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Comparative Efficacy of different Funnel Diameters in Light Traps against Major Phototactic Insect Pests of *rabi* Season

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Light traps have been long used to reduce and manage insect populations. Although there are numerous types and designs of insect light traps. Four distinct light traps were employed for the study and positioned within the BSP Unit Adhartal, JNKVV Jabalpur from mid-November 2022 to mid-April 2023 for the study of the efficiency test of different funnel diameters of light traps based on performance. Comparative studies of light trap catches revealed that 50 cm funnel diameter light traps have given higher response in following species for *Helicoverpa armigera* (13.91%), *Agrotis ipsilon (*14.36%), *Creatonotus gengis* (13.97%), *Gryllus bamaculatus* (22.26%), *Gryllotalpa orientalis* (45.30%), *Nezara viridula* (9.82%), *Amata cyssea* (13.35%), *Asota ficus*

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(7.01%), *Perina nuda* (21.78%), and *Thysanoplusia orichalcea* (22.75%). There was a statistically significant increase in trap catches in the 50 cm funnel diameter light traps compared to the 40 cm funnel diameter traps. However, there was a statistically non-significant difference between the 40 cm and 50 cm funnel diameter traps for *Spodoptera litura* and *Theretra oldenlandiae* species, although the trap catches were numerically higher in the 50 cm funnel diameter traps because 50 cm funnel diameter provide large catchment area for insects.

Keywords: Light traps; funnel diameters; insect pests; phototactic.

1. INTRODUCTION

Light trapping has proven to be a highly effective method for studying moths, enabling the reliable sampling of a diverse range of clades and individual specimens for various research purposes [1,2,3]. There are significant variations among traps, encompassing differences in the types of lamps used, structural designs, trap placement, and trapping mechanisms. While light traps may be relatively costly, they are remarkably efficient for collecting nocturnal insects [4,5]. Traps can be used as an effective IPM tool for the monitoring and management of phototactic pests. Many of the insects species, mostly nocturnal and few diurnal, species are positively phototropic (phototactic) and are attracted towards light [6].

Studies comparing trap catches have indicated that the use of a 15-watt Ultraviolet (UV) light source yields superior results compared to a 125-watt Mercury Vapor (MV) light source [7]. Earlier researchers assert that conducting comparisons among different light traps offers a straightforward way to evaluate the influence of structural design on trapping efficiency [3]. Additionally, Pachkin *et al*. [8] have observed that trap design significantly affects the efficiency of insect capture. Similarly, some other researcher viz. Singh et al. (2018) [3], Singh and Sharma [9], Kurmi et al. [10], Mishra et al. [11], Meena et al. [12], Sharma et al. [13], Ambulkar [14], Sharma [15], Bhargava [16], Sharma [17], Kakade [18], Sharma [19], Sharma [20], have also studied on the various aspects of light traps.

In the domains of applied and fundamental entomology, a variety of electric and solar-powered light trap designs are in use for moth capture, but there is a notable absence of comparative assessments that examine the structural designs and power sources utilized in these traps. Present study is put forth for evaluating comparative efficacy of the different funnel diameters in light trap against major phototactic insect pests of *rabi* season.

2. MATERIALS AND METHODS

The research was conducted at the BSP farm in Adhartal, JNKVV, Jabalpur (MP) from mid-November 2022 to mid-April 2023. Four distinct light traps were employed for the study and positioned within the BSP unit Adhartal,JNKVV Jabalpur .These traps were set up at the center of the cultivated field, on a raised board bund near an electric pole. The distance between each trap was approximately 100 meters [7]. All four traps were positioned in different directions and arranged to prevent light from spilling along them [21]. Each day, the traps were activated by turning on the 15 W ultraviolet light, running from 6:00 PM to 11:30 PM (a duration of 5.5 hours) [22]. In the morning, the insects captured in the collection chamber were collected by removing the collection tray. To euthanize the trapped insects in the collection chamber, 70% Formalin was placed in the collection tray [3].

To assess the effectiveness of different funnel diameters in light traps for observing major phototactic insect pest species, two treatments were compared. All four traps used the same 15-watt UV tube as the light source. Data were collected from traps with a 40 cm funnel diameter (both solar and electricity-powered light traps) and traps with a 50 cm funnel diameter (both solar and electricity-powered light traps). The data from these two treatments were combined and adjusted to represent a weekly total over a 7-day period, as per the experiment's computation [21].

