

BIOLOGY OF COCONUT WHITE GRUB *LEUCOPHOLIS*
CONEOPHORA BURM. (MELOLONTHINAE:
SCARABAEIDAE: COLEOPTERA)*

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ABSTRACT

Biology of the coconut white grub *Leucopholis coneophora* Burm. was studied in detail in field cages. Egg period 23 days. The mean larval durations were 260 and 270 days and pupal durations 25.3 and 25.7 days, for males and females, respectively. Sexes of beetles could be differentiated by size of antennal club. Adults emerged from soil at dusk for mating and returned to the soil in 23-25 minutes. Adults did not congregate on plants as done by many melolonthids and were not found feeding on vegetation.

INTRODUCTION

Among the insect pests of the coconut palm, the white grub *Leucopholis coneophora* Burm. is an important pest in Kerala and Karnataka. The grubs feed on the tender roots of the palm and affect the vitality of the palms and cause significant reduction in yield over the years. Adequate information on the biology of *L. coneophora* is not available. Nirula, Antony and Menon (1952) provided some information on the biology and bio-ecology of the insect. A comprehensive study on the biology of the pest was hence taken up and the results are presented in this paper.

MATERIALS AND METHODS

Beetles collected from an infested belt in Alleppey Dist., Kerala State were

used for starting a culture in laboratory. Mating pairs were collected in glass bottles half filled with moist soil and were brought to the laboratory. From these, one female and four males each were liberated in breeding cages, each consisting of 30 cm³ deal wood box filled to three-fourths with loamy soil passed through 20-mesh sieve and sterilized to eliminate fungi pathogenic to eggs of soil insects (Wightman and Flower, 1974). After releasing the beetles each cage was kept closed with a piece of nylon net held in position with a rubber band. The soil in the cage was passed through a 20-mesh sieve daily and the eggs caught in the sieve were kept in petridishes in batches of 5-10 covered with moistened soil. Water was sprinkled over the soil

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regularly to keep the same adequately moist throughout. Soon after hatching the grubs were transferred to garden pots and filled with soil and planted with sprouted groundnut seeds. At the end of the third day, when they were sufficiently grown up for handling, the grubs were collected from the pots and used for the experiments.

The pots used for rearing the grubs in the field were prepared by cutting the bottom. Twenty-mesh galvanised iron net cut into a circular disc was placed inside the pot at the bottom and the same was fixed to the rim with cement mortar. The pots were then kept buried to three-fourths in the soil in the open field. This facilitated the simulation of field conditions inside the pot while confining the grubs within the pots. The pots were then filled with loamy sandy soil.

Dehusked coconut having a tuft of fibres at the 'eyes' were planted in the above pots. Three months after the sowing of nuts the plants were used for rearing the pests.

For studying the biology three-day-old first instar grubs were released singly in the pots. When the plants in the pots wilted due to the feeding on roots the grubs were transferred to fresh plants which were potted earlier and were being maintained for the purpose. On reaching the prepupal stage, the grubs were transferred to fresh pots, half filled with soil. Each grub was placed in a small pit in the soil and was covered with an earthen dish over which further soil was added. This prevented the

formation of the earthen cell by the pupa and facilitated further observation on development. The pots were closed with nylon net held in position with rubber bands and buried to three-fourths in field. Emerging adults were maintained in egg laying cages each with one female and four males for observing their longevity and fecundity. The eggs collected from the egg laying chambers were allowed to hatch for assessing the viability of eggs.

Since the insect was being reared individually till the emergence of adults, the grubs destined to develop as males and females could be traced back and relevant data could be grouped separately.

RESULTS AND DISCUSSION

Eggs were seen laid in moist soil. Prior to egg laying the adult female extruded its vagina which helped to form bulbous egg chambers in soil. After laying one egg the vagina was withdrawn. This process continued till the egg laying was completed. Occasionally, eggs were seen in soil without any chamber also. Formation of egg laying chamber in soil was not reported in *L. coneophora* so far. Tashiro et al., (1969), Fleming (1972), Veeresh (1977) and Yadava (1981) had observed similar egg chambers in soil made by *Amphimallon majalis* (Razomowsky), *Popillia japonica* Newman, *Holotrichia serrata* Fabr. and *H. consanguinea* Blanchard, respectively.

Freshly laid eggs were white in colour with an yellow tinge, spherical, oval or elliptical, chorion smooth and coriaceous. As development progressed, colour of the egg changed to dirty white

and the mandibles of the developing embryo became visible as black spots. Chorion of the freshly laid egg was fragile and broke along the lower margin, if kept on dry surface. The length and width of the egg showed an increase up to nine days, and while the increase in weight reached its peak on the fifteenth day (Table I). Nirula (1958) also observed this phenomenon in *L. coneophora*. Fleming (1972) found that newly laid eggs of *P. japonica* contained 45-50 per cent water, while the water content increased up to 84 per cent at hatching. He observed that the increase in water content could be fully accounted for the increase in weight during the embryonic development.

