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Research Note

Predatory potential of *Chrysoperla zastrowi sillemi* (Esben-Peterson) and *Cryptolaemus montrouzieri* Mulsant on *Paracoccus marginatus* (Williams and Granara de Willink) infesting Sunflower

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ABSTRACT: Predatory potential of *Chrysoperla zastrowi sillemi* (Esben-Peterson) and *Cryptolaemus montrouzieri* Mulsant on *Paracoccus marginatus* (Williamsand Granara de Willink) infesting sunflower was studied in the lab. Results revealed that grubs of *C. zastrowi sillemi* fed 6.2 ± 1.1, 448.0 ± 76.4 and 68.8 ± 9.5 ovisacs, nymphs and adults of *P. marginatus* to complete their life stages. The consumption by first instar grubs of *C. zastrowi sillemi* was 1.4 ± 0.5, 85.0 ± 7.3 and 13.2 ± 1.3 ovisacs, nymphs and adults, respectively. Among various instars of the predator, second and third instar were voracious and consumed 1.6 ± 0.5, 139.0 ± 5.4 and 22.8 ± 2.1 and 3.4 ± 0.5, 230.4 ± 29.2 and 32.5 ± 2.6 ovisacs, nymphs and adults of *P. marginatus*, respectively. Grubs of *C. montrouzieri* fed 7.6 ± 0.7, 153.6 ± 23.8 and 62.8 ± 11.6 ovisacs, nymphs and adults of *P. marginatus* to complete their life stages. Among various instars of the predator, third and fourth instar were voracious and consumed 2.2 ± 0.4, 43.6 ± 2.0 and 23.2 ± 3.0 and 2.8 ± 0.4, 69.6 ± 4.6 and 27.6 ± 4.6 ovisacs, nymphs and adults of *P. marginatus*, respectively. Adult *C. montrouzieri* consumed on an average 5.2 ± 0.8, 101.2 ± 13.5 and 35.4 ± 8.6 ovisacs, nymphs and adults of *P. marginatus*.

KEY WORDS: Predatory potential, *Chrysoperla zastrowi sillemi*, *Cryptolaemus montrouzieri, Paracoccus marginatus*, sunflower

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Papaya mealybug *Paracoccus marginatus* is a polyphagous pest that can damage large number of economically important field crops, tropical and sub-tropical fruits, vegetables and ornamental plants (Ben-Dov, 2008). More than one hundred insect species have been reported as pests on sunflower and the yield loss ranges from 35.7 to 51.3 per cent due to insect pest damage (Bakhetia *et al*., 1997). Cotton mealybug and papaya mealybug are causing serious threat to sunflower cultivation (Anon., 2009). Mealybug infestation in sunflower resulted in yellowing, crinkling and curling of leaves, reduced plant growth, and in some cases death of plants. Mealybugs produce huge volume of honey dew, resulting in black sooty mould on the infested vegetation (Meyerdirk *et al.,* 2004). Number of chemical control measures are available to control *P. marginatus*, but the effect appears to be short lived. Typically, twice the normal dose is applied because mealybugs are protected by thick waxy, cottony sacs and often are concealed inside damaged leaves and buds. Thus, chemical control measures are only partially effective and require multiple applications (Regupathy and Ayyasamy, 2010). Sunflower is the crop frequently visited by honeybees and many insect pollinators. Use of chemical insecticides disturbs the natural balance of crop ecosystem greatly and also poses problems to honeybees and pollinators. Besides, the use of chemical insecticides is not advisable in oilyferous crops which might lead to serious problems of residue deposition in oil and oilcakes. Furthermore, problems with insecticide resistance make chemical control a less desirable management option to combat the mealybugs. Under this circumstance, biological control is the best option for the management of mealybugs. Natural enemies of the papaya mealybug under field conditions include the *Chrysoperla zastrowi sillemi* (Esben-Peterson) (Henry *et al.,* 2010) and *Cryptolaemus montrouzieri* Mulsant and these predators have a potential impact on mealybug populations (Walker *et al.,* 2006). Hence, the present study was carried out to assess the predatory potential of *C. zastrowi sillemi* and *C. montrouzieri* on *P. marginatus* to effectively employ them in the management of mealybugs infesting sunflower.

