



Development and Feeding Capacity of *Scaeva albomaculata* (Macqurt) (Diptera: Syrphidae) fed with rose aphid, *Macrosiphum rosae* (Homoptera: Aphididae)

Farzad Jalilian

Department of Plant Protection,
Agricultural Research Center, Kermanshah, IRAN

(Corresponding author: Farzad Jalilian)

(Received 29 March, 2015, Accepted 07 May, 2015)

(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Species of the genus *Scaeva Fabricius*, are predatory syrphids with an important role in the bio-control of aphid pests in different parts of the world. Some biological characteristics and larval feeding rate of hoverfly, *Scaeva albomaculata* (Macqurt) were investigated on *Macrosiphum rosae* (L.) at laboratory conditions. The experiments were carried out in growth chamber at $27 \pm 2^\circ\text{C}$, $60 \pm 5\%$ RH, and $16 : 8$ (L : D) photoperiod. The egg, 1st, 2nd, 3rd larval instars, pre-pupa, and pupa developmental times were determined as 4.50 ± 0.42 , 2.5 ± 0.22 , 2.66 ± 0.21 , 3.83 ± 0.37 , 1.16 ± 0.16 , 5.50 ± 0.71 days, respectively. Adult longevity was considerably increased (32.75 ± 2.78 days) when they were fed with honey solution, while in food free conditions, they were alive only 4.33 ± 0.88 days. Each female was produced 110.6 ± 11.77 eggs during oviposition period, 88.50% of these eggs were hatched to first instar larvae. Mean feeding rate of 1st, 2nd and 3rd instar larva were 22.5 ± 3.95 , 88.16 ± 11.4 and 400.5 ± 72.5 respectively. Each larva ate 516.167 ± 73.17 aphids during larval period. There were significant differences ($P < 0.01$) between daily feeding rates of larval instars. The third instar larvae had an important role in feeding rate and 78.32% of total larval feeding was due to this instar. Due to high potential of feeding rate of *Scaeva albomaculata*, it can be a good agent for bio-control and IPM programs of *Macrosiphum rosae*.

Keywords: *Scaeva albomaculata* (L.), *Macrosiphum rosae*, Biological Control, Hoverflies

INTRODUCTION

Aphids are an important pest in greenhouses and outdoors and one group of their natural enemies are hoverflies (Diptera, Syrphidae). *Macrosiphum rosae* is one of the serious pests of rose around world (Gilbert, 1993; Bergh & Short, 2008). It is estimated that their importance as natural enemies is equal to that of parasitoids, pathogenic fungi, ladybirds and lacewings. Only hoverflies of subfamily Syrphinae are aphid predators. Other hoverflies have very diverse larval feeding habits (Helyer *et al.*, 2003). Hoverflies have been used as indicators of agricultural pollution, habitat disturbance and habitat quality (Sommagio, 1999). In recent years, information about European hoverflies has become widely accessible through the development of the Syrph, the Net database (Speight *et al.*, 2004). Many authors have reported that syrphids lay eggs at the beginning of aphid population build-up and they are considered to be effective biological agents of the early aphid population management. (Soleyman-Nezhadiyan & Laughlin, 1998; Moetamedinia *et al.*, 2004; Hideki *et al.*, 2007). From the perspective of integrated pest

management, an ideal natural enemy is one that consumes or parasitizes sufficient numbers of prey/host to maintain a pest population below the economic injury threshold for the crop in question (Michaud and Belliere, 2001; Soleyman-Nazkadian & Laughlin, 1998). *Scaeva albomaculata* (Macqurt, 1842) larvae predatory on a wide range of aphids and distributed South part of Palaearctic to north part of Oriental region (Laska *et al.*, 2006). Larvae of *S. albomaculata* were described in Laska, *et al.*, (2006). *Scaeva albomaculata* is common and promising candidate species for the biological control of aphids and also third dominant species in West provinces of Iran, but little is known of quantitative aspects of its life (Fathipour *et al.*, 2006). The main purpose of the present research was to study the biology and voracity of larvae reared on rose aphids. In face of the problems resulting from chemical control of rose aphid (environmental contamination, in home gardens and other urban environments (such as parks) biological control represents an efficient and alternative for management of rose aphid populations (Frazer, 1988).

