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Scientific Note

First record of *Melanaphis donacis* (Passerini, 1861) (Hemiptera: Aphididae) in México

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Abstract. The aphid *Melanaphis donacis* (Passerini, 1861) (Hemiptera: Aphididae) is recorded in Mexico in seven locations in the Valley of Mexico Basin on the Poaceae *Arundo donax*, one of the most common host plants. Both the aphid and the host plant are species considered exotic to Mexico; especially *A. donax* is referred to as one of the hundred most important invasive alien species in the world and is also officially cited in Mexico. Observations and collections of both the aphid colonies and the host plant began in October 2022 to February 2023. The work includes the taxonomic determination of both the aphid and the host plant. Also reviewed of websites (www.naturalista.mx) where in two sites it was referred to in a preliminary way, without taxonomic certainty by a specialist. In addition to the worldwide distribution of the aphid species and its host plants. Parthenogenetic wingless and winged forms are presented and described in vivo, as well as in mounts of microscope slides. In all the cases observed in the field, a symbiotic association with ants of the species *Linepithema humile* Mayr, 1868 (Hymenoptera: Formicidae) is documented. Some natural enemies were obtained, such as *Harmonia axididis* (Palas, 1773) (Coleoptera: Coccinellidae); Scymninae, Chamaemyiidae and Syrphidae larvae, yet to be determined. It is suggested to increase the search both in other localities and in hosts potentially present in Mexico.

Keywords: Aphidomorpha, urban pest, exotic pest, Chamaemyiidae, *Linepithema humile*.

Aphids are a phytophagous group made up of 5,215 living species (Favret & Eades 2009), whose population increase, besides their vector capacity, can cause losses in forest plantations and crops, also affecting the aesthetics of urban vegetation (van Emden & Harrington 2007; Muñoz-Viveros et al. 2017). The incursion of exotic aphids can make their management difficult when they are not detected in time, which is complicated by their dispersal through the wind, their rapid reproduction and establishment by parthenogenesis (Teulon & Stufkens 2002).

The timely detection of exotic insects is part of the management strategies in Mexico. Where there is a line of research (https://redsaludforestal.com), developed by the National Council of Humanity Science and Technology (CONAHCYT) with the National Forestry Commission (CONAFOR), and some academic institutions. As part of this line, constant tours are carried out in urban and peri-urban areas to detect incursions of exotic organisms of potential forestry, urban agricultural importance. Therefore, the present work has the aim of reporting an aphid associated with urban secondary plants in the Valley of Mexico.

The surveys began in October 2022, derived from observations on a group of plants of the Poaceae family in the municipality of Nicolás Romero, State of Mexico. And was directed on mature leaves and shoots with the presence of aphids, recording the infestation level (Bowling et al. 2015), and cutting some plant fragments. Insects and plants were placed in hermetic plastic bags and transfer them to the Pest Control laboratory of the Faculty of Higher Studies Iztacala, UNAM.

Samplings continued monthly from November 2022 to April 2023 to monitor the progress of the colonies. Including additional and directed surveys, in February and July 2023, in the sites suggested by the naturalist website (https://www.naturalista.mx) Naturalista (2023), where users observed specimens similar to those initially found by the authors.

Insects were observed under a stereoscopic microscope for photographic registration and subsequent fixation in 70% ethanol. The montage was carried out with the technique proposed by Blackman & Eastop (2006) and they were determined with the keys of Blackman & Eastop (2023). Some specimens were deposited in the "Aphidomorpha de México" institutional collection. While the host plants were reviewed with the family Gramineae, subfamily Arundinoideae key (Steinmann 2008) and corroborated in the "Izta" herbarium of the institution itself. Part of the specimens were kept in a plastic container covered with cloth to wait for the development of wings and some natural enemies observed in the immature stage.

The aphid colonies observed were of the *Melanaphis donacis* (Passerini, 1861) (Hemiptera: Aphididae) species, which included both winged and wingless forms. They exclusively lived on the *Arundo donax* (L.) plant. *M. donacis* immatures nymphs have a reddish-brown coloration when they first emerge, and they acquire a darker hue and ash when mature. Apterous are covered by a whitish waxy powder with a characteristic pattern, which can easily come off on contact (Fig. 1). The alates have a dark venation in the forewings, and the secondaries have the pattern: III 3-13, IV 0-3, V 0-2 (Fig. 2).

