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Parasitoids (Hymenoptera: Chalcidoidea) of *Toumeyella* scales (Hemiptera: Coccidae) in the New World, with description of a new species from Mexico

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Abstract

Coccophagus funiculatus Myartseva **sp. nov.** (Hymenoptera: Aphelinidae), reared from the soft scale genus *Toumeyella* (Hemiptera: Coccidae), is described, and the aphelinid species associated with *Toumeyella* species in the New World are discussed and compared.

Key Words: beneficial insect; biological control; *Coccophagus*

Resumen

Se describe *Coccophagus funiculatus* Myartseva **sp. nov.** (Hymenoptera: Aphelinidae), criado de una especie de escama blanda del género *Toumeyella* (Hemiptera: Coccidae) y se discute la información de las especies de afelinidos asociados con las especies de *Toumeyella* en el Nuevo Mundo.

Palabras Clave: insectos benéficos; control biológico; *Coccophagus*

The world fauna of the soft scale genus *Toumeyella* Cockerell (Hemiptera: Coccidae) includes 17 species (Kondo & González 2014). *Toumeyella* is widely distributed in the New World with most species described from the USA (Kondo & Pellizzari 2011) (Table 1). In Mexico, 6 species are known: *T. erythrinae* Kondo & Williams, *T. fontanai* Kondo & Pellizzari, *T. martinezi*

Kondo & González, *T. mirabilis* (Cockerell), *T. parvicornis* (Cockerell), and *T. sallei* (Signoret) (Kondo & Pellizzari 2011; Kondo & González 2014).

Most *Toumeyella* species are oligophagous. Five Mexican *Toumeyella* species have been collected on species in the plant families Fabaceae, Rosaceae, and Pinaceae, and *T. martinezi* occurs on “garambullo” cac-

Table 1. Checklist of *Toumeyella* parasitoids in the New World, and their global distribution (after Noyes 2014).

Parasitoids	Other hosts (except <i>Toumeyella</i>)	Distribution
Aphelinidae		
<i>Mexidalgus toumeyellus</i> Myartseva	—	Mexico (Hidalgo)
<i>Coccophagus albicoxa</i> Howard	<i>Physokermes insignicola</i> (Craw)	USA, Panama
<i>C. bivittatus</i> Compere	<i>Akermes bruneri</i> Cockerell, <i>Ceroplastes pseudoceriferus</i> Green, <i>Coccus hesperidum</i> L., <i>Pulvinaria polygonata</i> Cockerell, <i>Cardiococcus bivalvatus</i> (Green), <i>Cryptinglisia elytrapappi</i> (Brain), <i>Kilifia acuminata</i> (Signoret), <i>Saissetia oleae</i> (Olivier)	Argentina, Egypt, India, Israel, Italy, South Africa
<i>C. flavifrons</i> Howard	<i>Coccus hesperidum</i> , <i>Mesolecanium nigrofasciatum</i> (Pergande)	USA, India
<i>C. funiculatus</i> sp. nov.	—	Mexico (Puebla)
<i>C. immaculatus</i> Howard	<i>Coccus hesperidum</i> L., <i>Pulvinaria bigeloviae</i> Cockerell, <i>Saissetia coffeae</i> (Walker)	USA, Chile
<i>C. lycimnia</i> (Walker)	More than 100 species of Coccidae and other families of Coccoidea	Cosmopolitan
<i>C. quaestor</i> Girault	<i>Coccus hesperidum</i> L., <i>Parasaissetia nigra</i> (Nietner), <i>Saissetia coffeae</i> , <i>S. miranda</i> (Cockerell & Parrott), <i>S. oleae</i> (Olivier)	Canada, USA, Mexico, El Salvador, Peru
Encyrtidae		
<i>Anicetus toumeyellae</i> Milliron	<i>Ceroplastes</i> sp.	USA
<i>Gahaniella saissetiae</i> Timberlake	<i>Coccus hesperidum</i> , <i>Milviscutulus mangiferae</i> (Green), <i>C. viridis</i> (Green), <i>Parasaissetia nigra</i> , <i>Saissetia coffeae</i> , <i>S. miranda</i> , <i>S. neglecta</i> De Lotto, <i>S. oleae</i>	Cuba, USA, South America
<i>Metaphycus flavus</i> (Howard)	More than 40 species of Coccidae and other families of Coccoidea	Almost cosmopolitan
<i>Microterys fuscicornis</i> (Howard)	Only known from <i>Toumeyella</i>	USA

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Table 2. *Toumeyella* species and their parasitoids in the Neotropical and Nearctic regions.

