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Assessment of different factitious and artificial adult diets on fecundity and longevity of *Chrysoperla zastrowi sillemi* (Esben-Peterson)

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ABSTRACT

The role of different artificial diets comprising diet 1 (protinex 5 g + fructose 5 g + honey 5 ml + powdered yeast 5 g + distilled water 15 ml) and diet 2 (egg yolk 5 ml + milk 10 ml + honey 5 ml) alone and in combination with castor or maize pollen and control (50% honey solution) was inspected with a view to appraise the fecundity, longevity, larval and pupal period, pupal weight and adult emergence of *Chrysoperla zastrowi sillemi*. The highest fecundity was documented on diet 9 (diet 1 + diet 2 + maize pollen), diet 6 (diet 1 + diet 2 + castor pollen) and diet 3 (diet 1 + diet 2) with 367.00, 366.00 and 354.93 eggs per female respectively. Highest longevity of female and male was verified on diet 9 (34.33 and 30.33 days respectively) and diet 6 (33.67 and 29.67 days respectively). The shortest larval period of *C zastrowi sillemi* was perceived on diet 9 (7.06 days) and diet 6 (7.09 days) while it was longest in control (7.82 days). Pupal period was found shortest on diet 6 (6.3 days), diet 9 (6.4 days) and diet 3 (6.4 days) while longest in control (6.9 days). Pupal weight and adult emergence were found more when adult was fed on diet 9 and diet 6 while it was found less in control.

Keywords: Adult emergence; artificial diets; *C zastrowi sillemi*; fecundity; longevity

INTRODUCTION

The common green lacewing also known as aphid lion belongs to family Chrysopidae and 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. In India 65 species of chrysopid predators belonging to 21 genera have been recorded from various crop ecosystems out of certain widely recorded genera as natural enemies (Singh et al 1994).

Green lacewing, *Chrysoperla zastrowi sillemi* (Esben-Peterson) is an example of one among these species that is not predacious in the adult stage; larval stage is predatory stage. Adults feed only on pollen, nectar and aphid honeydew. They are pale green, about 12-20 mm long with long antennae and bright, golden or copper-coloured eyes. They have large, transparent, pale green wings and a delicate body. The adults are active fliers particularly during the evening and night and have a characteristic fluttering flight (Mendel et al 2003, Zhang et al 2006). Adults have a strong flight urge and may fly for 3 to 4 hours each of their first two nights and lay eggs on fifth day after adult emergence.

This predator has a tremendous predacious potential and can consume many species of insect pests such as whiteflies, aphids, thrips and eggs of bollworms (Atlihan et al 2004). An artificial diet-based rearing system would be useful only if the targeted entomophage was able to meet criteria such as high kill rates, good search qualities and proven non-destructiveness to other beneficial arthropods or crop plants. *Chrysoperla* spp which are highly generalist predators meet all of these criteria.

During present study efforts were made to develop efficient artificial diets for *C zastrowi sillemi*

as well as the techniques for presenting that diet to the adults.

MATERIAL and METHODS

The culture of the predator *C zastrowi sillemi* was taken from Biocontrol Research Laboratory, Junagarh Agricultural University, Juanagadh, Gujarat and to adopt the culture to the laboratory condition it was reared for two generations continuously on *Corcyra* eggs under laboratory conditions.

The experiment was conducted under completely randomized design (CRD) at 26 ± 2°C temperature, 65 ± 5 per cent RH and 16:8 L:D. Ten different diets were used in the experiment and it was considered as ten treatments with three replications each having ten pairs of newly emerged adults (Table 1). These adults were confined to plastic bottles. The head of the plastic bottle was covered with the rough brown paper with small holes. Rough surface of the paper was kept to inner side of the bottle. The cotton wool soaked in each diet was provided as a food for the adults with the help of small plastic plate. All diets were replaced at an interval of 24 h. Eggs laid by female green lacewing on the wall of plastic bottle and rough surface of the paper were harvested with sharp razor and one egg per plastic tube (5 × 2 cm) was placed with the help of camel hair brush.

The newly hatched larvae were fed on frozen eggs of *Corcyra* (0.2 g per tube) that were provided with the interval of four days. The process was continued until the formation of cocoons. The cocoons were removed gently with camel hair brush from the plastic tubes and were shifted to other empty plastic bottle to observe and record the emergence of adults.

