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Research Note

Studies on *Marietta leopardina* Motschulsky (Hymenoptera:Aphelinidae) and *Chartocerus* sp. (Hymenoptera: Signiphoridae), hyperparasitoids of papaya mealybug parasitoid, *Acerophagus papayae* Noyes & Schauff (Hymenoptera: Encyrtidae)

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ABSTRACT: *Acerophagus papayae* Noyes & Schauff, a solitary endoparasitoid of *Paracoccus marginatus* William Granara DeWillink which parasitizes the early stage nymphs was released in India during 2010 for biological control of papaya mealybug. It could substantially reduce the incidence of *P. marginatus* within a span of 6-8 months. There were no parasitoids reported on *A. papayae* so far from any part of the world. *Marietta leopardina* and *Chartocerus* sp. hyperparasitoids of other mealybugs recorded in India were for the first time found to parasitize *A. papayae* by upto 1.25 per cent and 1.09% respectively. Under laboratory rearing, the time required for emergence of *M. leopardina* was found to be 12-16 days and that of *Chartocerus* sp was 12-15 days.

KEY WORDS: *Paracoccus marginatus, Acerophagus papayae,* hyperparasitoid, *Marietta leopardina, Chartocerus* sp.

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Acerophagus papayae Noyes & Schauff, *Anagyrus loecki* Noyes & Menezes and *Pseudleptomastix mexicana* Noyes and Schauf (Hymenoptera: Encyrtidae) released in India during 2010 for the biological control of papaya mealybug *Paracoccus marginatus* could substantially reduce its incidence within a span of 6-8 months. *A. papayae* is a solitary endoparasitoid of *P. marginatus* and it parasitizes the early stage (II instar) nymphs of the mealybug. However, when the host availability is reduced the parasite shifts to super parasitism and utilizes all the available stages of the host from II stage to adult mealybugs wherein the number of emerging parasitoids vary from 1-14 (Shylesha and Joshi, 2013). There are no parasitoids reported on *A. papayae* so far from any part of the world. During September 2012, two of the indigenous parasitoids of mealybug / scale parasites *viz., Chartocerus* sp. and *Marietta leopardina* were found to be parasitizing *P. marginatus* parasitized by *A. papayae.*

Mealybug infested leaf samples were collected from papaya fields from Bagalur village near Bengaluru. Samples of 5cm x 5cm cut leaves were kept on a wet filter paper in cages for emergence of parasitoids. Along with the primary parasitoid *A. papayae*, hyperparasitoids *M. leopardina* and *Chartocerus* sp. were also collected. The percentage of hyperparasitization in the field was calculated based on the total number of *A. papayae* emerged. For studying the biology of the hyperparasitoids, pure culture of *P. marginatus* was established on potato sprouts as per the mass production procedure described by Shylesha *et al.,* (2011). *Acerophagus papayae* was released on *P. marginatus* grown on potato sprouts for parasitization by releasing 10 pairs per sprouted potato kept in cages. After the first generation of the parasitoid emergence (15-17 days after release of parasitoids) the emerging parasitoids were not collected so that they parasitized the remaining mealybugs on the sprouts. Honey solution was provided as food for the parasitoids. Twenty days after the release of *A. papayae,* 10 numbers of *M. leopardina* and 10 numbers of *Chartocerus* sp. were released separately to the cages having parasitized *P. marginatus.* This was done to make sure the availability of old and young mummified mealybugs containing *A. papayae* for oviposition by the hyperparasitoids. Three replications were maintained in both the cases. Observations on the emergence, survival and longevity of the hyper parasitoids were recorded. From 30th day of

first release of the *A. papayae*, emerging parasitoids and also the hyper parasitoids were recorded till 45th day. Per cent hyper parasitization was calculated in relation to *A. papayae* emergence in control.

Among the five samples collected a total of 638 *A. papayae*, 8 numbers of *M. leopardina* and 7 numbers of *Chartocerus* sp.emerged (Table 1). Field parasitism of *M. leopardina* was upto 1.25 per cent and that of *Chartocerus* sp. was 1.09%. Under laboratory rearing, time required for the emergence of *M. leopardina* was found to be 12- 16 days and that of *Chartocerus* sp. was 12-15 days. Both the species were found to prefer 2-4 day old *A. papayae* mummified mealybugs (Fig. 1). Hyper-parasitization of 20.28 per cent (*Chartocerus* sp.) and 15.94 per cent (*M. leopardina)* was observed. Longevity of *M. leopardina* ranged from 12-16 days while that of *Chartocerus* sp. was 12-15 days (Table 2).

Table 1. Hyperparasitoids *Chartocerus* sp. and *Marietta leopardina* on *Acerophagus papayae* pupae

Sl. No.	Number of parasitoids emerged (5cm x 5cm infested mealybug on papaya leaf)		
	A. papayae	*Marietta leopardina*	*Chartocerus sp.*
1	122	2	1
2	145	nil	1
3	132	1	1
4	114	3	2
5	125	2	2
Total	638	8	7
Mean	(127.6)	(1.25%)	(1.09%)

Marietta leopardina is a small (0.5-1.0 mm long), usually pale coloured, with a pattern of dark bands or spots or both on head, thorax, gaster and legs. Antenna six-segmented in female (antennal formula 1-1-2-1-1) and five-segmented in male (1-1-2-1). Pronotum narrow and transverse, composed of a single plate. Fore wing of almost all known species characteristic and conspicuously maculated with a dark and light pattern of setae; marginal vein long, postmarginal absent, stigmal vein barely visible to punctiform. Mesopleuron large and undivided as in encyrtids. *Marietta* can be readily identified by the striking patterns on the body and fore wing.

