A MALAISE TRAP MODIFICATION FOR TARGETED SAMPLING OF APHIDIINAE (HYMENOPTERA: BRACONIDAE)

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ABSTRACT

Townes-style Malaise traps were modified with a mesh exclusion panel to target small aphid-parasitoid wasps of the subfamily Aphidiinae (Hymenoptera: Braconidae) in soybean (*Glycine max* L.) and adjacent fields. The addition of a mesh excluder greatly increased the number of recoverable and higher quality specimens of wasps, and reduced the number of medium to large-sized non-target insects in samples, prevented preservative dilution caused by excess non-target organisms, minimized damage to the small parasitoids, and reduced overall sample sort time and labor costs.

Keywords

Collecting method, sampling, biodiversity, multitrophic interactions, aphid parasitoid

INTRODUCTION

Parasitoid wasps in the subfamily Aphidiinae (Hymenoptera: Braconidae) are aphidophagous predators that provide biological control of native and introduced aphid (Homoptera: Aphidoidea: Aphididae) species in a variety of natural, field, and greenhouse settings. Aphidiine wasps are normally best collected by gathering aphid colonies and rearing the adult parasitoids. Because they are aphid-obligate parasitoids, this collecting method allows for targeted active sampling that is directed at confirming the hosts and host plants and allows for observations of parasitoid behavior and biology in the field. Rearing parasitoids from their hosts also results in greater natural history and specific biological data for each wasp taxon, including inferences into associated multitrophic relationships between host plant, host, and primary and secondary parasitoids. Aphidiines, like other braconids, can also be collected using sweep nets and beating sheets, and will occasionally come to yellow pan traps, blacklights, and mercury vapor lights. Flight intercept traps, particularly Malaise traps, are the primary passive sam-

pling method for collecting aphidiines in the field. However, in many habitats, including vast agroecosystems, samples from Malaise traps quickly become overburdened with large numbers of non-target insects, such as ubiquitous flies (e.g., Calliphoridae, Muscidae), moths (e.g, Noctuidae), and other common insects. This abundance of non-target insects causes dilution of the collecting preservative and damages aphidiines because of their fragility during encounters with the larger insects in the trapping matrix. Due to their small size, aphidiines, as well as aphids and other small insects, are often "hugged" by larger insects and become trapped between the legs, under the wings of, or in the bristles and setae of larger insects. Smaller insects must then be carefully removed from their entanglement, during which they may become damaged and can be easily overlooked during sample sorting. This phenomenon is well-known to those who sort bulk samples from Malaise traps. Further, the scales shed from the wings of non-target moths and butterflies cloud samples and stick to other insects, reducing overall specimen quality.

Malaise traps were used in published surveys of Aphidiinae (e.g., Starý et al. 2008, Starý et al. 2010) which illustrated that these wasps are often recovered only in low numbers from samples. This relatively low recovery rate may be a function of the local fauna or recovery of specimens during sorting from traps; regardless, the historical lack of effective passive sampling techniques has hindered faunal studies on aphidiines. Modification of Malaise traps using mesh exclusion panels was mentioned by Peck (2006) to prevent large Lepidoptera from entering the collecting head. However, exclusion panels have not been used for targeted sampling of micro-Hymenoptera in any known published works. The modification described herein was found effective and efficient in a focused sampling effort during a survey of Aphidiinae present in soybean (*Glycine max* L.) fields in South Dakota (Martens et al. 2019).

METHODS

Townes-style Malaise traps were purchased from Sante Traps (Lexington, KY, USA) for a survey of aphidiine braconids in soybean fields. Components of this modification and tools used to install it are common and easily obtained. They include a mesh sleeve, braided fishing line (Berkely® Trilene® XT™ 10lb break strength), crafting needles (Dritz® 2 inch standard crafting needles), a screwdriver, and a pair of scissors. Mesh sleeves from bulk garlic, available at most grocery stores, were modified and used as the exclusion panel. First, the junction of the trap body with the collecting head was removed using a Phillips screwdriver (Figure 1). The garlic mesh sleeve was cut into approximately 16-cm long pieces. The openings in the mesh can be expanded or contracted based on how tightly or loosely the mesh is stretched. For this project, the openings in the mesh averaged about 2.5 mm by 3.0 mm, but because of the tubular nature of the mesh sleeve when it was flattened and sewn into the trap, some of the openings in the two mesh layers overlapped which further restricted flow into the collecting head (Figures 1–2). Next, the mesh was handsewn over the entrance to the collecting

head using a crafting needle and braided fishing line (Figure 1). Braided fishing line is preferred over cotton or polyester thread because of its strength and durability; it lasts for more than one field season as it more easily withstands varied atmospheric conditions, such as extreme heat, rain, strong winds, and chewing insect damage without appreciably degrading or decomposing. Finally, the junction of the trap was reattached to the collecting head with screws. The total cost of materials per trap was less than $2.00 with the garlic mesh being the most expensive component at about $1.50 per trap.