MATERIALS AND METHOD

A. Insects

The female flies of *S. albomaculata* captured while orienting to rose aphid colonies. *Macrosiphum rosae* were collected on roses in Agricultural Research Center of Kermanshah's Campus, Kermanshah, Iran. Gravid females of *S. albomaculata* that had swollen abdomen released to Petri dishes (8 cm diameter and 1 cm height). Oviposition was stimulated by introducing aphid infected young rose shoots in the rearing Petri dishes, because the selection of oviposition site by hoverfly predators relies on the perception of a volatile blend composed of prey pheromone and typical plant green leaf volatiles (Verheggen *et al.*, 2008). The flies were supplied with honey solution (10%) and canola pollen. Additionally longevity of females measured in food free conditions. Petri dishes were inspected daily intervals and any laid eggs, were collected. All rearing and experiments were conducted at $27 \pm 2^\circ\text{C}$, $60 \pm 5\%$ RH, 16 : 8 (L : D) photoperiod.

B. Biology and Consumption assays

Biology and consumption assays were conducted on a growth chamber (as above). The eggs were removed from the plant materials by cutting off a small piece of plant tissue then placed in a Petri dish individually. Cannibalism occurs in wide variety of predators (Banquart *et al.*, 1997), to avoid this behavior, an individual larva were reared in a single Petri dish throughout their developmental period. The dishes were held in the growth chamber and eggs were observed for larval eclosion at 24-h intervals. Aphid infected young rose shoots of mixed instars of rose aphids were cut off and were inspected under a binocular to remove unwanted materials such as other insect eggs, by a soft brush, then aphids offered to the neonate larvae of hoverfly. This plant part also provides humidity for the larva. There are about 200 rose aphids on plant parts. The number of consumed aphids were recorded daily, based on the remaining exuviae of aphids, to obtain daily and total life-time consumption, the remaining aphids were replaced inside Petri dishes. This experiment was replicated 6 times. Developmental period of all life stages were determined. Mortality of each immature stage were recorded. Flies were reared to maturity on rose aphid. Adult emergence was recorded and gender determination were based on adult possessing holoptic or dicoptic eyes.

C. Adult longevity and fecundity

The flies (<12-h-old) were placed individually in cages consisting of a clear plastic tube (16 cm high \times 7.5 cm diameter) with screened top that was placed in a flowerpot three-fourth full of damp sand and provisioned with a source of honey water, canola pollen

and a section of rose shoot as a perch. Pollen and honey water were replaced periodically. The flies were monitored until all had died.

Mean pre-imaginal duration were estimated by summing the mean time to egg hatch, the mean larval developmental time, the mean pre-pupa and pupation time.

D. Statistical Analysis

Mean developmental times of immature stages used to analysis of the results. Comparisons were made upon predation rates of 3 larval stages and longevity of adults using two-sample t-test at $\alpha=0.05$. Proc Univariate of SAS (SAS 9.1, 2003)

RESULTS AND DISCUSSION

A. Description of life stages

Adult females of *S. albomaculata* were collected from campus, laid eggs before dying within the 24 h of captivity. The eggs hatched in 4.50 ± 0.43 (Mean \pm SE) days. Total larval stage was 10 ± 0.76 days. Adults emerged through the pupae after 6.66 ± 0.80 days. Developmental times of different life stages of hoverfly were presented in Table 1.

Table 1: Mean duration of biological stages of *Scaeva albomaculata* on *Macrosiphum rosae* at $27 \pm 2^\circ\text{C}$.

