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Feeding efficiency of the larval stages of green lace wing, *Chrysoperla zastrowi sillemi* (Esben-Petersen) (Chrysopidae: Neuroptera) fed on eggs of diamond back moth of cabbage, *Plutella xylostella* (L.)

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Abstract
Feeding efficiency of the larval stages of green lace wing, *Chrysoperla zastrowi sillemi* (Esben-Petersen) (Chrysopidae: Neuroptera) fed on eggs of diamond back moth of cabbage, *Plutella xylostella* (L.) was conducted at the Bio-control Laboratory, IGKV, Raipur during 2020-2021 and 2021-2022. Result revealed that feeding efficiency increased consequently from 1st, 2nd, and 3rd instar with a mean of 28.34±0.06 eggs/day, 96.4±0.043 eggs/days and 193.8±0.048 eggs/day respectively. Total average larval consumption was found to be of 318.54±0.03 eggs/day and maximum number of eggs of *P. xylostella* was consumed by 3rd instar (193.8±0.048) eggs/day.

Keywords: *Chrysoperla zastrowi sillemi* (Esben-Petersen), feeding efficiency, *Plutella xylostella* (L.)

Introduction
Lacewings are important polyphagous predators of the Order Neuroptera and family Chrysopidae. 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.

In India, about 65 species of lacewings belonging to 21 genera have been recorded from various agricultural, horticultural and agro-forestry cropping systems, out of these *Chrysoperla* is the most dominant genera, containing several species which are widely used in augmentation programme (Gautam, 1994) [3]. The common green lacewing, *C. zastrowi sillemi* also known as 'golden eye 'or' aphid lion' is the most important species, found predating on a broad range of prey including several soft bodied insect pests *viz.*, aphids, scales, thrips, mealybugs, whiteflies, mites and eggs and neonate larvae of several lepidopteran pests and has high tolerance to various groups of pesticides (Ahmed *et al*., 2012, Tauber *et al*., 2000) [1, 8]. Their agricultural importance lies in their carnivorous habits. Chrysopid predators are known to feed on more than 80 species of insects and 12 species of mites (Kharizanov and Babrikova, 1978) [5]. A single grub may devour as many as five hundred aphids in its life time and there is no doubt that they play an important part in the natural control of many small homopterous pests (Michaud, 2001, Legaspi *et al*., 1994) [7, 6]. It has long been considered as a promising candidate for the pest management programs in India due to its wide prey range, geographical distribution, resistance to insecticides, voracious larval feeding capacity and commercial availability (Tauber *et al*., 2000, Venkatesan *et al*., 2008) [8, 9] and easy mass multiplication under laboratory conditions (Araujo and Bichao, 1990) [2].

There is a great scope to explore the use of *C. zastrowi sillemi* in the management of eggs of lepidopteran insects on field crops as well as horticultural crops. The available literature revealed that none of the earlier workers in Chhattisgarh has made an attempt to study the predatory efficiency of *C. zastrowi sillemi.* With the above facts, the present study entitled as "Feeding efficiency of the larval stages of green lace wing, *Chrysoperla zastrowi sillemi* (Esben-Petersen) (Chrysopidae: Neuroptera) fed on eggs of diamond back moth of cabbage, *Plutella xylostella* (L.)*"* was framed and carried out at Biocontrol Laboratory, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2020-2021 and 2021-2022.

Materials and Methods

Feeding potential of grubs of *C. zastrowi sillemi* on eggs of diamond back moth of cabbage, *Plutella xylostella* (L.) were carried out in completely randomized design replicated five times under laboratory controlled conditions of 27 ± 1 °C temperature and 65±5% RH.

