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Research Article

Feeding Efficiency of Green Lacewing, *Chrysoperla carnea* (Stephens) against Different Species of Aphid in Laboratory Conditions

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Abstract

Green lacewing, *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae) is the most effective polyphagous predator of different species of aphids and is commonly known as "aphid lion" . The experiment on feeding efficiency of green lacewing was studied in the laboratory of Entomology Division, NARC, Khumaltar, Lalitpur, Nepal from 21st , December 2015 to 26th, March 2016. The known number of predatory larva of green lacewings were fed with known number of seven different species of live aphid and frozen *Corcyra* eggs representing each treatment. The treatments were replicated four times. The predatory efficiency was calculated by counting the number of consumed host per day. The result revealed that the predatory efficiency of *C. carnea* larvae were increased from first to third instar and third instar were more voracious as compare to first two instars. It consumed significantly the highest rice moth, *Corcyra cephalonica* followed by *Aphis craccivora* and others aphid species, respectively. From this experiment, it is evident that the green lacewing is potent bio-agent against different aphid species and hence further research is required simultaneously in the farmer's field conditions.

Key words: *Chrysoperla carnea*; predatory efficiency; aphids; *Corcyra cephalonica*.

Introduction

Insects, diseases, weeds and nutritional factors are major constraints acting against the quality and quantity of crops yield. Out of many insect pests, aphids and mites are the most important and serious insect pests of crops (E.D., 2013). The aphids are one that damages the various crops in which they habitat. They damages crops by sucking sap from plant and transferring viral diseases to healthy plants. Aphids infest wide range of several agricultural crops in horticulture, cereal crops, oilseed crops etc.

Farmers are using more than one pesticide in alternating manner to suppress insect pest in their field (E.D., 2013). The average use of pesticides is 396 g a.i/ha in Nepal (PPD, 2015) and 500g a.i./ha in the world (Kodandaram *et al*., 2013). Although, use of pesticides rate in Nepal is lower, but indiscriminate use of chemical pesticides in the agricultural crops have created many problems. Resulting that development of resistance to insecticides, pesticides residue on food, air, water and soil, pest resurgence, killing of natural enemies, harmful effect on non-target organisms including pollinators and disruption of ecosystem, hereby increasing the cost of production and hazard on human beings and animals (Palikhe, 2002; Atreya, 2007; Neupane, 2010; Sharma *et al*., 2012).

These negative impacts of chemical pesticides on human health and environment, have led to realize the need for alternative method, which is environmentally friendly, economically viable and sustainable method of insect pest management. It can be reduced or minimized through the development, dissemination and promotion of alternative method such as botanical pesticides (Akter, 2015; Kafle, 2015), biological pest control (Pinstrup-Andersen and Hazell, 1985) and IPM approach (Neupane, 2010). It is important to reduce the pesticides application on crops by using or conserving the biologically derived predator in the field such as Green lacewing, *Chrysoperla carnea* (Stephens) (Sarwar, 2014). The common green lacewing is an important generalist predator (Cheng *et al*., 2010; Jokar and Zarabi, 2012 and Sarwar, 2014) is best known as bio-control agent (Menon *et al*., 2015). The larval stage are more voracious feeder of soft bodied insect such as aphid, whitefly, mealy bugs, thrips, mites, leaf hoppers, jassids, caterpillar and insect eggs (Ulhaq *et al*., 2006; Aryal and Giri, 2015; Sarwar and Salman, 2016) however, aphids are more preferred host (Solangi *et al*., 2013). The adults are free living and they only feed honey, pollen and water (Borah *et al*., 2012; E.D., 2013; Nadeem *et al*., 2014; E.D., 2015). The ability of *C. carnea* can be exploited as a bio-control agent in IPM program (Bozsik *et al*., 2009; Memon *et al*., 2015). The application of the predator reduces the use of insecticides and save money spent on importing pesticides (Zia *et al*., 2008).

After knowing the importance of *C. carnea* in agricultural systems, it is important to develop efficient pest management strategies that are simple, economical, sustainable and bio-friendly based on biological control. The objective of this study was to determine feeding efficiency of *C. carnea* on different species of aphid for effective management of aphids on agricultural crops.

Materials and Methods

The experiment was conducted on the feeding efficiency of *C. carnea* under controlled conditions at bio-agent insect rearing room, Entomology Division, NARC, Khumaltar, Lalitpur, Nepal during winter season from 21st December, 2015 to 26th March, 2016. The experiment was performed in a completely randomized design consisting of eight treatments, and each treatment was comprised of four replicates. The natural hosts were *Aphis craccivora* (Koch), *Brevicorynae brassicae* (Linnaeus), *Myzus persicae* (Sulzer), *Eriosoma lanigerum* (Hausman), *Lipaphis erysimi* (Kaltenbach), *Aphis fabae* (Scopoli), *Ceratovacuna lanigera* (Zehntner) and *Corcyra cephalonica* (Stainton) (Frozen eggs). The first seven hosts were collected from field on daily basis. Eggs of *C. cephalonica* were taken from laboratory culture maintained for experimental purpose.

