Predatory potential of zig zag ladybird beetle, Cheilomenes sexmaculata (Fabricius) (Coccinellidae: Coleoptera) on cowpea aphid, Aphis craccivora (Koch) (Aphididae: Hemiptera)

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Abstract

Studies on predatory potential of larva and adult of C. Sexmaculata on A. craccivora was carried out under laboratory conditions during January 2022 to March 2022 at Navsari Agricultural University, Navsari. The mean per day consumption of the first, second, third and fourth instar was 8.42±1.86, 10.21±3.34, 16.13±2.47 and 36.32±3.78 aphids, respectively. The mean total consumption of first, second, third and fourth instar was 10.78±2.71, 22.48±4.40, 36.78±6.93 and 119.12±18.18 aphids, respectively. The total larval consumption was 189.16±25.28 aphids during its developmental period when reared on A. craccivora. The mean per day consumption in female adults of C. sexmaculata was 35.54±11.66 aphids while in males it was 32.67±10.92 aphids. The mean total consumption in female and male adults was 760.62±49.33 aphids and 555.4±41.63 aphids, respectively.

Keywords: Cheilomenes sexmaculata, Aphis craccivora, predatory potential, coccinellid, aphid

1. Introduction

Biological control is a key ecosystem service and underlying pillar of Integrated Pest Management (Bale et al., 2008; Naranjo et al., 2015) [1, 5]. Biological control of insect pests signifies the use predators, parasitoids, and pathogens (Smith, 1919) [14]. Coccinellids are the major group of predatory insects feeding on many agricultural pests (Omkar and Pervez, 2000) [6]. Both the larval and adult stages are predaceous in nature. They have been used for successful biological control of many agricultural pests (Pervez and Harsur, 2020) [8]. The zigzag ladybird, Cheilomenes sexmaculata (Fabricius) is the predominant ladybird beetle with wide distribution in South Western Asia, Indonesia, Philippines, South Africa, Pakistan and India (Routray et al., 2016) [10]. The important features of C. sexmaculata includes its diverse habitats, wide host range, tolerance to certain pesticides, good searching ability, voracious larval and adult feeding capacity and easy rearing in laboratory (Shammugapriya et al., 2017) [11]. However, the development and feeding potential of coccinellids varies with their food and changes with the environmental conditions. Therefore, the study was undertaken to determine the feeding potential of C. sexmaculata on the cowpea aphid, Aphis craccivora (Koch) under South Gujarat.

2. Material and Methods

The predatory potential of C. sexmaculata was studied on A. craccivora as prey in the Post Graduate Research Laboratory of Department of Entomology, N.M. College of Agriculture, Navsari Agricultural University, Navsari during January 2022 to March 2022 at 27.18 ± 1.45°C temperature with a relative humidity of 49.80 ± 7.64 per cent. The aphid infested twigs of Indian Bean, (Dolichos lablab L.) and the adults of C. sexmaculata were collected from the field and maintained the stock culture of insects under laboratory.

2.1. Larval feeding potential

A set of fifty neonate larvae were reared separately in plastic vials (6 x 4 cm) right from the hatching to pupation to record the larval feeding potential. Each larval instar was provided with a counted number of aphids (nymphs and adults). The number of aphids were increased as the larva entered in to subsequent instar. The number of aphids consumed during 24 hours were obtained by subtracting the number of aphid left over from the total number of aphids.
supplied. The fresh new aphids were reintroduced daily during present investigation. Thus, the larval feeding potential was worked out for each instar as well as for entire larval period.

2.2. Adult feeding potential
The newly emerged adults of C. sexmaculata on A. craccivora were kept separately in plastic vials (6 x 4 cm) to study the feeding potential of adults. A set of fifty male and female adults were supplied with counted number of aphids. Number of aphids consumed during 24 hours was obtained by subtracting the number of aphid left over from the total number of aphid supplied. The fresh new aphids were reintroduced daily throughout the adult period.

3. Results and Discussion
3.1. Larval feeding potential
All the four stages of larvae of C. sexmaculata were voracious, feeding actively on the aphids. The early instar pierced the aphid’s body and sucked the internal contents, leaving the emptied exoskeleton (Fig. 1). Late instar larva in addition, consumed the whole body by chewing.

3.1.1. First instar
The newly hatched first instar larva initially fed on the chorion of the egg and then moved to feed on aphids. The per day consumption of the first instar larva varied between 5–13 aphids with a mean consumption of 8.42±1.86 aphids. The total consumption of first instar ranged between 7–17 with a mean of 10.78±2.71 aphids (Table 1). The present findings are similar to those reported by Solangi et al. (2007) who found that the number of aphids consumed per day by first instar varied between 6.20–12 aphids when reared on different aphids.

Similarly, Singh et al. (2008) reported that the per day consumption on L. erysimi was 9.68±0.54 aphids but the total consumption varied from the present results as it was reported as 24.23±1.83 aphids. More or less similar observations were obtained by Pandi et al. (2012) who noticed that the mean consumption of first instar varied as 4.6–14.2 aphids, when reared on different aphids. This results were further corroborated by the reports of Shinde (2012) and Priyadarshani et al. (2016).

3.1.2. Second instar
The per day consumption of the second instar larva varied from 5–17 aphids with a mean of 10.21±3.34 aphids, while the total consumption ranged between 11–33 aphids with a mean of 22.48±4.40 aphids (Table 1). These results are in tally with the findings of Solangi et al. (2007) who noticed that the mean consumption of second instar was 20.00–27.00 aphids when reared on different aphid species. Similar results were obtained by Shinde (2012) who reported that the average per day consumption of second instar larva was 14.41±2.54, while total consumption was 24.58±1.51. Priyadarshani et al. (2016) mentioned that the per day consumption of second instar larva was 7.5±1.3 aphids when reared on A. craccivora. The present findings are in deviation with the results of Singh et al. (2008) and Pandi et al. (2012). This could be due to variation in the larval duration, prey density and the prey species used.

