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Predatory Potential of Ladybird Beetle, *Cryptolaemus montrouzieri* and Parasitisation Level of Encyrtid Parasitoid *Acerophagus papayae* On Papaya Mealybug

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ABSTRACT

The predatory potential of grubs on adult females of papaya mealybug, P. marginatus revealed that the mean number of adult females of P. marginatus consumed by first, second, third and fourth instar grubs were 3.40±0.49, 11.20±1.47, 22.40±1.36, and 31.60±1.50, respectively during total development period of individual instars. A total of 68.60±3.01 adult females of P. marginatus were consumed by the predator in the grub stage. The third and fourth instar grubs were voracious and consumed 22.40±1.36, 31.60±1.50 adult females of P. marginatus respectively. The consumption by first and second instars was 3.40±0.49, 11.20±1.47 of adult females. The predatory potential was increased gradually from first instar to fourth instar.The encyrtid parasitoid, Acerophagus papayae is a predominant exotic parasitoid on papaya mealybugs. The parasitisation rate of A. papayae on second instar nymphs of papaya mealybug, P. marginatus was 84.5±3.25 per cent.

Key words: *Predatory potential, Paracoccus marginatus, Cryptolaemus montrouzieri, Acerophagus papayae*

INTRODUCTION

Papaya mealybug (PMB), *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae), native to Mexico and Central America[7] was introduced into the Caribbean islands and had become a pest in early 1990's; since then it invaded most of the Caribbean archipelago in 1994 and spread to South America in 1999, the pacific Island in 2002, and South Asia in 2008. In India, the pest was first reported from Coimbatore during 2008 infesting papaya and there after the list of agricultural and horticultural crops infested by this invasive pest is expanding[3].

Papaya mealybug is a polyphagous pest which cause damage to a large number of economically important field crops, tropical and sub-tropical fruits and the ornamental plants[6].

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The natural enemies of papaya mealybug include the commercially available mealybug destroyer ladybird beetle *Cryptolaemus montrouzieri* Mulsant, lace wings and hover flies; all are generalist predators and have potential impact on papaya mealybug population. In addition to predators, several parasitoids may attack papaya mealybug. In 1999, the USDA Animal and plant health inspecton service (APHIS) and USDA Agricultural Research Service (ARS) initiated a classical biological control programme for the papaya mealybug. Four species of encyrtid endoparasitic wasps specific to mealybug were collected in Mexico by USDA and ARS researchers and Mexican cooperators as potential biological control agents. These were *Acerophagus papaya* (Noyes and Schauff), *Anagyrus loecki* (Noyes and Menezes), *Anagyrus californicus* Compere and *Pseudleptomastix mexicana* (Noyes and Schauff)[5,10].

However, *A. papayae* emerged as the dominant species in controlling the papaya mealybug. An amount of Rs.122 crores have been saved by rural farmers for not advocating pesticide application for the past six months in papaya, mulberry and cassava due to release of parasitoids. An amount of Rs. 435 crores have been saved from loss due to the papaya mealybug in the above three crops[4].

MATERIALS AND METHODS

Predatory Potential of Ladybird beetle, Crypt olaemus montrouzieri on Papaya mealybug

Experiment was conducted to determine the rate of consumption of mealybugs (adults) by the predatory grub. The lady bird beetle, *Cryptolaemus montrouzieri* culture was obtained from NBAII, Bangalore. After hatching, each predatory grub of first instar confined in a petriplate and provided with the known number of female mealybugs (Plate 1). Observations were recorded on number of mealybugs consumed during every 24 hr interval. Surviving preys were counted and removed. Fresh preys were offered to predatory grubs every day until its pupation. Number of preys consumed by the predatory grub in each instar, and the total number of mealybugs consumed during its development as grubs were calculated. The feeding potential studies were conducted with five predatory grubs, where each predatory grub in a petriplate was considered as one replicate. Data on predatory potential of different instars were analysed with standard deviation.