The five freshly hatched *C. carnea* larvae were kept in plastic bottles sized 8cm×6cm for each treatment and provided with 25 number of hosts per day. After providing hosts, bottles were covered at the top by piece of black muslin cloth and were fastened by rubber string. The number of each prey consumed by the predatory larvae was recorded by counting the live preys after every 24 hrs. Then, fresh aphids and frozen eggs were provided in each treatment. Similar, counting method was adopted by Chakraborty and Korat (2010); Gupta and Mohan (2012); Memon *et al.* (2015). The larvae were fed with aphids in bottles until pupation. To avoid cannibalism between newly hatched larvae, use of small piece of photocopy paper (10cm×8cm) folding 3 to 4 times in plastic bottles (Fig. 1).

All the recorded data were subjected to statistical analysis (one-way analysis of variance, ANOVA), all treatments means were compared by using Duncan's Multiple Range Test (DMRT) with the help of GenStat statistical package (VSN international Ltd.) as analyzing tool. Five percent significance level was considered for ANOVA. The result reported as Mean ± S.D.

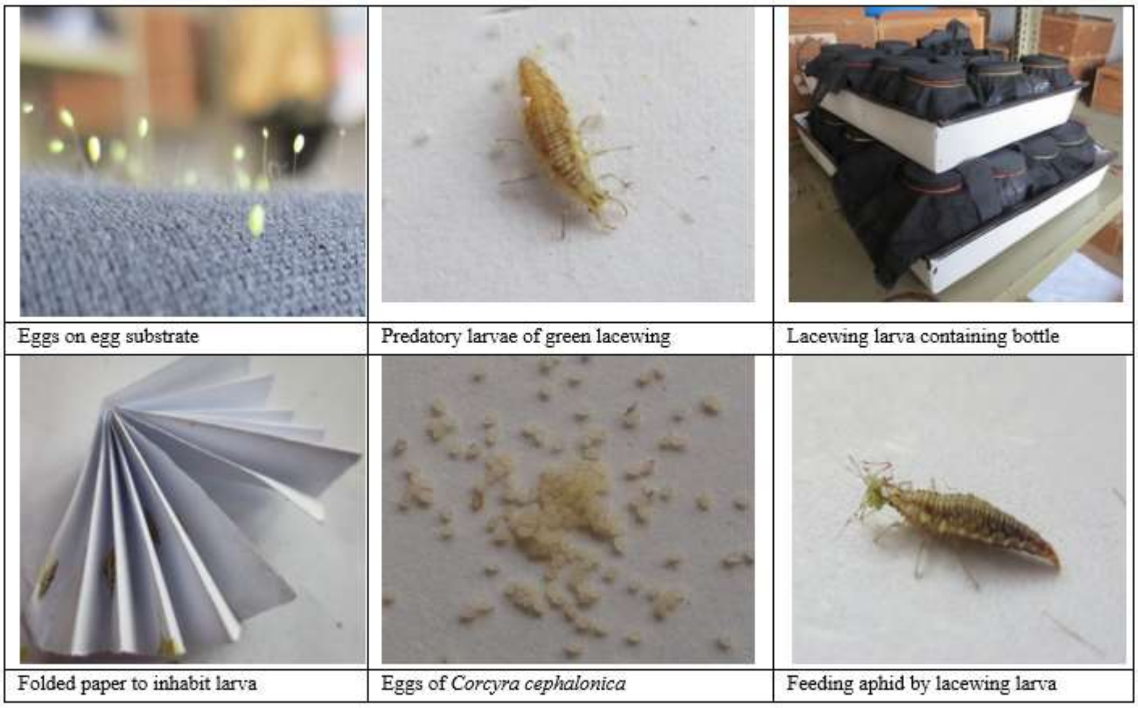

Fig. 1: Some photographs taken during experiment

Table 1: Prey consumption of different larval instar of *C. carnea* when reared on different preys species under no choice of feeding

Larval stage	Mean number of prey consumed by *C. carnea*±S.D.								L.S.D. 5%	C.V. (%)	F- value
	A. craccivora	*B. brassicae*	*M. persicae*	*E. lanigerum*	*L. erysimi*	*A. fabae*	*C. cephalonica*	*C. lanigera*			
1st	7.7±2.51a	15.55±3.15d	11.9±0.33b	11.75±0.49b	16.37±2.20d	12.8±2.11bc	14.25±0.45bc	14.4±1.89bc	3.25	17	<0.001
2nd	14.08±2.31a	16.73±1.69a	13.15±3.39a	12.99±1.62a	16.75±2.56a	13.87±3.77a	54±17.45b	20.42±5.36a	11.56	39.1	<0.001
3rd	110.43±35.69e	90.91±11.05cd	54.1±5.17ab	46.87±12.15a	89.66±8.59cd	56.33±13.26ab	166.87±36.09f	71.9±14.07ab	34.34	27.4	<0.001
Total	132.22±36.52e	123.20±9.78cd	79.15±5.22a	71.62±10.78a	122.78±9.78cd	83.01±14.68ab	235.12±43.32f	106.72±18.08abd	38.1	21.9	<0.001

Means in rows followed by same letter are not significantly different from each other at 5% level of significance by using LSD test.

