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Biology of *Corcyra cephalonica* (Stainton) at different temperature levels

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Abstract
The significantly shortest incubation period (2.67 days) of *C. cephalonica* was observed 35 ^{0}C temperature. The significantly lowest egg hatching (93.40 per cent), growth index (1.19) was observed at 35 ^{0}C and 20 ^{0}C temperatures, respectively. The significantly longer larval duration of *C. cephalonica* (52.33 days) was noticed at 20 ^{0}C temperature. The minimum instar duration (6.50 days) observed at 35 ^{0}C temperature and maximum at 20 ^{0}C temperature (8.72 days). The significantly lowest per cent pupation (62.38 per cent) was found at 20 ^{0}C temperature however, the highest percentage pupation (83.63 per cent) was noticed at 35 ^{0}C which was at par with the percentage pupation recorded at 30 ^{0}C temperature (82.54 per cent). The significantly longer life-cycle duration of male (70.08 days), female (72.20 days) and in general (71.13 days) was recorded at 20 ^{0}C temperature. The significantly lowest life-cycle duration in male (50.20 days), female (50.20 days) and in general (50.38 days) were recorded at 35 ^{0}C temperature. The significantly lowest adult emergence (69.00 per cent) was noticed at 20 ^{0}C temperature and highest at 30 ^{0}C (87.41 per cent). In general, highest adult longevity was observed at 20 ^{0}C temperature and shortest (11.34 days) at 35 ^{0}C temperature. The numerically lower fecundity (190.60 eggs) was observed at 20 ^{0}C temperature and highest (250.55 eggs) at 35 ^{0}C temperature.

Keywords: Bioloy, *Corcyra cephalonica*, stainton, temperature levels

Introduction
The rice moth (*Corcyra cephalonica*) Stainton is one of the common pests of several storage products. The rice moth is a notorious pest of stored cereals and cereal commodities in India as well as in other tropical and subtropical regions of the world. Its larval stages cause serious damage to rice, gram, sorghum, maize, groundnut, cotton seeds, peanuts, linseeds, raisins, nutmeg, chocolates, army biscuits, wheat, coffee, cocoa beans and milled products (Atwal, 1976; Cox *et al.*, 1981; Allotey and Kumar, 1985; Allotey, 1991) [5, 8, 2, 1]. *Corcyra cephalonica* is being utilized as main laboratory host for mass rearing or production of beneficial egg parasitoids *viz.*, *Trichogramma minutum* Riley and the egg-larval parasitoid like *Chelonus blackburnii* Cameron (Manoharan and Balsubramanian, 1982; Prasad *et al*., 1982) [17, 21], pupal parasitoid like *viz*., *Tetrastichus aggari* Rohwar (Krishnamurthy and Nagarkatti, 1981) [14].
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) [20].

Material and methods
The present investigations were carried out to study the biology and life-fecundity tables of *Corcyra cephalonica* (Stainton) on different temperature levels. 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) [25, 9]. 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.

Biology of *C. cephalonica* at different temperature levels

The studies on biology of *C. cephalonica* were carried out in a Completely Randomized Design replicated five times at different temperature levels *viz*., 20 ^{0}C, 25 ^{0}C, 30 ^{0}C, and 35 ^{0}C by using B.O.D. incubator. The freshly laid eggs collected from the maintained culture. One hundred freshly laid eggs were kept in five petri dishes each containing 20 eggs as a replicate. The observations were recorded in respect of incubation period and per cent egg hatch. The newly hatched larvae were reared individually in the plastic vials on crushed sorghum grains at four different temperature levels. The observations were made on the larval duration, per cent larvae pupated, pre-pupal and pupal duration, per cent adult emerged, longevity of male and female moths, per cent survival from egg to adult and growth index at respective temperature levels. The growth index was calculated by using Howe's (1953) formula.

$$\text{Growth index} = \frac{\text{Per cent larvae pupated}}{\text{Mean larval duration (days)}}$$

