# EFFICIENCY OF DIFFERENT LIGHT SOURCES IN LIGHT TRAPS IN MONITORING INSECT DIVERSITY

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[**Ramamurthy, V. V., Akhtar, M. S., Patankar, N. V., Menon, P., Kumar, R., Singh, S. K., Ayri, S., Parveen, S. & Mittal, V.** 2010. Efficiency of different light sources in light traps in monitoring insect diversity. Munis Entomology & Zoology 5 (1): 109-114]

ABSTRACT: Field observations were undertaken at weekly interval (standard week), in 2007-08 at the Indian Agricultural Research Institute, New Delhi for studying the effect of three light sources in light traps (*viz.*, mercury, black and ultra violet) on insect catch and relationship with weather parameters. Results when analysed revealed that coleopterans dominate the catches, followed by hemipterans, hymenopterans and lepidopterans. The mercury light was more efficient for Lepidoptera, Hemiptera, Hymenoptera, Odonata, and Diptera and black light was more efficient for Coleoptera, Orthoptera, Isoptera, and Dictyoptera. Similar attractiveness to the mercury and black light sources were found for coleopterans. Average temperature showed significant relationship with coleopterans, lepidopterans and hemipterans when all insect traps were considered together.

KEY WORDS: Mercury light trap, black light trap, ultra violet light trap, insects, population, climatic factors

Collections of a light trap provide significant clue to the diversity of insects active at night (Southwood and Henderson, 2000), their respective affinity to different wavelengths of light and to understand and predict how populations function (Southwood and Henderson, 2000). Such information, if properly documented, could be put to multi-dimensional use by field- researchers, such as, selection of light-traps for attracting specific order of insects. Inspite of the market being flooded with different models of light traps with lightsources varying in their intensity and wavelengths, no scientific data on the trap collection, diversity, number and its efficacy is available for ready use. Such a data could shed light on the insects attracted to specific range of light. In this regard, a comparative analysis of different light trap collections becomes mandatory in order to study the efficacy of different wavelengths of light in attracting insects of specific orders viz., Coleoptera (Sushil et al., 2004), Hemiptera (Rai and Khan, 2002; Manimaran and Manickavasagam, 2000), Lepidoptera (Rose et al., 2004), Hymenoptera and Diptera (Nair et al., 2004). Further corelating this data with weather parameters could help to predict the period of maximum insect diversity and activity. In order to make such information available, a complete segregation of the individual trap collection over a period of time on the basis of order and total catch, and simultaneously corelating it with the prevalent weather conditions becomes necessary. Hence, a comparative analysis of the light-trap collections using three different light sources and different agroecosystem was carried out correlating with weather conditions. The results of the preliminary observations obtained over two years are presented herein.

## MATERIAL AND METHODS

The present investigations were carried out from 1st to 52nd standard week of 2007-2008 in the experimental fields of Indian Agricultural Research Institute (28°4′N, 77°09′E and 228.16m above mean sea level), New Delhi. Three different light sources with lumens 2700, black or ultra violet-A 400–315 nm and ultra violet-C 280–100 nm (Fig. 5) designed on the bioquip model light trap with certain modifications incorporated towards essential requirements for field use were evaluated. This trap had four constituent parts, namely a. collecting chamber b. funnel shaped lid c. light source and d. lid from the top to protect from unexpected night showers. The light traps were installed in four different places viz., Site I (mix vegetation of vegetables and cereals), Site II (field of different vegetables), Site III (field for cereals for seed production) and Site IV (normal cereals) at weekly intervals for 7 to 8 h. Benzene was used as killing agent and the insects segregated orderwise for recording the observations. The weather data were obtained from IARI observatory (28°4′N, 77°09′E) and correlation coefficients worked out using SPSS-Version 10.

## RESULTS AND DISCUSSION

**Variation in different experimental sites:**

The insects were found round the year, but it show its dominancy from 10th to 45th standard and reach its peak on 27th and 30th standard week in 2007 and 2008 respectively (Fig. 1). The relative catch of insects in Site I, Site II, Site III and Site IV was 25%, 26%, 13% and 36% respectively (Fig. 2). In Site III, the total average catch was low due to the variation in the use of insecticides. The relative total catch (Fig. 3) of insects for UV, Mercury and Black light traps recorded at Site I was 14%, 56% and 30% respectively; at Site II 14%, 39% and 47% respectively; at Site III 09%, 51% and 40% respectively and at Site IV 08%, 42%5 and 50% respectively.

**Variation due to different light sources:**

Amongst the three light traps, Mercury light trap showed the maximum ability followed by Black light trap and UV light traps (Table 1); The details of insects of various orders in UV, Mercury and Black light traps were varied from 0.00 to 66.71; 0.01 to 53.15 and 0.00 to 70.89 percent respectively (Table 1). The total catch of UV, Mercury and Black light traps were varies from 27.89 to 37.17 percent in Coleoptera; from 29.47 to 37.79 percent in Hemiptera; from 19.57 to 56.97 percent in Hymenoptera and from 18.44 to 59.43 percent in Lepidoptera (Fig. 4). The observations are in agreement with those of Upadhyay *et al.,* (2000) and Nair *et al.,* (2004).

