

Association of ants with pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) and its influence on predatory fauna in mulberry ecosystem

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ABSTRACT

The pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Hemiptera: Pseudococcidae) is a major sucking pest of mulberry, infests tender shoot and causes bunchy top which leads to retarded growth of the plants. The leaves in the infested shoots become unfit for young age silkworm rearing. Infestation of *M. hirsutus* is often associated with attendant ants and they help spreading of the pest besides protecting from natural enemies. Thus, a study on the association of ants with *M. hirsutus* and their influence on the predatory fauna in mulberry gardens was carried out in southern Tamil Nadu. Four ant species viz. *Monomorium indicum*, *Solenopsis geminata*, *Tapinoma sessile* and *Camponotus compressus* were found to have association with the pink mealy bug in mulberry garden. Among the species, *M. indicum* was found predominant accounting for an average of 37.78 numbers per mealybug infested shoot whereas the rest of the species *S. geminata* (3.3), *T. sessile* (1.67) and *C. compressus* (0.56) were exhibited least association. The average mealy bug population was comparatively higher in ant attended colonies (61.22) than unattended ones (49.22). The population of predatory fauna decreased significantly (0.96) on ants association compared to the mealy bug infested shoots free from the ants (4.75) which indicates the deterring potentiality of the attendant ants. Destruction of the predominant *M. indicum* colonies in mulberry ecosystem could help increase the field activities of predatory fauna against *M. hirsutus*.

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INTRODUCTION

The mealy bug *Maconellicoccus hirsutus* infestation is found to be more destructive owing to the extent of qualitative and quantitative damage to mulberry leaves (Manjunath *et al.*, 1993). It infests tender shoot and causes bunchy top which leads to retarded growth of the plants. The leaves in the infested shoots become unfit for young age silkworm rearing. The symptoms caused by the mealy bug *M. hirsutus* are generally called Tukra (Reddy *et al.*, 1988). Though the intensity of damage differed among the varieties the symptoms were similar in all the varieties (Mahimasanthi and Kumar, 2011). The yield loss of mulberry ranged from 2.45 to 44.33 per cent depending upon the intensity of mealy bug infestation (Sugunakumari *et al.*, 2000; Veeranna *et al.*, 2001). Muthulakshmi *et al.* (2004) reported 50.6 per cent damage during summer months.

Mealy bugs are hard to be killed (Lower, 1968). The mealybugs habitat and the mealy coating protect themselves from the pesticides. The mechanical control of clipping the affected twig cause qualitative and quantitative damage in leaf production. On the other hand mealy bugs, being sessile, are more amenable to biological control in which parasitoids and predators can effectively reduce the mealy bug population (Mani, 1989). Ants are seen in association with mealy bugs (Mahimasanthi and Daniel, 2012). Navarrete *et al.* (2013) stated that in *Murraya paniculata* plant 20.36% of the nymphs of psyllid *Diaphorina citri* were parasitized by *Tamarixia radiata* from ant protected plants, compared to 0.39% parasitism in untreated control flushes where ants had not been excluded. According to Flanders (1951), ant plays an important role in the biological control of certain agricultural pests. In the present investigation, the association of ants with pink hibiscus mealybug, *Maconellicoccus hirsutus*

(Green) and its influence on predatory fauna in mulberry ecosystem were evaluated in South Tamil Nadu, India.

MATERIALS AND METHODS

Mulberry gardens, infested with pink hibiscus mealy bug were selected for the study. All the cultural activities such as pruning, weeding, fertilizer application and irrigation were done. Care was taken to avoid pesticide spray in and around the field. The mulberry garden was divided into five sub plots, four at corner, and one at the centre. From each sub plots ten plants were selected at random for observation. Thus 50 plants were observed every fortnight for two years. The mealy bug populations were recorded at fortnightly interval in Tukra infestations continuously for two years and the monthly average was taken for analysis. Predator populations in the mealy bug colonies were also recorded simultaneously. The type and number of ants attending mealy bug colonies were recorded. The recorded values were tabulated and analysed. Data from the experiments were analyzed by completely randomized block design. The following are the calculations employed:

Number of mealy bugs/infested branch = Total number of mealy bugs counted in infested branch / Total No. of infested branch counted.

Number of *N. regularis* /infested branch = Total number of *N. regularis* counted in infested Branch / Total No. of infested branch counted.

