Indian Farming 76 (07): 18-21; July 2026

Eco-friendly pest management with ICAR's insect light traps

Guru P.N.[1]* and Renu Balakrishnan[2]

[1]*ICAR-National Institute for Research on Commercial Agriculture, Research Station, Hunsur, Karnataka 571 105*
[2]*ICAR-Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab 141 001*

Insect light traps are an important eco-friendly tool for monitoring and managing insect-pests in agricultural ecosystems. They attract and capture nocturnal insects using specific light wavelengths, enabling early detection of pest outbreaks and facilitating timely management interventions. Their adoption reduces dependence on chemical pesticides, thereby minimising environmental contamination, conserving beneficial organisms, and maintaining ecological balance. In India, the Indian Council of Agricultural Research (ICAR) has played a pivotal role in developing, standardising, and promoting light trap technologies through its institutes and All India Coordinated Research Projects on Insect-Pest Management. ICAR has supported large-scale pest surveillance networks, farmer advisories, and integration of light traps into Integrated Pest Management (IPM) programmes. This article discusses the application and advantages of different light traps built by various institutes for pest forecasting, research, and climate-resilient agriculture. Overall, insect light traps represent a sustainable, cost-effective, and ICAR-supported innovation for environmentally responsible pest management and improved crop productivity.

Keywords: Cost effective, Environment friendly, Integrated pest management, Phototaxis

INSECT-PESTS pose a serious threat to agricultural crops, stored commodities, and food processing causing substantial quantitative and qualitative losses worldwide. They damage grains, seeds, fruits, and processed products, reduce market value, and can also contaminate food with insect fragments and waste. Traditionally, pest control has relied heavily on chemical insecticides and fumigants. While effective, excessive and indiscriminate use of these chemicals has led to several concerns, including insecticide resistance, environmental contamination, harmful effects on non-target organisms, and risks to human health. Increasing awareness about food safety and environmental protection has created a need for safer, sustainable, and eco-friendly pest management approaches. Insect light traps have emerged as an effective and environmentally safe tool for monitoring and managing insect-pests. These devices attract insects using specific wavelengths of light, particularly ultraviolet (UV) light, which many insect species are naturally drawn to. Once attracted, the insects are captured using sticky surfaces, funnels, or electric grids, depending on the trap design. Light traps can be used in agricultural fields, warehouses, storage godowns, food industries, and residential areas to monitor pest activity and reduce insect populations without the use of harmful chemicals.

One of the major advantages of insect light traps is their role in early detection and surveillance of pest infestations. By regularly observing trap catches, farmers, storage managers, and pest control professionals can identify pest species, assess population levels, and take timely management decisions. This helps in reducing unnecessary pesticide applications and supports integrated pest management (IPM) strategies. In addition, light traps are easy to operate, reusable, cost-effective over time, and safe for humans and the environment. Thus, insect light traps represent a practical and eco-friendly solution for sustainable pest management in modern agriculture and storage systems.

The Indian Council of Agricultural Research (ICAR) has played a significant role in the development, standardisation, and promotion of insect light traps for eco-friendly pest monitoring and management across agricultural and storage systems. Through its network of crop-specific institutes, agricultural universities, and All India Coordinated Research Projects (AICRPs), ICAR has conducted extensive research to understand

insect behaviour, particularly their attraction to different wavelengths of light. Based on these studies, ICAR scientists designed and refined efficient and affordable light trap models suitable for Indian farming conditions, including solar-powered and low-energy traps for use in rural and remote areas. ICAR institutes have evaluated light traps for monitoring major crop pests such as moths, beetles, and flying insects in crops like rice, cotton, pulses, oilseeds, and horticultural produce, as well as in storage and food processing environments. These traps have been integrated into IPM programmes to support early pest detection, population surveillance, and need-based pest control, thereby reducing unnecessary pesticide use.

Working of insect light traps

Insect light traps function based on a natural behavioural response of insects known as phototaxis, which is the movement of organisms toward or away from a light source. Many nocturnal insect-pests, such as moths, beetles, flies, and leafhoppers exhibit positive phototaxis, meaning they are strongly attracted to light, particularly ultraviolet (UV) and blue wavelengths. In nature, insects use natural light sources like the moon and stars for navigation. Artificial lights disrupt this orientation, causing insects to move toward the light source. Scientists have carefully studied this behaviour and exploited it in the design of insect light traps by selecting specific wavelengths. One such is UV light of around 350–370 nm that is highly attractive to a wide range of pest species. When insects are drawn to the illuminated trap, they are captured using different mechanisms depending on the trap type. Some traps use sticky glue boards, while others employ funnels that guide insects into collection chambers, or electric grids that immobilise them instantly. The captured insects can then be examined to identify pest species and estimate their abundance. This information is extremely useful for pest monitoring, forecasting outbreaks, and planning timely control measures. Modern light traps are designed to be energy-efficient and user-friendly, with options such as solar-powered units and automatic timers that operate during peak insect activity at night. By exploiting the natural phototactic behaviour of insects, these traps provide an effective, chemical-free method for pest surveillance and partial population control.