Results and discussion

Effect of different temperature levels on incubation period of *C. cephalonica*

The data (Table 1) revealed that significantly longer incubation period of *C. cephalonica* was recorded at 20 ^{0}C (5.53 days) and shortest incubation period was recorded at 35 ^{0}C (2.67 days). Osman *et al.* (1983) [18] reported that incubation period of *C. cephalonica* of 6.2 days at 28 ± 1 ^{0}C and 5.2 days at 30 ± 2 ^{0}C and 32 ± 1 ^{0}C temperature, respectively in *C. cephalonica.* Ray (1994) recorded egg period of *C. cephalonica* 7 days on maize at 28 ± 1 ^{0}C and 75 per cent RH. In the present investigation increase in temperature reduced the incubation period of *C. cephalonica*

Effect of different temperature levels on per cent egg hatching of *C. cephalonica*

The data on per cent egg hatching (Table 1) of *C. cephalonica* revealed that the highest egg hatching (99.20 per cent) was observed at 20 ^{0}C however, at par with egg hatching at 25 ^{0}C (98.00 per cent). The significantly lowest egg hatching was recorded (93.40 per cent) at 35 ^{0}C temperature.

Parameshawar and Jairao (1990) [20] reported maximum of 100 per cent hatching in *C. cephalonica* was observed at 20 ^{0}C and a maximum 91.7, per cent of hatching was observed at 35 ^{0}C temperatures. Allotey and Azalekar (2000) [2] found egg hatchability of *C. cephalonica* of 83 per cent at 27.5-30 ^{0}C and 60-73 per cent RH. However, Carmona (1958) [7], Karmel and Hassanien (1967) [13] reported that neither temperature nor humidity had any effect on the number of egg hatching.

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

Temperature Levels	Mean incubation Period (days)	Per cent egg Hatch	Mean larval Duration (days)	Growth Index
20 ^{0}C	5.53	99.20 (83.30)*	52.33	1.19
25 ^{0}C	4.41	98.00 (81.97)	46.72	1.54
30 ^{0}C	3.57	97.40 (80.92)	44.17	1.86
35 ^{0}C	2.67	93.40 (75.26)	39.04	2.18
S.E +	0.06	0.58	0.70	0.005
C.D at 5%	0.20	1.74	2.10	0.015
C.V. (%)	3.79	1.34	3.45	0.66

* Figures in parentheses indicate arcsine transformed values.

Effect of different temperature levels on larval duration of *C. cephalonica*

The significantly longer larval duration of *C. cephalonica* (52.33 days) was noticed at 20 ^{0}C temperature. The significantly shortest larval duration observed at 35 ^{0}C (39.04 days).

Osman *et al.* (1983) [18] reported larval period of 23.8 days at 28 ± 1 ^{0}C and 22.6 days at 30 ± 2 ^{0}C and 19.6 days at 32 ± 1 ^{0}C temperatures. Ray *et al.* (1990) found larval duration 44 days in *C. cephalonica* on crushed sorghum grains at 28 ± 1 ^{0}C and 75 per cent RH.

Effect of different temperature levels on growth index of *C. cephalonica*

The data on the growth index revealed that the significantly lowest growth index of *C. cephalonica* was recorded at 20 ^{0}C temperature (1.19) and highest at 35 ^{0}C temperature (2.18).

Malhotra *et al.* (1987) [15] observed highest growth index of 1.78 when *C. cephalonica* was reared on plstachios followed by almonds (1.47) and cashews (1.24) when reared at 27 ^{0}C temperature and 60 per cent RH.

Effect of different temperature levels on larval instar duration of *C. cephalonica*

The data (table 2) revealed that the significantly longer larval instar duration in I and III larval instar was observed (5.57 and 8.96 days, respectively) at 20 ^{0}C temperature and shorter (3.94 and 5.62 days) at 35 ^{0}C temperature. The larval instar duration at 20 ^{0}C, 25 ^{0}C, and 30 ^{0}C temperatures were higher but at par in II and V instars. In VI instar longer instar duration observed at 20 ^{0}C (12.82 days) which was at par 25 ^{0}C (12.29 days). The lower instar duration in VI instar noticed at 35 ^{0}C temperature (9.69 days) and was at par with instar duration recorded at 30 ^{0}C (9.84 days). In general instar duration at lower temperature was longer and at higher temperature it was shorter.

