New Parasitoid (Hymenoptera) Records for Bamboo-Shoot Flies (Tephritidae: Phytalmiinae and Dacinae)

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NEW PARASITOID (HYMENOPTERA) RECORDS FOR BAMBOO-SHOOT FLIES (TEPHRITIDAE: PHYTALMIINAE AND DACINAE)

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ABSTRACT

We provide new records of parasitoids (Hymenoptera) attacking bamboo fly (Tephritidae: Phytalmiinae, Dacinae) larvae in Malaysia. At least 7 parasitoid species from 4 families emerged from bamboo fly puparia. Most parasitoids were recovered from larvae that had bred in live shoots, although some stemmed from larvae that had developed in dead culms. Parasitoid developmental times ranged between 7 and 19 d. The braconid parasitoids of bamboo-infesting tephritids belong to the Alysiinae (*Phaenocarpa* Foerster) and Opiinae (*Fopius* Wharton, *Psyttalia* Walker). Hosts for some species have not been recorded previously. We also reared the alysiine *Heratemis filosa* Walker from puparia of cyclorrhaphous Diptera infesting bamboo shoots that had been attacked previously by the weevil *Cyrtotrachelus* sp.

Key Words: Bamboo-shoot flies, Phytalmiinae, Dacinae, Alysiinae, Opiinae

RESUMEN

Presentamos nuevos registros de parasitoides (Hymenoptera) de las moscas del bambú (Tephritidae: Phytalmiinae, Dacinae) en Malasia. Obtuvimos al menos siete especies de parasitoides (Hymenoptera) que emergieron de pupas de moscas. La mayoría de los parasitoides fueron obtenidos a partir de larvas de mosca criadas en brotes vivos, pero también se obtuvieron algunos de larvas desarrolladas en culmos muertos. El tiempo de desarrollo de los parasitoides varió entre 7 y 19 días. Los parasitoides bracónidos obtenidos de los tefrítidos que infestan al bambú pertenecen a las subfamilias Alysiinae (*Phaenocarpa* Foerster) y Opiinae (*Fopius* Wharton, *Psyttalia* Walker). Los hospederos de algunas de las especies de parasitoides no habían sido registrados previamente. Finalmente, obtuvimos al alisiino *Heratemis filosa* Walker de pupas de un díptero del suborden Cyclorrhapha que infesta tallos de bambú que fueron previamente atacados por el gorgojo *Cyrtotrachelus* sp.

Translation provided by the authors.

Bamboo-shoot fruit flies (Phytalmiinae: Acanthonevrini, Dacinae: Gastrozonini) are poorly known tephritid flies mainly distributed in Asia, with a few representatives of the Gastrozonini living in Africa (Hancock 1999). The Asian species breed in living or dead bamboos (Poaceae: Bambusoidea), whereas African species breed in other Poaceae (*Panicum*, *Sorghum* and *Zea*) (Hancock 1999; Hancock & Drew 1999). Only in a few species have specific host-plant associations fully been confirmed (Hancock & Drew 1999; Allwood et al. 1999). In the case of species such as *Cyrtostola* (formerly *Taeniostola*) *limbata* (Hendel) and *Paraxarnuta anephelobasis* Hardy females use the oviposition holes made by weevils of the genus *Cyrtotrachelus* (Curculionidae: Rhynchophorinae) to lay their eggs (Kovac & Azaree 1994; Dohm & Kovac 2001). Here, we provide new records of parasitoids (Hymenoptera) attacking bamboo fly larvae in Malaysia. The only other known records of parasitoids attacking bamboo flies stem from tephritid host surveys carried out by Chinajariyawong and collaborators (Chinajariyawong et al. 2000) in Malaysia and Thailand under the auspices of the Australian Centre for International Agricultural Research (ACIAR). These authors were able to retrieve *Diachasmimorpha longicaudata* and *Fopius deeralensis* adults from *Acroceratitis ceratitina* and *A. distincta* pupae, respectively.

