



Management of coconut slug caterpillar (*Macroleptra nararia*) with light traps

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Coconut (*Cocos nucifera* L.) is one of the widely cultivated palms which occupies a unique position in the socio-economic structure of the country. It is primarily confined to the four southern states in India. Andhra Pradesh is a major coconut growing state and the crop is cultivated in an area of 1.42 lakh ha with the coastal districts comprising East and West Godavari contributing fifty per cent share (<http://coconutboard.nic.in/stat.htm>). A major factor that contribute to the loss of production and productivity in coconut in these districts was the incidence of the coconut slug caterpillar, *Macroleptra nararia* Moore (Limaodidae:Lepidoptera). The incidence of this pest on coconut in East Godavari district was reported earlier by Sujatha *et al.* (2008), and on oil palm in West Godavari district by Kalidas (2002). Feeding by the early instar caterpillars cause leaf spots and grown up larvae feed on entire laminar portion of the leaf leaving the mid ribs. Scorched or burnt appearance of leaves is the predominant symptom observed in the field during severe infestation. Balls of excreta were also observed as a layer on the ground around the infested coconut palm basin. During outbreaks, all the functional leaves are dried leaving only the spindle leaves, which results in pre-mature drooping of leaves and shedding of nuts, ultimately leading to yield losses and delayed spathe emergence. In severe cases, the pest feeds on nuts and leaf stalks also (Sujatha *et al.*, 2008; Rajan *et al.*, 2011). The pest was

also observed to damage the intercrops *viz.*, banana and cocoa in coconut based cropping system in severe outbreaks.

Chemical control measures, though effective, for the management of coconut slug caterpillar, the residual toxicity and large scale adoption cost limits its usage in coconut plantations. This situation warrants to develop eco-friendly and economical pest control measures. Artificial light attracts many moths, especially light with high ultraviolet (UV) emission (Frank, 1988; 2006). Studies by Sujatha *et al.* (2011) revealed that slug caterpillar is positively phototactic and placing of various light traps at 45 cm above ground level in coconut slug caterpillar infested villages in East Godavari district of Andhra Pradesh resulted in attraction of large number of slug moths thereby reducing the damage by the caterpillars. This positive phototactic phenomenon, which is an economical and easy method of pest control, can be exploited for monitoring and mass trapping of this pest. The idea of using light traps as a control measure was put by Green (1906) who found that moths were prominently active after dusk and was attracted to acetylene light source. Light traps have been widely used in the past for survey and control of insect pest population in several crops (Otman, 1964; Kovitvadhi and Cantelo, 1966; Blair and Catting, 1974; Betts, 1976). In India, Jayanthi and Verghese (2009) recommended light trap as an important tool against sapota seed borer *Trymalitis margarias*.

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Keeping this in view, a study on the utility of various light traps in the management of coconut slug caterpillar was investigated in severely slug-infested coconut gardens of East Godavari district of Andhra Pradesh during January to July 2012. Studies were carried out at Atreyapuram, Vedireswaram, Palivela, Ganti and Komanapalii villages of East Godavari district of Andhra Pradesh, each village representing one replication. The experiments were laid out in gardens with 600 palms (10 acres) in the age group of 20-30 years.

Preliminary investigations were done with different kinds of lights sources *i.e.*, incandescent lamps, compact fluorescent light lamps (CFLs), emergency lights, gas lights, solar lamps and petromax lights. As no *M. nararia* moths were recorded with the light sources *viz.*, solar, emergency lantern, gas and petromax lights, their further testing was discontinued. The testing and evaluation of various intensities of incandescent lamps (100 W, 200 W and 500 W) and CFLs (8 W, 15 W and 20 W CFL) were carried out at 45 cm height based on preliminary studies in January and February months. The best intensity bulb which trapped higher number of moths was further used in investigation pertaining to optimum trap height *i.e.*, 45 cm, 120 cm and 300 cm above the ground and trapping method *i.e.*, water pan (16 inch diameter) on the ground below the light, yellow sticky trap, window bucket (16 liters capacity, 12 inches height with windows of 2.5 x 4.5 inches made on four sides at 10 inches height from bucket base) in April (in four experimental villages except Atreyapuram village) and May (in all five experimental villages). The light trap position was changed once in three days starting from centre of the field so as to have complete area coverage. Based on the results obtained pertaining to the light trap with best light intensity, height and method, traps were further evaluated to find the optimum number of lights traps per unit area to be installed in June and July. The light traps were run continuously during night from 18.00 hrs to 05.00 hrs on all days during the experimental period. The source of electricity for illuminating the lamps at the experimental sites was generated through invertors which were charged during day (1.4 KV Amaron Tribal Inverter with two numbers of 160 Ah Amaron make Tribal batteries)

and the lamps were connected with necessary electric wires (2 mm²). Observations were recorded throughout the night at hourly intervals in the months of April and May and data on number of moths captured per trap per hour and peak trapping hours in the night was arrived. Mean number of moths trapped per light per night from different intensity light sources and trapping methods as well as peak time of moth trapping were arrived, analyzed statistically and presented as monthly means. Further, the moths trapped were sexed and male female ratio was arrived.

