Research Article

DIVERSITY OF MEALYBUG PARASITOIDS (CHALCIDOIDEA: ENCYRTIDAE) FROM TAMIL NADU

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ABSTRACT

Sucking pest is one of the major threats in Agricultural and Horticultural ecosystems and mealybug plays a crucial role in higher damage. Parasitic Hymenoptera are a viable alternative for chemical pest control especially for this group of insects. Chalcidoidea is one of the entomophagus insects utilized for mealybug management and within Chalcidoidea, members belonging to Encyrtidae play a major role in bringing down their population in nature. In the present study, surveys were conducted to collect different mealybug hosts along with their host plants from various ecosystems. The collected mealybugs were reared under laboratory conditions and observed for possible parasitoid emergence. The following are the major mealybugs collected and parasitoids reared from them. Cotton mealybug, *Phenacoccus solenopsis* Tinsley (*Aenasius arizonensis* (Girault), *Prochiloneurus aegyptiacus* (Mercet), *Gentakola trifasciata* (Saraswat), *Promuscidea unfasciativentris* Girault.); Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink, *Pseudleptomastix mexicana* Noyes and Schauff, *Acerophagus papayae* Noyes and Schauff; Eggplant mealybug, *Coccidohystrix insolita* (Green) *Leptomastix nigrocincta* Risbec, *L. nigrocoxalis* Compere, *Prochiloneurus pulchellus* Silvestri, *P. aegyptiacus* (Mercet), *Chartocerus* sp. *Promuscidea unfasciativentris* Girault; Citrus mealybug, *Planococcus citri* (Rissco) *Leptomastix nigrocoxalis* Compere; Striped mealybug, *Ferrisia virgata* (Cockerell) *Aenasius advena* (Compere), *A.indicus* (Narayanan and Subba Rao), *Anagyrus indicus* (Subba Rao), *Blepyrus insularis* (Cameron); Root mealybug, *Formicoccus polysperes* Williams: *Anagyrus kamali*. *Blepyrus insularis* (Cameron). In addition, the parasitoids were also recognized at trophic level as to primary or secondary parasitoids apart from recording the entomophagous insects of parasitoids, if any. The host plants, host insects and parasitoids attacking the host insects and entomophages attacking the primary parasitoids are presented in a flowchart depicting the tritrophic relationship for easy understanding by biocontrol workers.

INTRODUCTION

In recent years mealybugs have become serious pest globally (Khaskheldi, 2006) including many states in India, causing severe damage to many crops (Suresh *et al.*, 2010). The mealybug species are widespread throughout the world. It has been found on a relatively wide variety of host plants like mango, grapevines, citrus, custard apple, sapota, cashew, pineapple and ornamentals like *Hibiscus*, croton, ferns, cacti, gardenias, orchids, etc. Besides these, mealybug infestation has also been reported in storage of tuber crops like aerial yam, elephant foot yam, *Colocasia*, cassava etc. (Keraba, 2011). The mealybug is called as "hard to kill pest of fruit crops". However, there are several reasons which may account for this fact (Lower, 1968). So far, various pesticides have been attempted for the control of mealybug either singly or as cocktails but did not give desired control of the pest (Anonymous, 1995). One of the reasons is that those sheltering in the crevices of the bark or any other hidden place, escape and re establish their population quickly (Manjunath, 1985).

Biological control of mealybugs has been widely studied since the early twentieth century, due to their economic importance and invasive habits (McKenzie, 1967). They have a wide variety of predators, including: coccinellids, lacewings (Chrysopidae, Coniopterygidae and Hemerobiidae), flies (Cecidomyiidae and Chamaemyiidae), anthocorids bugs, lycaenids and phytoseiid mites (Franco *et al.*, 2000), but encyrtids are the most important mealybug

parasitoids and species belonging to the genera *Anagyrus*, *Leptomastix*, *Leptomastidea*, *Gyranusoidea*, *Coccidoxenoides* and *Acerophagus* are worldwide used in biological control (Moore, 1988). Noyes and Hayat (1994) recorded 49 encyrtids as parasitoids of mealy bugs in India and Nalini and Manickavasagam (2011) reported 27 encyrtid parasitods from mealybugs in Tamil Nadu. The present study is meant to further explore the encyrtid – mealybug association, especially in Tamil Nadu with the aim of using them as biocontrol agents.

MATERIALS AND METHODS

Surveys were conducted from January, 2016 for two years in various districts of Tamil Nadu in search of potential natural enemies especially encyrtids to enhance biological control against mealy bugs. Mealybug infested plant parts were collected and secured in polythene cover with rubber band and reared in the laboratory to observe for emergence of parasitoids. The recovered parasitoids were either card or slide mounted on rectangle and labeled according to the standard procedure (Noyes, 1982). Diagnosis was done by using keys of Noyes and Hayat (1994) and Hayat (2006) and all the parasitoid are deposited with Parasitoid Taxonomy and Biocontrol Laboratory, Department of Entomology, Faculty of Agriculture, Annamalai University, Annamalainagar. The host mealy bugs were identified by experts.

