GLOBAL JOURNAL OF BIO-SCIENCE AND BIOTECHNOLOGY

www.scienceandnature.org

EFFECT OF MEALYBUG-ANTS ASSOCIATION ON PARASITOID, *AENASIUS BAMBAWALEI* HAYAT (HYMENOPTERA: ENCYRTIDAE) IN VADODARA, GUJARAT, INDIA

Anita Singh* & Dolly Kumar
Division of Entomology, Department of Zoology, Faculty of Science, M. S. University of Baroda, Vadodara-390002, Gujarat, INDIA.
*Corresponding author's email: anita.singh282@gmail.com

ABSTRACT
The present research work reported five different species of mealybugs in Vadodara. Out of these five different species of mealybug *Phenacoccus solenopsis* is consider as serious pest to agriculture and horticulture crops. Hence the objectives behind present research work are: to identify the severity of *P. solenopsis* on host plants; to identify the ant associated with mealybug and finally to record the role of ant-mealybug association on population of parasitoid *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae). The damage caused by *P. Solenopsis* was reported from 31 host plants in Vadodara. *P. solenopsis* are found to be associated with three ant species *Monomorium pharaonis* Linnaeus, *Camponotus compressus* Fabricius and *Tapinoma melanocephalum* Fabricius which causes major decline in population of parasitoid, *A. bambawalei* of *P. solenopsis*. Therefore this information helpful for providing proper use of biological control method for management of mealybug by managing the population ants associated with mealybug.

KEY WORDS: *Phenacoccus solenopsis*, *A. bambawalei*, Population, Host plant, Ant

INTRODUCTION

Phenacoccus solenopsis Tinsley (Hemiptera: Pseudococcidae) was found to attack large number of greenhouses, backyards, fruit trees and many plant species including vegetables, weeds (Ben-Dov *et al.*, 2010; Abbas *et al.*, 2010). This polyphagous nature of *P. solenopsis* and its mutual relationship known as trophobiosis with ant is helpful in its persistence throughout the year (Delabie, 2001). While feeding on host plants, *P. solenopsis* secretes honeydew which is utilized by ants for feeding. These ants, in return, give protection to mealybugs from predators and parasitoids (Del-claro and Oliveira, 1999). Thus, the present study is pioneer study for recording different host plants; ants associated with *P. solenopsis* and effect of mealybug-ant association on population of parasitoid and mealybug in Vadodara agriculture fields. This information will be valuable in managing *Phenacoccus solenopsis* using biological method by reducing the population of the associated ant species.

MATERIALS & METHODS

a. Collection, Preservation and Identification: Mealybug and associated ants was recorded in urban sites having community gardens as well as agricultural fields of Vadodara. Collection of mealybug females was done by handpicking method from mealybug infested plants of the selected study sites. For collection of ants both pitfall and hand picking methods are used which was further preserved in 70 % alcohol for laboratory identification. Identification and labeling was done using standard taxonomic literature. Collected insects were identified with the help of keys. Mealybugs were identified by using scale insect key provided by Millar *et al.*, (2007). Ants are identified by keys provided by Bolton (1994). A stereomicroscope Leica MPS 60 Ø 28/8x/MPS was used for identification. The identification of all host plants species were done by the Botany Department of The Maharaja Sayajirao University of Baroda.

b. Assessment of infestation rate of mealybugs: Assessment of infestation by mealybug on various crops was done as per the scale given by Vennila and his Co-author in National Centre for Integrated Pest Management, New Delhi in year 2010.

0-4 Scale infestation:

0 Grade: No mealybug/ indecently seen

1 Grade: Scattered appearance of few mealybug on the plants

2 Grade: Sever incidence of mealybug on only one branch

3 Grade: Sever incidence of mealybug on more than one branch

4 Grade: Sever incidence of mealybug on whole plants was recorded

c. Effect of ants on parasitoid *Aenasius bambawalei* and mealybug *P. solenopsis* population: The population of parasitoid, *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae) and mealybug *P. solenopsis* was recorded on 15 cm apical shoot length from 2008 to 2011 at weekly interval from 25 randomly selected plants. The collected population data was further compared with the population of parasitoid and mealybug recorded from host plant not having ants association.

d. Data analysis:

The raw data of all the sampled sites from the field diary of the three consecutive years was transferred in an electronic format in spreadsheet layout (Microsoft Excel). Data so obtained were analyzed statistically using the ANOVA using statistical software prism 3.0 version and graphs were produced accordingly.

