Special Issue on Wider Adoption of IPM: A Way Forward for Success to Farmers
Volume 3, Issue 1 - 2021, Pg. No. 34-38

Short Article

Peer Reviewed Journal

Management of Important Insect Pests of Horticultural Crops using Traps

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How to cite this article:
Patidar RK, Dutta P, Patil J et al. Management of Important Insect Pests of Horticultural Crops using Traps. *Int J Agric Env Sustain* 2021; 3(1): 34-38.

Date of Submission: 2021-05-20
Date of Acceptance: 2021-06-13

I N T R O D U C T I O N

Trap is simple interception devices that capture insects moving through an area. It is used for general survey of insect diversity, new invasions of insect pests and monitoring population levels of established pests. Traps may be used as direct control measures, for example, by mass trapping (use of a high density of traps throughout the infested area) or by perimeter trapping (use of traps as a barrier around a pest-free area to intercept insects moving into the area) to remove a large number of individuals, with the goal of preventing or suppressing population buildup to cross economic injury level. This information is used to make decisions on the initiation of control measure or to measure effectiveness of a pest management program. Farmers will have to use data from traps in combination with other observations to make crop pests management decisions. Farmers should experiment with traps in their own fields to increase their understanding of pest populations and to learn how to use traps as a monitoring tool.

Monitoring of insects pests is necessary over an area to create IPM program. If we assess target pests at the right time with the right product, it can save our money and makes our pest control program more effective as well as helps in preserving natural enemy in an applied area. Traps are based on the principles of IPM and avoid the application of chemical pesticides to a great extent. Worldwide pesticide problem was reduced by trap invention. Trap application performs much better in the sustainable agriculture practices, as it doesn't give any residual effects on the field because of absence of chemicals. Especially light trap follows the IPM practices almost ideally. According to the desire we can kill the pests or simply trap them. Trapped insects can also be used for studying their interaction with environment and their further physiomorphic characters or can be utilize as pesticide solution from the trapped insects. Finally, these traps have been accepted to encompass significant importance in IPM. Some common traps that are often used to catch insects are: sticky traps, pheromone traps and light traps and many other traps based on utility as discussing below. Other types of traps include those that are used to kill or capture rodents (mice, rats).

Monitoring of Pest Invasion by Trap

Monitoring of insect pests at regular intervals is essential and it can be done by using different types of traps. Monitoring determines if pests are present, how many, where they are located and often why the problem occurred. Monitoring includes the following such as identifying and locating pests, recognition of sensitive area, size of pest populations, identifying the factors that are contributing to the pest problem, effectiveness of management practices, effects on non-target species, assessing natural enemies and assessing environmental conditions. There are three basic components to a monitoring program. (1) Visual inspections (2) Use of various types of monitoring traps (3) Information from personnel working on site.

Monitoring of insects pest can be done with three major types' traps such as A. Sticky traps-which use an adhesive to capture insects, B. Pheromone traps- which use chemical attractants to draw certain species of pests into the trap and C. Light traps- which use ultraviolet light to lure and capture certain flying insects.

Sticky Traps: These traps were use an adhesive to capture insects. Usually it is further divide into Sticky trap, Yellow sticky traps, Blue sticky traps, White sticky trap.

Sticky Traps: Sticky trap are simply paper, cardboard, or other materials and it's covered with glue. They can be flat, triangular, boxlike, or hanging tapes (for flying insects). They are a simple and inexpensive way to capture cockroaches, ants and other pests. Sticky traps are good positive indicators of an infestation, but are not accurate in proving that the area is pest-free. The distribution of pests on the trap can help determine a site of infestation. Sticky traps are good tools to evaluate the success or failure of your IPM program. Are the trap catches decreasing? This suggests control actions are successful. Technicians need to use the same brand of trap in the same places over the same time periods. IPM programs must include "action thresholds," of pest levels. Sticky traps are a good measuring tool for action thresholds.

Sticky traps should be placed on insect habitat. Traps should replace that have already captured pests, and record the capture information. They should also replace any trap whose glue has become dusty or dirty and follow the manufacturer's recommendations on a regular replacement schedule. The life of sticky trap is probably three months.

