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BIOLOGY AND PREYING POTENTIAL OF *Coccinella septempunctata* (Linn.) ON CABBAGE APHID, *Brevicoryne brassicae* (Linn.) UNDER LABORATORY CONDITION

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ABSTRACT

The present investigation was conducted to study the biology and consumption rate of coccinellid predator, *Coccinella septempunctata* (Linn.), on cabbage aphid, *Brevicoryne brassicae* (Linn.) in the Department of Entomology, T. D. P. G. College, Jaunpur, during the year 2024-2025. It was observed that, incubation period, grub period of four instars, pre pupal and pupal period was 3.4± 0.51, 2.6 ±0.51, 2.4±0.51, 3.5±0.52, 4.5±0.52 and 5.9±0.87 days, respectively. Oviposition period of female was 344-368 days with average fecundity of 357.5±6.77 eggs. 4th instar grubs consumed significantly more aphids when compared to 1st, 2nd and 3rd instars. Total consumption of aphids during 1st to 4th instar grub stage was 240-280 aphids with an average 266.7±11.92 in 14-18 days. *Coccinella septempunctata* (Linn.) adult female consumed 1385-1457 with an average 1408.1±29.32 while adult male consumed total of 1120-1265 with an average of 1194.7±56.09 aphids during its total life period. Total feeding capacity of *Coccinella septempunctata* in its entire (total) life period was 2868.25±37.05 aphids.
Keyword **:** *Coccinella septempunctata, Brevicoryne brassicae,* Preying potential

Introduction

The cabbage aphids, *Brevicoryne brassicae* (Linn.) is one of the most important insect pest of the family Aphididae. They grayish green with waxy covering appearance, and they have one pair of tube like structure (Siphunculi) which is presented on the abdominal region. Adults are present in both wingless and winged form. However, wingless females producing live young (nymphs) are the most common. It is one of the most serious sucking pests of brassica plants.

Coccinella septempunctata is major predatory group of insect which is belongs to the order Coleoptera and family is Coccinellini. They also feed the soft bodied insects like as white flies, aphids and mealy bugs (Prajapati *et al*., 2022) *Coccinella septempunctata* can be found wherever significant numbers of prey, particularly aphids, are present. This normally includes small herbaceous plants, shrubs and trees in open fields, grasslands, marshes, agricultural fields, sub-urban gardens and parks. The preferred overwintering habitat for *Coccinella septempunctata* is an open area with sheltering boulders, small tussocks, or hedgerows of densely packaged grasses that are south-facing, maximizing sunlight hours.

The eggs of *Coccinella septempunctata* are small (1mm long) and oval-shaped. ("*Coccinella septempunctata* L.", 2011; Cantrell, 2011; Hodek and Michaud, 2008). The larval instars of *C. septempunctata* can be variable in color depending on temperature but are generally dark and highly segmented. Size increases with each consecutive moulting. ("*Coccinella septempunctata* L.", 2011; Angalet, *et al*., 1979; Beverley, *et al*., 2012; Cantrell, 2011). The pupa is slate gray to black, sometimes having white or orange markings on the outside. It has a hardened exoskeleton which develops from the fourth instar. Its size is approximately the size of the adult *Coccinella septempunctata*. ("*Coccinella septempunctata* L.". 2011: Cantrell, 2011)

Life parameters such as growth and development, reproduction *etc* are at the beck and call of various biotic and abiotic environmental factors. What is seen is the outcome of the interplay between the genetic makeup and the prevailing environment. Among the biotic factors, food (quality and abundance) is perhaps the most influential factor (Jervis, Copeland and Harvey, 2005). As far as the predaceous coccinellids are concerned, the effect of prey species on life parameter has thoroughly been investigated. As such, prey is categorized into essential, alternative and rejected prey, on the basis of quantitative data on developmental parameters (rate of development, survival and reproductive capacity) (Hodek, 1962; Hodek and Honek, 1996). Coccinellid larvae need to consume several prey individuals during development, and each successive instar will show a maximum rate of growth and development at different levels of prey availability. Mortality due to nutritional stress apparently occurs at feeding rates very much higher than the minimum rate necessary for growth and development, so that individuals that are growing normally at low feeding rates are apparently highly likely to suffer high mortality at the moult (Beddington *et al*., 1976b).

