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Plumeria alba an alternate host for mass multiplication of papaya mealybug parasitoid, *Acerophagus papayae*

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Abstract

The papaya mealybug, *Paracoccusmarginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) is native to Mexico and Central America. *Acerophagus papaya* is distributed for control of papaya mealybug in India. The mass multiplication requires potato tubers and regulated environment for the multiplication of papaya mealybug and was unsuccessful due to high temperature at Trichy, Tamil Nadu. Hence a study was under taken to find the feasibility of rearing of *A. papaya* on *Plumeria.*

Key words: Papaya mealybug, *Plumeria* sp., *Acerophagus papayae,* arasitization

Introduction

The papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) is native to Mexico and Central America. Between 2008 and 2009 it was detected variously in South India, Indonesia, Malaysia, Sri Lanka and Thailand (Muniappan *et al.,* 2008). Mealybugs are generally difficult to control chemically due to their thick waxy secretion covering the body, and their ability to hide in the damaged buds and leaves without being exposed to the insecticide. Hence, biological control agents like parasitoids and predators are preferred for the control of papaya mealybug.

The identified natural enemies are solitary and parasitic wasps that belong to the family Encyrtidae in the order Hymenoptera collected in Mexico as potential biological control agents. They are *Acerophagus papayae*, *Anagyrus loecki*, *Anagyrus californicus* and *Pseudoleptomastix mexicana*. *Acerophagus papayae, Anagyrus loecki and Pseudoleptomastix mexicana* are three parasitoid species that are currently used in the biological control of papaya mealybug. Of these *Acerophagus papayae* was found to be more efficient and is under commercial distribution for control of papaya mealybug in India. The mass multiplication of *A. papayae*

was done by rearing the papaya mealybug in potato sprouts followed by parasitizing by *A. papayae.*

The mass multiplication requires potato tubers and regulated environment for the multiplication of papaya mealybug and was unsuccessful due to high temperature. Hence a study was undertaken to find the feasibility of rearing *A. papayae* in plumeria.

Materials and Method

The economically important host range of the papaya mealybug includes papaya, hibiscus, acalypha, plumeria, avocado, citrus, cotton, tomato, eggplant, pepper, beans and peas, sweet potato, mango, cherry, mulberry and pomegranate (Chellappan *et al*., 2013)

The plumeria plant was taken for the study since it is hardy, the leaves have numerous lateral veins which aids in easy development of mealybug, needs zero maintenance, easily infested by papaya mealybug. It can withstand heavy population of papaya mealy bug and can recover after a heavy infestation and thus acts as a natural mass multiplication centre for the parasitoid *Acerophagus papayae*.

The study was conducted at the Department of Plant Protection, ADAC & RI, NavalurKuttapattu, Tiruchirappalli, Tamil Nadu (10.755655°N 78.606448°E) Twenty five plants of plumeria were raised in cement pots and were used for the study. The mealybugs were collected from natural and infested host. The effect of plumeria on the biology parameters like the number of instars, development period of each instar, sex ratio and fecundity of *Paracoccus marginatus* was recorded.

Biology of *Paracoccus marginatus*

The development biology of *Paracoccus marginatus* was studied in a 5-cm long terminal shoot and one tender leaf was selected as a replicate. In plumeria, each terminal shoot was hydrated using a ball of cotton tied to the cut end of the shoot, and moistened daily with distilled water.

Egg sac collected from a single female was placed on the leaves of host with 10 eggs per leaf using a paintbrush. Eggs were collected within 24 h of oviposition. Dishes were checked daily for egg hatch and shed exuviae. The number of days for the egg to hatch, emergence and survival of each instar, and number of emerging adult males and females were recorded. The developmental time and the survival of eggs and first instars were not separated by gender. The gender of each individual mealybug was determined during the later part of the second instar when males change their color from yellow to pink. At this point, the developmental time of males and females were counted separately. For each plant, 35 Petri dishes (replicates) with 10 eggs were used. This experiment was repeated twice.

Freshly emerged virgin females obtained from the developmental study were used to assess reproduction. Virgin females were placed individually in Petri dishes with either a leaf or a terminal shoot prepared as mentioned above. Females were held alone to assess asexual reproduction or were provided with three newly emerged males from the same host plant for sexual reproduction. The date of oviposition, the number of eggs laid, and adult mortality were recorded. For each of the two treatments (indoor and outdoor) 10 females were used, and each female was considered a replicate. This experiment was repeated twice using newly emerged males and females collected from developmental time experiments.

