

ROLE OF PHEROMONE IN AGRICULTURAL PEST MANAGEMENT

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ABSTRACT

Most of the pests which damage our agricultural crops are insects. Some of them are beneficial while others are harmful in different ways. From the middle part of the last century to control and to kill the pests, insecticides are being used at an increasing rate but nobody is aware of the long term ill effect of using such type of chemicals. But now we have realized and trying to find a solution in such a way that environment is not polluted. Biological control is a part of IPM and in this control method, pheromones are the useful substance and it acts as an attractants. Pheromones are semiochemicals that insects and other animals release for communication purpose with other members. Pheromones are species-specific and produced by exocrine glands. A particular molecule of pheromone can be detected by the individuals of the same species. Because of this sensitivity, insect sex pheromones are now used in IPM. However, it is only recently that the pheromone and its benefits have truly come to shine. The use of integrated systems of pest control and pest management using pheromones rather than other insecticides is one such action to minimize the quantities of these toxic substance discharged into the environment.

Keywords: Pheromones, semiochemicals, communication, IPM, pests.

INTRODUCTION

Man being a dominant organism of most ecosystems controls and modifies environment most extensively than any other organism. Due to population increase, demands of more food production also increase and this demands more lands for agriculture and habitat. Deforestation has provided land for agriculture resulting mass scale destruction of fauna and flora which become detrimental to ecosystem. On the other hand, deforestation of land created two dangerous problems- one is a faunal vacuum and second due to cultivation of more crops the herbivores animals which depend on weeds, now gradually

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start depending on food crop because food present an unlimited food supply to those animals. So they crossed the threshold level and finally appeared as permanent pests. As most of the pests which damage our crops are insects and for this reasons to kill the pests insecticides are being used at an increasing rate but nobody is aware about the long term ill effect of using such type of chemicals (Kirsch, 1988). But now we have realized and trying to find a solution in such a way that environment is not polluted, more food production is possible but pests will be checked and controlled without disturbing the ecosystem. Biological control is a part of Integrated Pest Management (IPM) and different biological agents or components are used for the pest control and it is harmless for our environment. Pheromone is known as one of the important bio-chemical agent. Pheromones can be used to disrupt insect communication to prevent mating and larval damage (Siddal and Olsen, 1976; Kirsch, 1988).

BACKGROUND

A pheromone (from Greek -“to bear” + hormone from Greek- “*impetus*”) is a secreted or excreted chemical that triggers a social response in members of the same species. Pheromones are chemicals capable of acting outside the body of the secreting individual to impact the behaviour of the receiving individual (www.medterms.com). In insects, these pheromones are detected by the antennae on the head. Pheromones are species-specific and produced by exocrine glands and released in minute quantity bringing about major effect by functioning as chemical messengers. The term “pheromone” was introduced by Peter Karlson and Martin Lüscher in 1959, based on the Greek word *pherein* (to transport) and *hormone* (to stimulate). These chemical messengers are transported outside of the body and result in a direct developmental effect on hormone levels or behavioural change (Kohl *et.al.*, 2001). German Biochemist Adolf Butenandt characterized the first such chemical, bombykol, a chemically well-characterized pheromone released by the female silkworm to attract mates (Karlson and Lüscher, 1959).

TYPES AND SOURCES OF PHEROMONES

Different types of pheromones are found in the insect communities. Aggregation pheromone acts against predators and mate selection. Male-produced sex attractants have been called aggregation pheromones but most sex pheromones are produced by the females and small percentage of sex attractants are produced by males (www.msu.edu). Aggregation pheromones have been found in members of the Coleoptera, Diptera, Hemiptera, Dictyptera

and Orthoptera. These pheromones is useful against the boll weevil (*Anthonomus grandis*), stored product weevils (*Sitophilus zeamais*, *Sitophilus granarius*, *Sitophilus oryzae*), pea and bean weevil , *Sitona lineatus* (Landolt, 1997). Some species release a volatile substance when attacked by a predator that can trigger flight (in aphids) or aggression (in ants, bees, termites) (Šobotnik *et.al.*, 2008). Certain ants lay down an initial trail of pheromones and these pheromones are common in social insects (Kohl *et.al.*, 2001). Pheromones are most common among the moths (*Bombyx mori*), butterflies and Hymenopteran insects. While most success have been with Lepidopteran insects, research in other insect order- such as Heteroptera (e.g., Stink bugs) or Coleoptera (beetles)- is promising (McBreien *et.al.*, 2002; Millar *et.al.*, 2002).

HOW ARE PHEROMONES USED IN IPM?

