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Development of Rice Meal Moth, *Corcyra cephalonica* Stainton (Lepidoptera : Pyralidae) on Proso Millet (*Panicum miliaceum* L.)

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Abstract

The average pre-oviposition and post-oviposition periods of *Corcyra cephalonica* Stainton on proso millet were 1.35 and 2.5 days, respectively. The average duration of egg, larva and pupal periods were 4.84, 33.67 and 12.34 days respectively. The average longevity recorded was 9.66 days in unmated males, 6.63 days in mated males, 11.33 days in virgin females and 9.33 days in mated females without food. A predominance of female over male was evident (1.70 ; 1 and 1.51 : 1, respectively) both in laboratory cultures and from the collections in godowns. The whole process took 60 to 120 minutes. The fecundity varied from 90 to 250 with a mean of 163.33 eggs per female.
Key words : *Corcyra cephalonica,* Proso millet, Biology.

Proso millet, *Panicum miliaceum* (L.) is a small millet and quick growing crop, particularly suited to a dry continental climate. This is widely grown in USSR, Central Asia, Arabia, Iran, Iraq and Afghanistan, constituting a staple food. Proso millet grains are commonly infested by store pest like the rice meal moth *Corcyra cephalonica* Stainton which is also known to infest cereals like rice, wheat, ragi, maize, sorghum, millets, oil seeds like groundnut, sesamum and oilcakes, cottonseed and pulses like red gram. black gram, cowpea, with a wide distribution in tropical and subtropical countries (1). Stainton (2) first described the adult rice moth from the specimen recorded on dried currants and named it as *Melissoblaptes cephalonica* Later, new genus *Corcyra* was erected by Ragonot (3) to accommodate this insect. Rice moth is recorded not only in India but throughout the world. The first record of its occurrence in India was by Ramaprishna Ayyar (4). Some workers observed that *C. cephalonica* was a secondary pest, which needing damaged grain for successful establishment (5). There have been no reports of this pest on proso millet even though their incidence is noticed. Since millets are important crops in certain regions and serve as food security for the population. It was felt essential to work out basic studies on this pest which would pave way in developing a management program. A study was undertaken to study the biology of *Corcyra cephalonica* on proso millet.

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Methods

Five grams cleaned broken proso millet grains each were placed in 50 cleaned glass tubes (8 cm × 2 cm) Into these tubes freshly hatched first instar larva one per each was introduced by using camel hair brush, from petridish in which eggs was kept for hatching. The open end of the tube was closed with cotton plug.

Observations on durations of different larval instars and pupal period were made in respect of all the enclosed larvae. Observations recorded from a day after introduction of larva into tubes. The larvae started forming grain cluster around them and started feeding inside the grain cluster. Therefore, every day three grain clusters were dissected and observed to note the stage of the larva until completion of the developmental period, commencing from the day of release. Thirty tubes were maintained till the end of observation. Measurements of dimensions on length and breadth of egg, larvel head capsule width, thorax and body length were recorded, using calibrated ocular micrometer mounted on sterco binocular microscope.

Table 1. Duration of different life stages of *C. cephalonica.*

Stages	Range (days)	Mean ± SD (days)
Egg	4—7	4.84 ± 0.84
Larval instars		
I	4—6	4.5 ± 0.40
II	6—7	6.5 ± 0.408
III	4—5	4.33 ± 0.55
IV	3—5	3.83 ± 0.849
V	3—5	4.0 ± 0.816
VI	8—10	8.83 ± 0.849
Total larval period	29—37	33.67 ± 3.399
Pupal period	9—16	12.34 ± 2.867

Table 2. Dimensions of head capsule, thorax and body length of different larval instars and pupae.

Stages	Length (mm)	Width (mm)	
Egg	0.50—0.70 (0.6)	0.30—0.40 (0.35)	
Larval instars	Head capsule width (mm)	Thorax width (mm)	Body length (mm)
I	0.25	0.17	1.29
II	0.30	0.40	2.64
III	0.41	0.80	4.11
IV	0.61	1.07	7.32
V	0.82	1.34	9.52
VI	1.07	1.51	10.94
Pupa	0.86	0.95	10.57

Ovipositional Studies

Newly emerged moths obtained from the mass culture were sexed based on the difference in the labial palpi which is elongated and snout like projection, in females and blunted in males (1). A pair of moth was enclosed in a glass vial (8 cm long × 3 cm diameter) and the open end closed with cotton plug. Observations on mating period, pre-ovipositional and ovipositional period and post ovipostional period were recorded. Number of eggs laid per female was recorded till egg laying ceased or till the death of the female moth. In all, 15 pairs were enclosed separately in 15 tubes.

Adult Longevity

The ability of the adults of *C. cephalonica* to live in the presence and absence of food was determined by enclosing male and female moths obtained from culture separately; 15 glass vials were maintained for both unmated and mated males and females to test longevity. Fifteen such vials were maintained for each of the females without food to record longevity and fecundity of females. Similarly another set of 15 vials enclosed with freshly emerged females, each was set up with 50% honey solution as food. Adult longevity and number of eggs laid per female were recorded for those female moths provided with food. Temperature and relative humidity prevailing in the laboratory were recorded. It ranged from 25 to 30 C and 68 to 75%, respectively.