Soft scales	Distribution	Parasitoids	References
<i>T. liriodendri</i> (Gmelin)	USA, Cuba	Aphelinidae: <i>Coccophagus bivittatus</i> , <i>C. flavifrons</i> , <i>C. lycimnia</i> Encyrtidae: <i>Metaphycus flavus</i> , <i>Anicetus toumeyellae</i>	Frank & Foltz (1997); Evans (2000); Myartseva & Ruíz-Cancino (2004); Myartseva et al. (2004); Trjapitzin & Ruíz-Cancino (2009)
<i>T. martinezi</i> Kondo & González	Mexico	Aphelinidae: <i>Mexidalgus toumeyellus</i>	Myartseva et al. (2014)
<i>T. parvicornis</i> (Cockerell)	Canada, USA, Mexico, Puerto Rico, Turks & Caicos Islands	Aphelinidae: <i>Coccophagus albicoxa</i> , <i>C. immaculatus</i> , <i>C. quaestor</i> , <i>Coccophagus</i> sp. Encyrtidae: <i>Microterys fuscicornis</i> , <i>Metaphycus</i> sp.	Myartseva & Ruíz-Cancino (2011); Malumphy et al. (2012); Clarke (2013); Kondo & González (2014)
<i>T. pini</i> (King)	Canada, USA	Aphelinidae: <i>Coccophagus albicoxa</i> , <i>C. lycimnia</i>	Clarke & DeBarr (1989)
<i>T. pinicola</i> Ferris	USA	Aphelinidae: <i>Coccophagus lycimnia</i>	Noyes (2014)
<i>Toumeyella</i> sp.	Mexico	Aphelinidae: <i>Coccophagus funiculatus</i> sp. nov. Encyrtidae: <i>Encyrtus</i> sp.	New data
<i>T. turgida</i> (Cockerell)	USA	Aphelinidae: <i>Coccophagus immaculatus</i>	Noyes (2014)

tus *Myrtillocactus geometrizans* (Mart.) (Cactaceae) (Kondo & González 2014). This cactus is widely distributed in xerophyllic habitats in Mexico, but in the town of Huichapan (State of Hidalgo, Mexico), populations are declining due to damage by *T. martinezi*. Three hymenopteran species of endoparasitoids are associated with *Toumeyella* species in this area: *Mexidalgus toumeyellus* Myartseva and *Coccophagus ruizi* Myartseva & Ruiz (Aphelinidae), and *Metaphycus* sp. (Encyrtidae) (Martínez 2015).

Four species of Aphelinidae have been reported from *T. parvicornis*, a scale that can cause severe decline of *Pinus* species. *Coccophagus albicoxa* Howard, *C. immaculatus* Howard and *C. quaestor* Girault (Aphelinidae) are primary parasitoids; an *Aphytis* species (Aphelinidae) was reported from this host, but the record is considered erroneous because all other *Aphytis* species parasitize armored scales (Diaspididae) (Malumphy et al. 2012).

Coccophagus quaestor was described from Mexico and has been reported in Canada, El Salvador, Peru, and the USA; *C. immaculatus* was described from the USA and has been reported in Chile; and *C. albicoxa* was described from the USA and is also known to occur in Panama (Noyes 2014). See Table 2 for a detailed listing of *Toumeyella* species and their parasitoids in the Neotropical and Nearctic regions.

Coccophagus Westwood, with 259 species, is the second most speciose genus in Aphelinidae after *Encarsia* Förster; 30 species of *Coccophagus* occur in Mexico (Myartseva et al. 2012). *Coccophagus funiculatus* **sp. nov.** was reared from *Toumeyella* sp. from the State of Puebla, Mexico, and is described in this article.

Species of both *Mexidalgus* and *Coccophagus* parasitize *Toumeyella* scales in Mexico. According to Hayat (1998), *Mexidalgus* is placed in the subfamily Coccophaginae based on the following characteristics: antennal flagellum with 5 to 6 segments, pale lines and sutures on the head,

forewing without a linea calva. This genus possesses characters that occur in the genera *Coccophagus* and *Coccobius* Ratzeburg (Myartseva et al. 2014), but is distinguished from all other genera of Coccophaginae by the following combination of characters: 7-segmented female antennae, 2-segmented club; mandible with 2 short teeth and 1 truncation, apical margin with small serrations; 3rd valvula of ovipositor absent (possibly 2nd valvifer and 3rd valvula are very closely fused); 7-segmented male antennae, 2-segmented club, elongated apical segment of club; reduced mandible, without teeth, about half as long as the female mandible; genitalia shorter than the mid tibia; 3rd to 6th gastral sternites with an area of large pegs located in the middle.

Coccophagus funiculatus **sp. nov.** is the 2nd species in Mexico reared from species in the genus *Toumeyella*. The new species belongs to a group that includes *C. mexicanus* Girault and *C. albicoxa* and is characterized by having pale hind coxae and a densely setose scutellum; see Table 3 for a comparison of *C. funiculatus* **sp. nov.** with *C. mexicanus* and *C. albicoxa*.