ICAR's insect light traps

ICAR has progressively improved insect light traps from mercury vapour lamps in the 1970s to modern solar-powered UV-LED traps, making them safer, energy-efficient, and suitable for both field crops and stored commodity protection. Most ICAR light traps use UV light around 350–370 nm, which is highly attractive to nocturnal insects, and are designed in electric, solar, or LED versions to suit both research and farmer use. ICAR institutes including ICAR-CISH, ICAR-NRRI, ICAR-CIPHET, ICAR-NBAIR, and ICAR-IIHR have developed solar-powered, UV-based, and visible-light insect traps tailored for field crops, orchards, and stored commodities, helping farmers reduce pesticide use and adopt eco-friendly pest management.

Advantages and eco-friendly benefits

Insect light traps offer several advantages as an eco-friendly tool for pest management in agricultural fields, horticultural orchards, storage structures, and protected cultivation systems. Following points highlight the benefits:

- Light traps control and monitor insects without insecticides, reducing pesticide residues on crops and stored commodities i.e. it is a chemical free pest management technique.
- Insect light traps are compatible and easy to adopt technologies in IPM. They help in early detection, monitoring, and forecasting of pest populations, enabling timely and need-based pest control decisions.
- Farmers can avoid unnecessary pesticide sprays, lowering input costs and minimising health and environmental risks. In addition, light traps do not contaminate soil, water, or air and help maintain ecological balance. Reduced reliance on chemicals slows the development of resistance in pest populations.
- Modern traps use UV-LED and solar power, making them suitable for rural and off-grid areas with minimal electricity requirements. Some traps include controlled illumination and escape mechanisms to minimise capture of natural enemies.
- Since no chemicals are involved, they help maintain hygiene and food safety standards.
- Light traps are simple to operate, reusable, and require only periodic cleaning and monitoring.

Limitations

Despite their usefulness in eco-friendly pest management, insect light traps have certain limitations. Following are some of the limitations:

- The most basic limitation is that not all insect-pests are attracted to light. Only insects showing positive phototaxis, mainly nocturnal and flying species such as moths and some beetles, are effectively captured.
- In some models/designs, they may also attract and kill beneficial insects, such as pollinators and natural enemies of pests.
- The trap catches insects depending on weather conditions, sun/moon light intensity, temperature, and seasonal factors, which can influence insect activity and attraction to light. This variability requires careful interpretation of trap data.
- Light traps are mainly useful for monitoring and partial control, but they cannot completely eliminate pest populations, especially during heavy infestations.

Adoption of insect light traps in storage unit

In India, food grain storage warehouses have traditionally relied heavily on chemical fumigants such

Table 1. Insect light traps developed by ICAR institutes (2010 onwards)

Year of development	Trap name/ model	Light source (power), feature	Target usage	Developed by	Image/ Photo
		For agricultural field use			
~2010	Improved electric erid light trap	UV tube with electric grid	Field crops with nocturnal lepidopteron pests	ICAR-National Research Institute for Integrated Pest Management (NRIIPM) formerly NCIPM	
~2010–2015	CISH Trap-1 CISH Trap-2 CISH Trap-3	• Solar powered CFL light • Solar powered dual UV lamps • Electric UV light source (battery)	Vegetable and Horticulture crops	ICAR-Central Institute for Subtropical Horticulture (CISH), Lucknow	  
2014	Alternate Energy Light Trap (AELT)	Solar powered UV lamp	Rice and other field crops	ICAR-National Rice Research Institute (NRRI), Cuttack	
~2014–2015	UV light trap for protected cultivation	Battery operated UV bulb or UV-LEDs	Crops in protected cultivation	ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru	
2017	VL White grub beetle light trap	Electric light source with reflector fins	White grub beetles in hill agriculture	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora	
2020	Solar 24 × 7 insect trap	Micro solar panel with LEDs	Field crops	ICAR-NRRI, Cuttack	
2025	Solar powered universal insect trap (day/night)	Solar powered visible range LED lights	Both storage and field pest management	ICAR-Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana	
		For commodity storage			
2023	Visible light insect trap	Electrically charges batteries, blue LED lights	Storage beetles, moths, warehouse pests	ICAR-CIPHET, Ludhiana	