Materials and Methods

Rearing of Ladybird for Cabbage aphid (*Brevicoryne brassicae*)

In the Laboratory, potted cabbage seedlings were maintained in cages (18x18x18 cm). To rear the predator coccinellids, and aphid colonies were collected from pesticide free vegetable fields in the College Campus aphid colonies were maintained in the separately.

The ladybeetle cultures were initiated by collecting the newly emerged over wintering adults of the respective coccinellid species. The adults of *Coccinella septempunctata* species were maintained in plastic jars (height 20cm and diameter 15cm) with abundant supply of prey from the aphid colonies till oviposition. The rearing jars were provided with crumpled paper to act as ovipositing sites for the females. The eggs laid on the crumpled paper were collected every 24 hours and transferred to petri dishes for the proposed studies on the biology of the coccinellids. Coccinellid cultures were maintained on the *Brevicoryne brassicae*, different growth stages were harvested from time to time for the studies on functional response of the coccinellids. All the cultures were maintained at a temperature of 25+2°C and 65±5% relative humidity with a photoperiod of 14:10 light and dark hours in controlled environment rooms.

For studies on biological parameters of coccinellid species *viz. Coccinella septempunctata* was studied under laboratory conditions. Newly emerged larvae of the predator was taken from the stock cultures and fed separately with abundant levels of 3rd or 4th instar nymphs of the aphid species, The aphids were fed on leaves of cabbage in petri dishes. Each treatment was replicated 10 times for all parameters. The studies were carried out at a temperature of 25+2°C and 65+5% relative humidity with a photoperiod of 14:10 light and dark hours in controlled environment rooms.

The detailed methodology adopted for studying various parameters of biology of the predator species (*Coccinella septempunctata*) is described as follows.

Studies on the predatory potential of grubs of *Coccinella septempunctata* on *Brevicoryne brassicae*

Ten newly hatched grubs of *Coccinella septempunctata* were kept individually in petridishes. The grubs were fed separately in petridish with cabbage aphids (*B. brassicae*) and the experiment was replicated 10 times. Counted numbers of aphids were provided daily in the morning hours i.e. 10, 20, 40, 80 and 160 number of cabbage aphids for 1st, 2nd, 3rd, 4th instars grubs and adult coccinellids, respectively. The number of aphids consumed was recorded daily and new aphids were provided as per their requirement. Feeding potential of grubs were recorded on Instar wise.

Predatory potential of adult beetles of *Coccinella septempunctata* on *Brevicoryne brassicae*

Under this experiment feeding consumption of newly hatched adult beetles starved for 24 hours, both males and females, collected from stock culture were tested for their predatory potential. Each beetle was kept separately in petridishes and provided with cabbage aphid, *B. brassicae* daily till death of the beetles and the number of aphids consumed daily were cumulated. The experiment was replicated 10 times.

Statistical analysis

The data on the duration of various growth and developmental stages, fecundity was subjected to analysis of variance in completely randomized design (CRD) and least significant difference (LSD) test for the comparison of means. The data were statistically analyzed using OPSTAT software.

Results and Discussion

Biology of *Coccinella septempunctata* on *Brevicoryne brassicae* as food are shown under follows:

Development period and reproductive parameter of *Coccinella septempunctata* was showed in the