Number of Ants /infested branch = Total number of Ants counted in infested Branch / Total No. of infested branch counted.

RESULTS AND DISCUSSION

Ants in the mulberry ecosystem

The mealy bug colonies in huge mulberry vegetation were easily identified by the movement of ants. Five types of ants were recorded in mulberry plants. They were *Camponotus compressus*, *Monomorium indicum*, *Dorymyrmex pyramicus*, *Solenopsis geminata* and *Tapinoma sessile*. The species *M. indicum* were seen more in mealy bug colonies. Even though the species *D.*

pyramicus was seen in the mulberry plants they did not attend mealy bug colonies. *M. indicum* is recorded invariably in all the months in association with the mealy bug. The range increased from 12 to maximum of 157 numbers per infested branch. The ant species *S. geminata* is found only during June and July. The average number of *S. geminata* present in the infested branch is 10 to 15. *T. sessile* is seen in association with mealy bug in July and *C. compressus* in June only.

Mealy bug in the mulberry ecosystem

The mealy bugs *M. hirsutus* were seen in all the months except winter season. The population was low during rainy month, but increased after rains. The mealy bugs preferred tender leaves and twigs. Mealy bugs continuously fed on mulberry and caused severe tukra symptoms. The mealy bug formed colonies in the twigs. When undisturbed the colonies grew in to large masses of white waxy coverings on the twigs. Malformed leaves, stunting, shortened internodes and rosetting of leaves were observed. Honeydew is secreted by the mealy bugs in the colonies.

Influence of ants on the mealybug population

Ants were seen in association with mealy bugs' colonies, attending mealy bugs in all stages including eggs, nymphs and adults. The *M. hirsutus* population in ant attended colonies was higher than that in unattended colonies (Table.1). An average of 61.22 mealy bugs were recorded in ant attended colonies and 49.22 in unattended colonies. Four types of ants *M. indicum*, *C. compressus*, *S. geminata* and *T. sessile* were recorded attending mealy bugs. Among the species, *M. indicum* was found predominant accounting an average of 37.78 numbers per mealybug infested shoot whereas the rest of the species *S. geminate*, *T. sessile* and *C. compressus* exhibited least association. Due to continuous feeding honeydew is secreted by the mealy bug. In ant attended colonies the honeydew is fed by the ant, leaves are clean and free from sooty mould growth. In unattended ants colonies the leaves were affected by sooty mould growth, which is a secondary contamination.

Influence of ants on the predatory population

Predatory beetle recorded was *Nephus regularis* (Sic.) (Coleoptera;Coccinellidae) was the common predominant predator seen feeding on mealy bugs.

Month	<i>M. hirsutus</i> Population		<i>Nephus regularis</i> population	
	Ant attended colonies	Ant unattended colonies	Ant attended <i>M. hirsutus</i> colonies	ant unattended <i>M. hirsutus</i> colonies.
February	57	28	1	4
March	50	40	0	6
April	61	39	1	5
May	41	40	3	3
June	80	70	0	3
July	117	85	2	6
August	59	71	0	5
September	58	45	1	6
October	28	25	1	5
Total	551	443	9	43

Table.1 Population mealy bug and its predator *Nephus regularis* in ant attendant and unattendant colonies.

They were seen inside the tukra curls. The grubs were black coloured with white mealy coating seen inside the tukra curls feeding on mealy bugs. Adults were very small oval shaped brown coloured beetles. The population of this beetle increased with increase in mealy bug population. The predator population was only 0.96 per colony in ant attended colonies but 4.78 numbers in ants unattended colonies. Ants associated mealy bug colonies were free from other insects. The ants protected the sucking pest from predators and other insects as well as helped in spreading of the pests.

Interaction between the mealy bug and ants

Beneficial interaction existed between the mealy bug and ants. Ants were found feeding on the honey dew secreted by homopterans. The observation on feeding of honey dew by ants is similar to the reports of Way (1963) and Dejean and Bourgoin (1998). They reported that the honey dew is excreted by abdominal contractions or passive elimination by the anus. The ants attended mealy bugs drummed the abdominal extremity of the

mealy bug with their antennae which stimulated the secretion. Way (1963) reported that ants exploited homopterans not only for their honeydew but also for their protein. Helm and Vinson *et al.* (2002) reported that the ant *Solenopsis invicta* gained 70 per cent of their energy from the mealy bug colony, *Antonina graminis*. Way *et.al.*2002 reported that *S. geminata* showed a predatory action against Homopteans in paddy ecosystem whereas in the present study no such activity is observed in Mulberry ecosystem.

