



BIOLOGY OF *CHRYSOPERLA ZASTROWI ARABICA* (HENERY ET AL) ON DIFFERENT PREY

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ABSTRACT

The biology of *Chrysoperla zastrowi arabica* (Henery et al.) was studied on different prey at the Bio-control Research Laboratory, Department of Entomology, Rajasthan College of Agriculture, Udaipur during October, 2014 to March, 2015. The influence of the eggs, neonate larvae of *Corcyra cephalonica* (Stainton) and nymphs of five different aphid species [*Nyzus nerii* (Boyr.), *Lipaphis erysimi* (Kalt.), *Aphis gossypii* (Glov.), *Aphis craccivora* (Koch.) and *Rhopalosiphum maidis* (Fitch.)] on different biological parameters was investigated. The maximum incubation period of *C. zastrowi arabica* 4.50 days was recorded on the larval diet of *N. nerii*, while the minimum of 3.4 days on the neonate larvae of *C. cephalonica*. The longest larval period of 13.03 and 13.35 days and pupal period of 10.51 and 10.73 days, for the males and females, respectively, were observed when fed on *A. craccivora*. Considering the consumption rate of *C. zastrowi arabica* adults, the females consumed more than males and the highest consumption rate was obtained when reared on the eggs of *C. cephalonica* with the highest pupal weight of 10.39 and 10.73 mg and maximum adult emergence of 92.05 and 95.84 percent for the males and females, respectively.

Key words: Biology, prey hosts, *Chrysoperla zastrowi arabica*.

INTRODUCTION

The green lacewings, *Chrysoperla zastrowi arabica* Henry et al. (Neuroptera: Chrysopidae) is a cosmopolitan polyphagous predator, commonly found in agro ecosystems in different parts of the world. Chrysopids are the most intensively studied predators because of their wide geographical distribution, broad habitats with high relative frequency of occurrence, good searching ability and easy rearing in the laboratory. The larvae of Chrysopids feed on a wide range of pest species while adults are free living and feed only on nectar, pollen and honey dew and are not predatory. Biological control agents are difficult to maintain when pesticides are applied to control key pests because natural enemies are often more sensitive to insecticides compared with the pests. Multiple natural enemy species can cause interactions in predators and prey by reducing or increasing predation risk for the prey (Singh et al. 1998), and this interaction may increase or decrease the equilibrium level of the prey (Losey and Denno 1998). The study of the biology and feeding potential of, *C. zastrowi arabica* on different hosts would help to use this insect of proper biological control, reproductive potential, duration of different life stages (egg, larva, pupa and adult) on different hosts' pests and to know which host pest most preferred by them. Such information would be helpful for optimizing the mass rearing of *C. zastrowi arabica* and for understanding its

population dynamics. The results may also help in designing integrated pest management (IPM) programs involving the use of *C. zastrowi arabica* as a biocontrol agent of pests on various crops.

MATERIALS AND METHODS

Rearing of *Chrysoperla zastrowi* under laboratory conditions:

The nucleus culture of *Chrysoperla zastrowi arabica* (Henry et al.) was obtained from Navsari Agricultural University, Gujarat and was maintained in the laboratory throughout the period of study. The larvae were reared in plastic cubicles of 3 x 2.5 cm size to avoid cannibalism (Olkowski et al., 1992). The bottom side of the cubicle was covered with purplex glass sheet and upper part was also covered likewise. A single larva was kept in each cubicle and about 1,000 eggs of *Corcyra cephalonica* (Stainton) were split into three doses and given to the larvae as food. In a period of 7-10 days, cocoons were spinned, which were gently removed from the cubicles and placed in plastic containers of two litre capacity. After 3-4 days, adults emerged and they were fed on the diet proposed by Krishnamoorthy (1984) consisting of fructose, proteinex, yeast powder and honey in equal amounts v/v. All ingredients were mixed in equal parts with a little water to obtain a semi-liquid diet, which was offered to the adults. The adults were transferred to a rearing cage of size: 2.5 ft. x 1.5 ft. x 1.5 ft.; the top of

which had a sliding door and was covered by a black cotton cloth. The adults after mating laid stalked eggs on the cloth of the sliding door; after 24-28 hours, the stalked eggs were rubbed off gently with the help of soft sponge. The eggs so obtained were kept in plastic containers along with paper bits and *C. cephalonica* eggs as food for larvae after hatching. The newly hatched larvae were maintained at a temperature of 26 ± 2 °C that were used in different feeding studies.

