J. Biol. Control, 23(1): 53-56, 2009

Biology and predatory potential of aphidophagous syrphids on guava aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae)

R. K. MURALI BASKARAN, S. SASIKUMAR, D. S. RAJAVEL and K. SURESH
Department of Agricultural Entomology, Agricultural College and Research Institute (TNAU), Madurai 625104, Tamil Nadu, India.
E mail: muralibaskaran2007@rediffmail.com

ABSTRACT: The biology of four species of aphidophagous syrphids, namely, *Paragus serratus* (F.), *Episyrphus balteatus* (De Geer), *Ischiodon scutellaris* (F.) and *Dideopsis aegrota* (F.) was studied on guava aphid, *Aphis gossypii* Glover, during 2007-08 and all the four species successfully completed their life cycle on *A. gossypii*. *P. serratus* had the shortest life cycle on *A. gossypii* with a total developmental period of 20.7 ± 1.36 days, followed by *E. balteatus* (21.5 ± 1.17 days), *I. scutellaris* (21.8 ± 0.91 days) and *D. aegrota* (26.3 ± 1.08 days). The total larval period of *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota* averaged 9.8 ± 0.82, 10.6 ± 0.43, 10.0 ± 0.56 and 11.2 ± 0.64 days, respectively. The pupal period, fecundity and longevity of the syrphids on *A. gossypii* were recorded. In order to complete the larval period, each larva of *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota* required a total of 333.7 ± 59.12, 380.7 ± 75.85, 410.8 ± 87.60 and 472.5 ± 56.89 numbers of *A. gossypii*, respectively.

KEY WORDS: *Aphis gossypii*, biology, *Dideopsis agerota*, *Episyrphus balteatus*, *Ischiodon scutellaris*, *Paragus serratus*, predatory potential.

INTRODUCTION

Aphids (Hemiptera: Aphididae) are some of the most destructive pests of crop plants. *Aphis gossypii* Glover is one of the polyphagous species which attacks the growing shoots of young guava plants both in nursery and main field. Larvae of syrphids rank as the major natural enemies and play an important role in the suppression of aphid populations (Ghorpade, 1981). Though aphidophagous syrphids reduce natural populations of aphids (Hagen and Bosch, 1968), no serious attempt has been made for their utilization in biocontrol programmes, may be due to the lack of information on the biology and ecology of syrphids and the problem of rearing the adults (Schneider 1969; Frazer, 1972). Considerable work has been carried out with reference to syrphids in India by Roy and Basu (1977), Ghorpade (1981), Radhakrishnan and Muraleedharan (1993), Joshi *et al*. (1997, 1998), Chitra Devi *et al*. (2002), Verma *et al*. (2005), Verma and Sharma (2006) and Murali Baskaran *et al*. (2007). In order to generate information on the biology and predatory potential of syrphids on *A. gossypii* with special reference to southern districts of Tamil Nadu, the present work was carried out at the Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai, during 2007-08.

MATERIALS AND METHODS

Cultures of *Aphis gossypii* maintained on guava shoots were used for studying the biology of four species of syrphids, *viz., Paragus serratus*, *Ischiodon scutellaris*, *Episyrphus balteatus* and *Dideopsis aegrota*. Eggs obtained from each species were allowed to complete one generation on *A. gossypii* and used in the experiment (Murali Baskaran *et al*., 1999). Twenty-five fresh eggs collected with the help of a camel hair brush from various parts of guava shoots were placed individually on a fresh guava leaf and transferred to a 5 ml screw cap vial, plugged with cotton wrapped in muslin cloth. The egg period was calculated by recording the day of eclosion from the date of release. After hatching, first instar larvae of the four species were kept singly on guava leaves with aphids in the vial. Known numbers of aphids were provided to the individual larva as food. On the following day, live aphids in each vial were counted and aphids eaten by each larva were noted. The vials were cleaned daily and soaked in 70 per cent alcohol so as to provide hygienic condition for the developing larva. The number and duration of instars were recorded by observing the moulted skins and the total larval period was counted.

The pupae were collected and kept in adult emergence cage. Pupal period, total developmental period, fecundity, oviposition period and longevity of male and female

syrphids were recorded as per Joshi *et al*. (1999). After hatching, one larva of each species of syrphid was confined separately in a 5ml vial and provided daily with known number of guava aphids sufficient enough for the next 24 hours (Verma *et al*., 2005). Surviving aphids were counted and removed daily and fresh aphids were provided to the larvae until pupation. The number of aphids consumed by the larvae in each instar and also the total number consumed during the larval period were calculated. The predatory potential studies were conducted with ten larvae and each was considered as one replication.

