Influence of Prey Species on Feeding Preference, Post-Embryonic Development and Life Span of *Cheilomenes Sexmaculata* (Fabricius)

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Abstract

Coccinellid beetles due to high foraging performance, immense predatory potential and high reproductive efficacy possess the potential to be effectively employed in biological control programme for several destructive insects such as aphids, coccids, scale insect etc. *Cheilomenes sexmaculata* is very common in the target area and found abundantly predating on several aphids. Hence, the feeding performance and post embryonic development of *C. sexmaculata* feeding on three economically important aphids, *Aphis craccivora, Aphis gossypii* and *Lipaphis erysimi* have been studied. The grubs of the predator, *C. sexmaculata* showed greater preference for *A. craccivora* (141.4± 6.67 aphids) followed by *A. gossypii* (122.25 ± 7.44 aphids) and *L. erysimi* (106.95 ± 7.73 aphids). The higher development period was observed on *L. erysimi* (17.50 ± 0.72 days) than *A. gossypii* (16.0 ± 0.5 days) and *A. craccivora* (15.6± 0.24 days). Similarly *C. sexmaculata* had higher pre-pupal and pupal period when fed on *L. erysimi* than *A. gossypii* and *A. craccivora*. The higher longevity of the *C. sexmaculata* was observed on *A. craccivora* (39.6 ± 1.21 days) than *A. gossypii* (35.25 ± 0.47 days) and *L. erysimi* (33.25 ± 0.47 days). It is probably due to more preference of *A. craccivora* than *A. gossypii* and *L. erysimi*. Hence, this predator consumed more *A. craccivora* than *A. gossypii* and *L. erysimi* during its life span and also during larval development period.

Keywords : *C. sexmaculata*, Feeding potential, Aphids.

Introduction

Coccinellids are economically very important predators because they feed on several serious pests such as aphids, coccids, mites and other soft bodied insects. They have been reported to play an important role in suppressing and regulating the aphid population (Shands & Simpson, 1972). The predaceous coccinellids are linked to biological control more often than any other taxa of predatory organism (Obrycki & Kring, 1998).

Due to high predatory efficiency, several species of ladybird beetles are considered as an important component of biological control programme against scale insects and aphids (Agarawala & Chaudhuri, 1995, Agarawala et. al., 1998, Gurney & Hussey, 1970). The predatory insects show efficiency differences in utilizing the available nutrients (Hodek, 1973) and energy from their prey which are eventually reflected in their growth and reproductive performance (Ananthakrishnan et. al., 1986, Muthukrishnan & Pandiyan, 1987; Babu, 1999, 2001: Rakhshan & Ahmad, 2015a). Much variability was observed in the number of aphids consumed by larval and adult stages of any species of coccinellids when feed on different species of aphids (Ali & Rizvi, 2007; Gurney & Hussey, 1970; Jandial & Malik, 2006 ; Pirsanna et. al.,2013; Priayadarshani et al., 2016 ; Mari et al.,2016).

Cheilomenes sexmaculata is a very common predator and was recorded on 16 aphid species in northeast Bihar. The high rate of predation was observed on *Aphis craccivora, Aphis gossypii, Lipaphis erysimi, Myzus persicae* and *Sitobion miscanthi* (Ahmad et al., 2012). The development and potential feeding of coccinellids vary with choice food and change with environment condition (Rakhshan & Ahmad, 2015b). The present study has undertaken in order to make the quantitative estimate of feeding potential of different instar grubs and adults (Fig. 1 & 2), post embryonic development and life span of *C. sexmaculata* feeding on three economically important aphids, *A. craccivora, A. gossypii* and *L. erysimi*. This information will provide a preliminary step in exploitation of this predator in biological control of above mentioned aphids of economic significance.

Material and methods

Three host plants viz., *Lablab purpureus, Lagenaria siceraria* and *Brassica campestris* were grown in the experimental field for aphid infestation and appearance of coccinellids**.** Larvae and adults of *C. sexmaculata* were collected from leaves of *L. purpureus, L. siceraria* and *B. campestris* infested by *A. craccivora, A. gossypii* and *L. erysimi* respectively from experimental field. The beetles were reared on aphids in glass jar (25 X 10 cm) in the laboratory in the normal condition during January and February. The average temperature was 20 ± 2^0C. The glass jars were covered on the top with muslin cloth. Fresh aphids were provided daily. Fresh eggs of predator deposited on aphid infested host plant leaves were taken as such from the laboratory culture and kept in separate glass containers (7.5 cm X 2.5 cm). The petioles of these leaves were plugged with wet cotton to avoid desiccation till hatching of the eggs. Thereafter, 5 sets of each group of neonate larvae were reared on aphid replenished every day in glass containers. 100 aphids of mix age were provided daily till the emergence of adults. The post–embryonic developmental period (covering the entire larval and pupal duration) and adult longevity were recorded. For evaluating the predatory potential, the daily consumption of nymphs or adult of aphids (A. *craccivora*, *A. gossypii* and *L. erysimi*) was assessed till the pupation. The prey density was also maintained uniform consisted of 100 aphids/predator until pupation. The predatory potential at different life stages, development period and life span of *C. sexmaculata* was statistically analysed by Analysis of variance test (ANOVA).