(Table.1). The females of Coccinella were laid eggs in clusters of range between 22-25 adhered to each other. The egg period lasted for 3.4± 0.51 days in January during 2025. The results are in conformity with findings of Prajapati *et al.* (2022) found the *Coccinella septempunctata* egg period is 3.6±0.44 on cabbage aphid. Kumar *et al*. (2019) where they revealed that eggs of *Coccinella septempunctata* were laid compactly of 4-8 adhered to each other. They are in partial agreement with the finding of Shanmugapriya *et al*. (2017) found that an incubation period of 1-3 days with an average of 1.48 ± 0.54 days was observed under laboratory conditions. The present observations in accordance with Varshney *et al*. (2016) revealed that the incubation period was 2.6 ± 0.51 days and an average (82.87 ±6.66) % hatchability was observed. Results also correlate with the study of Singh and Singh (2014) in which the freshly laid were small, cigar shaped and shiny deep yellow, and turned light gray just before hatching. The average incubation period was 4.60 ± 0.31 and 4.40±0.26 days during 2009 to 2010 and 2010 to 2011 respectively. There were four larval instars. The mean larval duration of *Coccinella septempunctata* was recorded as first, second, third and fourth instars were 2.6±0.51, 2.4±0.51, 3.5±0.52, 4.5±0.52 days during the month of January to March 2025. The total larval period varied from 16.9±1.59 days during 2025. In their study on the biology of *C. septempunctata*, Prajapati *et al.* (2022) 15.8±1.64 and Kumar *et al*. (2019) reported that the average durations of first instar grub, second instar grub, third instar grub and fourth instar grubs were 2.33±0.33, 2.33±0.33, 3.67±0.33 and 4.67±0.33 days respectively. The present observations showed that the total grub period was 12-14 days. There are in partial agreement with the finding of Shanmugapriya *et al*. (2017) suggested that the duration of Ist instar grub was 1-3 days with an average of 1.88 0.73 days under laboratory conditions. Varshney *et al.* (2016) revealed that the average duration of first, second, third and fourth instar larvae of *Coccinella septempunctata* was 1.6±0.69, 1.7±0.48, 2.3±0.67 and 3.1±0.87 days respectively. The total larval period ranged from 7-12 days. Singh and Singh (2014) studied that the total grub period was recorded as 10.00 ± 0.47 and 12.30 ± 0.53 days respectively, with mean period of first, second, third and fourth instars being 2.86±0.12, 2.38±2.43±0.11, 2.30 ± 0.13 and 3.55 ± 0.14 days and total grub period was as 11.15 ± 0.50 days. The pupal period varied from 5.9± 0.87 days during 2025. Prajapati *et al.* (2022) and Kumar *et al*. (2019) revealed that the present observations showed that the pupal period lasted for 5.4±0.54 days, 5.67±0.33 days, respectively. Shanmugapriya *et al*. (2017) results also correlate Pupal stage, lasting 1-3 days with an average of 5.88 ± 0.73 days. Varshney *et al*. (2016) found that the total larval period ranged from 7-12 days whereas the pupal period varied from 4-7 days. Results also in conformation with the study of Singh and Singh (2014) which showed the total grub period was 11.15 ± 0.50 days. The longevity of *C. septempunctata* male and female was 35.8±1.47, 40.3±1.25 days. Prajapati *et al.* (2022) Longevity of female ranged from 42-45 days and male ranged from 33-37 days and Kumar *et al*. (2019) found that the duration of female longevity ranged from 36 to 37 days with an average of 36.67±0.33 days. Shanmugapriya *et al*. (2017) showed approximate result with *Cheilomenes sexmaculata* Male lasted for 13-8 days with an average life span of 16 ± 1.19 days, whereas female survived longer with an average life span of 22.04 ± 2.42 days. Varshney *et al*. (2016) suggested that the longevity of male beetles ranged from 19-26 days while the female adult beetle survived for 21-33 days. Singh and Singh (2014) which show the average longevity of adults were 120.25 ± 3.75 and 125.60 ± 4.35 during 2009 to 2010 and 2010 to 2011, respectively, while the mean was 122.93 ± 4.05 days.