For testing the feeding potential of *C. zastrowi sillemi* on eggs of *P. xylostella*, larvae of *P. xylostella* were collected from cabbage fields of IGKV, Raipur. Cabbage leaves were used as food for maintaining larvae of *P. xylostella* by washing thoroughly with water to remove traces of insecticides and were placed at the bottom of petri plates (5 × 2 cm) (Plate: 1). Fresh leaves were provided daily. The mature larvae were transferred to another container for pupation. After pupation, the pupae were transferred to another glass container with a small cotton plug dipped in water to provide moisture for adult emergence. After adult emergence, they were collected and shifted inside a glass container (12 cm diameter × 6.5 cm high) for mating, provided with cotton plug dipped in 50% honey - water solution as food for moths. Small branches of gram leaves were kept inside the oviposition chambers to allow the moths to oviposition. The glass jars were covered with black muslin cloth. Egg laid on the inner surface or black muslin cloth were collected daily and placed in clean containers. The eggs thus obtained were used for testing the feeding efficiency of grubs (larvae) of *C. zastrowi sillemi.* Observations were taken at 24 hr. intervals to record the duration of each instar, the summation of each of which gave the total larval period. The data were subjected to square root transformation and statistically analysed with CRD using OPSTAT.

Plate 1: Collection of eggs of *P. xylostella* from cabbage plants and from eggs obtained by rearing under laboratory conditions used as prey for *C. zastrowi sillemi:* (A) Oviposition cages, (B) Eggs, (C) Larvae and (D) Pupae.

Results and Discussion

The predatory efficiency of the larvae were determined by counting total number of eggs of *P. xylostella* consumed by each larval instar of *C. zastrowi sillemi.* The data presented in the (Table 1, plate 2 and fig. 1) shows that the rate of consumption increased gradually from the first to third instar. Consumption of 1st instar (28.34±0.06 eggs/day) and 2nd instar (96.4±0.043 eggs/days) were recorded. 3rdinstar larval showed better predatory efficiency than first two earlier instars and were very active until pupal transformation as they required more food than the earlier instars due to larger size, longer duration and to accumulate nutrients for pupal period. In the 3rd instar, the mean consumption was estimated to be 193.8±0.048 eggs/day.

Thus, the present studies conducted on the feeding potential of green lace wing, *C. zastrowi sillemi* on eggs of diamond back moth of cabbage, *P. xylostella* (L.) revealed that the mean maximum consumption of eggs of *P. xylostella* increased from 1st to 3rd instar with maximum consumption by 3rd instar larval *i.e.*, 193.8±0.048 eggs/day. Feeding efficiency of *C. zastrowi sillemi* larval increased consequently from 1st, 2nd and 3rd instar and total consumption in larval instar was 318.54±0.03 eggs/day.

Table 1: Feeding efficiency of *C. zastrowi sillemi* fedson eggs of *P. xylostella* (L.)

Stage of *C. zastrowi sillemi*	Average number of eggs consumed
1st Instar	28.34±0.06
2nd Instar	96.4±0.043
3rd Instar	193.8±0.048
Total	318.54±0.03
SE(m)±	0.046
CD (P=0.05)	0.14

Plate 2: Grub of *C. zastrowi sillemi* feeding on eggs of *P. xylostella* (L.)

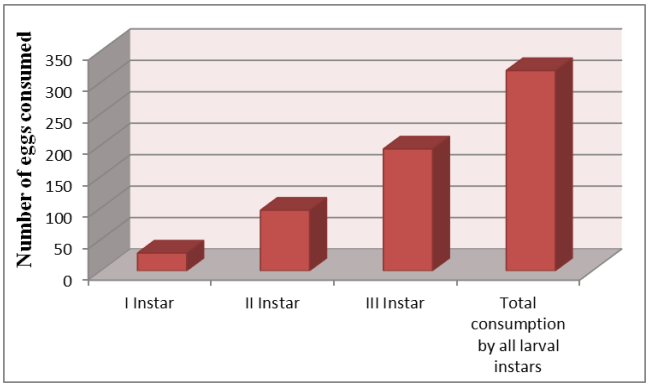

Fig 1: Graph showing feeding efficiency of *C. zastrowi sillemi* fed on eggs of *P. xylostella* (L.)

Discussion

The present findings confirms that *C. zastrowi sillemi* as an efficient predator of the eggs of *P. xylostella*, which corroborates the findings of Hassan (2014) [4] who also reported that *C. carnea* larvae feeds on the eggs masses of *C. cephalonica, Pectinophora gossypiella* and *Sitotroga cerealella* with an average of 493.6±50.32, 654.3±32.54 and 673.9±31.52 eggs 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.

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