Biology of *Chrysoperla zastrowi arabica* (Henery *et al.*) on different prey:

The biology was studied in the laboratory under Completely Randomized Design (CRD) with four replications. The larvae were fed on the nymphs of five different aphid species, eggs and neonate larvae of *C. cephalonica ad lib* as per details given below:

- T₁ - Eggs of *C. cephalonica* (Staint.)
- T₂ - Neonate larvae of *C. cephalonica* (Staint.)
- T₃ - Nymphs of aak aphid, *Nyzus nerii* (Boyr.)
- T₄ - Nymphs of mustard aphid, *Lipaphis erysimi* (Kalt.)
- T₅ - Nymphs of cotton aphid, *Aphis gossypii* (Glov.)
- T₆ - Nymphs of beans aphid, *Aphis Craccivora* (Koch.)
- T₇ - Nymphs of barley aphid, *Rhopalosiphum maidis* (Fitch.)

In each treatment (for each prey) ten larvae were kept, replicated four times and reared individually in plastic containers (9 x 4 cm size). The *C. zastrowi arabica* larvae were provided prey food at regular intervals. The following observations were recorded:

- i. Egg incubation period
 - ii. Developmental period of different larval instars
 - iii. Pupal period and
 - iv. Adult emergence (expressed as a percentage)
- (a) **Incubation period:** To study the incubation period of eggs, the freshly laid eggs (1-2 hour old) obtained from different treatments were kept individually in clean tubes (size 6 x 2 cm). Observation on hatchability was taken regularly at six hour intervals in different treatments and the total time required in hatching of eggs was recorded. The number of eggs hatched per hundred test eggs, kept in each plastic container (size 6 x 2 cm) was recorded to work out percent hatchability in each treatment.
- (b) **Larval development:** The freshly hatched larvae (1-2 hour old) were reared individually in plastic containers (9 x 4 cm. size) on the respective food.

The food was provided to the developing larvae. The larvae were examined daily to record moulting. The duration of development of different instars was estimated by the period spent from one instar to the next instar. The presence of larval exuviae indicated the change in the instar. Moults were recognized by recording the shedding of exuviae. The exuviae were removed so as to avoid confusion while recording subsequent moultings. Numbers of moultings were recorded to work out the larval instars.

(c) **Pupal period:** To study the duration of pupal period, freshly spinned cocoons were marked and placed individually in clean plastic tubes to record the emergence of adults. The period spent from spinning of cocoon till the emergence of adult was considered as pupal period.

(d) **Adult emergence:** The number of adults that emerged from the total number of pupae was recorded separately for each treatment and mean adult emergence was worked out.

RESULTS AND DISCUSSION

Egg: The freshly laid eggs of *C. zastrowi arabica* were pale green in colour, oval in shape and surmounted with a slender hair like foot stalk which always stuck to any substrate. The length and breadth as well as stalk length of individual stalk egg was measured by its stage. The length ranged between 0.7 to 1.2mm with an average of 0.870 0.001 mm; the breadth varied from 0.415 to 0.429 mm with an average of 0.421 0.001 mm; and length of the slender stalk ranged from 6 to 7.5 mm with an average of 6.923 0.121 mm. A micropyle was present on the apical end of the egg. The chorion was ornamented with waxy areolate sculpture. The eggs were usually laid singly in loose groups. Within 3-4 days, the pale green eggs turned into pale whitish to pinkish grey just before hatching and the rupture of chorion took place on the 4 – 5th day.