Arundo donax and *Phragmites* spp., are the recorded host for this specie in different regions of the world (Blackman & Eastop 2006; 2023), and less frequently on *Arundinaria variegata* Makino and *Bambusa* sp. (Holman 2009).

The distribution of *M. donacis* is reported in Europe (France, Georgia, Italy, Spain, and two autonomous regions of Portugal), Asia (Azerbaijan, India, Iran, Iraq, Israel, Japan, Lebanon, Nepal and Pakistan), Africa (Algeria, Egypt, Morocco and Tunisia), North America (California State of USA) and South America (Chile and Argentina) (Hille 1966; Raychaudhuri & Banerjee 1974; Stary & Sekkat 1987; Belda et al. 1994; Ortego et al. 2004; Tsitsipis et al. 2007; Holman 2009; Ali et al. 2012; Bodlah 2017; Muhammad et al. 2019; Khaled-Gasmi et al. 2022).

The genus *Melanaphis* has 25 species worldwide most of them of Asian origin (Blackman & Eastop 2023). In Mexico this genus was reported for the first time in 2014 with introducing of a pest, first named as *Melanaphis sacchari* (Zehntner, 1897) (Hemiptera: Aphididae)

(Nibouche et al. 2014; 2018), and sometime later it was proposed as *Melanaphis sorghi* (Theobald, 1904) (Hemiptera: Aphididae) (Nibouche et al. 2021). Whose economic impact was estimated at 194 million dollars in one year effect on sorghum crops [*Sorghum bicolor* (L.) Moench.] from Tamaulipas (the norther main producer State in Mexico), from which it dispersed in all sorghum regions of the country (Rodríguez-del-Bosque & Terán 2015). And generating continental concern for its agricultural impact (Rodríguez-del-Bosque et al. 2015; Bowling et al. 2016; Fernandes et al. 2021; Saluso et al. 2022).

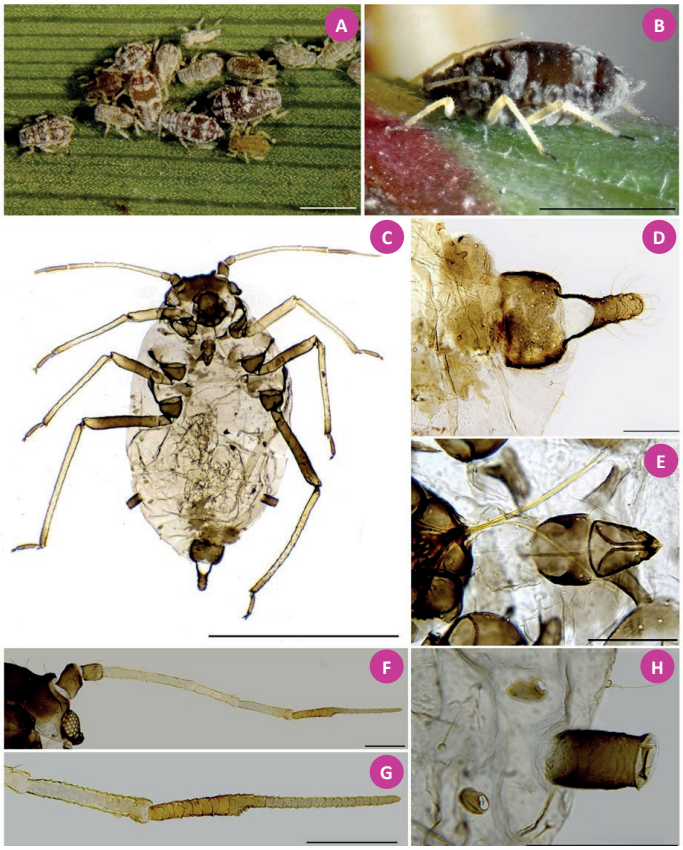

Figure 1. *Melanaphis donacis* in State of Mexico and apterous diacritics characters. 1A) Incipient colony of *M. donacis*, 1mm. 1B) Lateral view of apterous, 1mm. 1C) *Habitus*, 1mm. 1D) Cauda, anal and genital plate, 0.1mm. 1e) *Rostrum,* 0.1mm, 1F) Antenae, 0.1mm, 1G) Detail of last anteromerous segments, 0.1mm. 1H) Sifunculus, 0.1mm.

