

Feeding and Biotic Potential of Coccinellid Predators on Coriander Aphid

ABSTRACT

The work on feeding and biotic potential of coccinellid predators on coriander aphid was studied under ambient laboratory condition at the Department of Entomology, SKN College of Agriculture (SKNAU), Jobner and observed that the first, second, third and fourth instar grubs of *C. septempunctata* were consume 33.60, 55.22, 129.11 and 193.88 aphids during their respective stages. A grub of *C. septempunctata* consumed 411.13 ± 10.82 aphids during its total life span. The adult male and female beetles consumed 1425.50 ± 231.82 and 1983.25 ± 177.92 aphids during their adult longevity with daily aphid consumption ability of 54.35 ± 2.95 and 64.14 ± 3.90 aphids per day, respectively.

Key Words: Biotic; Predators; Adult; Grub

1. INTRODUCTION

Coriander (*Coriandrum sativum* L.) is one of the important winter seasons seed spice crop belongs to family Apiaceae (Umbelliferae), native of Mediterranean region. It is popularly known as “*Dhaniya*”. India is the largest producer, exporter and consumer of coriander in the world. Coriander crop is extensively grown in the arid and semi-arid regions of India, covering an area of about 711.47 thousand hectares with the production of 947.76 thousand metric tonnes [1]. In the India, Rajasthan and Gujrat states have emerged as seed spice bowl and together contribute more than 80 per cent of the total coriander production. In Rajasthan, it is cultivated in 103.58 thousand hectare area with an annual production of 135.81 thousand metric tonnes and productivity being 1488 kg/ha [1]. Coccinellid predators, *Coccinella septempunctata* (L.) and *Menochilus sexmaculatus* (L.) play a significant role in reduction of the aphid population [2 & 3]. *C. septempunctata* play an important role as a biological control agent because of its extent control of many soft bodies insects mainly the aphid on

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which its larvae as well as adults feed vigorously. Ladybird beetles are very popular cosmopolitan insects, most of which feed on aphids, mealy bugs, scale insects, whiteflies, thrips, leafhopper, mites and other small body insects [4 & 5]. Keeping in view the above facts, the present study on “Bio-ecology and Management of Major Insect Pests of Coriander (*Coriandrum sativum* L.) in Semi-arid Region of Rajasthan”.

2. MATERIAL AND METHODS

As *C. septempunctata* was observed to be the major predator on coriander aphid, therefore, the studies were concentrated to this predator only. The grubs and beetles (males and females) of the predator were collected from coriander fields of the spice block of agronomy farm of the college and cultured by releasing them in glass jars (15×10 cm) and were kept at 28±2 °C in BOD incubator to obtain eggs. Fresh leaves and umbels of the coriander harbouring aphids were kept in each glass jar to serve as food for predator. The jars were covered with muslin cloths and tied with rubber bands. Side by side, a culture of coriander aphid, *H. coriandri* was also maintained on coriander potted plants to ensure continuous supply of food for the predator as well as for the experimental purpose.

The newly hatched first instar grubs of *C. septempunctata* were released (one grub/ jar of size 6.4×4.5 cm) separately each in ten glass jars. About hundred freshly collected apterous aphids were released in each jar along with fresh coriander plant parts, daily during morning hours.

2.1. Observations

The coccinellid predator was allowed to feed for 24 hours and after feeding the left-over aphids were counted. This process was continued till the adult emergence took place. The individual male and female adult was kept separately and provided with food till death and observations were recorded during experimental period to determine predatory potential.

3. RESULTS AND DISCUSSION

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During the present studies, *C. cecimella septempunctata* L. has been observed as the major potential predator of coriander aphid, therefore, the feeding and biotic potential of this predator were studied under laboratory conditions at room temperature 24 °C to 28 °C with relative humidity of 60 to 75 per cent. The observations on feeding potential of different grub stages of the predator has been presented in Table-1.