The light sources and trapping methods employed in the studies were detailed as

1. Intensity of light source at 45 cm above the ground level and water pan
 - T1 - 100 W incandescent lamp
 - T2 - 200 W incandescent lamp
 - T3 - 500 W incandescent lamp
 - T4 - 8 W CFL
 - T5 - 15 W CFL
 - T6 - 20 W CFL
2. Best intensity lamp with different heights and trapping method
 - a. Lamp arranged at 45 cm with sticky trap
 - b. Lamp arranged at 45 cm with water pan
 - c. Lamp arranged at 120 cm with window bucket trap
 - d. Lamp arranged at 300 cm with window bucket trap
3. Number of lights per ha.
 - a) One light trap per ha.
 - b) Two light traps per ha.
 - c) Three light traps per ha.

The incidence of coconut slug caterpillar was observed on a severe scale in coconut plantations in all the five experimental villages in January 2012 but its incidence continued only in Atreyapuram and Vedireswaram village experimental sites in February 2012 and in March 2012 the moth catches were not recorded in any of the experimental sites. However, the incidence was again observed in April 2012 (except in Atreyapuram village) and continued up to July 2012 in all the villages. Therefore, the testing and evaluation of incandescent lamps (100 W, 200 W and 500 W),

Table 1. Mean catch of *M. nararia* moths in various light traps during January 2012

Lamp arranged at 45 cm above with water pan	Mean moth catch in January 2012 (Numbers)
T1 100 W Incandescent lamp	302 (16.36)
T2 200 W Incandescent lamp	780 (25.79)
T3 500 W Incandescent lamp	615 (22.78)
T4 8 W CFL lamp	108 (08.58)
T5 15 W CFL lamp	190 (12.03)
T6 20 W CFL lamp	336 (16.61)
S EM+	2.7
C.D at 5 %	8.1

*Figures in parentheses are (n+1) square root transformed values

CFLs (8 W, 15 W and 20 W) for best light intensity was carried out in 2012 January and February months. There was significant difference among the traps with respect to number of moths trapped in January. Among the various lamps installed at 45 cm above the ground with water pan for capturing adult slug moths, the 200 W incandescent lamp recorded the highest mean

moth catch of 780 moths per month followed by 500 W incandescent lamp with 615 moths. A lowest catch of 108 moths was recorded in 8 W CFL, however the trap catches in 100 W incandescent lamp and 20 W CFL were statistically at par with 500 W lamp catch. Sujatha *et al.* (2011) reported that 500 W lamp and water pan recorded the highest catch followed by 100 W lamp and water pan as compared to CFLs. However, in the present study, 200 W incandescent lamp recorded the highest mean moth catch compared to 500 W lamp and were at par with each other. In general, compared to incandescent lamps, low catches were recorded CFLs in all the experimental sites in January 2012 (Table 1). It is possible that slug moths preferred the yellow colour of light produced by incandescent bulbs and heat generated in 200 W incandescent lamp was optimum as compared to 100 and 500 W incandescent lamps.

However, in February 2012 catches were recorded for 15 days only in Atreyapuram and Vedireswaram village experimental sites. In both the villages, the highest total trap catch was recorded in 200 W incandescent lamp (total month catch of

Table 2. Total moth catch of *M. nararia* in February 2012 in various light traps at Atreyapuram and Vedireswaram village experimental sites

Treatments	Total moth catch in Atreyapuram village (10 acres)	Total moth catch in Vedireswaram village (10 acres)
T1 100 W Incandescent lamp	277 (16.29 ±2.27)	223 (13.11±3.62)
T2 200 W Incandescent lamp	1424 (83.76±11.56)	353 (20.76±4.75)
T3 500 W Incandescent lamp	471 (27.71±4.60)	240 (14.12±3.33)
T4 8 W CFL	266 (15.65±2.94)	132 (7.76±2.35)
T5 15 W CFL	398 (23.41±2.90)	101 (5.94±1.51)
T6 20 W CFL	183 (10.76±1.65)	106 (6.24±1.79)

Figures in parentheses are Mean± Standard Error

Table 3. Mean moth catch of *M. nararia* in 200 W lamp at different heights and trapping methods

Trap particulars (200 W Incandescent lamp)	Mean moth catch in April 2012 (In four experimental locations)	Mean moth catch in May 2012 (In five experimental locations)
T1 45 cm above + sticky trap	739 (25.51)	301 (15.19)
T2 45 cm above + water pan	1538 (34.77)	848 (27.17)
T3 120 cm above + window bucket	357 (18.30)	137 (11.48)
T4 300 cm above + window bucket	264 (15.87)	93 (09.43)
S EM+	4.0	2.3
C.D (5 %)	12.8	7.0

*Figures in parentheses are (n+1) square root transformed values

Table 4. Sex ratio of coconut slug caterpillar *M. nararia* caught in light traps