Yellow Sticky Traps: This trap is quite effective against white flies, aphids, leaf miners of vegetable, flowers and many agricultural crops. Take new or used sheet of plywood board or hardboard or card board (1.5 ft X 1.0 ft size). Paint it with yellow colour oil paint. Allow it for drying. Apply grease or glue on the painted board. Erect these traps above crop canopy with the help of bamboo poles. No. of traps require per acre is 6-8. Yellow sticky traps are highly effective, non-toxic and easy to use.

Figure 1.Yellow Sticky Trap

Blue Sticky Traps: This trap is quite effective against thrips of cotton, paddy, vegetables and flowers. Number of traps require per acre is 10-15.

White Sticky Traps: Pests attracted toward the white sticky trap are flea beetles, plant bugs of vegetables and fruits. Number of traps require per acre is 6-8.

Pheromone Traps

Pheromones are the natural scents that insects produce to communicate with each other. The term "pheromone" was introduced by Peter Karlson and Martin Luscher in 1959. Scientists have isolated some of these scents and they can be used in traps to attract insect pests. Pheromone traps are valuable tools for monitoring certain pests, particularly cigarette beetles and Indian meal moths, gypsy moths, Japanese beetles and many pests of field crops and fruit trees. Based on the responses of elicited pheromones can be classified into 2 groups.

Figure 2.Pheromone Trap

Primer Pheromones: Primer pheromones trigger off a chain of physiological changes in the recipient without any immediate change in the behaviour. They act through

gustatory sensilla such as caste determination and reproduction in social insects like ants, bees, wasps and termites are mediated by primer pheromones. These pheromones are not having much practical value in IPM.

Releaser Pheromones: These pheromones induce an immediate change in the behaviour of the recipient. Releaser pheromones act through olfactory (smell) sensilla and directly act on the central nervous system of the recipient and modify their behaviour. They can be successfully used in pest management programmes. Releaser pheromones may be further subdivided based on their biological activity into Sex pheromones, Aggregation pheromones, Alarm pheromones and Trail pheromones.

Sex Pheromones: These pheromones are released by one sex only and trigger behaviour patterns in the opposite sex that facilitate in mating. In general pheromones have a large number of carbon atoms (10-20) and high molecular weight (180-300 Daltons). In Lepidoptera sex pheromone produced by eversible glands at the tip of the abdomen of the females. Female sex pheromones are usually received by olfactory sensillae on male antennae. Aphrodisiac glands of male insects are present as scent brushes at the tip of the abdomen which produce the pheromone (e.g. Male butterfly of Danaus sp.). In over 150 species of females have been found to release sex pheromones and about 50 males species produces. Aphrodisiacs are substances that aid in courtship of the insects after the two sexes are brought together. In many cases males produce aphrodisiacs. Insect orders producing sex pheromones are Lepidoptera, Orthoptera, Dictyoptera, Diptera, Coleoptera, Hymenoptera, Hemiptera, Neuroptera and mecoptera. In Lepidoptera, sex pheromonal system is highly evolved.

Table 1.List of Sex Pheromone Produce by Females

S. No.	Sex pheromones	Insects pests
1.	Bombycol	*Bombyx mori*
2.	Gossyplure	*Pectinopora gossypiella*
3.	Helilure	*H. armigera*
4.	Cuelure	*Bactocera cucurbitae*
5.	Ferrolure	*Rhynchophorus ferrugineues*
6.	Leucilure	*Leucinodes arbonalis*
7.	Litlure	*Spodoptera litura*
8.	looplure	*Cabbage semilooper*
9.	(z)-9-hexadecenal and (z)-11-hexadecenal (1:3)	*Scirpophaga incertulus*

Role of Sex Pheromone in Pest Management: Monitoring of insect pests (4 traps/ acre) can be achieved by synthetic pheromone and it is useful in estimating the insect population. Through male annihilation technique large number of pheromone traps can be used to capture the males in field and reduce the mating. Mating disruption can be achieved by releasing higher concentration of pheromone in the atmosphere so that, the opposite sex is rendered to confused and unable to locate their mates.

Benefits of Sex Pheromones: Sex pheromones are species specific, safe to natural enemies and environment, requires small dose, economical viable and compatible with IPM components.

