



EXPLORATION OF NATURAL ENEMY FAUNA OF PAPAYA MEALYBUG, *PARACOCCUS MARGINATUS* (HEMIPTERA: PSEUDOCOCCIDAE) ON DIFFERENT HOST PLANTS AT ISLAMABAD PAKISTAN

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ARTICLE INFORMATION

Received: January 07, 2017

Received in revised form: June 04, 2017

Accepted: June 10, 2017

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ABSTRACT

Papaya mealybug (*Paracoccus marginatus*) is a highly invasive pest of many important agricultural crops and recently has been a great threat in coastal areas of Pakistan. A survey study was conducted to explore the availability of natural enemies of *P. marginatus* on its various host plants around the vicinity of National Agriculture Research Center (NARC), Islamabad, Pakistan. The infestation of *P. marginatus* was recorded on guava, jatropha and china rose. The recorded natural enemies of *P. marginatus* included insect predators (*Anegleis cardoni*, *Brumoides suturalis*, *Chilocorus nigrita*, *Nephus quadrimaculatus*, *Chrysoperla carnea*, *Cyrtopeltis* sp., and ants), parasitoid (*Acerophagus papayae*) and spider (*Phintella vittata*). Except *A. papayae* and ants, the population of other natural enemies were only recorded during the first observation i.e. 26.09.2016. Moreover, population of *A. cardoni*, *B. suturalis*, *C. nigrita*, *N. quadrimaculatus*, *C. carnea*, *Cyrtopeltis* sp. and *P. vittata* were only recorded from guava plants at three different locations within National Agriculture Research Centre Islamabad, Pakistan.

Keywords: Predators, Parasitoids, *Paracoccus marginatus*

INTRODUCTION

Papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) is a polyphagous sucking pest that attacks number of host plants, including economically vital tropical fruits, vegetables and ornamentals, (Ben-Dov., 1994). Infestation of the mealybug shows up as bunches of cotton-like masses on all above ground portion of infested plants. Juvenile and adult females of *P. marginatus* suck the sap of the plant and infested leaves become crinkled, yellowish and wilted. The honeydew discharged by this bug serves a growth media for black sooty mould development which impairs the photosynthetic efficiency of the infested plants (Tanwar *et al.*, 2010). The papaya mealybug, *P. marginatus* is an exotic polyphagous pest (Muniappan *et al.*, 2009). It originated from Mexico (Milleret *et al.*, 1999) and recently has been accidentally introduced in many countries of the oriental region including

Pakistan (Muniappan *et al.*, 2009; Mastoi *et al.*, 2014). The pest has high reproductive potential under favourable conditions (Mastoi *et al.*, 2014). Heavy attack of papaya mealybug has been observed in India on wider range of cultivated crops and weed hosts belonging to different families of plant kingdom (Walker *et al.*, 2006; Tanwar *et al.*, 2010). *Paracoccus marginatus* has never been a threat at its native habitats due to the presence of its natural enemies complex like Encyrtids, *Anagyrus* spp., *Acerophagus* spp. and *Apoanagyrus* spp. (Walker *et al.*, 2003; Meyerdirk *et al.*, 2000, 2004). *Spalgus epeiis* Westwood is the predominant natural enemy of *P. marginatus* damaging several host plants in South India (Thangamalar *et al.*, 2010). *Cryptolaemus montrouzieri* Mulsant, a general predator of mealybug, was also recorded occasionally on *P. marginatus* in India and elsewhere. Parasitoids of *P. marginatus* from Mexico and Caribbean are listed by Schauff (2000). Among four species of chalcidoid parasitoids, *Acerophagus papayae* is one of the

Cite this article as: Fazlullah, M.I. Mastoi, Ehsan-ul-Haq, T. Mahmood, A.A. Gilal, A. Arshad, A.R. Bhatti and A. Shehzad, 2017. Exploration of natural enemy fauna of papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) on different host plants at Islamabad Pakistan. Pak. Entomol., 39(1):23-27.

major parasitoids of *P. marginatus*. Moreover, in Malaysia, two predators i.e., *Apertochrysa* sp. and *Cryptolaemus montouzieri* were found attacking on *P. marginatus* (Mastoi *et al.*, 2011).

