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Biology and feeding potential of the seven-spotted lady beetle, *Coccinella septempunctata* on the mustard aphid, *Lipaphis erysimi*

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ABSTRACT

The lady beetle, *Coccinella septempunctata*, is a notable predator of aphids. Laboratory study conducted at the Department of Entomology, G.D. Goenka University, Gurugram, examined the developmental biology and feeding potential of *C. septempunctata* using the mustard aphid, *Lipaphis erysimi*, as prey. The average incubation period for *C. septempunctata* was 4.23 ± 1.12 days, followed by a larval period of 12.76 ± 1.56 days. The pre-pupal stage lasted 1.23 ± 0.67 days, and the pupal stage extended for 5.2 ± 1.03 days. The life span of an adult male was recorded as 32.38 ± 4.31 days, while that of an adult female was 34.28 ± 5.24 days. However, overall male longevity was 43.42 ± 4.38 days, whereas female longevity reached 48.27 ± 5.18 days. Aphid consumption per instar of *Coccinella septempunctata* grubs was recorded as follows: 3.23 ± 0.68 aphids for the first instar, 2.54 ± 0.52 for the second, 3.43 ± 0.64 for the third, and 3.56 ± 0.82 for the fourth instar. The predation potential of male beetles was 125.44 ± 8.89 aphids per day, while female beetles consumed 158.16 ± 6.85 aphids per day. Fourth-instar grubs exhibited a higher pest suppression capacity, as they consumed more aphids daily than adult beetles.

Figure : 00 References : 17 Tables : 02
KEY WORDS : *Coccinella septempunctata,* Feeding potential, Lady beetle, *Lipaphis erysimi*

Introduction

The seven-spotted ladybird beetle, *Coccinella septempunctata*, is a well-known predator of soft-bodied insect pests, particularly aphids. It measures approximately 6–7 mm in length and has an oval, dome-shaped body adorned with seven distinct black spots on its dark reddish elytra. As an aphidophagous species, it belongs to a diverse group of predatory coccinellids and plays a vital role in natural pest control. *C. septempunctata* thrives in a wide range of habitats, including homes, mountains, coastal regions, forests, fields, and relatively unpolluted urban areas[1]. While aphids are found worldwide, they are most abundant in cold and temperate regions[3], where *C. septempunctata* significantly contributes to their population regulation.Biological control of aphids serves as an eco-friendly alternative to the harmful and hazardous insecticides commonly used in plant protection[2]. Among the most significant groups of predatory and parasitoid species is the aphidophagous ladybird beetle, with *Coccinella septempunctata* being a prominent member that preys on a wide range of aphid species. *C. septempunctata* has strong potential as a biological control agent in developing sustainable strategies for managing mustard aphids using bio-agents. To effectively integrate predaceous coccinellids into pest management programs, comprehensive studies on their biology and predatory efficiency are essential. As a key component of Integrated Pest Management (IPM), biological control is gaining increasing attention from policymakers and entomologists.This is because it provides a practical and sustainable approach to controlling insect population . To effectively integrate predaceous coccinellids into Integrated Pest Management (IPM) strategies, a thorough understanding of their bio-ecology and predation potential is essential. Studying their biology and feeding behavior is crucial for mass production and efficient utilization in pest management programs[4].

Material and Methods

A controlled laboratory study on the biology of *Coccinella septempunctata* was conducted in the Department of Entomology, G.D. Goenka University, Gurugram. The experiment was conducted between December 2023 and February 2024 under controlled environmental conditions: a photoperiod of 16 hours of light to 8 hours of darkness, a temperature of 24±1°C, and a relative humidity of 65±2%. To assess the development and feeding potential of the ladybird beetles, they were provided with nymphs of the mustard aphid, *Lipaphiserysimi*.

