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BIOLOGY AND PREDATORY POTENTIAL OF *COCCINELLA SEPTEMPUNCTATA* LINN. ON *SCHIZAPHIS GRAMINUM* APHID UNDER CONTROLLED CONDITIONS

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ABSTRACT:- The biology and predatory potential of *Coccinella septempunctata* (Linn.) were studied on aphid, *Schizaphis graminum* (Rondani) at three constant temperatures 20±1 ˚C, 25±1 ˚C and 30±1 ˚C in Insectary-Bio Control Laboratories, National Agricultural Research Centre (NARC), Islamabad. The results revealed that incubation period of *C. septempunctata* was 5.12, 3.62 and 3.20 days with 75.6%, 82.0% and 71.2% hatchability, respectively. The larval durations were 29.5, 15.9 and 8.1 days with predatory potential of 573.7, 575.0 and 667.8 aphids per larvae. The results indicated that with increasing temperature, developmental duration decreases significantly. The pupal developmental duration was 14.0, 9.2 and 5.2 days, respectively which are significantly different from each other. The adult male and female longevity were 44.7, 37.7, 30.0 and 60.3, 58.9 and 43.7 days. Fecundity rate of females were 123.5, 251.5 and 293.2 eggs per female, respectively. This indicates that adult male and female developmental duration, female fecundity rate were significantly different from each other at three constant temperatures. Maximum female and male predatory potential was 3262.8 and 2571.7 aphids at 25 ±1 ˚C while minimum was 2276.8 and 1890.6 aphids, respectively.

Key Words: Coccinella septempunctata; Schizaphis graminum; Biological Parameters; Temperatures; Developmental Stages; Pakistan.

INTRODUCTION

The ladybird beetle, *Coccinella septempunctata* Linn. (Coccinellidae: Coleoptera) is well known and diverse group of predator beetle feeding on soft bodied insect pests. It is found in many habitats, including fields, gardens, forests, sea coast, mountains and cities (Ali and Rizvi, 2009). The beetle has a considerable range of prey, which includes some of the most destructive group of insects, notably the aphids and the scale insects. Seven-spotted ladybird beetles are predaceous on various types of aphids (rose aphid, green peach aphid, green bug aphid and green mustard aphid), mealy bugs, sugarcane aleyrodid, citrus psyllid, mites and sorghum stem borer, *Chilo partellus*. The predator has high potential of predation both in the immature as well as adult stage (Shepard, 1998).

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Wheat aphids are one of the most emerging problems causing serious threat to wheat crop in Pakistan for the last few years. Of these, green bug is the most important as it has the potential to cause severe damage to wheat when population level increases to outbreak level. Direct yield losses caused by aphid have not been yet estimated (Inayatullah et al., 1993). However, they transmit several viral diseases, like barley yellow dwarf, sugarcane mosaic and maize dwarf mosaic etc. No control measures have been adopted to manage these aphids attacking on wheat crop in the country. Utilization of biocontrol agents like predators and parasitoids has great potential to keep the population of various pests (Sunil et al., 2007).

Therefore, present studies were conducted to investigate the biological parameters and predatory potential of ladybird beetle *C. septempunctata* feeding on *S. graminum* under different temperature regimes.

MATERIALS AND METHOD

The studies of the predatory potential of *C. septempunctata* feeding on *S. graminum* were carried out under controlled conditions. The experiments were conducted at Insectary-Biological Control Labs., Insect Pest Management Programme (IPMP), Institute of Plant and Environmental Protection (IPEP), National Agricultural Research Centre (NARC), Islamabad, Pakistan. Adults of the *C. septempuctata* were collected from wheat and *Brassica* crops grown at NARC, Islamabad. The culture of predator was established on aphids reared on wheat plants. The pairs of *C. septempunctata* were collected from the stock culture and kept into the plastic jars. Aphid infested leaves of wheat plant were kept inside the plastic jar to serve as a food for the predator. Every day in the morning, the eggs deposited by each female were collected. Fresh counted number of eggs (n=100) obtained from jars and transferred to Petri dishes (9cm diameter) with the help of soft camel hair brush and allowed to hatch at three constant temperatures (20 ± 1˚C, 25 ± 1˚C and 30 ± 1 ˚C) and 60 5 % R.H in growth chamber. The data on incubation period and hatching percentage were recorded.

