Effect of Different Photo Periods on the Biological Parameters of *Chrysoperla carnea* under Laboratory Conditions

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Abstract: Many insects are known to give response in adaptive way for seasonal changes in day lengths. Photoperiod control's many developmental responses and allows insects to survive periods of unfavorable environmental conditions. An experiment was conducted to study the effect of different photoperiod lengths on biological parameters of green lacewing, *Chrysoperla carnea*. Four different photoperiod regimes were selected with varying lengths of light/dark hours (8/16, 10/14, 24/0 and 0/24) at a constant 26±2°C temperature with 70 % RH (relative humidity) in the laboratory. Photoperiod regimes affected the development of *C. carnea* from egg to adult. In complete darkness (L: 0 D: 24), minimum egg laying, hatching, larval survival and adult emergence were recorded. Incubation period for eggs, larval period and pupal duration were also significantly longer in complete darkness as compared to other treatments 8L: 16D and 10L: 14D. Whereas, the treatment with complete light hours (L: 24, D: 0) resulted in maximum egg laying hatching, larval survival and adult emergence. The incubation period for eggs, larval and pupal duration significantly shortened as compared to other treatments.Sex ratios skewed towards female when full light hours were provided for development.

Keywords: *Chrysoperla carnea*, photoperiod regimes, hatching, larval survival, sex ratios.

INTRODUCTION

The effect of photoperiod on the biology of insects is much more far-reaching and fundamental than the mere regulation of behavioral pattern [1]. [2-4] bugs etc. reported that green lacewings, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is a cosmopolitan polyphagous predator, commonly found in agricultural systems. It has been recorded as an effective generalist predator of aphids, coccids; mites and mealy bug etc. [5, 6] have reported that due to its ubiquitous nature, polyphagous habits, compatibility with selected chemical insecticides and microbial agents and amenability to mass rearing [7-9]. Demonstrated that mass rearing and marketing of commercially in North America and Europe have been successful. It has been widely used for aphid control world wide for population management of many insect pests, [10-12]. Laboratory studies performed by [13] suggested that photoperiod was an important environmental aspect in mass rearing of *C. carnea*. Several authors had given different data about photoperiod values for rearing *C. carnea* [14]. Reported the effects of photoperiod on the developmental period of the larval stages of *C. carnea* under laboratory conditions. The durations of the pre-imaginal stages were longer under 16L-8D, 13.5L-10.5D and 10L-14D than 14L-10D and 13L-11D and indicated that the pre-imaginal stages are sensitive to both short and long day [15]. Tested four photoperiods on developmental period of *M. tasmaniae* from egg to adult was reported significantly shorter at 24:0 and 16:8h (light: Dark) than at 12:12 and 0L: 24D [16]. Observed effect photoperiods (14/10, 12/12 and 10/14 h. L/D) on the larval, pupal duration *C. carnea* reared on *Aphis craccivora* Koch and reported that increasing of photoperiod resulted in decreasing in pupal duration but increased the larval duration. The objective of the current investigation was to study the effect of photoperiods on biological aspects viz number of egg laying, hatching time (incubation period) and adult emergence of *C. carnea* under laboratory conditions to gain some knowledge for mass rearing.

MATERIALS AND METHODS

Cultures of adult *C. carnea* were obtained from Biological Control Laboratory of Nuclear Institute of Agriculture, Tandojam and were reared under constant temperature of 26±2 ^{o}C with a relative humidity of 65-70%. Newly emerged 50 adults of *C. carnea* were kept in rearing cage (5 mm width, sheets (40 x 40 cm), for maturity inside the incubators under four different photoperiods light/dark hours (8/16, 10/14, 24/0 and 0/24) separately. Standerd diet of protein hydrolysate (Nulure) was offered to adults in droplet form with help of camel hair brush inside the cage on white paper cards. After four days these mature adults were paired in 4 liter glass jars and same protein hydrolysate diet was offered to adults both sexes in incubators daily.

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Table 1: Performance of Biological Parameters of C. *carnea* under Different Photoperiod Regimes

Photo periods (L/ D)	No. of eggs laid	No. of hatched eggs	Hatch time (days)	Larval period (days)	No. of pupae	Pupal period (days)	No. of emerged adults
8:16	31.9±3..08 bc	8.8±0.38 bc	4.0±0.00 b	8.0±0.57 b	5.8±0.33 b	5.3±0.33 b	4.8±0.06 bc
10: 14	37.8±3..93 ab	11.0±1.54 ab	3.6±0.33 bc	7.6±0.33 b	7.8±0.18 ab	4.5±0.29 bc	5.7±0.21 b
24: 0	50.6±8.29 a	14.9±2.09 a	3.0±0.00 c	6.0±0.00 c	9.8±1.08 a	4.0±0.00 c	8.0±0.77 a
0: 24	19.5±0.67 c	5.8±0.70 c	5.3±0.33 a	11.6±0.33 a	3.5±0.66 c	10.3±0.33 a	2.8±0.96 c

These glass jars were covered with black muslin cloth for egg laying. These covers were changed daily to record observation on fecundity (no of egg laid) by *C. carnea* females, eggs of laboratory reared host *Sitotroga cerealella* (olive) were provided inside the changed cover for feeding to newly hatched larvae of *C. carnea*. After three days observation were recorded on hatching percentage, hatching time (incubation period), larval period, larval survival (No. of pupae obtained), pupal period, pupal survival (Adult emergence) and sex ratio. Experiment was replicated four times.