Materials and Methods

Parasitoids reported here were mainly collected in the Ulu Gombak Field Studies Centre (UFSC) of the University of Malaya (West-Malaysia, Selangor Darul Ehsan), located at 3°19'32"N and 101°45'16"E (altitude of 250 m) (Kovac & Streit 1996). Clumps of *Gigantochloa scortechinii* Gamble and *Dendrocalamus giganteus* Wall ex. Munro can be found as part of the secondary vegetation that developed in the UFSC premises (or in its vicinity) after the primary forest was selectively logged in the late 1950s (Kovac & Streit 1996). Additional bamboo species (e.g., *Dendrocalamus pendulus* Ridley) can be found on road sides near the station. Further collections were made during short field trips in Hulu Langat (Selangor), near Labis (Johor) and near Kampung Padang and Sik (both Kedah).

Larvae of bamboo tephritids were obtained from living young and mature bamboo shoots, dead bamboo shoots and culms, and from shoots showing signs of attack by *Cyrtotrachelus* sp. (Curculionidae: Rhynchophoridae) (Kovac & Azaree 1994; Dohm & Kovac 2001). In the case of the young shoots, we cut them and then artificially created suitable crevices by making cuts in the bamboo sheaths with a Machete, further details in Table 1 and Dohm et al. (unpublished data). Shoots were then left in the field up to 2 weeks to allow complete development of the larvae.

Most infested bamboo material was dissected to retrieve larvae, which were placed in plastic containers (18 × 12.5 × 6.5 cm) with pupating medium (moistened tissue paper). Some shoots were placed in plastic fish tanks (40 × 20 × 30 cm) covered with fine-meshed gauze to preclude ants or other insects from reaching the larvae or to impede them from escaping (the larvae of several species are able to jump). Larvae leaving the bamboo tissue to pupate were transferred to plastic containers (18 × 12.5 × 6.5 cm) with moistened tissue paper as pupating medium. Some larvae pupated directly in the bamboo internodes. All puparia were collected and transferred into small vials closed with fine-meshed gauze until all adult flies or parasitoids emerged. Vials were stored in take-away food boxes, which were placed in a plastic box or fish tanks that had ca. 2 cm layer of water on the floor to create a humid environment that prevented desiccation of the pupae. Vials were checked daily for eclosed adult flies and parasitoids, which were killed with ethyl acetate and preserved in 70 or 100% alcohol together with the puparia. In the case of flies we waited until the adults had hardened and developed full wing coloration before killing them.

Voucher specimens of all parasitoid species were deposited in the TAMU insect collection (Texas A & M University, College Station, Texas) curated by R. A. W. Vouchers of all fly species mentioned here were deposited in the insect collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM) curated by Allen Norrbom. Vouchers of larvae of most fly species mentioned were deposited in the Florida State Collection of Arthropods (Gainesville, Florida) curated by Gary Steck.

Results and Discussion

A total of at least 7 parasitoid species from 4 families emerged from bamboo fly puparia (Table 1). Most parasitoids were recovered from larvae that had bred in live shoots, although some stemmed from larvae that had developed in dead culms. Parasitoid developmental times ranged between 7 and 19 d. Considering the fact that we did not keep puparia for extended periods of time (maximum of 6 months, normally up to 3 months), we were unable to determine if parasitoids entered diapause or not.

The braconid parasitoids of bamboo-infesting tephritids belong to the *Phaenocarpa* Foerster (Alysiinae) and *Fopius* Wharton, *Psyttalia* Walker (Opiinae), both large subfamilies comprising species that are exclusively parasitoids of cyclorrhaphous Diptera. *Phaenocarpa cameroni* Papp is a widespread species, recorded from India (Bhat 1979) through Malaysia and Vietnam to Taiwan (Papp 1967). Hosts for this species have not been recorded previously, to our knowledge. Several species of *Phaenocarpa* have been reared from fruit, and 1 species has been reared from pod-infesting tephritids in South America (Trostle et al. 1999). Known hosts for *Phaenocarpa*, however, are primarily from other families of cyclorrhaphous Diptera, especially Anthomyiidae (Wharton 1984, 2002; van Achterberg & Roques 1987; van Achterberg 1988; Yu et al. 2005). Where known, the species of *Fopius* are exclusively parasitoids of fruit-infesting Tephritidae.

