PREDATORY AND FEEDING POTENTIAL OF APHID LION, CHrysoperla carnea (STEPHENS) ON DIFFERENT PREYS

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KEYWORDS
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ABSTRACT

The feeding potential of *Chrysoperla carnea* larvae on *Aphis gossypii*, *Maconellicoccus hirsutus*, *Sitotroga cerealella*, *Pectinophora gossypiella* and *Helicoverpa armigera*, was investigated in ambient laboratory conditions at Biocontrol laboratory, Main Agricultural Research Station, Raichur, Karnataka. The third instar larvae consumed significantly more amount of prey compared with younger instar larvae. The maximum numbers of eggs of *S. cerealella* were consumed by 3rd instar larvae (1770.00) followed by 2nd instar (215.09) and 1st instar (102.89). In all hosts 1st instar larvae consumed less number of prey/diet. Consumption of prey by third instar larva was in the order of *S. cerealella > A. gossypii > P. solenopsis > H. armigera > P. gossypiella*. The overall highest live weight of *A. gossypii* was 474.04 number of *S. cerealella* larvae followed by 2088.37 eggs of *A. gossypii*. The eggs/nymphs of hosts were collected from cotton field of Institute and reared in laboratory for experimental purpose. Angoumois eggs were also obtained from culture maintained in the laboratory. The effect of food consumption on predation by instars, larval growth and development time were studied in the laboratory at controlled condition (26 ± 2°C; 65 ± 5%).

INTRODUCTION

The common green lacewing, *Chrysoperla carnea* (Stephens) is an important predator; it belongs to order ‘Neuroptera’. This order consists of a group of insects with rather soft bodies, biting mouthparts and two pairs of very similar membranous wings which are usually held roof-like along the abdomen at rest. Their agricultural importance lies in their carnivorous habits. The larvae are all predators. Some are terrestrial, feeding on jassids, psyllids, aphids, coccids, mites etc., and others are aquatic. It is rare in the tropics to find a large colony of aphids without at least some neuropterous larvae feeding on them. One larva may devour as many as five hundred aphids in its life and there is no doubt that they play an important part in the natural control of many small homopterous pests (Michaud, 2001; Liu and Chen, 2001; Yadav and Pathak, 2010).

Interest in using beneficial predators as a component of integrated pest management programs for field and horticultural crops has recently increased, as growers seek alternatives to insecticides for managing insect pests. The larvae of *Chrysoperla* spp. are among the most efficient predators of many important agricultural insect pests (Lingren et al., 1968), particularly *C. carnea* (Stephens) (Neuroptera: Chrysopidae), which is the most abundant species in the genus (Van den Bosh and Hagen 1966). The larvae of *C. carnea* are voracious and generalist predators, while adults only feed on nectar and pollen (Tauber et al., 2000). Green lacewings, *C. carnea*, is an example of one of these species that is not predacious in the adult stage; larval stage is predatory stage while in some species adults are also predators. These lacewings larvae are considered generalist predators; the larvae are sometimes called aphid lions and have been reported to eat between 100 to 600 aphids each (Tauber et al., 2000). Keeping this in view the present studies were carried out to study the feeding preference and predatory potential of *C. carnea* on different hosts in the laboratory.

MATERIALS AND METHODS

Predatory efficiency of *Chrysoperla carnea* on four natural hosts was studied in Bio-control laboratory, University of Agricultural Sciences, Raichur. The natural hosts were: cotton aphids, (nymphs/adults); cotton mealy bug, (nymphs); Pink bollworm (larvae); Angoumois grain moth, (frozen eggs) and American bollworm (eggs). The eggs/nymphs of hosts were collected from cotton field of Institute and reared in laboratory for experimental purpose. Angoumois eggs were also obtained from culture maintained in the laboratory. The effect of food consumption on predation by instars, larval growth and development time were studied in the laboratory at controlled condition (26 ± 2°C; 65 ± 5%).