Though several methods were available, excellent control of mealybug was obtained by the use of biocontrol agents throughout the World (Meyerdirk *et al.*, 2000). In case of papaya mealybug also, outstanding control was achieved with use of parasitoids in several countries of the world (Shylesha *et al.*, 2011; Mani *et al.*, 2012). Therefore, considering the wide spread infestation of *P. marginatus* on various host plants in different regions of Pakistan especially Islamabad, the survey was conducted to collect and identify the potential natural enemies of *P. marginatus* from its host plant.

MATERIALS AND METHODS

A comprehensive survey for the availability of natural enemies of *P. marginatus* was conducted at various locations (API Hostel, PGRI, National Insect Museum (NIM), Chak Shehzad) around National Agriculture Research Center (NARC), Islamabad, Pakistan. During survey, guava (*Psidium guajava* L.), jatropha (*Jatropha curcas* L.) and china rose (*Hibiscus rosa-sinensis* L.) plants infested with *P. marginatus* were surveyed around various locations of NARC. A sample of severely infested branch from infested plants was collected and put in a plastic bag. The collected samples were brought to Biocontrol Laboratory, NARC. The mummies from the infested leaves were also collected and kept in separate capsule until the emergence of adult parasitoids. The survey for the collection of natural enemies was continued approximately for a period of one month from 26.09.2016 to 20.10.2016. The identification of natural enemies was done according to all the available identification sources from the literature.

RESULTS AND DISCUSSION

During the survey around various locations of NARC (API Hostel, PGRI, National Insect Museum, Chak Shehzad), the population of *P. marginatus* was recorded on Guava, Jatropha and China rose. The natural enemies of *P. marginatus* recorded from these plants consisted of insect predators including *Anegleis cardoni*, *Brumoides suturalis*, *Chilocorus nigrita*, *Nephus quadrimaculatus*, *Chrysoperla carnea*, *Cyrtopeltis* sp. and ants; one insect parasitoid, *Acerophagus papayae* and a spider, *Phintella vittata* (Plate #1). It was observed during the study that except *A. papayae* and ants, population of other natural enemies on *P. marginatus* was only recorded during the first observation i.e., 26.09.2016. Moreover, population of *A. cardoni*, *B. suturalis*, *C. nigrita*, *N. quadrimaculatus*, *C. carnea*, *Cyrtopeltis* sp. and *P. vittata* was only recorded from guava plants located at API Hostel, PGRI, National Insect Museum. The population of *P. marginatus* showed a slight increase during the 2nd week of observation but a declining trend during 3rd and 4th week of observation. However, *A. papayae* population showed a gradual increase during the study period. Ants population showed a rapid increase during 2nd week, but remained constant during later study period between 6.4-8.5 ants / observation (Table 1).

The brief description of natural enemies of *P. marginatus* recorded during the study is given below:

· Afroze, S., 2000. Bioecology of the coccinellid *Anegleiscardoni* (Weise) (Coleoptera:

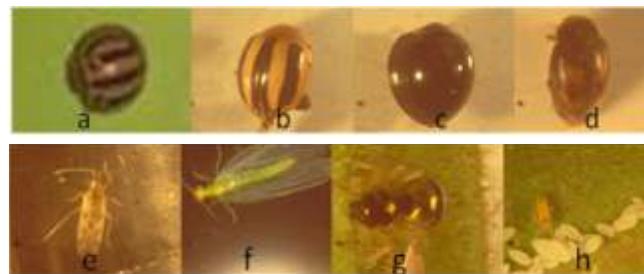


Plate #1.

