

BIOLOGY OF COCONUT MOTH, *BATRACHEDRA ARENOSELLA* WALKER (LEPIDOPTERA : BATRACHEDRIDAE) ON IMMATURE NUTS OF COCONUT IN INDIA

C. Prashantha^{1#*}, T. Shivashakar² and A. K. Chakravarthy³

¹Department of Agricultural Entomology, UAS, GKVK, Bengaluru - 560 065, India.

²College of Agriculture, Mandya, India.

³Division of Entomology and Nematology, Indian Institute of Horticultural Research, Bengaluru - 560 089, India.

*e-mail: prashanthpachy@gmail.com

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ABSTRACT : Larvae of coconut moth, *Batrachedra arenosella* Walker (Lepidoptera : Batrachedridae) were found damaging premature nuts of coconut for the first time in India. The feeding resulted on an average of 20% loss of nuts in Mysore and Mandya districts of Karnataka, South India. The mean egg incubation period was 2.95 ± 0.55 days. Larval stage comprised four instars and the mean duration of first, second, third and fourth instar larvae were 2.55 ± 2.50 , 2.75 ± 0.35 , 3.40 ± 0.57 and 4.10 ± 0.61 days, respectively. Total larval period varied from 11 to 14 days, with an average of 12.80 ± 1.01 days. Mean pupal period was 7.20 ± 0.86 days. The total developmental period occupied 22.95 ± 1.17 days. Adult females lived longer (6.50 ± 1.20 days) than males (5.50 ± 0.78 days). The study indicated that *B. arenosella* has more than one generation a year. Short life cycle, presence of adults and larvae throughout the year in an overlapping manner and a perennial host characterizes *B. arenosella* to be an economically important pest.

Key words : Coconut, *Batrachedra arenosella*, coconut moth, biology, India.

INTRODUCTION

The coconut palm, *Cocos nucifera* L. (Arecaceae) has been variously described as “the tree of heaven”, the ‘*Kalpavriksha*’ because of its great versatility and multiple uses of its different parts. Farmers in India are facing the major problem of shedding of immature nuts or buttons in coconut garden. This might be due to physical factors, drought, nutrient deficiencies and insect pests (Rajapakse, 1995). In recent times, an insect is responsible for the immature nut fall which has now been identified as coconut moth, *Batrachedra arenosella* Walker (Lepidoptera: Gelichoidea: Batrachedridae).

Batrachedra arenosella is geographically distributed in India, Indonesia, New Zealand and Australia, from the Northern Territory and Northern Queensland to New South Wales and South Australia, Guianas, Congo, the Malay Peninsula, Indonesia, New Guinea, Melanesia and Tasmania (Walker, 1864b). However, Nirula (1955) reported that the moth is found in India only. Other plant species attacked are *Elaeis* and *Arecastrum*, the caterpillars have also been found in fallen oranges, grains of *Juncus* and the fungus *Protuberata*.

Nirula (1955) reported that the larvae of coconut moth *B. arenosella* are often found gnawing the flowers of coconut and the latter frequently develop a distinctly black appearance. Corbett (1932) recorded 65 per cent loss of

[#]Present address: Regional Plant Quarantine Station, Chennai, India.

female flowers due to *B. arenosella* in certain areas of Malaya peninsula. Though, *B. arenosella* is reported as a pest on coconut flowers, its damage on premature nuts is not reported, although it is becoming increasingly visible in South India. The consolidated work on this emerging pest on coconut in India is lacking. So a study on the biology and damage of the insect *B. arenosella* on coconut was initiated.

MATERIALS AND METHODS

The incidence of the pest in coconut plantations at Mysore and Mandya were recorded in 50 selected coconut plantations having Tiptur and Arasikere tall local cultivars during September and October 2012. Detailed biology of coconut moth was studied on immature coconuts under laboratory conditions at College of Agriculture, Mandya. During the period of investigation mean maximum and minimum temperatures recorded in the laboratory were 33.5°C and 18.5°C, respectively with mean relative humidity of 62.5 per cent. To study the biology, a large numbers of fallen nuts were collected from several coconut plantations in Mysore and Mandya districts of Karnataka. The nuts collected were taken to the laboratory for initiating and maintaining laboratory culture. These nuts bracts were carefully opened by holding the immature nuts vertically and inspected for the presence of larvae or pupae of *B. arenosella*. The immature nuts with the caterpillars of *B. arenosella* were

kept individually in plastic containers with lid (20 cm diameter). Tissue paper was at the base to absorb excess moisture released by the fruit to avoid contamination of saprophytic microorganisms. These containers were observed daily until the adult emergence. The insect exhibited sexual dimorphism. Females were always larger than males.