Developmental stage	Mean \pm SE
Egg	4.50 \pm 0.43
1st instar larva	3.50 \pm 0.21
2 nd instar larva	2.67 \pm 0.24
3 rd instar larva	3.83 \pm 0.31
Pre-pupa	1.17 \pm 0.17
Pupa	5.50 \pm 0.72
Pre-imaginal	20.16 \pm 1.30
Longevity of adults with feeding	32.75 \pm 2.78
Longevity of adults without feeding	4.33 \pm 0.88

Developmental times presented here contradicted in part, those of Nourbakhsh *et al.*, (2007). They put eggs of *S. albomaculata* in 20°C and reported the incubation period, 2.2 ± 0.04 days. This difference may be due to that, they collected eggs from natural colonies and some of development of eggs take place in natural conditions. Also they found that larval developmental times of *S. albomaculata* on almond aphid, *Brachycaudus amigdalinus* (Schouteden) as a prey, in laboratory conditions (20 ± 2 and 45% RH) were 2.57, 1.57 and 4.3 days for larval stages.

All of the developmental times were considerably less than our finding except duration of 3rd instar larva. Exposure to higher temperature reduces developmental period of immature stages of insects and consequently increases the developmental rate. Results of Fathipour *et al.*, (2006) are very near to our results. They were studied *S. albomaculata* biology on green peach aphid, *Myzus persicae* at $25 \pm 2^\circ\text{C}$. They reported incubation period, larval, pupal and total immature stages as, 4.67, 11.33, 7.83 and 24.83 days, respectively. The fecundity of females (95.50) and survival of eggs (85.97%) on *M. persicae* is near to our results. At 27°C developmental rate and fecundity of *S. albomaculata* increased without decreasing survival rate, and we can recommended this temperature, as optimum temperature for laboratory rearing of this hoverfly. In similar conditions another

species, *Scaeva pyrastris* showed very close durations to our study (Golmohammadzadeh-Khiaban, 1998).

B. Feeding rate

Late instar larvae were more voracious than younger instars and about 78.32% of this consumption occurred during the 3rd instar which comprised only 42.59% of developmental period (Table 2). There were significant differences ($P < 0.1$) between daily feeding rates of the first, second and third instar larvae. Each larva fed average 516.16 ± 73.17 aphids during larval period and revealed a high potential of feeding on *M. rosae*. There was significant difference between the consumption rates of larval stages ($p < 0.05$). Values marked with different letters in each column are significantly different ($p < 0.05$).

Table 2. Daily and total feeding rate of larval stages of *S. albomaculata* on *M. rosae* Mean \pm SE.

Developmental stage	Mean Daily feeding rate	Mean total rate
1st instar larva	8.79 ± 0.44^a	22.5 ± 3.95^a
2 nd instar larva	38.06 ± 1.69^b	88.16 ± 11.4^b
3 rd instar larva	76.31 ± 3.28^c	400.5 ± 72.5^c

Values marked with different letters in each column are significantly different ($p < 0.01$)

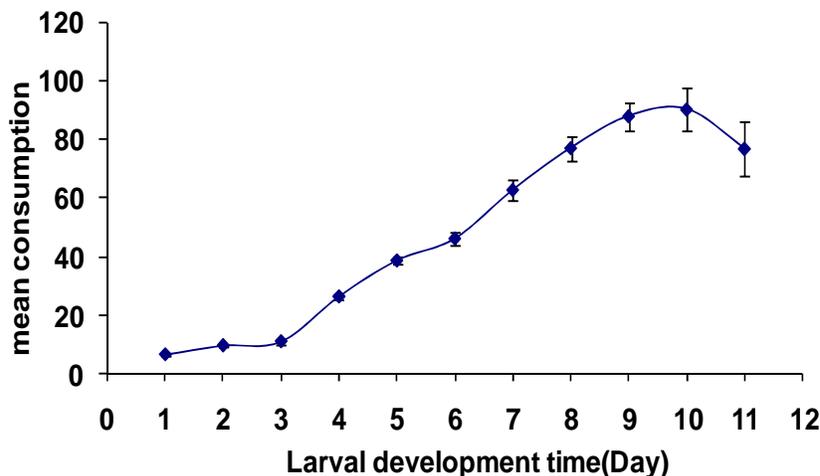


Fig. 1. Daily consumption trend of *Scaeva albomaculata* on *Macrosiphum rosae*.

