



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2020; 8(1): 337-342

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Received: 01-11-2019

Accepted: 05-12-2019

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Biometric studies of *Corcyra cephalonica* (Stainton) at different temperature levels

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Abstract

The observed progression factors for larval head capsule width, body length, body width and body weight at 20 °C temperature were 1.05, 1.25, 0.97, and 1.32, respectively. The corresponding values at 25 °C, 30 °C and 35 °C temperature were (1.16, 1.40, 0.99 and 1.38), (1.23, 1.38, 0.99, and 1.37) and (1.16, 1.25, 0.99 and 1.48), respectively.

Keywords: Biometrics, *Corcyra cephalonica* (Stainton), temperature levels

Introduction

The rice moth, *Corcyra cephalonica* (Stainton) is able to survive in a wide range of temperature and humidity in fact the life cycle can be completed between 15^oC and 35^oC and between 15 to 90% relative humidity, and high damage has been reported even under extreme condition (Parameshwar & Jairao, 1985) [4] this characteristics are important element for explaining the ubiquitous distribution of *Corcyra cephalonica* which was comes in prominence in India in recent years mainly due to its adaptability for use as laboratory host of many parasitoids and predators employed in biological control of insect pests. There is little information available on the development of *C. cephalonica* under different sets of controlled temperatures and humidity on stored broken grains of sorghum mass multiplication of natural enemies depends on effective rearing of laboratory host like *C. cephalonica* under different environmental conditions (Parameshwar and Jairao, 1990) [4].

Material and Methods

The laboratory experiments were conducted at the Department of Entomology, College of Agriculture, Latur during 2015-2016.

Rearing of test insect

The laboratory culture of rice moth *Corcyra cephalonica* Stainton (Pyralidae: Lepidoptera) was initiated by collecting larvae from previous culture of bio-control laboratory, Department of Entomology, during 2015. The larvae were reared individually in round clean plastic boxes. They were fed on crushed sorghum grains till pupation. After pupation the sexes of pupae were determined on the basis of distance between the two apertures. In case of male, the distance between genital and anal aperture is less, while it is more in case of female (Shrivastava and Pande, 1966 and Dani *et al.* 1980) [6, 2]. The adults that emerged on the same day were placed in oviposition cage for the purpose of egg laying and cotton swab dipped in 50 per cent honey solution was provided as food to the adults. Thus, the freshly laid eggs were used for investigation on biology, biometrics and life-fecundity of *C. cephalonica* at different temperature levels.

Biometrical studies of *C. cephalonica* at different temperature levels

The studies on biometrics of *C. cephalonica* were also carried out at four different temperature levels *viz.*, 20 °C, 25 °C, 30 °C and 35 °C. Immediately after hatching larvae of *C. cephalonica* for each instar were transferred into separate small plastic vials. They were reared individually at four different temperature levels *viz.*, 20 °C, 25 °C, 30 °C and 35 °C. Every day fresh crushed sorghum grains were provided to the larvae. The observations on the casting of exuviae were made under microscope. During each instar immediately after moulting, the head capsule width and body length, width and weight of each larva was measured with the help of ocular

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.

$$\text{Log}_{10} Y = a + bx$$

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

Result and Discussion

1. Larval head capsule width

Temperature at 20 °C

The results presented in Table 1 revealed that the larvae of *C. cephalonica* passed through six instars. The head capsule width was $0.82 + 0.01$, $1.12 + 0.01$, $1.42 + 0.01$, $2.96 + 0.01$, $3.68 + 0.01$ and $4.86 + 0.01$ mm for I, II, III, IV, V and VI instars, respectively grown at 20 °C temperature. The mean observed and calculated progression factors were 1.05 and 1.09, respectively. The regression equation was $\log_{10}y = -0.0861 + 0.1122x$

Table 1: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *C. cephalonica* on at 20°C temperatures

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed head capsule width (mm) + S.E.	0.82±0.01	1.12±0.01	1.42±0.01	2.96±0.01	3.68±0.01	4.86±0.01	
Growth ratio	--	1.37	1.27	1.08	1.24	1.32	1.05
Calculated head capsule width (mm)	1.06	1.37	1.78	2.30	2.98	3.86	
Growth ratio	--	1.29	1.30	1.31	1.30	1.31	1.09
Difference	-0.24	-0.25	-0.36	0.65	0.69	0.99	
Per cent difference	29.26	22.32	25.35	21.95	18.75	20.37	