Table 2: The mean larval instars duration *C. cephalonica* at different temperature levels

Temperature Levels	Larval instars						Total	Mean
	I	II	III	IV	V	VI		
20 ^{0}C	5.57	5.23	8.96	9.14	10.58	12.82	52.33	8.72
25 ^{0}C	4.80	5.51	6.36	7.60	10.15	12.29	46.71	7.78
30 ^{0}C	4.61	5.31	6.75	6.80	10.90	9.84	44.17	7.36
35 ^{0}C	3.94	3.78	5.62	6.61	9.41	9.69	39.04	6.50
S.E. +	0.07	0.06	0.11	0.11	0.18	0.21	-	-
C.D. at 5%	0.22	0.20	0.35	0.35	0.55	0.63	-	-
C.V. (%)	3.5	3.11	3.82	3.53	4.02	4.24	-	-

Pupal duration

Effect of different temperature levels on per cent pupation of *C. cephalonica*

The significantly lowest per cent pupation (62.38 per cent) was observed at 20 ^{0}C temperature (Table 3). The highest percentage pupation (83.63 per cent) was noticed at 35 ^{0}C which was at par with the percentage pupation recorded at 30 ^{0}C temperature (82.54 per cent). The literature on the effect of temperature on the per cent pupation of *C. cephalonica* wanting so results could not be discussed.

Effect of different temperature levels on pupal duration of *C. cephalonica*.

The data (Table 3) on effect of different temperature levels on pupal duration of *C. cephalonica* revealed that shorter pupal duration (6.71 days) was observed at 35 ^{0}C temperature the longer pupal duration (10.21 days) found at 20 ^{0}C however, it was at par with pupal duration at 25 ^{0}C (9.56 days). Osman *et al.* (1983) [18] found pupal period in C. *cephalonica* of 9.8 days at 28 ± 1 ^{0}C and 8.3 days at 30 ± 2 ^{0}C and 8.5 days at 32 ± 1 ^{0}C. Ashwini kumar *et al.* (2002) [4] observed pupal duration of *C. cephalonica*, 7.75 days on maize, 7.78 days on sorghum, 8.02 days on wheat and 8.23 days on rice. Bhandari *et al.* (2014) [6] observed the maximum pupal duration of *C. cephalonica* was found on rice (10.33 days) at 26 ± 2 ^{0}C temperature and 70 ± 5 per cent RH.

Table 3: The per cent larva pupated, pre-pupal and pupal duration of *C. cephalonica* at different temperature levels

Temperature Levels	Per cent larvae Pupated	Pre-pupal duration (days)	Pupal duration (days)
20 ^{0}C	62.38 (52.17)*	3.06	10.21
25 ^{0}C	72.2158.16)	2.63	9.56
30 ^{0}C	82.54(65.39)	2.57	7.74
35 ^{0}C	83.63(66.17)	1.94	6.71
S.E. +	1.08	0.06	0.23
C.D. at 5%	3.25	0.18	0.69
C.V. (%)	3.23	5.47	6.07

* *Figures in parentheses indicate arcsine transformed values.

Effect of different temperature levels on pre-pupal duration of *C. cephalonica*

The significantly shortest mean pre-pupal duration (1.94 days) was recorded at 35 ^{0}C temperature and longer pre-pupal duration (3.06) at 20 ^{0}C temperature.

Effect of different temperature levels on life-cycle duration of *C. cephalonica*

The data (Table 4) showed that the significantly highest life cycle duration of male (70.08 days), female (72.20 days) and in general (71.13 days) was observed at 20 ^{0}C temperature. The significantly shorter life-cycle duration in male (50.20 days), female (50.20 days) and in general (50.38) were recorded at 35 ^{0}C temperature. Panomkorn-Phermpoon (1980) observed life cycle *C. cephalonica* of 54.13 days at 31.7^o C and 72.2% R.H when reared on rice. Osman (1983) [18] reported 40.7 days life cycle of *C. cephalonica* at 28 ± 1 ^{0}C and 34.5 at 30 ± 2 ^{0}C while it was 31.3 days at 32 ± 1 ^{0}C temperatures. Hugar *et al.* (1997) [11] reported that temperature has got negative effect on the longevity of the insect in its all life stages. These results are in agreement with the results in the present investigation.

