

PREDATORY POTENTIAL OF *CHRYSOPERLA CARNEA* (STEPHENS) (NEUROPTERA: CHRYSOPIDAE) AGAINST COTTON MEALY BUG

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ABSTRACT

Predatory potential of *Chrysoperla carnea* (Stephens) was studied on the mealy bugs under laboratory conditions ($26 \pm 2^\circ\text{C}$ and $65 \pm 2\%$ R.H). The results revealed that *C. carnea* larvae were voracious feeder of mealy bugs. On an average, a single larva consumed 1604.0 nymphs of 1st instar, 689 nymphs of 2nd instar and 144.7 nymphs of 3rd instar of cotton mealy bug in its entire larval period (no choice feeding). First instar nymph of mealy bug was most preferred for feeding (free choice feeding). *C. carnea* is a potential predator of mealy bug and can be utilized to reduce its populations.

INTRODUCTION

Cotton crop is damaged by many sucking and bollworms insect pests and improper management of these pests has increased their populations (Wu, 1986). Cotton mealy bug, *Phenacoccus* sp. (Homoptera: Pseudococcidae) is a soft-bodied insect that sucks the cell sap of cotton plant and plays havoc with the crop. It has emerged as an important pest of cotton in Pakistan recently within 2-3 years. It also attacks a number of other crops, ornamentals and fruit trees (Aijun *et al.*, 2004). Winged male of mealy bug has four nymphal instars while wingless female has three instars. Besides sucking the cell sap of plants, mealy bug releases toxic substance causing curling and drying of leaves and drastically decreases the yield (Mani, 1989). Different management strategies like chemical, biological and cultural control have been used to combat this menace. Since pesticides lead to many serious problems like air and water pollution, health hazards, killing of beneficial organisms, pest resistance, pest resurgence, secondary pest outbreak, interruption in ecocycles and biodiversity (Bellows, 2001).

Biological control by the use of predator, *Chrysoperla carnea* has gained importance in pest management in Pakistan. The larvae of *C. carnea* have a ferocious appetite for aphids, mealy bugs, immature scales, whiteflies, thrips, spider mites and other plant pests (Saminathan and Bas Karan, 1999).

Therefore, studies were conducted to determine feeding efficiency of *C. carnea* on cotton mealy bugs for effective control of the pest.

MATERIALS AND METHODS

Studies on predatory potential of *Chrysoperla carnea* (Stephens) on cotton mealy bug were conducted at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during 2006-07. The larvae of different instars of the predator were taken from the Mass Rearing Laboratory of Bio-Control Agents and mealy bugs were collected daily from the cotton fields. The experiments were conducted at $26 \pm 2^\circ\text{C}$ and $65 \pm 2\%$ R.H.

i) Free choice larval feeding on different mealy bug instars

Single larva of each *C. carnea* instars was placed in a glass jar (7x3cm) lined with black muslin cloth. Known number of mealy bugs of 1-3 instars was introduced into jar with the help of camel hair brush for larval feeding. Consumption of each instar of mealy bugs was recorded daily till completion of each larval instars of *C. carnea*. The experiment was replicated 8 times. The results were summed for statistical analysis.

ii) No choice larval feeding on different mealy bug instars

Feeding efficiency of *C. carnea* larval instars was studied on 1st, 2nd, and 3rd instars of mealy bugs separately. Neonate 1st, 2nd and 3rd instar larvae of *C. carnea* were placed singly in glass jars (7x3cm) in three sets. Counted numbers of each instar nymphs of prey were provided to larvae of *C. carnea*. Mealy bugs consumption day⁻¹ of each instar of *C. carnea* was recorded. The experiment in each set was replicated 8 times.

