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LIGHT TRAPS FOR MANAGING THE COCONUT BLACK HEADED CATERPILLAR

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ABSTRACT : Moths of *Opisina arenosella*, the major defoliator of coconut palms in India and Sri Lanka, are known to be phototropic. However, this feature has not been exploited in managing the pestiferous populations of *Opisina*. Therefore, the present study aimed at designing and evaluating suitable light traps, which could be integrated with the current scheme of pest management. Four types of traps – bucket trap, modified bucket trap, tray-water trap and trench trap, were evaluated. Results showed the tray-water trap to be the most efficient. Using this trap four light sources (halogen bulb, CFL lamp, petromax and mercury vapour lamp) at two different heights (ground level and 3' above ground level) were further evaluated. It was found that the tray-water trap placed at 3' above ground with a halogen bulb facing upwards was the best combination for trapping moths of *Opisina*. It appears that there is enough potential to include light trapping of moths as one of the components of IPM of *Opisina*.

Key Words : light traps, *Opisina arenosella*, pest management

INTRODUCTION

Opisina arenosella (Walker) (Lepidoptera: Oecophoridae), commonly called as 'coconut black-headed caterpillar', is distributed in India (Rao *et al.*, 1948; Nadarajan and ChannaBasavanna, 1980) and Sri Lanka (Parera *et al.*, 1988). It is the most important defoliator pest of coconut palms in the region. Infestation leads to stunting and delayed flowering in young palms (Rao *et al.*, 1948; Nirula, 1951); and reduction in the number of spikes, increase in immature nut fall and reduction in the size and number of nuts among mature palms (Jayarathnam, 1941; Narayanan, 1954). Integrated management has been most successful strategy in managing this pest. Some of the components of IPM currently in practice include cutting and burning of infested fronds, root feeding of conventional insecticides or botanicals and mass-release of parasitoids (Anon., 2003).

The idea of using light traps as a control measure was put up as early as in 1906 (Green, 1906). He found that the moths were prominently active after dusk and were attracted to acetylene light source. Nevertheless, several reports that followed Green (1906) have different opinions and largely suggest that moths were poorly attracted to light - "a few moths might 'accidentally' get attracted to light" (Nirula, 1956); "moths did not move to light when let out from the glass tube during night" (Nayak, 1970). Nagarkatti (1973) mentions that moths may not be attracted to ordinary light and recommended the use of UV light traps for moth attraction. However, systematic studies carried out by Ramkumar (2002) clearly demonstrated that the moths were highly phototropic, even to ordinary light sources. It was demonstrated that moths were attracted to light irrespective of gender, age or mating status. He has argued that lack of clear understanding of the developmental and population biology of the species led to some of the workers reporting that *Opisina* was not phototropic.

As it has now been established that moths are attracted to light, we made an attempt to design a suitable light trap for monitoring/ managing populations of *Opisina*. Success in light-trapping depends on the design of the trap and the light source. We describe the design of the light traps, and present results of the trials conducted to evaluate them and the various light sources from the context of trapping moths of *Opisina*.

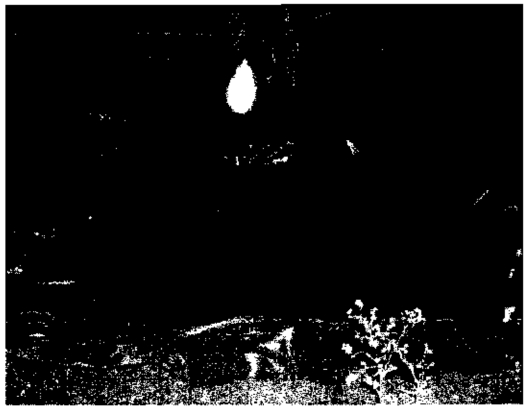

Fig. 1. Trench method adopted for trapping moths of *Opisina arenosella*

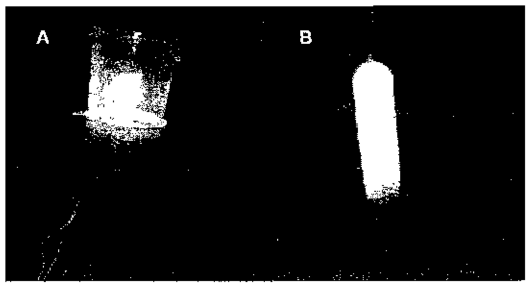

Fig. 2 Bucket trap developed for trapping moths of *Opisina arenosella*. A) Entire set up; B) Moths attracted to the light but not trapped

MATERIALS AND METHODS

Three types of traps – *bucket trap, modified bucket trap* and *tray-water trap* were designed and tried for trapping moths of *Opisina*. Farmers had designed the fourth type, called as *trench trap*, to trap the moths. All four traps were evaluated during the present investigation.