Results and discussion

The quantitative estimation of feeding potential of different instar grubs and adults, post embryonic development and life span of *C. sexmaculata* feeding on three economically important aphids, *A. craccivora, A. gossypii* and *L. erysimi* were studied.

Feeding potential

The predatory potential of *C. sexmaculata* was also studied on three species of aphids viz., *A. craccivora, A. gossypii* and *L. erysimi* reared on *L. purpureus, L. siceraria* and *B. campestris* respectively. The feeding potential of adult *C. sexmaculata* was observed higher on *A. craccivora* (514.4 ±15.47) than *A. gossypii* (499.75±13.70) and *L. erysimi* (374.5±22.82). Similarly, the predatory potential in terms of total no. of aphids devoured during each larval instar was also observed higher on *A. craccivora* than *A. gossypii* and *L. erysimi* (Table 1). This difference is observed significant by ANOVA test (F1=24.39, F2= 208.53) (Fig. 3). The grub of *C. sexmaculata* during its entire development fed 141.40 ± 6.67 *A. craccivora*, 122.25±7.44 *A. gossypii* and 106.95±7.73 *L. erysimi*. Both grubs and adults of the predator, *C. sexmaculata* showed greater preference for *A. craccivora* than *A. gossypii* and *L. erysimi*. Similarly Pirasanna et. al. (2013) also reported that *A. gossypii* was most preferred prey by both grubs as well as adults than the *Rhopalosiphum maidis* and *L. erysimi*. Babu (2001) has also studied the predatory potential of *C. sexmaculata* on *A. gossypii* collected from cotton leaves at 25^0C. He has reported that the grubs of *C. sexmaculata* during its development fed a total of 295.96 nymphs of *A. gossypii* which is much higher than the present observation. It is probably due to effect of host plants and temperature. The feeding potential of *C. sexmaculata* increased with the increase of age of grubs. The 4^{th} instar grubs consumed more aphids (*A. craccivora*, 51.40±1.94; *A. gossypii*, 46.25±4.04 and *L. erysimi*, 43.25 ±1.25) than the other instars (Table 1). However, Jandial & Malik (2006) reported that 4^{th} instar grubs of *C. septempunctata* consumed 64.00 aphids of *L. erysimi*.

It shows that *C. septempunctata* has more feeding potential than the *C. sexmaculata* on *L. erysimi*. The overall feeding efficiency of both adult predators was observed significantly higher on *A. craccivora A. gossypii* as well as *L. erysimi* than grubs, such investigation is in consonance with the judgement of Singh et. al. (1994); Babu (2001); Ali & Rizvi (2007) and Pirsanna et. al. (2013).

Fig. 1: Larva feeding on *A. craccivora*

Fig. 2: Adult feeding on *A. craccivora*

In the present study, it was also observed that the 4^{th} instar grubs consumed more aphids per day than the other instars and adults when feed on *A. craccivora, A. gossypii* and *L. erysimi*. Pirasanna et. al. (2013) has also reported that the 4^{th} instar grubs consumed significantly more aphids when compared to 1^{st}, 2^{nd} and 3^{rd} instars per day. Similar observation has been also made by Babu (2001) and Ali & Rizvi (2007) on *C. sexmaculata* and *C. septempunctata* respectively.

Post embryonic development

The higher development period was observed on *L. erysimi* (17.50 ± 0.72 days) than *A. gossypii* (16.0 ± 0.5 days) and *A. craccivora* (15.6± 0.24 days) (Table 2; Fig. 4). The variation is observed significant by ANOVA. Similar observation has been made by Pirasanna et. al. (2013) on *A. gossypii* and *L. erysimi*. Similarly, *C. sexmaculata* had higher pre-pupal and pupal period when fed on *L. erysimi* (1.8 ± 0.2; 9.25 ± 0.25 days) than *A. gossypii* (1.50 ± 0.29; 6.25 ± 0.25 days) and *A. craccivora* (1.20 ± 0.19; 5.20 ± 0.19 days) (Table 2). *C. sexmaculata* completed their post embryonic development faster when reared on *A. craccivora* (21.80 ± 0.19 days) than *A. gossypii* (23.75 ± 4.26 days) and *L. erysimi* (28.55 ± 4.5 days). The effect of prey on the post embryonic development of *C. sexmaculata* is also observed significant by ANOVA test. Pirasanna et. al. (2013) also observed the fast development of this predator on *A. craccivora*.