Effect of different temperature levels on per cent adult emergence of *C. cephalonica*.

The data (Table 4) on effect of different temperature levels on the adult emergence of *C. cephalonica* revealed that significantly lowest adult emergence was noticed at 20 ^{0}C temperature (69.00 per cent) and significantly highest adult emergence was observed at 30 ^{0}C temperature (87.41 per cent). Allotey and Azalekar (2000) [2] found 83.7 per cent moth emergence of *C. cephalonica* on cow pea, 67.5 per cent on broken groundnut and 82.5 per cent on powdered bambara groundnut at 27.5 to 30 ^{0}C and 60-73 per cent RH. Bhandari *et al.* (2014) [6] found the moth emergence in *C. cephalonica* was highest of 94.67 per cent on millet millet + groundnut and lowest of 55 per cent on rice at 26 ± 2 ^{0}C temperature and 70 ± per cent RH.

Effect of different temperature levels on longevity of *C. cephalonica*.

The data (Table 4) revealed that higher male longevity (10.57 days) was observed at 20 ^{0}C temperature and it was at par with male longevity recorded at 25 ^{0}C temperature (10.31 days). The significantly shorter longevity of *C. cephalonica* was recorded at 35 ^{0}C (7.24). The significantly longer female longevity (12.47 days) recorded at 20 ^{0}C temperature and shortest female longevity (9.28 days) at 35 ^{0}C temperature. (7.24). In general, highest longevity (13.20 days) was observed at

20 ^{0}C temperature and shortest (11.34 days) at 35 ^{0}C temperature. Shazali and Smith (1986) [24] observed adult longevity of *C. cephalonica* male and female of 7.5 days and 11.2 days, respectively at 25 ^{0}C and 70 per cent RH. When

reared on sorghum. Allotey and Azalekar (2000) [2] reported the adult longevity of *C. cephalonica* ranged from 1.5 ± 0.5 to 11.9 ± 1.3 days for males and 1.5 ± 0.5 to 16.5 ± 1.2 days for females at 27.5-30 ^{0}C temperature and 60-73 per cent RH. These results are in line with the results obtained in the present investigation.

Table 4: The per cent adult emergence, life-cycle duration and longevity of *C. cephalonica* at different temperature levels

Temperature Levels	Per cent adult emerge-nce	Life-cycle duration (days)			Longevity (days)		
		Male	Female	General	Male	Female	General
20 ^{0}C	69.00 (56.22)*	70.08	72.20	71.13	10.57	12.47	13.20
25 ^{0}C	81.16(64.27)	63.02	64.40	63.32	10.31	11.26	12.23
30 ^{0}C	87.41(69.25)	57.20	59.40	58.05	9.65	11.70	12.30
35 ^{0}C	81.97(64.92)	50.20	50.20	50.38	7.24	9.28	11.34
S.E +	1.36	0.81	0.9	--	0.19	0.18	--
C.D at 5%	4.08	2.42	2.76	--	0.59	0.54	--
C.V. (%)	3.81	3.01	3.35	--	4.67	3.64	--

Figures in parentheses indicate arcsine transformed values.

Effect of different temperature levels on pre-oviposition period of *C. cephalonica*

The data (Table 5) revealed that significantly highest pre-oviposition period (3.29 days) was recorded at 20 ^{0}C the lowest pre-oviposition period (2.52 days) was observed at 35 ^{0}C however, it was at par with pre-oviposition period recorded at 30 ^{0}C temperature (2.60 days). Osman *et al*. (1983) [18] observed the pre-oviposition period of *C. cephalonica* was 2.6, 2.5 and 2.9 days at 28 ± 1 ^{0}C, 30 ± 2 ^{0}C and 32 ± 1 ^{0}C, respectively. Jagdish *et al*. (2009) recorded the pre-oviposition period of *C. cephalonica* was 1-2 days on foxtail millet.

