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Fruit flies reared from *Terminalia catappa* in Thailand

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ABSTRACT

Bactrocera fruit flies (Diptera: Tephritidae) are pests of cultivated plants worldwide. Many *Bactrocera* flies are specific to commercial vegetable and fruit crops but some may develop in alternate hosts. One such alternate host is malabar or Indian almond, *Terminalia catappa* L. (Combretaceae) in Thailand. We studied a wild mature tree that was at least 20 years old and growing in a protected environment of Kasetsart University Kamphaeng Saen campus in 2008. We found that fruit flies and their associated parasitoids were recovered only from ripening (yellow colored) malabar almond fruits. Four species of fruit flies were recorded: *Bactrocera dorsalis* (Hendel), *B. correcta* (Bezzi), *B. latifrons* (Hendel) and *B. cucurbitae* (Coquillett). Of the four species of parasitoids recorded; the braconid *Fopius arisanus* (Sonan) (Hymenoptera: Braconidae) was most commonly recovered.

Introduction

There are more than 200 pest species of tephritid fruit flies recorded worldwide and *Bactrocera* flies are a threat to fresh fruit exports worldwide and rank high on quarantine target lists (White and Elson-Harris, 1992; Drew and Romig, 1997). Many *Bactrocera* spp. are native to tropical Asia but have spread to new continents (White and Elson-Harris, 1992; Drew, 2004; Clarke et al., 2005). Fleshy fruits are damaged by several highly polyphagous species with abilities to disperse widely, such as *Bactrocera dorsalis* (Hendel), *Bactrocera cucurbitae* (Coquillett), and *Bactrocera latifrons* (Hendel) (Diptera: Tephritidae) (Clarke et al., 2001). A significant reduction in vegetable and fruit production due to these flies reduces farm income and leads to overuse of pesticides. Growers and governments face rising costs as they attempt to meet demands for food. Hence, pest-free or low pest density zones are being advocated worldwide for fruit export with minimal or zero quarantine restrictions (FAO, 2006).

Female fruit flies insert their ovipositor into the fruit's soft skin which scars the fruit surface. However, larvae that feed and develop within the fruit cause the most damage. Larvae tunnel throughout the fruit as they feed and grow. They also introduce bacteria and fungi which cause infested fruit to quickly turn putrescent and to fall to the ground prematurely (Christenson and Foote, 1960; Fletcher, 1987).

The focus of fruit fly management is often on the crop. However, alternate host plants exist and *Terminalia catappa* L. (Combretaceae) (Clarke et al., 2001) is one of them. Malabar or Indian almond, *T. catappa*, is commonly found in coastal areas and along road sides in Southeast Asian countries (Chin and Enoch, 1988; Corner, 1988). Locally known as *Hu-kwang* (Veesommai and Janjittikul, 2001), malabar almond is usually planted as a shade tree throughout Thailand. The fruit is edible raw and cooked (Burkill, 1935). Young leaves are used in the Philippines for medicinal purposes (Thomson and Evans, 2006). While it is known as a host plant for *Bactrocera* spp., little is known of its role in as a pest source despite many complaints that existing control measures directed at the crop are not effective (Mar, 2007). This study will attempt to show the necessity to include alternate hosts in the management of pest fruit flies.

Hence, we studied the breeding of fruit flies in the alternate host plant *T. catappa* at Kamphaeng Saen, Nakhon Pathom, Thailand. We hypothesized that alternate host plants may serve as reservoir of fruit flies during crop off-season. The information will help farmers and extension workers plan effective fruit fly management strategies. Knowledge of associated biological control agents also will be useful in understanding where they live during the crop off-season.

Materials and methods

The fruiting cycle of malabar almond

The study was conducted from 28 December 2007 to 19 December 2008 at the Research and Training Station of AVRDC – The World Vegetable Center, Asian Regional Center, Kasetsart University,

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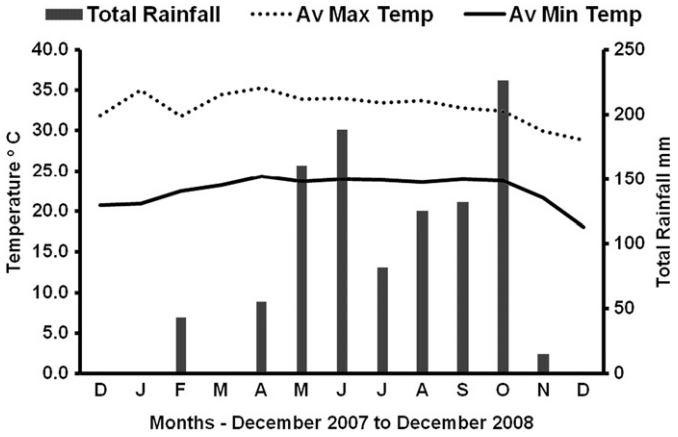

Fig. 1. Total monthly rainfall (mm) and average monthly maximum and minimum temperatures (°C) recorded by the Kamphaeng Saen Meteorological Station for December 2007 to December 2008.