Ten pairs (10 male and 10 female) of freshly emerged adults were released into the insect rearing cage (35 × 45 × 20 cm) with freshly harvested immature nuts (8-10 cm diameter) for mating and oviposition. Cotton wads soaked in 10 per cent honey solution served as food for the adults. After one or two days, bracts from each nut was carefully dissected and observed under stereo binocular microscope for eggs or larvae. After hatching the neonate larva were placed individually on freshly harvested nuts (8-10 cm diameter) using camel hair brush. This nut was kept in a plastic container (10 cm dia) with ventilation and tissue paper at the base. Daily observations on the larval growth were made at 12 hr intervals. The length, width and the head capsule of the caterpillar was measured using an ocular micrometer attached to the stereomicroscope and life stages were also recorded.

The freshly emerged adult specimens were carefully pinned and stretched using wood and cork mounting board for 3-4 days. Ten such specimens in formalin solution were submitted to Department of Entomology, Punjab Agricultural University, Ludhiana and Jones estate, Bhimthal, Uttar Pradesh for identification of coconut moth.

RESULTS AND DISCUSSION

The larvae of the moth were found feeding on immature nuts in coconut plantations at Mysore and Mandya. A survey of 50 plantations in Mandya and Mysore during September-October 2012 revealed that the larvae on an average caused damage to 20% nuts (n=50) which failed to develop into matured nuts. The damaged nuts were rendered unsuitable for marketing. Nirula (1955) observed larvae gnawing of only flowers of coconut. Indeed this becomes the first report of the insect causing economic loss to coconut.

The eggs were deposited singly on the cracks of the coconut perianth. The freshly laid eggs of *B. arenosella* were white, flat and translucent, later the eggs turned to light yellow. The corium was cross linked with tiny circles on its surface and was hexagonally reticulate. The incubation period in laboratory varied from 2.00 to 3.50 days, with an average of 2.95 ± 0.55 days (Table 1). These results were in agreement with earlier workers, viz. Taylor (1930) and Corbett (1932). Similar results were recorded on *Batrachedra nuciferae* by Soto (2004).

During larval period, the caterpillar moulted thrice resulting in four larval instars. The head capsule width of neonate larvae to last instar increased in a regular geometrical progression in successive instars by 1.4 times *i.e.*, from first instar (0.20 mm) to fourth instar (0.60 mm).