Temperature at 25 °C

C. cephalonica passed through six instars (Table 2) when reared at 25 °C temperature. The head capsule width was $0.98 + 0.01$, $1.3 + 0.01$, $1.4 + 0.01$, $2.1 + 0.01$, $3.5 + 0.01$ and

$4.95 + 0.01$ mm for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 1.16 and 1.06, respectively. The regression equation was $\log_{10}y = -0.0633 + 0.1044x$

Table 2: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *C. cephalonica* at 25 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed head capsule width (mm) + S.E.	0.98+0.01	1.3+0.01	1.4+0.01	2.1+0.01	3.5+0.01	4.95+0.01	
Growth ratio	--	1.33	1.08	1.50	1.67	1.41	1.16
Calculated head capsule width (mm)	1.10	1.40	1.78	2.26	2.87	3.66	
Growth ratio	--	1.27	1.27	1.27	1.27	1.27	1.06
Difference	-0.12	-0.10	-0.38	-0.16	0.63	1.29	
Per cent difference	-12.16	-7.52	-26.97	-7.65	17.86	26.14	

Temperature at 30 °C

The results presented in Table 3 revealed that the larvae of *C. cephalonica* reared at 30 °C temperature passed through six instars. The larval head capsule width was $0.76 + 0.01$, $1.15 + 0.01$, $2.26 + 0.01$, $3.16 + 0.01$, $4.15 + 0.01$ mm and $5.01 +$

0.01 mm for I, II, III, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 1.23 and 1.11 respectively. The regression equation was $\log_{10}y = -0.0771 + 0.1227x$.

Table 3: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *C. cephalonica* at 30°C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed head capsule width (mm) + S.E.	0.76+0.01	1.15+0.01	2.26+0.01	3.16+0.01	4.15+0.01	5.01+0.01	
Growth ratio	--	1.51	1.97	1.40	1.31	1.21	1.23
Calculated head capsule width (mm)	1.11	1.47	1.95	2.59	3.44	4.56	
Growth ratio	--	1.33	1.33	1.33	1.33	1.33	1.11
Difference	-0.35	-0.32	0.31	0.57	0.71	0.45	
Per cent difference	-46.13	-28.06	13.55	17.99	17.61	9.00	

Temperature at 35 °C

The results presented in Table 4 revealed that the larvae of *C. cephalonica* passed through six instars. The head capsule width was $0.98 + 0.01$, $1.54 + 0.01$, $2.14 + 0.01$, $2.97 + 0.01$, $4.13 + 0.01$ and $4.99 + 0.01$ mm for I, II, III, IV, V and VI

instars, respectively when grown at 35 °C temperature. The mean observed and calculated progression factors were 1.16 and 1.10, respectively. The regression equation was $\log_{10}y = -0.0258 + 0.1191x$

Table 4: Comparison of observed and calculated values of mean measurements of larval head capsule width (mm) of *C. cephalonica* at 35 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed head capsule width (mm) + S.E.	0.98± 0.01	1.54± 0.01	2.14± 0.01	2.97± 0.01	4.13± 0.01	4.99± 0.01	
Growth ratio	--	1.57	1.39	1.39	1.39	1.21	1.16
Calculated head capsule width (mm)	1.21	1.60	2.10	2.77	3.65	4.81	
Growth ratio	--	1.32	1.32	1.32	1.32	1.32	1.10
Difference	-0.14	-0.09	-0.01	0.15	0.42	0.11	
Per cent difference	-12.69	-5.89	-0.24	4.98	10.11	2.12	

2. Larval body length Temperature at 20 °C

The results presented in Table 5 indicated that the larval body length of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 20 °C temperature was 1.75+ 0.02, 4.11+ 0.04, 6.01+

0.06, 7.55+0.07, 9.20+0.08 and 11.00 + 0.10 mm, respectively. The mean observed and calculated progression factors were 1.25 and 1.30. The regression equation was $\log_{10}y = 0.0771 + 0.1931x$.

Table 5: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *C. cephalonica* at 20 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed body length (mm) + S.E.	1.75± 0.02	4.11± 0.04	6.01± 0.06	7.55± 0.07	9.20± 0.08	11.00± 0.10	
Growth ratio	--	2.35	1.46	1.26	1.22	1.20	1.25
Calculated body length (mm)	1.86	2.91	4.53	7.07	11.04	17.22	
Growth ratio	--	1.56	1.56	1.56	1.56	1.56	1.30
Difference	-0.11	1.20	1.48	0.48	-1.84	-6.22	
Per cent difference	-6.47	29.27	24.54	6.29	-19.97	-56.54	

Temperature at 25 °C

The results presented in Table 6 indicated that the mean larval body length of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 25 °C temperature was 1.28+ 0.02, 4.22+

0.04, 6.28+ 0.06, 7.65+ 0.07, 9.80+ 0.08 and 11.21+ 0.10 mm, respectively. The mean observed and calculated progression factors were 1.40 and 1.31, respectively. The regression equation was $\log_{10}y = 0.0493 + 0.1980x$.

