Eco. Env. & Cons. 23 (3) : 2017; pp. (1631-1635)
Copyright@ EM International
ISSN 0971–765X

Adult emergence pattern of *Leucopholis burmeisteri Brenske* (Coleoptera : Scarabaeidae) infesting Arecanut in coastal Karnataka

C.M. Kalleshwaraswamy*, S.K. Adarsha, N.L. Naveena and B. B. Kumar

Department of Entomology, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga 577 225, India

(Received 26 October, 2016; accepted 25 December, 2016)

ABSTRACT

White grubs, *Leucopholis burmeisteri* Brenske (Coleoptera: Scarabaeidae: Melolonthinae) is one of the important insect pests infesting areca nut in costal region of Karnataka. They feed on roots causing reduced number of roots, loss of anchorage, stem tapering, reduced number of fronds, yellowing of leaves, yield reduction and death of the plants. The biological and ecological aspects of this species are scanty. The aim of this study was therefore to understand the adult emergence pattern of this species to provide information on its management. The adult emergence pattern of *L. burmeisteri* was observed daily in the rainy season, starting from June to November during 2013 and 2014. The temporal emergence of adults was analyzed. Adult emergence period was noticed only between June I week to July IV week and no adults emerged after July. Emergence restricted to 18.00h to 22.00h in a day within this period peak emergence of adult beetles was noticed from 1900 to 2000 h. Local weather parameters had no influence on adult emergence even though maximum temperature and Relative humidity had significant effect on emergence. Female biased sex ratio was observed (male: female; 1:2.52 and 1:1.57 in 2013 and 2014, respectively). The implications of the study in developing IPM practices for this pest are discussed.

Key words : *Adult emergence, Areca nut, Leucopholis burmeistri, Sex ratio, White grubs*

Introduction

White grubs or root grubs (Coleoptera : Scarabaeidae : Melolonthinae) are important pests of palms, mainly areca nut and coconut in Western Ghats region of India (Veeresh *et al.,* 1982). In this region, three important species which infest areca nut and coconut roots are *Leucopholis lepidophora* Blanchard, *L. burmeisteri* Brenske and *Leucopholis coneophora* (Veeresh *et al.,* 1982). Among these three, *L. burmeisteri* is considered as a major species distributed in coastal and hilly regions of Karnataka and Kerala (Veeresh, 1983). These root grubs damage the roots by feeding resulting in symptoms like yellowing of leaves, stem tapering, and nut fall ultimately leading to reduced vigour and yield (Nair and Daniel, 1982).They show a particular preference for feeding on tender roots. The roots are fed from the tip or cut across at various points. When population densities increase, the entire base of the bole is denuded (Kumar, 1997). Affected palms loose anchorage and topple when disturbed (Nair and Daniel, 1982). Few grubs are enough to kill the living trees (Kumar *et al.,* 2011). This species causes 28.80% damage of with a yield reduction of 39.79– 41.60% in Udupi taluka of coastal region of Karnataka

***Corresponding author's email:** kalleshwara@gmail.com

(Kalleshwaraswamy *et al.,* 2015). Several strategies have been advocated to tackle the menace of different species of areca white grubs (Veeresh *et al.,* 1982; Kumar, 1997). This includes larval collection by digging soil, soil application of bio control agents and insecticides, and adult collection during their emergence (Veeresh *et al.,* 1982; Kumar *et al.,* 2011; Prabhu *et al.,* 2011; Adarsha *et al.,* 2015). Insecticidal application *viz.,* Chlorpyriphos, Imidacloprid and Phorate to the soil targeting grubs is widely followed method that gives considerable control (Prakash, 2011; Adarsha *et al.,* 2015).

Adult emergence pattern of *L. lepidophora* was occurred between July-October (Kalleshwaraswamy *et al.,* 2016). Similarly, Prathibha *et al.* (2013) studied the adult emergence pattern of another areca nut pest, *L coneophora* Burmeister in coastal region of Kerala. These studies have opened up number of avenues for management of these dreaded pests. However, there is no published information on the emergence pattern of adults *L. burmeisteri* covering a complete emergence season which is crucial for their collection and destruction. The detailed pattern of adult emergence studies may have lot of implication in designing management strategies and hence this study was undertaken.

Material and Methods

Experimental site and preliminary study to record timing of adult emergence using nylon net field cage

Field studies were conducted in Aladka village (Udupi District; 13°35' N; 74° 86' E) in a grower's field. Selected areca nut garden was of 18 years old with an incidence about 75 per cent (based on the number of areca palms showing symptoms of white grub infestation). A Preliminary study was conducted to record the timing of adult emergence as reported earlier for *L. lepidophora* (Kalleshwaraswamy *et al.,* 2016). During the field observation, the flight behavior, the height of flight, resting behavior and host plant of adults were also recorded.

