



Research Article

## Predatory potential of two indigenous anthocorid predators on *Phenacoccus solenopsis* Tinsley and *Paracoccus marginatus* Williams and Granara de Willink

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**ABSTRACT:** The predatory potential of two anthocorid predators, *Blaptostethus pallescens* Poppius and *Anthocoris muraleedharani* Yamada on cotton mealybug, *Phenacoccus solenopsis* Tinsley and papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink was studied under laboratory conditions. During the nymphal stage, *A. muraleedharani* could feed on a total of 66 crawlers of *P. solenopsis* and the adult consumed 141 crawlers. Young nymphs (3-4 day old) of *B. pallescens* could not predate on *P. solenopsis* crawlers, while, the mature nymph could consume 35 *P. solenopsis* crawlers and adult 23 crawlers. *B. pallescens* could feed on *P. marginatus* and the feeding potential was recorded as 18, 29 and 31 crawlers, for young nymph, mature nymph and adult, respectively. However, the longevity of *B. pallescens* was found significantly reduced when fed on *P. marginatus*. *A. muraleedharani* could not predate on *P. marginatus*. Though *B. pallescens* could predate on both mealybug species, *A. muraleedharani* appeared to be a more voracious predator of *P. solenopsis* based on its greater predatory potential, higher adult longevity and shorter nymphal duration.

**KEY WORDS:** *Anthocoris muraleedharani*, *Blaptostethus pallescens*, feeding potential, *Paracoccus marginatus*, *Phenacoccus solenopsis*

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### INTRODUCTION

Mealybugs have recently emerged as serious pests on several crops. The cotton mealybug, *Phenacoccus solenopsis* Tinsley and papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink are reported to cause severe damage to various crops. The cotton mealybug is considered to be an exotic species that has its origin in the USA and is reported to have entered into India from Pakistan. It was initially noticed in Punjab and in 2007 it spread throughout the major cotton growing districts causing 30 to 40 % yield loss in cotton. *P. solenopsis* infestation was also reported from all the nine cotton growing states of India viz., Punjab, Haryana, Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Tamil Nadu, Andhra Pradesh and Karantaka (Dharajyoti *et al.*, 2008). *P. marginatus*, a native to central America/Mexico has spread to more than 50 countries ever since the first report of the pest in the Caribbean islands. In India, the pest was first reported from Coimbatore during 2007 infesting papaya and since then the list of agricultural and horticultural crops damaged/infested by this invasive pest is expanding. The major host plants of *P. solenopsis* include cotton, sunflower, vegetables (brinjal, tomato, chilli, okra, cucurbits), pulses

and also the weed parthenium, while, the major host plants of *P. marginatus* are papaya, tapioca, cotton, *Plumeria alba*, jatropha, mulberry, almost all vegetables, mulberry, tapioca, some flower crops, weeds, forest trees like teak, rain tree and *Prosopis*. In some regions, *P. marginatus* has replaced *P. solenopsis* as a predominant pest of cotton. Chemical pesticides could not provide satisfactory control of these mealybugs.

Several indigenous parasitoids and predators were recorded on *P. marginatus* and *P. solenopsis*. Anthocorid predators have been reported to be potential predators of sucking pests like thrips, aphids and mealybugs. *Blaptostethus pallescens* Poppius was originally described as *Blaptostethus piceus* Fieber var. *pallescens* Poppius from Celebes. It has been assessed as a potential predator of pests in the maize ecosystem and grain warehouses in Egypt (Tawfik and El-Husseini, 1971; Tawfik *et al.*, 1974). *B. pallescens* was recorded from Tamil Nadu and Bombay (Muraleedharan, 1977) Pune (C. R. Ballal, unpublished), Bangalore (Jalali and Singh, 2002) and Madagascar (Muraleedharan, 1977). Predation by *B. pallescens* was recorded as a potential mortality factor of cassava mealybug *Phenacoccus manihoti* Matile-Ferrero in Africa (CABI, 2005).

Species of the genus *Anthocoris* are recorded as potential predators of aphids, psyllids, thrips, mites, and other tiny arthropods. In India, Poppius (1909) described *Anthocoris annulipes*, and *Anthocoris indicus*, both from Sikkim and Muraleedharan (1977) described *A. nilgiriensis* from Tamil Nadu. *Anthocoris muraleedharani* Yamada was recorded as a predator of the striped mealybug, *Ferrisia virgata* (Cockerell) on purple orchid tree, *Bauhinia purpurea* Linnaeus (Yamada *et al.*, 2010).