RESULTS AND DISCUSSION

All the four species of syrphids successfully completed their life cycle on guava aphid, *A. gossypii*. *P. serratus* had the shortest life cycle on *A. gossypii* with the total developmental period of 20.7 ± 1.36 days, followed by *E. balteatus* (21.5 ± 1.17 days), *I. scutellaris* (21.8 ± 0.91 days), and *D. aegrota* (26.3 ± 1.08 days) (Table 1). But the development periods of *P. serratus*, *I. scutellaris* and *E. balteatus* on mustard aphid, *Lipaphis erysimi* (Kalt.) were reported to be shorter, recording 16.1, 13.3 and 10.9 days, respectively (Chitra Devi *et al*., 2002). The egg period was 3.6 ± 0.16 days in *P. serratus*, 3.1 ± 0.11 days in *I. scutellaris*, 3.2 ± 0.23 days in *E. balteatus* and 4.5 ± 0.13 days in *D. aegrota* (Table 1). Slight variation in the egg period of various species of syrphids was reported when they were reared on mustard aphid, *Lipaphis erysimi* (Roy and Basu, 1977), tea aphid, *Toxoptera aurantii* (Boyer De Fonscolombe) (Radhakrishnan and Muraleedharan, 1993), rose aphid, *Macrosiphum rosae* L. (Verma and Sharma, 2006) and *Aphis fabae* Scopoli (Verma *et al*., 2005).

Three instars were observed in all four species of syrpids, when reared on *A. gossypii* and the average duration of first, second and third instars lasted 2.6 ± 0.19, 3.5 ± 0.25 and 3.7 ± 0.19 days for *P. serratus*, 3.0 ± 0.18, 3.7 ± 0.12 and 3.9 ± 0.13 for *I. scutellaris*, 2.8 ± 0.14, 3.5 ± 0.25 and 3.7 ± 0.17 days for *E. balteatus* and 3.5 ± 0.21, 3.8 ± 0.21 and 3.9 ± 0.22 days for *D. aegrota*. The total larval period of *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota* averaged 9.8±0.82, 10.6 ± 0.43, 10.0 ± 0.56 and 11.2 ± 0.64 days, respectively (Table 1). The present findings are supported by Roy and Basu (1977) and contradicted by Radhakrishnan and Muraleedharan (1993) who observed that the total larval period were 6.7, 8.0, 7.7 and 9.8 days for *P. serratus*, *I. scutellaris*, *B. serarius* and *D. aegrota*, respectively, on *T. auranti*. Verma *et al*. (2005) reported a larval period of 6.75 days for *E. balteatus* on *A. fabae*, as against 10.0 days in the present study. The pupal period lasted 7.3 ± 0.38, 8.1 ± 0.37, 8.3 ± 0.38 and 10.6 ± 0.31 days on *A. gossypii* (Table 1). However, the pupal period of the four syrphid species in the present study on *A. gossypii* was shorter than that on *T. aurantii* and *A. fabae* (Radhakrishnan and Muraleedharan, 1993).

The highest fecundity was noticed in *I. scutellaris* (45.5 ± 1.36 eggs / female) with an oviposition period of 2.9 ± 0.40 days, followed by *P. serratus* (35.8 ± 1.90 eggs / female), *E. balteatus* (21.2 ± 0.78 eggs / female) and *D. aegrota* (3.5 ± 0.17 eggs / female) with an oviposition period of 2.7 ± 0.59, 3.1 ± 0.59 and 0.79 ± 0.29 days, respectively (Table 1). Though the oviposition period of the four syrphids in the present study was comparable with the findings of Radhakrishnan and Muraleedharan (1993), the fecundity of *P. serratus* (35.8 eggs / female) and *I. scutellaris* (45.5 eggs / female) was high on *A. gossypii* as against only 11.75 and 7.60 eggs / female on *T. aurantii*.