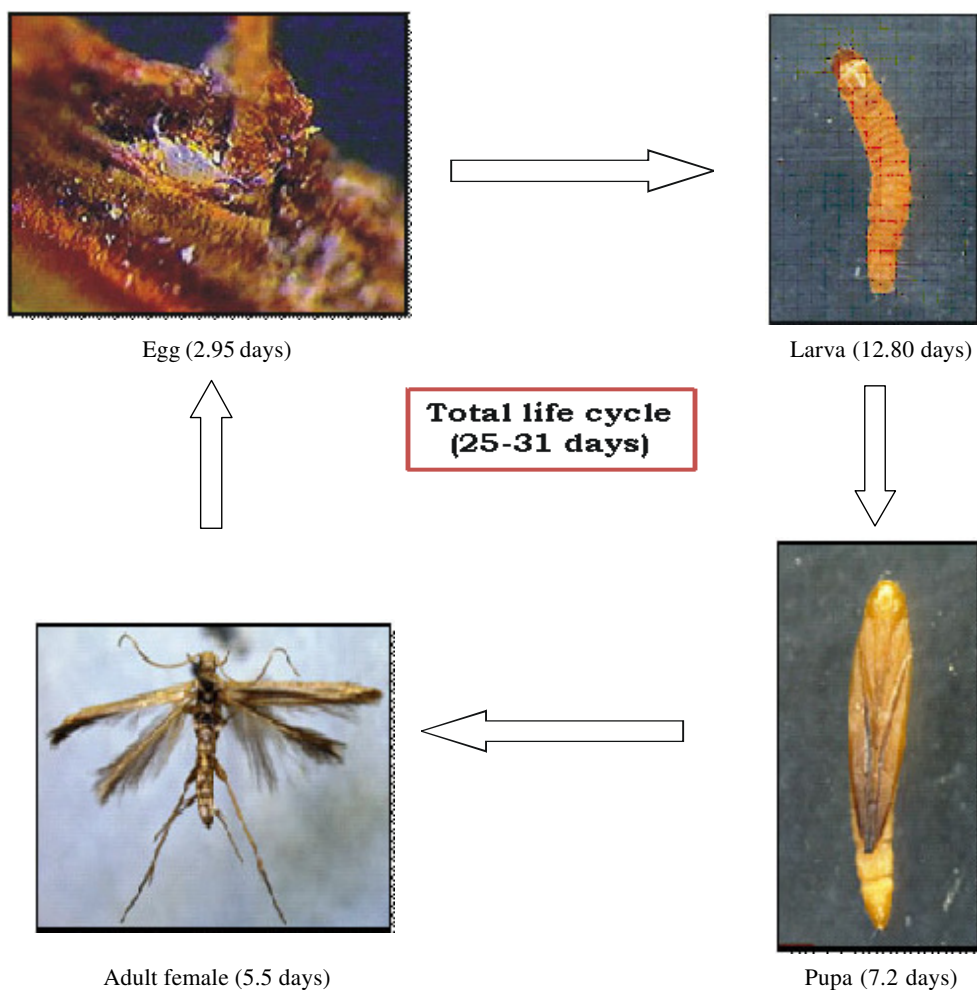
The newly hatched larvae were minute, light creamy white with black head. Head and prothorax were wider than the rest of the body. Soon after hatching, the neonate larvae were active and started feeding on mesocarp of the immature nuts below the perianth by forming a silken web with excretory pellets. The first instar larval duration ranged from 2.00 to 3.50 days with an average of 2.55 ± 0.50 days (Table 1).

The second instar larvae differed from the first in size and colouration. Larvae had light brown coloured head and prothorax and the body was orange. These larvae were always found within the silken strands with faecal pellets. The second instar larval duration ranged from 2.50 to 3.50 days with an average of 2.75 ± 0.35 days (Table 1).

The third instar larvae differed markedly from first and second in having a dark brown head. The caterpillar body was pinkish to brownish. When the larva is disturbed it gets alerted and makes rapid movements. These larvae also feed under silken stands covered with faecal pellets. The third instar larval duration ranged from 2.50 to 4.00 days with an average of 3.40 ± 0.57 days (Table 1).

The fourth instar larvae were brownish with dark brown head and distinct thoracic shield, with tubercles arising conspicuously. These larvae were more or less cylindrical in shape, tapering towards ends. Head was distinctly smaller than thoracic shield, mandibles were prominent. Prolegs were located on third to sixth abdominal segment and anal prolegs located on 10th abdominal segment. Larvae were generally less active than previous stages. The larvae were photophobic and avoided the sunlight and searched for a dark area when exposed to light. Full grown larva concealed itself and fed under the silken web intermingled with faecal pellets. The larva ceases feeding for a day before entering the pupal stage. Larvae actively located cracks and crevices and concealed for pupation. The duration of fourth instar larvae ranged from 3.00 to 5.00 days, with an average of 4.10 ± 0.61 days. Total larval period ranged from 11.00 to 14.00 days with an average of 12.80 ± 1.01 days (Table 1).

The average head capsule width was 0.20 ± 0.03 , 0.29 ± 0.03 , 0.42 ± 0.05 and 0.45 ± 0.65 mm, respectively for the four successive larval instars of *B. arenosella*. The mean head capsule width of the caterpillars was



Life cycle of *B. arenosella*.

Table 1 : Duration of life stages of coconut moth, *B. arenosella*.