To Compare the efficiency of these two light trap designs, the collected data were subjected to statistical analysis. Paired and two-sample t-tests were conducted to determine if there was a significant difference between the two treatments, as required by the research [21].

T_1 = 40 cm funnel diameter [11]
T_2 = 50 cm funnel diameter [23]

The present study is a part of my thesis work entitled “Comparative efficacy of the different funnel diameters and different power sources used in light trap against major phototactic insect pests of *rabi* season”

3. RESULTS AND DISCUSSION

Comparison of efficiency of both the funnel diameters, the observed data were analyzed by paired and two sample t test for testing the significant difference between two treatments. Mainly 12 species data were analyzed that were regular occurrence in light trap minimum 12 weeks. Results are presented below.

Treatments – T_1 = 40 cm funnel diameter
T_2 = 50 cm funnel diameter

For species such as *Helicoverpa armigera* (13.91%), *Agrotis ipsilon (*14.36%), *Creatonotus gengis* (13.97%), *Gryllus bamaculatus* (22.26%), *Gryllotalpa orientalis* (45.30%), *Nezara viridula* (9.82%), *Amata cyssea* (13.35%), *Asota ficus* (7.01%), *Perina nuda* (21.78%), and *Thysanoplusia orichalcea* (22.75%), there was a statistically significant increase in trap catches in the 50 cm funnel diameter light traps compared to the 40 cm funnel diameter traps.

However, for *Spodoptera litura* and *Theretra oldenlandiae* species, there was no statistically significant difference between the 40 cm and 50 cm funnel diameter traps, although the trap catches were numerically higher in the 50 cm funnel diameter traps.

Similarly, Mohammed et al. [24] found that the highest population of the Coleoptera order in all traps occurred in August, specifically in the Jermy-type light trap equipped with a 50 cm funnel diameter. In this, the trap during August, the total number of individuals accounted for 18.58% of the trap's overall count. Similarly, in both the Robinson mercury vapor type and Jermy-type traps, the Coleoptera population collection in August represented 30.10% of the total number of individuals in each respective trap. Additionally, in October, the Robinson-type light trap with a 50 cm funnel diameter recorded a Coleoptera population comprising 18.49% of the total number of individuals in that particular trap.

In Szentkirályi's study in [25], it was found that the Hungarian light trap network, equipped with a 50 cm funnel diameter, outperformed the Jermy light trap, also with a 50 cm diameter. This superior performance was attributed to factors such as the spatial distribution of traps, the duration of the data collection period, and the diversity of insect groups that underwent taxonomic identification.

According to a report by Saeidi Z, [23], the efficiency of mass trapping for *Z*. *pyrina* in walnut orchards was notably enhanced by the combination of a light trap with a 50 cm funnel diameter and a pheromone trap.

Table 1. Comparative efficacy of different funnel diameters in light traps

S. No.	Name of the Insects Species	T_1 (40 cm funnel) Weekly (pooled) mean per trap	T_2 (50 cm funnel) Weekly (pooled) mean per trap	Statistically difference	Increase in trapping efficiency over T1 (%)
1.	*Helicoverpa armiger*a	6.05 (2.40)	6.89 (2.56)	S	13.91
2.	*Agrotis ipsilon*	5.53 (2.34)	6.32 (2.51)	S	14.36
3.	*Creatonotos gangis*	10.25 (3.26)	11.68 (3.48)	S	13.97
4.	*Spodoptera litura*	10.95 (3.36)	11.98 (3.50)	NS	-
5.	*Gryllus bimaculatus*	7.45 (2.77)	9.11 (3.06)	S	22.26
6.	*Gryllotalpa oreintalis*	4.29 (2.13)	6.23 (2.52)	S*	45.30
7.	*Nezara viridula*	9.45 (3.02)	10.38 (3.20)	S	9.82
8.	*Amata cyssea*	9.02 (2.95)	10.23 (3.15)	S	13.35
9.	*Asota ficus*	8.26 (2.85)	8.84 (2.97)	S	7.01
10.	*Perina nuda*	8.42 (2.81)	10.25 (3.13)	S	21.78
11.	*Thysanoplusia orichlcea*	7.03 (2.64)	8.63 (2.93)	S	22.75
12.	*Theretra oldenlandiae*	5.65 (2.40)	6.64 (2.55)	NS*	-

*(__) – Figures in parentheses are (X+0.5) square root transform value. * - Analysis by two sample t-test*