Natural enemies of papaya mealybug, *P. marginatus* (a. *Anegleis cardoni*; b. *Brumoides suturalis*; c. *Chilocorus nigrita*; d. *Nephus quadrimaculatus*; e. *Cyrtopeltis* sp.; f. *Chrysoperla carnea*; g. *Phintella vittata*; h. *Acerophagus papayae*)

Anegleis cardoni Weise (Coleoptera: Coccinellidae)

Anegleis cardoni is a good predator and a potential bio-control agent of *P. marginatus*. The beetle is 4-5 mm in length with three characteristic black strips and two black dots on yellow elytra. The larvae and adults of *A. cardoni* feed on different aphid species, viz. *Aphis gossypii* Glover, *Brevicoryne brassicae* Linnaeus, *Macrosiphum miscanthi* Takahashi and *M. pisi* Kaltenbach (Afroze, 2000). *Anegleis cardoni* is one of the essential predators of sugarcane pyrilla in Mardan and Swabi districts of Khyber Pakhtunkhwa, Pakistan (Rafi *et al.*, 2005).

Brumoides suturalis Fabricius (Coleoptera: Coccinellidae)

The head and thorax of *B. suturalis* are brown and have black eyes. Wings of the beetle are ivory covered with two black strips, one extending down the trailing edge and the other through the middle of each cover. *Brumoides suturalis* is the most important predator of mature and immature stages of mealy bug on different field and vegetable crops of Sindh (Lohar, 2001). The beetle is widely distributed in all the ecological areas and various habitats of Pakistan and is a major biological control agent of aphids, mealybugs, scale insects, thrips, and mites (Rafi *et al.*, 2005).

Chilocorus nigrita Fabricius (Coleoptera: Coccinellidae)

Chilocorus nigrita is sub circular in body outline, typical coloration with elytra, pronotum and outer margins of elytral epipleura very dark pitchy to black, and with head, lateral parts of pronotum, legs underside and elytral epipleura yellowish brown. *Chilocorus nigritus* have an important role in regulating various insect pest species through classical biological control, especially aphids, leafhoppers, scale insects, mealy bugs, mites and other soft bodied insects (Slipinski, 2007).

Nephus quadrimaculatus Herbest (Coleoptera: Coccinellidae)

Nephus quadrimaculatus can reach a length of 1.5-2

millimetres. Elytra are black and each elytra with two red-yellow spots. It feeds on aphids and mealybugs and is considered as an effective bio-control agent of *P. ficus* under augmented programmes in California, USA (Daane *et al.* 2004).

***Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae)**

The green lacewings larvae and adults are recorded to feed on papaya mealybug nymphs from study area. Klingen *et al.* (1996) reported that green lacewings prefer to feed on aphids, but also recorded to prey on whiteflies, spider mites and thrips. The green lacewings larvae are polyphagous insects and they feed on many soft bodied organisms that are small enough for them to capture, including aphids, scales, mealybugs, whiteflies, small caterpillars, leafhoppers, psyllids, thrips, mites, insect eggs and mites and others (Olkowski *et al.*, 1996; Strand, 2006). *Chrysoperla carnea* is a cosmopolitan predator, commonly found in agricultural systems as an effective and predator of many sucking and chewing insect pests along with its eggs (Yuksel and Goemen, 1992; Singh and Manoj, 2000; Zaki and Gesraha, 2001).

***Cyrtopeltis* sp. (Hemiptera: Miridae)**

Members of this genus are easily diagnosed by the presence of globose, pygophoral process, and the dissected dorsal surface of the pygophore. The head is more elongated in *Cyrtopeltis* sp. and somewhat similar to *Macrolcephus* taxa. The left clasper shaft is extremely broad, the male vesica is characterized by the tuberculations (Goula, 1985).