RESULTS AND DISCUSSION

The results on free choice predation of *C. carnea* on different instars of mealy bug (Table 1) indicated that 3rd instar larvae of the predator consumed significantly ($P < 0.05$) high number of 1st, 2nd and 3rd instar of mealy bugs as compared to 2nd and 1st instar of the predator. Likewise, 1st instar of mealy bug was preferred to its 2nd and 3rd instar for feeding by the predator. Feeding efficiency of *C. carnea* (No choice) larvae on 1st, 2nd and 3rd instars of the mealy bug is depicted in Tables 2, 3 and 4 respectively. The predation efficiency of *C. carnea* from 1st to 3rd instar increased tremendously. The 1st instar of the predator consumed 125.8, 108.3 and 10.0 mealy bugs of 1st, 2nd and 3rd instars, respectively. Second instar of predator consumed 510.8, 208.8 and 36.9 mealy bugs of 1st, 2nd and 3rd instars respectively. While the consumption by the 3rd instar *C. carnea* larvae were the highest as 967.4, 372.6 and 97.8 mealy bugs of 1st, 2nd and 3rd instars respectively.

Gautam and Tesfaye (2002) found that the predatory potential of the predator was high in the older instars than the younger ones. The estimated handling time was some what lower for the third instar because of the higher prey consumption. Atlzhan *et al.* (1999) reported that increased prey consumption in immature stages resulted in higher reproduction rate.

The increased prey densities reduced developmental time and mortality rate of *C. carnea* (Table 5). Larval survival was recorded 77.09, 83.36 and 93.36 % in 1st, 2nd and 3rd instars of *C. carnea* respectively. Percent adult emergence was about 82.8, 82.2 and 87.4 in 1st, 2nd and 3rd instars respectively. Pupal period was recorded 27, 9.7 and 8.0 days in 1st, 2nd and 3rd instar, respectively. Pupal weight, adult male and female percent were more or less similar in all three instars.

The prey density of immature and mature larval stages had a pronounced effect on the oviposition period of the adult female of *C. carnea* (Table 6). The average fecundity of *C. carnea* females fed on mealy bug nymphs were 598.1 eggs per female. Increased prey densities for larvae resulted in higher net reproduction rate (Williams *et al.*, 2001). Our findings conform to the work done by Ashfaq *et al.* (2002). Average mean fertility, pupation, percent emergence, percent male and female were 83.2, 83.7, 89.3, 42.0 and 47.1, respectively. Nordlund and Correa (1995) studied the correlation between the predator and its prey and found similar findings as we had. Kamath *et al.*, (2001) determined the same predatory efficiency of *C. carnea* as is reported in the present study. Larvae of *C. carnea* not only feed on nymphs of mealy bugs but can complete its life cycle successfully without any adverse effect on growth and reproduction.

Table 1. Predatory potential of *C. carnea* on mealy bugs (Free choice feeding)

Instars of <i>C. carnea</i>	Instars of mealy bug		
	1 st Instar	2 nd Instar	3 rd Instar
1 st	57.8 c	23.2 c	4.3 c
2 nd	165.2 b	88.3 b	9.8 b
3 rd	424.6 a	164.7 a	14.2 a
L.S.D.=0.050	12.33	4.14	0.44

Note: Letters indicate the significant difference.

Table 2. Per day mean consumption of 1st instar of mealy bug (No choice feeding)

Instars of <i>C. carnea</i>	Days				Means
	1 st	2 nd	3 rd	4 th	
1 st	92.0	103.0	121.1	187.2	125.8
2 nd	407.5	435.1	519.1	681.6	510.8
3 rd	784.5	902.0	1029.8	1153.3	967.4
Grand Total					1604.0

Table 3. Per day mean consumption of 2nd instar of mealy bug (No choice feeding)

Instars of <i>C. carnea</i>	Days				Means
	1 st	2 nd	3 rd	4 th	
1 st	63.7	98.3	120.8	150.5	108.3
2 nd	176.5	189.5	205.1	264.3	208.8
3 rd	280.2	320.3	430.2	459.8	372.6
Grand Total					689.7

Table 4. Per day mean consumption of 3rd instar of mealy bug (No choice feeding)

