Lecture 21: PHEROMONES

Semiochemicals are chemical substances that mediate communication between organisms. Semiochemicals maybe classified into Pheromones (intraspecific semiochemicals) and Allelochemics (interspecific semiochemicals).

Pheromones are chemicals secreted into the external environment by an animal which elicit a specific reaction in a receiving individual of the same species. Pheromones are volatile in nature and they aid in communication among insects.

Pheromones are exocrine in origin (i.e. secreted outside the body). Hence they were earlier called as ectohormones. In 1959, German chemists Karlson and Butenandt isolated and identified the first pheromone, a sex attractant from silkworm moths. They coined the term pheromone. Since this first report, hundreds of pheromones have been identified in many organisms. The advancement made in analytical chemistry aided pheromone research.

Based on the responses elicited pheromones can be classified into 2 groups

a) **Primer pheromones:** They trigger off a chain of physiological changes in the recipient without any immediate change in the behaviour. They act through gustatory (taste) sensilla. (eg.) Caste determination and reproduction in social insects like ants, bees, wasps, and termites are mediated by primer pheromones. These pheromones are not of much practical value in IPM.

b) **Releaser pheromones:** These pheromones produce an immediate change in the behaviour of the recipient. Releaser pheromones may be further subdivided based on their biological activity into

Sex pheromones
Aggregation pheromones
Alarm pheromones
Trail pheromones

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.

1) **Sex pheromones** are released by one sex only and trigger behaviour patterns in the other sex that facilitate in mating. They are most commonly released by females but may be released by males also. In over 150 species of insects, females have been found to release sex pheromones and about 50 species males produce.

Aphrodisiacs are substances that aid in courtship of the insects after the two sexes are brought together. In many cases males produce aphrodisiacs.

Major differences between male and female produced pheromones are listed below.

Sl. No	Properies	Female sex pheromone	Male sex pheromone
1.	Range	Acts at a long range. Attracts males from long distance	Acts at a short distance
2	Role of other stimuli	Play less role	Visual and auduitory stimuli play major role
3.	Action elicited in the other sex	Atrracts and excites males to copulate	Lowers females resistance to mating
4.	Importance in IPM	More important	Less important

Insect orders producing sex pheromones

Lepidoptera, Orthoptera, Dictyoptera, Diptera, Coleoptera, Hymenoptera, Hemiptera, Neuroptera and mecoptera. In Lepidoptera, sex pheromonal system is highly evolved.

Pheromone producing glands:

In Lepidoptera they are produced by **eversible glands** at the tip of the abdomen of the females. The posture shown during pheromone release is called 'calling position'. Aphrodisiac glands of male insects are present as **scent brushes** (or hair pencils) at the tip of the abdomen (eg. Male butterfly of *Danaus sp.*). **Andraconia** are glandular scales on wings of male moths producing aphrodisiacs.

Pheromone reception:

Female sex pheromones are usually received by olfactory sensillae on male antennae and males search upwind, following the odour corridor of the females. In pheromone perceiving insects, the antennae of male moths are larger and greatly branched than female moths to accommodate numerous olfactory sensilla.

Chemical nature of sex pheromones

In general pheromones have a large number of carbon atoms (10-20) and high molecular weight (180 – 300 daltons). Narrow specificity and high potency are two

attributes which depend on long chain carbon atoms and high molecular weight. But since pheromones are volatile their molecular weights cannot be very high as they cannot be carried by wind.

Butenandt and his coworkers in 1959 isolated 12mg of pheromone from the abdomen of half a million virgin females of silkworm. They named the pheromene as Bombykol. The chemical name is 10,12 – hexadeca dienol. It is a primary alcohol.

The following are some of the female sex pheromones identified in insects

Sl. No.	Name of the Insect	Pheromone
1.	Silkworm, *Bombyx mori*	Bombykol
2.	Gypsy moth, *Porthesia dispar*	Gyplure, disparlure
3.	Pink bollworm ,*Pectinophora gossypiella*	Gossyplure
4.	Cabbage looper, *Trichoplusia ni*	Looplure
5.	Tobacco cutworm, *Spodoptera litura*	Spodolure, litlure
6.	Gram pod borer, *Helicoverpa armigera*	Helilure
7.	Honey bee queen, *Apis sp.*	Queen's substance

Examples of male sex pheromones

Cotton boll weevil, *Anthonomas grandis*, Coleoptera
Cabbage looper, *Trichoplusia ni*, Lepidoptera
Mediterranean fruitfly, *Ceratitis capitata*, Diptera.

Multi-component pheromone system : If the pheromone of an insect is composed of only one chemical compound we call it monocomponent pheromone system. Pheromones of some insects contain more than one chemical compound. In this case we call it as multi-component pheromone system. The sex pheromone of two different species may contain same chemical compounds but the ratio of the compounds may vary. This brings about species specificity.

Pest Management With Sex Pheromones

Synthetic analogues of sex pheromones of quite large No. of pests are now available for use in Pest management. Sex pheromones are being used in pest management in three different ways.

a) In sampling and detection (Monitoring)
b) To attract and kill (Mass trapping)
c) To disrupt mating (Confusion or Decoy method)

a) In sampling and detection (Monitoring) :

Pheromones can be used for monitoring pest incidence/ outbreak in the following ways.