Kamphaeng Saen Campus, Thailand. The *T. catappa* tree selected was more than 15 m tall with a stem diameter of 94 cm and was growing for over 20 years in a secured area with no trimming or harvesting. There was no hindrance to the collection of fruits that fell naturally from the tree. The selection criteria included the proximity to a meteorological station.

Collection of fruits and processing them

To measure fruit infestation, a 7 × 5 m plastic mat was placed under the *T. catappa* tree overnight, and the number of green and yellow fruits that fell on the mat were collected and recorded the following morning. Collection was made every 3 weeks, to coincide with the life cycle of common fruit flies. Ripe/mature (yellow) and immature (green) malabar almond fruits were sorted and placed in clear plastic containers measuring 26 × 17.5 × 10.5 cm (length × width × height). Fresh fruits were placed on top of a mesh placed on top of heat sterilized sand. The boxes were kept at room temperature out of direct sunlight. The heat-sterilized sand was sieved weekly for four successive weeks to recover pupating larvae and pupae. Pupae were put into plastic cups and stored in air-conditioned rooms. Each cup was examined regularly to recover adult flies and parasitoids. Adult fruit flies were kept alive until the body and wings hardened and colors developed fully before killing by freezing. Fruits were discarded after four weeks. The number of adult flies and parasitoids were recorded, and fly species were identified based on White and Elson-Harris (1992) and Carrol et al. (2002).

Parasitoid collection

Hymenopterous parasitoids were collected, killed and identified. Unemerged pupae were examined for parasitism based on a method described by Bressan-Nascimento (2001). Parasitoid species were identified using the taxonomic keys of PaDIL (Pests and Diseases Image Library, http://www.padil.gov.au) and Parasitic Hymenoptera Research Labs, Texas A&M University (http://hymenoptera.tamu.edu) and confirmed by Dr. Amporn Winotai.

Meteorological data

Meteorological data on the average minimum and maximum air temperature and rainfall were provided by the Kamphaeng Saen Meteorological Station (Fig. 1). Correlations between number of fruit flies and monthly rainfall, average monthly temperatures, number of yellow fruits, and number of parasitoids were analyzed with SAS (Statistical Analysis System) software.

Results

Fruiting period of malabar almond

Flowering and fruiting occurred continuously throughout the year. However, there were no mature fruit from March to early May (Table 1). The largest numbers of malabar almond were recorded from May to June.

Fruit flies recovered

Of 1983 malabar almond fruits collected, 1667 were yellow (ripe) and 318 were green. Only yellow fruits yielded fruit fly pupae. In total, 9022 fruit fly pupae were collected, of which 7587 were in the genus *Bactrocera*. The number of pupae per yellow fruit ranged from 1 to 19 (Table 1). Four fruit fly species were identified. The most common species was *B. dorsalis,* followed by *B. correcta, B. latifrons, and B.*

Table 1
Number of green and yellow fruits sampled, total tephritid pupae recovered and number of tephritid pupae per yellow fruit recorded from *Terminalia catappa* L. at Kamphaeng Saen Campus, Kasetsart University, Nakhon Pathom, Thailand.

Sampling dates	No. of fruits collect		Total tephritid pupae collected	No. of tephritid pupae/yellow fruit
	Green	Yellow		
28 December 2007	18	358	292	1
18 January 2008	0	184	100	1
8 February 2008	0	8	7	1
29 February 2008	82	0	0	0
21 March 2008	0	0	0	0
11 April 2008	0	0	0	0
2 May 2008	0	3	0	0
12 May 2008	42	266	1077	4
23 May 2008	11	236	2115	9
13 June 2008	15	218	2434	11
4 July 2008	0	8	58	7
25 July 2008	17	13	253	19
15 August 2008	81	25	336	13
5 September 2008	5	66	832	13
26 September 2008	10	18	112	6
17 October 2008	6	46	500	11
7 November 2008	10	24	258	11
28 November 2008	17	135	383	3
19 December 2008	2	59	265	4