Abundance of Tended and Non-Tended Dalbulus Leafhoppers (Hemiptera: Cicadellidae) and their Parasitoids within the Gamagrass Tripsacum Habitat

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Abundance of tended and non-tended *Dalbulus* leafhoppers (Hemiptera: Cicadellidae) and their parasitoids within the gamagrass *Tripsacum* habitat

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Abstract

The present study evaluated the abundance of tended and non-tended *Dalbulus* DeLong (Hemiptera: Cicadellidae) sp. leafhoppers and their parasitoids. A field study was conducted in the gamagrass *Tripsacum dactyloides* (L.) L. (Poaceae) habitat, where the mutualistic association between the leafhopper *Dalbulus quinquenotatus* DeLong & Nault (Hemiptera: Cicadellidae) and its tending ant *Brachymyrmex obscurior* (Forel) (Hymenoptera: Formicidae) occurs. Yellow sticky card traps were used to determine the abundance of *Dalbulus* leafhoppers and their parasitoids in this habitat. The results showed that *D. quinquenotatus* was the most abundant leafhopper, whereas *Dalbulus gelbus* DeLong and the corn leafhopper *Dalbulus maidis* (DeLong) (both Hemiptera: Cicadellidae), both non-tended species, were least abundant. Three egg parasitoid wasp species were identified: *Anagrus naulti* Triapitsyn & Moya-Raygoza (Hymenoptera: Mymaridae), which was the most abundant of the trapped parasitoids, and *Paracentrobia* Howard sp., and *Pseudoligosita* Girault sp. (both Hymenoptera: Trichogrammatidae). The parasitoids that inhabit the wild *Tripsacum* habitat are important to conserve due to their potential as biological control agents against corn leafhopper pests.

Key Words: Deltocephalinae; Hymenoptera; Mymaridae; Trichogrammatidae; Poaceae

Resumen

En este estudio se evaluó la abundancia de atendidas y no atendidas chicharritas del genero *Dalbulus* y sus parasitoides. Un trabajo de campo fue conducido en el hábitat de *Tripsacum dactyloides,* donde la asociación de mutualismo entre la chicharrita *Dalbulus quinquenotatus* Delong & Nault (Hemiptera: Cicadellidae) y sus hormigas *Brachymyrmex obscurior* (Forel) (Hymenoptera: Formicidae) ocurre. Trampas amarillas pegajosas fueron usadas para determinar la abundancia de *Dalbulus* y sus parasitoides en este hábitat. Los resultados mostraron que la chicharrita *D. quinquenotatus* fue la más abundante, mientras que *Dalbulus gelbus* Delong y la chicharrita del maíz *D. maidis* (Delong), ambas no atendidas, fueron menos abundantes. Tres especies de avispas parasitoides de huevos fueron identificados: *Anagrus naulti* Triapitsyn & Moya-Raygoza (Hymenoptera: Mymaridae), la cual fue la más abundante de los parasitoides colectados, y *Paracentrobia* sp., and *Pseudoligosita* sp. (ambos Hymenoptera: Trichogrammatidae). Los parasitoides que habitan en el hábitat natural de *Tripsacum* son importante consérvalos debido a su potencial como agentes de control biológico contra chicharritas plagas del maíz.

Palabras Claves: Deltocephalinae; Hymenoptera; Mymaridae; Trichogrammatidae; Poaceae

Ants establish mutualistic interactions with hemipteran insects belonging to 2 suborders: Auchenorrhyncha, which includes the Cicadellidae (leafhoppers) and Membracidae (treehoppers); and Sternorrhyncha, which includes the Aphididae (aphids), Coccidae (soft scales), and Pseudococcidae (mealybugs) (Delabie 2001; Styrsky & Eubanks 2007). These interactions are widespread in insects, and most of the ant-tended Hemiptera share several characteristics: nymphs and adults are gregarious, they produce honeydew, and they feed on plant phloem. Nymphs and adults of the leafhopper *Dalbulus quinquenotatus* DeLong & Nault (Hemiptera: Cicadellidae) aggregate within partially unfolded leaves at the base of their gamagrass host plants *Tripsacum* (Poaceae) (Nault et al. 1983), which is a relative of maize (*Zea mays* subsp. *mays* L.; Poaceae) (Wilkes 1972). There, they produce large amounts of honeydew, which attracts certain ant species, resulting in an obligatory mutualistic association with the leafhopper (Moya-Raygoza & Nault 2000).