Demerits of Sex Pheromones: Availability of sex pheromone only for few species, regular replacement of lures for excellent catches and traps only a target pest.

Aggregation Pheromone

The pheromone released by one sex only elicits response in both the sexes of a species. It is common in Coleopteran, Hemiptera and Dictyoptera.

Table 2.Commercially Available Aggregation Pheromone in Insects

S. No.	Insect	Aggregation pheromone
1.	Rhynchophorus ferrugineus	RPW Lure
2.	Orcytes rhinoceros	RB Lure

Alarm Pheromone

A substance produced by an insect to repel or disperse or attraction or aggregation of other insect in the area. This pheromone are reported in homoptera, hymenoptera, isopterans and it is released by organs such as mandibular, anal, Dufour's and poison glands in Ants, Cephalic glands in termites, sting apparatus and mandibular glands of worker bees and cornicles or siphunculi in aphids. An individual also release them when an enemy attacks.

Parapheromones

When chemical not found in insect or it is not naturally occurring in insect but has a pheromone like action, artificially synthesized, then it is often referred to as Parapheromones such as methyl eugenol.

Table 3.Commercially Available Parapheromones in Insects

S. No.	Insect	Parapheromones
1.	Melon fruit Fly	Bacu lure
2.	Oriental fruit fly	Bador lure

Sex Pheromone Traps: Sex pheromones are insect specific produced artificially in laboratories and used separately. Male moths are attracted and while attempting for mating,

fall into a container having pesticide. The lure will release the sex pheromone at a constant rate over a period of 2-4 weeks. The lure should be change once in 15-20 days. Pest attracted toward sex pheromone are American boll worm, spotted boll worm, pink boll worm, diamond back moth, white grubs etc.

Fruit Fly Management in Fruit Crops: Fruit flies trap should be attach to a bamboo or wooden stake or hang on branch of a tree or place traps for different pests at least 3 meters apart. If traps are used for monitoring the pests, 2-3 traps are enough for 1 ha field.

Table 4.No. of Traps and Lure Require for Management of Fruit Fly

S. No.	Insect	pheromones	No. of traps/ acre
1.	Melon fruit Fly	Cue Lure	2-3
2.	Oriental fruit fly	Methyl Eugenol	3-5
3.	Mediterranean fruit fly	Trimedlure	3-5

Light Traps

Light traps have been widely used for collection of nocturnal insects. Light trap data provide valuable information about the distribution, abundance and the seasonal flight periods of insects. With a minimum effort, light trapping yields large number of insect specimens. Light traps are efficient to collect the insects like moths, beetles, bugs, some flies and other active insects. Different light sources like mercury vapor lamps, gas lamps and fluorescent UV light tubes are used for sampling purposes. Insect are lured by light and fall the victim of getting trapped into the collecting chamber. UV light traps are relatively inexpensive, hence mostly used. Mercury as well as black light collects more insects than incandescent light. Insect species differ in the attractiveness and depends upon the specific wave length of light. Laboratory tests show European corn borer has maximum attractiveness near ultraviolet region of the spectrum. Certain insect groups like Diptera are attracted in large numbers by incandescent traps while Lepidoptera are attracted strongly by ultra-violet light. Pectinophora gossypiella show a tendency towards UV light. Insects like bugs, beetles and moths, are attracted to almost any kind of light source in tropics.

Installation of light trap should be near or within the field. Operating time of light trap is from early evening 6:00 p.m. to 10:00 p.m. Collect the trapped insects daily and dispose them properly. It is recommended that two traps per acre should be used for insect monitoring. Pest attracted toward the light trap are armyworm, bugs, cutworm, flies, gnats, boll worm, leaf hoppers, plant hoppers, stem borers etc.

Indigenous Light Trap Developed by ICAR-NCIPM

ICAR-NCIPM has developed an improved insect light trap for mass trapping of selective phototrophic macro-lepidopteran insect-pests like hairy caterpillars, boll worm's grubs. This light traps can be used to trap all these major pests that are prevalent in almost all agro-ecological regions of country on majority of crops including field and commercial crops, pulses, oilseeds, cereals and vegetable crops. Mass trapping of adults of both sexes of insect-pests by light traps are pod borer, semilooper, tobacco caterpillar and macro coleopteran help in minimizing their infestation in the crop fields. On the other side, the facility to escape off non-target/ beneficial insects from the insect collecting chamber is a desirable attribute. Although the device cannot restore all beneficial insects the dimensions are good enough to enable escape of several non-like white target and beneficial insect fauna including micro-hymenopteran (Ichneumonidae, Formicidae, other hymenopteran insects), micro-coleopterans (Staphylinidae), micro-dipterans (Ephydridae), micro-dermapterans (Forficulidae) and several other insect fauna. It is a proven important eco-friendly tool against crop pests.