The voracity of larvae of *Melungyna viridiceps* and *Symosyrphus grundicornis* fed on the rose aphid, *M. rosae*, was measured at 10, 15 and 20°C , over the three larval instars, a lifetime total of about 300 aphids (third-instar equivalents) was consumed (Fig. 1). Third-instar larva ate about 85% of the total, although this instar accounted for only 55% of larval development time (Soleyman-Nezhadiyan & Laughlin, 1998).

C. Adult longevity and fecundity

Adult longevity was considerably increased (days) when they were fed with honey solution plus canola pollen. Adult longevity varied from 25 to 35 days, with an average of 32.75 ± 2.78 days while in food free conditions, they were alive only 4.33 days (Table 1).

The results indicated that each female produce average 110.6 ± 11.77 eggs during oviposition period (Fig. 2), 88.50% of these eggs hatch to first instar larvae. Trend of oviposition showed in Fig. 2, Peak of oviposition occurred in day 5 of oviposition period. Moetamedinia

and colleagues (2004) studied the biology of Syrphid fly, *Sphaerophoria scripta* on *Aphis craccivora*, they showed that the maximum oviposition occurred on 4th and 5th days, each female laid on average 195.2 ± 56.08 eggs.

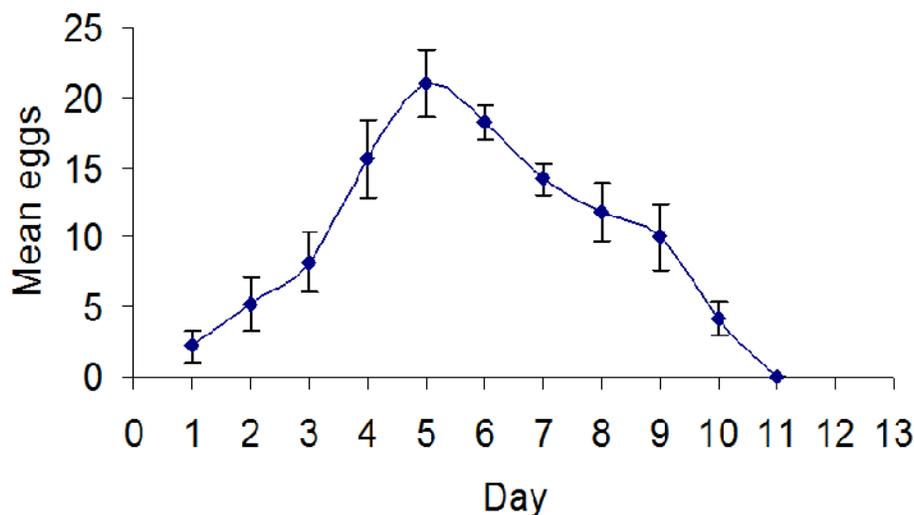


Fig. 2. Oviposition trend of *Scaeva albomaculata*.

Data from the current study confirms that fly *S. albomaculata* has considerable potential for biological control of aphid pests, specially rose aphid, *M. rosae*. These data reveal new information about the voracity of *S. albomaculata* on rose aphid and should enhance further studies on its relative role and effectiveness at suppressing outbreak of rose aphid.

ACKNOWLEDGMENTS

This study was partially funded by the Agriculture Research Center of Kermanshah, Iran.