The nymphs of *D. quinquenotatus* are parasitized by the dryinid wasp *Anteon ciudadi* Olmi (Hymenoptera: Dryinidae) (Moya-Raygoza 1995). Using baited gamagrass plants, it was determined that *D. quinquenotatus* eggs are parasitized by *Anagrus naulti* Triapitsyn & Moya-Raygoza (Hymenoptera: Mymaridae), *Paracentrobia* sp. near *subflava* (Girault), and *Pseudoligosita* sp. near *longifrangiata* (Viggiani) (both Hymenoptera: Trichogrammatidae) (Moya-Raygoza & Triapitsyn 2015). The canopy leaves of the gamagrass plants are inhabited by *Dalbulus maidis* (DeLong) and *Dalbulus gelbus* DeLong (both Hemiptera: Cicadellidae) adults, but they have not been observed to be attended by ants (Larsen et al. 1992). To our knowledge, little is known about the community of egg parasitoids that attack Hemiptera tended by ants in the habitat where they have established this mutualistic interaction. The objective of the present study was to evaluate the abundance of *D. quinquenotatus* and its congeners, and the abundance of the egg parasitoid species living in the *Tripsacum dactyloides* (L.) L. (Poaceae) habitat. It was demonstrated recently that egg parasitoids living in the *Tripsacum* habitat parasitize, develop, and emerge from *D. maidis* eggs, reaching high rates of parasitism (Moya-Raygoza 2021). The corn leafhopper, *D. maidis*, is one of the most important maize pests

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in Latin America (Nault 1990), and parasitoids found in the wild *Tripsacum* habitat could be a biological control agent for control of *D. maidis*.

Materials and Methods

This study was conducted in a natural field population of *T. dactyloides*. This is a large population located at 20.5202778°N, 103.4822222°W; 1,621 masl, near the town of San Agustin, Jalisco State, in western central Mexico. This site was selected because the ant *Brachymyrmex obscurior* (Forel) (Hymenoptera: Formicidae) tends nymphs and adults of *D. quinquenotatus* on the basal leaves of *Tripsacum*. The presence and abundance of adult *Dalbulus* leafhoppers and adult egg parasitoids was monitored at the end of the wet season of 2018. Both leafhoppers and parasitic wasps (parasitoids of nymphs and eggs) were surveyed using double-sided yellow sticky card traps (AlphaScents, Bridgeport, New York, USA). Each trap was set 1 m from *Tripsacum* patches colonized by *B. obscurior* ants and *D. quinquenotatus*. In total, 14 traps, each 14 × 20 cm in size, were set for each sampling period. The traps were changed every 7 d from 11 Oct to 30 Nov, a seasonal period when leafhoppers and parasitic wasps are abundant on gamagrass (Larsen et al. 1992; Moya-Raygoza 1995). The traps were changed 7 times. Adult *Dalbulus* leafhoppers collected in the traps were identified using the keys developed by Triplehorn and Nault (1985), and adult egg parasitoids were identified with the keys of Moya-Raygoza and Triapitsyn (2015). Abundance of each of the adult *Dalbulus* species was compared using the Kruskal-Wallis test, and the same test was applied to compare the abundance of the adult egg parasitoid species. Statistical analyses were conducted in R (R Core Team 2018).

Results

During the survey, 723 adult *Dalbulus* leafhoppers belonging to 3 species were collected using yellow sticky card traps during the last mo of the wet season, between Oct and Nov (Table 1). The species found in the *Tripsacum* habitat were *D. quinquenotatus*, *D. maidis*, and *D. gelbus*. The abundance of the 3 species was significantly different (H = 145.86; df = 2; P = 0.0001) (Fig. 1). The most abundant leafhopper species was *D. quinquenotatus* (73.31%), whereas *D. maidis* was the least abundant (1.24%) (Table 1).

In total, 1,551 adult egg parasitoids were collected on the same yellow sticky cards (Table 1). The collected species were *A. naulti*, *Paracentrobia* sp., and *Pseudoligosita* sp. The abundance differed significantly among the 3 species (H = 21.86; df = 2; P = 0.0001; Fig. 2). *Anagrus naulti* was most abundant (42.74%), followed by *Paracentrobia* sp. and *Pseudoligosita* sp. (22.37 % and 34.89 %, respectively; Table 1). No *A. ciudadi* adults, which parasitize nymphs of *D. quinquenotatus*, were found on any of the yellow sticky cards.

Table 1. Total number of *Dalbulus* and parasitic wasp species captured by yellow sticky traps, with percentage of abundance in parentheses for each species. All sampling from the *Tripsacum dactyloides* habitat was conducted during 2018, at the end of the wet season, in Jalisco, Mexico.