The scientific and governmental literature about *M. donacis* review did not show knowledge in the country, while in other internet sources there are images of an insect colony published on June 12, 2017, in Rosarito, Baja California and some users suggest as ID to *M. donacis* (https://www.naturalista.mx) Naturalista (2023). This municipality is a border tourist point, and it is possible that specimens were transported from the United States. The species was confirmed from surveys at Rosarito and Ensenada municipalities in July 2023, and have an association with the "Argentine Ant" *Linepithema humile* Mayr, 1868 (Hymenoptera: Formicidae), and the "Crazy Black Ant" *Paratrechina longicornis* (Latreille, 1802) (Hymenoptera: Formicidae), respectively. Another web mention, only as a genus *Melanaphis*, is included in the image uploaded to the same website on October 24, 2022, from Coyoacán, Mexico City; this site was visited (February 2023), without finding evidence of the host plant because of pruning actions in the green area, although the aphid was located 1 km from the site showed on the web; besides other locations in the Valley of Mexico (Tab. 1).

In the municipality of Nicolás Romero, Valley of Mexico, site of the first observations by the authors, it was recorded that the populations had an infestation level 2 (average of 38 aphids/leaf) in October 2022, and gradually increased in each monthly sampling to level 4 (average of 300 aphids/leaf) in February 2023, and in all the evaluations *M. donacis* had an association with *L. humile* ants. In Chile, populations of 170 aphids/leaf on average and a maximum of 350 individuals are reported (Undurraga et al. 2020). In March-April 2023, it was recorded that *A. donax* leaves infested with a density of over 500 aphids/leaf presented reddish coloration at the tip and noticeable dehydration in some others. These effects were similar in the Tlalnepantla plants, located 12 km away. In both cases a phytosanitary pruning was observed; inclusive, in Hidalgo State, it was observed affected by burning, since it is considered weed on the roadside.

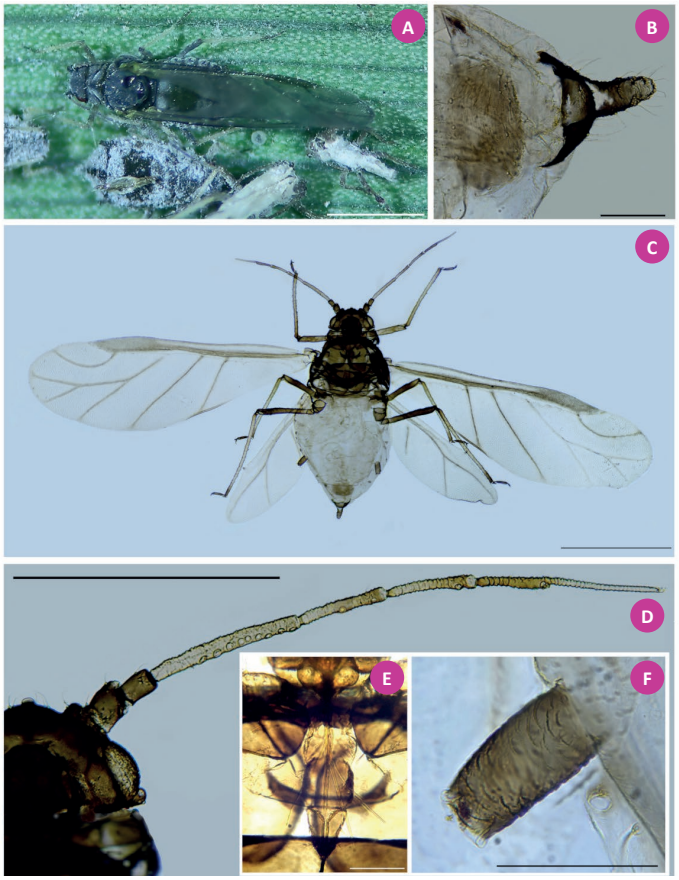

Figure 2. *Melanaphis donacis* in State of Mexico and alate diacritics characters. 2A) *M. donacis* alate in incipient colony, 1mm. 2B) Cauda, anal and genital plate, 0.1mm. 1C) *Habitus*, 1mm. 1D) Detail of anteromerous, 0.1mm 1E) *Rostrum,* 0.1mm, 1F) Sifunculus, 0.1mm.