**Relationship with weather factors:**

On comparing the weather parameters it was evidenced that; average temperature varies from 9.3 to 36.7 °C shown most significant relationship with total insects catch (r=0.36) followed by rainfall (varies from 0 to 28.71) (r=0.24). Lepidoptera (r=0.21), Coleoptera (r=0.41), Hemiptera (r=0.20) and Coleoptera (r=0.27), Dictyoptera (r=0.22), Odonata (r=0.20) showed positive significant correlation with average temperature and rainfall respectively. Other insect orders did not show any significant relationship with weather parameters (Table 2).

Hence, the knowledge of insect catch in light trap can be used for developing measures to safeguard the health of agricultural environments. Insect population analysis is required for interpreting and forecasting the response of different orders to weather patterns varying seasonally, or as a long-term consequence of global climate change. The data analysis shall allow field workers to pin down and isolate crop pests and there by providing scope for ETL of crop pests and thereby providing scope for implementation of appropriate management practices.

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Table 1. Relative catch (percentage) of different insects order in light traps.

| Orders / Light Sources | LEP | ORT | HEM | HYM | DIP | COL | DIC | ODO | DER | ISO | NEU | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UV | 2.82 | 0.83 | 20.00 | 3.00 | 4.42 | 66.71 | 0.07 | 0.01 | 2.02 | 0.11 | 0.00 | 10.09 |
| MER | 9.09 | 0.35 | 23.10 | 8.74 | 4.32 | 53.15 | 0.07 | 0.32 | 0.83 | 0.02 | 0.01 | 48.13 |
| BLA | 3.39 | 0.46 | 18.01 | 3.60 | 2.19 | 70.89 | 0.32 | 0.13 | 0.87 | 0.14 | 0.00 | 41.78 |

LEP = Lepidoptera; ORT= Orthoptera; HEM= Hemiptera; HYM= Hymenoptera; DIP= Diptera; COL=Coleoptera; DIC= Dictyoptera; ODO= Odonata; DER= Dermaptera; ISO= Isoptera; NEU= Neuroptera; UV= Ultra Violet light; MER= Mercury light; BLA= Black Light

Table 2. Correlation between weather parameters and insects caught in light traps #

| Orders / Climatic factors | LEP | ORT | HEM | HYM | DIP | COL | DIC | ODO | DER | ISO | NEU | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Av T | 0.21* | 0.16 | 0.20* | 0.16 | 0.16 | 0.41** | 0.09 | 0.08 | 0.13 | 0.19 | 0.15 | 0.36** |
| Av RH | 0.02 | 0.12 | -0.08 | 0.14 | -0.13 | 0.03 | 0.13 | 0.12 | 0.06 | 0.12 | -0.05 | 0.03 |
| SSH | 0.02 | -0.01 | 0.04 | -0.11 | 0.13 | -0.05 | -0.17 | -0.16 | 0.01 | 0.00 | -0.03 | -0.04 |
| RF | 0.12 | 0.07 | 0.09 | 0.18 | -0.02 | 0.27** | 0.22* | 0.20* | 0.07 | -0.02 | -0.05 | 0.24* |

Av T= Average temperature; SSH= Sun Shine Hours; Av RH= Average % Relative Humidity; RF= Rainfall; LEP = Lepidoptera; ORT= Orthoptera; HEM= Hemiptera; HYM= Hymenoptera; DIP= Diptera; COL=Coleoptera; DIC= Dictyoptera; ODO= Odonata; DER= Dermaptera; ISO= Isoptera; NEU= Neuroptera *= Correlation is significant at the 0.01 level (2-tailed).; **= Correlation is significant at the 0.05 level (2-tailed); # all light sources combined

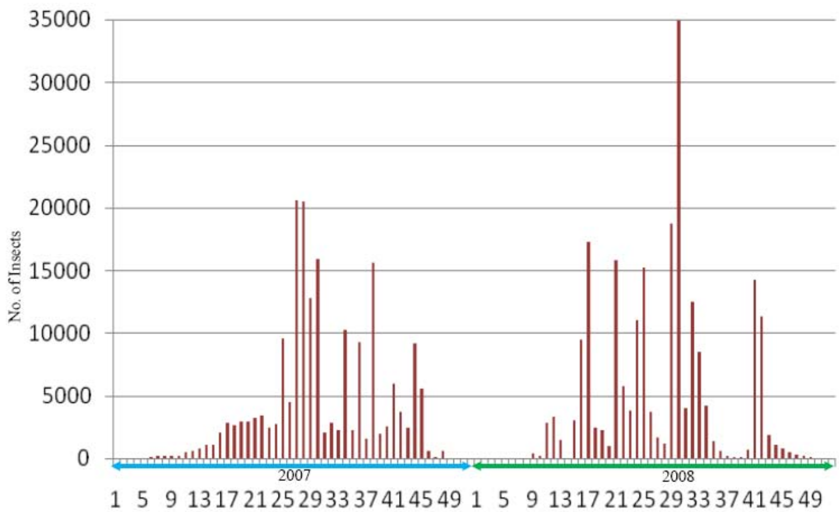


Fig. 1. Population fluctuation of insects with regression equation, 2007 and 2008