Table 6: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *C. cephalonica* at 25 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed body length (mm) + S.E.	1.28± 0.02	4.22± 0.04	6.28± 0.06	7.65± 0.07	9.80± 0.8	11.21± 0.10	
Growth ratio	--	3.30	1.49	1.22	1.28	1.14	1.40
Calculated body length (mm)	1.77	2.79	4.40	6.94	10.95	17.28	
Growth ratio	--	1.58	1.58	1.58	1.58	1.58	1.31
Difference	-0.49	1.43	1.88	0.71	-1.15	-6.07	
Per cent difference	-38.09	33.91	29.93	9.25	-11.77	-54.17	

Temperature at 30 °C

The results presented in Table 7 indicated that the larval body length of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 30 °C temperature was 1.32+ 0.02, 4.11+ 0.04, 6.51+

0.06, 7.81+ 0.07, 9.62+ 0.08 and 11.35+ 0.10 mm, respectively. The mean observed and calculated progression factors were 1.38 and 1.32, respectively. The regression equation was $\log_{10}y = 0.0518 + 0.1985x$.

Table 7: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *C. cephalonica* at 30 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed body length (mm) + S.E.	1.32± 0.02	4.11± 0.04	6.51± 0.06	7.81± 0.07	9.62± 0.08	11.35± 0.10	
Growth ratio	--	3.11	1.58	1.20	1.23	1.18	1.38
Calculated body length (mm)	1.78	2.81	4.44	7.01	11.07	17.49	
Growth ratio	--	1.58	1.58	1.58	1.58	1.58	1.32
Difference	-0.46	1.30	2.07	0.80	-1.45	-6.14	
Per cent difference	-34.80	31.62	31.82	10.25	-15.08	-54.05	

Temperature at 35 °C

The results presented in Table 8 indicated that the larval body length of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 25 °C temperature was 1.56+ 0.02, 3.22+ 0.04, 5.22+

0.06, 6.22 + 0.07, 9.45 + 0.08 and 10.22 + 0.10 mm, respectively. The mean observed and calculated progression factors were 1.25 and 1.28, respectively. The regression equation was $\log_{10}y = 0.0463 + 0.1866x$.

Table 8: Comparison of observed and calculated values of mean measurements of larval body length (mm) of *C. cephalonica* on at 35 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed body length (mm) + S.E.	1.56± 0.02	3.22± 0.04	5.22± 0.06	6.22± 0.07	9.45± 0.08	10.22± 0.10	
Growth ratio	--	2.06	1.62	1.19	1.52	1.08	1.25
Calculated body length (mm)	1.71	2.63	4.04	6.21	9.54	14.66	
Growth ratio	--	1.54	1.54	1.54	1.54	1.54	1.28
Difference	-0.15	0.59	1.18	0.01	-0.09	-4.44	
Per cent difference	-9.60	18.39	22.63	0.21	-0.95	-43.46	

3. Larval body width Temperature at 20 °C

The results presented in Table 9 indicated that the larval body width of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 20°C temperature was 0.74+ 0.02, 0.81+ 0.03, 0.95+

0.04, 1.15+ 0.05, 1.35+0.06 and 1.59+ 0.07 mm, respectively. The mean observed and calculated progression factors were 0.97 and 0.89, respectively. The regression equation was $\log_{10}y = -0.0698 + 0.0270x$.

Table 9: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *C. cephalonica* at 20 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body width (mm) + S.E.	0.74± 0.02	0.81± 0.03	0.95± 0.04	1.15± 0.05	1.35± 0.06	1.59± 0.07	
Growth ratio	--	1.09	1.17	1.21	1.17	1.18	0.97
Calculated larval body width (mm)	0.91	0.96	1.03	1.09	1.16	1.24	
Growth ratio	--	1.06	1.06	1.06	1.06	1.06	0.89
Difference	-0.17	-0.15	-0.08	0.06	0.19	0.35	
Per cent difference	-22.45	-19.04	-8.00	5.06	13.95	22.25	

Temperature at 25 °C

The results presented in Table 10 indicated that the larval body width of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 25 °C temperature was 0.69+ 0.02, 0.85+ 0.03, 0.91+

0.04, 1.18+ 0.05, 1.38+0.06 and 1.65+ 0.07 mm, respectively. The mean observed and calculated progression factors were 0.99 and 0.89, respectively. The regression equation was $\log_{10}y = 0.0767 + 0.0294x$.