Mean incubation period of 100 eggs was 23 days and nearly 95 per cent of the eggs hatched within this period.

The freshly hatched grubs were semitransparent, but within a day or two the colour became bluish white and

the head and appendages turned brown. First instar grubs started feeding 24 hours after emergence. On the first day of emergence they were inactive and only slight feeding was noticed on the egg shell. On coconut, they fed on the tender and soft terminal parts of the main roots. The head capsule width of first instar grub was 3.19 mm (range 3.13 to 3.34 mm). There was no marked difference between the body size, weight or duration of first instar grubs destined to become males and females.

At moulting to second instar, the grubs became cream coloured and soft. It was inactive during the first day after moulting and body gradually became more sclerotized. Mean head capsule width was 4.84 mm (range 4.37 to 5.21 mm). The second instar grubs fed on coconut roots.

The just moulted third instar grub was creamy white. The dorsal side of the proximal half of the abdomen had

Table I. Mean increase in length, width and weight of eggs of *L. coneophora* during embryonic development (Total 9 eggs)

		Days of development								
		1	3	6	9	12	15	18	21	23
Length (mm)	Maximum	4.80	4.96	5.28	5.92	5.92	5.92	5.92	6.08	6.08
	Minimum	4.32	4.48	4.80	5.28	5.28	5.28	5.28	5.28	5.60
	Mean	4.49	4.65	5.08	5.70	5.71	5.72	5.72	5.79	5.90
Width (mm)	Maximum	3.04	3.20	4.00	4.80	4.80	4.80	4.80	4.96	4.96
	Minimum	2.72	2.88	3.84	4.32	4.32	4.32	4.32	4.32	4.32
	Mean	2.95	3.02	3.89	4.55	4.56	4.58	4.60	4.62	4.64
Weight (g)	Maximum	0.0203	0.0205	0.0340	0.0445	0.0587	0.0715	0.0780	0.0795	0.0795
	Minimum	0.0173	0.0187	0.0305	0.0400	0.0505	0.0636	0.0635	0.0638	0.0641
	Mean	0.0194	0.0200	0.0326	0.0408	0.0553	0.0669	0.0694	0.0703	0.0718

brownish tinge, while the distal half is slate-coloured with a greyish tinge. They fed well on coconut roots. Feeding was confined to the soft tip of the root up to 10 cm from the distal end. Mean width of head capsule was 7.1 mm (range 7.08 to 8.13 mm). Grubs bite strongly with mandibles when handled. A black fluid also was ejected through mouth while biting. The grubs coming in contact fought among themselves often leading to the death of all of them. The grubs moved in tunnels using their legs or on their back. When kept out of soil they moved on their back only.

The full grown grub turned deep yellow. They then stopped feeding, constructed a boat shaped chamber in soil. Walls of the chamber were smooth and firm. Grubs lay on their back and became inactive. The body then gradually shrunk, intestinal content was voided and it entered the prepupal stage. The prepupa was deep yellow and it changed into the pupa in 4 to 8 days. Mean larval period extended to 260 days (range 249 to 269 days) for males and 270 days (range 257 to 281 days) for females.

The three larval instars could be distinguished by the difference in head capsule width and body size. The difference in head capsule widths could easily be made out by visual observations also. By applying Dyar's law the ratio of head capsule width between the second and first instar and third and second instar grubs were 1.51 and 1.58, respectively. There was no significant difference in the size of head capsule of the first and second instar grubs of

male and female insects. But in third instar stage the male grubs were significantly shorter and weighed just half that of female (Table II). Sekhar (1958) and Nirula (1958) had given a brief description of the first and third instar grubs of *L. coneophora* collected from the field. The measurements reported by these authors showed slight variations from those of the present studies. This can be due to the fact that the earlier workers had recorded the measurements from field collected grubs and hence the actual age of the grubs might not have been known.

Fresh pupa was light brown in colour and as development progressed the colour gradually turned to deep brown. A few days before emergence of the beetle, the pupa became blackish brown. Pupa was exarate and lay on its back in the earthen pupal chamber. Size and weight of male pupa was less than those of female pupa. However, there was no major difference between the pupal periods of the two sexes.

Total life period of male from egg to emergence of adult was 308.3 days (range 295 to 317 days) and of female 318.7 days (range 304 to 333 days).

The body of the newly emerged beetle was soft and greyish white in colour. In 3 to 4 days body became hardened and the colour turned deep greyish brown and head black. Female was bigger than the males in body size and weighed almost double. However, the adult longevity of both sexes was around 42 days. Mean pre-oviposition period was 34.8 days and mean number of eggs laid was 18.5.

