Identification of Predatory and Parasitoid Insect Species Associated with Melanaphis sacchari (Hemiptera: Aphididae), a Sorghum Pest in Nuevo León, Mexico

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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. For the first monitoring period, the crop was planted at the end of Aug 2017 in the Marin municipality, Nuevo León State, Mexico (25.3833333°N, 100.0333333°W; 393 masl). The first samplings were carried out once per wk, starting in Sep 2017 and ending in Nov 2017 when the sorghum was harvested. For the second monitoring period, the crop was planted in Jan 2018; the second samplings started in Feb and finished in Jul 2018.

Predator and parasitoid collections were performed with a sweep net in fields, where a major infestation of aphids was observed (about 17–20 nymphs per cm^2), in the following manner: 1 collection was done by applying 20 sweeps with the net, and 1 was carried out by directly sampling leaves on the plants that were infested by aphids and showing parasitism symptoms. Collected leaves with insects were transferred individually into a new zip-top plastic bag. All collected material was placed and preserved inside plastic containers with 70% alcohol, and were taken to the laboratory for identification purposes. The insect specimens were added to the entomological collection of the Departmento de Entomología of 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 (*Ocyptamus dimidiatus* [F.] and *Allograpta* sp. Osten-Sacken; both Diptera: Syrphidae) (probably predators), and at least 2 sugarcane aphid parasitoids species (*Aphidius* sp. Ashmead; Hymenoptera: Braconidae; and *Pachyneuron* 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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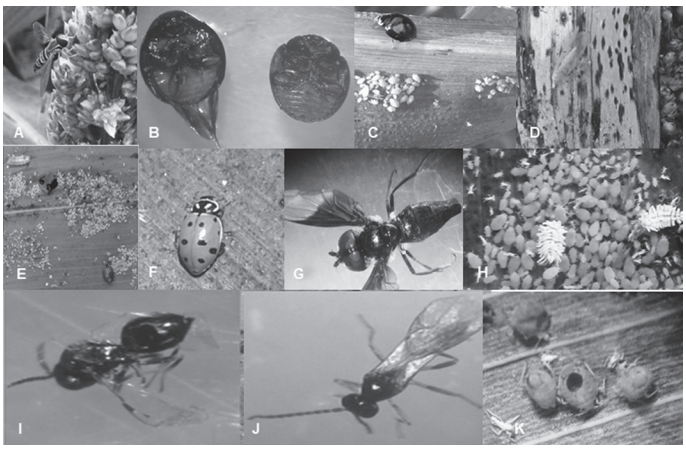

Fig. 1. *Melanaphis sacchari* predators and parasitoids found in Nuevo León, Mexico. (A) *Allograpta* sp. in adult status, (B) *Chilocorus cacti* (left), and *Chilocorus stigma* (right), (C) *Olla v-nigrum*, (D) *Chrysoperla* sp., (E) *Allograpta* sp. (left) in larval status, and *Cycloneda sanguinea*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

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 Jaimes-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 Rodriguez-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 chrysopid 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 cm^2); when the sampling ended, population was reduced by about 70.6% (about 5 nymphs per cm^2), 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

Sumario

Melanaphis sacchari Zehntner (Hemiptera: Aphididae) es una plaga destructiva importante en el sorgo forrajero en Nuevo León, México. Este estudio tuvo como objetivo identificar las especies de insectos depredadores y parasitoides asociados con esta plaga en Nuevo León, y su impacto en su biocontrol. Durante el período de monitoreo, los insectos identificados indicaron la existencia de ocho especies de coccinélidos; dos especies de sírfidos y una especie de crisópidos. Además, se identificaron dos especies de himenópteros. Después de las aplicaciones de insecticidas, la población se redujo aproximadamente 20.6% (acerca de 14 ninfas para cm^2); cuando finalizó el muestreo, la población se redujo aproximadamente el 70.6% (acerca de 5 ninfas para cm^2), lo que indica biocontrol por depredadores y parasitoides. Los datos recopilados nos permitieron concluir que los controladores biológicos fueron responsables de la principal reducción de la población de la plaga. En general, los resultados mostraron que las especies de depredadores y parasitoides del pulgón amarillo de la caña de azúcar pueden desempeñar un papel importante en el manejo de esta plaga en los cultivos de sorgo en Nuevo León, México.

Palabras Clave: Chrysopidae; Coccinellidae; Hymenoptera; Syrphidae; pulgón amarillo de la caña de azúcar

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