Result and Discussion

Table 1 illustrates the prey consumption of different larval instar of *C. carnea*. The first instar larva of *C. carnea* was consumed significantly maximum number (16.37±2.20) of *L. erysimi* followed by *B. brassicae*, eggs of *C. cephalonica*, *C. lanigera*, *A. fabae*, *M. persicae*, *E. lanigerum*, *A. craccivora*, respectively. The second instar larva of *C. carnea* was consumed significantly maximum number (54±17.45) eggs of *C. cephalonica* followed by *C. lanigera*, *B. brassicae*, *L. erysimi*, *A. craccivora*, *M. persicae*, *A. fabae*, *E. lanigerum*, respectively. Similarly, third instar larva was consumed significantly more number eggs of *C. cephalonica* (166.87±36.09) followed by *A. craccivora*, *B. brassicae*, *L. erysimi*, *C. lanigera*, *A. fabae*, *M. persicae*, *E. lanigerum*, respectively. The result was supported by the authors Aravind *et al*. (2012) who reported that the third instar larvae of *C. carnea* was consumed more number eggs of *C. cephalonica*.

The host consumption data revealed that the consumption rate of predator, *C. carnea* was increased with increased predatory stages: first, second and third larval instar in all the prey species. From the study, it was evident that the third instar larvae of *C. carnea* consumed maximum number of aphids and eggs of *Corcyra*. This is in conformity with the study of various authors Chakraborty and Korat (2010); Gupta and Mohan (2012); Solangi *et al*. (2013). It was observed that maximum food consumption (60-67%) by third instar larvae of *C. carnea* followed by second (20-24%) and first instar (10-17%) respectively (Yadav and Pathak, 2010).

Khan *et al*. (2013) reported that the predatory efficiency of first, second and third instar larva of *C. carnea* was 61±1.97, 113.6±2.42 and 239.2±6.87 number of aphids respectively. This result also supported our present finding as they concluded that the third instar larva of *C. carnea* was consumed maximum number of aphids than first and second respectively.

The total number food consumed by the predatory larva of *C. carnea* on the different hosts in the sequence of feeding potential in decreasing order eggs of *C. cephalonica*> *A. craccivora*>*B. brassicae*> *L. erysimi*>*C. lanigera*>*A. fabae*>*M. persicae*>*E. lanigerum* respectively. This decreasing order shows that the predatory larva of *C. carnea* consumed maximum on eggs of *C. cephalonica* and minimum fed on apple wooly aphid (*E. lanigerum*). According to Nandan *et al*. (2014) larvae of *Chrysoperla* was more preferred to feed eggs of *C. cephalonica* followed by different host *A. craccivora*, *B. brassicae*, *A. gossypii*, *M. persicae and L. erysimi* respectively.

Hassan (2014) reported that the *C. carnea* larva was fed on the different eggs masses of *C. cephalonica*, *Pectinophora gossypiella* and *Sitotroga cerealella* with an average 493.6±50.32, 654.3±32.54 and 673.9±31.52 numbers respectively under no choice feeding conditions. However, the host preference (free Choice) data revealed that the predatory larva consumed 264.1±68.8, 111.2±56 and 63.3±47 numbers eggs of *C. cephalonica*, *P. gossypiella* and *S. cerealella*, respectively. This result shows that the most preferred host of *C. carnea* larvae was eggs of *C. cephalonica*.

Yadav and Pathak (2010) observed that the maximum predation rate of *C. carnea* larva on *A. craccivora* followed by *A. gossypii*, *M. persicae* and *L. erysimi*. However, in an another study, the total consumption of aphids by the predatory larva of *C. carnea* was 174.63±6.11, 143.40±8.70 and 131.80±6.62 numbers on *L. erysimi, A. craccivora,* and *B. brassicae,* respectively, during whole larval period (Chakraborty and Korat, 2010). The results of present study and previous researcher showed different in the feeding efficiency of predatory larva of *C. carnea* in the different hosts. Previous authors (Chakraborty and Korat, 2010; Yadav and Pathak, 2010; Khan *et al*., 2013) reported that there are different factors that play important role in obtaining different results such as different stages (instars) of prey offered for feeding, size of prey species, different hosts species, preys populations and environmental conditions prevailing during the study period.

Conclusion

The present research finding demonstrates that the third instar larvae of *C. carnea* are more voracious as compare to 1st and 2nd instars. It is evident that the eggs of rice meal moth, *C. cephalonica* were more preferred host of *C. carnea* hence; it can be utilized as mass rearing diet of this predator. The predatory larvae fed on different aphid species and hence, these potential to utilize for biological control agent for management of the aphids. This result guides the entomologist to consider the *C. carnea* as efficient bio-control agent in eco-friendly management of aphids on agricultural crops and so, enhancing the potential of predators.

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