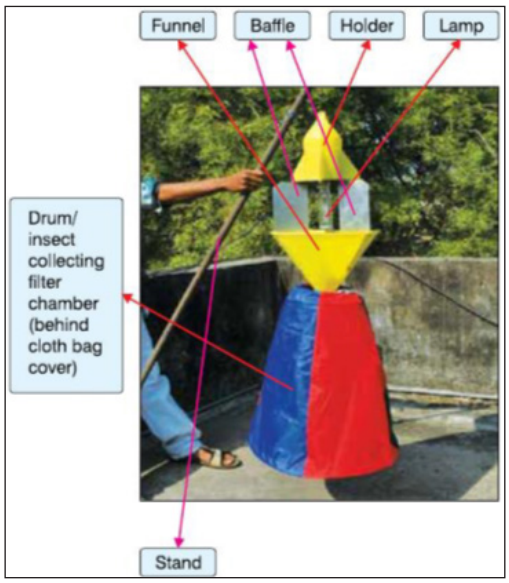

Figure 3.Light Trap Developed by ICAR-NCIPM

Factors affecting the Collection of Light Trap: Light trap catch is influenced by type of vegetation, lunar light and weather. Weather is an important factor, which decides the light trap catch. It has been mentioned that warm, humid and moonless nights produce a rich sample of insects in general.

Limitations and Difficulties with Light Traps: The main disadvantage of light traps is their limitation to nocturnal species and hence a direct comparison of quantitative data is difficult. The problem with the light trap data is its difficulty to be sure over what area the trap is effective.

It has been found that they measure activity rather than relative abundance. Light trap catch is affected by many variables like trap size, design, height, bulb type and surroundings and varies between species. Timing of trap operation, illumination by moon light and light sources also decides the insect catch. At high voltage light source can burn the important identification marks or the body parts of the insect.

Application of Different Types of Traps I Horticultural Crops

Management of Bactocera cucurbitae: Installation of trap with waste water bottle can be use as bait with cue-lure saturated wood blocks (ethanol: cuelure: carbaryl in a ratio 8:1:2) @ 25 traps/ ha prior to flower initiation.

Management of Helicoverpa armigera in Tomato: Pheromone traps can be used @ 5traps/ ha with Heli-lure for monitoring of H. armigera at flowering stage.

Diamondback Moth (Plutella xylostella) Management in Cabbage: Use of light traps @ 3/ acre for adults of DBM. Installation of pheromone traps i.e. DBM lure @ 10/ ha for mass trapping.

Shoot & Fruit Borer management in brinjal (leucinoides arbonalis): Installation of plastic funnel traps 100/ ha baited with sex pheromone lures i.e Leucilure from 15-20 days of planting traps at 10 m distance.

Delta Traps and Yellow Sticky Traps for White Fly in Brinjal: Installation of Delta traps and yellow sticky traps for white fly management in Brinjal.

Tomato moth (Tuta absoluta) management in Tomato: The effectiveness of mass trapping the moths of Tuta absoluta was evaluated using light traps in tomato polyhouse at ICAR-IIHR, Bengaluru. They evaluated, yellow and white (bluish) color light source were found relatively effective for attraction of the moths. Also they observed that incandescent yellow bulb of 60 W was found most efficient in attracting both sexes of Tuta moths. Thus light traps can be an effective tool for IPM of this pest on tomato, under polyhouse conditions.

Pest Management in Cardamom: Set up yellow pan water/ sticky traps 15 cm above the canopy for monitoring aphids and blue pan water/ sticky trap for thrips @ 4-5 traps/ acre. Locally available empty tins can be painted yellow/ blue and coated with grease/ castor oil on outer surface can be used.

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