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The data presented in table-1 indicated that the first instar grub period of *C. septempunctata* was ranged from 2.0 to 4.0 days (average 3.30 ± 0.67 days) with average daily aphid consumption of 9.04 aphids/ day (range 7-13 aphids), moreover, total aphid consumption by first instar was 33.60 aphids (range 27-37 aphids). The aphid consumption by first instar grub was found to be lowest consumption to other grub instar.

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The duration of second instar grub period ranged from 2.0 to 3.0 days (average 2.70 ± 0.48 days). The average daily aphid consumption by second instar grub was 19.32 aphids/ day (range 13-32 aphids) with a total aphid consumption of 55.22 aphids (range 48-60 aphids).

The duration of third instar grub varied from 2.0 to 4.0 days (average 3.44 ± 0.73) with total aphid consumption of 129.11 aphids (range 86-146 aphids). However, the average daily aphid consumption was 37.29 aphids/ day (range 32-44 aphids).

The duration of fourth instar grub varied from 3 to 5 days (average 3.88 ± 0.99 days). The total aphid consumption was 193.88 aphids (range 167-220 aphids), whereas, the average daily aphid consumption was 48.66 aphids/ day (range 40-66 aphids). It was also observed that the duration as well as aphid consumption of this instar was found to be highest among all the instars.

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In the present investigation, the duration of total grub period ranged from 11 to 15 days (average 13.25 ± 1.49 days) and the total aphid consumption was 411.13 aphids (range 397-431 aphids), whereas, the average daily aphid consumption was 25.32 aphids/ day (range 7-66 aphids).

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The duration of adult male ranged from 21 to 29 days (average 26.25 ± 3.78 days). The total aphid consumption was 1425.50 aphids (range 1104-1602 aphids) with an average daily aphid consumption was 54.35 aphids/ day (range 48-59 aphids).

The duration of adult female ranged from 28 to 33 days (average 31.00 ± 2.45 days). Total aphid consumption was 1983.25 aphids (range 1763-2137 aphids) in entire female life span with average daily aphid consumption was 64.14 aphids/ day (range 51-78 aphids). The life span as well as total aphid consumption and daily aphid consumption was observed to be more in case of adult female as compared to adult male.

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On several occasions, insecticidal applications have accentuated the aphid population and quite often resulted in outbreak [6]. Therefore, use of natural enemies in biological control is a good pest management tactic to minimise the population level of invasive pest [7]. Ladybird beetles are generalized predator that feed on a diverse range of foods and aphids are the principal food of ladybird beetles [8].

During present studies, ladybird beetle, *C. septempunctata* was observed to be the major predator of coriander aphid, *H. coriandri*. Ali and Rizvi [9] have been reported maximum predatory performance of *C. septempunctata* on *H. coriandri* are in agreement of present investigations.

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The predatory response of different developmental stages of *C. septempunctata* exhibited that the first, second, third and fourth instar grubs of *C. septempunctata* were found to consume 33.60 ± 2.95 , 55.22 ± 4.44 , 129.11 ± 17.75 and 193.88 ± 19.22 aphids, respectively. A grubs consumed 411.13 ± 10.82 aphids during its life span. The adult male and female beetles consumed 1425.50 ± 231.82 and 1983.25 ± 177.92 aphids during their adult longevity with daily ability to consume 54.35 ± 2.95 and 64.14 ± 3.90 aphids per day, respectively. These finding have been well supported by the finding of Pareek *et al.* [10] who reported that the first. Second, third and fourth instar grubs were found to consume 27.0 ± 5.35 ; 34.22 ± 4.29 ; 91.44 ± 25.13

and 237.37 ± 88.37 aphids, respectively. A grubs consumed 380.62 ± 81.66 aphids during its life span. The adult male and female beetles consumed 1345.0 ± 227.66 and 1948.0 ± 123.4 aphids during their adult longevity with daily ability to consume 52.5 ± 4.74 and 63.5 ± 10.87 aphids per day, respectively. The present finding are partially in conformity with those of Choudhary and Jat [11], Choudhary [12], Bana ([2] and Mishra *et al.* [13).

4. CONCLUSION

The feeding and biotic potential was observed to be higher in adult female *C. septempunctata* as compared to adult male.

