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Ethology of coconut root grub chafer *Leucopholis coneophora* Burmeister (Melolonthinae: Scarabaeidae)

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ABSTRACT

Root grub, *Leucopholis coneophora* Burm. is a polyphagous pest of coconut and intercrops grown in sandy loam soils in south India. It damages seedlings and adult palms by feeding on roots, boring the bole and collar regions. Understanding the ethology of the pest would aid to develop an ecofriendly pest management strategy. Though control measures have been developed, imperative need is there to search for newer method. On this line it was attempted to study the adult emergence pattern during 2011-2013 in root grub infe, Kerala. Adult emergence initiated on receipt of summer shower in third week of April in 2011, 2012 and 2013. The peak emergence attained during June, after the receipt of >200 mm rainfall. The emergence commenced when illuminance fell down to 124.37±75sted coconut gardens (N12º31.550' E074 º58.081') at CPCRI experimental farm, Kasaragod.5lx in the evening and prolonged up to 1.2±04lx. However, heavy rainfall during this part of the day delayed/stopped the emergence. Maximum swarming occurred at 32.6±15.1lx. Female emergence and mating started at 12.04±8.1 lx. The operational sex ratio was wider during initial days of emergence, which narrowed down in subsequent days. Overall sex ratio was 1: 5.37. The duration of active emergence period of cockchafer was about two weeks commencing from the first day of south west monsoon. But the emergence pattern varied according to the rainfall pattern. Mechanical capture is highly significant over light trapping. There is no significant difference between the captures made by different light traps. Hence mechanical capturing and destruction of adults for two weeks from the onset of monsoon is suggested for controlling *L.coneophora* rather than light trapping.

Key words: cockchafers, Leucopholis coneophora, coconut, adult emergence, ethology, illuminance

1. INTRODUCTION

Root grub, *Leucopholis coneophora* Burm. is a subterranean pest of coconut grown in sandy loam soils and prevalent in costal belts of peninsular India. It was first reported as a pest of coconut by Nirula *et al.* (1952). It tunnels in to the bole and collar region of the seedlings and severe infestation leads to death of the seedlings. In adult palms they feed on roots impairing the conduction of water and nutrient and thus leads to yellowing of fronds and complete yield loss (Nirula *et al.*, 1952; Sekhar, 1958; Abraham and Kurian, 1970; Abraham and Mohandas, 1988). This polyphagous pest causes damage to rhizomatous and tuberous intercrops raised in palm garden *viz.*, banana, colocasia, cassava, elephant foot yarm, sweet potato and fodder grasses *etc.* Presently the grubs are managed by applying soil insecticides belonging to organo phosphorus and neonicotinoid groups which give varying results in farmer's field. The pest has annual life cycle and adult emergence coincides with the onset of monsoon (Abraham, 1983; 1993; Abraham and Mohandas, 1988). Mass capturing and destroying the adults is one of the components in IPM of root grubs and several conditions have been suggested for root grub management by adult collection to be successful. Collective effort by the farmers to collect the emerging beetles from the very first day of the adult activity begin (Veeresh, 1983). Techniques have been evolved to effectively accomplish with grub management by adult collection with success. But these successes were with only two species of the genus *Holotrichia.* (veeresh, 1974; 1983; 1984; Yadava *et al*., 1976). The technique has never been investigated for the management of white grub species of other genera. Various ecological and behavioural studies of the melolonthinid root grubs are largely restricted to the species of the genus *Holotrichia* in India. Little / scanty literatures are available on ethology of *L.coneophora.* The strategy developed could be used as component in IPM. This necessitates the need to study the adult emergence pattern and the factors governing the emergence pattern and behaviour