In America, *M. donacis* has an ambiguous relevance, since in California its usefulness to reduce the populations of *A. donax* is being explored (Dudley 2000), a plant registered among the 100 worst invasive species in the world (GISD 2023). In Mexico, this host species is also classified as an invasive exotic (DOF 2016) and is considered an ecological problem because of its impact on primary vegetation, besides affecting drainage in urban areas, developing it as a weed in a large part of the national territory (Sánchez-Ken et al. 2012), affecting crops such as the chili *Capsicum annum* L. (Ávila-Quezada et al. 2022).

However, *A. donax* is also used as ornament, raw material for handicrafts, housing construction material, and its suitability as an urban green barrier is being explored (Rodríguez-Salinas et al. 2017). Therefore, the impact of *M. donacis* could be categorized as urban and peri-urban, of uncertain importance even for Mexican artisanal economic activities. In contrast, the potential of *A. donax* to produce biofuel is explored in Chile, for which *M. donacis* gains the pest category and products are evaluated for its control (Undurraga et al. 2019) and natural enemies are sought to control it (Undurraga et al. 2020).

In Chile the coccinellids *Eriopis connexa* (Germar, 1824) and *Hippodamia convergens* (Guérin-Méneville, 1842) (Coleoptera: Coccinellidae) and the hoverfly *Allograpta pulchra* (Shannon, 1927) (Diptera: Syrphidae) are mentioned (Undurraga et al. 2020). While in the present work a low percentage of parasitism (1% and 4%) was founded in Nicolas Romero and Rosarito, respectively, which could be related to the fact that the wasps are still adapting to their host, although it is not ruled out that there are defense mechanisms, since this aphid has a bacterium symbiont related to the immune system (Jousselin et al. 2013). This defensive capacity was recorded in

Table 1. Collection and referral sites on the web about *Melanaphis donacis* in Valley of Mexico.

State/Municipality	Coordinates (WBG84)	Altitude	Infestation**
Baja California			
Ensenada[2,§§]	31.902993 N, -116.731668 O	0 m	12
Rosarito[1,*]	32.203025 N, -116.911365 O	--------	Unknown
Rosarito[2,§]	32.228645 N, -116.921204 O	0 m	75
Guerrero			
Taxco	18.567417 N, -99.593434 O	1666 m	38
Hidalgo			
Lagunilla[2]	20.345439 N, -99.029244 O	1921 m	38
San Salvador[2]	20.315302 N, -99.009521 O	1957 m	75
Tasquillo[2]	20.551637 N, -99.287224 O	1637 m	38
Mexico City			
Azcapotzalco[2]	19.498239 N, -99.210835 O	2241 m	12
Coyoacán[1,*]	19.323948 N, -99.17566 O	--------	Unknown
Coyoacán[2]	19.309021 N, -99.180181 O	2304 m	12
State of Mexico			
Nicolás Romero[2,§]	19.606332 N, -99272716 O	2349 m	500
Tequixquiac[2]	19.901876 N, -99.144052 O	2222 m	38
Tlalnepantla de Baz[2]	19.521486 N, -99.193967 O	2243 m	500

[1]Web reference (www.naturalista.org) Naturalista (2023). [2]Author's surveys, corroborated aphid. *Host not found not found in referenced site-**average aphids/leaf based on scale of Browing et al. (2015). [§]Associate with Argentine ant *Linepithema humile*. [§§]Associate with "Crazy Black Ant" *Paratrechina longicornis.*

populations of *M. sorghi* from Guanajuato, Mexico, which developed melanization by encapsulation when parasitized (unpublished data). A low percentage of parasitism (0.8%) was mentioned for the wasp *Lysiphlebus testaceipes* (Cresson, 1880) (Hymenoptera: Braconidae) on *M. sacchari* from Coahuila, Mexico (Payán-Arzapalo et al. 2018).

In Nicolás Romero, larvae of the Scymninae subfamily and adults of *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) were also obtained feeding on *M. donacis*, as well as larvae of the Chamaemyiidae and Syrphidae (Diptera) families. In the pupae of syrphids isolated in the laboratory, 16% parasitism was got by wasps of the Braconidae family. The more specific determination of these organisms is in process.

Finally, although there is ambiguity about the relevance of *M. donacis* to *A. donax* on the continent, it is an exotic species, whose first verified record in Mexico is the present work. It is suggested to monitor the urban and peri-urban vegetation, including *Phragmites australis* and potential crops where it could develop.

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Authors' Contributions

All authors conceived the research. J.M.V.R Field work. R.P.M. Manuscript concept. A.L.M.V. Taxonomic determination and manuscript concept. All authors reviewed the manuscript.

Conflict of Interest Statement

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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