Table II. *Duration, body size and weight of different life stages of L. coneophora reared on coconut*

Stage	Male				Female			
	Duration (days)	Length (mm)	Width (mm)	Weight (g)	Duration (days)	Length (mm)	Width (mm)	Weight (g)
First instar grub	34-46 (40.3)	13-15 (14.6)	2.75-3.20 (2.95)	0.0469-0.0680 (0.0574)	38-51 (40.09)	13-17 (14.8)	2.7-3.2 (2.99)	0.0447-0.0634 (0.0592)
Second instar grub	45-60 (51.56)	22-27 (24.85)	3.5-6.0 (5.5)	0.36-0.605 (0.4890)	40-57 (51.6)	22-27 (24.75)	5-7 (5.7)	0.371-0.708 (0.4781)
Third instar grub	155-173 (168.1)	42-52 (48.8)	13-15 (13.9)	2.67-4.98 (3.42)	164-189 (177.5)	52-60 (56.3)	15-17 (16.3)	4.78-6.65 (5.68)
Pupa	23-29 (25.3)	30-34 (31.3)	14-17 (15.0)	2.06-2.63 (2.35)	23-29 (25.7)	34-38 (35.5)	16-18 (16.8)	3.85-4.63 (4.28)
Adult	36-50 (42.3)	26-28 (26.8)	12.5-16.0 (13.6)	1.34-2.10 (1.69)	37-50 (42.6)	27-32 (30.9)	13-18 (16.9)	2.72-4.21 (3.16)

Figures in parentheses are mean values of ten individuals of each sex

In earlier descriptions of the adults of *L. coneophora*, Nirula (1958) attempted to differentiate the two sexes on morphological characters. He had pointed out the difference in shape of the tibial spur of the hind legs as a reliable character for differentiating the sexes. In the case of *L. irrorata* (Lopez, 1931) and *Amphimalon majalis* (Tashiro et al., 1969) differences in the morphology of antennae were suggested as reliable means for separating the sexes. In *L. coneophora* it was observed that sexes could easily be separated on the basis of size of the antennal club. Mean length of antennal club of 10 males was 2.55 mm (2.52-2.58mm) and thrice as long as its width 0.803 mm (0.802-0.804

mm), whereas in the case of 10 females it was 1.62 mm long (1.58 to 1.64 mm) and twice as long as its width 0.86 mm (0.83-0.88 mm).

Emergence of adults commenced with the pre-monsoon showers in April/May. The males emerged first. They came up pushing the soil outwards and remained for a short time with the head and prothoracic legs protruding from the soil surface, facing the sky. The antennae were also held in erect position with the lamellae stretched out. Gradually they came out of the soil and took to wings with a 'buzzing' sound, leaving a circular emergence hole of about 12-14 mm in diameter on the

surface. Numerous such holes could be noticed on the ground during the emergence season in infested areas. Males seldom flew or made such emergence holes. They remained in soil with their antennae and part of the head protruding.

Sex ratio of male to female collected from field was 1:0.099 and ratio observed in the present study was 1:0.734. This variation is due to the fact that female beetles seldom fly and when mass collection from field was made mostly the flying males were caught. The beetle emergence was at dusk around 6.45 pm and when the light intensity in the field was around 200 Lux and maximum emergence was at 70 Lux.

The males alighting on the ground located the females remaining in soil with their antennae protruding out and then crawled to them. When the female came in contact with a male it came out of soil and the male was seen mounting for copulation. A little later the male fell on its back and in line with the female continuing the copulation. After three minutes the female started digging the soil and she crawled dragging the male also with her. Mating continued for about 7-9 minutes. During the peak period of emergence several males could be seen clustering around each female attempting to mate. Mating took

place with one of the males and while in mating process each pair dug into soil and the entry point could not be easily detected later except for the loose soil particles at the site.

The emerging males did not settle on any plant species in the infested localities and were not found feeding on vegetation. The gut contents of beetles were examined by dissection and no food material could be seen. Leaves and roots of common plants in coconut gardens viz., banana, cocoa, wild-sannhemp, elephant foot yam, cassava, colocasia, *Eupatorium*, pigeon pea, drum stick plant, rose and different grasses were provided in the laboratory to the adults of *L. coneophora* for feeding. The adults did not feed on any of them. Sekhar (1958), Nirula (1958) and Veeresh et al., (1982) had reported that the adults of *L. coneophora* did not consume food. As the adults of *L. coneophora* do not congregate or feed on any plant species the method of tackling beetles at the time of mass emergence on such host plant species, as is being practised in the case of *H. serrata*, *H. consanguinea* etc, is not practicable.

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