Trench trap consisted of a pit measuring 3 feet in length, 2.5 feet in width and 1.5 feet in depth dug on the ground. A plastic sheet was spread over the inside of the pit to prevent seepage. This was filled with water to which 15 ml kerosene was added. A bulb was hung above the water surface in the middle of pit (Fig. 1). Such a method was being practiced by a couple of farmers in the locality. *Bucket trap* consisted of a transparent plastic circular box (collection jar) measuring 20 cm long and 15cm wide. A funnel measuring 20 cm wide was placed over the collection jar. Over this funnel another plastic box (trapping jar) 25 cm long and 20 cm broad was placed (Fig. 2). The bottom of the trapping jar was cut open with four large openings to facilitate entry of moths into the collection chamber through the funnel. A provision was made at the bottom of the trapping jar to fix a bulb in an upright position. *Modified bucket trap* was designed as an improvisation over the bucket trap, where a few difficulties were observed. The only modification made over the bucket trap was to make large openings along the sides of the trapping jar to facilitate entry of moths inside the

Table 1: Various light sources in different positions in traps evaluated by placing the traps on ground and 3 feet from the ground

Light source	Position of the light source	Placement Height
Halogen bulb	Upward facing	3 feet above the ground
Halogen bulb	Downward facing	3 feet above the ground
Halogen bulb	Downward facing	On the ground
Mercury vapour lamp	Upward facing	3 feet above the ground
Mercury vapour lamp	Downward facing	3 feet above the ground
Mercury vapour lamp	Downward facing	On the ground
CFL lamp	Upward facing	3 feet above the ground
CFL lamp	Downward facing	3 feet above the ground
CFL lamp	Downward facing	On the ground
Petromax	-	3 feet above the ground
Trench method with mercury vapour lamp	Downward facing	

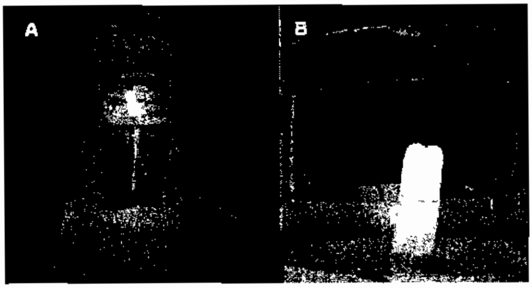

Fig. 3 Modified bucket trap with openings made for the moths to enter the trap. A) Entire set up; B) Moths attracted to the light but not trapped

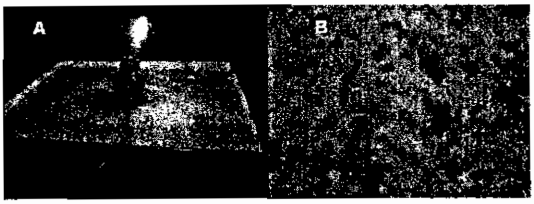

Fig. 4 Tray water trap developed to trap moths of *Opisina arenosella*. A) Entire set up; B) Moths of *O. arenosella* floating on the water

trap than mere settling on the trap (Fig 3). *Tray–water trap* is a simple structure consisting of a metal tray of 1M x 1M. Provision was made in the middle of the tray to fix a bulb in an upright position. The tray was filled with water up to 2" deep (Fig 4). Five ml kerosene was added to break the surface tension of water and kill the trapped moths.

Initially, traps were evaluated and screened using CFL bulbs with respect to landing of moths, entry of moths into the trap and the number of moths trapped. However, in the case of the trench traps we continued with mercury vapour lamp, which was being used by the farmers.

Four light sources – mercury vapour lamp, halogen bulb, CFL lamp and petromax light were evaluated using tray-water trap, the trap that was found promising during the preliminary evaluation. These bulbs were further evaluated at two positions – upward facing and downward facing; and at two heights – on ground and 3' from the ground as detailed in table 1.

Experiments were carried out in a garden with 500 palms in the age group of 20-24 years at Kuppala village, Kadur taluk during December 2004. The garden selected for the evaluation of traps was part of a continuous stretch of infestation spread across 180 acres of coconut

Table 2 Evaluation of light traps against *Opisina arenosella*

Sl. No.	Trap type trap/night#	Number of moths attracted/ moths trapped/trap/night	Per cent of attracted
1	Bucket trap	9.78 ± 2.63^{b}	25 ± 9.19^{c}
2	Modified bucket trap	11.11 ± 2.61^{b}	44.29 ± 7.06^{b}
3	Tray-water trap	$14 \pm 8.9 \pm 3.21^{a}$	100 ± 0.00^{a}
4	Trench method	6.16 ± 2.40^{c}	—

#Mean of nine replications

Means along the column not followed by the same letters are significantly different (Duncan's Multiple Range Test; $p<0.05$).

