



## EFFECT OF THREE CONSTANT TEMPERATURES ON THE BIOLOGY AND PREDATORY POTENTIAL OF *MENOCHILUS SEXMACULATUS* FAB. (COLEOPTERA: COCCINELLIDAE) FEEDING ON *SCHIZAPHIS GRAMINUM* APHID (HEMIPTERA: APHIDIDAE)

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### ABSTRACT

The effect of three constant temperatures i.e.  $22\pm 1^\circ\text{C}$ ,  $28\pm 1^\circ\text{C}$  and  $34\pm 1^\circ\text{C}$  on the biological parameters of *Menochilus sexmaculatus* Fab. was studied at Insectary-biological control laboratories, National Agricultural Research Centre Islamabad during 2012. There was a significant effect of temperatures on the developmental durations and predatory potential of *M. sexmaculatus* reared on *Schizaphis graminum* aphid. The incubation period was  $4.22\pm 0.12$ ,  $3.64\pm 0.11$  and  $2.12\pm 0.11$  days with  $73.2\pm 3.07$ ,  $80.8\pm 2.06$  and  $64.8\pm 3.50$  percent hatchability. The total larval duration was  $9.48\pm 0.09$ ,  $7.89\pm 0.07$  and  $5.65\pm 0.07$  days. The predatory potential of larval stage was ranged from 161 to 184 aphids/larvae. The pupal duration was  $4.28\pm 0.08$ ,  $3.69\pm 0.05$  and  $2.24\pm 0.06$  days. The results indicate that temperature have significant effect on the developmental durations and predatory potential of *Menochilus sexmaculatus*. The adult female longevity at three constant temperatures was  $56.83\pm 0.45$ ,  $42.47\pm 0.42$  and  $36.07\pm 0.32$  days with fecundity rate of  $452.13\pm 8.20$ ,  $631.23\pm 10.79$  and  $473.67\pm 8.31$  eggs per female when feeding on *Schizaphis graminum* aphid. The adult predatory potential of female beetle was significantly higher than male. The adult male consumed aphids range from 2468 to 2501 and female consumed from 3175 to 3356 aphids. The result of the present study indicates that temperature has significant effect on duration, survival and predatory potential of the predatory. Coccinellid and with increasing temperature the duration significantly decreased. The optimum temperature for quality mass rearing of the predator was  $28\pm 1^\circ\text{C}$  out of the tested temperatures.

**Keywords:** Biology, *Menochilus sexmaculatus*, predatory potential, *Schizaphis graminum* aphid, temperatures

### INTRODUCTION

Coccinellids has been widely used in biological control for over a century and the methods for using these predators have remained virtually unchanged but the causes for the relatively low rates of establishment of Coccinellids in biological control have not been examined for most species. The predacious Coccinellids are considered to be of great economic importance and they have been successfully employed in the biological control of many injurious insect pests and are easily available in agricultural ecosystem (Irshad, 2001).

*Menochilus sexmaculatus* Fab. (Coleoptera: Coccinellidae) is a common aphid predator and widely distributed in many countries of the world (Solangi *et al.*, 2007). It is distributed in South East Asia, Indonesia, Philippines, South Africa, Pakistan and India (Rahman *et al.*, 1993). Adult beetle are bright yellow in color with black zigzag lines on the dorsal side of both elytra. The adult length is 3.8 mm and width 2.8 mm (Atwal, 1991)

*M. sexmaculatus* has wide range of hosts i.e. rose aphid, green peach aphid, green bug aphid, coffee green bug, thrips, green mustard aphid, scales, jassid, corn borer, sorghum shoot fly, and maize aphid. (Palaniswami *et al.*, 1995). *M. sexmaculatus*

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is an efficient predator of many aphid species. (Mari *et al.*, 2005)

Insects have an optimum temperature at which they can perform their best. Above and below the optimum their performances decline. In extreme temperatures insects can be suffered by damages and even death can be caused. Extreme temperature affects their developmental rate and increases their mortality. A slight increase in the temperature will cause increase in the activity. (Rana, 2006).