Reproductive parameters such as, pre-oviposition, oviposition, and post oviposition of *C. septempunctata* was 5.8±1.47, 12.3±1.70 and 4.5+0.52 days respectively. Similar results also revealed by Kumar *et al*. (2019) average pre-oviposition and post-oviposition periods were 6.00±1.16 and 4.33±0.88 days respectively. Male duration ranged from 30-32 days. Shanmugapriya *et al*. (2017) also saw similar results for the pre- oviposition period of 2 to 12 days with an average of 3.88 ± 1.88 days. The oviposition period lasts about 16 -38 days with an average of 22.96 ± 3.54 days and a short post oviposition period of 2 to 5 days (Average 3.36± 1.04). There are in partial agreement with the finding of Varshney *et al*. (2016) reports that the average pre-oviposition, ovi-position and post-oviposition period of *C. septempunctata* was 6.5±3.53, 12.8±3.91 and 3.2+1.31 days respectively. Singh and Singh (2014) suggested that the females started oviposition after 6.20 ± 0.30 and 6.40 ± 0.42 days of mating with an average of 6.30 ± 0.36 days in between the range of 4.00 to 7.00 days. The fecundity per females of *Coccinella septempunctata* was 357.5±6.77 eggs during 2025 in different months of the year. Kumar *et al*. (2019) reported that during the peak oviposition period, a single female laid 349.67±10.11 eggs during her life. Shanmugapriya *et al*. (2017) also saw similar results that the number of eggs laid by the female varied 257 to 386 eggs with an average of 323.52 ± 24.80 eggs/female. Varshney *et al*. (2016) suggested that *C. septempunctata* laid an average of

232±5.45 eggs in its total life span. Singh and Singh (2014) revealed that the adult females laid an average of 360.75 ± 25.71 and 395.25 ± 27.31 eggs during 2009 to 2010 and 2010 to 2011, respectively while mean fecundity was 378.00±26.51.

Table 1: Developmental period and reproductive parameters of Ladybird beetle, *Coccinella septempunctata* during *Rabi* cabbage crop year 2025

Biology of *Coccinella septempunctata* under Laboratory Condition on Cabbage aphid (*B. brassicae*)			
Development Stage	**Duration Days**		
	Minimum	**Maximum**	**Mean ± SD**
Egg (Incubation Period)	3	4	3.4± 0.51
Larval Stage			
Ist Instar	2	3	2.6±0.51
II nd Instar	2	3	2.4±0.51
IIIrd Instar	3	4	3.5±0.52
IVth Instar	4	5	4.5±0.52
Complete Larval Period	15	19	16.9±1.59
Pupal Period	5	7	5.9±0.87
Longevity			
Female	39	42	40.3±1.25
Male	34	38	35.8±1.47
Pre-oviposition	4	8	5.8±1.47
Oviposition	10	15	12.3±1.70
Post- oviposition	4	5	4.5±0.52
Fecundity of Female	344	368	357.5±6.77

Preying potential of *Coccinella septempunctata* on Cabbage aphids (*B. brassicae*)

Studies on preying potential of *C. septempunctata* grubs offered 10, 20, 40, and 80, 160 *B. brassicae* revealed that the mean daily consumption of aphids by their successive instars and adult female & male as 4 to 6. 11 to 15.21 to 25 and 32 to 38 with average of 4.89 ± 0.74, 11.78±0.79, 22.44±0.68 and 35.67±2.16, 57.44±3.20 and 33.89±1.37 aphids/day, respectively. (Table.2 & Fig.1). The aphids consumption of adult female of *C. septempunctata* increased up to (57.44 aphids/day) with increased densities of test prey. Followed by IVth instar larvae (35.6 aphids/day), adult male (33.8 aphids/day), IIIrd instar larval grub (22.4 aphids/day), second instar (11.7 aphids/ day) and first instar larval grub is (4.8 aphids/day). Prajapati. S *et al.* (2022) reported the aphids consumption of adult female of *C. septempunctata* increased up to (56.6 aphids/day) with increased densities of test prey. Followed by IVth instar larvae (34.7 aphids/day), adult male (31.4 aphids/day), IIIrd instar larval grub (21.4 aphids/day), second instar (10.8 aphids) and first instar larval grub is (4.2 aphids/day). In During of whole life the four instar of grub, the beetle consumed 268.8±18.8 aphids whereas adult male and female consumed the 1251.50±55.28, 2398.25±78.42 aphids, respectively. *C. septempunctata* consumed 2093.80 aphids during its total life period from grub to adult. Khan (2009) reported the aphid consumption of forth instar larva increased up to 28.40 aphids/day with increased densities of test prey. Followed by adult female (25.06 aphids/day), third instar larva (24.06 aphids/day), second instar larva (21.73 aphids/day), adult male (20.06aphids/day) and first instar larva (13.06aphids/ day). In duration of whole life 4-6 days, first instar of *C. septempunctata* consumed total of 10 to 18 aphids with average of 13.9±1.52 aphids mean while the II nd IIIrd and IVth instars consumed 30-40, 65-75, 165-175 with average of 36.5±2.91, 70.3±3.12 and 169.5±2.55 respectively. Total no. of aphids consumption on grub stage of *C. septempunctata* was 240-280 aphids with average of 266.7±11.92 aphids in 14-18 days of grub period.