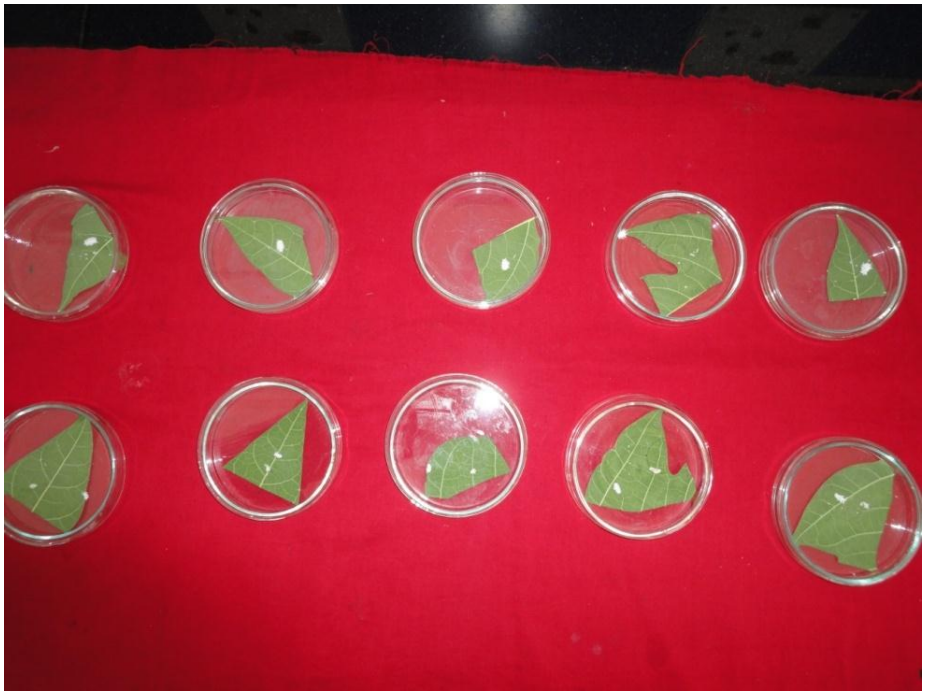

Plate 1: Feeding potential of Ladybird beetle, *Cryptolaemus montrouzieri* on adult females on papaya mealybug, *Paracoccus marginatus*

Parasitisation level of Encyrtid Parasitoid Ac erophagus papayae Noyes and Schauff on Papaya mealybug

Experiment was conducted to determine the parasitisation rate of *Acerophagus papaya*e on papaya mealybugs. The parasitoid, *Acerophagus papayae* culture was obtained from NBAIR, Bangalore. For each parasitoid the known number of mealybugs was provided. After 15 days the parasitized mealybugs were observed. Number of mummified mealybugs was recorded and maintained in glass jars for parasitoid emergence. The parasitisation rate was calculated as given below:

$$\% \text{ Parasitisation rate} = \frac{\text{No. of mummified mealybugs}}{\text{Total No. of mealybugs}} \times 100$$

RESULTS AND DISCUSSION

Predatory Potential of Ladybird Beetle, Cryptolaemus montrouzieri MULSANT on P. marginatus

The grubs of *Cryptolaemus montrouzieri* were found to be active predators on mealybugs. The feeding potential of grubs was studied by providing them adult females of papaya mealybug, *P. marginatus.*

In the present findings, it was observed that the mean number of adult females of *P. marginatus* consumed by first, second, third and fourth instar grubs were 3.40±0.49, 11.20±1.47, 22.40±1.36, and 31.60±1.50, respectively. A total of 68.60±3.01 adult females of *P. marginatus* were consumed by the predator in the grub stage. Among various instars of the predator, the third and fourth instar grubs were voracious and consumed 22.40±1.36, 31.60±1.50 adult females of *P. marginatus* respectively. The consumption of first and second instars was 3.40±0.49, 11.20±1.47 adult females of *P. marginatus* respectively (Table 1) (Fig 1). The predatory potential of each instar was increased gradually from first instar to fourth instar. The results of present study are in close agreement with the findings of Suganthy and Sakthivel[9] who reported that the mean number of adult females of *P. marginatus* consumed by first, second, third and fourth instar grubs was 2.6±0.8, 9.4±1.6, 23.2±3.0, and 27.60±4.6, respectively. A total of 62.8±11.6 adult females of *P. marginatus* were consumed by the predator in the grub stage.

Table 1: Feeding potential of different instars of *Cryptolaemus montrouzieri* Mulsant on adult females of papaya mealybug, *Paracoccus marginatus*

Instar	Mean number of *P. marginatus* consumed*
	Mean± SD
I instar	3 .40 ± 0.49
II instar	11.20 ± 1.47
III instar	22.40 ± 1.36
IV instar	31.60 ± 1.50
Total	68 .60 ± 3.01

