



## Biology and Predation Potential of Seven Spotted Ladybird Beetle, *Coccinella septempunctata* on cabbage Aphid, *Brevicoryne brassicae* L. under Laboratory Conditions

Puneet\*, S.S. Yadav and Sunita Yadav

Department of Entomology,

CCS Haryana Agricultural University, Hisar (Haryana), India.

(Corresponding author: Puneet\*)

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**ABSTRACT:** The biology of *Coccinella septempunctata* was studied under laboratory conditions on cabbage aphid, *Brevicoryne brassicae*. The results revealed that the duration of egg, larval, pupal, adult (male) and adult (female) life stages were found to be  $2.50 \pm 0.51$ ,  $17.50 \pm 2.52$ ,  $3.80 \pm 1.09$ ,  $28.00 \pm 5.04$  and  $37.27 \pm 3.21$  days, respectively. The total number of aphids consumed by larval I, II, III and IV instars was found to be  $6.76 \pm 1.05$ ,  $14.36 \pm 1.32$ ,  $24.80 \pm 3.82$  and  $42.53 \pm 2.17$  aphids, respectively. The female adults on an average consumed significantly higher number of aphids (2314.04) than male adults (1797.63).

**Keywords:** *Coccinella septempunctata*, *Brevicoryne brassicae*, biology, predation potential.

### INTRODUCTION

Ladybird beetle or the seven-spotted ladybird beetle, *Coccinella septempunctata* (Coleoptera: Coccinellidae) is a species native to temperate areas of Europe, North Africa and Asia but now is distributed in 74 countries owing to its potential as a biological control agent of a number of soft-bodied insect-pests. *C. septempunctata* has been reported as natural enemy of 87 species encompassing several orders (Beverley, 2022). Among the various aphid species, *B. brassicae* is one of the preferred prey species for *C. septempunctata* as reflected by higher growth and quick development (Panchal *et al.*, 2013). *C. septempunctata* is a highly effective predator of *B. brassicae* and is reported to consume as much as 2728.90 aphids during the aphidophagous stages of its life cycle (Jesu Rajan *et al.*, 2018) making it a suitable alternative for reduction in pesticide usage in crops infested by *B. brassicae* leading to delay in development of resistance. Bilashini *et al.* (2007) studied the biological control potential of *C. septempunctata* on three aphid species (*L. erysimi*, *M. persicae* & *B. brassicae*) on rapeseed and reported that the feeding preference was maximum for *L. erysimi* followed by *M. persicae* and *B. brassicae*. The fourth larval instar of *C. septempunctata* showed highest voracity in feeding on all three species of aphids. The female adults were reported to consume much more number of aphids than any other stage. Prey requirement of *C. septempunctata* on *B. brassicae* and reported that the mean incubation period of *C. septempunctata* eggs when fed on *B. brassicae* was 3.6 days. The mean duration of I, II, III and IV larval instars was found to be 2.6, 2.6, 3.4 and 4.4 days, respectively with total grub period of 15.8 days. The pupal period was found to be 5.4 days. Male adult

longevity was 35.2 days whereas the female longevity was 42.4 days with a mean fecundity of 353.4 eggs/female. Mean consumption of aphids per day was found to be 4.2, 10.8, 21.4 and 34.7 during I, II, III and IV larval instars, respectively. The total aphid consumption during I, II, III and IV larval instars was found to be 14.4, 35.4, 68.6 and 178.6, respectively with mean consumption of 268.8 aphids during the entire grub period. Females consumed more aphids (56.1/day) as compared to males (31.4/day). Total number of aphids consumed by adult females was much higher (2398.25) as compared to adult males (1251.50). Panchal *et al.* (2013) compared the biology and consumption capacity of *C. septempunctata* on three aphid species *B. brassicae* (cabbage aphid), *Uroleucon carthami* (safflower aphid) and *Lipaphis erysimi* (mustard aphid). The results indicated that *B. brassicae* was the most suitable aphid species for growth and development of *C. septempunctata* as reflected by minimum duration of life cycle *i.e.*, 45.72 days in male and 54.11 days in females as compared to *U. carthami* (males-58.97 days & females-65.37 days) and *L. erysimi* (males-51.10 days & females-57.10 days). The consumption of aphids by both the females and males of *C. septempunctata* was in the order *B. brassicae* > *L. erysimi* > *U. carthami*. Keeping these views in mind, the current studies were undertaken.