The prey insect *Corcyra cephalonica* (Stainton) was reared in the laboratory following the procedure of Navarajanpaul (1973). *C. zastrowi sillemi* was cultured using the eggs of *C. cephalonica* as prey as described by Patel *et al.* (1988). Larval rearing was done in round

plastic basins (40 cm dia) at 250 larvae per basin covered with cotton cloth. During adult rearing, on the fifth day the adults were transferred to fresh G.I. tray, which was already wrapped on inner sides with a brown paper sheet acting as substratum for egg laying. The standard food for the adults prepared by mixing equal parts of fructose, Protinex®, yeast powder, honey and a little quantity of water was placed in the form of a thick paste on the outside of the cover cloth. To meet the water requirement of the adult, cut piece of sponge foam soaked in water was also kept over the top of the cover cloth. The trays were kept at the room temperature (27 ± 4° C) with 8 to 10 h. photoperiod. Every day the adults were transferred to fresh rearing tray. The paper sheets containing *C. zastrowi sillemi* eggs were removed daily and used for further studies.

C. montrouzieri was multiplied on pumpkin infested with *Maconellicoccus hirsutus* (Green). One fully infested pumpkin was taken separately in a wooden cage of 1' x 1' x 1' size and 50 adults of *C. montrouzieri* (15 days old) comprising both sexes were introduced on the infested pumpkin. Vials containing 50 per cent honey solution was kept inside the cage as supplementary food for the mating adults. The cages were kept under dark for mating and oviposition of beetles (Mani and Krishnamoorthy, 1997). During this period, beetles deposited their eggs either singly or in groups in the ovisacs of female mealybugs. The grubs were visible in such cages within a week after the introduction of the beetles. Grubs of *C. montrouzieri* pupated on the pumpkin or anywhere inside the breeding cage after a period of 20 days. To facilitate easy removal of pupa, dried guava leaves were kept at the base of the pumpkin in the cages. Emerged adults were collected and introduced into pumpkin with 15 days old mealybugs for further multiplication. Thus, the cycle was repeated. Various life stages of *C. montrouzieri* were taken from this laboratory cultures for conducting experiments. The culture of mealybug species, *M. hirsutus* and the predator, *C. montrouzieri* were maintained in the laboratory with 25.5 ± 2.1° C and 69.9 ± 5.5 % RH at the Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore.

The predatory potential of the different larval instars of *C. zastrowi sillemi* against each stage of mealybug *viz.,* ovisacs, second instar nymphs and adults was studied. Sunflower leaf was cut into circular pieces and kept inside petriplate (9mm dia.) containing agar to maintain the turgidity of the leaves. Known numbers of different stages of prey insects were provided separately for the first, second and third instars of *C. zastrowi sillemi*. Each treatment was replicated ten times. The number of preys consumed was recorded daily and fresh mealybugs were transferred until they reached the next instar. The number of prey consumed during each larval instar was recorded.

Experiment was conducted to determine the rate of consumption on different stages of mealybugs (ovisacs, second instar nymphs and adults) by the *C. montrouzieri* grubs and adults. Sunflower leaf was cut into circular pieces and kept inside petriplate (9mm dia) containing agar to maintain the turgidity of the leaves. Freshly emerged grub of *C. montrouzieri* was provided with known number of ovisacs, nymphs and adults of mealybugs, separately. Fresh hosts were offered to the grubs until they reached the next instar. Number of prey consumed by the grub in each instar and the total consumption during grub period were calculated. Number of prey consumed by the adult in a period of 24 h. was recorded. The feeding potential studies were conducted with ten grubs considering each one as replication. Data on predatory potential of different instars were analysed with standard deviation.

RESULTS AND DISCUSSION

Grubs of *C. zastrowi sillemi* fed 6.2 ± 1.1, 448.0 ± 76.4 and 68.8 ± 9.5 numbers of ovisacs, nymphs and adults of *P. marginatus* and completed their life stages. Among the various instars of the predator *C. zastrowi sillemi*, second and third instars were voracious and consumed 1.6 ± 0.5, 139.0 ± 5.4 and 22.8 ± 2.1 and 3.4 ± 0.5, 230.4 ± 29.2 and 32.5 ± 2.6 ovisacs, nymphs and adults of *P. marginatus*, respectively. The consumption by first instar *C. zastrowi sillemi* was 1.4 ± 0.5, 85.0 ± 7.3 and 13.2 ± 1.3 ovisacs, nymphs and adults of *P. marginatus*, respectively (Table 1).