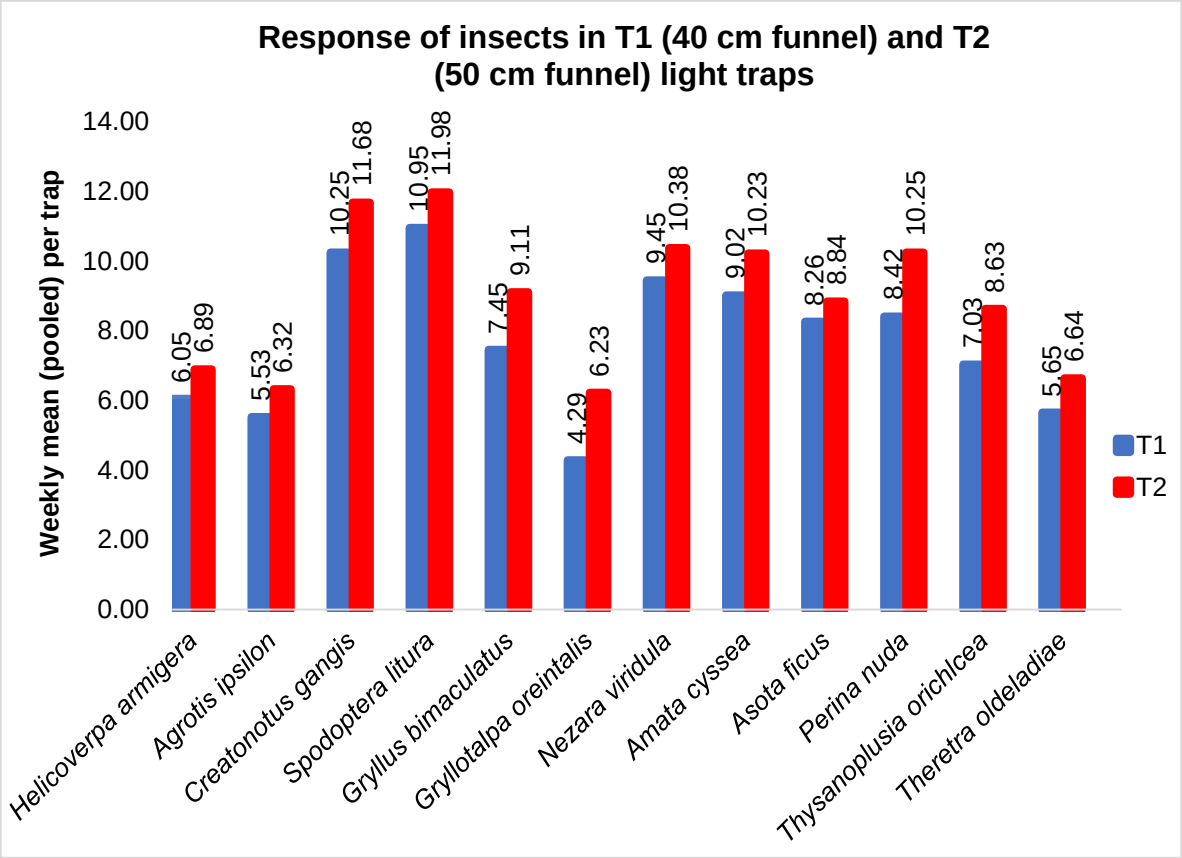

Fig. 1. Comparative efficacy of different funnel diameters in light traps

Whereas Nowinszky et al. [26] found that light traps with a 40 cm funnel diameter exhibited significant variations in catch maxima for different species during different moon quarters. Similarly, Meena et al. [12] and Mishra et al. [11] also reported the efficacy of light traps equipped with a 40 cm funnel diameter for capturing phototactic insect pest species in paddy fields.

Similarly, Sheikh et al. [27], Singh et al. [3], and Pachkin et al. [8] have also documented that the structural design of light traps significantly influences their trapping efficiency.

4. CONCLUSION

In summary, the results of the statistical analysis comparing two different light trap funnel diameters, specifically the 50 cm and 40 cm funnel diameters, both equipped with a 15W ultraviolet light source, consistently favored the 50 cm funnel diameter design in terms of trapping efficacy across most of the tested species. The larger funnel diameter in the 50 cm traps provided a more extensive catchment area for insects, resulting in a higher success rate in capturing them compared to the 40 cm traps. As a result, it is advisable to opt for 50 cm funnel diameter light traps to enhance trapping efficiency in studies involving insect collection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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