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Biometrics of *Chrysoperla carnea* (Stephens) on *Corcyra cephalonica* (Stainton) at different temperature levels

Timke SH, Shetgar SS and Khandare RY

Abstract
The mean measurements of head capsule width and larval body length, width and weight of *C. carnea* at 20 ^{0}C temperature were 0.28, 0.59 and 0.77 mm, 2.82, 3.72 and 6.10 mm, 0.86, 1.14 and 1.24 mm and 0.92, 1.95 and 5.80 mg for I, II and III larval instars, respectively. The corresponding values at 25 ^{0}C and 30 ^{0}C temperatures were 0.38, 0.66 and 0.84 mm, 3.06, 4.24 and 6.43 mm, 1.12, 1.21 and 1.83 mm, 1.28, 7.10 and 12.01 mg, and 0.55, 0.70 and 0.91 mm, 3.72, 4.66 and 6.76 mm, 1.14, 1.24 and 1.85 mm, 1.30, 7.86 and 12.24 mg. The progression factors for larval head capsule width, body length, width and weight at 20 ^{0}C temperature were 1.70, 1.47, 1.20 and 2.54, respectively. The corresponding values for 25^{0}C and 30 ^{0}C temperatures were 1.50, 1.44, 1.29 and 3.61 and 1.28, 1.35, 1.28 and 3.79.

Keywords: Biometrics, *Chrysoperla carnea*, *Corcyra cephalonica*, temperature

1. Introduction
In India 65 species of Chrysopids belonging to 21 genera have been recorded. Among them, *Mallada boninensis* (Okamoto), *Chrysoperla. carnea* (Stephens) and *Apertochrysa crassinervis* are most common [11]. *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), the potent predator, is a voracious feeder of soft bodied arthropods such as aphids, whitefly, thrips, American bollworms, mites, army worms, small larvae of beetles, eggs of lepidopterous insects etc. Larvae of *C. carnea* are voracious and feed on insect pests [4] and gaining importance in integrated pest management [10]. *Chrysoperla carnea* Stephens (Neurotera: Chrysopidae) is one of the most important generalist predators. The larval stages are active in suppressing pest, while it is free living in adult stages. 100% cannibalism among green lacewings larvae in the absence of aphids, but if the aphids were presented, the abundance of the cannibalism was negligible [7]. Cannibalism is a disadvantage in mass production of green lacewings larvae for biological control of plants [13]. Mass release of the predator has been effective in reducing the insect-pests in several crops and it is reckoned as a key component of IPM in many crops [12]. The Chrysopids have emerged as strong and potent biocontrol agents. The temperature is one of the principal environmental factors during the development, Survival and diapauses of insects. It also affects different biological traits of insects such as fertility, fecundity, survival, adult life-span and and sex-ratio [14]. So, the present study was planned to find out the temperature effects on the survivor of developmental stages of *C. carnea* including the egg hatching, larval period, pre pupal and pupal stages.

2. Materials and Methods
The studies on biometrics of *C. carnea* were also carried out at three different temperature levels *viz*., 20, 25 and 30 ^{0}C maintained in the BOD incubator. Immediately after hatching fifteen larvae of *C. carnea* for each instar were transferred into separate vials. They were reared individually on sterilized eggs of *C. cephalonica*. Every day fresh eggs were provided to the larvae. The observations on the casting of exuvae were made under microscope. During each instar immediately after moulting, the head capsule width and body length, width and weight of each larva were measured with the help of occular and stage micrometer to the nearest value of 0.0091 mm. The regression relationship between the instar and mean head capsule width, body length, body width and body weight of larvae in different instars was calculated by using the following formula.

$Log_{10} Y = a + bx$

Where
Y = Head capsule width / body length / body width /body weight of larva (mean)
a = Constant
b = Logarithm of growth ratio
x = Number of instars

The growth ratio calculated by dividing the mean value of head capsule width / body length / body width / body weight of larval instar by the value of mean head capsule width / body length /body width/ body weight of larva of preceding instar. The average of growth ratio indicates progression factor.