Figure 1. Left: A Townes-style Malaise trap from Sante Traps with the junction of the trap showing the collecting head removed with a screwdriver. Right: The junction of the trap with the mesh exclusion panel installed.

Figure 2. Left: Trap junction with mesh panel installed. Right: Mesh panel blocking large flies in a field setting.

A modified Malaise trap was deployed at each of five South Dakota State University research farms in eastern South Dakota for 12 weeks from mid-July through September. Trap samples were collected, and preservation fluid was replenished on a weekly basis. Samples were sorted using Rose Entomology specimen sorting trays, watchmaker forceps, and a Wild M5 microscope with 10x ocular lenses. Recovered parasitoids and aphid specimens were preserved in 80% ethyl alcohol. Parasitoids were chemically dehydrated following Heraty and Hawks (1998), point-mounted, and sorted to genus. Identifications were verified using a reference collection and van Achterberg (1997). Voucher specimens of aphidiines and associated aphids collected throughout this study were deposited in the Severin-McDaniel Insect Research Collection (SMIRC), South Dakota State University, Brookings, SD, with duplicates in the collection of Abigail P. Martens (APMC).

RESULTS AND DISCUSSION

Non-target insects in samples from modified Malaise traps were markedly reduced (Figures 3–4), and samples were composed almost entirely of small parasitoid wasps, small beetles and flies, and alate aphids (Figure 3), relative to unmodified trap samples. Over the course of the 12-week continuous sampling period, more than 1,500 aphidiine specimens representing eight genera and 10

Figure 3. A modified Malaise sample from a seven-day period.

species were collected (Martens et al. 2019). While observing the exclusion panel in the field, we noted that larger insects, most commonly medium and large-sized flies (e.g. Calliphoridae and Muscidae), would encounter the panel and then slowly move back down and out of the trap while the smaller insects would move through the mesh and into the collecting head. We also observed that modification of the trap with a slightly larger mesh size (3.0 mm by 5.0 mm) resulted in non-target insects, primarily medium and large flies, becoming stuck by their heads in or between the panels of the mesh and expiring; this would in some cases cause a slight blockage at the collecting head entrance and subsequent decay of the insects between the mesh panels.

Modification of the Malaise traps substantially reduced overall sample size and number of non-target species (Figures 3–4) and reduced individual sample sort time by several hours. Because of the cleaner samples provided by the modified trap, aphidiines and aphids were quickly and easily recovered from the samples. These specimens were of higher quality and less damaged compared to specimens from unfiltered samples. The exclusion panel substantially reduced the influx of non-target organisms in Malaise trap samples and improved overall specimen quality. The time to sort a single sample was reduced from between 8-24 hours to <2 hours for a sorter familiar with the target taxa. Reduction in number of hours spent per sample resulted in lower per specimen cost based on time and effort that went into sorting samples from modified versus conventional traps.

Figure 4. Samples from unmodified (left) and modified (right) Malaise traps both left in the field for the same seven-day period. The unmodified sample contains numerous medium to large non-target flies and Lepidoptera while the modified sample contains microhymenoptera, aphids, and small non-target insects.

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LITERATURE CITED

Heraty, J., and D. Hawks. 1998. Hexamethyldisilizane - a chemical alternative for drying insects. Entomological News 109:369–374.

Martens, A.P., P.J. Johnson, A. Boe, and A. Varenhorst. 2019. The diversity of aphid parasitoids (Hymenoptera: Braconidae: Aphidiinae) in soybean fields of eastern South Dakota. Proceedings of the South Dakota Academy of Science 98:77–89.

Peck, S.B. 2006. The Beetles of the Galápagos Islands, Ecuador: Evolution, Ecology, and Diversity (Insecta: Coleoptera). NRC Research Press, Ottawa, Ontario, Canada. 314 p.

Starý, P., M. Sharkey, and C. Hutacharern. 2008. Aphid parasitoids sampled by Malaise traps in the national parks of Thailand (Hymenoptera, Braconidae, Aphidiinae). Thai Journal of Agricultural Science 41:37-43.

Starý, P., E. Rakhshani, Ž. Tomanovíc, N.G. Kavallieratos, and M. Sharkey. 2010. Aphid parasitoids (Hymenoptera, Braconidae, Aphidiinae) from Thailand. Zootaxa 2498:47–52.

Van Achterberg, C. 1997. Subfamily Aphidiinae, Pages 118–131 *in* R.A. Wharton, P.M. Marsh, and M.J. Sharkey, editors. Manual of the New World Genera of the Family Braconidae (Hymenoptera). Special Publication No. 1. International Society of Hymenopterists, Washington D.C.