Table 3 Evaluation of different light sources placed at different heights from the ground in various positions using the tray-water trap

Sl. No.	Light source and the position of the trap	Mean no. of moths trapped per trap#
1	Halogen bulb facing up and placed at 3 ft height	44.43 ± 7.52^{a}
2	Halogen bulb facing down and placed at 3 ft height	33.16 ± 6.05^{b}
3	Halogen bulb facing down and placed on ground	11.50 ± 2.74^{d}
4	Mercury vapour lamp facing up and placed at 3 ft height	35.33 ± 7.25^{b}
5	Mercury vapour lamp facing down and placed at 3 ft height	20.83 ± 4.99^{c}
6	Mercury vapour lamp facing down and placed on ground	8.33 ± 1.76^{de}
7	CFL lamp facing up and placed at 3 ft height	17.16 ± 3.38^{c}
8	CFL lamp facing down and placed at 3 ft height	11.16 ± 2.64^{d}
9	CFL lamp facing down and placed on ground	7.00 ± 2.28^{de}
10	Petromax light at 3 ft height	5.16 ± 1.73^{e}
11	Petromax light on ground	3.16 ± 1.48^{e}

#Mean of six replications

Means not followed by the same letter are significantly different ($p < 0.05$) Duncan's Multiple Range Test.

grooves. The traps were run for three consecutive nights from 6pm to 11pm after which the light was put off and total number of *Opisina* moths was counted in each trap. The traps were at least 100M away from each other. Positions of the traps were changed at random after each night. Two traps for each light source were simultaneously run on all the nights. The average number of moths collected from the two traps (for each light source) per night was noted. Each of the three nights served as a replication. Duncan's Multiple Range Test was used to detect the most efficient light source in trapping moths of *Opisina*.

RESULTS AND DISCUSSION

There was a significant difference among the traps with respect to number of moths trapped (DMRT; $p<0.05$). The tray-water trap attracted more number of moths (14.89±3.21 moths/trap/night) compared to bucket trap and modified bucket trap (9.78±2.63 and 11.11±2.61 moths/trap/night, respectively). All the moths attracted were trapped in tray-water trap, while, only 25±9.19 and 44.29±7.06 per cent of the total moths attracted were trapped in bucket trap and modified bucket trap, respectively (table 2). Trench method with mercury bulb facing downwards attracted 6.16±2.40 moths/trap/night.

Four light sources placed at different positions and heights were evaluated for attracting moths of *Opisina* (table 3). There was a significant difference in number of moths attracted to the type of light source (DMRT; $p<0.05$) height of the trap placed (DMRT; $p<0.05$) and direction of the light source (upwards or downwards) (DMRT; $p<0.05$). Traps placed at 3 feet height from the ground attracted more number of moths (79.03 moths/night/3 trap types) compared to same traps when placed on the ground (26.83 moths/night/3 trap types). Among the various light sources (bulbs) tried, halogen bulb facing upwards and placed at 3 feet from the ground attracted significantly more adults (44.43±7.52 moths/trap/night) compared to other light sources experimented. This was followed by halogen bulb facing down and mercury vapour lamp facing up and placed 3 feet above the ground, which attracted 33.16±6.05, and 35±7.25 moths per trap per night, respectively. CFL bulb facing down and placed on ground, petromax light placed on the ground and 3 feet from the ground attracted least number of moths (7.00±2.28, 5.16±1.73, 3.16±1.48, respectively). Light sources facing upwards attracted significantly more moths (96.92 moths/night/3 trap types) compared to light source facing down (65.15 moths/night/3 trap types).

Green in 1906 was the first to show that moths were attracted in large numbers to acetylene lamps and promoted the concept of using light traps in managing populations of *Opisina*. However, attraction to light was not confirmed till Ramkumar (2002) observed that moths got attracted to light in sufficiently large numbers, and that males and mated, unmated, spent and unspent females were attracted to light. He also showed that the peak attraction time was between 19.00 and 22.00 hours in a day. Of the several light traps tried during the current trials, tray-water trap was the most efficient. The bucket and modified-bucket traps although attracted moths, were inefficient in trapping them. Among the various light sources tried, halogen bulb placed upwards at 3 feet from the ground attracted the largest number of moths. Hence, tray-water traps with halogen bulb facing upwards forms an ideal combination for trapping the moths.

It appears that the number of moths trapped during the study period may not prompt a grower to set up the traps to catch and kill the moths. In this connection, it must be noted that the incidence and activity of moths at the time of the evaluation was poor and could be the reason for poor catches in the traps. In another study the aforesaid best combination of trap and light source was used to understand the moth activity pattern during the flight period of one of the generations. Three such traps trapped a total of 9049 moths over the flight period (Muralimohan and Srinivasa, in press). This shows that the traps can be effective in not only monitoring the populations but also in managing them, if sufficiently large numbers could be laid. A word of caution here is that light traps should be set up only during the flight period as populations follow discrete generation cycles (Ramkumar *et al.*, 2006). This calls for monitoring the stage of the population before fixing the period of operation of the light traps during each generation of the pest.

It has been observed that when population levels are very high, the parasitoids released may not be sufficient to kill large number of individuals (Muralimohan *et al.*, manuscript under review). In case a significant number of moths are trapped in the light traps, the population would have dwindled in the next generation providing an opportunity for the parasitoids to make an impact. Hence, light traps may be integrated with other management strategies for reducing *Opisina* populations. However, this needs to be studied, especially with respect to their efficiency at varying pest loads. Additionally, future studies should focus on a thorough assessment of the impact of light traps on the population density of the next generation, and on standardizing the number of traps necessary to bring down the population significantly.

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