Materials and Methods

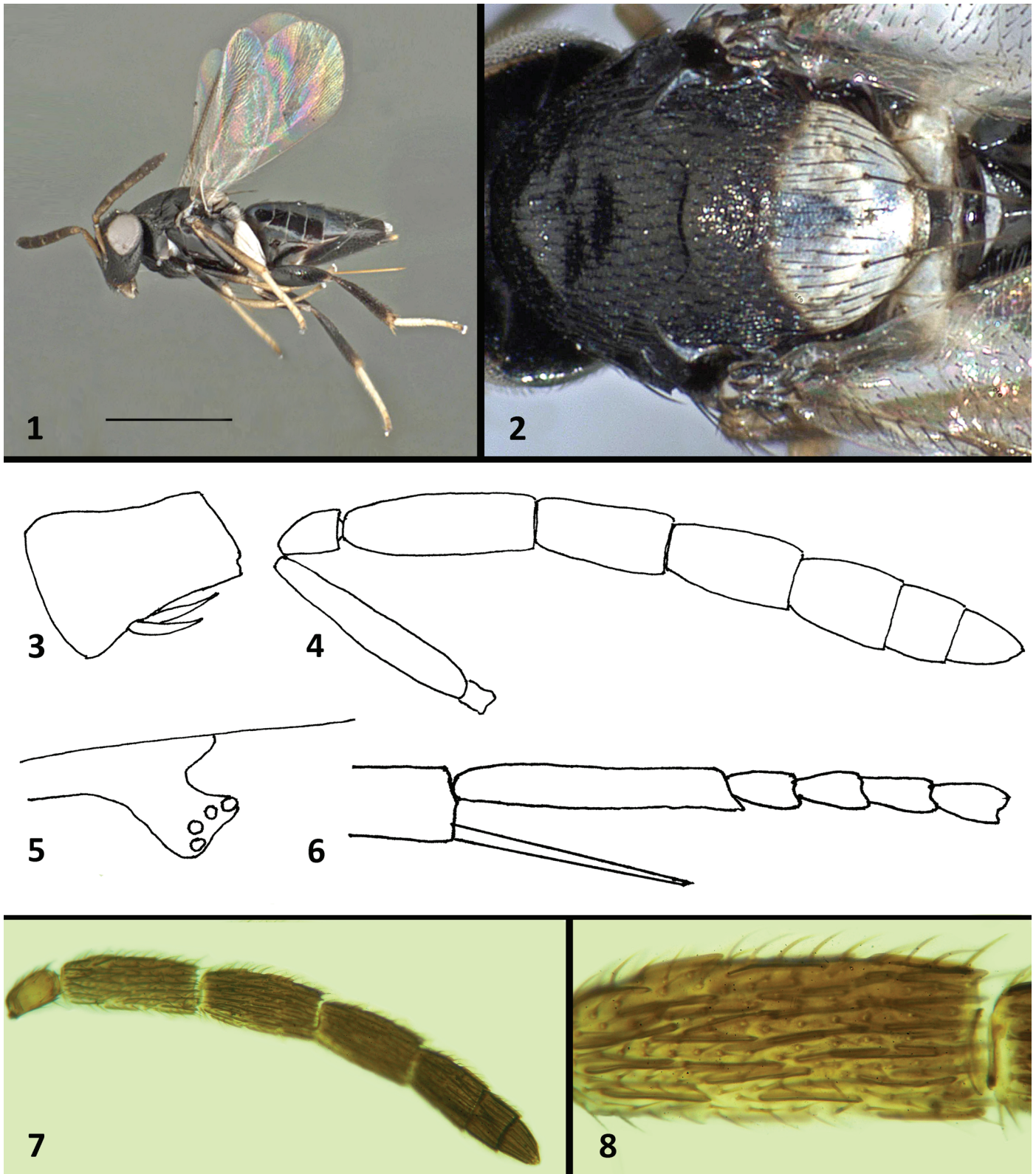
Adults and larvae of *Toumeyella* sp. were collected on “tejocote” in May 2014 in Chiautcingo, State of Puebla, Mexico. Parasitic wasps of the families Aphelinidae and Encyrtidae (Chalcidoidea) were reared in the laboratory from this material. Some specimens were used for preparing microslides, following Noyes (1982). Morphological characters were examined using a Leica GME compound microscope. Compere (1931), Woolley (1997), Myartseva (2006), and Trjapitzin et al. (2008) were used for identification. Other specimens were preserved on small

Table 3. Differences between 3 closely related species of *Coccophagus*.