Biology : In the laboratory, *Coccinella septempunctata* were reared on mustard aphids (*Lipaphi serysimi*) after being collected from various field crops. For mass rearing, adult beetles were housed in pairs within 15.0 × 1.5 cm Petri plates and provided with *L. erysimi* as a food source. After two to three days, eggs laid by females on leaves or along the margins of the Petri plates were carefully collected using a fine camel hairbrush and transferred into glass vials. Once hatched, the larvae were initially reared in groups for a few days before being individually placed in 9.0 × 1.5 cm Petri plates, each containing 20 larvae. Fresh *L. erysimi* nymphs were supplied daily, and the Petri plates were regularly monitored to ensure optimal development. The incubation period and hatching time of the eggs were carefully recorded. Initially, each larva was provided with 15–20 aphids, with the quantity gradually increasing as the larvae developed. The number of instars and the duration of each developmental stage were determined by examining the exuviae shed during molting. Once pupation occurred, the pupae were separated and left undisturbed until adult emergence. The overall life span and the duration of each instar were calculated, and the mean values along with standard deviations were determined for statistical analysis. Laboratory-reared adult *Coccinella septem punctata* were sexed based on body size, distinguishing males from females. To assess longevity, ten pairs of beetles were housed individually, and their lifespan was recorded separately for each sex. The pre-oviposition period was defined as the duration between adult emergence from the pupal stage and the onset of egg-laying. The oviposition period encompassed the active phase of egg-laying, while the post-oviposition period was recorded as the time from the cessation of egg-laying until the female's death.

Feeding potential : From hatching to pupation, individual grubs were maintained in Petri dishes under controlled conditions. Each grub was provided with fresh *Lipaphis erysimi* twice daily, once in the morning and again in the evening. The duration of each instar was recorded, along with the number of aphids consumed over a 24-hour period. To evaluate the predation efficiency of adults, twenty newly emerged beetles were placed in Petri dishes, each containing aphid-infested host plant leaves, and their daily feeding rates were carefully monitored.To maintain the predator population in the laboratory, aphid nymphs were provided *ad libitum,* ensuring a constant and ample food supply, which was replenished daily. The daily consumption rate of both nymph and adult aphids by Coccinellids was determined by counting the number of aphids remaining after a 24-hour period.

Results and Discussion

Biology : The eggs had an average incubation period of 4.23 ± 1.2 days. The larvae underwent three molts, progressing through four distinct instars, with an average larval duration of 12.76 ± 1.56 days. Adult males had an average lifespan of 32.38 ± 4.31 days, while females lived slightly longer, averaging 34.28 ± 5.24 days. The overall mean lifespan was recorded as 43.42 ± 4.38 days for males and 48.27 ± 5.18 days for females (Table 1). These results align with previous studies[5], which reported that *Coccinella septempunctata* reared on *L. erysimi* exhibited developmental durations of 4.40 ± 0.77 days for the egg stage, 13.67 ± 1.77 days for the larval period, and 6.73 ± 1.11 days for the pupal stage. The adult life span averaged 31.33 ± 3.28 days for males and 37.30 ± 3.44 days for females. Similarly, under laboratory conditions, when feeding on mustard aphids, the first four larval instars lasted 2.7, 2.6, 3.2, and 3.8 days, respectively.They recorded a total grub development period ranging from 9 to 19 days, with an average duration of 13.67 ± 1.77 days[1] . The duration of the 1st, 2nd, 3rd, and 4th instars varied between 3 to 5, 2 to 4, 2 to 5, and 2 to 5 days, respectively, with corresponding mean values of 3.73 ± 0.77, 2.80 ± 0.76, 3.50 ± 0.78, and 3.63 ± 0.85 days[1]w . The average lifespan of male *C. septempunctata* reared on mustard aphids (*L. erysimi*) was found to be 30.67 ± 0.67 days, while author[11] reported a significantly longer male longevity of 44.73 ± 0.65 days when fed on *Schizaphis graminum*. Female *C. septempunctata* reared on mustard aphids exhibited a lifespan ranging from 30 to 45 days, with an average longevity of 37.30 ± 3.44 days.