In the present findings, it was observed that the second and third instar grubs of *C. zastrowi sillemi* consumed

Table 1. Feeding potential of *Chrysoperla zastrowi sillemi* on *Paracoccus marginatus*

C. zastrowi sillemi (Instar)	Feeding potential (Mean Number ± SD)		
	P. marginatus		
	Ovisacs	Nymphs	Adult
I	1.2 ± 0.4 [c]	78.6 ± 7.7[c]	13.5 ± 1.1[c]
II	1.6 ± 0.5 [b]	139.0 ± 5.4[b]	22.8 ± 2.1[b]
III	3.4 ± 0.5[a]	230.4 ± 29.2[a]	32.5 ± 2.6[a]
CD ($P < 0.05$)	0.2000	0.2903	0.0943
Total	6.2 ± 1.1	448.0 ± 76.4	68.8 ± 9.5

Table 2. Feeding potential of *Cryptolaemus montrouzieri* on *Paracoccus marginatus*

Life stages of *C. montrouzeuri*	Feeding potential (Mean Number ± SD)		
	P. marginatus		
	Ovisacs	Nymphs	Adult
Grub (Instar)			
I	1.2 ± 0.4[e]	15.2 ± 1.3[e]	2.6 ± 0.8[e]
II	1.4 ± 0.5[d]	25.2 ± 3.1[d]	9.4 ± 1.6[d]
III	2.2 ± 0.4[c]	43.6 ± 2.0[c]	23.2 ± 3.0[c]
IV	2.8 ± 0.4 [b]	69.6 ± 4.6[b]	27.6 ± 4.6[b]
Adult	5.2 ± 0.8 [a]	101.2 ± 13.5[a]	35.2 ± 8.6[a]
CD ($P < 0.05$)	0.1327	0.2944	0.3386
Total	12.8 ± 1.69	254.8 ± 37.1	98.0 ± 19.5

more number of nymphs than adults. Tesfaye and Gautam (2002) reported that the predatory potential of *C. zastrowi sillemi* was high in late instars than the early instars. The gradual increase in the feeding rate of older larvae might be due to their increased nutritional requirement. Sakthivel (2011) recorded similar results in papaya on *P. marginatus* in papaya.

Mahalakshmi (2009) stated that all the three larval instars of *C. zastrowi sillemi* consumed higher numbers of first instar of *Phenococcus solenopsis* Tinsley compared to its second and third instar of mealybugs. Sattar *et al*., (2007) reported that *C. zastrowi sillemi* larvae were voracious feeders of cotton mealybugs and the predation efficiency increased tremendously under no choice larval feeding. Atlzhan *et al*., (1999) reported that increased prey consumption in immature stages resulted in high reproductive rate. Nordlund and Correa (1995) and Kamath *et al*., (2001) observed the similar predatory efficiency of *C. zastrowi sillemi* on *Corcyra* eggs and groundnut aphids as reported in the present study.

Grubs of *C. montrouzieri* fed 7.6 ± 0.7, 153.6 ± 23.8 and 62.8 ± 11.6 ovisacs, nymphs and adults of *P. marginatus* and completed their life stages. Adult *C. montrouzieri* consumed on an average of 5.2 ± 0.8, 101.2 ± 13.5 and 35.4 ± 8.6 ovisacs, nymphs and female adults of *P. marginatus*. Among various instars of the predator, third and fourth instar were voracious and consumed 2.2 ± 0.4, 43.6 ± 2.0 and 23.2 ± 3.0 and 2.8 ± 0.4, 69.6 ± 4.6 and 27.6 ± 4.6 numbers of ovisacs, nymphs and adults of *P. marginatus*, respectively. The consumption of first and second instars were 1.2 ± 0.4, 15.2 ± 1.3 and 2.6 ± 0.8 and 1.4 ± 0.5, 25.2 ± 3.1 and 9.4 ± 1.6 ovisacs, nymphs and adults of *P. marginatus*, respectively (Table 2).

Allwin (2007), reported that among two life stages, adults of *C. montrouzieri* was more voracious and each adult consumed an average 258.7, 352.1 and 217.3 numbers on *M. hirsutus* while it was 323.8, 715.6 and 328.6 number of eggs, nymphs and adults for *Planococcus citri* Ckll., respectively. According to Mahalakshmi (2009), the grubs of *S. coccivora* consumed maximum numbers of cotton mealybugs compared to the grubs of *C. montrouzieri*, while, the predatory efficiency of adult of *C. montrouzieri* was found to be higher than the adult of *S. coccivora.*

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