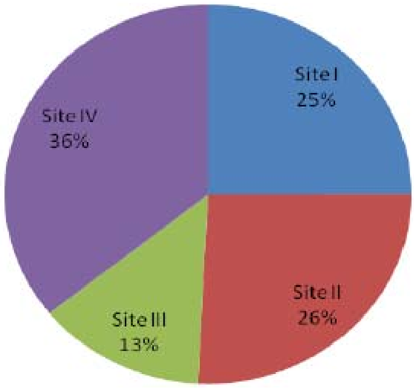


Fig. 2. Relative catch of insects at different localities: Site I (mix vegetation of vegetables and cereals), Site II (field of different vegetables), Site III (field for cereals for seed production) and Site IV (normal cereals).

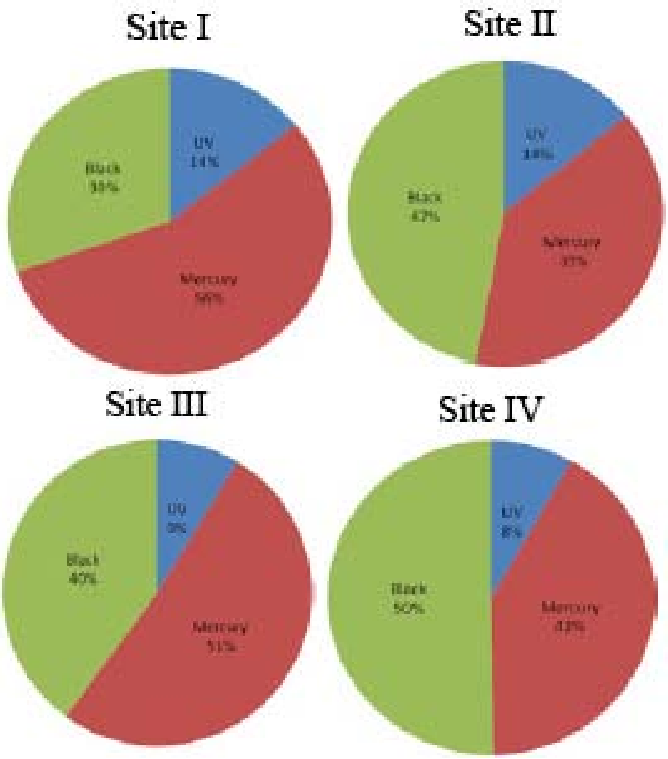


Fig. 3. Relative catch of insects using UV, Mercury and Black light trap in different localities. Site I (mix vegetation of vegetables and cereals), Site II (field of different vegetables), Site III (field for cereals for seed production) and Site IV (normal cereals)

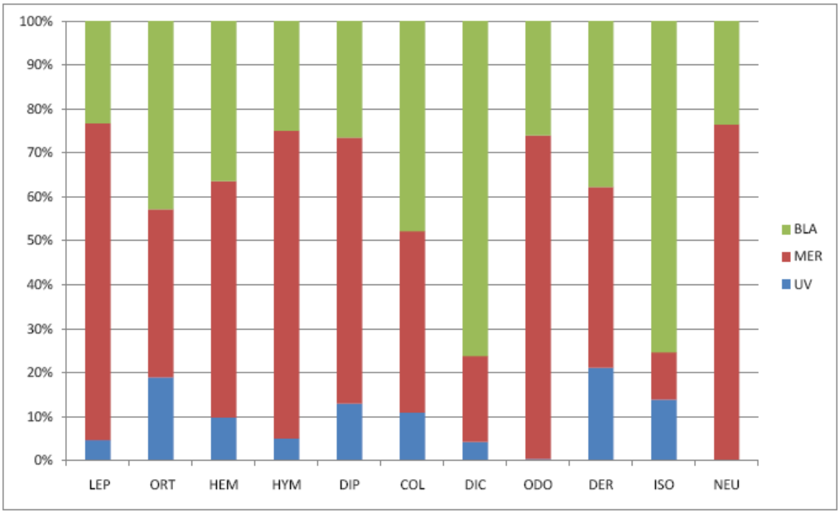


Fig. 4. Efficiency of different light sources (viz., UV = Ultra Violate, MER= Mercury and BLA= Black) on different insect orders (LEP = Lepidoptera; ORT= Orthoptera; HEM= Hemiptera; HYM= Hymenoptera; DIP= Diptera; COL=Coleoptera; DIC= Dictyoptera; ODO= Odonata; DER= Dermaptera; ISO= Isoptera; NEU= Neuroptera)


Fig. 5. Disassembled and assembled light traps; UV (i), Mercury (ii) and Black (iii); Collecting chamber (a), Lid from the top (b), Light source (c), Funnel shaped lid (d)