Note: The above-mentioned traps are collected from available resources, with representative images and any exclusions from this list is not done purposively.

as aluminium phosphide and prophylactic spray like malathion and deltamethrin to manage insect-pests. The average chemical consumption for a single warehouse of 1000 sq. ft. annually is around 50 kg of chemical fumigant, and approx. 30 kg of malathion and deltamethrin is required. The average cost of this is around ₹1 lakh. If this storage warehouse deploys the eco-friendly non-chemical light traps at the rate of at least 3/warehouse (₹12,000), it can help to reduce a minimum of 20% of chemical load, which tunes to about 15–16 kg chemical reduction, i.e. ₹20,000 saving. Apart from this, the manpower and chemical effects can be reduced. When scaled to the storage depots of 2000 (of at least 1000 sq ft each), even partial implementation (e.g. 25% coverage) of light traps could lead to a reduction of over 10,000 kg of chemicals annually, promoting sustainable storage, minimising residues, and improving food safety.

Technological advancements and future thrust

In recent years, insect light trap technology has undergone significant advancement. Traditional fluorescent and mercury vapour lamps are increasingly being replaced by UV-LED light sources, which consume less power, have a longer lifespan, and provide more targeted wavelengths for attracting insect-pests. The development of solar-powered light traps has further enhanced their usefulness, especially in rural and off-grid areas. These traps use solar panels and rechargeable batteries to operate automatically during night hours, reducing dependence on electricity and lowering operational costs. Improved trap designs now include funnels, sticky boards, and escape mechanisms that help capture target pests while minimising harm to beneficial insects. Some advanced models also incorporate programmable timers, light sensors, and adjustable wavelengths, allowing selective attraction and improved trapping efficiency. Recent innovations have focused on integrating insect light traps with digital and smart technologies. Smart traps equipped with cameras and sensors can automatically record insect catches and transmit data through mobile networks, enabling real-time pest monitoring and early warning systems.

In the future, insect light trap technology is expected to become an important component of precision and climate-smart agriculture. The integration of artificial intelligence, image recognition, and Internet of Things (IoT) will allow automatic pest identification, population forecasting, and advisory services through mobile applications. Further improvements in solar efficiency, battery storage, and low-cost materials will enhance accessibility for small and marginal farmers. Development of species-specific wavelength traps and integrated multi-attraction systems will increase selectivity and efficiency while protecting beneficial insects. These technological advancements will strengthen eco-friendly pest management and contribute to sustainable crop production and safe storage systems.

Implications of the technology

A study conducted using VL-white grub beetle trap-1, where 47 light traps were installed, and beetle catches were recorded from June to October each year. A total of 1.25 lakh beetles were captured in 2006, which declined to 0.72 lakh in 2007 and 0.31 lakh in 2008, indicating a substantial reduction in the pest population. This continuous trapping resulted in a 41.92% reduction in beetle population in 2007 and a 75.28% reduction in 2008 compared to the previous year, demonstrating the effectiveness of light traps in suppressing white grub infestations and protecting crops.

SUMMARY

Insect light traps have emerged as an effective, eco-friendly, and technology-driven tool for sustainable insect monitoring and management. They provide real-time information on pest population dynamics, seasonal trends, and migration patterns, enabling timely and need-based interventions. By reducing indiscriminate pesticide applications, light traps help conserve beneficial insects, minimise environmental contamination, and lower production costs. Technological advancements such as solar-powered systems, automated sensors, and AI-based insect identification have further enhanced their efficiency, accuracy, and usability, particularly in remote and resource-limited areas. Their integration into integrated pest management programmes strengthens climate-resilient agriculture and supports biodiversity conservation. With continued innovation and wider adoption, insect light traps will play a crucial role in promoting precision agriculture, ecological balance, and sustainable crop protection for future farming systems.

*Corresponding author email: gurupn5016@gmail.com

Van Mahotsav: A Commitment to Green India

A nationwide tree-planting festival aimed at increasing forest cover and raising awareness about environmental conservation. Initiated in 1950, it encourages communities, schools, and organisations to plant trees, protect biodiversity, combat climate change, and promote a greener, healthier environment. Van Mahotsav Week is celebrated every year during 1st–7th July.

Generally, native trees are planted owing to their ability to adapt to the local conditions better and thus have a higher survival rate. State Governments and civic bodies supply saplings to schools, colleges and academic institutions, NGOs and welfare organisations for planting trees during this week-long festival. Additionally, programmes like screening of short films and documentaries, seminars and exhibitions, and painting and poster making competitions are organised to mark the occasion.