Anthocorids consume different types of prey having distinct nutritional values, which alter the biological parameters of the predator. The available literature on anthocorid predators include reports on their feeding potential on lepidopteran eggs (Ballal *et al.*, 2003; Gupta and Ballal, 2006), thrips species (Devi *et al.*, 2007), pear psyllid, *Cacopsylla pyri* L. (Sigsgaard *et al.*, 2006) and whitefly (Kemasa *et al.* 2008). Very few reports are available on anthocorids as predators of mealybugs. Fabres and Ferrero (1980) reported *Cardiastethus exiguus* Poppius to be preying on *P. manihoti* in the People's Republic of Congo and Tohamy *et al.* (2008) reported *Orius albidipennis* Reut. as one of the predators of pink sugarcane mealybug *Saccharicoccus sacchari* (Cockerell). However, there is no information available on the feeding potential of any anthocorid predator on mealybugs. Therefore, an attempt was made to determine the feeding potential of two indigenous anthocorid predators *B. pallescens* and *A. muraleedharani* on *P. solenopsis* and *P. marginatus*.

## MATERIALS AND METHODS

The two mealybug cultures were maintained on sprouted potato tubers. The cultures of the mealybugs and anthocorid predators were maintained in the Mass Production Laboratory, NBAII, Bangalore. Preliminary studies were conducted on the stage of the mealybug preferred by the anthocorid predators and 3 to 4 day old crawlers of the mealybug and newly hatched nymphs (of *A. muraleedharani*) were used for the predatory potential studies. Newly hatched nymph of *B. pallescens* could not predate on the mealybug crawlers, hence, *Corcyra cephalonica* (Stainton) eggs were provided for the first four days of its nymphal period and four-day-old nymphs were used for predatory potential studies. The prey density was maintained at 10 crawlers per nymph initially and the density was increased gradually based on the consumption. Mealybug crawlers were released (@ 20 crawlers per container) on sprouted potatoes (at 24 hour interval) in a round ventilated plastic container (measuring 16cm diameter x 8cm height) and one anthocorid nymph released. The experiment was replicated ten times separately for nymph and adult of both the anthocorid species. A control batch was also maintained without releasing the predator in order to determine the normal mortality and population growth. Observations were made on the number of mealybugs dead in treatments as well as in control. Feeding

potential was calculated based on the corrected mortality of the mealybugs in the treatment batches in comparison to the control. The same method was followed for studying the feeding potential of the two anthocorids on *P. marginatus* crawlers also.

## RESULTS AND DISCUSSION

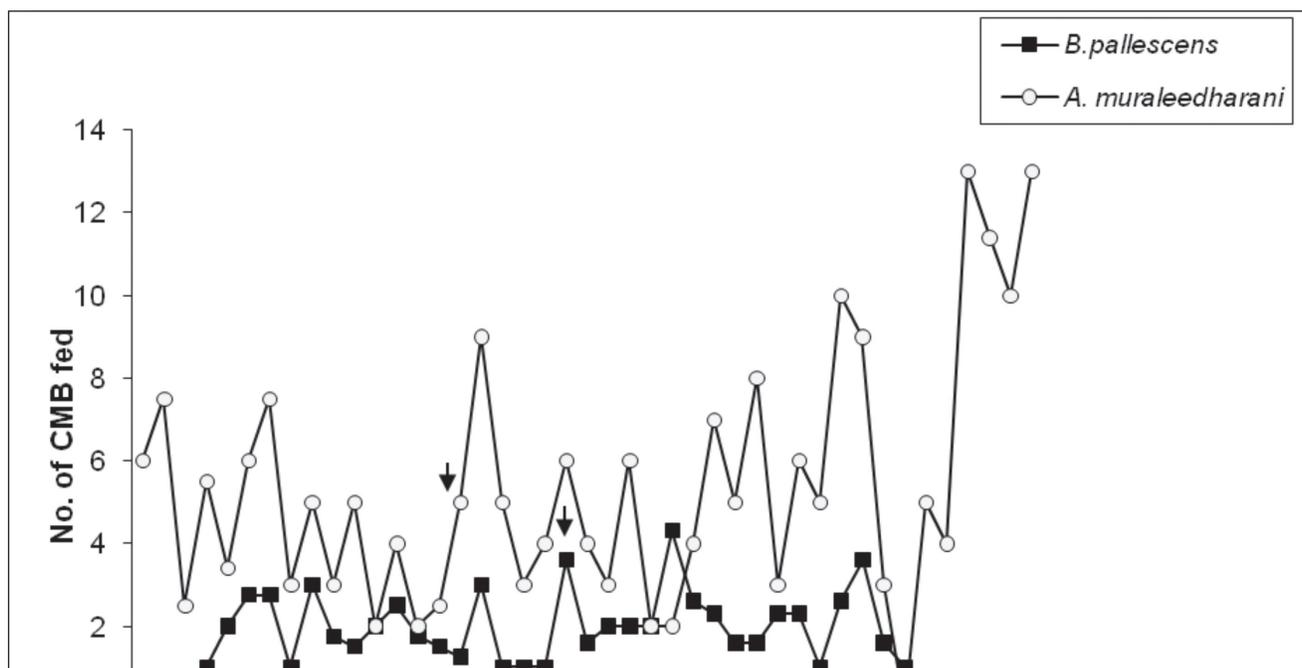
### Feeding potential on cotton mealybug

