A Study on Light Traps for Attracting and Killing the Insects Using PKL Electricity

K. A. Khan, Rajia Sultana, Shahinul Islam, and S. M. Zian Reza

Abstract Insects can see the radiation of Ultra Violet (UV) light. Nocturnal insects emit Ultra Violet light and the light source can attract them. To keep it in mind a PKL light source has been designed and developed to kill the insects in the paddy, vegetables, flowers, and fruits field. PKL light traps have been used to reduce the damage of the paddy, flowers, vegetables, and fruits from the nocturnal moths. Some lamps are used to control the type of pests those species are attracted to yellow color. To control the flying insects in the cultivated land a new and innovative PKL electric lighting system based on LED have been designed and developed.

Keywords Nocturnal insects · Insecticide · PKL light · LED · Moths · Pest

1 Introduction

Bangladesh is a agricultural land dependent country (Coombe 1981, 1982; Costa and Robb 2002; Cowan 2009). Farmers are cultivating paddy, fruits, flowers, vegetables, etc. (Day 1941; Emura and Tazawa 2004; Khan et al. 2016a). But the insects are disturbing to cultivate crops in the field (Khan et al. 2016b, 2017; Rahman et al. 2018). That is why this work is important for the betterment of the farmers. The variation of sensitivity with the variation of wave length for UV, green, and blue color have been studied (Khan et al. 2019a, b). There are four steps of growing insects. The steps are as follows: (1) Egg (2) Larvae (3) Pupae (4) Adult. Sometimes eggs, or Sometimes larvae or, sometimes pupae or Sometimes adults are harmful for the paddy, flowers, vegetables and fruits leave from the nocturnal moths. Their sensitivity for different colors is different which is shown in the table-1. This work will help

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for the cultivation of lands for fruits and vegetables. Bangladesh is an agricultural-dependent country. The insects are destroying fruits and vegetables every year. This technology can help to destroy harmful insects.

2 Objective of the Study

1. To design and fabricate light traps for attracting and killing the insects using PKL electricity.
2. To Popularize the light traps for attracting and killing the insects using PKL electricity.

3 Methods and Materials

3.1 Technique of Attracting and Killing the Insects Using PKL Electricity

Figure 1 shows the technique of attracting and killing the insects using PKL electricity. A PKL electric system was set up beside the field during night time. There were two street lights for this PKL electric system. Each of the street light was 300 watts. It had been operated using PKL electricity.

It is shown (from Fig. 2) the design of a funnel type PKL light trap (Prototype). The designed light trap is low cost.

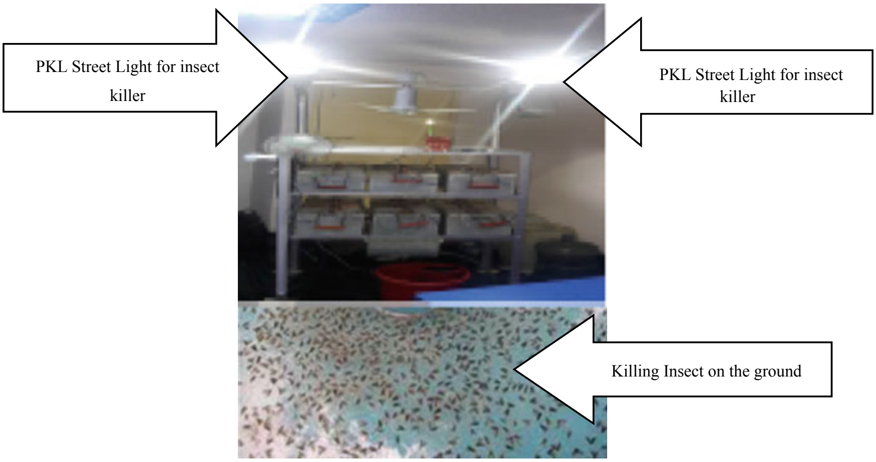

Fig. 1 Methods of attracting and killing the insects using PKL electricity

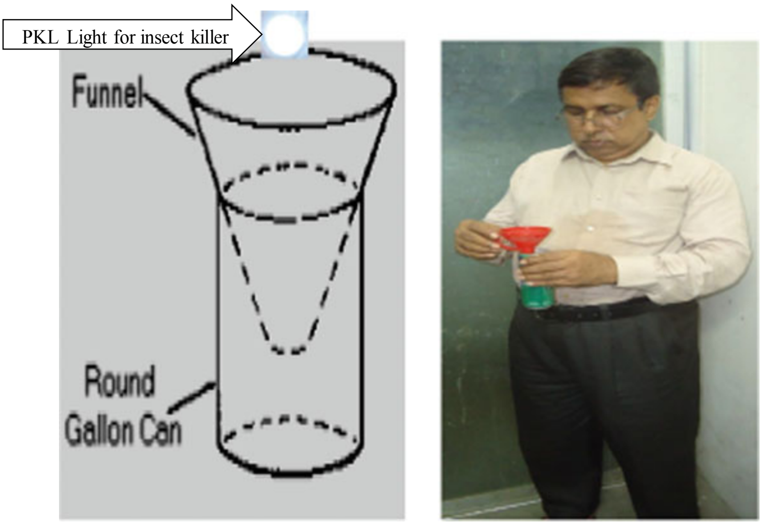

Fig. 2 Design of a funnel type PKL light trap (Prototype)