3. Results and Discussion

The larval development of *C. carnea* was completed by passing through three larval instars when fed on sterilized eggs of *C. cephalonica* under investigation. The shortest mean larval duration of *C. carnea* to the extent of 6.96 days was observed at 30^{0}C temperature followed by 10.81 days at 25^{0}C temperature and 20.93 days at 20^{0}C temperature (Table 1). The mean measurements of larval head capsule width (mm) of *C. carnea* on eggs of *C. cephalonica* at 20^{0}C temperature was 0.28, 0.59 and 0.77 mm for I, II and III instars, respectively (Table 2). The corresponding values at 25^{0}C and 30^{0}C temperatures were 0.38, 0.66 and 0.84 mm and 0.55, 0.70 and 0.91 mm for I, II and III larval instars, respectively (Table 2). The mean observed progression factors were 1.80 each for 20^{0}C, 1.50 each for 25^{0}C temperature and 1.28 each for 30^{0}C temperature levels (Table 2). The literature on biometrics of *C. carnea* on sterilized eggs of *C. cephalonica* at different temperature levels is lacking. Hence, the results of biometrical observations of *C. carnea* under present investigation are discussed with the earlier results of biometrics of *Chrysoperla* sp. reared at different temperature levels. The head capsule width of newly hatched larvae of *C. carnea* to the tune of 0.35 mm [9]. The head capsule width of I, II and III larval instars of *C. carnea* ranging from 0.31 to 0.37, 0.49 to 0.66 and 0.73 to 0.90 mm, respectively [1]. The head capsule width was 0.6 ± 0.01, 0.75 ± 0.01 and 0.98 ± 0.01 mm for I, II and III instars, respectively [5].

The mean body length of *C. carnea* for I, II and III instars reared at 20 ^{0}C, 25 ^{0}C and 30 ^{0}C temperature were 2.82, 3.72 and 6.10 mm, 3.06, 4.24 and 6.43 mm and 3.72, 4.66 and 6.76 mm (Table 3), respectively. The observed progression factors were 1.47 each (20^{0}C), 1.44 each (25^{0}C) and 1.35 and 1.34 (30^{0}C) temperature levels, respectively (Table 3).

The mean body width of *C. carnea* for I to III larval instars were observed to be 0.86, 1.14 and 1.24 mm, 1.12, 1.21 and 1.83 mm and 1.14, 1.24 and 1.85 mm (Table 4), respectively. The observed progression factors were 1.20 each (20^{0}C), 1.29 and 1.28 (25^{0}C) and 1.28 and 1.26 (30^{0}C), respectively (Table 4). The similar results were also observed that the larval body breadth of *C. carnea* to the tune of 0.47, 1.02 and 2.24 mm and 0.40 to 0.70, 0.80 to 1.30 and 2.00 to 2.50 mm, for I, II and III instars, respectively [1,8]. The mean measurements of head capsule width and larval body length, width and weight of *M. boninensis* reared on sterilized eggs of *C. cephalonica* were 0.44, 0.74 and 0.81 mm, 2.80, 4.92 and 7.16 mm, 0.81, 1.67 and 2.27 mm and 0.86, 5.72 and 11.01 mg, for I, II and III larval instars, respectively [3].

The mean observed body weight of I, II and III larval instars of *C. carnea* on sterilized eggs of *C. cephalonica* were 0.92, 1.95 and 5.80 mg at 20^{0}C, 1.28, 7.10 and 12.01 mg at 25^{0}C and 1.30, 7.86 and 12.24 mg at 30^{0}C (Table 5), respectively. The observed progression factors for these respective temperature levels were 2.54 and 2.52, 3.61 and 3.05 and 3.79 and 3.07 (Table 5). The similar observations were also recorded that the larval body weight of *C. carnea* was observed to be 7.93 mg when fed on eggs of *C. cephalonica* [2]. The biometrical observations revealed that *C. carnea* when grown at different temperature levels indicated that larval head capsule width, body length, width and weight was found to be more when grown at 30^{0}C temperature. Slow and prolonged development of *C. carnea* was observed at 20^{0}C while, it was rapid at 31^{0}C [6].

Table 1: The mean incubation period, per cent egg hatch, larval duration, per cent pupation and growth index of *C. carnea* on eggs of *C. cephalonica* at different temperature levels

Temperature levels	Larval instar duration (days)			Total	Mean
	I	II	III		
20 ^{0}C	6.57	7.04	7.32	20.93	6.97
25 ^{0}C	3.06	3.66	4.09	10.81	3.60
30 ^{0}C	2.96	2.02	1.98	06.96	2.32
S.E +	0.09	0.12	0.13	-	-
C.D at 5%	0.29	0.37	0.41	-	-
C.V (%)	5.16	6.27	6.63	-	-

Figure in parentheses indicate arcsine transformed values.