Sampling for emerged adults of *L. burmiestri* to record the adult emergence pattern

The same nylon net field cages **[(**size of nine feet (L) X nine feet (B) X six feet (H), 20 mesh/cm^2; (inside land area of the trap was 81sq ft)] in between four areca nut palms (plant spacing 3m X 3m) in a growers field. The cages were set in the field on the day following the first day of the South West monsoon *i.e.,* June I week. The beetles that emerged from the soil and settled inside the nylon net cages were collected, counted and sexed. As per the results of preliminary experiment, observations on adult emergence were recorded daily from 1800 to 2100 h after the beginning of the monsoon (fourth week of June during 2013 and first week of June 2014) and sampling was terminated when no beetles had emerged for a period of 15 days (October of 2013 and 2014). Field visits were also made during hours of dusk whenever off season rain was received, to know whether beetles emerged during these days. Beetles were sexed based on the character of hind tibial spur; female spoon shaped, and male spine like as in case of *L. lepidophora*.

Data were subjected to simple correlation coefficient analysis to determine the extent and nature of association between number of beetles trapped per day and different daily weather parameters. The weather parameters considered were daily maximum temperature (MT), minimum temperature (mT), relative humidity at 0730 h (RH 1) and 1330 h (RH 2) and rainfall (RF). Correlation was also performed between number of beetles emerged per trap per week taken at weekly intervals using SPSS version 16.0 software. Significance of correlation coefficients were tested at P=0.05 and P=0.1 between calculated 'r' value and table 'r' value. Further, daily beetle collection data was converted to a weekly basis for calculating sex ratio and also to record the swarming trend or peak emergence of adult beetles. A light trap was also set in another grower's field in the same village to know the response towards light. Random survey and visits were made during off season rains to know the emergence if any during this time as well.

Results

Timing of adult emergence in a day and behavior of adults after emerging from soil

Out of total 37 beetle emerged inside the cage of 81sq ft area, 28 were emerged between 1900 and 2000 h. Four adults emerged between 1800 h and 1900 h and remaining five adults emerged between 2100 h to 0600 h. No adult emergence occurred during day time. Hence, in order to study the adult

Table 1. Number of adults (*L. burmiestri*) emerged per hour in a day for nine consecutive days inside two nylon nets (each of 81 sq ft area)

	*L. burmiestri**									
1800 h-1900 h	0	1	2	1	0	0	0	0	0	**4**
1900 h-2000 h	4	6	5	5	1	0	4	1	2	**28**
2000 h-2100 h	2	1	1	0	0	0	0	0	0	**4**
2100 h-2200 h	0	0	0	1	0	0	0	0	0	**0**
2200 h-0600 h	0	0	0	0	1	0	0	0	0	**1**
Total	**6**	**8**	**8**	**6**	**2**	**0**	**4**	**1**	**2**	**37**

*June 6, 2013 (Day 1)toJune 15,2013 (Day 9)

emergence pattern, monitoring period was restricted to 1800h to 2100h. Once the adults emerged from the soil, they waited less than a minute on the ground and then took to flight making buzzing sound and they flew at the height of around 15-40 feet above the canopy of areca nut. This species were found feeding on host plants causing characteristic serrated semicircular excavations on leaves of *Dipterocarpus turbinatus* (Gaertn) and *Anacardium occidentale* (Linn.), which belongs to plants of family Anacardiaceae and Dipterocarpacea, respectively which are present on the borders of the areca gardens.

Adult emergence pattern of *L. burmiestri* and their relationship with weather parameters

Number of *L. burmesteri* adults trapped in nylon net varied from 0-8 per trap per day during 2013. A total of 122 adults were collected during the trapping period from 22-06-2013 to 21-07-2013 using 2 nylon net cages. Similarly, during 2014, a total of 142 beetles were collected during the trapping period from 02-062014 to 30-07-2014. Perusal of figure 2 indicated that, the peak emergence reached in June second week. Thereafter, the emergence reduced over period. The trap catches of *L. burmesteri* had negative correlation with maximum temperature [r= -0.076 and r=-0.16 for 2013 for I year and II year, respectively], but were non-significant. Negative correlation was also observed between morning RH (recorded at 0730 h) [r=-0.022 (I year) and -0.17(II year)] and rainfall [r= -0.029 (only in the II year)]. Overall, none of the parameters significantly affected the adult emergence (Table 2). No beetles were emerged during off-season rains. Adults of *L. burmesteri* were not attracted to light trap.