RESULTS & DISCUSSION

In Vadodara, five different species of mealybugs were collected and identified in the laboratory. The identified mealybugs are belongs to three different families. They are *Phenacoccus solenopsis* Tinsley, *Maconellicoccus hirsutus* Green, 1903 and *Ferrisia virgata* Cockerell, 1893 from family: Pseudococcidae; *Ceroplastes ceriferus* Fabricius, 1798 Belongs to family Coccidae and *Icerya purchase* Maskell, 1878 belongs to family Monophlebidae. Out of these five identified species *Phenacoccus solenopsis* was considered as major pest in Vadodara. It was found that the mealybug, *P. solenopsis* is polyphagous and caused severe damage to many host plants (Table 1). In Vadodara 31 host plant species were recorded from 17 different families. Similarly, Arif *et al.* in 2009 reported 159 host species of plants of mealybug, *Phenacoccus solenopsis* in Pakistan. Major hosts of the mealybugs in agriculture fields of Vadodara are *Gossypium arboretum*, *Ricinus communis*, *Abelmoschus esculentus*, *Lycopersicon esculentum*, *Solanum tuberosum* and *Solanum melongena*. The infestation started appearing in month of August which progressively increases with the advancement of crop growth in agriculture field crops (Singh and Kumar 2012). Whereas *Hibiscus mutabilis*, *Hibiscus rosa-sinensis, Tagetes erecta, Nerium indicum, Ziziphus mauritiana, Ficus bengalensis and* certain weeds around the hedges of fields like *Datura metel* and *Xanthium strumarium* act as alternative host of mealybugs throughout the year. Hence, host plant species belonging to family Malvaceae (16%), Solanaceae (13%) and Asteraceae (10%) were found as preferred hosts of mealybugs in Vadodara (Graph 1). This wide host range make the mealybug, *Phenacoccus solenopsis* polyphagous which found to shared a mutual interaction with *Monomorium pharaonis* Linnaeus, *Camponotus compressus* Fabricius and *Tapinoma melanocephalum* Fabricius of ants in Vadodara (Table 2). Similar type of research is reported from Pineapple research Institute of Hawaii by Jahn *et al*. (2003) who recorded 28 different species of ants associated with mealybug of pine apple. In India, from Haryana seven species of ants were recorded which are associated with *Phenococcus solenopsis* (Kedar *et al.*, 2011).

The present study also shows that due to the presence of ants, the population of parasitoid cocoons *Aenasius bambawalei* as bio-control agent gets affected which gives inverse positive impact on mealybug population. In Channi fields, when mealybug *P. solenopsis* were attended by population of *Tapinoma melanocephalum* and *Monomorium pharaonis*, the number of parasitoid cocoons of *A. bambawalei* gradually decrease when compare to the field where ant-mealybug association are absent (Graph 2). This leads to increase in population of mealybug which was attended by ants when compare to the population of mealybug in absence of ants (Graph3). Helm and Vinson in 2007 also reported the increase in the population of ants *Solenopsis invicta* causes an increase in the population of mealybug, *Antonina graminis* in the Southeast of United States. Similarly, Styrsky and Eubanks in 2007 reported 76% increase in the activity of predators against hemipterans due to removal of ant species, *Formica propinqua.* Daane *et al.* (2007) in California reported the increase in the population of obscure mealybug, *Pseudococcus viburni* and lowered densities of its parasitoids, *Pseudophycus flavidules* and *Leptomastix epona* due to presence of ant.

During the study it was also observed that *Camponotus compressus* move adult mealybugs from one plant to other by holding it in its mouth. This is acts as one of the reason for *P. solenopsis* dispersion from one plant to other in cotton, okra and ornamental plants in Vadodara. Hence, presence of alternative hosts and ants build good shelter for the mealybug which is helpful for its prolonged persistence. Therefore the proper management of weeds or alternative hosts and ants will be highly significant in increasing the population of parasitoid *Aenasius bambawalei* (biocontrol agent) for management of mealybug *Phenacoccus solenopsis*.