Table 10: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *C. cephalonica* at 25 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body width (mm) + S.E.	0.69± 0.02	0.85± 0.03	0.91± 0.04	1.18± 0.05	1.38± 0.06	1.65± 0.07	
Growth ratio	--	1.23	1.07	1.30	1.17	1.20	0.99
Calculated larval body width (mm)	0.90	0.96	1.03	1.10	1.18	1.26	
Growth ratio	--	1.07	1.07	1.07	1.07	1.07	0.89
Difference	-0.21	-0.11	-0.12	0.08	0.20	0.39	
Per cent difference	-29.97	-12.89	-12.82	6.91	14.84	23.79	

Temperature at 30 °C

The results presented in Table 11 indicated that the larval body width of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 25 °C temperature was 0.71+ 0.02, 0.88+ 0.03, 0.95+

0.04, 1.32+ 0.05, 1.45+ 0.06 and 1.68+ 0.07 mm, respectively. The mean observed and calculated progression factors were 0.99 and 0.90, respectively. The regression equation was $\log_{10}y = -0.0708 + 0.0336x$.

Table 11: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *C. cephalonica* at 30 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body width (mm) + S.E.	0.71± 0.02	0.88± 0.03	0.95± 0.04	1.32± 0.05	1.45± 0.06	1.68± 0.07	
Growth ratio	--	1.24	1.08	1.39	1.10	1.16	0.99
Calculated larval body width (mm)	0.92	0.99	1.07	1.16	1.25	1.35	
Growth ratio	--	1.08	1.08	1.08	1.08	1.08	0.90
Difference	-0.21	-0.11	-0.12	0.16	0.20	0.33	
Per cent difference	-29.27	-12.69	-12.79	12.30	13.74	19.56	

Temperature at 35 °C

The results presented in Table 12 indicated that the larval body length of *C. cephalonica* for I, II, II, IV, V and VI instars reared at 25 °C temperature was 0.67+ 0.02, 0.82+

0.03, 0.98+ 0.04, 1.16 + 0.05, 1.28+ 0.06 and 1.58+ 0.07 mm, respectively. The mean observed and calculated progression factors were 0.99 and 0.89, respectively. The regression equation was $\log_{10}y = -0.0757 + 0.0265x$.

Table 12: Comparison of observed and calculated values of mean measurements of larval body width (mm) of *C. cephalonica* at 35 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body width (mm) + S.E.	0.67± 0.02	0.82± 0.03	0.98± 0.04	1.16± 0.05	1.28± 0.06	1.58± 0.07	
Growth ratio	--	1.22	1.20	1.18	1.10	1.23	0.99
Calculated larval body width (mm)	0.89	0.95	1.01	1.07	1.14	1.21	
Growth ratio	--	1.06	1.06	1.06	1.06	1.06	0.89
Difference	-0.22	-0.13	-0.03	0.09	0.14	0.37	
Per cent difference	-33.25	-15.72	-2.91	7.60	11.00	23.37	

4. Larval body weight Temperature at 20 °C

The results Table 13 indicated that the larvae of *C. cephalonica* when grown at 20 °C temperature its body weight was recorded to the tune of 0.98 ± 0.01, 1.80 ± 0.04,

3.65 ± 0.09, 4.90 ± 0.12, 6.88 ± 0.14 and 9.20 ± 0.18 mg for I, II, II, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 1.32 and 1.23, respectively. The regression equation was $\log_{10}y = -0.0339 + 0.1686x$.

Table 13: Comparison of observed and calculated values of mean measurements of larval body weight (mg) of *C. cephalonica* at 20 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body weight (mm) + S.E.	0.98± 0.01	1.80± 0.04	3.65± 0.09	4.90± 0.12	6.88± 0.14	9.20± 0.18	
Growth ratio	--	1.57	1.97	1.50	2.01	1.41	1.32
Calculated larval body weight (mm)	1.34	1.98	2.92	4.31	6.35	9.36	
Growth ratio	--	1.47	1.47	1.47	1.47	1.47	1.23
Difference	-0.36	-0.18	0.73	0.59	0.53	-0.16	
Per cent difference	-37.22	-10.14	19.93	12.07	7.68	-1.78	

Temperature at 25 °C

The results table 14 indicated that the larvae of *C. cephalonica* when grown at 25 °C temperature its body weight was recorded to the tune of 0.90 ± 0.01, 1.92 ± 0.04, 3.88 ± 0.09, 4.92 ± 0.12, 6.93 ± 0.14 and 9.96 ± 0.18 mg for I,

II, II, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 1.38 and 1.24, respectively. The regression equation was $\log_{10}y = -0.0452 + 0.1728x$.