The following abbreviations are used:

PP— Primary parasitoids
HP—Hyper parasitoids

RESULTS AND DISCUSSION

From the present survey, the following mealybugs were collected *Phenacoccus solenopsis* Tinsley; *Paracoccus marginatus* Williams and Granara de Willink; *Coccidohystrix insolita* (Green); *Planococcus citri* (Rissco); *Ferrisia virgata* (Cockerell) and *Formicoccus polysperes* Williams. From these mealybugs, the following parasitoids were respectively recovered: *Aenasius arizonensis* (*A. bambawalei*) (Girault), *Prochiloneurus aegyptiacus* (Mercet), *Gentakola trifasciata* (Saraswat), *Promuscidea unfasciativentris* Girault; *Pseudleptomastix mexicana* Noyes and Schauff, *Acerophagus papayae* Noyes and Schauff; *Leptomastix nigrocincta* Risbec, *L. nigrocoxalis* Compere, *Prochiloneurus pulchellus* Silvestri, *P. aegyptiacus* (Mercet), *Chartocerus* sp, *Promuscidea unfasciativentris* Girault; *Leptomastix* sp. ; *Aenasius advena* (Compere), *A. indicus* (Narayanan and Subba Rao), *Anagyrus indicus* (Subba Rao), *Blepyrus insularis* (Cameron); *Anagyrus kamali*. and *Blepyrus insularis* (Cameron). Among the mealybug parasitoids recovered *Aenasius arizonensis* was the dominant followed by *Pseudleptomastix mexicana and Acerophagus papayae.* The flow chart given below gives an idea of the tritrophic relationship of the mealybugs collected.

Tritrophic relationship of various mealy bug parasitoid

1. Cotton mealybug

Gossypium sp. *Murraya koenigii*, *Abutilan indicum*, *Tithona diversifolia* *Solanum torvum*, *Hibiscus* sp. → *Phenacoccus solenopsis* —PP→ *Aenasius arizonensis*

Aenasius arizonensis —HP→
1. *Promuscidea unfasciativentris*
2. *Prochiloneurus aegyptiacus*

2. Eggplant mealybug

Solanum molongena, *Hibiscus* sp. → *Coccidohystrix insolita* —PP→ 1. *Leptomastix nigrocincta*, 2. *L. nigrocoxalis*

1. *Leptomastix nigrocincta*, 2. *L. nigrocoxalis* —HP→
1. *Prochiloneurus pulchellus*,
2. *P. aegyptiacus*,
3. *Chartocerus* sp.
4. *Promuscidea unfasciativentris*

3. Papaya mealybug

Carica papaya, *Jatropha* sp. → *Paracoccus marginatus* —pp→ 1. *Pseudleptomastix mexicana*
Tecamo stans, *Parthenium* sp. 2. *Acerophagus papayae*
Helianthus annuus

4. Citrus mealybug

Citrus sp. → *Planococcus citri* —pp→ *Leptomastix nigrocoxalis*.

5. Striped mealybug

Oryza sativa, *Pisidium guajava* *Nerium* sp., *Hibiscus* sp. → *Ferrisia virgata* —pp→ 1. *Aenasius advena*, 2. *Aenasius indicus*, 3. *Anagyrus indicus*, 4. *Blepyrus insularis*

6. Root mealybug

Mangifera indica → *Formicoccus polysperes* —pp→ 1. *Anagyrus kamali*. 2. *Blepyrus insularis*

Table 1. List of mealybugs and their parasitoids

Sl. No	Mealybugs reared	Parasitoids recovered
1.	Cotton mealybug, *Phenacoccus solenopsis* Tinsley	*Aenasius arizonensis* (Girault), *Prochiloneurus aegyptiacus* (Mercet), *Gentakola trifasciata* (Saraswat). *Promuscidea unfasciativentris* Girault.
2.	Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink	*Pseudleptomastix mexicana* Noyes and Schauff, *Acerophagus papayae* Noyes and Schauff
3.	Eggplant mealybug, *Coccidohystrix insolita* (Green)	*Leptomastix nigrocincta* Risbec, *L. nigrocoxalis* Compere, *Prochiloneurus pulchellus* Silvestri, *P. aegyptiacus* (Mercet), *Chartocerus* sp. *Promuscidea unfasciativentris* Girault.
4.	Citrus mealybug, *Planococcus citri* (Rissco)	*Leptomastix* sp.
5.	Striped mealybug, *Ferrisia virgata* (Cockerell)	*Aenasius advena* (Compere), *A.indicus* (Narayanan and Subba Rao), *Anagyrus indicus* (Subba Rao), *Blepyrus insularis* (Cameron).
6.	Root mealybug, *Formicoccus polysperes* Williams	*Anagyrus* sp. *Blepyrus insularis* (Cameron)

Survey results from the present study is in conformity with those of Moore (1988); Noyes and Hayat (1994); Ram and Saini (2010) and Manickavasagam *et al*. (2013) who reported similar encyrtids from various mealybugs. *Aenasius arizonensis* is a specific PP on *P. solenopsis* and its parasitization is to the tune of 87.3% (Tanwar *et al.*, 2011), in spite of hyperparasitization by *Promuscidea unfasciativentris* and *Prochiloneurus aegyptiacus*; *Paracoccus marginatus* was parasitized by introduced specific parasitoids like *Pseudleptomastix mexicana and Acerophagus papayae*. But *Anagyrus loecki* was not observed. It is worthwhile to note here that *A. papayae* was recovered only from *P. marginatus* reared on papaya plant whereas from other host plants, only *P. mexicana* emerged; from eggplant mealybug *Coccidohystrix insolita, Leptomastix nigrocincta* and *L. nigrocoxalis* emerged as

reported by Mani *et al*. (2011); from the striped mealybug *Ferrisia virgata* , *Aenasius advena*, *Aenasius indicus*, *Anagyrus indicus* and *Blepyrus insularis* and from *Formicoccus polysperes Anagyrus* sp. *Blepyrus insularis* emerged. The result obtained here is similar to that of Noyes and Hayat (1994); Nalini and Manickavasagam (2011), who reported similar encyrtids as parasitoids of mealybugs in Tamil Nadu. However I the present study only 15 encyrtids were recorded. This might be due to less number of survey and collection localities.

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