Table 1. Biological parameters of syrphid species reared on guava aphid, *A. gossypii* (mean ± SD)

Life stages	*Paragus serratus*	*Ischiodon scutellaris*	*Episyrphus balteatus*	*Dideopsis aegrota*
Egg (days)	3.6 ± 0.16	3.1 ± 0.11	3.2 ± 0.23	4.5 ± 0.13
Larva (days)				
I instar	2.6 ± 0.19	3.0 ± 0.18	2.8 ± 0.14	3.5 ± 0.21
II instar	3.5 ± 0.25	3.7 ± 0.12	3.5 ± 0.25	3.8 ± 0.21
III instar	3.7 ± 0.19	3.9 ± 0.13	3.7 ± 0.17	3.9 ± 0.22
Total larval period (days)	9.8 ± 0.82	10.6 ± 0.43	10.0 ± 0.56	11.2 ± 0.64
Pupal period (days)	7.3 ± 0.38	8.1 ± 0.37	8.3 ± 0.38	10.6 ± 0.31
Total developmental period (days)	20.7 ± 1.36	21.8 ± 0.91	21.5 ± 1.17	26.3 ± 1.08
Fecundity/female (Nos.)	35.8 ± 1.90	45.5 ± 1.36	21.2 ± 0.78	3.5 ± 0.17
Oviposition period (days)	2.7 ± 0.59	2.9 ± 0.4	3.1 ± 0.59	0.79 ± 0.29
Male longevity (days)	1.2 ± 0.23	1.2 ± 0.13	1.3 ± 0.20	1.48 ± 0.15
Female longevity (days)	5.3 ± 0.16	5.5 ± 0.20	5.3 ± 0.16	5.6 ± 0.15

Table 2. Number of *A. gossypii* consumed by different instars of syrphids

Larval instar	Number of *A. gossypii* consumed (Mean ± SD)							
	P. serratus	% consumption	*I. scutellaris*	% consumption	*E. balteatus*	% consumption	*D. aegrota*	% consumption
I	28.5 ± 9.45	8.5	35.5 ± 8.81	9.3	52.8 ±10.45	12.8	55.4 ± 12.32	11.7
II	80.4 ± 15.42	24.1	94.8 ± 18.23	24.9	112.4 ± 25.01	27.4	126.4 ± 13.45	26.8
III	224.8 ± 34.25	67.4	250.4 ± 48.81	65.8	245.6 ± 52.14	59.8	290.7 ± 34.12	61.5
Total consumption	333.7 ± 59.12		380.7 ± 75.85		410.8 ± 87.60		472.5 ± 56.89	

The adult male of *D. aegrota* survived slightly longer (1.48 ± 0.15 days), followed by *E. balteatus* (1.3 ± 0.20 days), *I. scutellaris (*1.2 ± 0.13 days) and *P. serratus* (1.2 ± 0.23 days) when reared on *A. gossypii*, while the longevity of female adult was 5.6 ± 0.15, 5.5 ± 0.20, 5.3 ± 0.10 and 5.3 ± 0.10 days in *D. aegrota*, *I. scutellaris*, *P. serratus* and *E. balteatus*, respectively (Table 1). These findings are in accordance with Radhakrishnan and Muraleedharan (1993); however, the longevity of *E. balteatus* on *A. fabae* was higher (15 days for male; 20 days for female). This disparity might be due to the prevalence of lower temperature at Nauni, Solan, as compared to Madurai, Tamil Nadu.

Among the four syrphids, *D. aegrota* consumed the highest number of guava aphids followed by *E. balteatus*, *I. scutellaris* and *P. serratus.* The third instar was most voracious and required around 59 to 67 per cent of the total aphid requirement. Each larva of *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota* required a total of 333.7 ± 59.12, 380.7 ± 75.85, 410.8 ± 87.60 and 472.5 ± 56.89 numbers of *A. gossypii*, respectively (Table 2).

Dideopsis aegrota required the highest number of aphids to complete the larval period and the requirement for I, II and III instar was 55.7 ± 12.32, 126.4 ± 13.45 and 290.7 ± 34.12 aphids, respectively, which accounted for 11.7, 26.8 and 61.5 per cent of total aphids consumed. *E. balteatus* consumed 52.8 ± 10.45, 112.4 ± 25.01 and 245.6 ± 52.14 aphids during I, II and III instar, respectively, which was 12.8, 27.4 and 59.8 per cent of the total aphids consumed, followed by *I. scutellaris* [35.5 ± 8.81 (9.30%), 94.8 ± 18.23 (24.9%) and 250.4 ± 48.81 (65.8%) aphids during I, II and III instar, respectively] and *P. serratus* [28.5±9.45 (9.45%), 80.4 ± 15.42 (24.10%) and 224.8 ± 34.25 (67.40%) aphids during I, II and III instar, respectively] (Table 2). *D. aegrota* consumed the highest number of guava aphids followed by *E. balteatus*, *I. scutellaris* and *P. serratus.* Each larva of *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota* required a total of 333.7 ± 59.12, 380.7 ± 75.85, 410.8 ± 87.60 and 472.5 ± 56.89 numbers of *A. gossypii*, respectively. This is in conformity with Radhakrishnan and Muraleedharan (1993) who reported that *D. aegrota* required 454 numbers of tea aphid. Total consumption of *A. gossypii* (380.7 aphids) by *I. scutellaris*, in the present study, is in agreement with Roy and Basu (1977), Radhakrishnan and Muraleedharan (1993) and Chitra Devi *et al*. (2002) who reported the aphid requirement of 406.2, 296.7 and 397.0 numbers, respectively, when *I. scutellaris* was reared on mustard aphid, tea aphid and *Brassica juncea* (Linn.) aphid. The requirement of aphids (*T. aurantii* and *L. erysimi*) by *P. serratus* was 160.4 and 163.0 respectively, and it was doubled (333.7 aphids) when reared on *A. gossypii*. In the present study, the third instar of all the species of syrphids was the most voracious and required 67.4, 65.8, 59.8 and 61.5 per cent of the total aphids (*A. gossypii*) consumed for *P. serratus*, *I. scutellaris*, *E. balteatus* and *D. aegrota*, respectively, as reported by Lakhanpal and Desh Raj (1998).