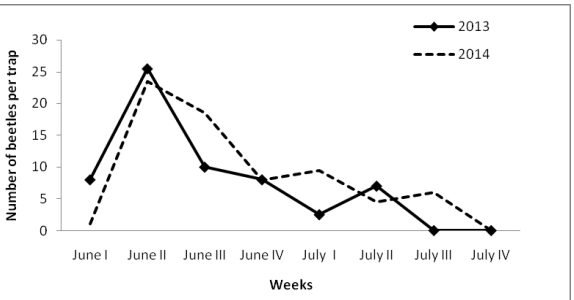

Fig 1. Emergence pattern of *L. burmesteri* adults

Table 2. Simple correlation values between mean number of *L. burmiestri* in nylon nets (81sq. ft. area) and mean weekly weather parameters during 2013 (I year) and 2014 (II year)

Weather parameter	*L. burmiestri*	
	2013 (I year)	2014 (II year)
MT (°C)	-0.076	-0.16*
mT (°C)	0.036	0.086
RH 1 (%)	-0.022	-0.17*
RH 2 (%)	0.043	-0.052
RF (mm)	0.063	-0.029

*Significant at p=0.05; **Significant at p=0.1;
Year 2013; N=52 days; r=0.27 at p=0.05; r=0.23 at p=0.1
Year 2014; N=59 days; r=0.25 at p=0.05; r=0.21 at p=0.1
MT and mT= Maximum & minimum temperature (°C); RH 1 and RH 2= Relative humidity at 0730 hr & 1330 hr (%); RF=Rainfall (mm)

Sex ratio of beetles

Out of the 122 beetles collected in the first year, 34 were males and 86 were females. Perusal of table 4 indicated that for few weeks from the initiation of emergence, the sex ratio was male biased. During 2013, the sex ratio was female biased throughout the trapping period where in the overall sex ratio of 1:2.52 (male: female) was recorded. During 2014, Out of the 162 beetles collected, 52 were males and 76 were females. Only males were emerged in the first week of emergence (June-I). However, from June second week, the sex ratio was female biased

Table 3. Number of adults collected[#] and their sex ratio of *L. burmeisteri*

Weekly intervals	*L. burmeisteri*							
	2013				2014			
	Male	Female	Total	Sex ratio (Male:Female)	Male	Female	Total	Sex ratio (Male:Female)
June-I	6	10	16	1:1.66	2	0	2	1:0.00
June-II	13	38	51	1:2.92	26	31	57	1:1.19
June-III	4	14	20	1:3.50	14	33	47	1:2.35
June-IV	5	11	16	1:2.20	4	12	16	1:3.00
July-I	1	4	5	1:4.00	8	11	19	1:1.37
July-II	5	9	14	1:1.80	4	5	09	1:1.25
July-III	0	0	-	-	5	7	12	1:1.40
July-IV	0	0	-	-	0	0	0	-
Total	34	86	122		63	99	162	1:1.57

[#] Collection from two nylon net field cages

(up to 1:3.00). The overall sex ratio was 1:1.57 (male:female).

Discussion

It is evident that adults of *L. burmeistri* emerged between 1800 h and 2100 h with a maximum emergence between 1900 and 2000 h (IST). Emergence started roughly 30 minutes after sundown (1930 h) and continued for 2.5 hours. Similarly, Kumar (1997) reported that adults of *L. lepidophora* were emerged between 1915 and 1945 h during July to October. Channakeshava (2006) reported that highest numbers of adult beetles of *L. lepidophora* (21.59 %) emerged between 7.00 and 7.30 PM, while more than 60.42 per cent of the adult beetles emerged at dusk between 1800 and 2000 h. Padmanaban and Daniel (2003) reported that maximum number of *L. burmeisteri* adult beetles emerged within 3 to 4 days during evening hours at 18.45 and 19.30 hours. Prathibha *et al.* (2013) reported that 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 1910 h). Our earlier reports of adult emergence pattern of *L. lepidophora* were defined between June and October during 2013 and 2014 (Kalleshwaraswamy *et al.*, 2016). The sex ratio of *L. lepidophora* varied over time, but the overall sex ratio was female biased in both the study years (male:female; 1:1.18 and 1:1.46 in 2013 and 2014, respectively) (Kalleshwaraswamy *et al.*, 2016). Light trap did not attract adults of *L. burmeistri* hence; use of light trap is not an option for their management.

Our studies conclusively demonstrated that unlike *L. lepidophora*, the *L. burmiestri* has very short period of emergence in a year. Hand collection of these beetles was difficult because they were very fast fliers and flew at height of 15-40 feet above depending on the crop canopy. Manual collection of beetles or trapping beetles using nylon net is not a worthy option in large areas. The required labour and searching for beetles during night hour limits applicability of manual collection. Our earlier reported suggests existence of female produced semiochemical in *L. lepidophora* (Kalleshwaraswamy *et al.*, 2016). The presence of same type of female produced sex pheromone in *L. burmiestri* needs to be explored, to utilize them for attracting and trapping. The study provides number of opportunities for management of this pest which has restricted distribution but causes serious loss within its area of distribution.