***Acerophagus papayae* Noyes and Schauff (Hymenoptera: Encyrtidae)**

Acerophagus papayae, the primary parasitoid of papaya mealybug, spends a significant portion of its life cycle attached with a single host viz. *P. marginatus*. The body length of female parasitoid is 1.0 mm whereas, male is smaller than female in size (0.6-0.7 mm). The color of the *A. papayae* is generally pale orange with brown marks on the neck of pronotum. The parasitoid has greenish compound eyes with red ocelli. Antennal club is three segmented with five funicles and 5th funicle segment is comparatively smaller and dusky in colour (Noyes and Schauff, 2003).

***Phintella vittata* (Arachnida: Araneae: Salticidae)**

Phintella vittata is generalist predator and commonly known as jumping spider. Cephalothorax of the spider is grey brown with blue metallic lustre posteriorly. Surroundings of the eyes are black grey with sparse grey brown setae; abdomen is dark grey with longitudinal rows of light grey spots. It also bears bigger patches posteriorly whose whole surface is covered with grey brown sparse bristles and small grey setae, some of them having red metallic lustre. Moreover, clypeus of *P. vittata* is grey brown (Benjamin *et al.*, 2012).

ACKNOWLEDGEMENTS

The research is part of USDA supported project “Phytosanitary Risk Management Programme in Pakistan” implemented by CABI South and West Asia.

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Table 1.
Population of mealy bug and its natural enemies on various host plants

Location	Host Plants	No. of mealy bugs	Density of natural enemies of <i>Paracoccus marginatus</i>										
			Parasitoid			Insect Predators							
			<i>A. Papayae</i>	<i>Brumoides stutturalis</i>	<i>Anegleis cardoni</i>	<i>Chilocorus nigrita</i>	<i>Nephus quadrimaculatus</i>	<i>Chrysoperla carnea</i>	<i>Cyrtopeltis sp.</i>	Spider <i>Phintella vittata</i>	Ants		
26.09.2016													
API hostel	Guava	280	03	1	1	-	-	-	-	-	1	-	5
PGRI	Guava	168	08	-	-	-	-	-	-	-	-	-	3
Museum	Jatropha	112	10	-	-	1	-	2	-	-	-	1	4
PGRI	Jatropha	243	11	-	-	-	-	-	-	-	-	-	6
Chak	China Rose	112	09	-	-	-	-	-	-	-	-	-	4.5
Shehzad	China Rose	183	8.2	1	1	1	1	2	-	-	1	1	09
Mean													12
04.10.2016													
API hostel	Guava	183	10	-	-	-	-	-	-	-	-	-	03
PGRI	Guava	133	09	-	-	-	-	-	-	-	-	-	04
Museum	Jatropha	126	07	-	-	-	-	-	-	-	-	-	02
Pgri	Jatropha	374	27	-	-	-	-	-	-	-	-	-	09
Chak	China Rose	148	16	-	-	-	-	-	-	-	-	-	14
Shehzad	China Rose	192.8	13.8	-	-	-	-	-	-	-	-	-	6.4
Mean													03
13.10.2016													
API hostel	Guava	113	11	-	-	-	-	-	-	-	-	-	04
PGRI	Guava	97	05	-	-	-	-	-	-	-	-	-	02
Museum	Jatropha	147	17	-	-	-	-	-	-	-	-	-	09
PGRI	Jatropha	287	34	-	-	-	-	-	-	-	-	-	14
Chak	China Rose	134	13	-	-	-	-	-	-	-	-	-	6.4
Shehzad	China Rose	155.6	16.0	-	-	-	-	-	-	-	-	-	08
Mean													05
20.10.2016													
API hostel	Guava	105	09	-	-	-	-	-	-	-	-	-	17
PGRI	Guava	173	15	-	-	-	-	-	-	-	-	-	40
Museum	Jatropha	84	17	-	-	-	-	-	-	-	-	-	12
PGRI	Jatropha	306	40	-	-	-	-	-	-	-	-	-	18.6
Chak	China Rose	128	12	-	-	-	-	-	-	-	-	-	04
Shehzad	China Rose	159.2	18.6	-	-	-	-	-	-	-	-	-	8.5
Mean													

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