Incubation period: The data presented in Table (1) show that the maximum incubation period of 4.50 days was recorded on the larval diet of aak aphid, *Nyzus nerii*. El-Serafi *et al.*, (2000) reported that the maximum incubation period of 3.5 days of *C. carnea* was observed on *A. nerii*.

Larva: The newly hatched larvae were initially very soft, but hardened within a few minutes and remained at the empty egg- shell without feeding for several hours. Number of larval instars along with their duration was determined on the basis of exuviae cast-off by the larvae. The freshly emerged larvae were compodeiform and were more or less colourless and transparent. After the first meal, the larvae markedly changed in colour, as the gut contents were clearly visible through the translucent

Table 1: Effect of different prey on the biology of male *Chrysoperla zastrowi arabica* (Henery *et al*)

| Treatments Prey | Egg incubation period in (days) | Average larval period male (days) | | | Total larval period male (days) | Pupal period male (days) | Adult emergence (male) |
|------------------------------------------------|---------------------------------|-----------------------------------|-----------|------------|---------------------------------|--------------------------|------------------------|
| | | I Instar | II instar | III instar | | | |
| Eggs of <i>Corcyra cephalonica</i> (Staint.) | 3.77 | 3.89 | 2.90 | 3.39 | 9.18 | 9.42 | 92.05 (73.62)* |
| Larvae of <i>Corcyra cephalonica</i> (Staint.) | 3.54 | 3.51 | 2.78 | 3.07 | 9.36 | 9.29 | 85.46 (67.59) |
| Nymphs of <i>Nyzus nerii</i> (Boyr.) | 4.50 | 3.39 | 2.64 | 2.90 | 8.93 | 9.16 | 84.47 (66.79) |
| Nymphs of <i>Lipaphis erysimi</i> (Kalt.) | 3.59 | 4.25 | 3.03 | 3.74 | 11.01 | 10.12 | 78.82 (62.60) |
| Nymphs of <i>Aphis gossypii</i> (Glov.) | 4.07 | 4.17 | 3.10 | 3.78 | 11.04 | 9.46 | 71.28 (57.61) |
| Nymphs of <i>Aphis craccivora</i> (Koch.) | 3.95 | 5.14 | 3.45 | 4.45 | 13.04 | 10.51 | 89.92 (71.49) |
| Nymphs of <i>Rhopaloshium maidis</i> (Fitch) | 3.80 | 3.82 | 2.85 | 3.35 | 10.03 | 8.90 | 90.90 (72.45) |
| S. Em. ± | 0.09 | 0.08 | 0.07 | 0.07 | 0.18 | 0.09 | 1.98 |
| C. D. at 5 % | 0.27 | 0.22 | 0.19 | 0.22 | 0.52 | 0.25 | 5.83 |

*Figures in parenthesis are retransformed per cent values

cuticle. Simultaneously, the dorsal pigmentation of the vertex and trunk gradually took place and the extent of subcutaneous pigmentation was influenced by the diet the larvae consumed. There were three larval stages in *C. zastrowi arabica*. The head of *C. zastrowi arabica* was broad and dorso-ventrally flattened with filiform antennae, slightly dorsal and anterior to the eyes. Mandibles and maxillae were curved and closely associated on each side to form a channel for passage of food. Prolonged larval duration of 13.04 and 13.35 days was recorded for the male and female, respectively, on the bean aphid, *Aphis craccivora* and shortest larval period of 8.93 and 9.90 days for the male and female was recorded when fed on *N. nerii*. El-Serafi *et al.*, (2000) also reported the shortest larval period of 18.77 days on *A. nerii* among different treatments. Similar observations were also made by Khuro *et al.*, (2012) who reported that when *C. sinica* fed on *A. craccivora* the pre-imaginal development was longer.