In the present study, the pre-oviposition, oviposition, and post-oviposition periods were recorded as 7.68 ± 1.84, 21.60 ± 2.45, and 7.57 ± 1.33 days, respectively. These findings are consistent with those of authors , who reported a post-oviposition period of 7.16 ± 1.77 days for *Coccinella septempunctata* on *L. erysimi*, and author[1], who documented a slightly shorter post-oviposition period of 4.6 ± 0.84 days.

The pre pupal and pupal periods were1.23± 0.67

TABLE-1 : Biology of *Coccinella septempunctata* on the mustard aphid, *Lipaphis erysimi*

Predator developmental stage	Duration (days)	Mean± SD
Egg	3-6	4.23± 1.12
1st instar	3-5	3.23± 0.68
2nd instar	2-4	2.54± 0.52
3rd instar	2-5	3.43± 0.64
4th instar	2-5	3.56± 0.82
Total	9-19	12.76± 1.56
Pre pupal	1-2	1.23± 0.67
Pupal Period	5-8	5.2± 1.03
Adult Male Longevity	26-29	32.38± 4.31
Adult Female Longevity	30-45	34.28± 5.24
Pre oviposition period	4-13	7.68± 1.84
Oviposition period	13-26	21.60± 2.45
Post oviposition	4-10	7.57± 1.33
Total life span		
Male	40-63	43.42± 4.38
Female	44-66	48.27± 5.18

and 5.2± 1.03, respectively. The results are in conformity with the earlier[5,13,15], which reported the pupal period of 5.35±0.15, 5.00±0.58 and 5.60±0.18 days respectively.

Feeding potential : The daily feeding capacity of the predator *Coccinella septempunctata* was determined by measuring the total number of aphids consumed by each instar grub over a 24-hour period. Aphid consumption for each instar was recorded as follows: **18.26 ± 3.28** for first instar grubs, **56.1 ± 2.45** for second instar grubs, **158.48 ± 4.88** for third instar grubs, and **259.62 ± 7.11** for fourth instar grubs. First-instar grubs consumed fewer aphids compared to later instars. As the grubs developed, their feeding capacity increased, with the second, third, and fourth instars exhibiting progressively higher predation activity. Fourth-instar grubs were the most active predators until pupation, displaying the highest aphid consumption rates.

A study on the daily feeding efficiency of adult *Coccinellids* revealed that females consumed more aphids than males. The recorded aphid predation rates were **125.44 ± 8.89** aphids per day for males and **158.16 ± 6.85** aphids per day for females, indicating a higher feeding capacity in females.

These findings are consistent with previous research. For instance, workers[14] reported that first-instar grubs typically consumed **19.72** aphids, while

TABLE-2 : Feeding potential *Coccinella septempunctata* on the mustard aphid, *Lipaphis erysimi*

Different stages	Mean no. of aphids consumed daily
1st Instar	18.26± 3.28
2nd Instar	56.1± 2.45
3rd Instar	158.48± 4.88
4th Instar	259.62± 7.11
Adult Male	125.44± 8.89
Adult Female	158.16± 6.85

second-instar grubs consumed **45.1 ± 0.45** aphids. Accordingly[12] third-instar grubs had an average aphid consumption of **107.4.** It was found[8] that when reared on coriander aphids (*Hyadaphis coriandri*), fourth-instar grubs of *Coccinella septempunctata* consumed an average of **237.37 ± 88.37** aphids. Similarly, Workers[7]documented the following predation rates for different instars of *C. septempunctata*: **15.86 ± 0.34**aphids for the first instar, **45.1 ± 0.45** aphids for the second instar, **124.62 ± 0.88** aphids for the third instar, and **238.82 ± 1.11** aphids for the fourth instar.

Conclusion

The larvae of *Coccinella septempunctata* progressed through four distinct instars, each with a different developmental duration. Adult females had a longer lifespan compared to males. Notably, fourth-instar grubs consumed more aphids per day than adults, making them more effective in pest suppression. Similarly, female beetles exhibited higher aphid consumption rates than males.

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