INSECT TRAPPING : AN EFFECTIVE GREEN TECHNOLOGY FOR PEST MANAGEMENT

Guru P. N., Sharma, A., Nancy M., Kalnar Y. B., & Abhishek TS.
ICAR-Central Institute of Post-Harvest Engineering and Technology
PO-PAU Campus, Ludhiana-141004, Punjab (India) & LPU, Phagwara

INTRODUCTION

Insect pest management in agriculture compiles several technologies based on the type of crop/commodity, commercial value, type of storage/processing and duration of handling or storage of the commodity. While devising any pest management strategy, avoidance and preparedness is always better than cure and control. Among the options, easier and the most accepted methods are; the use of synthetic pesticides as they are simple to handle and their easy availability. Simultaneously, it was also admitted by many that the usage of pesticide affects the environment and health, if not used judiciously. Awareness on food safety, quality and its benefits on human health value are earmarked by many and lead to the advancement in exploration of non-chemical management options.

Among such non-chemical management options, trapping by use of physical or biological means is one of the old yet improved in its form for pest monitoring and management. These traps are based on different trapping mechanisms. In common usage these traps are mainly used for estimation of pest populations, which further used to devise the management strategies. Once the insect population in the light traps crosses economic threshold level, then decision making will be easier. In grain storages too, several kinds of traps are commercially available to monitor facilities for the presence of stored grain pests. Reliant on the pest, lures may include female sex pheromones, male aggregation pheromones, or food attractants.

These traps are generally categorized under pest monitoring tools that are mainly used for: 1) Early detection of pest infestations, 2) Measuring the severity of infestations, 3) Selecting the best time to implement control measures, 4) Evaluating the effectiveness of applied control measures, and 5) Decision making on number of sprays. For reading convenience, these traps are described below:

SEMIOCHEMICAL BASED TRAP

Semiochemicals includes groups like pheromones and allelochemicals, wherein, pheromones are the chemical cues emitted by organisms of the same species to influence each other (intra-specific) however, allelochemicals are chemical cues which are emitted by any organisms for interaction between members of different species. They are utilized in a variety of control techniques, including attract-and-kill, push-pull, mass trapping, and mating disruption. Eight different categories of pheromones have been established: aggregation, alarm, oviposition-deterrent, home identification, sex, trail, recruitment, and royal pheromones. For over 20 species of stored grain pests, pheromones are now commercially accessible across globe. The use of sex pheromones for detection and population control is where they are most effective. The "lures" can be employed in the various trap models that are shown in the figures below. Three crucial uses for pheromone traps in pest control include (a) monitoring insect pests (4traps/acre) (b) Mass trapping (male annihilation technique) (c) Mating disruption- releasing higher concentration of pheromone in the atmosphere the opposite sex is rendered confused and unable to locate their mates. Their limitations are availability only for few species, regular replacement of lure for good moth catch and trapping only a target pest.

Sleeve trap

Fruit fly trap

Bucket trap

Water trap

Multi-funnel trap

Delta trap

1. LIGHT

Light traps are having the principal component as light sources, which worked on the basis of photo tactic behavior of the insects. The light slowly affects the physiological and biological systems in insects and was also reported to cause sterility if the intensity was higher. Apart from deciding the time for management, light traps provide information related to insect distribution, abundance, flight patterns. Besides light traps are useful tools to forecast the pest outbreak. There are thousands of insect species which are nocturnal and cannot be collected by conventional methods of insect control. For such insects, light traps work best as sampling tools. Farmers must be aware that by attracting and killing one adult moth they can control around 300-400 insect progenies. Efficiency of light traps is affected by many factors like trap size, design, bulb type and environmental factors. Efficiency of light traps can be calculated correctly by keeping in mind the temperature, air humidity, rainfall, wind speed, moonlight and cloud cover. There are few important types of light traps which are named as follows:

(a) Box trap
(b) Heinstand trap
(c) Robinson trap

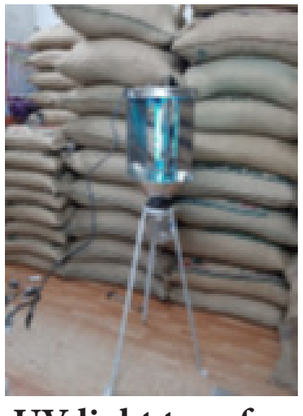
Two important traps used in common are:

UV light trap:

Ultraviolet source is the primary component of the UV light trap (4 W germicidal lamp) 253 nm ultraviolet photons are produced by such a lamp. A funnel with a 310 mm top diameter and an 85 mm bottom diameter is fitted with the light in the centre. A clear plastic container is affixed to the funnel's bottom end so that the caught insects can be collected there. Three hooks have been installed at the funnel's edge so that the unit can be hung at the desired locations. A tripod support is also included with the item. The UV light trap can be positioned in grain godowns for food at a height of 1.5 metres.