Rana (2001) studied the predatory potential of *Coccinella septempunctata* (Coleoptera: Coccinellidae) in wheat crop and observed that the climatic factors (minimum and maximum temperature, relative humidity, rainfall and sunshine hours) played a crucial role in the establishment of the aphid as well as predator. When temperature was less than 10°C, the predator could not establish itself at this point aphid started settling on the crop. When temperature started rising and was above 15°C, the predator showed activity in its grub stage and was observed activity feeding on aphid.

Ali and Rizvi (2009) studied age specific life table of *M. sexmaculatus* at varying temperature (20±1°C, 24±1°C and 28±1°C). The results revealed that it took shortest development period (41 days) at 28±1°C and longest (49 days) at 20±1°C. There was an undulating pattern of mortality was observed at different age intervals with varying temperature. However, a sharp decline in expectation of life towards the end of generation was seen especially at 28±1°C as compared to other temperatures.

Therefore, it is very important to study the relationship between temperature and development for any economically important species.

Keeping in view the importance of natural enemies the present study were conducted on biological parameters and predatory potential of *M. sexmaculatus* on wheat aphid *S. graminum* at three constant temperatures. This information will be ascertained to enhance the predatory potential of the predator against aphid pest of wheat.

## MATERIALS AND METHODS

### Maintenance of *S. graminum* culture

The culture of wheat aphid *S. graminum* was maintained on wheat variety NARC-2008, under glasshouse condition at Insectary-biological control laboratories. Initially the aphids were collected from wheat field and then released on wheat plants in the bed under glass house conditions. The colony was maintained throughout the experimental duration for feeding to the predator.

### Maintenance of *M. sexmaculatus* culture

Coccinellid predator *M. sexmaculatus* was initially collected from wheat field at NARC farm and the adults were kept in plastic rearing jars at Insectary. The adults were provided *S. graminum* aphid inside the jars on wheat leaves daily. The eggs were collected from the jars on wheat leaves and also on tissue which was also provided inside the jars. Freshly collected eggs of known age were separated and kept for hatching at each required temperature.

## Experiments

The experiments were conducted at the Insectary-Biological Control Labs., Insect Pest Management Programme (IPMP), Department of Plant and Environmental Protection (DPEP), National Agricultural Research Centre (NARC), Islamabad at three constant temperature (22±1°C, 28±1°C and 34±1°C) and 60±5% R.H. in insect holding room.

### Developmental durations and predatory potential of immature stages of *M. sexmaculatus*

Freshly laid eggs of counted number (n = 50) were transferred into Petri dishes (9cm diameter) with the help of soft camel hair brush and allowed to hatch at three constant temperature levels. Incubation period and number eggs hatched per batch were recorded. Upon hatching thirty-first instar grubs of the same age were collected from jars and reared on *S. graminum* at three constant temperatures in plastic vials (4.0 × 6.0cm). Counted number of first and second instars of *S. graminum* was provided as food to the early instar larvae of *M. sexmaculatus*. Initially the first instar grubs were provided 20 aphids and with increasing age of the predator the number of aphids were increased and the fourth instar grubs were provided up to 250 aphids inside the vials. This procedure was followed till pupation. The data on developmental period and predatory potential of immature *M. sexmaculatus* were recorded.

### Adult developmental durations and predatory potential

To study the adult developmental duration, fecundity and predatory potential thirty pair of newly emerged adults were collected from culture and each pair was released in small plastic jars covered with muslin cloth at the top. Sufficient aphids (250-400 nymphs per day) were provided to *M. sexmaculatus* in jars daily till the predator's mortality. The eggs laid by female in the jars were counted and collected daily. The data on developmental durations and eggs laid by female were recorded daily. To study the predatory potential of adult male and female a total of 20 adults of male and female were separated and kept in plastic jars covered with muslin cloth at the top. Counted numbers of aphids from 150 up to 250 were provided inside the jars. The number of aphids consumed and the remaining in the jars were counted daily. The process was continued till the mortality of all male and females in the jars and the data obtained was analyzed statistically by applying analysis of variance technique according to procedure given by (Mari *et al.*, 2005). The means of significant differences were compared by LSD at 5% level.

