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Investigation note

New report of *Bradysia* sp. (Diptera: Sciaridae) associated with *Lilium* sp.(Liliaceae) in Ocotlan of Morelos

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Abstract

Adult and immature stages (larvae and pupae) of 'black fungus gnats' (Diptera: Sciaridae) were collected from July to September 2019 in nurseries of production of potted lily (*Lilium* sp.) in Ocotlán de Morelos, Oaxaca, Mexico. One hundred percent of the specimens collected in the field corresponded to the genus *Bradysia* Winertz, 1867 (*Diptera*: *Sciaridae*). The present study represents the first record of this genus in *Lilium* sp. plants in Ocotlán de Morelos, Oaxaca, Mexico.

Palabras clave:

Diptera, lilies, black fungus gnat, Mexico.

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The production of 'lilies' (*Lilium* L.; Liliaceae) in Mexico has gained popularity as a cut and potted flower, ensuring a good market demand (Castro and Londoño, 2008). The main producing states are Mexico and Veracruz, with a planted area of 270.18 ha and a production of 735 472.2 t (SIAP, 2021). In the municipality of Ocotlán de Morelos, Oaxaca, Mexico, the demand for the *Lilium* flower has increased considerably within the local market, which has aroused interest in producing this ornamental plant, considering that the climatic conditions of the Central Valleys region of Oaxaca are suitable for the establishment of the plant, as it develops smoothly.

However, similar to other crops, the lily flower is threatened by the presence of pests that directly affect its production and, consequently, its quality, which is why producers are facing a serious phytosanitary problem. This is the presence of a pest whose taxonomic status is not yet known, which is very similar to a 'fungus gnat', a nematoceran dipteran that may belong to the family Sciaridae or Mycetophilidae (García, 2008).

Globally it is estimated that the number of 'black fungus gnat' species ranges between 5 000 and 10 000, of which about 2 400 species have been described (Mohrig and Menzel, 2009; Ramírez and Alonso, 2014); in the Nearctic region (Canada, United States of America, and North of Mexico), 166 species of 25 genera are estimated (Mohrig *et al*., 2012). The genus *Bradysia* Winnertz is the most numerous of the family Sciaridae, with 433 species (Menzel and Mohrig, 1999). This pest is considered mycophagous, although it has also been described as an opportunistic herbivore (Katumanyane *et al*., 2018) and, despite its economic and ecological importance, it has been little studied due to its small size, way of life, and difficulty in determining its taxonomic identity (Mohrig and Menzel, 2009; Villanueva-Sánchez *et al*., 2013).

Larvae of nematoceran dipterans cause direct damage by feeding on plant roots and/or bulbs (White *et al*., 2000; Cibrián *et al*., 2008; Marín-Cruz *et al*., 2017) and also cause indirect damage due to their ability to transmit phytopathogenic fungi such as *Botrytis cinerea* Pers. 1797, *Pythium* sp. nov., *Fusarium oxysporum* Schltd., 1824, *Verticillium alboatrum* Reinke & Berthold, 1879, *Verticillium fungicola* (Preuss) Hassebr., 1936 and *Fusarium circinatum* Nirenberg & O' Donnell 1998 (Hurley *et al*., 2007; Shamshad *et al*., 2009; Cloyd, 2015; Marín-Cruz *et al*., 2015).

Worldwide, the presence of the 'black fungus gnat' is described in greenhouses and nurseries of ornamental and forest species, vegetables, and gardens (White *et al*., 2000; Garcia, 2008; Santos *et al*., 2012; Villanueva-Sánchez *et al*., 2013; Han *et al*., 2015; Menzel *et al*., 2020). At the national level, there is little information on the identity of 'black fungus gnats' species associated with crops of ornamental, vegetable, and forest species (Villanueva-Sánchez *et al*., 2013; Marín-Cruz *et al*., 2015).

For this reason, adult specimens and immature stages (larvae and pupae) of 'black fungus gnat' were collected in nurseries of production of *Lilium* sp., in pots in the municipality of Ocotlán de Morelos, Oaxaca, Mexico, with the aim of identifying the 'black fungus gnat' at the genus level and describing the damage caused by the larvae to the plants. Three samplings were carried out from July to September 2019 in five nurseries of production of *Lilium* sp. in pots located at 16°46' 13.1" north latitude and 96° 40' 28.1" west longitude in the municipality of Ocotlán de Morelos, Oaxaca, Mexico (Figure 1).