Babu (2001) also reported that larval-pupal duration of this predator on *A. gossypii* is about (15.4 ± 0.45 days) at 25^0 C which is much less than the present observation (23.75 ± 4.28 days) at 20 ± 2^0C. Omkar and James (2004) studied the effect of temperature on the development of *C. transversalis*. They reported 21.56 ± 2.18 and 15.56 ± 1.58 days for complete development at 20^0 C and 25^0C respectively. Thus, the difference in the total development period in present observation is due to effect of temperature.

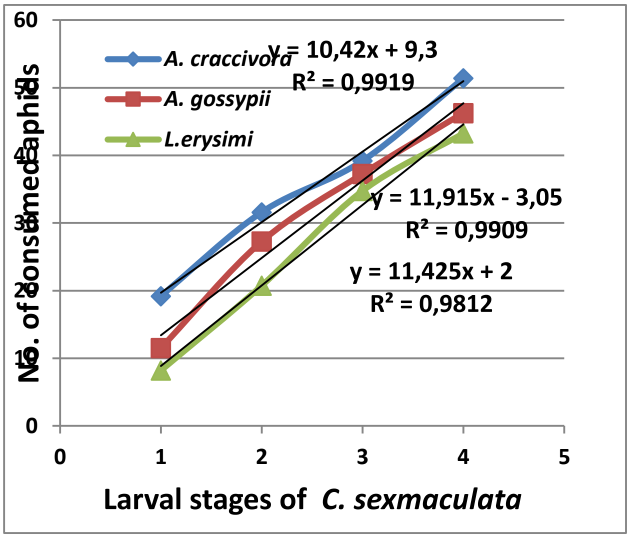

Fig. 3: Feeding potential of larval stages on aphids

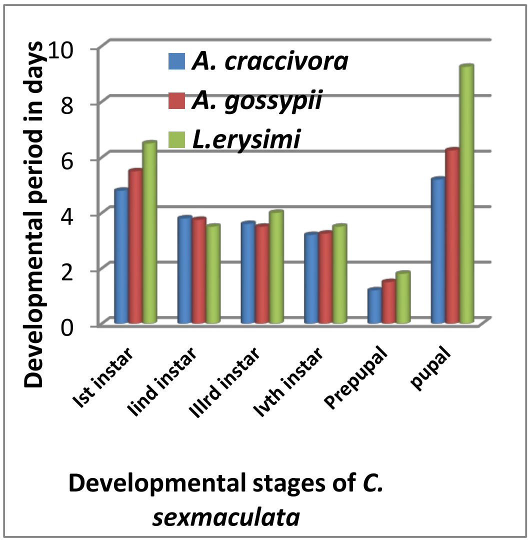

Fig. 4 : Development period of predator

Adult life span

In the present observation, the longevity (adult life span in days) of *C. sexmaculata* was observed higher on *A. craccivora* (39.60±1.21) than *A. gossypii* (35.25 ± 0.47) and *L. erysimi* (33.25 ± 0.47) (Table 2). Babu (2001) also reported 36.4 ± 0.45 days adult life span of this predator on this aphid. Pirasanna et. al. (2013) has also reported lowest male and female longevity of *C. sexmaculata* on *L. erysimi* than the *A. gossypii*. Hence, it is observed that *A. craccivora* is more preferred and suitable aphid for *C. sexmaculata* than *A. gossypii* and *L. erysimi.*

Thus, giving the present observation concerning the effect of prey, it can be concluded that nutritional quality plays a major role in influencing the predatory potential, post-embryonic development and adult life span of any predator.

Table 1: Feeding potential (no. of aphids consumed) of different larval stages and adult of *C. sexmaculata.*

Aphid sp.	Ist Instar	IInd instar	IIIrd Instar	IVth Instar	Adult
craccivora	19.2 ±1.68	31.6 ±1.33	39.2 ±3.04	51.4 ±1.94	514.4 ±15.47

gossypii	11.5±1.85	27.25 ±1.97	37.25 ±5.11	46.25 ±4.04	499.75±13.7
L. erysimi	8.2 ±0.45	20.75 ±1.11	34.75 ±1.80	43.25±1.25	374.5±22.82

Table 2: Developmental periods of different larval stages and longevity of adults (days) *C. sexmaculata.*

Aphid sp.	Larval	Prepupal	Pupal	Adults
craccivora	15.6±0.24	1.2 ±0.19	±0.19	39.6±1.21
A. gossypii	16.0±0.51	1.5 ±0.29	6.25 ±0.25	35.25 ±0.47
L. erysimi	17.5 ±0.72	1.87 ±0.2	9.25 ±0.25	33.25±0.47

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Refrences:

1. Agarwala, B. K and Chaudhuri, M.S. (1995).Use of alternate food in rearing of aphidophagous ladybird beetle, *Menochilus sexmaculatus* Fabr., *Entomon*, **20 (2)**: 19-23.
2. Agarwala, B. K., Bhattacharya, S. and Bardhanroy, P. (1998). Who eats whose eggs? Intra versus interspecific interaction in starving ladybird beetles predaceous on aphids. *Ethology Ecology & Evolution*, **10**: 361-368.
3. Ahmad, M. E., Parween, N. and Kumar, S. (2012). Taxo-ecological study of aphids infesting vegetable plants with their parasitoids in northeast Bihar. *J. Appl. Zool. Res*., **23**(**2**): 103-114.
4. Ali, A. and Rizvi, P. Q. (2007). Development and predatory performance of *Coccinella septempunctata* L. (Coleoptera : Coccinellidae) on different aphid species. *J. Bio.Sci.*, **7** (8) : 1478-1483.
5. Ananthakrishnan, T. N., Sanjayan, K. P. and Sureshkumar, N. (1986). Host plant preference in *Cyrtacanthacris ranacea* Stal in some malvaceous host in terms of food utilization, *Proceeding of the Indian National Science Academy* **96B** : 351-357.
6. Babu, A. (1999). Influence of prey species on feeding preference, post- embryonic development and reproduction of *Coccinella transversalis* F. (Coleoptera : Coccinellidae). *Entomon*, **24(3)** : 221-228.

7. Babu, A. (2001). Predatory potential and life Parameters of *Cheilomenes (Menochilus) sexmaculata* (F.) (Coleoptera : Coccinellidae) in relation to energetics of *Aphis gossypii* Glover (Homoptera : Aphididae). Entomon, **26 (1)** : 29-36.
8. Gurney, B. and Hussey, N. W. (1970). Evaluation of some Coccinellids species for the biological control of aphids in protected cropping. *Ann. Appl. Biol*., **65** :451-458.
9. Hodek, I. (1973). Biology of Coccinellidae, Dr. W. J. Junk Publishers: *The Hague, (Holland).* 259pp.
10. Jandial, V. K., and Malik, K. (2006). Feeding potential of *Coccinella septempunctata* Linn. (Coccinellidae : Coleoptera) on mustard aphid, *Lipaphis erysimi* Kalt., and potato peach aphid, *Myzus persicae* Sulzer. *J. ent. Res*., **30(4)** : 291-293.
11. Mari J.M., Bugti G.A., Bin, W., and Na, C. (2016): Biological parameters and preferential feeding response of *Coccinella undecimpunctata* L. on three aphid species. *Journal of Entomology and Zoology Studies* **4**(4): 1306-1310.
12. Muthukrishnan, J. and Pandian, T. J. (1987). In: Animal Energetics, Pandian, T. J. and Venberd, F.J. : (Editors). Academic Press: New York (USA). *Insecta* 373-511.
13. Obrycki, J. J. and Kring, T. J. (1998). Predaceous coccinellidae in biological control. *Annu. Rev. Entomol.*, **43** : 295 – 321.
14. Priyadarshani T.D.C., Hemachandra K.S., Sirisena U. G. A. I. and Wijayaguasekara (2016): Developmental Biology and feeding Efficiency of *Menochilus sexmaculata* (Coleoptera: Coccinellidae) (Fabricius) reared on *Aphis craccivora* (Hemiptera: Aphididae) (Koch) *Tropical Agriculture Research*, **27**(2):115-122.
15. Pirasanna, P. G. G.; Bishwajeet, P.; Shah, V. and Shankarganesh, K. (2013). Feeding potential and biology of Coccinellid predator *Cheilomenes sexmaculata* (Fabricius) (Coleoptera) on aphid hosts. *Indian J. Entomo.*, **74** : 388-393.
16. Rakhshan and Ahmad, M. E. (2015). Influence of host plants on the growth and development of *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: coccinellidae) prey on *Aphis craccivora* Koch. *International Journal of Science and Research*., **4** (5) :250-254.
17. Rakhshan and Ahmad, M. E. (2015). Predatory efficiency of *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae)

against *Aphis craccivora* Koch on various host plants of family fabaceae. *European Scientific Journal.,* **11**(18) :154-161.

18. Shands, W. A. and Simpson, G. W. (1972). Insect predators for controlling aphids on potato Green peach aphid consumptions by *Coccinella septempunctata* and *C. Transversoguttata*. *J. Eco. Ent*., **65**: 1388-1392.
19. Singh, V. S.; Yadav, R. P. and Singh, R. (1994). Post-embryonic development, survival rate and predation potential of *Coccinella septempunctata* Linn.**In**: relation of mustard aphid (*Lipaphis erysimi* Kalt.). *J. Entomol. Res.,* **18** : 5-10