## RESULTS AND DISCUSSION

### Incubation period and percentage of egg hatchability

The data revealed that there was a significant effect of different temperature regimes on the incubation period and egg hatchability of *M. sexmaculatus*. The egg incubation period was 4.22±0.12, 3.64±0.11 and 2.12±0.11 days with 73.2±3.07, 80.8±2.06 and 64.8±3.50% hatchability (Table 1).

**Table 1**

Biological parameters of *Menochilus sexmaculatus* reared on *Schizaphis graminum* aphid at three constant temperatures i.e. 22<sup>o</sup>C, 28<sup>o</sup>C and 34<sup>o</sup>C.

Parameters	22±1°C	28±1°C	34±1°C	LSD
Egg incubation period (days)	4.22±0.12 a	3.64±0.11 b	2.12±0.11 c	0.3531
No of eggs/female	452.13±8.20 b	631.23±10.79 a	473.67±8.31 b	25.794
Percent hatchability	73.2±3.07 ab	80.8±2.06 a	64.8±3.50 b	9.0572
Duration of 1 <sup>st</sup> instar (days)	2.38±0.04 a	1.96±0.03 b	1.16±0.02 c	0.0888
Duration of 2 <sup>nd</sup> instar (days)	2.41±0.04 a	1.90±0.05 b	1.20±0.02 c	0.1058
Duration of 3 <sup>rd</sup> instar (days)	2.14±0.05 a	1.87±0.03 b	1.25±0.03 c	0.1042
Duration of 4 <sup>th</sup> instar (days)	2.55±0.07 a	2.16±0.05 b	2.04±0.05 b	0.1524
Total larval duration (days)	9.48±0.09 a	7.89±0.07 b	5.65±0.07 c	0.2199
Pupal period (days)	4.28±0.08 a	3.69±0.05 b	2.24±0.06 c	0.1869
Pre-oviposition (days)	7.46±0.17 a	5.99±0.13 b	4.14±0.12 c	0.4139
Oviposition (days)	41.78±0.51 a	30.65±0.47 b	27.57±0.34 c	1.2553
Post-oviposition (days)	7.59±0.14 a	5.86±0.16 b	4.39±0.13 c	0.3992
Adult longevity Male (days)	41.63±0.45 a	33.00±0.35 b	26.57±0.23 c	0.9939
Adult longevity female days)	56.83±0.45 a	42.47±0.42 b	36.07±0.32 c	1.1215

Means in rows followed by same letter are not significantly different at  $p \leq 0.05$ .

Solangi et al., (2005) reported incubation period of *M. sexmaculatus* was 3.6 days and eggs percent hatchability was 64.33 to 70.69 at 25±2°C.

#### Developmental period of larval stages

The larvae passed through 4 larval instars with three moults as confirmed from the observation of exuviae in the Petri dish. The data on developmental period revealed that temperature significantly influenced the development of first, second, third and fourth instars of *M. sexmaculatus* reared on *S. graminum* (Table 1).

The duration of larval/grub stage was 9.48±0.09, 7.89±0.07 and 5.65±0.07 days. The results indicate that there was significant difference in larval duration at three constant temperatures (Table 1). The result further indicates that with increasing temperature the duration of larval stage decreased significantly. The pupal period was 4.28±0.08, 3.69±0.05 and 2.24±0.06 days. The duration of pupal stage decreased significantly as the temperature increased (Table 1).

These results are in agreement with Prodhhan et al., (1995) who reported that the larval duration of the *M. sexmaculatus* lasted for 7 to 9 days on bean aphid. Pupal period of the *M. sexmaculatus* ranged between 2.24 to 4.28 days at different temperatures. These findings are very close with Solangi et al., (2007) who reported that the pupal period was 3.1 to 5.5 days at two temperatures 34±1°C and 20±1°C, which indicates that with increasing temperature duration of the pupal stage decreased significantly.