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Figure 1. Location of the municipality of Ocotlán de Morelos, Oaxaca, Mexico.

The pots of *Lilium* sp. were in a semi-controlled environment with a shade mesh of intensity 80:20. As part of the agronomic management, the producers disinfected the lily bulb with preventive fungicides to avoid rotting caused by the phytopathogenic fungi *Fusarium* spp. (Hypocreales: Nectriaceae), *Pythium* spp. (Pythiales: Pythiaceae) and *Phytophthora* spp. (Pythiales: Pythiaceae).

The irrigations were light and carried out every three days or depending on the plant's requirements. Fertilization was performed with urea, potassium nitrate, monoammonium phosphate (MAP), and calcium nitrate. In each nursery, 50 pots of 'lilies' were checked for the presence of adult 'black fungus gnat' (Figure 2), which were collected with a mouth aspirator (Figure 3).

Figure 2. Nurseries visited where the presence of the 'black fungus gnat' was detected. Ocotlán de Morelos, Oaxaca.

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Figure 3. Mouth aspirator and microcentrifuge tubes with larvae and adults of *Bradysia* sp.

To detect immature stages of the 'black fungus gnat', the substrate was removed from each pot to later collect larvae of different instars and pupae with the help of entomological tweezers. All collected instars were placed in 1.5 ml Eppendorf tubes with 70% alcohol previously labeled with the collection data. To preserve the larvae, they were placed in boiling water for 60 s, then returned to the corresponding Eppendorf tube. To corroborate that the larvae corresponded to the 'black fungus gnat', a breeding stock was established in the basic science laboratory of the Novauniversitas University located in Ocotlán de Morelos, Oaxaca.

The adult specimens of 'black fungus gnat' collected in the nurseries were processed in the National Laboratory of Agri-Food and Forestry Research and Service (LANISAF, for its acronym in Spanish) using the technique proposed by Ibáñez-Bernal (1999) and were identified at the genus level, which was carried out with the keys by Steffan (1981); Brown (2009), through their observation in a Carl Zeiss Tessovar photo-microscope, with a PaxCam 3 digital camera for microscopy. In total, 1 000 adult specimens were collected, and 100% corresponded to the genus *Bradysia* sp. (Figure 4).

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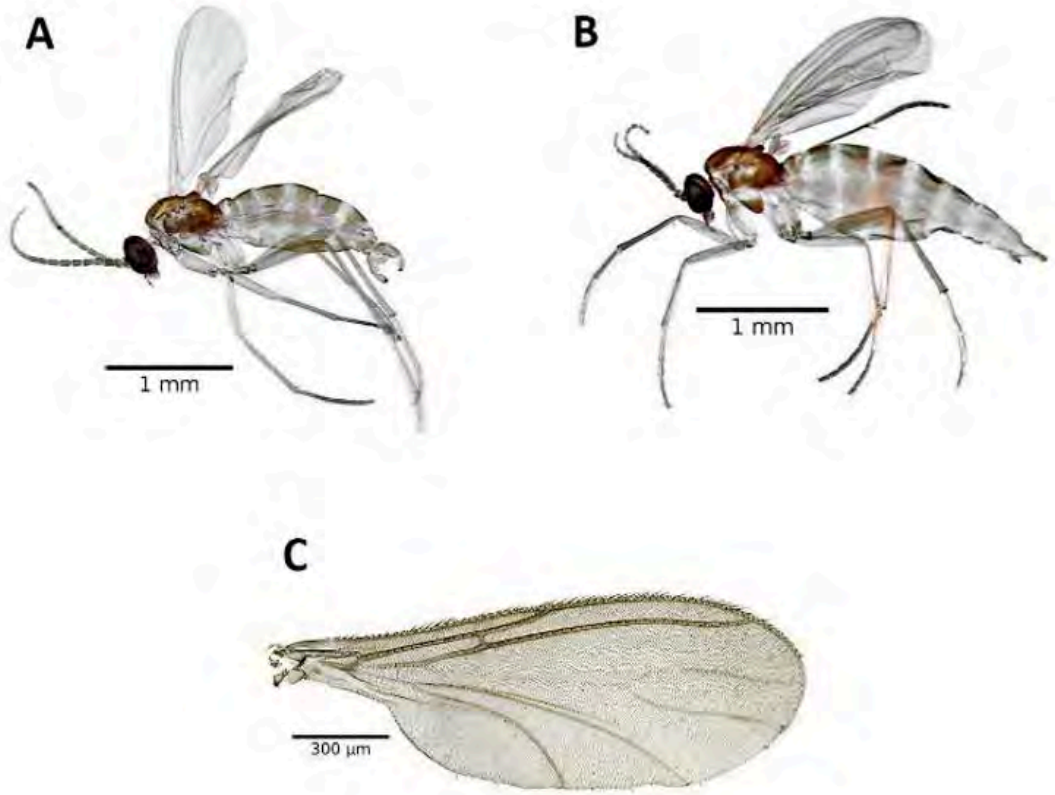
Figure 4. *Bradysia* sp. A) male. Habitus, side view; B) female. Habitus, side view; and C) wing.



