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Biology of *Coccinella septempunctata* Linn. (Coleoptera: Coccinellidae) and its Predatory Potential on Cotton Aphids, *Aphis gossypii* Glover (Hemiptera: Aphididae)

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Abstract.- The predatory potential and biology of seven spotted ladybird beetles (*Coccinella septempunctata* Linn.) fed on cotton aphid (*Aphis gossypii* Glover) have been studied under laboratory conditions (26±2ºC and 65±5% R.H.). The results revealed that mean consumption of aphids per *C. septempunctata* adult was 77.8±5.15, whereas, 21.9, 55.9, 107.4 and 227.3 aphids were consumed by a single larva during 1st, 2nd, 3rd and 4th instars, respectively. A single female laid 177.0±23.03 eggs during entire life period. The egg hatching was 98.3±2.79% while 82.2±6.20% larvae survived upto pupal stage. Total larval and pupal duration was 18.3±0.53 and 4.9±0.58 days, respectively. Mean percent emergence in male and female was 36.6±2.98 and 56.6±4.21, respectively. Male to female sex ratio was recorded 1:1.5.

Key words: Predatory efficiency, ladybird beetle.

INTRODUCTION

Cotton aphid is one of the most injurious insect pests which suck the cell sap and hence is one of the crop yield limiting factors (Fondren *et al*., 2004). They affect the general vigor of plant by secreting honey dew which encourages sooty mould development that disturbs the normal physiology of the leaves (Dixon and Kindlmann, 1998). To protect the plants and environment, biological control of aphids is a good replacement of highly toxic insecticides which is a common practice for its control (Bellows, 2001). It is not surprising that pests often develop resistance to these chemicals (Henn and Weinzieral, 1990). Some times Coccinellids larvae are not killed by systemic insecticides that are injurious to predators (Banken and Stark, 1998). The Coccinellid predators are tolerant to many insecticides which is an advantage over other predators. It is the most important beneficial insect of cotton pests, with its immature and mature stages as voracious feeder of all the species of aphids (Srivastiva *et al*., 1987; Karpacheva, 1991). It has been widely used to control aphids, through augmentation by translocation or mass rearing and release (Saharia, 1982). Biological control of aphids and other small soft bodied pests in some system appears to be benefiting from various appetite of multicolored Asian lady beetle (Koch, 2003). Seven spotted ladybird beetle *Coccinella septempunctata* Linn. feeds primarily on aphids and also preys on both adult and immature soft-bodied crop pests (Nunez-Perez *et al*., 1992). It belongs to family Coccinellidae which includes 4500 species world over. Being an important biological control agent, it predates also on other soft bodied arthropods besides aphids (Nakamuta and Saito, 1985, Debaraj and Singh, 1990).

The biological control with coccinellids has contributed greatly and suppressed the pests below economic damage (Hoy and Nguyen, 2000). The present studies were conducted to determine the biology of *Coccinella septempunctata* and its predation on cotton aphids under laboratory conditions so that inundative biological control may

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be streamlined keeping in view the feeding potential of the beetle.

MATERIALS AND METHODS

The adults of the predator seven spotted ladybird beetle, *Coccinella septempunctata* Linn., were collected from the cotton field of Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. The stock culture was prepared in laboratory under controlled conditions (26±2ºC and 65±5 % R.H.) in six replications. Single pair of the newly emerged virgin adults of *C. septempunctata* were placed in glass jars and fed with counted number of cotton aphids *Aphis gossypii* Glover. The top of the glass jar were covered with muslin cloth, 10% honey solution and water were also placed in jars for adult feeding. Damp cotton wool was placed on the top of the cover, to ensure humidity.

Eggs laid by female on the walls of glass jar were removed daily, counted and transferred in glass petri dishes (9cm dia). Thirty eggs were observed in six replications for percent hatching and incubation period was recorded. After hatching, the larvae were collected with a fine point camel hair brush and placed in new glass jars. In six replications thirty larvae each were observed for larval and pupal duration (days) from which later percent pupation and mortality was calculated. Each larval instar was provided with a known number of aphids (nymphs, adults) for feeding. The numbers of aphids was increased daily and as the larvae entered to next instar. The feeding potential was recorded by counting the number of aphids, fed by 1st, 2nd, 3rd and 4th instars of *C. septempunctata* up to pupation. Thirty pupae per replicate were used in six replications to record the data on percent male and female emergence and sex ratio. Longevity and fecundity of *C. septempunctata* female on aphids were noted.