REFERENCES

Chitra Devi, L., Singh, T. K. and Varatharajan, R. 2002. Role of natural enemies in the management of *Lipaphis erysimi* (Kalt.) on *Brassica juncea* var. *rugosa* (Linn.). *Journal of Biological Control*, **16**: 27-30.

Frazer, B. D. 1972. A simple and efficient method of rearing aphidophagous hover flies (Diptera: Syrphidae). *Journal of Entomological Society of British Columbia*, **69**: 23-24.

Ghorpade, K. 1981. Insect prey of Syrphidae (Diptera) from India and neighbouring Countries: A review and bibliography. *Tropical Pest Management*, **27**: 62-82.

Hagen, K. S. and Bosch, V. 1968. Impact of pathogens, parasites and predators on aphids. *Annual Review of Entomology*, **13**: 325-384.

Joshi, S., Ballal, C. R. and Rao, N. S. 1998. An efficient and simple mass culturing technique for *Ischiodon*

scutellaris (Fabricius), an aphidophagous syrphid. *Indian Journal of Plant Protection*, **26**: 56-61.

Joshi, S., Ballal, C. R. and Rao, N. S. 1999. Biotic potential of three coccinellid predators on different aphids hosts. *Journal of Entomological Research*, **23**: 1-7.

Joshi, S., Venkatesan, T. and Rao, N. S. 1997. Host range and predatory fauna of *Aphis craccivora* Koch in Bangalore, Karnataka. *Journal of Biological Control*, **11**: 59-63.

Lakhanpal, G. C. and Desh Raj. 1998. Predation potential of coccinellid and syrphid on important aphid infesting rapeseed in Himachal Pradesh. *Journal of Entomological Research,* **22**: 171-190.

Murali Baskaran, R. K., Suresh, K., Rajavel, D. S., Usha Rani, B. and Joshi, S. 2007. Monitoring of population fluctuation of guava aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) and its predators. *Hexapoda*, **14**: 157-161.

Murali Baskaran, R. K., Geetha Lakshmi, L. and Uthamasamy, S. 1999. Comparative biology and predatory potential of Australian ladybird beetle (*Cryptolaemus montrouzieri*) on *Planococcus citri* and *Dactylopius tomentosus*. *Indian Journal of Agricultural Sciences*, **69**: 605-606.

Radhakrishnan, B. and Muraleedharan, N. 1993. Bio-ecology of six species of syrphid predators of the aphid, *Toxoptera aurantii* in Southern India. *Entomon*, **18**: 175-180.

Roy, P. and Basu, S. K. 1977. Bionomics of aphidophagous syrphid flies. *Indian Journal of Entomology*, **39**: 165-174.

Schneider, F. 1969. Bionomics and physiology of aphidophagous syrphids. *Annual Review of Entomology*, **14**: 103-112.

Verma, J. S. and Sharma, K. C. 2006. Biology and predatory potential of *Metasyrphus confrater* on aphid, *Macrosiphum rosae* L. infesting *Rosa* spp. *Journal of Entomological Research*, **30**: 31-32.

Verma, J. S., Sharma, K. C., Anil Sood and Meenu Sood. 2005. Biology and predatory potential of syrphid predators on *Aphis fabae* infesting *Solanum nigrum* L. *Journal of Entomological Research*, **29**: 39-41.

(Received: 16-10-2008; Revised: 25-11-2008; Accecpted: 02-12-2008)