Table 14: Comparison of observed and calculated values of mean measurements of larval body weight (mg) of *C. cephalonica* at 25 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body weight (mm) + S.E.	0.90± 0.01	1.92± 0.04	3.88± 0.09	4.92± 0.12	6.93± 0.14	9.96± 0.18	
Growth ratio	--	2.13	2.02	1.27	1.41	1.44	1.38
Calculated larval body weight (mm)	1.34	2.00	2.97	4.43	6.59	9.81	
Growth ratio	--	1.49	1.49	1.49	1.49	1.49	1.24
Difference	-0.44	-0.08	0.91	0.49	0.34	0.15	
Per cent difference	-49.06	-4.01	23.38	10.05	4.94	1.55	

Temperature at 30 °C

The results table 15 indicated that the larvae of *C. cephalonica* when grown at 30 °C temperature its body weight was recorded to the tune of 0.95 ± 0.01, 2.15 ± 0.04, 4.01 ± 0.09, 5.62 ± 0.12, 7.30 ± 0.14 and 10.20 ± 0.18 mg for

I, II, II, IV, V and VI instars, respectively. The mean observed and calculated progression factors were 1.37 and 1.25, respectively. The regression equation was $\log_{10}y = -0.0323 + 0.1776x$.

Table 15: Comparison of observed and calculated values of mean measurements of larval body weight (mg) of *C. cephalonica* at 30 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body weight (mm) + S.E.	0.95± 0.01	2.15± 0.04	4.01± 0.09	5.62± 0.12	7.30± 0.14	10.20± 0.18	
Growth ratio	--		2.26	1.87	1.40	1.30	1.37
Calculated larval body weight (mm)	1.40	2.10	3.17	4.76	7.17	10.79	
Growth ratio	--	1.51	1.51	1.51	1.51	1.51	1.25
Difference	-0.45	0.05	0.84	0.86	0.13	-0.59	
Per cent difference	-47.07	2.19	21.07	15.24	1.78	-5.80	

Temperature at 35 °C

The results table 16 indicated that the larvae of *C. cephalonica* when grown at 35 °C temperature its body

weight was recorded to the tune of 0.70 ± 0.01, 2.10 ± 0.01, 3.56 ± 0.01, 5.20 ± 0.01, 6.36 ± 0.01 and 9.55 ± 0.01 mg for I, II, II, IV, V and VI instars, respectively. The mean observed

and calculated progression factors were 1.48 and 1.24, respectively. The regression equation was $\log_{10}y = -0.0619 + 0.1709x$.

Table 16: Comparison of observed and calculated values of mean measurements of larval body weight (mg) of *C. cephalonica* at 35 °C temperature

Parameter	Larval instars						Progression factor
	I	II	III	IV	V	VI	
Observed larval body weight (mm) + S.E.	0.70± 0.01	2.10± 0.04	3.56± 0.09	5.20± 0.12	6.36 ± 0.14	9.55± 0.18	
Growth ratio	--	3.00	1.70	1.46	1.22	1.50	1.48
Calculated larval body weight (mm)	1.29	1.91	2.82	4.19	6.21	9.20	
Growth ratio	--	1.48	1.48	1.48	1.48	1.48	1.24
Difference	-0.59	0.19	0.74	1.01	0.15	0.35	

The biometrical observations of *C. cephalonica* 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 25 °C temperature. Osman *et al.* (1983)^[3] studied effect of temperature on size of head capsule of *C. cephalonica* and reported average size of head capsule from 0.195 mm to 1.299 mm at 28 °C in first to sixth instar larvae. They also observed average size of head capsule from 0.177 to 1.210 mm at 30 °C and 0.194 to 1.270 mm at 32 °C in first to sixth instar larvae. Bhubaneshwari *et al.* (2013)^[1] reported the morphometric measurements of *C. cephalonica* that the mean length and breadth of 1st, 2nd, 3rd, 4th, 5th and 6th instars larvae were 2.72, 3.74, 5.63, 7.55, 9.20, 11.21 and 0.31, 0.39, 0.95, 1.16, 1.35, 1.59 mm, respectively.

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