2. MATERIAL AND METHODS

A study was conducted in root grub infested coconut garden of 20,000 m^2 area (N12º31.550' E074 º58.081') during 2011-2013 in CPCRI, Experimental farm, Kasaragod. Soil type is sandy and annual rainfall is 3000mm. The adult emergence observed weekly in the month of March, April, May and July, August and daily in the month of June between 6.15 pm to 7.20 pm. Duration of emergence period, operational sex ratio and behaviour towards light were studied. The data on rainfall, soil temperature, and illuminance in the field during beetle activities were recorded. An attempt was made to mass trap the beetles using light traps lured with different light sources *viz.*, incandescent lamp (60 w), and CFL (11 w and 15 w) in June. The light traps were kept @ 1/ha and switched on between from 6.00 pm to 6.00 am. The light trap capture examined daily and the number of males and females were recorded. The beetles possess sexual dimorphism in antennal and hind tibial characters (Veeresh 1981; Patil and Veeresh, 1981). Size of terminal club forming segments of antenna is comparatively smaller in females than that of males (Figure 1). A pair of spines present at the posterior end of hind tibia are broad and flattened in females but in males it is circular in cross section (Figure 2). Based on these morphological markers, males and females were distinguished and sex ratio was calculated.

3. RESULTS AND DISCUSSION

Studies conducted revealed that the adult emergence started from third week of April in 2011, 2012, and 2013 immediately on receipt of summer shower. No emergence was noticed during initial three weeks of May when there was no rainfall and soil temperature was quite high (36.28±2.5ºC). Yadava and Saxena (1977) revealed that sufficient rain was required for the emergence of melolonthinid cock chafer, *Holotrichia serrata* and drought during monsoon season caused the death of beetle in the soil itself. Eventhogh, south west monsoon sets in third week of May in Kerala, sometimes it may delay for one or two weeks. It is noticed that the adult emergence also delayed accordingly and attained at the peak after the receipt >200 mm of rainfall which was within first or second week of June. In 2011 onset of monsoon was in the last day of May and peak adult emergence noticed on 6th June-2011. During 2012 monsoon was delayed for a week and the intensity of rainfall was less during initial days (first week of June). The peak swarming was also delayed and noticed on 10th June (Table 1). But in 2013 S.W.monsoon commenced on 21st May itself and received about 200mm of rainfall in the beginning of June. The emergence attained at the peak on first June. There is a correlation between beetle emergence and rainfall. Veeresh *et al*. (1982) observed that pupating *Leucopholis* grubs go deeper, sometimes reaching up to 60- 70 cm, substantial precipitation is necessary for the moisture to reach this depth to trigger the beetle emergence. The duration of active swarming of cockchafer was noticed only for two weeks during three seasons of study. But the emergence pattern varied according to the distribution of rainfall.

During 2011 scanty emergence was reported in the month of July and August also. Where as in 2012 the emergence was restricted to June, which indicated the uniform age of the population. Abraham (1993) reported the emergence of *L.coneophora* in Alappuzha district even up to August and September during 1976 to 1978 and the active swarming period was prolonged for 60 days. There is a huge shift in the emergence pattern of *L.coneophora.* A hike in soil temperature (an average increase of 35.26°C in total soil temperature from March to September) is recorded during 2011-2013 than that in 1976 to 1978. According to India Meteorological Department (IMD), a clear upward trend in surface air temperature across the West Coast between 1961 and 2003 was noticed (Attri and Tyagi, 2010). Gopakumar (2011) reported a raise of 0.8°C in maximum and 0.2°C in minimum temperature with an increase in average surface air temperature of 0.6°C. The concept of thermal time, where a linear relationship between developmental rate and environmental temperature is assumed for plants and poikilothermic animals. Ju *et al*. (2011) reported reduced life span, adult longevity as well as oviposition period of lace wing bug at higher temperature regime. Reduction in oviposition period leads to the building up of chronologically uniform population.