3.1.3. Third instar
The per day consumption of the third instar larva ranged between 10–23 aphids with an average of 16.13±2.47 aphids and the total consumption varied between 30–58 aphids with an average of 36.78±6.93 aphids (Table 1). Similar the results were obtained by Solangi et al. (2007) who reported that the mean consumption of third instar was 30.5 aphids when reared on A. gossypii. The present results are in partial agreement with the results given by Shinde (2012) where the per day consumption varied between 12.16–26.47 aphids and the total consumption ranged between 27.75–53.73 aphids when reared on different aphid species. These results are in disagreement with the earlier reports of Singh et al. (2008), Pandi et al. (2012) and Priyadarshani et al. (2016).

3.1.4. Fourth instar
The data on per day consumption of fourth instar revealed that it ranged between 27–47 aphids with an average of 36.32±3.78 aphids and the total consumption varied between 74–145 with an average of 119.12±18.18 aphids (Table 1). The present results are in agreement with the reports of Solangi et al. (2007) who reported that the mean consumption of fourth instar larva was 115.87 when reared on maize aphid, R. maidis. Pandi et al. (2012) noticed that the mean consumption of fourth instar larva was 116.8±2.58 when reared on L. erysimi. More or less similar results were obtained by Shinde (2012) when reared on different aphids. Among all, the fourth instar was a voracious feeder and consumed a greater number of aphids. This could be attributed to larger size, longer duration of the fourth instar which necessitates higher intake, as well as the requirement to accumulate nutrients for the pupal period (Pandi et al., 2012). The higher attack rate and the lower handling time of the prey by the fourth instar also facilitates higher consumption (Gupta et al., 2012).

3.1.5. Total larval feeding potential
The data presented on feeding potential of C. sexmaculata during its entire larval period revealed that the total consumption varied between 125–239 aphids with an average of 189.16±25.28 aphids (Table 1). More or less similar results were obtained by Shinde (2012) when reared on different aphids.

3.2. Adult feeding potential
The adult attacked the aphid and consumed the whole prey by chewing (Fig. 2). The data obtained on feeding potential of adult revealed that the per day consumption in females varied between 16–58 aphids with a mean of 35.54±11.66 aphids in females while in males it was 11–54 aphids with a mean of 32.67±10.92 aphids. The total consumption was enumerated and it ranged between 642–842 aphids with an average of 760.62±49.33 aphids and in males it was 622–548 aphids with an average of 555.4±141.63 aphids. The present results are in close agreement with the findings of Pandi et al. (2012) who found that the per day mean consumption in males and females was 37.2±3.32 and 35.8±2.67 aphids, respectively when reared on A. craccivora. More or less similar observations were recorded by past workers.

3.3. Adult feeding potential
The adult attacked the aphid and consumed the whole prey by chewing (Fig. 2). The data obtained on feeding potential of adult revealed that the per day consumption in females varied between 16–58 aphids with a mean of 35.54±11.66 aphids in females while in males it was 11–54 aphids with a mean of 32.67±10.92 aphids. The total consumption was enumerated and it ranged between 642–842 aphids with an average of 760.62±49.33 aphids and in males it was 622–458 aphids with an average of 555.4±141.63 aphids. The present results are in close agreement with the findings of Pandi et al. (2012) who found that the per day mean consumption in males and females was 37.2±3.32 and 35.8±2.67 aphids, respectively when reared on A. craccivora. More or less similar observations were recorded by past workers. Bhadauria et al. (2001) mentioned that per day consumption of adult C. sexmaculata was 28.0 individuals. Shinde (2012) noticed that per day aphid consumption in female and male was 20.69±1.20 and 20.33±2.86 and the total aphid consumption was 789.92±32.72 and 491.60±33.05, respectively. This shows that the female consumed more number of aphids as compared to males. This could be due to the nutritional
requirements to meet the reproductive attributes and also the higher longevity in females compared to males. The higher attack rate and the lower handling time in females also helps in higher consumption of the prey (Gupta et al., 2012; Mrosso et al., 2013).

Table 1: Feeding potential of larva and adult of Cheilomenes sexmaculata on Aphis craccivora

<table>
<thead>
<tr>
<th>Stages</th>
<th>No. observed</th>
<th>Per day consumption of aphids (No.s)</th>
<th>Total consumption of aphids (No.s)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Min.</td>
<td>Max.</td>
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<tr>
<td>Larva</td>
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<tr>
<td>I instar</td>
<td>50</td>
<td>5</td>
<td>3</td>
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<tr>
<td>II instar</td>
<td>50</td>
<td>5</td>
<td>17</td>
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<tr>
<td>III instar</td>
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<td>10</td>
<td>23</td>
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<tr>
<td>IV instar</td>
<td>50</td>
<td>27</td>
<td>47</td>
</tr>
<tr>
<td>Total consumption</td>
<td>50</td>
<td>-</td>
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<tr>
<td>Adult</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Female</td>
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<td>16</td>
<td>58</td>
</tr>
<tr>
<td>Male</td>
<td>50</td>
<td>11</td>
<td>54</td>
</tr>
</tbody>
</table>

Fig 1: Larva of Cheilomenes sexmaculata feeding on Aphis craccivora

Fig 2: Adult of Cheilomenes sexmaculata feeding on Aphis craccivora

Acknowledgement
The authors are thankful to Principal and Dean, N.M. College of Agriculture, Navsari as well as Director of Research and Dean, P.G. Studies, Navsari Agricultural University, Navsari for providing necessary facilities.

References