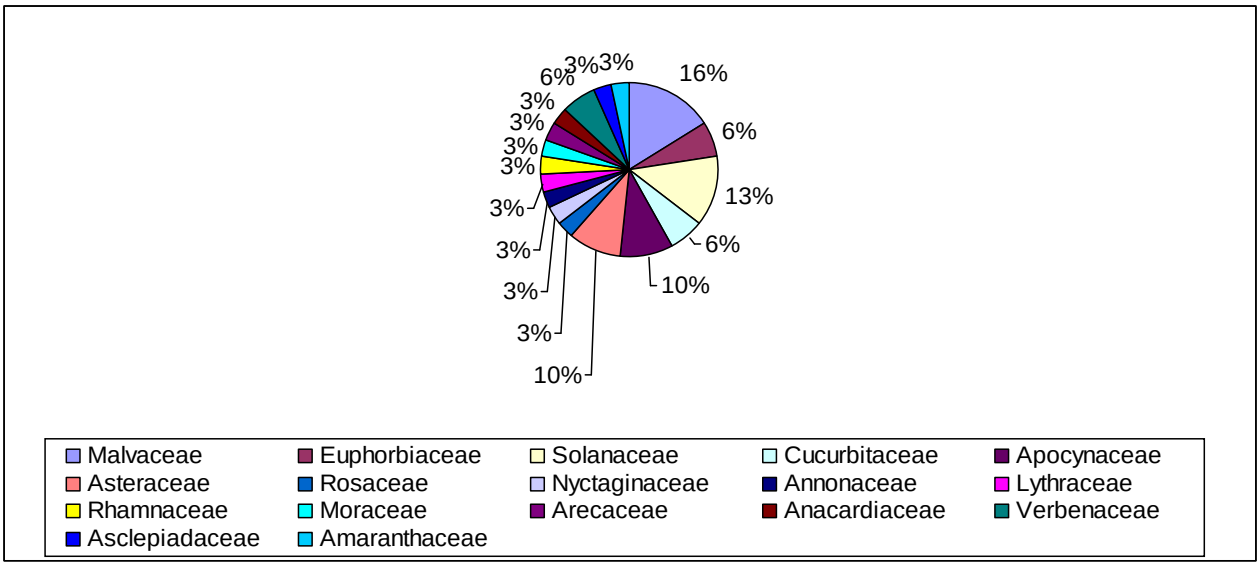
TABLE 1: Host plants of *Phenacoccus solenopsis* Tinsley with its infestation level in Vadodara:

Host category	Botanical Name	Common Name	Family	Infestation
Field crops	*Gossypium hirsutum* (Linn.)	Cotton	Malvaceae	4 Grade
	Ricinus communis (Linn.)	Castor	Euphorbiaceae	1 Grade
Vegetables	*Solanum melongea* (Linn.)	Brinjal	Solanaceae	3 Grade
	Solanum tuberosum (Linn.)	Potato	Solanaceae	3 Grade
	Lycopersicon esculentum (Linn.)	Tomato	Solanaceae	4 Grade
	Abelmaschus esculentus (Linn.)	Lady's finger	Malvaceae	4 Grade
	Momordica charantia (Linn.)	Bitter gourd	Cucurbitaceae	1 Grade
	Lufa cyclindrica (Linn)	Sponge gourd	Cucurbitaceae	0 Grade
Ornamental crops	*Nerium indicum* (Mill.)	Oleander	Apocynaceae	0 Grade
	Tagetes erecta (Linn.)	Marigold	Asteraceae	4 Grade
	*Hibiscus mutubilis (*L.)	Cotton rose-mallow	Malvaceae	4 Grade
	Hibiscus rosa-sinensis (Linn.)	China rose	Malvaceae	4 Grade
	Tabernaemontana coronaria (Linn.)	Crape jasmine	Apocynaceae	1 Grade
	Tabernaemontana divaricata (Linn.)	Pinwheel flower	Apocynaceae	1 Grade
	*Jatropha integerrima (*Jacq.)	Peregrina	Euphorbiaceae	0 Grade
	Rosa indica (L.)	Rose	Rosaceae	1 Grade
Fruit trees /trees and shrubs	*Bougainvillea glabra* (Chois)	Paper flower	Nyctaginaceae	1 Grade
	Annona squamosa (Linn.)	Custard apple	Annonaceae	4 Grade

	Punica granatum (Linn.)	Pomegranate	Lythraceae	2 Grade
	Ziziphus mauritiana (Lam.)	Chinee apple	Rhamnaceae	1 Grade
	Ficus bengalensis (Linn.)	Fig	Moraceae	2 Grade
	*Areca catechu (*Linn.)	Nut palm	Arecaceae	0 Grade
	Mangifera indica (Linn)	Mango	Anacardiaceae	0 Grade
	Lantana camara (Linn.)	Red sage	Verbenaceae	0 Grade
	Clerodendron inerme (Gaert.)	Gardenia	Verbenaceae	0 Grade
	Datura metel (Linn.)	Angel's trumpet	Solanaceae	4 Grade
	Xanthium strumarium (Linn.)	Common cocklebur	Asteraceae	4 Grade
	Parthenium hysterophorus (L.)	Whitetop weed	Asteraceae	4 Grade
	Calotropis procera (W.T.Aiton)	Apple of sodom	Asclepiadaceae	2 Grade
	Achyranthes aspera(L.)	Prickly chaff flower	Amaranthaceae	2 Grade
Weeds	*Malvastrum coromandelianum* (linn.)	Malvastrum	Malvaceae	2 Grade

Infestation based on presence or absence of mealybugs and the severity/ level of infestation measured by using 0 to 4 scale infestation.