SD = Standard Deviation,

* Mean number of five replications

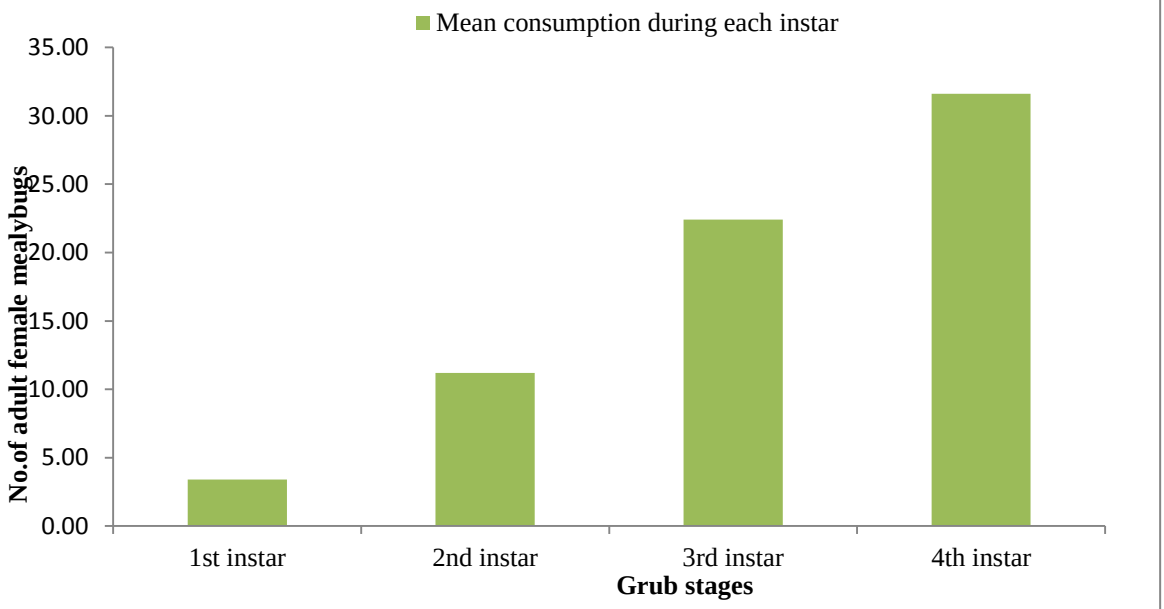

Fig 1. Feeding potential of different instars of *Cryptolaemus montrouzieri* Mulsant on adult females of papaya mealybug, *Paracoccus marginatus*

Parasitisation rate of Encyrtid Parasitoid Acerophagus Papayae on Papaya Mealybug, P. marginatus

The encyrtid parasitoid, *Acerophagus papayae* was the predominant on papaya mealybugs. The parasitisation rate of *A.* papayae was studied by providing them second instar nymphs of papaya mealybug, *P. marginatus.*

The results of present study revealed that the mean per cent parasitisation rate of *A. papayae* was 84.5±3.25 (Table 2) (Plate 2). The present results are in close agreement with the findings of Amarasekare *et al*[1]., who reported that the mean per cent parasitism of *A. papayae* was 82.8±21. Similarly, Noyes and Schauff[8] who reported that the *A. papaya*e complete their life cycle in the second instar of mealybugs and produced a higher proportion of female progeny because, second instar mealybugs may have enough resources for the smallest parasitoid *A. papayae.* Amarasekare *et al*[2]., also reported that the maximum parasitisation was observed in stem and twigs as compared to other parts of plant.

Plate 2: Parasitized mealybugs on papaya leaves

Table 2: Parasitisation rate of *Acerophagus papayae*

No. of *Acerophagus papayae*/sample	No. of Second instar mealybugs provided /Sample	No. of mummified mealybugs/Sample	% parasitisation
1	40	35	87.5
1	40	32	80
1	40	33	82.5
1	40	35	87.5
1	40	34	85
Mean per cent parasitisation rate (Mean ±SD)			84.5±3.25

CONCLUSIONS

The predatory potential of grubs on adult females of papaya mealybug, *P. marginatus* revealed that the mean number of adult females of *P. marginatus* consumed by first, second, third and fourth instar grubs were 3.40±0.49, 11.20±1.47, 22.40±1.36, and 31.60±1.50, respectively during total development period of individual instars. A total of 68.60±3.01 adult females of *P. marginatus* were consumed by the predator in the grub stage. The third and fourth instar grubs were voracious and consumed 22.40±1.36, 31.60±1.50 adult females of *P. marginatus* respectively. The consumption by first and second instars was 3.40±0.49, 11.20±1.47 of adult females. The predatory potential was increased gradually from first instar to fourth instar.

The encyrtid parasitoid, *Acerophagus papayae* is a predominant exotic parasitoid on papaya mealybugs. The parasitisation rate of *A. papayae* on second instar nymphs of papaya mealybug, *P. marginatus* was 84.5±3.25 per cent.

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