Effect of different temperature levels on oviposition period of *C. cephalonica*

The data (Table 5) revealed higher oviposition period (7.20 days) was recorded at 20 ^{0}C temperature and it was at par with oviposition period recorded at 25 ^{0}C temperature (6.80 days). The significantly shorter oviposition period (4.84 days) was recorded at 35 ^{0}C temperature. Osman *et al*. (1983) [18] recorded the oviposition period of *C. cephalonica* was 3.3, 3.7 and 2.6 days at 28 ± 1 ^{0}C, 30 ± 2 ^{0}C and 32 ± 1 ^{0}C, respectively. Jagdish *et al.* found that 6-8 days oviposition period *C. cephalonica* on foxtail millet was 2.6, 2.5 and 2.9 days at 28 ± 1 ^{0}C, 30 ± 2 ^{0}C and 32 ± 1 ^{0}C, respectively.

Table 5: The pre-oviposition, oviposition and fecundity per female of *C. cephalonica* at different temperature levels.

Temperature Levels	Pre-oviposition period (days)	Oviposition period (days)	Fecundity / female
20 ^{0}C	3.29	7.20	190.60 (13.82)*
25 ^{0}C	2.90	6.80	218.00(14.70)
30 ^{0}C	2.60	5.94	243.60(15.60)
35 ^{0}C	2.52	4.84	250.55(14.19)
S.E. +	0.10	0.18	10.82
C.D. at 5%	0.30	0.56	N.S.
C.V. (%)	7.93	6.82	11.35

* Figures in parentheses indicate square root transformed values

Effect of different temperature levels on fecundity of *C. cephalonica*.

Numerically the lowest fecundity (Table 5) was observed at 20 ^{0}C (190.60 eggs per female) temperature and highest fecundity (250.55 eggs per female) was recorded at 35 ^{0}C temperature. Osman *et al.* (1983) [18] observed the fecundity of *C. cephalonica* to the extent of 105.4 eggs per pair at 30 ± 2 ^{0}C and 68 ± 2 per cent RH. They also reported 83.7 eggs per pair at 28 ± 1 ^{0}C temperature and 68 ± 2 per cent RH. Bhandari *et al.* (2014) [6] observed fecundity of 192.7 eggs when *C. cephalonica* reared on millet and 192 eggs when reared on wheat at 26 ± 2 ^{0}C temperature and 70 ± 5 per cent RH. Mehendale *et al.* (2014) [16] found that the significantly maximum fecundity of *Corcyra cephalonica* was 611.54 eggs per female when reared on sorghum + groundnut + powdered yeast and the lowest fecundity of 368.89 eggs per female was recorded on sorghum alone at 26 ± 2 ^{0}C and 66 ± 13 per cent RH.

References

1. Allotey J. Development and fecundity of the rice moth *Corcyra cephalonica* (Pyralidae). Discovery and Innovation. 1991; 3:123-126.
2. Allotey J, Azalekor W. Some aspects of the biological and control using botanicals the rice moth, *Corcyra cephalonica* (Stainton) on some pulses. J stored Prod. Res. 2000; 36(3): 235-243.
3. Allotey J, Kumar R. Competition between two moths *Corcyra cephalonica* (Stainton) and *Ephestia cautella* (Walker) in cocoa beans. Insect science and its application. 1985; 6: 627-632.
4. Ashwini Kumar S, Maninder S, Brar KS. Development of *Corcyra cephalonica* (Stainton) on different foods. M.Sc. Thesis. Punjab Agriculture University, India, 2002.
5. Atwal AS. Agricultural pests of India and South East Asia, Kalyani Publisher, Delhi, 1976, 502.
6. Bhandari G, Regmi R, Shrestha J. Effect of different diets on biology of *Corcyra cephalonica* (Stainton) under laboratory condition in Chitwan, Nepal. Int. J Appl. Sci. Biotechnol. 2014; 2(4):585-588.
7. Carmona MM. An entomofauna dos productos armazendes *Corcyra cephalonica* (Stainton) *Estudes ensaiose* documentos 55, Ministerio do Ultrama Lisboa, 1958.
8. Cox PD, Crawford LA, Gjestrud G, Bell CR, Bowley CR. The influence of temperature and humidity on the life cycle of *C. cephalonica* (Lepidoptera: Pyralidae). Bull. Ent. Res. 1981; 71:171-181.