Characters	<i>funiculatus</i> sp. nov.	<i>albicoxa</i>	<i>mexicanus</i>
Scutellum	apical 1/2–2/3 whitish	apical half whitish	apical 1/4 whitish
Propodeum	whitish yellow, medial part black	yellow, sides and center black	entirely black
Frons and face	black	black	yellow
Scape and pedicel	dark yellow	dark brown	yellowish
Pedicel: 1st funicular segment	pedicel subequal to 0.35 of 1st funicular segment	pedicel subequal to 0.5 of 1st funicular segment	—
First funicular segment	3.0–3.3 times as long as wide	2.0 times as long as wide	slightly longer than wide
Third funicular segment	2.0 times as long as wide	1.3 times as long as wide	slightly longer than wide
Club	shorter than 3rd and 2nd funicular segments combined	about as long as 3rd and 2nd funicular segments combined	—
Scape	shorter than pedicel and 1st funicular segment combined	as long as pedicel and 1st funicular segment combined	—
Length of body	1.75–2.1 mm	2.5 mm	1.6 mm

rectangular cards. Type material was preserved in UCRC (Research Entomological Museum, University of California, Riverside, California), BMNH (The Natural History Museum, London, United Kingdom), CNIN (Colección Nacional de Insectos, Instituto de Biología, Universidad Na-

cional Autónoma de México), CEAM (Colección de Insectos del Colegio de Postgraduados, Campus Montecillo, Texcoco, Estado de México), and UAT (Insects Museum, Universidad Autónoma de Tamaulipas, Ciudad Victoria, Mexico).



Figs. 1–8. *Coccophagus funiculatus*, sp. nov., female. 1, Lateral view of body; 2, mesoscutum, dorsal view; 3, mandible; 4, antenna; 5, stigmatal and postmarginal veins; 6, mid-tarsus and mid-tibial spur; 7, antenna with sensilla; 8, 1st funicular segment.

Results

Coccophagus funiculatus Myartseva, sp. nov.

(Figs. 1–8)

TYPE MATERIAL

HOLOTYPE: female, MEXICO, Puebla, Municipio de Chiautcingo, San Nicolás Zecalacoayan, 19.199167°N, 98.488333°W, 2,460 m, 8-V-2014, ex *Toumeyella* sp. on *Crataegus mexicana* (col. R. C. Hernández-De la Cruz). Paratypes: same data as holotype, 14 females, and 1 female collected on 1-VII-2014, all point-mounted, and 3 additional females on slides. Holotype and 4 paratypes preserved at UCRC, 4 paratypes at BMNH, 4 paratypes at CNIN, 3 paratypes at CEAM, and 3 paratypes on slides at UAT.

DESCRIPTION

Length: 1.75–2.1 mm. Coloration: Head black; scape and antennal pedicel dark yellow, flagellum dark brown. Mesosoma black, tegulae whitish-yellow with dark apical margin, scutellum whitish-yellow on apical 1/2–2/3, with black setae; forewings hyaline with brown venation. Propodeum whitish-yellow laterally, black medially. Legs black, except the following, which are yellow: apices of fore and mid-femur, fore and mid-tibiae ventrally and on apical half, apices of hind tibiae; all tarsi whitish, without infusate apical segment; white hind coxae and trochanters; gaster bright black.

Body: (Figs. 1 and 2; female, lateral view and dorsal view of mesoscutum). Head slightly wider than mesosoma, slightly wider than height. Frontoververtex about 0.5 times as wide as width of head. Ocelli obtuse triangle. Eyes finely setose, 1.5 times as wide as cheeks. Mandible (Fig. 3) with 2 ventral teeth only, slightly developed, with wide truncation. Antenna (Fig. 4) arising at level of lower margin of eye. Radicle short, slightly longer than wide (5:4). Scape long, 6.0 times as long as wide. Pedicel 1.4 times as long as wide. First funicular segment longest, 3.0–3.3 times as long as wide. Second and 3rd segments subequal in length and width, each about 2.0 times as long as wide. Club shorter than 3rd and 2nd funicular segments combined. First segment of club about 1.3 times as long as wide and slightly wider than funicle; 2nd segment slightly wider than long (3:4), apical segment subequal in length and width. Flagellar segments with numerous longitudinal sensilla, situated in rows of 4, 3, 3, 2, 1, 1, respectively, from 1st to 6th segments (Figs. 7 and 8). Mid-lobe of mesoscutum with many scattered setae. Scutellum with many short setae and 2 pairs of long, strong bristles, apical pair longer. Forewing 2.4 times as long as wide, with very short marginal fringe. Submarginal vein with 7 long setae on anterior margin. Marginal vein longer than submarginal vein. Stigmal and post-marginal veins as in Fig. 5. Mid-tibial spur (Fig. 6) long and slightly shorter than basitarsus; basitarsus with a row of peg-like setae. Dorsal margin of hind tibia with a row of stout, suberect setae. Ovipositor slightly exerted, 1.7 times as long as mid-tibia; 3rd valvula about 0.3 times as long as 2nd.

Male: Unknown.

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