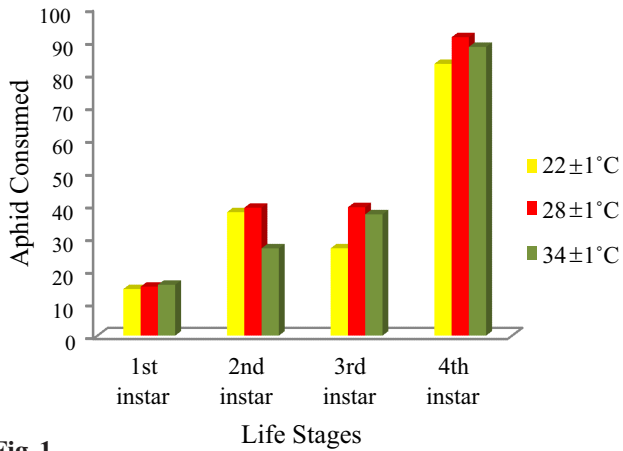
#### Developmental period of adults

The data regarding three constant temperature effect on the adult biology and predatory potential of *M. sexmaculatus* indicates that temperature have significant effect on developmental durations, fecundity and predatory potential.

The data revealed that longevity of adult *M. sexmaculatus* (male and female) ranged between 26.57- 41.63 and 36.07- 56.83 days. The duration of adult female was longer at 22°C. (Table 1). The results also showed that adult female lived longer than male on *S. graminum* at the three constant temperatures. Pre-oviposition, oviposition and post-oviposition period ranged from 4.14 to 7.46, 27.57 to 41.78 and 4.39 to 7.59 days, respectively. Similar, findings were reported by Pirzado et al., (1999) that the longevity of male was less (41.8 days) than female (49.7 days) and oviposition period was 38.0 days fed on *R. maidis*.

#### Predatory potential of immature stages

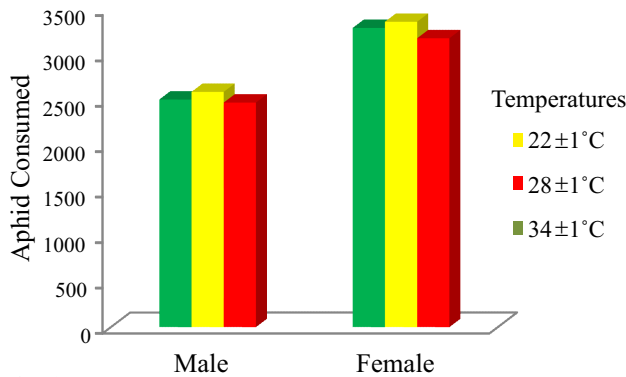
Predatory potential of first, second, third and fourth instar ranged from 14.20 to 15.50, 26.60 to 39.00, 26.63 to 39.13 and 82.83 to 90.96 aphids at different temperatures and the total larval potential was between 161.29 to 184.02 aphids (Figure 1). These results are similar with Solangi et al. (2007) results who reported that the total larval predatory potential ranged from 100.16 to 228.44 aphids on three different types of foods.



**Fig. 1**  
Predatory potential of immature stages of *M. sexmaculatus* feeding on *S. graminum* at three temperature levels.

**Predatory potential of adults**

Predatory potential of adult female ranged from 3175.5 to 3356.8 aphids and was greater than the adult male, 2468.5 to 2585.9 aphids at three temperature levels. Predatory potential of male was significantly higher at 28°C, however, it was equally good at 22°C and 28°C (Figure 2). These results are close with Mari et al., (2005). He found that the predatory potential of male *M. sexmaculatus* and *C. undecimpunctata* was 2548 and 2930, and of female 2800 and 3080 on alfalfa aphids, respectively.



**Fig. 2**  
Predatory potential of adult *M. Sexmaculatus* feeding on *S. graminum* at three temperature levels.

**CONCLUSION**

The results of the present study indicates that out of the three tested temperature (28±1°C) was more suitable for mass rearing of *M. sexmaculatus* feeding on *S. graminum* aphid. The percent hatchability of eggs was maximum (80.8%) and female reproductive potential was 631.23 eggs per female. The predatory potential of adult female was maximum (3356.8 aphids/ adult female at 28±1°C). The results further indicates that temperature have significant effect on the biology and predatory potential of *M. sexmaculatus* and with increasing temperature developmental duration decreased. The results of the present study can be utilized for quality

mass rearing of the predator under controlled conditions.

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