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Phenacoccus solenopsis Tinsley (Hemiptera: Pseudococcidae) and its parasitoid *Aenasius arizonensis* (Girault) (Hymenoptera: Encyrtidae) in Tamil Nadu

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Abstract

Surveys were conducted for two years from 2017 to 2018 in Dindigul district of Tamil Nadu to explore the parasitoids associated with *Phenacoccus solenopsis* Tinsley on different host plants in Tamil Nadu and each one encyrtid and aphelinid parasitoids were recorded among which *Aenasius arizonensis* (Girault) was dominant and primary parasitoid. Overall percentage ranged from 4.44 to 56%. The parasitoids were active during all around the year. The collected *P. solenopsis* were reared under laboratory conditions and observed for possible parasitoid emergence. *Aenasius arizonensis* (Chalcidoidea: Encyrtidae), an indigenous parasitoid 90% and along with hyperparasitoid as *Promuscidea unfasciiventris* Girault is also recorded. The tritrophic relationship is presented in a form of flowchart for easy understanding of biocontrol workers.

Keywords: Encyrtidae, solenopsis mealybug, entomophagous insects, Aphelinidae

1. Introduction

Mealybug is one of the major threats in agro ecosystems at present. In recent years mealybugs have become serious pests globally [1]. The mealybugs are widespread and about 5000 species of mealybugs have been recorded from 246 families of plants throughout the world. Among these, 56 species have been reported from 15 genera of the family Malvaceae, including cotton and many other plants of economic importance [2]. The mealybug is called as hard to kill pest of fruit crops [3].

The solenopsis mealy bug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) was described originally from the USA [4]. It is a polyphagous pest reported on 154 plant species belonging to 53 families [5], on including field crops, vegetables, ornamentals, weeds, bushes and trees. Most of these plants belong to the families Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae. In the Indian subcontinent, the pest has caused widespread and serious damage to cotton crop [6, 7].

Biological control of mealybugs has been widely studied since the early twentieth century, due to the economic importance and invasive habits of this mealybug [8]. Encyrtids are the most important mealybug parasitoids and species belonging to the genera *Anagyrus*, *Leptomastix*, *Leptomastidea*, *Gyranusoidea*, *Coccidoxenoides* or *Acerophagus* are used worldwide in biological control [9]. A solitary endoparasitoid, *Aenasius bambawalei* Hayat (Hymenoptera: Chalcidoidea: Encyrtidae) apparently introduced along with the host, has been recorded from nearly all the cotton growing states on *P. solenopsis* in 2008-09. This parasitoid was reported first time from Pakistan as *Aenasius* sp. nr. *longiscapus* Compere. In India, it stated appearing in northwestern India [10, 11] and slowly causing moderate to high rates of parasitism and this was taxonomically described [12]. This *A. bambowali* synonymized under *Aenasius arizonensis* by Fallahzadeh *et al.* [13]. Tendency of this mealybug to cause damage to various host plants and its association with *Aenasius arizonensis*, needs to *Phenacoccus solenopsis* and its parasitoid *Aenasius arizonensis*. Application of these studies will be helpful during proper implementation of various control measures against this pest.

2. Materials and Methods

A field survey was conducted in 2017 -2018 in various agricultural ecosystems in Dindigul districts of Tamil Nadu, India. In search of potential natural enemies especially encyrtids to

enhance biological control against solenopsis mealy bugs, *P. solenopsis* infested parts were collected and kept in polythene bags and reared in the laboratory to observe for emergence of parasitoids. To score the per cent parasitization, total number of mealybugs was counted along with the mealy bug mummies which appeared dark brown in colour. A small piece of plant containing these mealy bug mummies was separated from the plant and kept in plastic jars provided with brass mesh for proper ventilation for emergence of parasitoids in the laboratory.

2.1 Collection and identification of mealy bug species

Field collected mealy bugs from different plants were brought to the laboratory and reared. Few mealybugs samples were preserved in 70 per cent ethyl alcohol for identification.

2.2 Collection and identification of parasitoids

The emerged parasitoids were preserved in 70% alcohol for identification. The recovered parasitoids were then dry mounted on rectangle card and labeled according to the standard procedure provided by Noyes [14].

Percent parasitism was calculated as per the following formula

$$\frac{\text{Total number of mummies}}{\text{Total number of mummies and surviving mealybugs}} \times 100$$

3. Results and Discussion

Solenopsis mealybug incidence

The data on solenopsis mealybug infestation on different agricultural crops were noted, during 2017 and 2018, per cent field infestation was very high. *Phenacoccus solenopsis* was the most commonly prevalent mealy bug collected from *Gossypium hirsutum*, *Abelmoschus esculentus*, *Hibiscus rosa-sinensis*, *Abutilon indicum*, *Tithonia diversifolia* and *Solanum torvum* infestation were noted under field collections. From 75 per cent field infested during June- July. On the other hand it was quit variable in 2017.