The concept of IPM is based on the recognition that no single approach to pest control offers a universal solution, and that the best crop protection can be provided by a fusion of various tactics and practices based on sound ecological principles. Pheromones are a commonly used component of many insect IPM programs. There are three common uses of pheromones---

i) Detection and monitoring of pest population: The main use of the insect sex pheromone is to attract insects to traps for detection of their distribution. Traps vary in design and size dependent on the behaviour of the target insects. The information from trap catches can be very useful for decision making on insecticide applications or other control measures. Careful monitoring and experience in interpreting collected data are important for success. Traps may also be placed with the objective of destroying males for population control.

ii) Second major use of pheromone is to mass trap to remove large numbers of insects from the breeding and feeding population: Adult female insects that are ready for mating emit species-specific chemical odours to attract males. Lab synthesized pheromones are specially packed and supplied as lures to be used along with suitable traps to deceive, attract and trap male insects on agricultural fields. Sex-pheromones and traps are generally used as a device for reducing the population of target pests. The majorities of females present in crop fields remain unmated and lay infertile eggs as a result of mass trapping of males (Oehlschlager *et.al.*, 2002). There are several types of insect traps available such as- Funnel Trap, Wota-T, Fruit Fly Trap, Coco-Trap etc. Installation of traps with suitable pheromone lures @ 2-3 per acre can provide information on pest incidence and intensity in agricultural fields. Based on the number of males caught, the timing and frequency of control measures can be

determined. For storage, lures must be stored under refrigerated condition and traps should be stored in cool or dry places. Particular lure should be used for specific species only. Lure/pack is hermitically sealed and must be opened only at the time of using 1 set/pack.

iii) Third major use of pheromone is the mating disruption: Mating disruption is a pest management technique and it is useful to control some insect pest infestations. Generally, synthesized sex pheromones are used to disrupt the reproductive cycle of insects. The Lepidopteran females emit a volatile chemical of sex pheromone which is known as pheromone plume (Welter *et.al.*, 2001; Carter and Fraser, 2003) and the males of the same species use that information (Mafra-Neto *et.al.*, 1994) to locate the females. The main effect of mating disruption is to confuse the male insects by masking the natural pheromone plumes, causing the males to follow “false pheromone trails” and it reduces the chances of mating with the females. The California Department of Pesticide Regulation, The California Department of Food and Agriculture and The United States Environmental Protection Agency consider mating disruption to be among the most eco-friendly treatments used to eradicate pest infestations (California Department of Food & Agriculture, 2007).

ADVANTAGES OF PHEROMONES IN PEST CONTROL

Majority of pests those attacks our crop plants are insects. For this reason farmers are being used different kinds of chemical insecticides or pesticides. The excessive chemical insecticides destroys soil microfauna, changes the water quality and created cancer like disease in human body due to the presence of chlorinated hydrocarbons, chlorophenoxy acids, organophosphates, carbamates etc. The interests in biopesticides are based in the disadvantages associated with chemical pesticides. The excessive use of chemicals results resistance in the insects, as for example *Helicoparva sp* has become resistance to most of the insecticides and for this reasons, the concept of IPM has been evolved (Trematerra, 1997). Different tools and techniques are used in IPM and one of the most important things is biological control i.e control of insect pests using bioagents (pheromones) or components such as plant or animals' material, bacteria, birds etc (Batra,1982). The important advantages are—
a) pheromones are usually non-toxic than conventional pesticides. b) This biopesticide affect only the target pests and closely related organisms. c) They are effective in very small quantities and decompose quickly. d) If used as a component of IPM programme, it can greatly decrease the use of conventional

chemical pesticides. e) An added benefit of limited application to infested areas only and for this reason many beneficial insects are saved from destruction. The beneficial insects (like *Cicindela sp*) effectively control many cotton pests, such as bollworm and aphids. We can also use pheromones in mating disruptions. Conventional pesticide based control methods, kill insects directly, whereas mating disruption simply confuses male insects from accurately locating a mating partner (Mafra-Neto *et.al.*, 1994). Mating disruption is a valuable tool that should be used in IPM programmes.

CONCLUSIONS

The human population increases rapidly but equally food production in agricultural fields also increases. Sustainable food production is possible if we manage or check the population of harmful insect pests without creating any problems for our environment. The excessive use of insecticides helps us for more food production but during this time the insecticides pollute the soil, air and water bodies. So, biological control or the use of bio-pesticides are the useful procedures for control of pest populations. Pheromone is a chemical substance and it can be effective for pest control in agricultural fields as it is biodegradable biocomponent. Recent awareness by Governments of the damage caused to the environment by toxic chemicals has ensured that attention will be increasingly directed towards removing these chemicals from our precariously balanced environment. The use of integrated systems of pest control and pest management using pheromones rather than conventional means of spraying insecticides is one such action to minimize the quantities of these toxic substances discharged into the environment. So, finally it can be said that if we get a sustainable environment, our biodiversity will automatically be preserved or will be protected for our indefinite future. The selection and application of pheromone or other biopesticides should be done carefully for the conservation of fauna as well as floral diversity.

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