Identification of predatory and parasitoid insect species associated with *Melanaphis sacchari* (Hemiptera: Aphididae), a sorghum pest in Nuevo León, Mexico

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The aphid *Melanaphis sacchari* Zehntner (Hemiptera: Aphididae) is an economically important sorghum pest that significantly reduces grain yield and quality (Bowling et al. 2016). This pest was first detected in Mexico, and resulted in severe damage to the sorghum yield in northern Tamaulipas in Nov 2013 (Rodríguez-del-Bosque & Terán 2015), and it rapidly spread to the nearest sorghum-growing areas (Rodríguez-del-Bosque & Terán 2015; Provisor-Bermudez & López-Martínez 2016).

Sorghum typically is infested soon after plant emergence, and damage includes purple leaf discoloration of the seedlings, followed by chlorosis, necrosis, flowering delay, and poor grain fill, which leads to reduced grain quality and quantity, resulting in yield losses. Leaves below the infected ones often are covered with sooty mold, which grows on the honeydew produced by the aphids (Narayana 1975). In addition, the aphid is a sugar cane yellow leaf virus vector (Schenck 2000; White et al. 2001; Behary et al. 2011).

In Mexico, the resulting damage, and the negative impact leading to significant sorghum yield reduction in the production areas (1,196,537 ha) (SIAP 2016), has prompted studies to find and evaluate natural enemies that may play an important role in sugarcane aphid biocontrol. Indeed, native species may be able to succeed more readily because they are habituated to these environmental conditions. Several insect species that control yellow sugar cane predators are well known, particularly Coccinellidae and Chrysopidae family species (§Provisor-Bermudez & López-Martínez 2016; Rodríguez-Palomera et al. 2016; Rodríguez-Vélez et al. 2016; Vázques-Navarro et al. 2016). The present study was undertaken to identify predatory and parasitoid species associated with the yellow sorghum aphid in Nuevo León, and their impact on its biocontrol.

Two *M. sacchari* monitoring periods were conducted, the first during the fall of 2017, and the second from the winter to mid-summer of 2018. Collection areas were selected after detecting a high *M. sacchari* population in a forage sorghum area, located in the Facultad de Agronomía facility at the Universidad Autónoma de Nuevo León, Ciudad General Escobedo, Nuevo León, Mexico. After the monitoring periods, numerous coccinellids (*Cycloneda sanguinea* [L.], *Coccinella septempunctata* L., *Hippodamia convergens* Guérin-Méneville, *Olla v-nigrum* Mulsant, *Scymnus* sp. [Mulsant], *Coleomegilla maculata* [De Geer], *Chilocorus cacti* [L.], and *Chilocorus stigma* [Say]; all Coleoptera: Coccinellidae), chrysopids (*Chrysoperla* sp. Steinmann; Neuroptera: Chrysopidae), syrphids (*Crysoperla* sp. *C. stigma* [Sp. Walker]; Hymenoptera: Pteromalidae) were identified. Predators responsible for the sugarcane aphid population reduction were identified primarily as ladybeetles (Coleoptera: Coccinellidae), lacewings (Neuroptera: Chrysomelidae), and hoverflies (Diptera: Syrphidae) (Fig. 1). Most species were present during all sampling periods, but the most abundant parasitoid detected was *Aphidius* sp., which was detected in all the sampling periods (Fig. 1). Differences were observed in the evaluated periods. In the fall monitoring, the collected insects preying on *M. sacchari* were more abundant and diverse; coccinellids *C. cacti* and *C. stigma*, and the syrphid *O. dimidiatus* was present only in fall 2017, whereas the coccinellid *C. maculata* was present only during the second sampling (mid-summer 2018).