Fabrication of a Prototype PKL Light Trap for attracting and killing flying insect in the paddy, flowers and fruits field by a two small modules

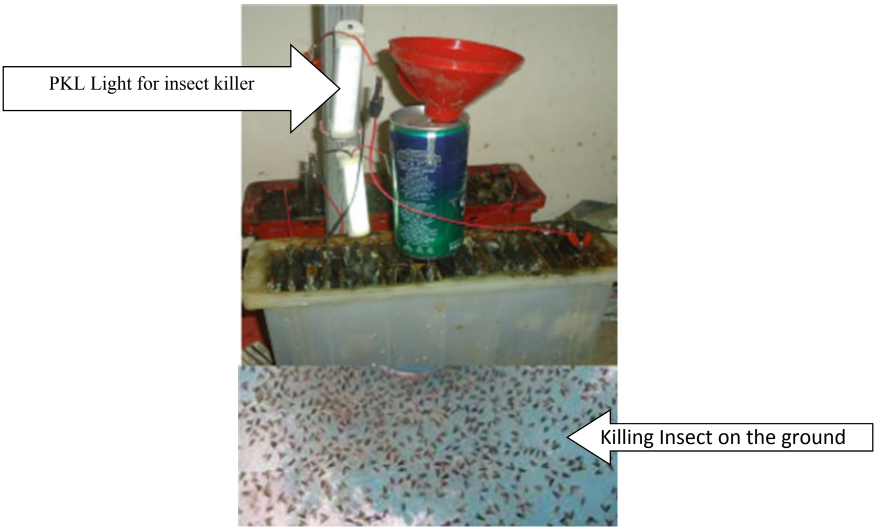

Fig. 3 Fabrication of a funnel type PKL light trap (Prototype)

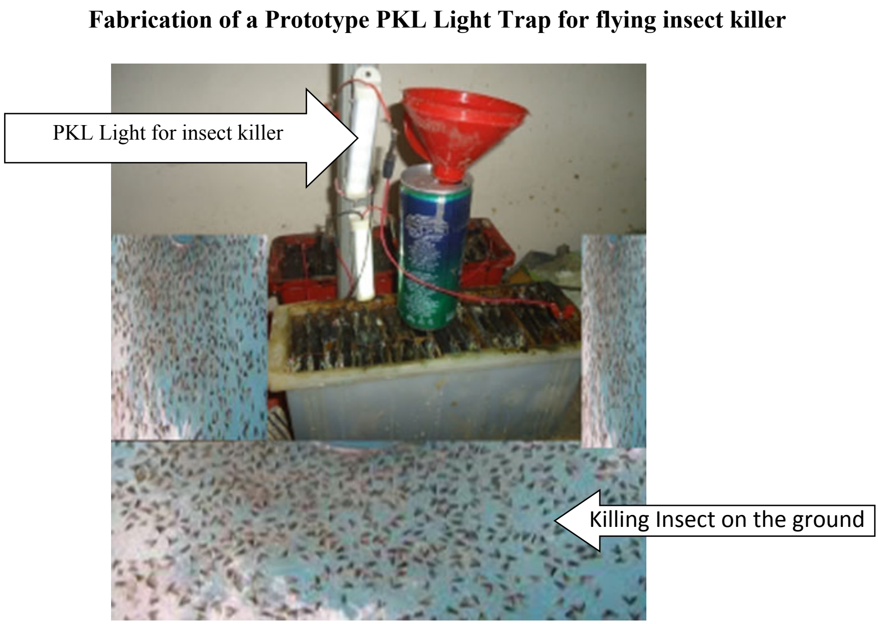

Fig. 4 Fabrication of a funnel type PKL light trap (Prototype)

It is shown (from Fig. 3) the designed and fabricated funnel type PKL light trap (Prototype). The fabricated light trap is low cost which is killing the insect on the ground (Fig. 3).

The light source was provided by PKL current (in Fig. 4) with LED Light. At the base of trap a poison bottle having potassium cyanide with a layer of plaster of parris was hanged for the killing purpose. Adult catches were recorded on daily basis. Dead insects were identified and pinned in the collection boxes. Collections of natural enemies were maintained separately from other insect pests. Effects of moth catches were evaluated on the bases of larval population of major insect pests in the treated as well as the control plot. In addition to major pests of gram and mungbean, many other species of various pests were also attracted.