Table 2: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *C. carnea* on sterilized eggs of *C. cephalonica* at different temperature levels

Temperature levels	Parameter	Larval instars			Progression factor
		I	II	III	
20 ^{0}C	Observed head capsule width (mm) ± S.E.	0.28 ± 0.01	0.59 ± 0.01	0.77 ± 0.01	
	Growth ratio	--	2.10	1.30	1.70
	Calculated head capsule width (mm)	0.30	0.50	0.83	
	Growth ratio	--	1.67	1.66	1.67
	Difference	-0.02	0.08	-0.06	
	Per cent difference	-7.14	13.55	7.79	
25 ^{0}C	Observed head capsule width (mm) ± S.E.	0.38 ± 0.01	0.66 ± 0.01	0.84 ± 0.01	
	Growth ratio	--	1.73	1.27	1.50
	Calculated head capsule width (mm)	0.40	0.59	0.88	
	Growth ratio	--	1.47	1.49	1.48
	Difference	-0.02	0.06	-0.04	
	Per cent difference	-5.26	9.09	-4.76	
30 ^{0}C	Observed head capsule width (mm) ± S.E.	0.55 ± 0.01	0.70 ± 0.01	0.91 ± 0.01	
	Growth ratio	--	1.27	1.30	1.28

	Calculated head capsule width (mm)	0.54	0.71	0.90	
	Growth ratio	--	1.29	1.28	1.28
	Difference	0.001	-0.005	0.003	
	Per cent difference	0.18	-0.71	0.32	

Table 3: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *C. carnea* on sterilized eggs of *C. cephalonica*

Temperature levels	Parameter	Larval instars			Progression factor
		I	II	III	
20 ^{0}C	Observed head capsule width (mm) ± S.E.	2.82 ± 0.02	3.72 ± 0.05	6.10 ± 0.07	
	Growth ratio	--	1.31	1.61	1.47
	Calculated head capsule width (mm)	2.71	3.99	5.88	
	Growth ratio	--	1.47	1.47	1.47
	Difference	0.10	-0.27	0.21	
	Per cent difference	3.54	-7.25	3.44	
25 ^{0}C	Observed head capsule width (mm) ± S.E.	3.06 ± 0.02	4.24 ± 0.05	6.43 ± 0.07	
	Growth ratio	--	1.38	1.51	1.44
	Calculated head capsule width (mm)	3.01	4.36	6.33	
	Growth ratio	--	1.44	1.45	1.44
	Difference	0.04	-0.12	0.09	
	Per cent difference	1.30	-2.83	1.39	
30 ^{0}C	Observed head capsule width (mm) ± S.E.	3.72 ± 0.02	4.66 ± 0.05	6.76 ± 0.07	
	Growth ratio	--	1.25	1.45	1.35
	Calculated head capsule width (mm)	3.63	4.89	6.59	
	Growth ratio	--	1.34	1.34	1.34
	Difference	0.08	-0.23	0.16	
	Per cent difference	2.15	-4.93	2.36	

Table 4: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *C. carnea* on sterilized eggs of *C. cephalonica* at different temperature levels

Temperature levels	Parameter	Larval instars			Progression factor
		I	II	III	
20 ^{0}C	Observed head capsule width (mm) ± S.E.	0.86 ± 0.02	1.14 ± 0.06	1.24 ± 0.03	
	Growth ratio	--	1.32	1.08	1.20
	Calculated head capsule width (mm)	0.88	1.06	1.28	
	Growth ratio	--	1.20	1.20	1.20
	Difference	-0.02	0.07	-0.04	
	Per cent difference	-2.32	6.14	-3.22	
25^{0}C	Observed head capsule width (mm) ± S.E.	1.12 ± 0.02	1.21 ± 0.06	1.83 ± 0.03	
	Growth ratio	--	1.08	1.51	1.29
	Calculated head capsule width (mm)	1.05	1.35	1.73	
	Growth ratio	--	1.27	1.29	1.28
	Difference	0.06	-0.14	0.09	
	Per cent difference	5.35	-11.57	4.91	
30 ^{0}C	Observed head capsule width (mm) ± S.E.	1.14 ± 0.02	1.24 ± 0.06	1.85 ± 0.03	
	Growth ratio	--	1.08	1.49	1.28
	Calculated head capsule width (mm)	1.08	1.37	1.75	
	Growth ratio	--	1.26	1.27	1.26
	Difference	0.05	-0.13	0.09	
	Per cent difference	4.38	-10.48	4.86	

Table 5: Comparison of observed and calculated values of mean measurements of larval body weight (mm) of *C. carnea* on sterilized eggs of *C. cephalonica* at different temperature levels