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Coccinellids (H. convergens, C. sanguinea), chrysopids (Chrysoperla sp.), syrphids (Scymnus sp.), and parasitoids such as Aphidius sp. were found preying or parasitizing the sugarcane aphid, as previously reported in Mexico (Provisor-Bermudez & López-Martínez 2016; Rodríguez-Palomera et al. 2016; Rodríguez-Vélez et al. 2016; Vázquez-Navarro et al. 2016). In addition, C. cacti and C. stigma coccinellids were detected, similar to that reported by Jaimez-Orduña et al. (2018). This difference during the sampling periods may be due to changing climatic conditions. During the first sampling, the maximum temperature average was 33.3 °C, whereas the minimum was 12 °C, with a fluvial precipitation of 81.6 mm; during the second sampling, temperatures were higher with less rain, where the average maximum temperature was 37.2 °C and the minimum temperature was 13.7 °C, with a fluvial precipitation of 40.5 mm.

Species responsible for the most sugarcane aphid population reduction were from the predator groups, mainly ladybeetles (Coleoptera: Coccinellidae), lacewings (Neuroptera: Chrysomelidae and Hemerobiidae), and hoverflies (Diptera: Syrphidae). In general, 13 aphidophagous (8 Coleoptera, 2 Diptera, 1 Neuroptera, and 2 Hymenoptera) predator or parasitoid species associated with M. sacchari biocontrol were identified. By the end of Sep 2017 (first sampling), 3 insecticide applications were dispensed for sugarcane aphid control, but this treatment only reduced the amount of the population by about 20.6%. As the sampling ended (mid-summer, late Jul 2018), results indicated that the predators and parasitoids were responsible for significantly reducing M. sacchari populations (about 70.6% reduction). Similar results were reported by Rodríguez-del-Bosque et al. (2018) who, after monitoring predators and parasitoids from the sorghum crop during the spring and fall growing seasons of 2016 and 2017 in Río Bravo, northern Tamaulipas, Mexico, reported 19 species, where 1 species was the principal species responsible for aphid biocontrol; the braconid parasitoid Lysiphlebus testaceipes (Cresson) (Hymenoptera: Braconidae) comprised 90% of the detected emerging parasitoids. Based on Colares et al. (2015), exotic aphid invasions present various stages: at first they show a large and very destructive population, then the population begins to decrease with some outbreaks in specific geographical areas, and finally they establish as endemic species upon crop availability, and weather and cultural factors, where native predator and parasitoid populations will control the aphid. Taken together, the results showed the importance of such predator and parasitoid species as potential biological control agents for M. sacchari in Nuevo León, Mexico, where the third stage is continuing, at least in Northeast Mexico.

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Summary

Melanaphis sacchari Zehntner (Hemiptera: Aphididae) is an important destructive pest in forage sorghum in Nuevo León, Mexico. This study was conducted to identify predatory and parasitoid insect species associated with this pest in Nuevo León, and their impact on its biocontrol. During the monitoring period, identified insects indicated the coexistence of 8 coccinellid species, 2 syrphid species, and 1 chrysypid species. In addition, 2 hymenopteran species were identified. After the insecticide applications, sugarcane aphid population was reduced by about 20.6% (about 14 nymphs per cm²); when the sampling ended, population was reduced by about 70.6% (about 5 nymphs per cm²), thus indicating predator and parasitoid biocontrol. Collected data allowed us to conclude that the biological controllers were responsible for the principal pest population reduction. Overall, results showed that yellow sugarcane aphid predatory and parasitoid species may play an important role in the pest management in sorghum crops in Nuevo León, Mexico.

Key Words: Chrysopidae; Coccinellidae; Hymenoptera; Syrphidae; sugarcane aphid

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Fig. 1. Melanaphis sacchari predators and parasitoids found in Nuevo León, Mexico. (A) Allograptus sp. in adult status, (B) Chilocorus cacti (left), and Chilocorus stigma (right), (C) Olla v-nigrum, (D) Chrysoperla sp., (E) Allograptus sp. (left) in larval status, and Cycloneda sanguinea (right), (F) Hippodamia convergens, (G) Ocyptamus dimidiatus, (H) Scymnus sp., (I) Pachyneuron sp., (J) Aphidius sp., (K) Melanaphis sacchari mummies.
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