REFERENCES

- Bergh, J.C. and Short, B.D. (2008). Ecological and life-history notes on syrphid predators of wooly apple aphid in Virginia, with emphasis on *Heringia calcarata*. *BioControl*. **53**:773-786. DOI 10.1007/s10526-007-9114-0.
- Branquart, E., Hemptinne, J. L., Bauffe, C. and Benfekih, L. (1997). Cannibalism in *Episyrphus balteatus* (Dip.: Syrphidae). *Entomophaga*. **42**(1/2): 145-152.
- Fathipour, Y., Jalilian, F., and Talebi, A. A. (2006). Biology and larval feeding rate of *Scaeva albomaculata* (Dip. : Syarphidae) on myzura persicae (Homoptera: Aphididae) at laboratory conditions. *Iranian Journal of Agricultural Sciences*; **37**(2): 249-254.
- Frazer, B. D. (1988). Predators, p.217-230. In: A. K. Minks & P. Harrewijn (Eds.). *Aphids, their biology, natural enemies and control*. Amsterdam, Elsevier, vol. **2B**, 364 p.
- Golmohammadzadeh-Khiaban, N. (1998). Faunistic study of syrphid flies in Urmia region. Msc Thesis, Urmia Univ. 131 pp.(in farsi and English abstract)
- Helyer, N., Brown, K. and Cattlin, N.D. (2003). *Biological Control in Plant Protection*. Manson Publishing.
- Hideki I., Nijima, K. and Matsuka, M. (2007). An artificial diet for aphidophagous syrphid, *Episyrphus balteatus* (de Geer) honeybee brood powder. *Appl. Entomol. Zool*. **42**(2): 167-172
- Laska, P., Perez-Banon, C., Mazanek, L., Rojo, S., Stahls, G., Marcos-Garcia, M. A., Bicik, V. and Dusek, J. (2006). Taxonomy of genera *Scaeva*, *Symosyrphus*, and *Ischiodon* (Diptera: Syrphidae) : Description of immature stages and status of taxa. *Eur. J. Entomol*. **103**: 637- 655,
- Michaud, J. P. and Belliure, B. (2001). Impact of Syrphid predation on production of migrants in colonies of the brown citrus aphid, *Toxoptera citricida* (Homoptera: Aphididae) *Biological Control*, **21**, 91-95

- Moetamedinia, B., Sahragard, A., Salehi, L. and Jalil-sendi, J. (2004). Biology of *Sphaerophoria scripta* (Dip.: Syrphidae) in laboratory conditions. *Journal of Entomological society of Iran*. **23**(2):33-43 (In Farsi with English abstract).
- Nourbakhsh, S. H., Soleymannejadian, E. and Nemti, A. R. (2007). Biology and population dynamics of *Scaeva albomaculata* (Diptera : Syrphidae) in almond orchards of Shahrekord, Iran. *Journal of Entomological Society of Iran*. **27**(2): 93-108.[in Farsi with English abstract].
- Sadeghi, H. And Gilbert, F. (2000). Oviposition preferences of aphidophagous hoverflies. *Ecological Entomology*, **25**: 91-100.
- Soleyman-Nezhadiyan, E. (1996). The ecology of *Melangyna viridiceps* and *Simosyrphus grandicornis* (Diptera: Syrphidae) and their impact on populations of rose aphid, *Macrosiphum rosae*. Ph. D thesis, University of Adelaide, Adelaide.
- Soleyman-Nezhadiyan, E. and Laughlin, R. (1998). Voracity of larvae, rate of development in eggs, larvae and pupae, and flight seasons of adults of the hoverflies *Melangyna viridiceps* Macquart and *Simosyrphus grandicornis* Macquart (Diptera: Syrphidae). *Australian Journal of Entomology*, **37**: 243-248
- Sommagio, D. (1999). Syrphidae: Can they be used as environmental bio-indicators? *Agriculture Ecosystem and Environment*, **74**: 343-356.
- Tenhuberg, B. (1995). Estimating predatory efficiency of *Episyrphus balteatus* (Diptera: Syrphidae) in cereal fields. *Environmental Entomology*, **24**: 687-691
- Verheggen, F. J., Arnaud, L., Bartram, S., Gohy, M. and Haubruge, E. (2008). Aphid and plant volatiles induce oviposition in an aphidiophagus hoverfly. *J. Chem. Ecol.* **43**: 301-307.