Statistical Analysis

All statistical analyses were conducted by using Statistix® Version 8.1, Analytical Software, Inc., Tallahassee, FL, USA.

RESULTS

Result with complete light hours (L: 24, D: 0) in Table **1** showed increased in number of egg laying, (50.6±8.29) (Mean±SE), maximum hatching (14.9±2.09), enhanced larval survival (No. of pupae) (9.8±1.08) and increase in adult emergence (8.0±0.77) The incubation period (hatching time) (3.0±0.00), larval (6.0±0.00) and pupal (4.0±0.00) durations reared on *S. cerealella* eggs were reduced significantly under long photoperiods. The Complete darkness (L: 0 D: 24), resulted in minimum number of egg lying (19.5±0.67), reduced hatching (5.8±0.70), decreased larval survival (No. of pupae) (3.5±0.66) and reduction in adult emergence (2.8±0.96). Which compared with the treatments of 8L: 16D and 10L: 14D.The incubation period (hatching time) (5.3±0.33), larval (11.6±0.33) and pupal (10.3±0.33) durations was observed significantly longer at short photoperiod (L: 0, D: 24) compared with other treatments. 8L: 16D and 10L: 14D. Also, maximum sex ratios were observed in female production under full light hours (Figure **1**).

DISCUSSION

In this study photoperiod regimes significantly affected the development of *C. carnea* from egg to adult. The maximum egg laying, hatching, No. of pupae and adult emergence were observed at (24 L: 0D). The incubation period (hatching time), larval and pupal durations reared on *S. cerealella* eggs were shorter under long photoperiods (24L: 0D and 10L: 14D) compared with short photoperiod (0L: 24D and 8L: 16D). Sex ratio was also recorded in the favour of female with significant difference among photoperiods when full light hours (24L: 0D) were provided for development. According to [15] investigated that the development of another species of *Chrysoperla*

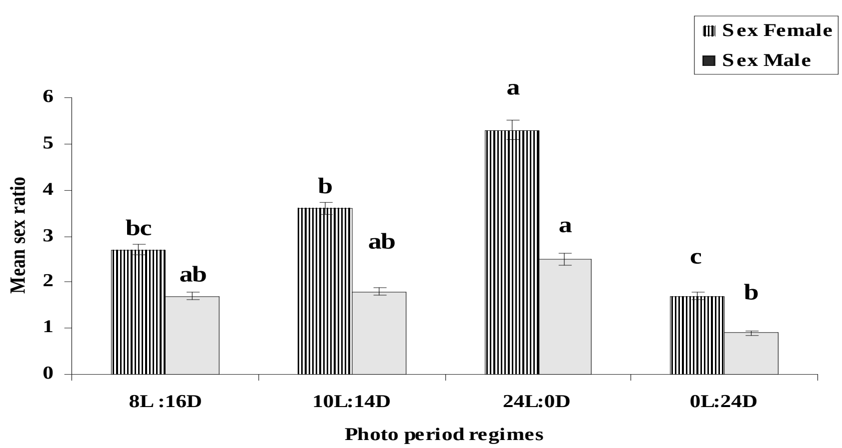

Figure 1: Effect of photoperiod on the female biased sex ratio of C. *carnea.*

Tasmanian lacewing *Micromus tasmaniae* (Walker) was significantly shorter at long photoperiod (24:0 and 16:8h) (light: Dark) than at shorter photoperiods (12:12 and 0L: 24D). The sex ratio of *M. tasmaniae* was male biased with no significant differences between photoperiods [16]. Also indicated that photoperiods (14:10, 12:12 and 10:14 h. L/D) effect the larval and pupal duration of *C. carnea* reared on *Aphis craccivora* Koch. Photoperiod (14L: 10D and 10L: 14D) a resulted longer in larval and pupal duration According [17] investigated the Short- and long-term storage (shelf-life) of diapausing *Chrysoperla carnea* (Stephens) adults can be achieved efficiently through manipulation of photoperiod. (10:14-8:16 [L: D] h). For long-term storage (18-31 wk or longer) was most efficient when pupae or young adults experienced a decrease in day length and diapausing adults were maintained under very short day length (8:16 [L: D] h) [18]. Indicated that Light was of significance for the development of the predator embryos and tested photo periods (8L: 16D, 16L: 8D. and 0L: 24D). During incubation period as no hatching occurred under continuous darkness, but hatching was reduced at 8L: 16D in comparison to hatching at 16L: 8D photoperiods [19]. Photoperiod may influence the development in a number of insects and growth and development are slower at shorter day length if insect diapause is induced by short photoperiod.

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