Lacewings: *C. carnea* larvae were obtained from laboratory-reared adults. After the identification of sexes, one male and one female was paired in a 250 mL beaker for mating and to lay eggs. Breeding pairs were provided with mixture of honey, protinex, yeast and water on a piece of sponge (Singh et al., 2005). The feeding efficiency of
all larval instars of C. carnea was recorded daily and total consumption data were also recorded. Each lacewings larva was examined daily for development and survival. The experiment was replicated 3 times and 10 C. carnea larvae were used in each replicate. Aphis gossypii and mealy bugs were collected from cotton field. All aphids (nymphs and adults) and mealy bugs (nymphs) were maintained in glass jars at 26 ± 2°C, 60 ± 5% relative humidity, in the laboratory on cotton. The lacewings larvae were provided a predetermined number of the fresh nymphs/adults of aphids and mealy bugs separately in glass vials (2.5 cm diameter, 8.5 cm length) covered with black muslin cloth. Wet cotton was placed on the top. Counted number of both the hosts were introduced with a fine brush in vials. Only the first to third instars of mealy bugs were used in all experiment because the adults were disliked by C. carnea larvae.

Angoumois grain moth eggs were obtained from the culture maintained on sorghum grain temperature 26 ± 2°C and 60 ± 5% R.H. The counted number of eggs of the Angoumois grain moth was offered to C. carnea larvae. After 24 hrs the remaining eggs were counted and replaced with new eggs, which were first exposed to 7°C in refrigerator to kill the embryo for 24 hours before using for the experiment. Pink bollworm and American bollworm: The eggs of both insects were incubated for 24 hours before using for the experiment. Pink bollworm which were first exposed to 7°C in refrigerator to kill the embryo remaining eggs were counted and replaced with new eggs, and then the eggs of Angoumois grain moth were offered to C. carnea larvae. After 24 hrs the remaining eggs were counted and replaced with new eggs. Pink bollworm eggs were covered with black muslin cloth. Wet cotton was placed on the top. Counted number of both the hosts were introduced with a fine brush in vials. Only the first to third instars of mealy bugs were used in all experiment because the adults were disliked by C. carnea larvae.

RESULTS AND DISCUSSION

The results in Table 1 show the predatory potential and consumption rate of the different larval stages, which varied significantly from host to host and instar to instar. The 3rd instar larva consumed significantly more amount of prey (F = 276.51; p < 0.001 for aphid) compared with younger instar larvae. The maximum numbers of eggs of S. cerealella were consumed by 3rd instar larvae (1770.00) followed by 2nd instar (215.09) and 1st instar (102.89). In all hosts 1st instar larvae consumed less number of prey.

Feeding potential and larval mortality: The analysis of variance revealed that the third instar larva consumed significantly high number percent of prey than first and second instars. The per day consumption pattern of C. carnea larva varied from prey to prey depending on the larval age (Table 1). The consumption by first instar larva is in the order of A. gossypii > S. cerealella > P. solenopsis > H. armigera > P. gossypiella. Consumption of prey by second instar as in order of A. gossypii > P. solenopsis > S. cerealella > H. armigera > P. gossypiella. While consumption of prey by third instar larva was in the order of S. cerealella > A. gossypii > P. solenopsis > H. armigera > P. gossypiella. The consumption capacity of C. carnea also differed significantly, when larvae were reared separately on the four aphid species at different temperatures. Consumption was maximum (320.5 ± 22.79 aphids) at 15°C when A. craccivora was given as prey to the larvae of this predator and minimum (143.3 ± 1.25 aphids) at 30°C when reared on L. Erysimum (Ranu Yadav and Pathak, 2010), similarly Rita Gupta and Mohan (2012) revealed that mean percent feeding per day by first, second and third instar larva was 6.5, 21 and 45 on mustard aphid and 4, 24 and 35.5 on cabbage aphid. Whereas total numbers of aphids consumed by 1st, 2nd and 3rd larval instar was 6, 72.5 and 100 in case of mustard aphids and 17.5, 37.5 and 71.5 in case of cabbage aphids. The 3rd instar larvae are more voracious eater of aphids in both the cases. The total food consumption of a single larva of C. carnea was 474.04 number of A. gossypii, 342.93 nymphs of M. hirsutus, 2088.37 eggs of S. cerealella and 643.62 eggs of H. armigera. The results in table 2 show that, the food consumption of C. carnea larvae on different hosts. The overall highest live weight of A. gossypii as a food was consumed by C. carnea larvae followed by S. cerealella eggs and P. solenopsis.