The results of the present investigation on *B. pallescens* indicated that during the nymphal stage *B. pallescens* could feed on a total of 34.8 crawlers and adult on 22.8 crawlers of cotton mealybug with a mean feeding rate of 1.7 and 1.9 per day, respectively.

The predatory potential depends on the host species, host stages and host plant of the pest species. *Orius majusculus* (Reuter) preferred to feed on thrips and mites and *Orius insidiosus* Say on mites (Sanderson *et al.*, 2005) and *Orius tristicolor* (White) on whitefly adults (Hagler *et al.*, 2004). The consumption of *Aphis gossypii* Glover by the female *O. insidiosus* was observed to be influenced by the host plant; the consumption rate being higher on *Chrysanthemum* variety White Reagan compared to that on variety Yellow Snowdon (Soglia *et al.*, 2007). In our studies, the low feeding potential of *B. pallescens* could have been due to the host plant material (sprouted potato tubers) used. The size of prey is known to be critical to the feeding success of any predator as has been reported by McAvoy *et al.*, (2011) in the case of adult *Tetraphleps galchanoides* Ghauri which preferred eggs of adelgid, *Adelges tsugae* Annand in comparison to the adult stage. Initial trials have also indicated that *B. pallescens* preference was more for eggs and young crawlers (Gupta *et al.*, 2011), while the adult stage of the mealybug was not preferred at all. This could be due to the size and increased mealy coating of the mealybug adults. Preferences for host stages could also vary based on prey density as described in the case of *T. galchanoides* which did not show any preference for its prey under low density, but preferences markedly varied at moderate and high prey densities (Li *et al.*, 2009).

Riudavets and Castane (1998) compared the predatory potential of nymphs and adults of *Orius* spp. and reported that the adults consumed more thrips than the nymphal stages. Contrary to that, our studies revealed that the nymph of *B. pallescens* was more voracious than the adult stage. However, both the nymphal and adult stages of *B. pallescens* could not predate on the adult stages of the *P. solenopsis*.

During the nymphal stage, *A. muraleedharani* consumed 65.5 crawlers of CMB, with a feeding potential of 4.6/day, while the corresponding figures for the adult stage were 124.3 and 6.1, respectively. Unlike *B. pallescens*, neonates and young nymphs of *A. muraleedharani* could feed on cotton mealybug crawlers (Fig. 1).



**Fig 1** Day-wise feeding potential of *Blaptostethus palleescens* and *Anthocoris muraleedharani* on *Phenacoccus solenopsis*; arrows indicate the point at which nymphs metamorphosed into adults

The results presented in Table 1 clearly indicated that the feeding potential of *A. muraleedharani* on *P. solenopsis* was significantly higher than that of *B. palleescens*. The comparative day-wise feeding potential of *B. palleescens* and *A. muraleedharani* is also depicted in Fig 1. The lower predatory potential of *B. palleescens* on mealybugs compared to that of *A. muraleedharani* could be due to the continuous rearing of the former on *C. cephalonica* eggs, while the latter was reared on mealybugs (*P. solenopsis* or *Ferrisia virgata*). Similar results based on habituation to the laboratory host were reported by Santi and Maini (2006), who observed that *Orius laevigatus* (Fieber) reared on frozen *Ephestia kuehniella* Zeller eggs rejected ladybird eggs. When reared on *P. solenopsis*, the duration of nymph was shorter and longevity higher in *A. muraleedharani* in comparison to those of *B. palleescens*, again indicating the prey suitability for *A. muraleedharani*. The flower bug *Orius similis* Zheng could predate on different aphid species, but, the nymphal duration varied significantly depending on the prey (aphid) species and its host plant (Sengonca *et al.*, 2008).