Pupa: The third instar larva was highly voracious feeder. However, it stopped feeding for 24-48 hours prior to pupation and shrunk assuming the shape of 'C'. At this stage the larva secreted a light yellow brownish fluid, discharged from the anus which oxidised to form silken thread network around the larva spinning a cocoon. Spinning was completed in 24-48 hours. The cocoon was sub-spherical, slightly elongated and was always attached to the substrate. The pupa of *C. zastrowi arabica* within the sub-spherical cocoon was decticious with freely movable legs the partially rolled antennae

were visible near the wing pad. The pupae had chitinized mandibles, which were helpful in biting a round lid in the cocoon for emergence. The maximum pupal period of 10.51 and 10.73 days was recorded for the male and female of *C. zastrowi arabica* when fed on *A. craccivora*, and the minimum pupal period of 8.90 and 9.16 days was recorded for the male and female respectively, when fed on *R. maidis*. Similar observations have been made by El-Serafi *et al* (2000), who reported the shortest pupal period of 9.4 days in *C. carnea* when fed on the *A. nerii*.

Adult emergence: The laboratory reared adults were sexed as male and female on the basis of size and external genitalia. Newly emerged adults from pupae were soft bodied, usually light green in colour with transparent wings, held roof like over the abdomen. The compound eyes were copper or golden coloured. In male the abdomen was narrow and tapering while in case of female it was 2 to 3 times broader than males. They mated within three days after emergence. Oviposition began in next 24 hours. The unmated females had a much longer pre-ovipositional period and laid sterile eggs. Significant difference was observed in per cent adult emergence. The adults that were reared from the larvae fed on different diets revealed that nearly absolute emergence 92.05 per cent in male and 95.84 per cent in female was observed when the larvae were fed eggs of *C. cephalonica*. Adult emergence data were at par with *R. maidis* 90.90 per cent in male and 94.65 per cent in female and *A. craccivora* with 89.92 per cent in male and 93.62 per cent in female. Rana *et al* (1998) reported

Table 2. Effect of different prey on the biology of female *Chrysoperla zastrowi arabica* (Henery *et al.*)

| Treatments Prey | Egg incubation period in (days) | Average larval period female (days) | | | Total larval period female (days) | Pupal period female (days) | %Adult emergence (male) |
|------------------------------------------------|---------------------------------|-------------------------------------|-----------|------------|-----------------------------------|----------------------------|-------------------------|
| | | I Instar | II instar | III instar | | | |
| Eggs of <i>Corcyra cephalonica</i> (Staint.) | 3.77 | 4.19 | 2.99 | 3.58 | 10.76 | 10.11 | 95.84 (78.23)* |
| Larvae of <i>Corcyra cephalonica</i> (Staint.) | 3.54 | 3.95 | 2.90 | 3.39 | 10.24 | 9.48 | 88.98 (70.61) |
| Nymphs of <i>Nyzus nerii</i> (Boyr.) | 4.50 | 3.80 | 2.80 | 3.30 | 9.90 | 9.67 | 87.94 (69.68) |
| Nymphs of <i>Lipaphis erysimi</i> (Kalt.) | 3.59 | 4.13ss | 3.02 | 3.59 | 10.73 | 10.38 | 82.06 (64.94) |
| Nymphs of <i>Aphis gossypii</i> (Glov.) | 4.07 | 4.30 | 3.35 | 3.93 | 11.38 | 9.64 | 74.21 (59.48) |
| Nymphs of <i>Aphis craccivora</i> (Koch.) | 3.95 | 5.56 | 3.80 | 3.99 | 13.35 | 10.73 | 93.62 (75.37) |
| Nymphs of <i>Rhopalosium maidis</i> (Fitch) | 3.80 | 4.11 | 2.96 | 3.48 | 10.54 | 9.16 | 94.65 (76.62) |
| S.Em. ± | 0.09 | 0.06 | 0.07 | 0.11 | 0.16 | 0.11 | 2.06 |
| C. D. at 5 % | 0.27 | 0.17 | 0.22 | 0.32 | 0.48 | 0.3113 | 6.07 |

*Figures in parenthesis are retransformed per cent values

that the mean emergence of adults of *C. carnea* was maximum on the eggs of rice grain moth with 97.15 per cent when tested on different eggs. Amarasekare *et al* (2013) revealed that all *C. carnea* pupae were able to develop into adults, whereas only 92 per cent of adult eclosion was observed from *C. johnsoni* pupae.