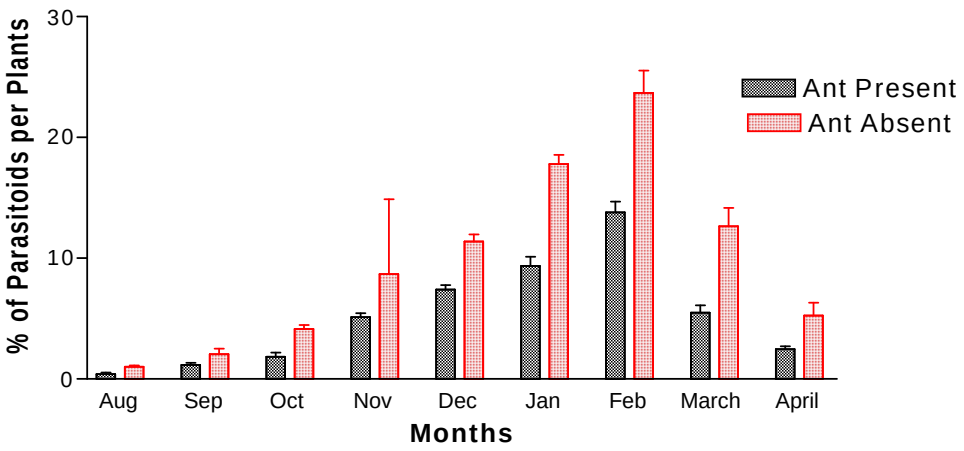
0 Grade: No mealybug/ indecently seen
1 Grade: Scattered appearance of few mealybug on the plants
2 Grade: Sever incidence of mealybug on only one branch
3 Grade: Sever incidence of mealybug on more than one branch
4 Grade: Sever incidence of mealybug on whole plants was recorded



GRAPH1: Showing the percentage infestation of different host plant by *Phenacoccus solenopsis* Tinsley

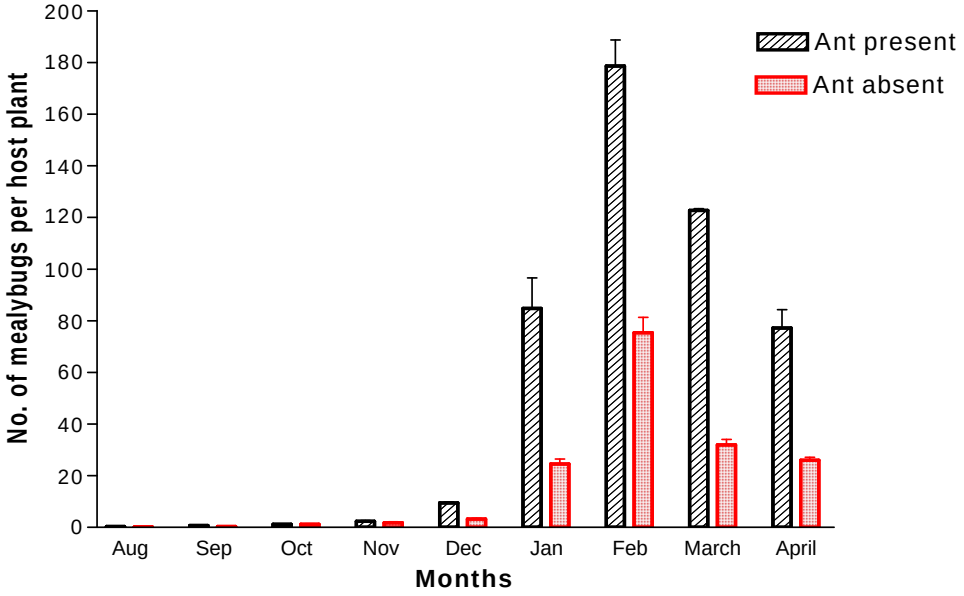
TABLE 2. Ants (Hymenoptera: Formicidae) associated with *Phenacoccus solenopsis* Tinsley on different host plants in selected sites of Vadodara

Family	Sub family	Scientific name	Host plants
Formicidae	Formicinae	*Camponotus compressus* Fabricius,1787	*Gossypium hirsutum* (Linn.) *Abelmaschus esculentus* (Linn.) *Hibiscus rosa-sinensis* (Linn.) *Tagetes erecta* (Linn.) *Ficus bengalensis* (Linn.) *Lantana camara* (Linn.) *Xanthium strumarium* (Linn.) *Parthenium hysterophorus* (L.) *Hibiscus mutubilis (*L.)
	Dolichoderinae	*Tapinoma melanocephalum* Fabricius,1793	*Gossypium hirsutum* (Linn.) *Abelmaschus esculentus* (Linn.) *Hibiscus rosa-sinensis* (Linn.)
	Myrmicinae	*Monomorium Pharaonis* Linnaeus,1758	*Gossypium hirsutum* (Linn.)