9. Dani A, Sharma N, Sehgal SS. The method of sexing pupae and adult of castor semilooper *Achaea janata*. Indian J Ent. Res. 1980; 3:186-190.
10. Howe RW. The rapid determination of intrinsic rate of increase of an insect population. Ann. Appl. Biol. 1953; 40:134-155.
11. Hugar PS, Adavani YN, Havaldar Udikeri SS. Effect of temperature and humidity on stage wise longevity of rice moth Kamataks. J Agric. Sci. 1997; 10(3):860-881.
12. Jagadish PS, Nirmala P, Rashmi MA, Hedge JN, Nangia N. Biology of rice moth, *Corcyra cephalonica* (Stainton) on foxtail millet *Setaria italica* (L.). Karnataka. Journal of Agricultural Science. 2009; 22:674-675.
13. Karmel AH, Hassanein MH. Biological studies on *Corcyra cephalonica* (Stainton) (Lepidoptera: Galleriidae). Bulletin Societe Entomologie d'Egypte. 1967; 51:1-8.
14. Krishnamurthy A, Nagarkatti S. A mass rearing technique for *Corcyra cephalonica* Banks. J Ent. Res. 1981; 5(1):93-98.
15. Malhotra I, Rose HS, Dhillon SS. Effect of three dry fruits on the post embryonic development of *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae: Galleriinae). Ann. Entomol. 1987; 5(2):21-23.
16. Mehendale SK, Patel MB, Shinde CU. Evaluation of different Rearing Media for *Corcyra cephalonica* (Stainton) Under Laboratory Condition. The Bioscan 2014; 9(1):259-264.
17. Manoharan V, Balsubramanian M. Host parasitoid density response to fecundity of *Chilonus blackburni* Proc. Ind. Nation. Acad. 1982; 48(2): 214-217.
18. Osman NB, Wright VF, Mills RB. The effect of temperatures on certain aspects of the biology of *Corcyra cephalonica* (St,). In: Proc. of the Third International Working Conference on Stored Product Entomology. 23 - 27Aug. 1983. Manhattan, Kansas, U.S.A, 1983.
19. Panomkorn-Phermpoon. Studies on biology and effect of gamma radiation on the growth and development of rice moth *C. cephalonica* Bankok (Thailand) (M.S. in Agriculture) 1980, 66 leaves.
20. Parameshwar H, Jairao K. Effect of Temperature and Humidity Combinations on incubation and hatching of the rice moth, *Corcyra cephalonica* (Stainton) Egg (Lepidoptera: Galleriidae) Karnataka J Agric. Sci. 1990; 3(3&4):195-199.
21. Prasad J, Pawar AD, Sharma RK. Bio-control traits with an exotic egg larval parasitoid *Chelonus blackburni* Cameron on *Heliothis armigera*. J Adv. Zool. 1982; 3(2):160-161.
22. Ray R. Life-table and intrinsic rate of increase of *Corcyra cephalonica* Stainton on maize. Environment and Ecology. 1994; 12(1):202-204.
23. Ray R, Shi N, Patnaik HP. The life-tables and intrinsic rate of increase of *Corcyra cephalonica* (Stainton) on jowar. Orissa J agric. Res. 1990; 3(1):22-26.
24. Shazali ME, Smith RH. Life history studies of externally, feeding pest of stored sorghum Corcyra *cephalonica* (Stainton). J Stored Products Res. 1986; 22(2):55-61.
25. Shrivastava RP, Pande YD. Bionomics of the castor semilooper in Rajasthan. Ann. Arid Zone. 1966; 5:262-264.