

## Insect Pheromones: An Eco-Friendly Tool for Insect Management

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ARTICLE ID: 49

### Abstract

Insects are the major concern of agricultural crop production loss. Records show that 30per cent of production loss in cotton, 25 per cent in rice, 20 per cent in oilseeds and sugarcane, 18per cent in maize, 15per cent in groundnut and pulses are caused by insects (Dhaliwal *et al.*, 2015). To get rid of these insects, farmers tend to use many insecticides. Insecticides are toxic not only to pests, but also to humans and animals, nearly 3,00,000 deaths are caused worldwide every year by poisoning from pesticides (Sabarwal *et al.*, 2018). Considering these and other associated drawbacks like resistance against pesticides, residues in edible foods and soil and resurgence of pestswith the usages of pesticides, scientists around the world tried to get to the bottom of this issue with sustainable approach by behavioral manipulation of insects through insect pheromone traps. Usage of the pheromone traps can lower the cost of production. Although, the pheromone traps are ecofriendly, creates no harmful effects on other organisms than the targeted one.

### Introduction

The word semiochemical is defined by Law and Regnier (1971)as, any chemical signal which conveys information between insects is termed a semiochemical. They are further divided in two categories *viz.*, allelochemicals and pheromones. Moreover, Wilson and Bossert (1963) divided pheromones into two categories according to their mode of influence *viz.*, primer pheromones and releaser pheromones. Among them, the releaser pheromones are of much importance, which includes sex pheromones, aggregation pheromones, alarm pheromones and trail pheromones. The sex pheromones are used in pheromone baited traps for monitoring, mass trapping and mating disruption of insects.

### Sex pheromones

Butenandt in 1959, isolated and identified a sex pheromone chemically known as, E-10-Z-12-hexadecadienol (bombykol) from the abdominal segments of female silkworm moth, *Bombyx mori* L. (Lepidoptera: Bombycidae). This discovery opened doors for the establishment of chemical ecology as a scientific discipline. Sex pheromones are typically much stronger and put off by short-lived one, mainly by females to attract males. Female sex pheromones are usually received by olfactory sensilla on male antennae and males search upwind, following the odor corridor of the females which could be discontinuous plume. While, aphrodisiac glands of male insects that present as scent brushes or hair pencils at the tip of the abdomen produces sex pheromones.

**Table 1: Examples of sex pheromones identified in various insects**

Sr. No.	Name of the Insect	Chemical formula	Pheromone
1.	<i>Pectinophora gossypiella</i> (Saunders)	(Z, Z) and (Z, E) 7,11-hexadecadienyl acetate (1:1)	Gossyplure, Pectinolure
2.	<i>Spodoptera litura</i> (Fabricius)	(Z, E)-9-11-tetradecadienyl acetate and (Z, E)-9-12-tetradecadienyl acetate (10:1)	Spodolure, lit-lure
3.	<i>Helicoverpa armigera</i> (Hubner) Hardwick	(Z)-11-hexadecenal and (Z)-9-hexadecenal	Heli-lure
4.	<i>Bactrocera dorsalis</i> (Hendel)	4-allyl-1,2-dimethoxybenzone	Methyl eugenol
5.	<i>Bactrocera cucurbitae</i> (Coquillett)	4(p-hydroxy phenyl) 2-butanone acetate	Cue-lure
6.	<i>Anthonomus grandisgrandis</i> Boheman	1-methyl-2-cyclobutaneethol	Grand lure

Among the mentioned pheromones, methyl eugenol and cue-lure are the para-pheromones (artificially synthesized attractant that is not original chemical of naturally occurring insect), while the grand lure is produced by the male cotton boll weevil, *A. grandisgrandis* Boheman (Coleoptera: Curculionidae).

### **Insect pheromones as an eco-friendly tool**

The use pheromone has become an important component of integrated pest management (IPM) system, which could be used for monitoring, mass trapping and mating disruption of insects.

- ✚ **Monitoring.** Pheromone traps with lures are useful to monitor different crop pest species. The trap catches correlated with weather parameters to develop forewarning

models. It is also useful for the detection of presence and abundance of the pest population, estimation of new areas of infestation at a very early stage and allows farmers to decision making for timely applications of management practices.

- ✚ **Mass trapping.** It is an extension of the use of species-specific pheromone baited monitoring traps, with the aim of reducing or eradicating populations (mass trapping) of target pests. Pheromone baited traps can be placed at suitable points with a lure and insecticide. This technique is also called as male annihilation technique (MAT). This strategy has been applied to insect pests of both field crops and stored products.
- ✚ **Mating disruption.** It can be explained by three mechanisms viz., confusion, camouflage and disguise. Pheromone is released from the dispensers that act as false source, or it is released at such a high rate that the male got disoriented or unable to detect the plume of the calling female. Pink bollworm (PB) knot, specialized pheromone and lure application technology for pink bollworm (SPLAT-PBW) and Sawaj mating disruption pheromone (MDP) technology which are innovative mating disruption tool in which pheromones and insecticides are encapsulated as a wax, gel, or paste and applied as droplets per hectare on the plant via dispensers and these are also slowly releasable in nature.

**Table 2: Recommendations by State Agricultural Universities (SAUs) of Gujarat, India**

Sr. No.	Insect	Lure	Recommendation	SAU
1.	Shoot and fruit borer in brinjal	Leuci-lure	40 pheromone traps/ha at 20 days after transplanting for mass trapping	SDAU
2.	Fruit fly in cucumber	Cue-lure	16 pheromone traps/ha at flowering stage for mass trapping	AAU
3.	Fruit fly in cucurbitaceous crops		10-12 pheromone traps/ha at flowering, fruiting and harvesting stage for mass trapping	NAU
4.	Fruit fly in mango	Methyleugenol	10-12 pheromone traps/ha at 4-5 feet height from the ground for mass trapping	
5.	<i>H. armigera</i> in pigeon pea	Heli-lure	10-12 pheromone traps/ha 1.5 feet above the crop canopy level at 50 % flowering stage for monitoring	
7.	<i>S. litura</i> in tomato	Spodo-lure	40 pheromone traps/ha at flowering for mass trapping	

10.	Fruit fly in mango	Methyl eugenol	Sawaj MDP technology, 400 g paste/ha by 1000 dots/ha on main and subsidiary branches of each tree, first application in the month of March and successive two applications at 30 days interval	JAU
11.	<i>Spodoptera frugiperda</i> (J. E. Smith) in maize	Spodo-lure	50 pheromone traps/ha at 10 days after germination and the lure to be changed after 40 days	

**Note:** SDAU: SardarkrushinagarDantiwada Agricultural University, AAU: Anand Agricultural University, NAU: Navsari Agricultural University, JAU: Junagadh Agricultural University

### Conclusion

Nowadays, environmental safety has become the national and global concern for mankind. Also, with increasing awareness regarding organic farming and natural farming concept farmers are more tend to use eco-friendly, cost effective, easily adoptable tools for management of insect pests. Therefore, pheromone lures have been developed for monitoring, mass trapping and mating disruption of many insect pests of agricultural importance, and these were significantly benefited in reducing insect population and load of chemical pesticides.

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