The apparently undescribed species of *Fopius* reared from bamboo flies belongs to a species group for which there are no prior host records (Wharton 1999). One individual was reared from a considerably larger host (*Enicoptera*), and is thus much larger. It is difficult to determine, based on this single individual, whether it represents a separate species, but slight differences in color pattern and punctation suggest that it is. These Malaysian species are similar morphologically to *F. taiwanicus* (Fischer) and *F. denticulifer* (Maeto and van Achterberg), both of which are much darker species. We therefore predict that both of these latter species attack bamboo flies. Based on morphology of the ovipositor tip, all 3 of these species are likely to oviposit in host eggs or maybe first instars soon after hatching. Fischer (1999) described a species of *Diachasmimorpha* Viereck, *D. thailandica* Fischer, whose description closely matches our material of *Fopius*. Un-

TABLE 1. PARASITOIDS ATTACKING BAMBOO FLIES (TEPHRITIDAE: PHYTALMIINAE: ACANTHONEVRINI, DACINAE: GASTROZONINI) IN MALAYSIA.

Parasitoid species	Family/Subfamily	Host (fly) species (subfamily in parenthesis)	Bamboo species in which host larvae developed	Plant part in which host larvae developed	Parasitoid developmental time days (mean ± SD)
Fopius (marangenis species group)	Braconidae/Opiinae	*Acroceratitis bilineata* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	13.7 ± 0.94
Psyttalia sp.	Braconidae/Opiinae	*Acroceratitis bilineata* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	11.0 ± 0.81
Heratemis filosa Walker	Braconidae/ Alysiinae	Emerged from puparia of cyclorrhaphous Diptera	*Gigantochloa scortechinii*	Shoot	10.1 ± 1.59
Fopius (marangenis species group)	Braconidae/Opiinae	*Enicoptera gigantea* (Dacinae)	*Gigantochloa scortechinii*	Dead tip of a shoot	21.0 ± 2.82
Phaenocarpa cameroni Papp	Braconidae/ Alysiinae	*Gastrozona fasciventris* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	20.5 ± 2.12
Phaenocarpa cameroni Papp	Braconidae/ Alysiinae	*Gastrozona fasciventris* or *Chaetellipsis maculosa* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	13.8 ± 4.6
Undescribed	Eulophidae	*Gastrozona fasciventris* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	16.0 ± 2.64
Undescribed	Eulophidae	*Langatia setinerva* or *Ptilona* cf. *confinis* (Phytalmiinae)	*Gigantochloa scortechinii*	Water-containing internodes of older cut-down shoot	N.D.
Undescribed	Eulophidae	*Gastrozona fasciventris* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	9.5 ± 0.7
Undescribed	Eulophidae	*Felderimyia gombakensis* (Phytalmiinae)	*Gigantochloa* sp.	Water-containing internodes of an older shoot	13.5 ± 2.25
Undescribed	Eulophidae	*Gastrozona fasciventris* (Dacinae)	*Gigantochloa scortechinii*	Cut shoot	15.0 ± 0.81
Undescribed	Encyrtidae	*Felderimyia gombakensis* (Phytalmiinae)	*Gigantochloa* sp.	Water-containing internodes of an older shoot	N.D.
Undescribed	Encyrtidae	*Gastrozona fasciventris* (Dacinae)	*Schizostachyum cf. grande*	Cut shoot	12.5 ± 4.94
Spalangia sp.	Pteromalidae	*Rioxoptilona vaga* (Phytalmiinae) or *Acroceratitis hardyi* (Dacinae)	*Dendrocalamus pendulus*	Cut shoot	13.0

fortunately, *D. thailandica* is known only from the male, and the question of whether it is identical to our material will require more detailed study. The apparently undescribed species of *Psyttalia* reared from bamboo flies is interesting in several respects. Morphologically, it belongs to the large concolor species group as segregated by Wharton (2009), and except for the much darker coloration, it is similar to *P. walkeri* Muesebeck. The species attacking bamboo shoot flies thus belongs to the group of *Psyttalia* that attack fruit-infesting tephritids rather than those that attack gall- making and flower head-infesting tephritids. We also reared the alysiine *Heratemis filosa* Walker from puparia of cyclorrhaphous Diptera infesting bamboo shoots that had previously been attacked by the weevil *Cyrtotrachelus* sp. There are no confirmed host records for any species of *Heratemis* Walker. Although 1 specimen of the widely distributed *H. filosa* has a label suggesting that the host is a cucurbit-infesting tephritid, this record is suspect (Wharton 2002; Yaakop et al. 2009). Similarly, although we reared several individuals, all from the same host (based on morphology of the puparium), we were unable to rear any flies from these puparia and hence the host remains unknown.

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