REFERENCES

- Amarasekare, K. G. and P. W. Shearer 2013. Life history comparison of two green lacewings species, *Chrysoperla johnsoni* and *Chrysoperla carnea* (Neuroptera: Chrysopidae). *Environmental Entomology*. **42**:1079-1084.
- Chakraborty, D., Korat, D.M. and Deb, S. 2011. Observations on the behaviour of the green lace wing, *Chrysoperla zastrowi sillemi* (Esben-Peterson). All India Co-ordinated Research Project on Biological Control of Crop Pests and Weeds. Anand, Gujarat, India. Anand Agricultural University. 399-403.
- El-serafi H.A.K., Abdel-salam A.H. & Abdel-bakey N.F. 2000: Effect of four aphid species on certain biological characteristics and life table parameters of *Chrysoperla carnea* (Stephens) and *Chrysoperla septempunctata* Wesmael (Neuroptera: Chrysopidae) under laboratory conditions. *Journal of Biology Science*. **3**: 239-245.
- Kabbisa, J. C. B., Kayumbo, H. Y. and Yarro, J. G. 1995. Comparative biology of *Mallada desjardinisi* Navas and *Chrysoperla congura* wlk (Neuroptera: Chrysopidae), predators of *Helicoverpa armigera* Hub. (Lepidoptera : Noctuidae) and *Aphis gossypii* Glover. (Homoptera : Aphididae) on cotton in Eastern Tanzania. *International Journal of Pest Management*. **41**: 214-218.
- Khuro, N.H., Chen, H., Zhang, Y., Zhang, L. and Wang, M. 2012. Effect of different prey species on the life history parameters of *Chrysoperla sinica* (Neuroptera: Chrysopidae). *European Journal of Entomology*. **109**: 175-180.
- Kowalaska, T. 1976. Mass rearing and possible uses of chrysopidae against aphids in glass houses. *Bull. OILB/CROP*. **4**: 80-85.
- Krishnamoorthy, A. 1984. Influence of adult diet on the fecundity and survival of the predator, *C. carnea* (Neuroptera: Chrysopidae). *Entomophaga*, **24**: 445-450.
- Losey, J.E. and Denno R.F. 1998. Interspecific variation in the escape response of aphids: Effect on risk of predation from foliar foraging and ground foraging predators. *Oecologia*, **115**: 245-252.
- Nandan, N., Korat, D. M. and Dabhi M.R. 2014. Influence of different host insects (prey) on biological parameters of *Chrysoperla zastrowi sillemi* (Esben-Peterson). *Insect Environment*. **20**: 40-45.

- Olkowski, W., Dietrick, E. and Olkowski, H. 1992. The biological control industry in the United States, part III. *IPM Practitioner*. **14**: 1-7.
- Principi, M. M., Pizzi, P. and Pasqualini, E. 1975. Influenze del fotoperiodo sul ciclo di sviluppo di *Chrysoperla flavifrons* (Neuroptera: Chrysopidae). *Bollettino dell'Istituto di Entomologia della Università di Bologna*. **32**: 305-322.
- Rana, B. S. and Shrivastava, R. C. 1998. Feeding potential and growth rate index of aphid lion, *Chrysoperla carnea* on different species of aphids. Paper presented in *National Seminar Entomology 21st Century*, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, April 30 to May 2, 1998.
- Saminathan, V. R., Baskaran, R. K. M. and Mahadevan, N. R. 1999. Biology and predatory potential of green lacewing (*Chrysoperla carnea*) on different insect hosts. *Indian Journal of Agricultural Science*. **69**: 502-505.