Instars of <i>C. carnea</i>	Days				Means
	1 st	2 nd	3 rd	4 th	
1 st	3.8	8.2	11.6	16.6	10.0
2 nd	21.5	35.6	39.7	50.7	36.9
3 rd	66.8	85.8	99.2	139.3	97.8
Grand Total					144.7

Table 5. Mean survival of life stages of *C. carnea* after feeding on mealy bug nymphs

Instar of <i>C. carnea</i>	Larval period (days)	% Larval survival	Pupal period (days)	% Emergence	% Male	% Female	Pupal Weight (g)
1 st Instar	9.3	77.0	27.0	82.8	35.2	47.6	0.0066
2 nd Instar	8.0	83.3	09.7	80.2	32.4	47.8	0.0073
3 rd Instar	5.0	93.3	08.0	87.4	35.2	52.2	0.0075

Table 6. Biology of *C. carnea* after feeding on mealy bugs

Rep.	Fecundity	Fertility %	Pupation%	Emergence%	% Male	% Female
R1	605.0	82.0	80.4	90.0	44.2	45.8
R2	572.6	76.0	81.3	85.7	46.4	39.3
R3	624.3	94.1	91.3	91.4	42.0	49.4
R4	595.3	81.7	79.9	89.6	39.2	50.4
R5	593.3	82.3	85.7	89.0	38.3	50.7
Means	598.1±18.8	83.2±6.6	83.7±4.8	89.1±2.1	42.0±3.3	47.1±4.7

REFERENCES

- Aijun Z., A. Divina, S. Shyam, S.S. Miguel, A.F. Rosa, E.O. James, A.K. Jerome, R.A. Jeffrey, E.M. Dale and L.L. Stephen, 2004. Sex pheromone of the pink hibiscus mealybug, *Maconellicoccus hirsutus*, contains an unusual cyclobutanoid monopterpene. The Nat. Acad. Sci. USA. 101 (26): 9601-9606.
- Ashfaq, M., A. Nasreen and G.M. Cheema, 2002. A new technique for mass rearing of Green lacewing on commercial scale. Pakistan J. Appl. Sci., 2: 925-926.
- Atlzhan, R., E. Denizhan and B. Ya Ar, 1999. Effects of different prey on the development and fecundity of *Scymnus subvillosus* Goeze (Coleoptera: Coccinellidae). Proceed 4th Turkish Nat. Cong. Biol. Contr., 26-29 January, Adana, Turkey, pp. 397-406.
- Bellows, T.S., 2001. Restoring population balance through natural enemy introductions. Biol. Contr., 21: 199-205.
- Gautam, R.D. and A. Tesfaye, 2002. Potential of green lacewing, *Chrysoperla carnea* (Stephens) in crop pest management. New Agriculturist, 13 (1/2): 147-158.
- Kamath, S.P., P.S. Hugar and K.B. Goud, 2001. Predatory efficiency of green lacewing, *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae). Karnataka J. Agric. Sci., 14 (2): 483-484.
- Mani, M., 1989. A review of the pink mealybug, *Maconellicoccus hirsutus* (Green). Insect Sci. Appl., 10: 157-167.

- Nordlund, D.A. and J.A. Correa, 1995. Improvements in the production system for green lacewings: An adult feeding and ovipositional unit and hot wire egg harvesting system. *Biol. Contr.*, 5: 179-185.
- Saminathan, V.R. and R.K.M. Baskaran, 1999. Biology and predatory potential of green lacewing, *Chrysoperla carnea* (Neuroptera: Chrysopidae) on different insect hosts. *Indian J. Agri Sci.*, 69 (7): 502-505.
- Williams, D.J., D. Matile-Ferrero and J.H. Martin, 2001. The mealybug *Planococcus lilacinus* (Cockerell) in Africa (Hemiptera: Coccoidea, Pseudococcidae). *Bull. de la Socit. Entomol. de France*. 106: 259-260.
- Wu, Q.L., 1986. Investigations of fluctuation of dominant natural enemy populations in different cotton habitats and integrated application with biological agents to control cotton pests. *Natural Enemies of Insects*, 8 (1): 29-34.