The parasitization potential of *A. papayae* was assessed. Twenty *A. papayae* were released per plant infested with mealybugs and covered with a mylar film cage. One week after releasing the parasitoids in the above said experiment, the sample leaves were taken from each plant. They were transferred to plastic containers of 10 cm diameter covered with a muslin cloth. The containers were checked daily for parasitoid emergence. From this data, the development period and the duration of different life stages of *A. papayae* on mealybugs reared on plumeria was worked out. Two months after releasing the parasitoids, the parasitism rate was observed in second and third instar, and adult female mealybugs separately.

The parasitism rate was calculated using the formula:

$$\text{Parasitization rate of } A.\ papayae = \frac{\text{Number of parasitized mealybugs}}{\text{Total number of mealybugs offered}} \times 100$$

Results and Discussions

Developmental period of papaya mealy bug on plumeria

The developmental period of papaya mealybug was studied by tying a polythene cover over one of the leaves where the other instars are brushed away and the eggs alone remain. The instars were counted using the remaining exuviae which is removed after counting. The egg period was 7.2 days, while 1st, 2nd, 3rd, and 4th instar were 5.3, 3, 5.2 and 3.9 days respectively. The total duration of male and female were 23.4 days and 33 days respectively. The fecundity was observed to be 370.4 eggs per female and is in agreement with Tanwar *et al.* (2010), and Kaushalya *et al.*, (2008).

Table 1. Developmental period (in days) of papaya mealybug *Paracoccus marginatus* on *Plumeria alba*

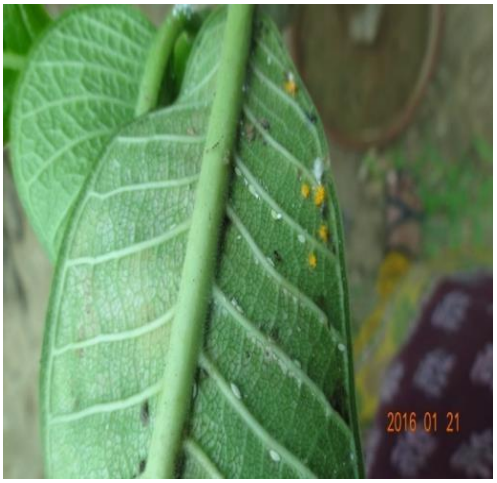
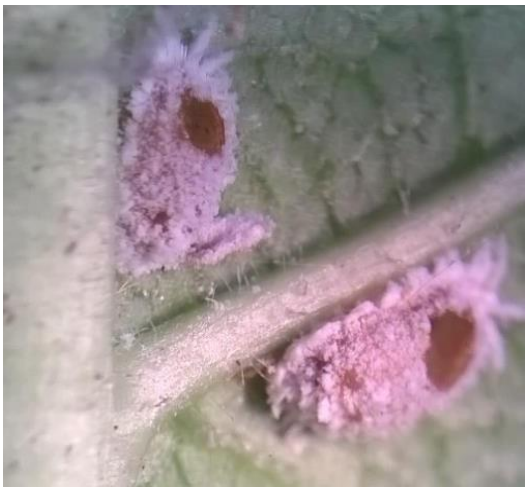
Egg period	I Instar	II Instar	III Instar	IV Instar	Male longevity	Female longevity	Male (Total Duration)	Female (Total Duration)	Fecundity
7.2± 0.33	5.3± 0.2	3± 0.15	5.2± 0.25	3.9± 0.1	15± 0.54	20.4± 0.50	23.4± 0.4	33± 0.44	370.4± 2.76

Table 2. Developmental period (in days) of *Acerophagus papayae* and parasitic potential of *A. papayae* on *P. marginatus* in plumeria

Egg period	First Instar	Second instar	Pupa	Total life cycle	Parasitic potential of *A. papayae* on *P. marginatus* mean parasitization rate (%) *		
					2nd instar PMB	3rdinstar PMB	Adult PMB
8+ 0.12	3.2+ 0.25	2.5+ 0.15	3.7+ 0.12	12.2+ 0.25	86+1.34	46.8+0.81	18.4+0.49

Parasitic potential of *A. papayae* on *P. marginatus* reared on plumeria

The results revealed that the parasitization of mealybug was noticed during the 2nd, 3rd and adult stages. The highest parasitisation of 81.2 percent was recorded in the second instar. The mean per cent parasitization in the third instar was comparatively lesser 42. 4 percent and the adult parasitization was 14.8 percent which is in accordance with Meyerdirk *et al.* (2004) and Muniappan *et al.* (2006), who reported that the second instar was the preferred stage for parasitization and the parasitisization reduces in 3rd, 4th instars and the adults.

	
Paracoccus marginatus on plumeria plant	Mealybug developing on the ventral side of the leaves
	
Crawlers emerging from ovisac	Exit hole of parasitoid on parasitized mealybug

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