The emergence initiated when illuminance fell down to 124.37 ± 75.5 lx (around 6.35 pm IST in June) in the evening and activities prolonged till 1.2 ± 0.4 lx (around 7.10 pm IST). However, heavy rainfall during this period delayed/stopped the emergence. During emergence period predatory birds *viz.*, king fisher (*Alcido altthis)*, brahminy kite (*Haliastur indus*) and craw (*Corvus* spp.) were found to be predating on cock chafers and their activity noticed upto 100 lx illuminance. In order to ward off predators, the maximum swarming of beetles occurred at 32.6 ± 15.1 lx illuminance. Males emerged first and rowed around the field near ground surface in search females. Female emergence and mating occurred at 12.04 ± 8.1 lx illuminance. There is a strong competition between males for mating during female emergence time. Number of aggregates of beetles observed in the field with one emerging female surrounded by 1 to 16 numbers of males, which indicates a wider operational sex ratio in the initial period. The size of the aggregates reduced in the later period of emergence. The adult beetles fed on variety of host plants *viz.*, *Ludwigea,* cashew, mango, bhendi, hibiscus *etc.* It did not show congregation on any particular host plant. Gupta (1973) reported congregation melolonthinid cockchafer, *Holotrichia serrata* on neem twigs. After mating and feeding the beetles go back to soil and

no activity of cockchafers observed after1.2 ± 0.4 lx illuminance. Light trap capture experiment indicated that mechanical capture is superior to light trapping (Figure 3, 4, 5). The beetles did not exhibit photo taxis, however a few number of beetles fell into light traps during its random movement. There is no significant difference between the captures made by different light traps. Among light traps, the light trap lured with 11W CFL captured more number of beetles.

Female cockchafers are larger in size (3.2 ±0.2 cm length and 1.51± 0.14cm width) than males (2.89 ± 0.15 cm length and 1.41± 0.07cm width). Males outnumber the population with a sex ratio of 1: 5.37