Sex Ratio

Adult sex ratio of *C. cephalonica* obtained from the laboratory culture maintained and from those occurring naturally in the godowns (National Seed Project, UAS,GKVK, Bangalore) was determined. In culture maintained in the laboratory 25 adults were randomly picked and sexed based on the difference in the labial palpi by (1). Similarly, 25 adults collected from godowns and were sexed and sex ratio was determined. It was worked out based on ratio of number of females to males.

Results and Discussion

Detailed investigation on the biology of the rice meal moth. *C. cephalonica* was carried out on stored broken proso millet from August 2007 to December 2007. The results of the studies are presented below.

Eggs

Freshly laid eggs were glistening pearly white in color with rough, irregularly sculptured surface, divided into small uneven areas. The eggs was small pearly, some what elliptical, with blunted at rounded ends and eggs posseessed a minute nipple like protuberance at one end. Prior to hatching, the bright color got slightly dim and assumed a slight touch of yellow on third day which developed into a dirty shade on the day of hatching or fourth day. Hatching usually took place in the night or early morning hours.

Table 3. Duration of different parameters of biology and sex ratio of *C. cephalonica.*

Duration	Range	Mean ± SD
Total developmental period (Egg + larva + pupa) days	40—58	40.95 ± 2.68
Mating period (minutes)	60—120	83.33 ± 26.24
Preovipositional period (days)	1—2	1.35 ± 0.32
Ovipositional period (days)	5—8	6.6 ± 1.247
Post oviposition period (days)	2—3	2.5 ± 0.408
Adult longevity (days)		
Virgin males	8—12	9.66 ± 1.699
Mated males	5—7	6.63 ± 0.942
Sex ratio (female : male)		
Laboratory culture	1.51 : 1 ± 1.31	
Godown culture	1.70 : 1 ±1.30	

Table 4. Effect of adult feeding on fecundity and longevity of *C. cephalonica.*values are mean of 15 replications.

	Total fecundity (number of eggs per female)		Longevity (days)	
	Range	Mean±SD	Range	Mean ±SD
Females provided with 50% honey solution	225–250	236±10.27	7–13	9.6±2.48
Females not provided with any food	80–220	160 ±58.57	3–18	9.33±6.34

The larvae eventually emerged by biting through the chorion with its dark mandibles and emerged from the ragged hole bitten at the side of egg through which the head was forced out. The larva took nearly quarter of an hour to work its way to come out. When larva emerged out from egg shell, the empty egg shell collapsed, became wrinkled and white in color. The incubation period ranged from 4 to 7 days (mean 4.84 ± 0.84) days (Table 1). The egg measured 0.50—0.70 mm in its length (average 0.59 mm) and 0.30 to 0.40 mm in its width (average 0.35 mm), respectively (Table 2).

Freshly emerged larva was creamy white in color, head capsule yellowish white with brownish margin and the cervical shield was not very distinct but demarcated as a light yellowish area. The setae are whitish ; dorsal ones are longer than the width of the body. The first instar larva was active and moving in a crawling fashion. Second instar larva had slight color variation with pronounced thoracic shield.

The duration of each larval instars and their dimensions are presented in Tables 1 and 2. These results are in conformity with earlier findings (12) which documented relatively shorter durations for first five instars and long last instar, respectively.

Pupa

The pupa was deep leathery brown in color and was enclosed in a cocoon. The cocoon was more or less elongate and thinly woven, with elliptical space at one end, which is the provision for the adult emergence. The white silken structure was covered with small and large proso millet grains, debris and excrement. After cocoon was spun, larva became inactive and shrinked in size. This pre-pupal condition lasted for a day or at most two. The female pupa was larger than male pupa. The pupal duration lasted 9 to 16 days with a mean of 12.34 ± 2.86 days (Table 1). The pupa measured 0.86 mm head capsule width, 0.95 mm thorax width and 10.57 mm body length (Table 2). The present study is in harmony with earlier reports (6—12).

Adults

The adults were comparatively small moths, exhibiting considerable variation in size. They were uniformly dark grey in color with a few dark hair lines. The sexes too were dissimilar in size, the females were ordinarily larger. The head was elongate and snout like projection of labial palpi in females whereas projection was less conspicuous and blunted in males. Longevity of adults is presented in Tables 3, 4 and 5.

Sex Ratio

In the present study a sex ratio (female : male) of 1.51 : 1 was recorded in laboratory cultures and 1.70 : 1 in the collections from godowns, indicating the predominance of female over male (Table 3). The adult moths were nocturnal and less active during the day. The sexes can be distinguished at rest, mainly by the differences in the head region and labial palpi.

Mating

Mating was observed during day time. The females began courtship 12 to 14 hours after adult emer-

Table 5. Effect of mating on fecundity and longevity of *C. cephalonica.* Values are mean of 15 replications.

	Total fecundity (number of eggs per female)		Longevity (days)	
	Range	Mean ± SD	Range	Mean ± SD
Virgin female	80—210	136±54.36	9—14	11.33±2.05
Mated female	90—250	163.33±65.99	8—15	10.66±3.09

gence, which lasted for an hour, when males were identified by darting or shaking their wings and frequently pair with females in a few minutes. Mating period observed ranged from 60 to 120 minutes with a mean of 83.33 ± 26.24 minutes (Table 3). Repeated mating between a pair was uncommon. The duration of pre-oviposition and post-oviosition are presented in Table 3. The present study shows *Corcyra cephalonica* larvae develops on proso millet in a period of 40—58 days and survives more than a week.

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