Light traps (in Fig. 5) play important role in field sampling, monitoring, capturing, killing, and biodiversity studies of nocturnal insect population. Funnel-shaped light traps were used in mungbean and gram crops throughout the year. Effects of light traps were assessed by daily night collections in relation with abiotic factors based on marginal cost-benefit ratio.

Fabrication of a Prototype PKL Light Trap for attracting and killing flying insect in the paddy, flowers and fruits field

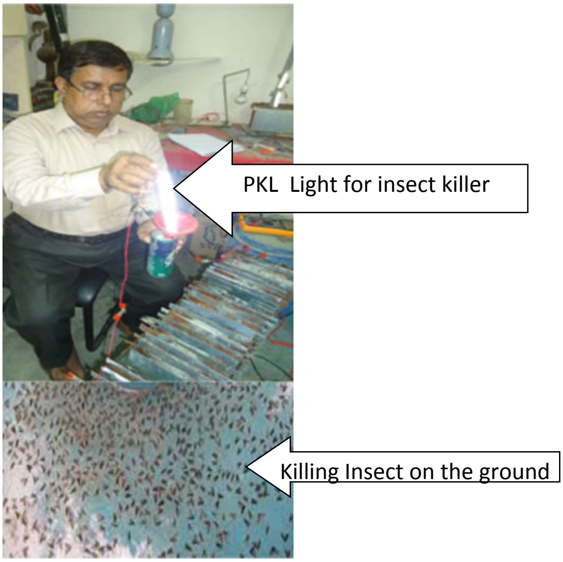

Fig. 5 Fabrication of a funnel type PKL light trap

3.2 PKL Light Sources Attracted by Insects During Night Time

It is shown (from Fig. 6) that the lights are attracted by different insects like Positive phototaxis, negative phototaxis, light adaptation, disturbance of circadian rhythm and photoperiodicity, Toxicity of UV on growth and development, Visibility control with UV-blocking film, and Dorsal light reaction.

4 Results and Discussion

It is shown (from Table 1) that the variation of Sensitivity with the variation of wave length (nm) for UV, Green, and Blue color. It is also shown (Table 1) that the variation of sensitivity for Ultra Violet decreases with the increase of wave length (nm).

The variation of sensitivity for Green decreases with the increase of wave length (nm) firstly and then increases and finally decreases. The variation of sensitivity for Blue decreases with the decrease of wave length (nm) firstly and then increases and finally decreases. It is also shown that the Sensitivity for Ultra Violet and Blue becomes 0 at the wave length (nm) of 550–600 nm.

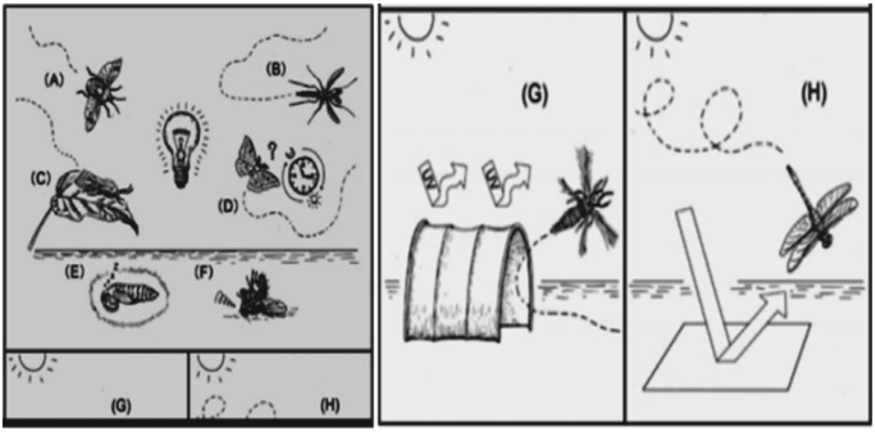

Fig. 6 Lights are attracted by insects: **a** Positive phototaxis, **b** negative phototaxis, **c** light adaptation, **d** disturbance of circadian rhythm and **e** photoperiodicity. **f** Toxicity of UV on growth and development. **g** Visibility control with UV-blocking film. **h** Dorsal light reaction

Table 1 Data for sensitivity versus wave length (nm) for UV, green, and blue color

Wave length (nm)	Sensitivity for ultraviolet	Sensitivity for green	Sensitivity for blue
300	0.28	0.12	0.08
350	1.0	0.45	0.20
400	0.10	0.21	0.75
450	0.05	0.48	0.65
500	0.02	0.75	0.07
550	0	0.80	0
600	0	0.10	0

