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Authors: Castañeda-Vildózola, Álvaro, Sánchez-Pale, Jesús R., Franco-Mora, Omar, and Hernández-Zetina, Dulce A.

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First record in Mexico of *Ceromasia auricaudata* Townsend (Diptera: Tachinidae) parasitizing *Neodiprion omosus* Smith (Hymenoptera: Diprionidae)

Álvaro Castañeda-Vildózola[1,], Jesús R. Sánchez-Pale[1], Omar Franco-Mora[1], and Dulce A. Hernández-Zetina[2]*

The family Diprionidae (Insecta: Hymenoptera), commonly known as sawflies, includes at least 90 described species and is a group of conifer-defoliating insects in the Northern Hemisphere (Smith 1988; Taeger et al. 2010; Smith et al. 2012). Many reports have indicated the presence of sawflies of the genus *Neodiprion* Rohwer, *Zadiprion* Rohwer, and *Monoctenus* Dahlbom (Hymenoptera: Diprionidae) in Mexican conifer forests (Smith 1988; Smith et al. 2010, 2012). Defoliation attributed to sawflies leads to reduced growth in terms of diam, height, and root size in affected trees; if attack is severe and prolonged, it can result in tree death, especially among young trees in the sprouting phase (González-Gaona & Sánchez-Martínez 2018; Aguilera-Molina et al. 2019).

The genus *Neodiprion* currently contains 51 described species (Taeger et al. 2010) of which *Neodiprion autumnalis* Smith, *Neodiprion bicolor* Smith, *Neodiprion equalis* Smith, and *Neodiprion omosus* Smith (all Hymenoptera: Diprionidae) are reported to occur in Mexico (Smith 1988). *Neodiprion omosus* is a univoltine species that is well known in central Mexico and is associated with 9 species of *Pinus* L. (Pinaceae) (Cibrián-Tovar et al. 1995; Coria-Avalos et al. 2014). The larvae of *N. omosus* are gregarious, feeding on young needles and the bark of young twigs. As they near pupation, *N. omosus* larvae leave the trees to overwinter underground as pupae. Adults emerge in summer (Cibrián-Tovar et al. 1995).

Parasitism is a natural cause of mortality of sawfly larvae (González-Gaona & Sánchez-Martínez 2018). The main groups of parasitoids associated with sawflies include members of the families Ichneumonidae (Hymenoptera) and Tachinidae (Diptera); however, many reports indicate that ichneumonids account for the majority of cases of parasitism in sawfly populations (Ruiz-Cancino & Khalaim 2015; Tao et al. 2016; Khalaim et al. 2019). Despite the abundance of ichneumonids, the literature cites 31 genera of Tachinidae associated with sawflies (Richter & Kasparyan 2013). In this study, we report for the first time the presence of *Ceromasia auricaudata* Townsend (Diptera: Tachinidae) in Mexico in association with larvae of the sawfly *N. omosus*, which constitutes a new host record.

In Aug 2018, we observed an outbreak of *N. omosus* larvae in the experimental station of the Facultad de Ciencias Agrícolas de la Universidad Autónoma del Estado de México, located in the community of the Cerrillo, Piedras Blancas (19.2432°N, 99.4120°W; 2,614 masl), Toluca, Estado de Mexico, Mexico. The outbreak affected 2 populations of 9-yr-old pine trees: 17 *Pinus gregii* Engelm. ex Parl. trees and 14 *Pinus patula* Schiede ex Schltdl. & Cham. (Pinaceae). In Oct of the same yr, 1,500 late stage *N. omosus* larvae were collected and transported to the laboratory for conditioning.

The larvae were placed in 32.5 × 18.0 × 11.5 cm plastic containers (Rubbermaid®, Atlanta, Georgia, USA) and fed with pine needles from *P. gregii* that were replaced every 5 d. A total of 1,294 puparia were obtained and transferred to a new container with previously disinfected soil with hot water (70 °C for 15 min) as a pupation substrate. The soil was moistened with distilled water once per wk to avoid desiccation and premature death of the pupae. The pupation containers were covered with cheesecloth so that parasitoids and sawfly adults could not escape, and were kept in uncontrolled laboratory conditions. Of the 1,294 puparia, 1,047 adult sawflies and 11 Tachinidae specimens emerged, with a single fly emerging from each puparia. It was identified as *C. auricaudata* by D. H. Zetina. The specimens were deposited in the Colección de Insectos del Colegio de Postgraduados, Montecillo, Texcoco, Estado de Mexico, Mexico.