### MATERIALS AND METHODS

The details of the experiment and observations recorded for studying the biology and predation potential of *C. septempunctata* on *B. brassicae* are as follows:

**Biology of ladybird beetle, *C. septempunctata* on cabbage aphid, *B. brassicae*.** Adults of *C. septempunctata* were collected from Experiment Area, Department of Entomology, CCS HAU, Hisar. The

adults were fed on cabbage aphid, *B. brassicae*. The duration of different instars of *C. septempunctata* was observed and mean was devised for 30 observations. Aphids were provided per day as: 20 (I larval instar); 25 (II larval instar); 50 (III larval instar); 75 (IV larval instar) and 100 (for both male and female adults).

**Predation potential of ladybird beetle, *C. septempunctata* on cabbage aphid, *B. brassicae*.** Predation potential of different instars of *C. septempunctata* was recorded by counting the number of prey (aphids) fed by different stages of larval instars. Each larval instar was provided daily a known number of prey for feeding and the number of prey eaten was counted. The number of prey was increased daily and as larvae entered in to next instar.

## RESULTS AND DISCUSSION

Biological parameters of *C. septempunctata* reared on *B. brassicae* were observed as follows:

**Pre-oviposition period.** The pre-oviposition period ranged from 1 to 13 days with mean period of  $9.30 \pm 1.89$  days.

**Oviposition period.** The oviposition period ranged from 17 to 28 days with mean period of  $23.360 \pm 4.24$  days.

**Post-oviposition period.** The post-oviposition period ranged from 4 to 9 days with mean period of  $6.00 \pm 1.89$  days.

**Incubation Period.** The incubation period of eggs ranged from 2 to 3 days with mean period of  $2.50 \pm 0.51$  days.

**Larval duration.** The mean duration of I, II, III and IV larval instars was found to be 2.83, 4.57, 4.60 and 5.50 days, respectively. The mean total duration of all larval instars was  $17.50 \pm 2.52$  days.

**Pupal period.** The duration of pupal period ranged from 2 to 5 days with mean duration of  $3.80 \pm 1.09$  days.

**Adult longevity.** The adult males lived for comparatively shorter period than the females. The mean adult longevity ranged from 20 to 45 days with mean longevity of  $28.00 \pm 5.04$  days. The adult female longevity ranged from 30 to 46 days with mean longevity of  $37.27 \pm 3.21$  days.

**Fecundity.** The females laid eggs in batches of 7-8 over the oviposition period ranging from 17 to 28 days. Mean fecundity ranged from 155 to 229 eggs per female with average fecundity of  $183.00 \pm 26.05$  eggs per female.

**Sex ratio.** The sex ratio (F: M) was found to be 1.16:1 indicating that the number of females in *C. septempunctata* population was about 16% higher than the males.

The findings are in line with Jesu Rajan *et al.* (2018) who studied biology of *C. septempunctata* on *B. brassicae* and reported that the mean duration of egg, larval and pupal stages were 2.50, 15.10 and 3.10 days, respectively. The adult longevity was found to be higher in female (33-41 days) as compared to males (21-39 days). The durations of larval instars as recorded

for larval instars I (2.6 days), II (2.6 days), III (3.4 days) and IV (4.4 days) are in corroboration with our findings. The mean fecundity was 353.4 eggs/female and longevity of females (42.4 days) was reported to be longer than males (35.2 days).

### **Aphid consumption by *C. septempunctata***

**I Larval instar.** The mean aphid consumption per day ranged from 5 to 8 aphids with mean of  $6.76 \pm 1.05$  aphids per day. The total aphid consumption during the I larval instar ranged from 12 to 22 aphids with mean of  $19.17 \pm 3.17$  aphids.

**II Larval instar.** The mean aphid consumption per day ranged from 12 to 16 aphids with mean of  $14.36 \pm 1.32$  aphids per day. The total aphid consumption during the II larval instar ranged from 31 to 58 aphids with mean of  $55.61 \pm 4.26$  aphids.

**III Larval instar.** The mean aphid consumption per day ranged from 20 to 31 aphids with mean of  $24.80 \pm 3.82$  aphids per day. The total aphid consumption during the III larval instar ranged from 104 to 129 aphids with mean of  $114.08 \pm 9.08$  aphids.

**IV Larval instar.** The mean aphid consumption per day ranged from 39 to 46 aphids with mean of  $42.53 \pm 2.17$  aphids per day. The total aphid consumption during the IV larval instar ranged from 218 to 276 aphids with mean of  $233.93 \pm 18.54$  aphids.

**Adult females.** The mean aphid consumption per day ranged from 72 to 85 aphids with mean of  $78.73 \pm 3.88$  aphids per day. The total aphid consumption during the adult female period ranged from 2240 to 2508 with mean of  $2314.04 \pm 48.49$  aphids.