Temperature levels	Parameter	Larval instars			Progression factor
		I	II	III	
20 ^{0}C	Observed head capsule width (mm) ± S.E.	0.92 ± 0.04	1.95 ± 0.09	5.80 ± 0.10	
	Growth ratio	--	2.11	2.97	2.54
	Calculated head capsule width (mm)	0.86	2.18	5.48	
	Growth ratio	--	2.53	2.51	2.52
	Difference	0.05	-0.23	0.31	
	Per cent difference	5.43	-11.79	5.34	
25 ^{0}C	Observed head capsule width (mm) ± S.E.	1.28 ± 0.04	7.10 ± 0.09	12.01 ± 0.10	
	Growth ratio	--	5.54	1.69	3.61
	Calculated head capsule width (mm)	1.56	4.77	14.63	
	Growth ratio	--	3.05	3.06	3.05

	Difference	-0.28	2.32	-2.62	
	Per cent difference	-21.87	32.69	-21.88	
30 ^{0}C	Observed head capsule width (mm) ± S.E.	1.30 ± 0.04	7.86 ± 0.09	12.24 ± 0.10	
	Growth ratio	--	6.04	1.55	3.79
	Calculated head capsule width (mm)	1.62	5.00	15.34	
	Growth ratio	--	3.08	3.06	3.07
	Difference	-0.32	2.85	-3.10	
	Per cent difference	-24.61	36.25	-25.32	

4. Conclusion

These results may help to design valuable pest management programs by using *C. carnea* as a biological control agent to control various insect pests. However, several other temperature related factors must be kept in mind when using these results to organize eco-friendly pest management programs.

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6. References

1. Chakraborty Dola and Korat DM. Biology of green lace wing, *Chrysoperla carnea* (Stephens) in middle conditions. Karnatak Journal Agricultural Science 2010;23(3):500-502.
2. Dhepe VR. Studies on biology of *Chrysoperla carnea* (Stephens) on different hosts. M.Sc. (Agri.) dissertation submitted to Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India 2001.
3. Doiphode PB, Shetgar SS. and Shinde ST. Biometrics of *Mallada boninensis* (Okamoto) on *Corcyra cephalonica* (Stainton). Journal of Entomological research 2012;36:183-186.
4. Hashami AA. Insect pest management in the 21st century. PARC, Islamabad, Pakistan 2001, 27.
5. Jadhav MS. Biology and life-fecundity tables of *C. carnea* (Stephens) at different temperature conditions. M.Sc. (Agri.) dissertation submitted to Vasantrao Naik Marathwada Krishi Vidapeeth, Parbhani 2013.
6. Kengo N, Ryoichi N, Ryo A. Effect of temperature on development, survival and adult body size of two green lace wings, *Mallada desjardinsi* and *Chrysoperla nipponesis* (Neuroptera: Chrysopidae). Applied Entomology Zoology 2005;40:615-620.
7. Mochizuki A, Naka H, Hamasaki K, Mitsunaga T. Larval cannibalism and intraguild predation between the introduced green lacewing, *Chrysoperla carnea*, and the indigenous trash-carrying green lacewing, *Mallada desjardinsi* (Neuroptera: Chrysopidae), as a case study of potential non-target effect assessment. Environ. Entomol 2006;35:1298-1303.
8. Nasir MM. *Chrysopa cymbele* Banks and its two new varieties. Indian Journal of Entomology 1947;**7**:119-120.
9. Patel KG, Vyas HN. Biology of green lace wing *Chrysopa (Chrysoperla*) *scelestes* Banks (Neuroptera: Chrysopidae) an important predator in Gujarat. Gujarat Agricultural Universities Research Journal 1985;11:18-23.
10. Sattar M, Abro GH. Mass rearing of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) adults for integrated pest management programmes. Pakistan J. Zool 2011;43:483-487.
11. Singh SP. Production and use of Chrysopid predator. Technical Bulletin No. 10. Project Directorate of Biological Control, Bangalore 1994.
12. Singh SP, Jalali SK. Chrysopid predators: Their production and use. Extension Bulletin, National centre for Integrated Pest Management 1991;2:12.
13. Van Lenteren JC. Quality control and production of biological control agents: theory and testing procedures. CABI Publishing 2003, 327.
14. Zheng FS, Zheng YZ. Du ZJ, Wang JJ. Effect of temperature on the demography of *Galerucella birmanica* (Coleoptera: Chrysomelidae) Insect Sci 2008;15:375-380.