Studies on preying potentiality of *C. septempunctata* adults to provide 160 *B. brassicae* revealed that the per day consumption of aphids is 52-64 aphids/day with an average of 57.44±3.20 and total consumption of aphids during adult period of female 42 to 45 days is 1408.1±29.32 and by adult period of male 30 to 36 aphids/day with a 33.89±1.37 and total consumption of adult male during total life period 33-37 days is 1194.7±56.09. (Table.2). Similarly, findings were reported by Varshney *et al*. (2016) the adult male and female consumed 103.2 ±1.52 and 116.6 ±1.46 aphids per day respectively at the 27 ±2^{0}C Mishra *et al*. (2020) reported that the average no. of aphids consumption per day by *Coccinella septempunctata* male and female 115.4, 121.5, respectively. Verma *et al*. (2013) reported the predation potential of *C. septempunctata* was also observed on aphid, *Aphis*

gossypii. The first to fourth instar grubs were found to consume 37.95 ±8.2, 39.7±15.57, 94.1±17.27 and 262.2±88.83 aphids, respectively during their development period.

Table 2: Preying potential of *Coccinella septempunctata* on Cabbage aphids (*B. brassicae*)

Stage	Consumption of aphids per Individual/Day			Total consumed of aphids on entire life	
	Prey offered	Aphid consumed range	Mean ± SD	Range	Mean ± SD
Grub stage					
Ist Instar	10	4-6	4.89± 0.74	10-16	13.9±1.52
IInd Instar	20	11-15	11.78±0.79	30-40	36.5±2.91
IIIrd Instar	40	21-25	22.44±0.68	65-75	70.3±3.12
IVth Instar	80	32-38	35.67±2.16	165-175	169.5±2.55
Total Consumed by I-IVth Grub Instar		70-86	78.11±4.70	240-280	266.7±11.92
Adult					
Female	160	52-64	57.44±3.20	1385-1457	1408.1±29.32
Male	160	32-36	33.89±1.37	1265-1120	1194.7±56.09
Total life period grub to adult					2868.25±37.05

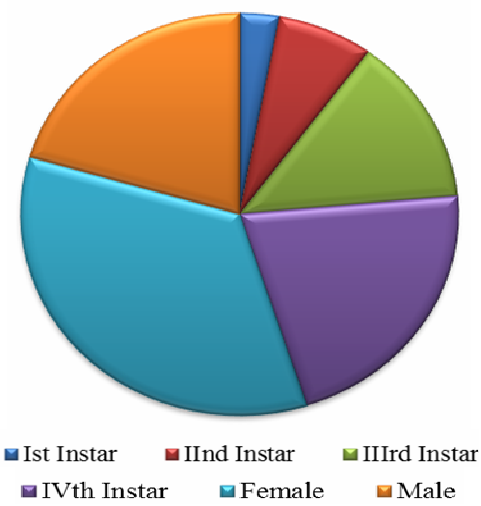

Fig. 1: *Coccinella septempunctata* consumed aphids consumption per day

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