In the first set of experiments, 35 grubs of same age of *C. septempunctata* were collected from the hatched eggs. These grubs were individually reared on *S. graminum* at three temperatures in plastic vials (4.0cm ×6.0cm). Counted number of second and third instar nymphs of *S. graminum* was provided as a food to the first instar larvae of *C. septempunctata*. Later on, the number of aphids was increased with development of larval instars. This procedure was followed till the pupation of predator beetle. The data on developmental period and predatory potential of immature predatory beetle were recorded.

In another set of experiments, 30 pairs of newly emerged adult male and female were selected at random from culture and each pair was released in small plastic jars. Green bug aphids (around 160 nymphs per day) were provided to the adults of *C. septempunctata* till their death. The data on developmental period and predatory potential of both the sexes were recorded. In addition, fecundity of each female was also recorded daily. 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

Development of Predator

The data of present study revealed that temperature had a significant effect on nearly all the developmental stages of *C. septempunctata* feeding on *S. graminum*. The data indicated that with the increase in temperature the egg incubation period was reduced (Table 1). However, the incubation period of eggs ranged from 3.2 to 5.1 days at three different temperatures. The present findings are in line with Hassan et al. (1999) who also reported that eggs incubated in 3.6 and 3.5 days at 20˚C and 25˚C, respectively. The percent egg hatchability was higher (82%) at 25˚C. These results differed from Sarwar and Saqib (2010) who found 59.5% egg hatchability at 25˚C feeding on natural diet.

The developmental period of first, second, third and fourth instars ranged from 1.1-5.9, 1.2-6.0, 1.6-5.0 and 4.0-12.4 days, respectively at different temperatures feeding on *S. graminum* and total larval duration was 8 - 29 days. With the increase in temperature the developmental duration of all larval stages decreased (Table 1). Solangi and Lohar (2005)

Table 1. Biological parameters of *Coccinella septempunctata* reared on *Schizaphis graminum* at three temperature regime

Parameter	Temperature (˚C)						
	20	1	25	1	30	1	LSD
Egg incubation period (days)	5.12	0.08 [a]	3.62	0.12 [b]	3.20	0.25 [b]	0.5271
No of eggs/female	37.80	0.37 [b]	41.00	0.70 [a]	35.60	0.24 [c]	1.4884
Percent hatchability	75.60	0.74 [b]	82.00	1.41 [a]	71.20	0.48 [c]	2.9768
Duration of 1st instar (days)	5.99	0.06 [a]	3.44	0.07 [b]	1.18	0.01 [c]	0.1711
Duration of 2nd instar (days)	6.03	0.11 [a]	2.78	0.10 [b]	1.26	0.02 [c]	0.2500
Duration of 3rd instar (days)	5.03	0.13 [a]	2.33	0.09 [b]	1.63	0.09 [c]	0.3038
Duration of 4th instar (days)	12.49	0.10 [a]	7.40	0.15 [b]	4.08	0.04 [c]	0.3122
Total larval duration (days)	29.55	0.18 [a]	15.96 ± 0.21 [b]		8.16 ± 0.06 [c]		0.4780
Pupal period (days)	14.01	0.11 [a]	9.27	0.11 [b]	5.22	0.09 [c]	0.2985
Pre-oviposition (days)	28.23	0.26 [a]	19.33	0.30 [b]	17.33	0.39 [c]	0.9185
Oviposition (days)	10.20	0.25 [c]	22.20	0.24 [a]	16.20	0.27 [b]	0.7224
Post-oviposition (days)	21.93	1.03 [a]	15.30	0.54 [b]	9.93	0.34 [c]	1.9839
Longevity male (days)	44.73	0.65 [a]	37.70	0.25 [b]	30.00	0.56 [c]	1.4621
Longevity female (days)	60.36	1.01 [a]	58.90	0.54 [a]	43.70	0.56 [b]	2.0171

Means followed by same letter do not differ significantly at ≤ 0.05

reported that duration of first, second, third and fourth instars as 2.7, 2.6, 3.2 and 3.8 days, respectively, under laboratory conditions feeding on mustard aphid. Sattar et al. (2008) observed that total larval and pupal duration of *C. septempunctata* was 18.3 and 4.9 days at 26±1C when feeding on cotton aphid. The difference in developmental period of predator may be due to nature and quality of prey.