According to current records of geographical distribution, *Bradysia* sp. has been recorded in Europe (Azerbaijan, Czech Republic, Finland, Germany, Ireland, Italy, Latvia, Netherlands, Spain, Switzerland, Ukraine, and United Kingdom), Asia (China, Japan, Russia, and South Korea), the Americas (Brazil, Canada, United States of America, and Venezuela), Africa (South Africa) and Oceania (Australia) in protected crops and nurseries (Menzel *et al*., 2003; Mohring *et al*., 2012; Shin *et al*., 2012).

In Mexico, the present study was the second record of the presence of this genus associated with an ornamental plant since the first record was reported by Villanueva-Sánchez *et al*. (2013) in the crop of 'poinsettia' (*Euphorbia pulcherrima* Willd, ex Klotzsch; Euphorbiaceae), in the producing area of the center of the country.

The damage caused by *Bradysia* sp. appeared 40 days after sowing bulbs of *Lilium* sp. The symptoms consisted of yellowing in the basal leaves, limited growth development, the presence of few roots, and finally, the premature death of the plant since it did not reach the flowering stage (Figure 5). The presence of adults and pupae of *Bradysia* sp. near the base of the plant and larvae feeding on the roots and bulbs were detected (Figure 6).

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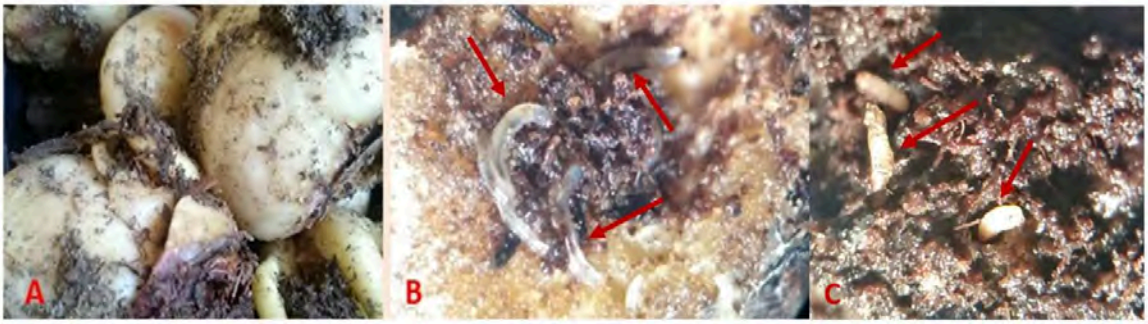
Figure 5. Symptoms caused by larvae of *Bradysia* sp. in plants of *Lilium* sp. A) yellowing of basal leaves; B) premature death of the plant; and C) presence of few roots.

Figure 6. A) lily bulbs infested by 'black fungus gnat' larvae; B) larvae found in bulbs; and C) pupae.



The larvae of the 'black fungus gnat' were the ones that caused the greatest damage to the bulbs and roots of the 'lilies' as a result of their feeding process. A 'rot' was observed in the bulbs, which affected the plant's normal development. It is important to mention that nurserymen do not have control over the amount of water provided to each pot, so the excess moisture favored the presence of the 'black fungus gnat', and as it has a short biological cycle, its population density increased considerably.

Conclusions

Bradysia is the genus of 'black fungus gnat' associated with the crop of *Lilium* in Ocotlán de Morelos, Oaxaca, Mexico; through the observations made, it is inferred that it is an important pest in the crop of *Lilium* sp.

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