**Adult males.** The mean aphid consumption per day ranged from 58 to 69 aphids with mean of  $64.20 \pm 4.01$  aphids per day. The total aphid consumption during the adult female period ranged from 1682 to 1996 with mean of  $1797.63 \pm 42.74$  aphids.

These findings are in line with the observations of Jesu Rajan *et al.* (2018) who reported the total mean consumption of aphids during I, II, III and IV larval instars to be 5.30, 12.40, 23.30 and 38.20 aphids per day. The total aphid consumption during the entire larval period was found to be 308.30 aphids. The total aphid consumption during the entire aphidophagous stages was found to be 2728.90 aphids. The mean consumption of aphids during entire grub period was 268.8 aphids with mean consumption of 14.4, 35.4, 68.6 and 178.6 aphids by I, II, III and IV larval instars, respectively. Devi *et al.* (1996) reported mean aphid consumption by larval and adult stages to be 291.65 and 141.33 aphids, respectively. Panchal *et al.* (2013) unravelled the preference of *B. brassicae* for feeding by *C. septempunctata* over aphid species *U. carthami* and *L. erysimi*. Bilashini *et al.* (2007) on the contrary reported that the preferred aphid species for feeding was *L. erysimi* as compared to *M. persicae* and *B. brassicae*. It was also reported that the IV larval instar of *C. septempunctata* was the most voracious feeder of aphids and the adult females were found to consume a greater number of aphids than other life stages.

**Table 1: Biology of *C. septempunctata* on *B. brassicae* under laboratory conditions.**

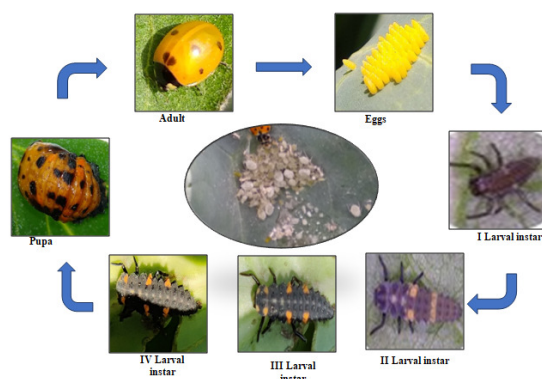
Stage	Range (days)	Mean* ± S.D. (days)
Pre-oviposition period	7-13	9.30 ± 1.89
Oviposition period	17-28	23.30 ± 4.24
Post oviposition period	4-9	6.00 ± 1.89
Fecundity**	155-229	183.00 ± 26.05
Incubation period	2-3	2.50 ± 0.51
<b>Larval instars</b>		
Larval instar I	2-4	2.83 ± 0.83
Larval instar II	3-6	4.57 ± 1.10
Larval instar III	3-6	4.60 ± 1.10
Larval instar IV	4-728.	5.50 ± 1.25
Total larval period		17.50 ± 2.52
Pupal period	2-5	3.80 ± 1.09
<b>Adult longevity</b>		
Female	30-46	37.27 ± 3.21
Male	20-45	28.00±5.04
Sex ratio	1:1.6 (M:F)	-

\*Mean of 30 observations; \*\*Mean of 10 observations

**Table 2: Predation potential of *C. septempunctata* on *B. brassicae* under laboratory conditions.**

Stage	Aphid consumption per day		Mean total consumption	
	Range	Mean* ± S.D.	Range	Mean* ± S.D.
Larval instar I	5-8	6.76 ± 1.05	12-22	19.17±3.17
Larval instar II	12-16	14.36±1.32	31-58	55.61±4.26
Larval instar III	20-31	24.80±3.82	104-129	114.08±9.08
Larval instar IV	39-46	42.53±2.17	218-276	233.93±18.54
Adult male	58-69	64.20±4.01	1682-1996	1797.63±42.74
Adult female	72-85	78.73±3.88	2240-2508	2314.04±48.49

\*Mean of 30 observations



**Life cycle of seven spotted ladybird beetle, *Coccinella septempunctata***

## CONCLUSIONS

Seven-spotted ladybird beetle is an effective predator of soft-bodied insects including aphids and *B. brassicae* is one of its preferred hosts.

## FUTURE SCOPE

### Author contributions

Conceived and deigned the experiment- SSSY, SY & P; execution of experiment and collection of data- P; analysed the data- P & SSSY; preparation of manuscript- P & SSSY; reviewed the manuscript- SSSY & SY.

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**Conflict of Interest.** None.

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