Figure 1. *Antennae of female and male beetles*

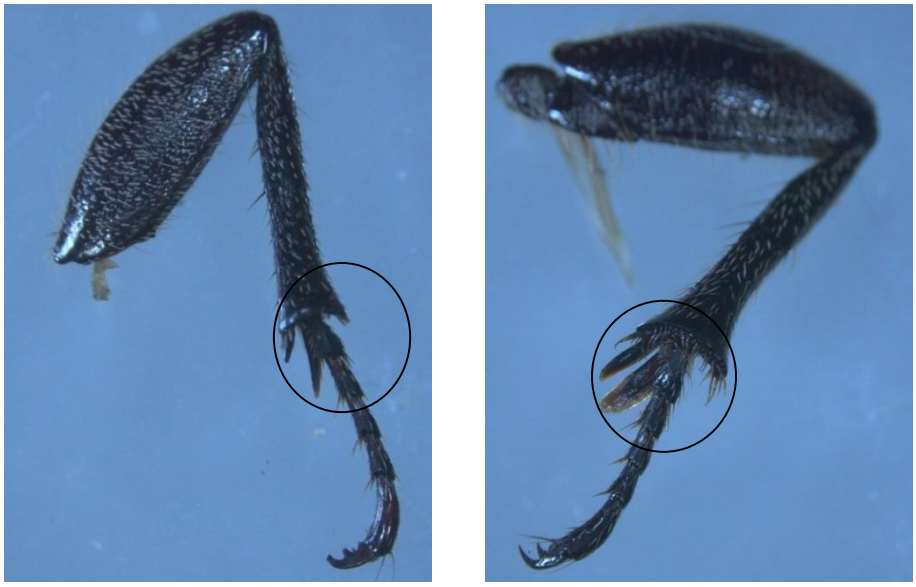

Figure 2. *Hind tibia of male and female beetles*

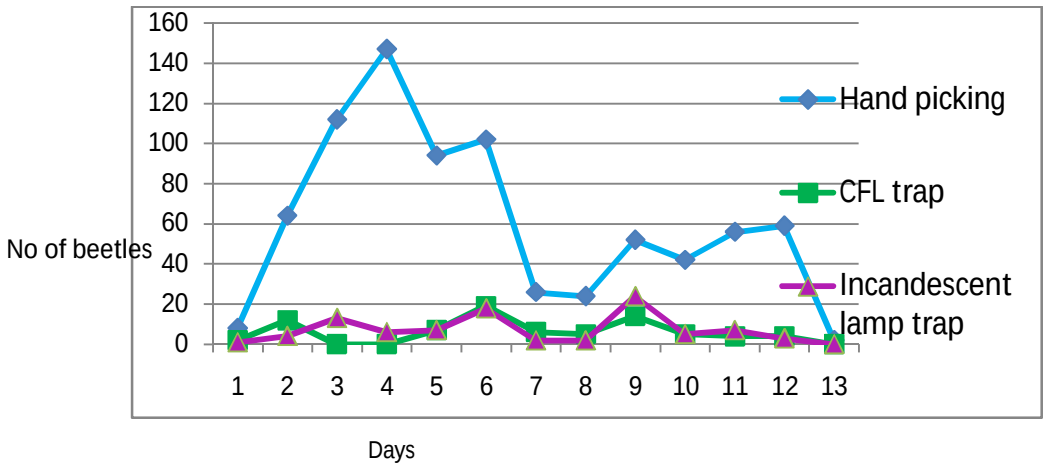

Figure 3. Mechanical and light trap captures of L .coneophora during 30th May to 15th June-2011

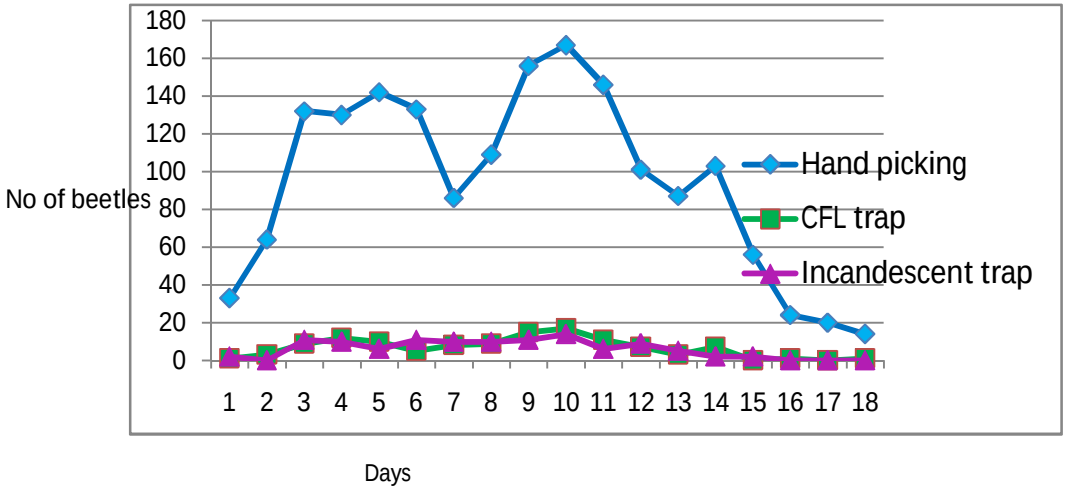

Figure 4. Mechanical and light trap captures of L .coneophora during 1st to 18th June-2011