RESULTS AND DISCUSSION

Female of seven spotted ladybird beetle, *C. septempunctata* Linn. laid clusters of bright yellow eggs that turned into dark yellow before hatching. Data in Table I shows that eggs incubation period was 4.3±0.81 days, percent egg hatching was 98.3±2.79 and percent mortality was observed 1.6. Xu (1985) recorded incubation period (3-4 days) nearly close to that in present studies. Results in Table II indicated that mean duration of 1st, 2nd, 3rd and 4th larval instars were 2.9±0.42, 4.69±0.47, 5.4±0.66 and 7.5±0.72 days respectively and the pupal period was 4.9±0.58 days. Debaraj and Singh (1990) reported that the pupal stage may last from 3-12 days depending upon availability of food and temperature. Takahashi (1987) observed cannibalism in *C. septempunctata* Linn. and reported that with in adequate supply of aphids, coccinellids eggs were occasionally eaten by 1st and 2nd instar but never by 3rd and 4th instar. Mean percent pupation, and pupal mortality was, 82.2±6.20, and 17.7±6.2, respectively (Table III).

Table I.- Hatching, incubation and mortality of eggs in *C. septempunctata*. The data is based on six replicates, each of 30 eggs. The values are Mean±SEM.

Eggs (number) per replicate	Incubation Period (days)	Hatching (number)	Mortality of eggs (number)
30	4.3±0.81	29.5±0.83 (98.3±2.79%)	0.5±0.83 (1.6±2.78%)

Table IV shows the mean male and female emergence was 36.6±2.98 and 56.6±4.21 percent, respectively. Mean pupal mortality was 17.7±6.2 %. Male to female sex ratio sex ratio was 1:1.5±0.18. It showed that sex ratio was skewed to female adults in the predatory beetle. As a result beetle population increased rapidly and made biocontrol of aphid more effective (Saharia, 1980). Table V showed that mean percent consumption of aphids by coccinellid adults was 86.5±5.74. A single female laid 177.0±23.03 eggs in its entire life span. Data in Table VI revealed that the mean consumption of aphids by coccinelids larvae of first, second, third and fourth instars were 71.8±9.57, 85.7±1.96, 89.2±2.46 and 90.8±2.19, respectively. Dixon *et al.* (1997) studied that the number of aphids consumed per day per larva varied from 1st to 4th instars. Dixon (2000) and Srivastiva *et al*. (1987) reported that among all larval stages, 4th instar took more

days and it was difficult to provide enough aphids to satisfy their voraciousappetites. Similar observations were recorded in our experiment that fourth instar fed voraciously for many days. Singh and Singh (1993, 1994) reported that larvae of ladybird beetle *(C. septempunctata)* behaved aggressively and their feeding on aphids was voracious.

Table II.- Duration (days) of larvae and pupae in *C. septempunctata.* The data is based on six replicates.

Duration of larval instars(days) (n=6)				Total larval Period (days)	Pupal Period (days)	Total larval & pupal duration(days)
First	Second	Third	Fourth			
2.9±0.42	4.6±0.47	5.4±0.66	7.5±0.72	18.3±0.53	4.9±0.58	25.6±1.83

Table-III.- Percent pupation and mortality in *C. septempunctata*. The data is based on six replicates, each of 30 larvae.

Larvae (number) / replicate	Pupal recovery / replicate	Pupal mortality / replicate
30	24.6±1.86 (82.2±6.20%)	5.3±1.86 (17.7±6.20%)

Table IV.- Percent emergence, sex ratio and mortality of adults in *C. septempunctata.* The data is based on six replicates, each of 30 pupae.

Pupae (No) / replicate	Adult emergence		Total male & female mortality (%)	Male to female ratio
	Males (No.)	Female (No.)		
30	11.0±0.89 (36.6±2.98%)	17.0±1.26 (56.6±4.21%)	6.6±4.21	1:1.5±0.18

Table V.- Percent aphid consumption per adult, female longevity and fecundity in *C. septempunctata.* The data based on six replicate each of 90 aphids offered for consumption.

Aphids offered (number)	Aphids consumed (number)	Eggs laid per female (number)	Female longevity (days)
90	77.8±5.16 (86.5±5.74%)	177.0±23.03	99.0±7.84

Table VI.- Aphid consumption by different larval instars of *C. septempunctata*

Instars	Age (days)	Aphid offered (number)	Aphids consumption (number)	Consumption (%)
First	1	25	14.6	58.6
	2	30	22.8	76.1
	3	35	28.3	80.9
	Mean	**30.0**	**21.9**	**71.8±9.57**
Second	4	50	41.6	83.3
	5	60	51.0	85.0
	6	70	60.8	86.9
	7	80	70.1	87.7
	Mean	**65.0**	**55.9**	**85.7±1.96**
Third	8	100	86.6	86.6
	9	110	95.8	87.1
	10	120	107.0	89.1
	11	130	120.0	92.3
	12	140	127.6	91.1
	Mean	**120.0**	**107.4**	**89.2±2.46**
Fourth	13	200	174.1	87.0
	14	220	201.0	91.3
	15	240	220.5	91.8
	16	260	243.6	93.7
	17	280	254.0	90.7
	18	300	270.5	90.1
	Mean	**250.0**	**227.3**	**90.8±2.19**

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