Fabricius), which are known to feed on roots. These two *Bracon* species were suggested to be parasitoids of the latter weevil species, which was found to feed on roots of *Ipomoea batatas* L., though the parasitisation process was unclear (Chalfant *et al.*, 1990). Also, the Asian species *B. yasudai* Maeto & Uesato has been reported as a parasitoid of *C. formicarius* in Japan, where it was observed in the laboratory to oviposit into the tuber of *I. batatas* above ground (Maeto & Uesato, 2007). Further field and laboratory observations are needed to confirm the host species of *B. hidalguensis* and its parasitising mechanism.

Acknowledgments

We thank Cristina Mayorga for helping with the curation of the examined specimens; and Susana Guzmán for taking the digital photographs. This work was in part funded by a grant given by the CONACyT, Mexico (Convocatoria Ciencia de Frontera 2019, Proyecto No. 58548) to AZR.

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