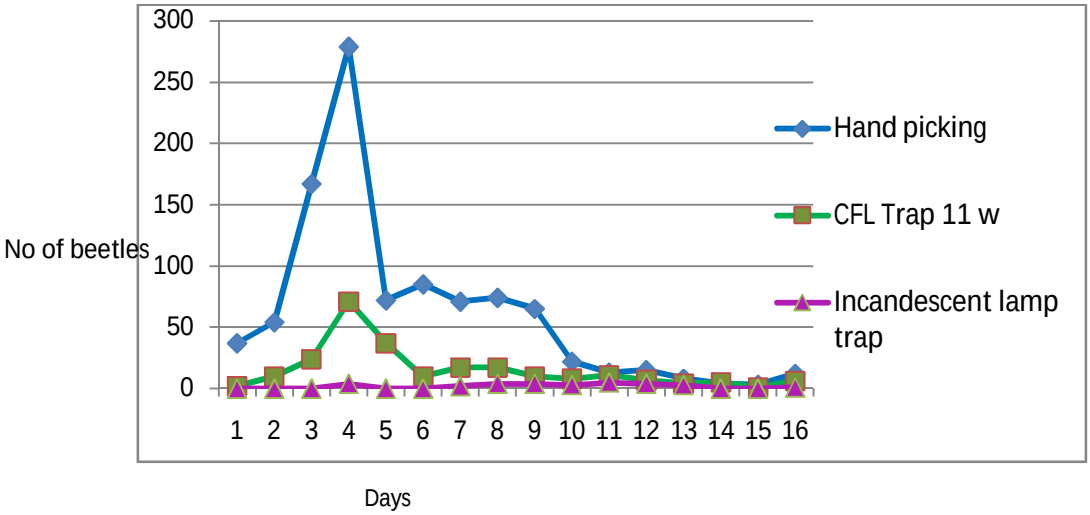

Figure 5. Mechanical and light trap captures of L .coneophora during 29 th to 14th June-2011

4. CONCLUSIONS

Present study indicated that, the adults of *L. coneophora* emerged with the onset of south west monsoon and attained at the peak after the receipt of 200 mm of rainfall. The active swarming period was restricted only for two weeks starting from the onset of monsoon. Daily the emergence took place between 124.37±75.5 lx to 1.2±04 lx illuminance period in the evening. The beetles could not capture by light trapping, since it does not exhibit phototaxis. So, mechanical capture and destruction of cockchafers between 6.35 pm to 7.15 pm for two weeks commencing from the first day of monsoon is advisable as a tool in IPM of coconut root grubs.

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5. REFERENCES

C P S Yadava and R C Saxena (1977), Bionomics of *Holotrichia consanguinea* Blanch. *Indian J.Agric.Sci.,* **47**, pp. 139-142.

C P S Yadava, R C Saxena, R K Mishra, and L N Dadheech (1976), Control strategy for anti- white grubs campaign in Rajastan. *Univ.U.Res.J.,* 14: pp. 62- 74

C S Gopakumar (2011), Impact of climate variability in agriculture in Kerala. *Ph.D . thesis submitted to CUSAT, Kerala 268 p.*

G K Veeresh (1974), War against white grubs. *Curr.Res.* **3**, pp. 87- 88.

G K Veeresh (1981), Larval taxonomy of white grubs with special reference to Melolonthinae beetles. Final project report, ICAR Ad hoc Project on larval taxonomy of Melolonthinae beetles, 1977- 80, Dept.of Entomology, UAS, Bangalore.

G K Veeresh (1983), Coconut root grubs and their control in Karnataka, India. In *coconut research and development* (G K Veeresh ed.), Wily Eastern *Ltd*., New Delhi, pp. 385- 391

G K Veeresh (1984), Management of white grubs in sugarcane cropping system. *J.soil Biol.Ecol.,* **4,***2*, pp. 124- 131

G K Veeresh, M Vijayaendra, V N Reddy, C Rajanna and P S Rai (1982), Bio ecology and management of areca white grubs (*Leucopholis* spp.*)* (Melolonthinae*:* scarabaeidae*). J.soil Biol.Ecol*ogy, **2,** *2,* pp. 78- 86

K K Nirula, J Antony and K P V Menon (1952), Anew pest of coconut palm in India. *Indian coconut J.* **12**, *1*, pp. *10-34*

K M Gupta (1973), Neem leaves attract white grub beetles. *Indian J. entomology,* **35,** *3,* pp. *276*

P S Sekhar (1958), Studies on the cock chafer *Leucopholis coneophora* Burm. A pest of coconut palm and other inter-cultivated crops. *Indian coconut J.* 11, pp. 67- 80

R T Ju, F Wang and B Li (2011), Effects of temperature on the development and population growth of the sycamore lace bug, *Corythucha ciliata*. *J Insect Sci.,* **11**, pp16-20

S D Attri and A Tyagi (2010), Climate profile of India. Contribution to the Indian net work of climate change Assessment (National communication II) to Ministry of Environment and Forest. *India meteorological department, Ministry of earth Sciences, New Delhi 1*29.p