Trap particulars		Month moth catch in all the experimental sites in June 2012				Month moth catch in all the experimental sites in July 2012 (up to 15 th July)			
		Male	Female	Sex ratio	Total	Male	Female	Sex ratio	Total
T1	One trap ha ⁻¹	353	880	1:2.5	1233	795	2138	1:2.7	2933
T2	Two traps ha ⁻¹	585	1208	1:2.1	1793	1655	4025	1:2.5	5680
T3	Three traps ha ⁻¹	1055	2828	1:2.7	3883	3221	7034	1:2.2	10255

1424 and 353 moths, respectively) followed by 500 W incandescent lamp (total month catch of 471 and 240 moths, respectively). Low trap catches were observed in CFLs compared to incandescent lamps during this period (Table 2). Studies by Nwosu and Nwosu (2012) on the attraction of the giant water bug *Lethocerus indicus* in Nigeria also revealed that incandescent light bulbs producing yellow colour light and glowing with much heat significantly attracted more bugs compared to fluorescent light tubes producing white coloured light and glowing with minimal heat. Sujatha *et al.* (2011) reported that trapping of slug caterpillar moths was higher in the incandescent lamps over the CFLs as in incandescent lamps 90 per cent electricity was converted to heat and moths may get attracted more to the light which also has heat generation. From the trap catches observed in 2012 January and February months, among the various light traps 200 W incandescent lamp was found to be the best in attracting and trapping higher number of slug caterpillar moths and this lamp was tested at different heights and trapping methods in the months of April (in four experimental sites) and May (in the five experimental sites). The trap

catches during these months revealed that 200 W lamp installed at 45 cm above the ground + water pan had significantly trapped higher number of moths 1538 in April 2012 and 848 in May 2012, followed by 45 cm above the ground + sticky trap treatment which trapped 739 and 301 moths, respectively. The trap catch in 45 cm above the ground + sticky trap was statistically on par with 45 cm above the ground + water pan only in the month of April 2012 (Table 3). Placing of the traps at 45 cm above the ground had attracted higher number of moths as many of the moths before falling into the traps were found clinging to the weed plants near the traps. In the light trap studies against coconut black headed caterpillar, *Opisina arenosella*, Muralimohan *et al.* (2007) reported that light traps placed at 45 cm from the ground attracted more moths than those placed on the ground.

Among the optimum number of traps tested for installation for trapping adult slug moths, it was observed that higher the number of traps per hectare, more the number of moths attracted, particularly when there is a severe outbreak. Therefore, three traps per ha trapped more number of moths followed by two traps per ha and one trap per ha. Regarding

Table 5. Hourly trap catches of *M. nararia* moths in various light traps at experimental villages in April and May 2012

Incandescent lamp (200 W) placed at	Month	Time of observation and moth catches (in numbers)												Total
		18.00 to 19.00	19.00 to 20.00	20.00 to 21.00	21.00 to 22.00	22.00 to 23.00	23.00 to 24.00	24.00 to 01.00	01.00 to 02.00	02.00 to 03.00	03.00 to 04.00	04.00 to 05.00		
45 cm above + sticky trap	April	0	51	156	336	388	759	673	372	221	0	0	2956	266.9
	May	0	58	79	113	289	395	369	138	65	0	0	1506	146.7
45 cm above + water pan	April	0	172	429	605	865	1226	1521	749	583	0	0	6150	510.6
	May	0	149	235	352	889	1215	1105	191	106	0	0	4242	458.3
120 cm above + window bucket	April	0	0	0	116	209	347	463	258	35	0	0	1428	165.6
	May	0	0	0	56	135	153	185	116	42	0	0	687	71.6
300 cm above + window bucket	April	0	0	0	98	187	263	285	198	25	0	0	1056	115.5
	May	0	0	0	43	93	112	138	58	19	0	0	463	51.3

sex ratio of the moths trapped, it was observed that on an average for one male there were two females trapped (Table 4). In light trap studies carried out in 2011 by Sujatha *et al.*, a sex ratio of 1:3 was recorded. The observations for identification of peak time of adult moth attraction were carried out from 18.00 hours to 05.00 hours. The results revealed that the moth flight activity was not noticed from 18.00 to 19.00 hours. The moth's attraction towards the light source started from 19.00 hour onwards and attained peak in between 21.00 to 01.00 hours and gradually the moth catch decreased to nil at 03.00 hours. Both the male and female moths were attracted to all the light sources. It was found that, the moth activity extended for about 8 hours *i.e.*, from 19.00 hours to 3.00 hours with peak attraction period of 4 hours in all the lamps from 22.00 to 02.00 hours (Table 5). Sujatha *et al.* (2011) observed that no moth activity was observed from 17.00 to 19.00 hours and peak attraction was between 23 to 24 hours. The attraction and destruction of slug caterpillar moths through light traps can be utilized in IPM programme particularly in plantations of coconut where application of pesticides is laborious.

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