Species of the genus *Marietta* were always hyper-parasitoids of Hemiptera, including Diaspididae, Coccidae and other families. Only *M. pulchella* Howard has been recorded as a primary parasitoid of the scale, *Conchaspis angracei* Cockerell (Beardsley and Tsuda, 1990). *M. leopardina* is known to be a secondary parasitoid of a great number of chalcidoid wasps (Hayat *et al.*, 2003; Noyes, 2003) and is synonymous with *M. cheriani* Mani, *M. exitiosa* Compere, *M. habrolepidis* Ghesquiere, *M. javensis* Howard, *M. javensis indi* Girault, *Perissopterus cheriani* Mani, *P. javensis* Howard (Chien *et al.*, 1991). It is recorded as a secondary parasite on *Pulvinaria psidii* Maskell, (Bhuiya *et al.*, 1997; Hayat, 1986), *Saissetia hemisphericum* (Targ.) (Compere, 1936); *Aonidiella orientalis* (Hayat, 1998) and *Planococcus citri* (Krishna-moorthy and Mani,1996). Hyperparasitization of 0.25 to 2.50 per cent in *Tamarixia radiata* (Waterson) and *Diaphorencyrtus aligarhensis* Shafee, Alam and Agarwal in Fuji and Taiwan (Waterhouse, 1998). On *Aenasius bambawalei*, *Phenacoccus solenopsis* Tinsley on cotton upto 2.9 percent during September in India (Pala Ram and Saini, 2010) was observed. The present observation on hyper parasitization by *M. leopardina* is also to the same extent reported by other workers.

Chartocerus sp. is small, 0.5–2 mm insectwith compact body strongly dorsoventrally flattened, and gaster broadly

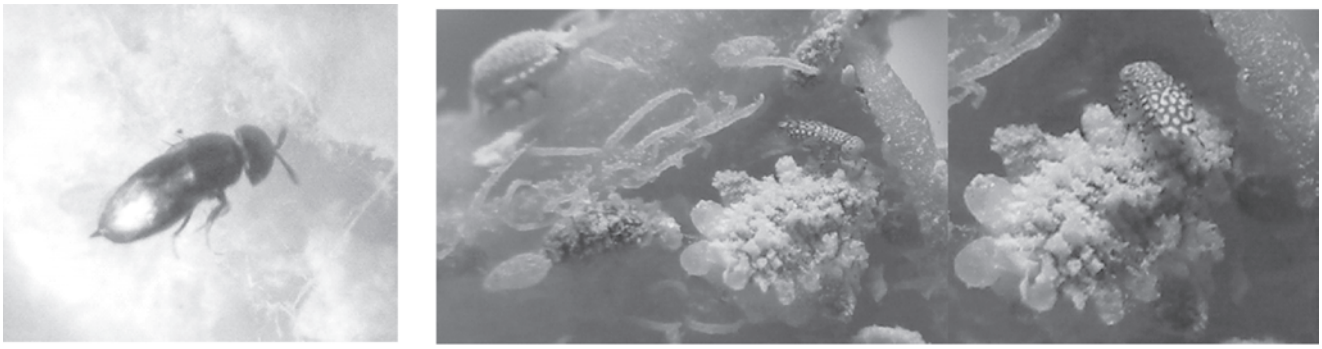

Fig. 1: Hyperparasitoids *Chartocerus* sp. and *Marietta leopardina* on *Acerophagus papayae* pupae

Table 2. Mean number of hyperparasitoids emerging from *Acerophagus papayae*

Treatment	Number of hyper parasitoids emerged	Number of A. papayae	Per cent hyperparasitization	Duration of life cycle (days)
Control	69±5			
Marietta leopardina	11± 2	47±3	15.94	12–16
Chartocerus sp.	14±3	51±3	20.28	12–15

attached to the mesosoma, often glossy, enlarged, undivided antennal club (funicle segments appearing at most like ring segments), scutellum and metanotum transverse, Femur and tibia mid thorny. Middle tibia with apical hope long ridge, Tarsi 5-segmented. Das and Sahoo (2005) recorded *Chartocerus* sp. from scale and mealybug pests of mango, *Rastrococcus invadens* Williams and *R. Iceryoides* Green from West Bengal. Daane *et al.* (2005) found that *Anagyrus pseudococci* was parasitized by *Chartocerus* sp. Agricola and Fischer (1991) and Georg Goergen and Peter Neuenschwander (1994) observed hyperparasitism of *Epidinocarsis lopezi* on *Phenacoccus manihoti* Matile-Ferrero (Hemiptera: pseudococcidae) by *Chartocerus* sp. and *M. leopardina*. The rate of hyper-parasitism varied considerably (20-90%). Hyperparasitism of *Anagyrus kamali* by *Marietta* sp. and *Chartocerus* sp. was frequently reported to be over 35% during 2000 in southern California (Roltsch *et al.*, 2006). *Chartocerus kerrichi* (Agarwal) was found to hyperparasitize *A. bambawale* on *P. solenopsis* 6-9% in Central India (Nagarare *et al.*, 2011, Pinjarakar *et al*., 2009).

Hyperparasitoids, *Marietta* sp. and *Chartocerus* sp. are common on different scales and mealybugs in India. As invasive papaya mealybug has spread in the country competing with other scales and mealybugs on various plants and subsequent inundation of *A. papayae*, the hyperparasitoids are also found to have colonized slowly on *A. papayae*. However, the hyperparasitization scenario is not alarming as on now but care has to be exercised in exchange of parasitods with other countries.

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