Insect stages	Duration (days)	
	Range	Mean ± SD
Incubation period	2.00-3.50	2.95±0.55
I instar	2.00-3.50	2.55±0.50
II instar	2.50-3.50	2.75±0.35
III instar	2.50-4.00	3.40±0.57
IV instar	3.00-5.00	4.10±0.61
Total larval period	11.00-14.00	12.80±1.01
Pupa	6.00-8.50	7.2±0.86
Total developmental period	20.50-24.50	22.95±1.17
Adult male longevity	4.50-6.50	5.50±0.78
Adult female longevity	5.00-8.50	6.50±1.20

n = 20

0.20 mm to 0.60 mm from first instar to fourth instar respectively with mean growth ratio of 1 : 1.4. Soto (2004), reported three larval instars of *B. nuciferae* with mean growth ratio of 1.76 ± 0.03 . Such differences could be due to differences in the species and or due to geographical variations in temperature, food and other

factors that play an important role in deciding different instars as mentioned by Parker (1930).

Pupa

The freshly formed pupa was cream coloured, after two to three days it turned to dark brown. The pupa was enclosed in an oval shaped white silken cocoon covered with faecal pellets and frass. After the cocoon was spun larvae became inactive and shrunken. It pupated in the corners of the rearing boxes, on the perianth of the nuts and on the stalk of the nuts. Pupal period lasted for 6.00 to 8.50 days, with an average of 7.2 ± 0.86 days (Table 1). The present study confirmed the findings of Corbett (1932), who recorded 6 to 8 days of pupal duration from Malaya but differed from Taylor (1930) who reported 9 to 11 days.

Total developmental period

The total developmental period of *B. arenosella* varied from 20.50 to 24.50 days, with an average of 22.95 ± 1.17 days (Table 1). Corbett (1932) reported that the total developmental period of *B. arenosella* ranged from

Table 2 : Morphometrics of life stages of coconut moth, *B. arenosella*.

Stages	Length (mm)		Width (mm)		Head capsule width (mm)		Ratio
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD.	
Egg	0.35 -0.48	0.42 \pm 0.04	0.28 - 0.33	0.30 \pm 0.02	-	-	-
I instar	0.75 - 2.04	1.44 \pm 0.42	0.13 - 0.25	0.19 \pm 0.05	0.15-0.25	0.20 \pm 0.03	-
II instar	2.12 - 4.30	2.96 \pm 0.82	0.25 - 0.50	0.38 \pm 0.07	0.26-0.37	0.29 \pm 0.03	1.45
III instar	3.75 - 6.20	4.67 \pm 0.95	0.40 - 0.75	0.56 \pm 0.11	0.35-0.50	0.42 \pm 0.05	1.44
IV instar	5.50 - 8.50	7.62 \pm 0.93	0.85 - 1.35	1.10 \pm 0.18	0.45-0.65	0.60 \pm 0.06	1.42
Pupa	4.50 - 6.40	5.70 \pm 0.61	0.85 - 1.30	1.11 \pm 0.15	-	-	-
Adult male	3.75 - 4.40	4.02 \pm 0.22	8.00 - 9.50	8.76 \pm 0.51	-	-	-
Adult female	4.00 - 4.90	4.50 \pm 0.30	9.0 - 11.5	10.0 \pm 0.90	-	-	-

n = 20

13 to 19 days in Malaya. It was 24 to 28 days in Fiji and Lever (1969) found that total developmental period of *B. peroptusa* was 15 to 18 days. Such variations in the above results could be attributed to differences in species involved or due to geographical variations in temperature and the host plant.

Adult

B. arenosella moth was tiny, exhibiting considerable variations in size. Adults had straw coloured forewings, speckled with dark grey and two conspicuous black spots. Hind wings had long fringes of hair like scales. Both the wings were narrow. The head was distinct with projection of labial palpi. The resting posture of adults was peculiar because it raised its anterior portion while forelegs were directed backwards. Adult males lived for a shorter duration which ranged from 4.50 to 6.50 days, with an average of 5.50 ± 0.78 days, while, adult female longevity ranged from 5.00 to 8.50 days with an average of 6.50 ± 1.20 days (Table 1). Similar findings were reported by Taylor (1930) and Soto (2004). Measurements concerning all life stages of *B. arenosella* are given in Table 2. Despite, little is known with regard to its biology and behavior, studies on the biology of coconut moth indicated that it has more than one generation in a year, as evidenced by the short life cycle, presence of adults and larvae throughout the year in a overlapping manner. The qualitative and quantitative loss estimation under high incidence is needed in further research, so by knowing its biology further it will helps in the management of this pest.

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