Survival to adult stage and fecundity of C. carnea was affected due to feeding on different hosts. The maximum survival to adult stage and fecundity were recorded when C. carnea were reared on S. cerealella eggs, while minimum survival to adult stage and fecundity were found for insects feeding on P. gossypiella eggs. Osman and Selman (1993) investigated the influence of different aphid species on larval development and fecundity of C. carnea. M. persicae and A. pisum were suitable, while A. fabae was most unsuitable prey causing high juvenile mortality. C. carnea larvae fed on this aphid and Macrosiphum albirens had reduced fecundity. Food consumption varied in C. carnea depending upon the host

Table 1: Predatory potential of C. carnea larvae for different insect hosts under no choice laboratory conditions

<table>
<thead>
<tr>
<th>Instars of C. carnea</th>
<th>Aphis gossypii (nymphs/adults)</th>
<th>Maconellicoccus hirsutus (nymphs)</th>
<th>Sitotroga cerealella (eggs)</th>
<th>Helicoverpa armigera (eggs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>38.78 ± 1.72</td>
<td>25.61 ± 0.29</td>
<td>102.89 ± 9.08</td>
<td>89.07 ± 1.02</td>
</tr>
<tr>
<td>2nd</td>
<td>132.08 ± 10.36</td>
<td>78.78 ± 0.31</td>
<td>215.09 ± 11.16</td>
<td>183.58 ± 2.94</td>
</tr>
<tr>
<td>3rd</td>
<td>303.18 ± 19.54</td>
<td>238.54 ± 0.56</td>
<td>1770 ± 17.27</td>
<td>370.97 ± 3.21</td>
</tr>
<tr>
<td>Total prey consumed</td>
<td>474.04</td>
<td>342.93</td>
<td>2088.37</td>
<td>643.62</td>
</tr>
<tr>
<td>F-value</td>
<td>276.51</td>
<td>0.001</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>P-value</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 2: Feeding potential of larval instars of C. carnea on different prey species (mg) under laboratory conditions

<table>
<thead>
<tr>
<th>Instars</th>
<th>Food offered (mg)</th>
<th>Aphis gossypii (nymphs/adults)</th>
<th>Maconellicoccus hirsutus (nymphs)</th>
<th>Helicoverpa armigera (eggs)</th>
<th>Pectinophora gossypiella (eggs)</th>
<th>Sitotroga cerealella (eggs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>10</td>
<td>41.08(39.86)</td>
<td>38.27(38.22)</td>
<td>29.80(33.09)</td>
<td>13.33(21.41)</td>
<td>40.80(39.70)</td>
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<tr>
<td>2nd</td>
<td>20</td>
<td>60.19(50.88)</td>
<td>62.67(52.34)</td>
<td>55.07(47.91)</td>
<td>50.04(45.02)</td>
<td>64.53(53.45)</td>
</tr>
<tr>
<td>3rd</td>
<td>30</td>
<td>79.83(63.31)</td>
<td>78.96(62.70)</td>
<td>60.92(51.31)</td>
<td>59.02(50.20)</td>
<td>80.58(63.85)</td>
</tr>
<tr>
<td>F-value</td>
<td></td>
<td>1189.12</td>
<td>118.51</td>
<td>13.28</td>
<td>12.66</td>
<td>2120.25</td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td>0.001</td>
<td>0.002</td>
<td>0.001</td>
<td>0.004</td>
<td>0.001</td>
</tr>
</tbody>
</table>

*Values in the parenthesis are arcsine transformed values
species. The maximum amount of food was consumed when fed on *S. cerealella* eggs followed by *A. gossypii* and *M. hirsutus*, in the present studies. *C. carnea* larvae are voracious predators of *A. gossypii, H. virescens, H. zea, H. armigera, P. gossypiella*, and *Leptinotarsa decemlineata* (Rafiq, 1974; Nordlund et al., 1991; Balasubramani and Swamiappan, 1994).

**CONCLUSION**

Finally the study revealed that among all the hosts with respect to total food consumption and feeding potential it can be concluded that for mass production of *C. carnea* under laboratory conditions *Sitotroga cerealella* is one of the best fictitious hosts for larval rearing, because it is very laborious to maintain natural hosts under laboratory conditions for rearing *C. carnea*.

**REFERENCES**