CHART.1 THE MEALYBUG POPULATION IN MULBERRY GARDEN ATTENDED & UNATTENDED BY ANT

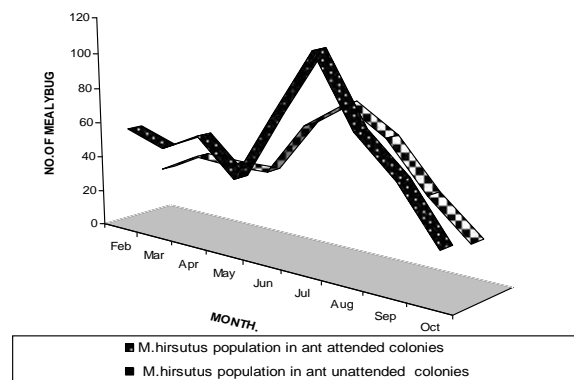


Fig 1. Mealybug population in mulberry is attended and unattended by ants.

When honeydew was largely secreted by *M. hirsutus* a secondary contamination of black sooty mould occurs. The sooty mould formation will reduce the photosynthetic area of leaves. These ants by feeding did a sanitary function by removing the honey dew from plants which in turn helped the homopterans and host mulberry also. Ant protected the homopterans from predator and helped in dispersal of mealy bug. This was in conformity with the findings of Way (1963), Messina (1981), Hanks and Sadof (1990), Bach (1991) and Raygoza and Nault (2000). The *M. hirsutus* population was heavily influenced by ant population. Significantly more *M. hirsutus* population was recorded in ant attended colonies than unattended colony (Figure 1). Same result was reported by Raygoza and Nault (2000) in leaf hopper colonies in Gamma grass. The predator populations in the ant attended colonies were significantly lower (Figure 2). The ant protected *M. hirsutus* from their natural enemies. This was in conformity with the reports of Way (1963), Raygoza and Nault (2000) and Delabie (2001). Navarrete *et al.* (2013) stated that the reduction in ant populations consequently increased

the percentage parasitism of the Asian citrus psyllid as specified below:

CHART.2 PREDATOR POPULATION IN THE MEALYBUG COLONIES ATTENDED & UNATTENDED BY ANT

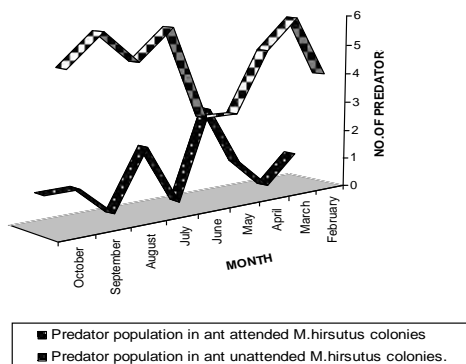


Fig 2. Predator population in ant attended and unattended by ants *M. hirsutus* colonies. Flanders (1951) also reported that the ants, feed on the honeydew secreted by such homopterous

insects and protect them from their natural enemies. Hence it is concluded that the biological control programmes on mealy bugs could be increased only through management of ant population. Hence destruction of the predominant *Monomorium indicum* colonies in mulberry ecosystem could help to increase the field activities of predatory fauna against *M. hirsutus*.

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Table 2. Types of ants and their influence on mealy bug population and its predators.

Month	Types of ant attending <i>M. hirsutus</i> colonies					<i>M. hirsutus</i> Population in ant attended colonies	Predator population in ant attended <i>M. hirsutus</i> colonies
	<i>Monomorium indicum</i>	<i>Solenopsis geminata</i>	<i>Tapinoma sessile</i>	<i>Camponotus compressus</i>	Total		
February	30	0	0	0	30	57	1
March	25	0	0	0	25	50	0
April	28	5	0	0	33	61	1
May	25	0	0	0	25	41	3
June	0	15	0	5	20	80	0
July	38	10	15	0	63	117	2
August	157	0	0	0	157	59	0
September	25	0	0	0	25	58	1
October	12	0	0	0	12	28	1
Total	340	30	15	5	390	551	9

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