The observations were taken on fecundity (number of eggs laid per female), larval and pupal period, pupal weight, per cent adult emergence and adult longevity. The data thus obtained were analysed statistically.

RESULTS and DISCUSSION

The effect of various artificial diets on fecundity, adult longevity, larval and pupal period, pupal weight and per cent adult emergence are given in Table 2.

Fecundity

The data reveal that the fecundity of *C zastrowi sillemi* when reared on different diets ranged from 228.93 to 367.00 eggs per female. Among the different artificial diets, diet 9 was found significantly superior over other treatments and registered fecundity of 367.00 eggs per female. Thus supplementing of protinex, fructose, honey, yeast, egg yolk, milk and pollen-based diets with addition of maize pollen increased the fecundity of *C zastrowi sillemi* as compared to diets having no pollen grain. The lowest fecundity of a female was observed on diet 10 (228.93 eggs per female) when reared on honey solution diet alone. The diet containing protinex, yeast, sugar, egg yolk, milk, honey and pollen proved to be the best resulting in significantly higher egg laying by the female *C zastrowi sillemi*. This diet consisted of different components and each component had the promoting effect on egg production. The present findings corroborate with the results reported by Cohen and Smith (1998) who observed that the adult laid 21.5 eggs per female per day on yeast, sucrose and water-based diet. Tesfaye and Gautam (2002) noted that the highest average number of eggs laid per female was 1245.2,

Table 1. Composition of different adult artificial diets for *C zastrowi sillemi*

Diet	Treatment
Diet 1	Protinex 5 g + fructose 5 g + honey 5 ml + powdered yeast 5 g
Diet 2	Egg yolk 5 ml + milk 10 ml + honey 5 ml
Diet 3	Diet 1 + diet 2
Diet 4	Diet 1 + castor pollen 2.0 g
Diet 5	Diet 2 + castor pollen 2.0 g
Diet 6	Diet 3 + castor pollen 2.0 g
Diet 7	Diet 1 + maize pollen 2.0 g
Diet 8	Diet 2 + maize pollen 2.0 g
Diet 9	Diet 3 + maize pollen 2.0 g
Control	50% honey

Table 2. Assessment of different adult artificial diets on fecundity and longevity of *C zastrowi sillemi*

Diet	Fecundity	Adult longevity		Larval period (days)	Pupal period (days)	Pupal weight (g)	Adult emergence (%)
		Female	Male				
Diet 1	17.51* (307.06)	33.83* (31.00)	31.52* (27.33)	7.55	6.60	0.0056	65.53* (82.67)
Diet 2	16.95 (287.20)	32.37 (28.67)	30.19 (25.33)	7.66	6.70	0.0051	64.43 (81.33)
Diet 3	18.84 (354.93)	35.26 (33.33)	32.79 (29.33)	7.12	6.40	0.0058	68.63 (86.67)
Diet 4	18.74 (351.13)	34.44 (32.00)	31.73 (27.67)	7.33	6.50	0.0056	67.53 (85.33)
Diet 5	17.21 (296.13)	32.79 (29.33)	31.08 (26.67)	7.60	6.60	0.0050	65.53 (82.67)
Diet 6	19.13 (366.00)	35.46 (33.67)	33.00 (29.67)	7.09	6.30	0.0060	71.01 (89.33)
Diet 7	18.76 (352.20)	34.85 (32.67)	31.95 (28.00)	7.40	6.50	0.0056	69.91 (88.00)
Diet 8	17.45 (304.67)	33.83 (31.00)	31.09 (26.67)	7.61	6.60	0.0052	66.53 (84.00)
Diet 9	19.16 (367.00)	35.87 (34.33)	33.42 (30.33)	7.06	6.40	0.0060	72.64 (90.67)
Diet 10	15.13 (228.93)	31.72 (27.67)	28.19 (22.33)	7.82	6.90	0.0049	64.43 (81.33)
SEm±	0.35	0.85	0.82	0.11	0.08	0.0001	2.34
$CD_{0.05}$	0.74	1.77	1.72	0.23	0.17	0.0003	4.89
CV (%)	2.43	3.05	3.20	1.82	1.53	2.88	4.25

*Angular transformation, Figures in parentheses are retransformed values

1069.2 and 450 on baker's yeast granules + 50 per cent honey, baker's yeast granules + castor pollen + 50 per cent honey and castor pollen + 50 per cent honey respectively.