Acknowledgements

Authors are thankful to areca grower, Mr. Naveena (Aladka, Udupi district) for the kind co-operation and support for our field studies. We would like to thank Rastiya Krishi Vikasa Yojana (RKVY), Government of India for financial support to this work.

References

Adarsha, S. K., Kalleshwaraswamy, C.M., Pavithra, H.B., and Sharanabasappa, 2015. Field evaluation of selected insecticides against areca nut white grub, *Leucopholis lepidophora* (Blanchard) (Coleoptera:

Scarabaeidae). *Pest Management in Horticultural Ecosystems*. 21 (1): 60-64.

Adsule, V. M. and Patil S. M. 1994. Biology of sugarcane white grub, *Leucopholis lepidophora Bl.* Coleoptera: Scarabaeidae: Melolonthinae. *Indian Sugar*. 44 : 25-28.

Channakeshava, A. 2006. Bio-ecology and management of arecanut root grubs with special reference to *Leucopholis lepidophora* Blanch. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore (India).

Kalleshwaraswamy, C. M. Adarsha, S. K. Naveena, N. L. and Sharanabasappa, 2015. Incidence of arecanut white grubs (*Leucopholis* spp.) in hilly and coastal regions of Karnataka, India. *Current Biotica.* 8 (4) : 423–424.

Kalleshwaraswamy, C. M., Adarsha, S.K., Naveena, N.L., and Sharanabasappa, 2016. Adult emergence pattern and utilization of females as attractants for trapping males of white grubs, *Leucopholis lepidophora* (Coleoptera: Scarabaeidae), infesting areca nut in India. *Journal of Asia-Pacific Entomology*. 19 : 15–22.

Kumar, A. R. V. 1997. Bio-ecology and management of arecanut white grubs. *Leucopholis* spp. (Coleoptera: Scarabaeidae) in Karnataka. Ph.D. Dissertation, UAS, Bangalore, p. 230.

Kumar, A. R. V. Prakash, K. V. Belavadi, V. V. and Chandrashekara, K. 2011. Management options for the white grubs (Coleoptera: Scarabaeidae): The Influence of biological and ecological features. In: Ambrose DP(eds) Insect Pest Management, A Current Scenario, Entomology Research Unit, St. Xavier's College, Palayamkottai, India, pp. 529-540.

Nair, C.P.R. and Daniel, M. 1982. Pests of areca nut In: Bavappa KVA, Nair MK, Premkumar T (eds) The Arecanut Palm (*Areca catechu* Linn.) CPCRI, Kasargod (India). pp: 162-184.

Padmanaban, B. and Daniel, M. 2003. Biology and bionomics of palm white grub, *L. burmeisteri, Indian Journal of Entomology*. 65 (4) : 444-452.

Prabhu, S.T. Rakesha, H. S. and Balikai, R. A. 2011. Field evaluation of fungal pathogens and plant extracts against areca nut root grub. *Leucopholis lepidophora* Blanchard. *Pest Management in Horticultural Ecosystems*. 17 (2) : 75-79.

Prakash, K.V. Kumar, A. R. V. and Ravikumar, B. 2011. Pest management practices of arecanut farmers against *Leucopholis* spp. (Coleoptera: Scarabaeidae) in karnataka. (In). Insect Pest Management, A Current Scenario, 2011 (eds) Dunston P. Ambrose, Entomology Research Unit, St. Xavier's College, Palayamkottai, India, pp. 558-563.

Prathibha, P. S. Kumar, A. R. V. and Subaharan, K. 2013. Ethology of coconut root grub chafer *Leucopholis coneophora* Burmeister (Melolonthinae: Scarabaeidae). *International Journal of Agriculture and Food Science Technology*. 4 : 24-29.

Raghavan, V. and Baruah, H.K. 1958. Areca nut: India's popular masticatory. History, Chemistry and Utilization. *Economic Botany*. 12 : 315-345.

Veeresh, G.K. 1983. White grubs, In: *Applied Soil Biology and Ecology* (eds) Veeresh GK, Rajagopal D (II eds. 1988) Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Veeresh, G. K. Vijayendra, M. Reddy, N. V. M. and Rajanna, C. 1982. Bio-ecology and management of areca nut white grubs (*Leucopholis* spp*)* (Coleoptera; Scarabaeidae: Melolonthinae). *Journal of Soil Biology and Ecology*. 2 : 78-86.