REFERENCES

1. Anonymous, Second advance estimates of area and production of horticulture crops. Ministry of Agriculture and farmer welfare; 2021-22.
2. Bana JK. Management of insect-pests of coriander, *Coriandrum sativum* (L.) with special reference to aphid, *Hyadaphis coriandri* (Das). M.Sc. (Ag.) Thesis submitted to Rajasthan Agricultural University, Bikaner; 2007.
3. Kalra VK. Population dynamics of various predators associated with coriander aphid, *Hyadaphis coriandri* (Das). Journal of Biological Control. 2011;2:77-79.
4. Gautam RD. Influence of different hosts on the adults of *Menochilus sexmaculatus* (Fab.). Journal of Biological Control. 1989;3:90-92.
5. Omkar and Prevez A. Biodiversity in predaceous coccinellid (Coleoptera: Coccinellidae) in India- A review. Journal of Aphidology. 2000;14: 41-66.
6. Orlandao A, Camauba T, Sobrinho, Suplicy FN. Tests on the control of yellow beetle, *C. vulgate* on Guava with new pesticides. Biologica. 1970;36:79-82.
7. Delfosse ES. Risk and ethics in biological control. Biological Control.

2005;35:319-329.

8. Bianchi JJ, Felix A, Werf W. Model evaluation of the function of prey in non-crop habitats for biological control by lady bird beetles in agricultural landscapes. *Ecological Modelling*. 2004;17:177-193.
9. Ali, Rizvi PQ. Development and predatory performance of *Coccinella septempunctata* L. (Coleoptera: Coccinellidae) on different aphid species. *Journal of Biological Sciences*. 2007;7:1478-1483.
10. Pareek RK, Sharma A, Kumawat KC. Feeding potential of *Coccinella septempunctata* L. on coriander aphid, *Hydaphis coriandri* (Das). *Indian Journal of Entomology*. 2014;76(1):52-56.
11. Choudhary RK, Jat BL. Feeding potential of *Coccinella septempunctata* Linn. on aphid, *Hydaphis coriandri* (Das). In: National Seminar on New Perspectives in Commercial Cultivation. Processing, Marketing of Seed Spices and Medicinal Plants. 2004 pp. 76.
12. Choudhary RK. Bio-ecology and management of insect-pests of fennel (*Foeniculum vulgare* Mill.). A thesis submitted for Ph.D. to Rajasthan Agricultural University, Bikaner; 2006.
13. Mishra I, Sontakke BK, Mishra BK. Biology and Predatory Potential of *Coccinella septempunctata* Linn. on *Aphis craccivora* under Controlled Condition. *International Journal of Current Microbiology and Applied Sciences*. 2020;9(1):919-924.

Table-1 Feeding and biotic potential of coccinellid predator, *Coccinella septempunctata* on Coriander aphid, *Hyadaphis coriandri*

Stage of predator	Number of individuals observed	Duration (days) observed	Total aphid consumption (No.)	Average daily aphid consumption (No.)
1 st instar grub	10	2.0 – 4.0	27 – 37	7 – 13
		3.30 ± 0.67	33.60 ± 2.95	9.04 ± 1.56
2 nd instar grub	10	2.0 – 3.0	48 – 60	13 – 32
		2.70 ± 0.48	55.22 ± 4.44	19.32 ± 4.61
3 rd instar grub	9	2.0 – 4.0	86 – 146	32 – 44
		3.44 ± 0.73	129.11 ± 17.75	37.29 ± 4.04
4 th instar grub	8	3.0 – 5.0	167 – 200	40 – 66
		3.88 ± 0.99	193.88 ± 19.22	48.66 ± 6.79
Total grub period	8	11 - 15	397 – 431	7 – 66
		13.25 ± 1.49	411.13 ± 10.82	25.32 ± 9.57
Adult male	4	21 - 29	1104 – 1602	48 – 59
		26.25 ± 3.78	1425.50 ± 231.82	54.35 ± 2.95
Adult female	4	28 - 33	1763 – 2137	51 – 78
		31.00 ± 2.45	1983.25 ± 177.92	64.14 ± 3.90

UNDER PEER REVIEW