Relative abundance of *Aenasius arizonensis*

Survey results from the present study is in conformity with those of Moore, Noyes & Hayat and Ram & saini [9, 15, 16, 10] who reported similar encyrtids from *P. solenopsis*. *Aenasius*

arizonensis is a specific Primary Parasitoids on *P. solenopsis* and its parasitization is to the tune of 87.3 per cent [17], in spite of hyperparasitization by *Promuscidea unfasciiventris*. *Aenasius arizonensis* was the only primary parasitoid recorded from *P. solenopsis*. Among encyrtid and apelinid parasitoids surveyed, *A. arizonensis* recorded as the most pre dominant parasitoid [18]. Field incidence of *P. solenopsis* parasitization by *A. arizonensis* are presented in Table 1.

Table 1: Field incidence of *Phenacoccus solenopsis* and its parasitization by encyrtids (2017-2018)

Crop	Month	Percent parasitization		Percent hyper parasitization	
		2017	2018	2017	2018
<i>Gossypium hirsutum</i>	April	20	32	0	4.0
	May	12	45	0	5.5
	June	24	15.25	12	1.5
	July	16.6	21.75	10	10
<i>Abelmoschus esculentus</i>	May	14.5	17	18	12
	June	20	17.2	2	0
	July	4.44	15	12	0
<i>Hibiscus rosa-sinensis</i>	April	18	25	0	0
	May	16.8	17	0	0
	June	12	18	0	0
	July	18	12.5	0	0
<i>Abutilon indicum</i>	April	48	42	60	58
	May	36	31.5	40	62
	June	38	48	67	66
	July	56	49	80	65
<i>Tithonia diversifolia</i>	April	22	12	0	0
	May	18	17.5	0	0
	June	16	15	0	0
	July	12	9.5	0	0
<i>Solanum torvum</i>	June	0	0	0	0
	July	0	12	0	0

Field incidence of *P. solenopsis* parasitization by encyrtids on *Abutilon indicum* was the maximum are represented 56 and 49 per cent during July 2017 & 2108 respectively. Next to *Abutilon indicum*, *Gossypium hirsutum* recorded higher per cent parasitism 24 & 16.6 % during 2017 June and July respectively. During 2018 May 45, June 15.25 and July 21.75 per cent was noticed. The least percent parasitism was noticed in *Solanum torvum* 12 during July 2018. The table indicated almost all the surveys the parasitization of *A. arizonensis* was noticed.

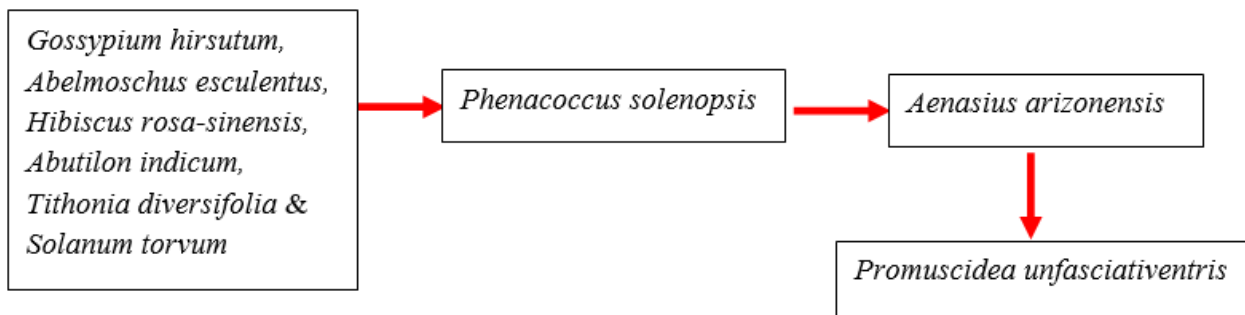


Fig: Tritrophic relationship of solenopsis mealybug parasitoids

Hyperparasitoid of *Aenasius arizonensis*

From the survey hyperparasitoid of *A. arizonensis* was recorded on field collected samples is *Promuscidea unfasciiventris* (Hymenoptera: Eriaporidae). Only the, *P. unfasciiventris* was the hyperparasitoid was noticed. There

was no hyperparasitoid on *Hibiscus rosa-sinensis*, *Tithonia diversifolia* and *Solanum torvum* attacking *P. Solenopsis*. The hyper parasitization was also noticed to be the maximum 80 and 67 per cent during July & June, 2017 respectively. *P. unfasciiventris* is considered to be hyperparasitoid and it is

expected that it may adversely affect the efficacy of *A. arizonensis* [19]. However, it is interesting to note that at most of the places *P. unfasciiventris* was present along with *A. arizonensis* and at all these locations the mealybug was successfully checked. *P. unfasciiventris* has also been reported as primary parasitoid of coccids [20]. From the two years' survey, it was noted that hyperparasitism is more common in weeds like *Parthenium*, *Abutilon* and *Solanum*, rather than in agricultural crops like cotton, okra, etc. This might be due to the sensitive nature of hyperparasitoids to pesticides.

4. Conclusion

It is evident that *P. solenopsis* acquired the status of a major pest in most of the agricultural crops. It will be effectively checked by indigenous parasitoid, *A. arizonensis* at most of the mealybugs surveyed. Though the parasitoid (*A. arizonensis*) has now been well established on *P. solenopsis* on different host plants especially the weeds which remained uncared for by the farmers and provides a continuous source of parasitoids for mealy bugs attacking cotton and other crops, yet there is a need to conserve the parasitoid in the nature.

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