Adult longevity

Female longevity: Female life differed significantly with the duration of 27.67 to 34.33 days when reared on different adult artificial diets. The female lived longer (34.33 days) when adult was fed on diet 9 and it was significantly superior over other diets whereas diet 6 (33.67 days), diet 3 (33.33 days), diet 7 (32.67 days) and diet 4 (32.00 days) were found next in order and they were at par with onr another. The lowest longevity of female was observed on diet 10 (27.67 days) which was at par with diet 5 (29.33 days) and diet 2 (28.67 days). It is evident from the data that the highest female longevity was perceived when the pollen or egg yolk and milk were added in protinex, fructose and yeast-based diet (diets 9 and 6). The female longevity increased as compared to diets that did not have any of these products. Earlier Nandan et al (2014) noted that the female longevity was significantly longer (41.50 days) when females were fed with equal proportion of protinex, yeast and honey.

Male longevity: Male life differed significantly with the duration of 22.33 to 30.33 days when reared on different artificial diets. The longevity on diet 9 (30.33 days) was significantly superior over other diets whereas diet 6 (29.67 days), diet 3 (29.33 days), diet 7 (28.00 days) and diet 4 (27.67 days) were found next in order and they were at par with one another. The lowest longevity was observed on diet 10 (22.33 days) which was at par with diet 2 (25.33 days). The results are in close agreement with those of Rendon and Fajardo (2002) who found that the male longevity (35.6 ± 5.7 days) was increased when diet contained honey, sugar, brewer yeast, egg yolk, distilled water, fresh milk and corn grit.

Larval period

The larval period differed significantly with the duration of 7.06 to 7.82 days when reared on different diets. The shortest larval period (7.06 days) was detected due to diet 9 which was at par with diet 6 (7.09 days) and diet 3 (7.12 days). It reflects that minimum larval period of *C zastrowi sillemi* was when the adult was reared on protinex, fructose, honey, yeast, egg yolk, milk, honey and pollen-based diet. However the maximum larval period (7.82 days) was noticed on diet 10 followed by diet 2 (7.66 days), diet 8 (7.61 days) and diet 5 (7.60 days). The larval period of 13.7 ± 2.5 days was observed when adult was reared on artificial diet containing honey, sugar, brewer yeast, egg yolk, distilled water, fresh milk and corn grit (Rendon and Fajardo 2002).

Pupal period

The pupal period ranged from 6.30 to 6.90 days when reared on different diets. Shortest pupal period (6.30 days) was observed in case of *C zastrowi sillemi* reared on diet 6 which was at par with diet 9 (6.40

days) and diet 3 (6.40 days). However the maximum pupal period (6.90 days) was noticed on diet 10 ie honey solution. Pupal period was more or less similar on different diets. The diet containing protinex, fructose, honey, yeast, egg yolk and milk resulted in minimum pupal period which was at par with control diet (50% honey solution). The present findings are supported by the results reported by Ulhaq et al (2006) who recorded pupal period of 6.33 ± 0.40 days on egg yolk-based diet.

Pupal weight

The weight of pupa differed from 0.0049 to 0.0060 g on different artificial diets. The significantly maximum pupal weight was observed on diet 6 (0.0060 g) and diet 9 (0.0060g) which were at par with diet 3 (0.0058 g). Minimum pupal weight was on diet 10 (honey solution) (0.0049 g) followed by diet 5 (0.0050 g) and diet 2 (0.0051 g).

Per cent adult emergence

The mean adult emergence in different diets ranged from 81.33 to 90.67 per cent. The highest adult emergence of 90.67 per cent was observed on diet 9 which was significantly superior to all other diets. However it was at par with diet 6 (89.33%), diet 7 (88.00 days) and diet 3 (86.67%). The lowest adult emergence (81.33%) was observed on diet 10 followed by diet 2 (81.33%). These results indicate that pollen and egg yolk when mixed with protinex, fructose, honey, yeast and milk were more effective resulting into higher adult emergence. These results are similar to those of Nandan et al (2014) who reported least (67.67%) hatching of eggs when females were fed with honey (50%) alone.

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