S P Patil and G K Veeresh (1981), Description of larvae *leucopholis burmeisteri and L.lepidophora* (Scarabaeidae: coleopteran) *in* Progress in *Soil Biology and Ecology in India* (G K Veereseh ed.), 1979, UAS Tech. Ser.No. 37, pp.172-178

V A Abraham (1993), Behaviour of adult beetles of the coconut white grub, *Leucopholis coneophora* Burm. *Indian coconut J.,* **24,***1* pp. 2-4

V A Abraham and C Kurian (1970), Save your coconut palms from the ravages of white grubs. *Coconut Bull.,* **1,** pp. 3-4

V A Abraham and Mohandas (1988), Biology of coconut white grub *Leucopholis coneophora* Burm. (Melolonthinae: Scarabaeidae: Coleoptera) *J. plantation Crops,* **16**, pp. 38- 44.

V A Abraham, (1983), Biology, bionomics and control of coconut cock chafer, *Leucopholis coneophora Burm. Ph.D Thesis:* Kerala agric. Univ., Vellanikkara, India

Table 1. Adult emergence pattern of L.coneophora during 2011, 2012 and 2013

2011				**2012**				**2013**			
Date	No of beetles	Soil temp (˚C)	Rainfall (mm)	Date	No. of beetles	Soil temp (˚C)	Rainfalll (mm)	Date	No. of beetles	Soil temp (˚C)	Rain fall (mm)
23.04.11	4	30.00	045.6	28.04.12	4	30.90	23.2	29.04.13	3	28.30	16.0
30.05.11	11	34.70	001.8	1.06.12	3	32.25	38.8	21.05.13	2	33.25	26.0
04.06.11	80	27.00	022.8	02.06.12	36	38.10	00.2	22.05.13	1	35.00	00.0
05.06.11	125	27.50	038.0	03.06.12	67	38.75	00.0	26.05.13	5	38.25	01.0
06.06.11	153	28.70	033.0	04.06.12	152	35.25	00.17	27.05.13	25	33.85	00.1
07.06.11	108	30.30	029.0	05.06.12	152	35.05	00.2	28.05.13	18	30.00	00.0
08.06.11	149	30.00	004.6	06.06.12	158	30.70	47.4	29.05.13	39	33.75	14.8
09.06.11	34	29.75	024.4	07.06.12	149	28.05	59.0	30.05.13	64	30.20	00.0
10.06.11	31	30.30	017.0	08.06.12	104	29.50	16.8	31.05.13	191	29.40	95.6
11.06.11	90	28.85	007.6	09.06.12	128	28.70	05.8	01.06.13	354	28.80	67.8
12.06.11	52	27.20	012.6	10.06.12	182	29.05	04.0	02.06.13	109	26.45	56.0
13.06.11	67	26.90	033.8	11.06.12	198	32.10	13.6	03.06.13	95	27.00	47.4
14.06.11	66	28.00	128.8	12.06.12	161	32.50	03.6	04.06.13	90	29.00	08.4
15.06.11	2	29.85	046.6	13.06.12	117	26.75	64.0	05.06.13	95	31.20	20.6
27.06.11	1	28.75	060.2	14.06.12	95	27.80	60.6	06.06.13	79	29.90	00.1
14.07.11	2	30.00	029.0	15.06.12	112	29.90	42.8	07.06.13	33	28.00	59.0
06.08.11	1	34.70	008.0	16.06.12	58	29.00	32.2	08.06.13	29	30.85	25.0
				17.06.13	25	28.50	05.8	09.06.13	26	29.05	95.0
				18.06.13	20	26.50	66.6	10.06.13	15	28.75	61.6
				23.06.12	15	25.65	96.5	11.06.13	9	27.90	49.8
				24.06.12	3	28.75	15.2	12.06.13	4	27.10	71.8
				25.06.11	1	30.25	17.6	13.06.13	19	29.15	76.4
								14.06.13 to26.06.13	6	30.80	10.8