Leafhopper	Number	Parasitoid	Number
Dalbulus quinquenotatus	530 (73.31%)	*Anagrus naulti*	663 (42.70%)
Dalbulus maidis	9 (1.24%)	*Paracentrobia* sp.	347 (22.37%)
Dalbulus gelbus	184 (25.45%)	*Pseudoligosita* sp.	541 (34.89%)
TOTAL	723 (100%)	TOTAL	1,551 (100%)

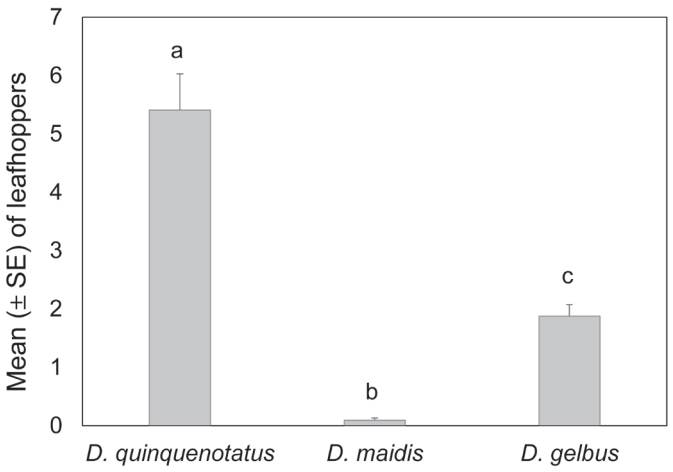

Fig. 1. Average number of adult *Dalbulus* leafhoppers trapped by yellow sticky traps within the *Tripsacum dactyloides* habitat during the end of the wet season of 2018, in Jalisco, Mexico. Different letters (a, b, c) indicate statistical significance.

Discussion

Little is known about the interactions between the Hemipterans tended by ants and the parasitoid community living in the field habitat where this mutualism occurs. In the present study, we found both tended and non-tended *Dalbulus* leafhoppers and 3 egg parasitoid species inhabiting the *Tripsacum* field habitat. *Dalbulus* leafhoppers and egg parasitoids were collected using yellow sticky card traps. Previously, Larsen et al. (1992) surveyed adult *Dalbulus* leafhoppers on gamagrass using this type of trap. They found *D. quinquenotatus*, *D. gelbus*, and *D. maidis* within the *Tripsacum* habitat during the wet season (Oct and Nov). In the present study, we found that *D. quinquenotatus*, a species tended by ants, was more abundant than *D. gelbus* and *D. maidis*. The sheer number of *D. quinquenotatus* adults trapped using the yellow card method suggests a great dispersal by these adults within the *Tripsacum* habitat. Likely, *D. quinquenotatus* reached these high numbers in this *Tripsacum* habitat because it is tended by *B. obscurior*. A recent study found that the tending ant *Solenopsis invicta* Buren (Hymenoptera:

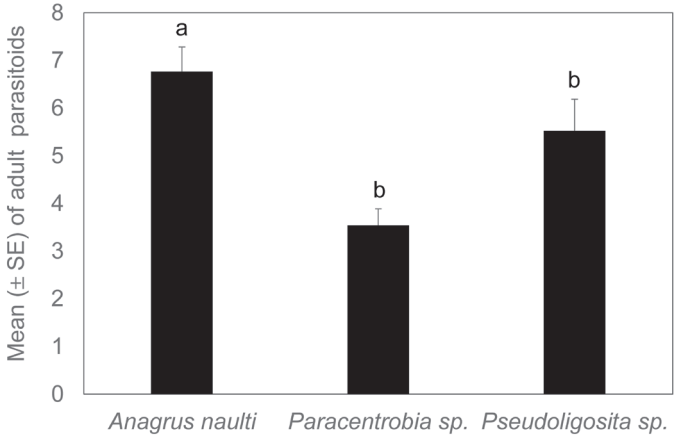

Fig. 2. Average number of adult egg parasitoids trapped by yellow sticky traps within the *Tripsacum dactyloides* habitat during the end of the wet season of 2018, in Jalisco, Mexico. Different letters (a, b) indicate statistical significance.

Formicidae) produces a trail pheromone containing (Z, E)-α farnesene as its major component, and that this pheromone benefits population growth of the tended aphid *Aphis gossypii* Glover (Hemiptera: Aphididae) (Xu et al. 2021).