The genus *Ceromasia* Rondani (Diptera: Tachinidae: Goniini) is composed of 3 species: *C. auricaudata*, *Ceromasia hybreas* (Walker), and *Ceromasia rubrifrons* (Macquart) (Diptera: Tachinidae), which are recorded from North America, Europe, and Asia (O'Hara et al. 2019). The current distribution of *C. auricaudata* includes Canada and the US (O'Hara et al. 2019). Our findings contribute to knowledge of range expansion of this species toward central Mexico. *Ceromasia auricaudata* is a solitary koinobiont endoparasitoid associated with larvae of the genus *Choristoneura* Lederer (Lepidoptera: Tortricidae) (O'Hara 2005). The literature does not report parasitism of sawflies by members of the genus *Ceromasia*; as such, our findings are also a new host-parasitoid interaction for Mexico, increasing the number of genera of Tachinidae associated with sawflies previously cited by Richter & Kasparyan (2013). Other cases of parasitism of sawfly larvae attributed to Tachinidae in Mexico include *Spathimeigenia* (*Vibrissina*) *mexicana* (Aldrich) (Diptera: Tachinidae) parasitizing larvae of *Zadiprion falsus* Smith (Hymenoptera: Diprionidae) in Michoacán (Méndez 1983); *Lespesia postica* (Walker) and *V. mexicana* (Diptera: Tachinidae) parasitizing larvae of *Monoctenus sanchezi* Smith (Hymenoptera: Diprionidae) in San Luis Potosí (Ordaz-Silva et al. 2014); and *Chetogena* (*Diplostichus*) nr. *lophyri* (Townsend) (Diptera: Tachinidae) reported as a parasitoid of

[1]Facultad de Ciencias Agrícolas, Universidad Autónoma del Estado de Mexico, Campus El Cerrillo, Toluca, Estado de Mexico, C.P. 50200, Mexico; E-mail: acastanedav@uaemex.mx (A. C.-V.), jrsanchezp@uaemex.mx (J. R. S.-P.), ofrancom@uaemex.mx (O. F.-M.)
[2]Instituto Interamericano de Cooperación para la Agricultura (IICA), Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria, Unidad Integral de Diagnóstico, Servicio y Constatación, Carretera Federal Mexico- Pachuca Km. 37.7, Tecámac, Estado de Mexico, C.P. 55740, Mexico; E-mail: zetinaadh@gmail.com (D. A. H.-Z.)
*Corresponding author; E-mail: acastanedav@uaemex.mx

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Zadiprion rohweri Middleton (Hymenoptera: Diprionidae) in Coahuila (Smith et al. 2016).

Other parasitoids that emerged from *N. omosus* in this study included the ichneumonids *Lamachus cushmani* Khaleim & Ruiz-Cancino and *Lamachus toluca* Khaleim & Ruiz-Cancino (Hymenoptera: Ichneumonidae), previously described by Khaleim et al. (2019).

According to O'Hara (2005), *C. auricaudata* eggs are deposited onto foliage and do not hatch until they are ingested by a potential host. This reproductive strategy leads to a low probability of parasitism, but is much more efficient than other tachinids with more conventional strategies. *Ceromacia auricaudata* overwintered as a larvae within an overwintering *N. omosus* prepupae. In this study, average time from the collection of parasitized larvae to the emergence of adult parasitoids was 297.72 d (n = 11, 170–340 days). Coppel & Maw (1954) pointed out that adult *C. auricaudata* required 9 to 11 d to emerge from their primary host, *Choristoneura fumiferana* (Clemens) (Lepidoptera: Tortricidae). Despite the ecological and behavioral similarity between diprionid and lepidopteran larvae, the use of sawfly larvae as potential hosts by tachinids has not been successful particularly from an evolutionary perspective, such that parasitism of diprionids by tachinids is apparently secondary (Richter & Kasparyan 2013). This behavior may explain why only 0.85% of *N. omosus* larvae were naturally parasitized by *C. auricaudata* in the study site.

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Summary

Ceromasia auricaudata Townsend (Diptera: Tachinidae) is recorded for the first time in Mexico. This also is the first time that *C. auricaudata* is associated with *Neodiprion omosus* Smith (Hymenoptera: Diprionidae), increasing the number of genera of Tachinidae associated with sawflies.

Key Words: sawfly; parasitoid; diprionid; tachinid

Sumario

Ceromasia auricaudata Townsend (Diptera: Tachinidae) se registra por primera vez en México. Este reporte es también la primera vez que *C. auricaudata* parasita a *Neodiprion omosus* Smith (Hymenoptera: Diprionidae), lo que aumenta el número de géneros de Tachinidae asociados con las moscas de sierra.

Palabras Clave: mosca sierra; parasitoide; dipriónido; taquínido

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