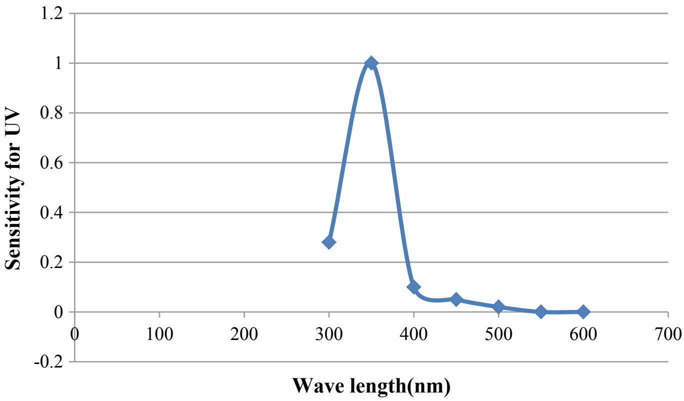

Fig. 7 Sensitivity versus wave length (nm) for UV

Figure 7 shows that sensitivity for UV increases up to 1 nm and then decreases up to 400 nm directly and finally it becomes zero. It is also shown that the maximum sensitivity is 1.00 at the wave length of 350 nm and the minimum sensitivity is 0 at the wave length of 550 and 600 nm. So that the difference between the maximum and minimum sensitivity is 1.00 and the difference between the waves lengths are (550–350) 200 nm and (500–350) 150 nm for maximum and minimum sensitivity of ultraviolet ray.

Figure 8 shows that sensitivity for green color increases and decreases from 0.10 to 0.80 nm. It is also shown that the maximum sensitivity is 0.80 at the wave length of 550 nm and the minimum sensitivity is 0.10 at the wave length of 600 nm. So that the difference between the maximum and minimum sensitivity is $0.80 - 0.10 = 0.70$ nm and the difference between the waves length is (600–550) 50 nm for maximum and minimum sensitivity of Green ray.

Figure 9 shows that sensitivity for blue color increases and decreases from 0.07 to 0.75 nm. It is also shown that the maximum sensitivity is 0.75 at the wave length of

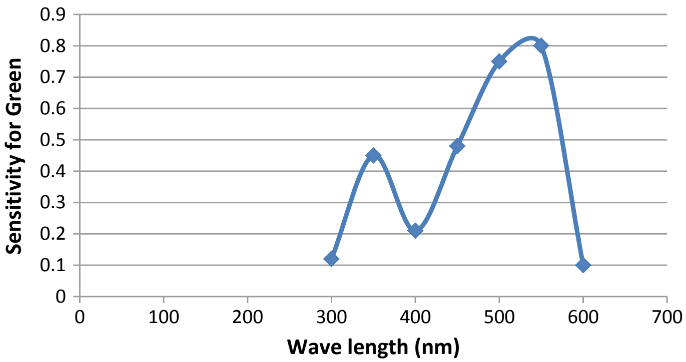

Fig. 8 Sensitivity versus wave length (nm) for green

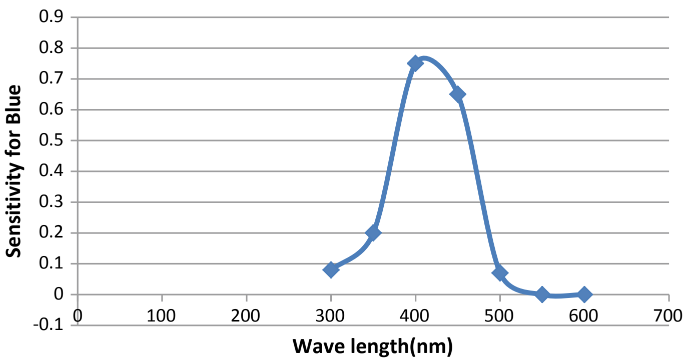

Fig. 9 Sensitivity versus wave length (nm) for blue

400 nm and the minimum sensitivity is 0 at the wave length of 550 and 600 nm. So that the difference between the maximum and minimum sensitivity is 0.75 and the difference between the wave lengths are (550–400) 150 nm and (500–400) 200 nm for maximum and minimum sensitivity of blue light.

5 Conclusions

Light traps are the best tool for the monitoring, attraction, killing, and biodiversity studies of pulses insect pest of Thal regions. This is best insect population controlling tool which can easily be manufactured at homes or small markets with idea Marginal Cost-Benefit Ratio. There are some harmful insects like black beetle, hoppers, green leap, short horn grasshoppers, and white leaf hoppers. Although there are some neutral insects. After using this PKL technology it is not needed to use insecticides in the paddy, fruits, flowers, tea garden, and vegetables field. This work will help to develop the economy of the nation. It can be used instead of fertilizer to kill the flying insects. As a result, people will get the healthy fruits, vegetables, tea, and other crops.

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