The present study revealed that adult male and female period of *C. septempunctata* ranged from 30.0 to 44.7 and 43.7 to 60.3 days, respectively, at different temperature regimes indicating that female took more days to complete its development than male. Sarwar and Saqib (2010) also found that the longevity of female was greater (50.8 days) than male (38.8 days) when fed on natural diet under laboratory conditions. Pre-oviposition, oviposition and post-oviposition period range were 17.3-28.2, 10.2-22.2 and 9.9-21.9 days, respectively at different temperatures (Table 1). Similar findings have been reported by Sarwar and Saqib (2010). The mean number of eggs laid per female ranged from 123.5 to 293.2 eggs at three different temperatures. The present findings are similar to those of Hassan et al. (1999) who reported that number of eggs laid were 146.6 and 37.3 at laboratory and semi natural conditions, respectively, for three species.

Predation

The predatory response of different immature developmental stages of *C. septempunctata* exhibited significant difference with respect to all temperatures. Predatory potential of first, second, third and fourth instars was from 21.0 to 37.0, 40.5 to 79.0, 73.8 to 124.8 and 342.1 to 481.5 aphids at different temperatures and total larval predatory potential ranged from 573.50 to 667.87 aphids (Table 2). With the increase in temperature the pre-

Table 2. Predatory potential of immature stages of *C. septempunctata* feeding on *S. graminum* at three temperatures regimes

Developmental stages	Temperature ˚C						LSD
	20 1		25 1		30 1		
	Aphid consumed		Aphid consumed		Aphid consumed		P = 0.05
	Mean	SE	Mean	SE	Mean	SE	
1st instar	37.03	1.28 [a]	32.13	1.19 [b]	21.00	0.53 [c]	2.982
2nd instar	79.06	2.61 [a]	57.90	5.30 [b]	40.50	0.63 [c]	9.661
3rd instar	115.50	3.93 [a]	73.80	2.97 [b]	124.80	10.15 [a]	18.328
4th instar	342.10	8.15 [c]	411.33	18.19 [b]	481.57	11.59 [a]	37.426
Total instars consumption	573.70 ± 9.79 [b]		575.00 ± 21.68 [b]		667.87 ± 7.17 [a]		40.322

Means followed by same letter do not differ significantly at $P \leq 0.05$

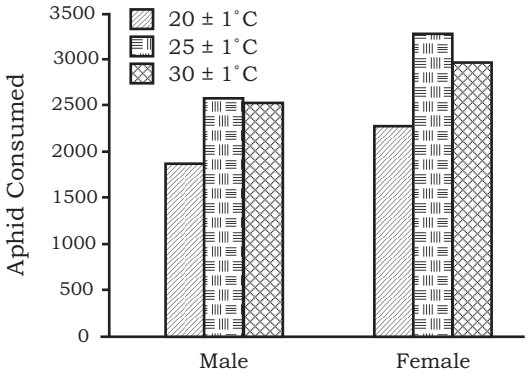

Figure 1. Predatory potential of adult of *C. septempunctata* feeding on *S. graminum* at three temperature regimes

datory potential of first and second instars decreased but increased in third and fourth instar stages due to increase in duration. These findings are in confirmation with Tomar and Yadav (2009) who reported that total larval consumption was 549.1, 579.4 and 493.8 aphids during three consecutive years under laboratory conditions.

Predatory potential of adult female ranged from 2276.8 to 3262 aphids and were greater than the adult male (1890.6 to 2571.7) aphids at three constant temperatures. The results indicated that female consumed more aphids as compared to male as some previous workers also indicated that female beetles required more aphids due to higher nutrition requirement for reproduction (Figure 1) (Parabakar, 1994; Pandey and Khan, 2002).

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