Electocuter grid insect trap: An electrical grid insect trap is used to control annoyance insects near homes, businesses, and food processing facilities. In order to allow attracted insects to come into touch with the charged grids, black light lamps are typically placed very close to the grids.When an insect flies between the wires, it normally draws current through its body, which results in death.

Light cum water trap



UV light trap for grain storage

Electro-cuter

2. AIR

Probe traps use the mechanism of the insect's respiratory cycle. Insects, unlike other species, also need oxygen to breathe. As a result, the insects are always concentrated at the grain's top layer or up to a depth of 0.7 to 1.0 meters. These traps are mostly utilized in grain bins, granaries, and milling locations.

TNAU Probe trap:

This trap is used to control grain storage bug populations. The air area between the trap tubes is where the insects usually migrate. The trap needs to be put in vertically into the grain bags. Can be efficient for grains that are 30 cm deep. This trap can be placed in the spaces between bags at any layer of a stack.

Pulse beetle trap:

It is a 10 X 15 cm plastic bottle. It is split into two pieces and joined together using a PVC coupler. The upper section has perforations. The joint at the bottom is used to insert a plastic funnel with a 10 cm diameter. The trap is positioned between oil seeds or pulse grains. Randomly crawling insects drop into the funnel from the openings inside the trap and get collected.

Pitfall trap:

It helps to trap insects moving on the soil surface, such as ground beetles, collembolans and spiders. Sinking glass jars or metal cans into the soil make the pitfall trap. It consists of a plastic funnel, opening into a plastic beaker containing kerosene and is supported inside a plastic jar.

TNAU Probe Trap

TNAU Stack probe trap

Pitfall trap

3. TRAPS OF MISCELLANEOUS NATURE

Few traps which do not fall under the above categories are listed with the brief details below:

- **Colored Sticky Trap:** In this trap Chromo graphic behaviour of the insect is exploited. Sticky traps are generally used for catching the smaller sized aerial insect population viz., leafhoppers, white flies and aphids. The sticky materials include castor oil, Vaseline, tangle foot, etc.
- **Window-pane trap:** It consists of a vertical glass pane with an insecticide trough below, especially suitable for coleopterans, which react by falling into the trough after hitting the pane.
- **Vacuum trapping or suction devices:** These are used to suck the pest in a portable motor run on petrol, propels a blower, which creates a sucking force.
- **Fish meal trap:** Moistened fish meal is used to attract and kill sorghum shoot fly, Atherigona soccata.

Sticky trap

Window pane trap

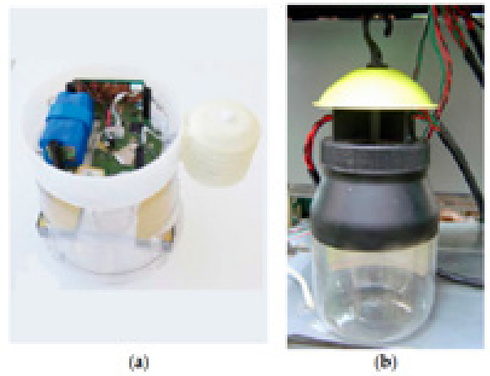
Suction trap

SMART TRAPS

Automatic detection traps are the new advancements that are being developed for many important pests. For instance, a commercial solution produced by EFOS Ltd. (A Slovenian IT and R&D company which developed Trapview, an insect-pest monitoring and forecasting platform) based on cloud computing and image processing. The model integrating bucket/funnel type of trap, especially suited for larger moth species that integrate in high numbers. It can remotely identify *Helicoverpa armigera, Autographa gamma* and *Spodoptera* spp. (Figure 1). To facilitate the operation of a low-cost McPhail trap, optoelectronics sensors were inserted to monitor the entrance of the pests and identify the species of incoming insects from the optoacoustic spectrum analysis of their wing beat. With this system, it was possible to distinguish fruit flies from other insects with 91% accuracy. A novel bimodal optoelectronic sensor that records the wing beat of an insect in flight with Fresnel lens was later on developed. This system was able to make a distinction between *Ceratitis capitata* and *Bactrocera oleae* with 98.99% accuracy

(a) (b)

Figure 1: Automatic trap for monitoring and trapping of (a) moth species and (b) fruitflies



(a) (b)

Figure 2: Electronic traps: traditional used traps converted to automatic fruitfly monitoring units (a) McPhil trap fitted with fresnel lens (b) Automatic trap with infrared sensor for *Bactrocera dorsalis*

CONCLUSION

In comparison to field pests, the management of stored product insects is more difficult because applying pesticides to storage bins or bags may contaminate the grain. About 70% of stored grains are stored in villages with traditional methods, which form a conducive environment for pests to flourish. Especially developing countries suffer a lot due to insect infestation. Integrated pest management is the best way to curtail the infestation status as management by synthetic insecticides has been proven less sustainable and also considered alarming for consumers of stored food grains/commodities. Green technology approaches, mainly trapping is quite useful as it does not require any chemical formulations and works simply on the natural (behavioral) photo taxis of insects. Trapping technology not only eliminates the use of chemicals but is a safer, environmentally acceptable and economically advantageous option too.