Within the *Tripsacum* habitat, the adult egg parasitoids *A. naulti*, *Paracentrobia* sp., and *Pseudoligosita* sp. also were trapped, with *A. naulti* being the most abundant. The same 3 parasitoid species were trapped using baited *Tripsacum* plants, but in this case, *Paracentrobia* sp. was the most abundant, even though *A. naulti* adults emerge earlier than *Paracentrobia* sp. adults (Moya-Raygoza & Triapitsyn 2015). These egg parasitoids are generalists and are known to parasitize eggs of *D. quinquenotatus* and *D. maidis* in the gamagrass habitat (Moya-Raygoza 2021). Parasitoid emergence and efficacy was similar in *D. maidis* eggs laid on landrace and hybrid maize tested within the *Tripsacum* wild habitat, and egg parasitoids found in maize relatives such as *Tripsacum* could be an important resource to control hopper pests in maize agroecosystems (Moya-Raygoza 2021). However, *Tripsacum* populations have disappeared in Jalisco, Mexico, during the past 20 yr, affecting leafhopper and parasitoid presence. In 1998, 13 sites with *Tripsacum* populations bearing the *D. quinquenotatus*-ant mutualistic association were reported in central Jalisco (Moya-Raygoza & Larsen 2001). Only 3 of the 13 *Tripsacum* populations observed in 1998 were found in 2020, which disappeared due to anthropogenic perturbation (G. M. R., personal observation). The conservation of *Tripsacum* populations is important for maintaining egg parasitoids, which could be used as biological control agents in maize fields throughout Latin America.

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References Cited

Delabie JHC. 2001. Trophobiosis between Formicidae and Hemiptera (Sternorrhyncha and Auchenorrhyncha): an overview. Neotropical Entomology 30: 501–516.

Larsen KJ, Nault LR, Moya-Raygoza G. 1992. Overwintering biology of *Dalbulus* leafhoppers (Homoptera: Cicadellidae): adult population and drought hardiness. Environmental Entomology 21: 566–577.

Moya-Raygoza G. 1995. Fire effects on insects associated with the gamagrass *Tripsacum dactyloides* in Mexico. Annals of the Entomological Society of America 88: 434–440.

Moya-Raygoza G. 2021. Efficacy and emergence of parasitic wasps that attack herbivorous insects on maize and its relatives in their region of origin. Arthropod-Plant Interactions 15: 409–415.

Moya-Raygoza G, Larsen KJ. 2001. Temporal resources switching by ants between honeydew produced by the fivespotted gama grass leafhopper (*Dalbulus quinquenotatus*) and nectar produced by plants with extrafloral nectaries. The American Midland Naturalist 146: 311–320.

Moya-Raygoza G, Nault LR. 2000. Obligatory mutualism between *Dalbulus quinquenotatus* (Homoptera: Cicadellidae) and attendant ants. Annals of the Entomological Society of America 93: 929–940.

Moya-Raygoza G, Triapitsyn SV. 2015. Egg parasitoids (Hymenoptera: Mymaridae and Trichogrammatidae) of *Dalbulus quinquenotatus* (Hemiptera: Cicadellidae), with description of a new species of *Anagrus* (Mymaridae) from Mexico. Annals of the Entomological Society of America 108: 289–298.

Nault LR. 1990. Evolution of an insect pest: maize and the corn leafhopper, a case study. Maydica 35: 165–175.

Nault LR, Delong DM, Triplehorn BW, Styer WE, Doebley JF. 1983. More on the association of *Dalbulus* (Homoptera: Cicadelllidae) with Mexican *Tripsacum* (Poaceae), including the description of two new species of leafhoppers. Annals of the Entomological Society of America 76: 305–309.

R Core Team. 2018. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Styrsky JD, Eubanks MD. 2007. Ecological consequences of interactions between ants and honeydew-producing insects. Proceedings of the Royal Society Series B Biological Sciences 274: 151–164.

Triplehorn BW, Nault LR. 1985. Phylogenetic classification of the genus *Dalbulus* (Homoptera: Cicadellidae), and notes on the phylogeny of the Macrostelini. Annals of the Entomological Society of America 78: 291–315.

Wilkes HG. 1972. Maize and its wild relatives. Science 177: 1071–1077.

Xu T, Xu M, Lu Y, Zhang W, Sun J, Zeng R, Turlings TCJ, Chen L.2021. A trail pheromone mediates the mutualism between ants and aphids. Current Biology 31. doi.org/10.1016/j.cub.2021.08.032