* The mean (± Standard error) of parasitoid cocoon per plants. Mean are significantly different at P ≤ 0.05

GRAPH 2: Percentage of parasitoids *Aenasius bambawalei* Hayat affected by presence of ants in mealybug infested field in Vadodara



* The mean (± Standard error) of mealybug per plants. Mean are significantly different at P ≤ 0.05

GRAPH 3: Population of Phenacoccus solenopsis Tinsley affected by presence of ants in Vadodara

ACKNOWLEDGEMENT

One of the authors (Anita Singh) sincerely thanks UGC for grants provided under RFSMS scheme.

REFERENCES

Abbas, G., Arif, M.J., Ashfaq, M., Aslam, M. and Saeed, S. (2010) Host plants, distribution and overwintering of cotton mealybug (*Phenacoccus Solenopsis*; hemiptera: pseudococcidae). International Journal of Agriculture and Biology 12: 421–425.

Arif, M.I., Rafiq, M. and Ghaffar, A. (2009) Host plant of cotton mealybug (*Phenococcus solenopsis*): a new menace to cotton agroecosystem of Punjab. International Journal of Agriculture and Biology 11(2):163-167.

Ben-Dov, Y., Miller, D.R. and Gibson, G.A. (2010) Scalenet. Accessed online at http://www.sel.barc.usda.gov /scalenet/ scalenet.htm.

Bolton, B.O. (1994) Identification guide to the ant genera of the world. Harvard University Press, Cambridge, MA. 222pp.

Daane, K.M., Sime, K.R., Dallon, J. and Cooper, M.L. (2007) Impact of Argentine ants on mealybugs and their natural enemies in California's coastal vineyards. Ecological Entomology 32: 583-597.

Delabie, J. H.C. (2001) Trophobiosis between Formicidae and Hemiptera (Sternorrhyncha and Auchenorrhyncha): an Overview. Neotropical Entomology 30(4): 501-516.

Del-Claro, K. and Oliveira, P.S. (1999) Ant-Homoptera Interactions in a Neotropicai Savanna: The Honeydew-ProducingTreehopper, *Guayaquila xiphias* (Membracidae) and its Associated Ant Fauna on *Didymopanaxvinosum* (Araliaceae). Biotropica 31(1): 135-144

Helm, K.R. and Vinson, S.B. (2007) Apparent facilitation of invasive mealybug by an invasive mealybug by invasive ant. Insects Socioux 50 (4): 403-404.

Jahn, G.C., Beardsley, J.W. and Gonzalez-Hernandez, H. (2003) A review of association of ants with mealybug wilts disease of pineapple. Proceedings Hawaiian Entomological Society 36: 9-28.

Kedar, S.C., Saini, R.K. and Ram, P. (2011) Record of ants (Hymenoptera: Formicidae) associated with mealybug, *Phenococcus solenopsis* Tinsley (Hemiptera: Pseudococcidae) from Haryana. Journal of Insect Science 24: 166-168.

Miller, D.R., Rung, A.,Venable, G.L., Gill R.J. and Willimas, D.J. (2007) Scale Insects Identification Tools for Species of Quarantine Significance. Accessed online at http://www.sel.barc.usda.gov/ScaleKeys/ index.html

Singh, A. and Kumar, D. (2012) Population dynamics, biology of mealybug *Phenacoccus solenopsis* (Tinsley) and its natural enemies in Vadodara, Gujarat. Recent Research in Science and Technology, 4(11): 22-27

Styrsky, J.D. and Eubanks, M.D. (2007) Ecological consequences of interactions between ants and honeydew-producing insects. Proceedings of Royal Society B: Biological Science 274 (1607):151-164.

Vennila, S., Ramamurthy, V.V., Deshmukh, A., Pinjarkar, D.B., Agarwal, M., Pagar, P.C., Prasad, Y.G., Prabhakar, M., Kranthi, K.R. and Bambawale, O.M. (2010) A treatise on mealybugs of Central Indian cotton production system. National Centre for Integrated Pest Management, New Delhi, Tec. Bull. No. 24.