**Table 2.** Comparative feeding potential, feeding rate and adult longevity of *Blaptostethus palleescens* when fed from nymphal and adult stage.

Treatment	Total feeding (No. of <i>P. solenopsis</i> crawlers)	Feeding rate (No. of <i>P. solenopsis</i> crawlers/day)	Adult longevity (in days)
Fed on <i>P. solenopsis</i> from adult stage	22.83	1.93	14.17
Fed on <i>P. solenopsis</i> from nymphal stage	38.70	2.25	17.00
CD at $P < 0.05$	13.89	NS	1.82

The total feeding potential and longevity of such adults which were reared on the *P. solenopsis* from the nymphal stage, were significantly superior to those which were reared on CMB crawlers only during the adult stage (Table 2). The observations on the day-wise feeding

**Table 1.** Feeding potential of *Blaptostethus palleescens* and *Anthocoris muraleedharani* on cotton mealybug (crawlers)

Anthocorid species	Nymph			Adult		
	Total no. of <i>P. solenopsis</i> fed	Feeding rate (consumption/day)	Nymphal period (in days)	Total no. of <i>P. solenopsis</i> fed	Feeding rate (consumption/day)	Longevity (in days)
<i>B. palleescens</i>	34.83 <sup>b</sup>	1.73 <sup>b</sup>	20.5 <sup>a</sup>	22.83 <sup>b</sup>	1.93 <sup>b</sup>	14.17 <sup>b</sup>
<i>A. muraleedharani</i>	65.50 <sup>a</sup>	4.60 <sup>a</sup>	14.5 <sup>b</sup>	140.67 <sup>a</sup>	7.73 <sup>a</sup>	28.00 <sup>a</sup>
CD at $P < 0.05$	16.85	1.34	0.72	51.68	4.79	7.86

indicated some higher peaks of feeding during the initial days in those adults which were fed on CMB crawlers from the nymphal stage.

### Feeding potential on papaya mealybug

Meyling *et al.*, (2003) reported that adult females of *Anthocoris nemorum* (Linnaeus) and *Anthocoris nemoralis* (Fabricius) preferred to predate on *Myzus persicae* Sulzer in comparison to other aphid species. In the present investigation also, it was observed that *A. muraleedharani* showed a clear preference for *P. solenopsis* and it could not

predate on *P. marginatus*. *B. pallelescens* could feed on papaya mealybug, but with a low feeding potential (Table 3). The two-day and seven-day-old nymphs could predate on a total of 18 and 29 papaya mealybug crawlers, respectively and per day feeding rate was 1.5 and 2.2, respectively. Gomaa and Agamy (2002) reported that *O. laevigatus* had a lower rate of survival when reared on thrips, *Gynaikothrips ficorum* (Marchal) than on acarid mite, *Tyrophagus putrescentiae* (Schrank). In the present investigation, the survival of the *B. pallelescens* nymphs was very poor when fed on *P. marginatus*. In the case of adults, one adult could feed on

**Table 3. Feeding potential of *Blaptostethus pallelescens* on papaya mealybug\***

Stage of <i>B. pallelescens</i>	Total No. of <i>P. marginatus</i> consumed	No. of <i>P. marginatus</i> fed per day	Nymphal period/longevity of adult
2 day old nymph	18	1.5	13
7 day old nymph	29	2.2	24
Adult	31	2.6	13

\* Nymphal survival was less than 10%, the data was generated from the few surviving nymphs, which could metamorphose into adults, hence data was not subjected to statistical analysis

a total of 31 crawlers during its life time with a feeding rate of 2.6/day. The adult longevity of *B. pallelescens* when fed on *P. marginatus* was significantly lower (13 days) in comparison to a longevity of 38–78 days when it was reared on preferred prey like eggs of *C. cephalonica* (Ballal *et al.*, 2003). Longevity of *O. insidiosus* was five times higher when fed on eggs of *E. kuehniella* when compared to that when fed on aphids and thrips (Mendes *et al.*, 2002).

The low feeding potential of *B. pallelescens* on papaya mealybug could have been because of the host plant used and the low density of the pest provided in laboratory experimental conditions. Montserrat *et al.* (2000) reported that *O. majusculus* left the plant when the density of whitefly *Trialeurodes vaporariorum* Westwood was low.

It is important to consider the predatory potential and foraging behavior of predators while developing biocontrol programmes. The present investigation gives an indication that the two indigenous anthocorid predators could work as potential predators of the cotton mealybug which however needs further investigations.

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