Plant Protection

Section-II: “Insect Pest”

Unit I: Introduction to insect Pests

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Plant Protection

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Unit I: Introduction to insect Pests

1a. Definition and losses caused by insect pests

1b. Causes for insects to assume pest status

1c. Classification of insect pests based on:

a) Occurrence of Pest

b) Intensity of Pest

c) Level of Infestation

d) Food requirement

❖ Insect Pests:

“ Insect pests are those insects that feed on, compete for food with or transmit diseases to humans and livestock.”

- Insects are the most unique, diverse and abundant groups of animals on earth.
- These tiny but versatile creatures are the major competitors with humans for the resources generated by agriculture.
- The damage caused by these insect pests is one of the most important factors in the reduced productivity of any crop plant species.

FAO / WHO (2014) have defined pest as, “Any species or biotype of plant, animal or pathogenic agent injurious to plants and plant products or environment and includes vectors of parasites or pathogens of humans and humans and animal disease and animals causing public health nuisance.”

❖Losses caused by insect pests:

➢The losses of crops caused by insect pests are quite high in both developed and developing countries.

➢ A crop loss is any reduction in quantity or quality of yield and is the equivalent of damage.

➢ Many insects are pests on the forest trees, plants, leaves, stems, buds, flowers, seeds and fruit etc.

➢ They also attack the bark and wood of trees, vegetables and cereals. It has been investigated that the damage done by insects amounts to a huge loss every year.

➢The ways in which they damage the crops are:

1) Direct loss to the plants

2) Indirect loss to the plants

3) Insects injurious to man and domestic animals

4) Poisonous insects

1) Direct losses to the plants:

There is no part of the plant which is not attacked by some or the other kind of insects.

a) Leaf eaters:

- They feed on leaves.
- Insects of these type have biting and chewing type mouth-parts to bite and chew leaves, thus causing a serious damage to the crops.
- e.g. Grass hopper, Locusts, Beeflies, weevils, larval stages of lepidoptera etc.

2. Feed on the leaves and defoliate the plants causing reduction in assimilative leaf area and thus hinder growth

Eg : 1.Semilooper caterpillar, *Achaea janata* on castor

2. Grass hoppers - *Hieroglyphus banian*
   Oxya spp.

} Feeding on maize

3. Notch the edge of the leaves

Eg : 1. Ash weevil – *Myllocerus sp*. feeding on a variety of crops like Ragi, Moringa, Brinjal, Cotton etc.,

b) Leaf rollers:

- Insects cause rolling of leaves in plants.
- The damage is done by **caterpiller.**
- The young caterpiller feeds on the lower surface of the leaf but when it grows older it rolls up the leaf and binds it down with silken threads, living safely within this fold.
- The pupation takes place either in rolled leaves or on the ground among the fallen leaves.

-e.g. *Sylepta derogata* (Cotton leaf roller), *Cnaphalocrocis medinalis* (Paddy leaf roller)

Paddy leaf roller – *Cnaphalocrocis medinalis*

Cotton leaf roller- *Sylepta derogota*

c**) Stem and root borers:**

- The insects which cause damage to the stem and roots of the plants.
- Many caterpillers are adapt in boring into the root and stems of several plants and thus a great deal of damage is caused to them.
- e.g. *Tryporyza incertulas*, the caterpiller bores into the stem near the root causing 'dead heart' or wilting of central shoots which easily comes off when pulled.

d) Bark feeders:

- These are so called as they make tunnel between the bark and wood of the trees.
- Bark feeders are mostly beetles and weevils.
- They are so destructive that cause huge loss in plants.
- e.g. *Inderbela quadrinotata*, termites etc.

Eg : Bark eating caterpillar – *Indarbela tetraonis* on Mango, Moringa, Curry leaf , rain tree etc.,

e) Sap sucking insects:

- A number of insects depends for their food on plants whose sap is sucked by them.
- e.g. *Leptocorisa varicornis* is the most destructive pest of paddy.

f) Fruit destroyers:

- The insects attack on fruits and render them good for nothing.
- e.g. *Dacus dorsalis*, bores into mango fruits and destroys the fruits to the point or rotting.

g) Insect damaging stored grains:

- Almost every godawn is infested with insect pests.
- The insects feed on different food grains hoarded in the godawns.
- The yearly deficit caused by various insect pests nearly about 5% of the total yield of the land.
- e.g. *Sitophilus oryzae, S. granarius, Tribolium castaneum, Trogoderma granarium* etc.

Sitophilus oryzae

S. granarius

Tribolium castaneum

Trogoderma granarium
(Khapra Beetle)

2) Indirect losses to the plants

a) **Disease transmitting insects:**

- A number of bacterial, fungal and viral diseases of the plants are transmitted from one to another by the various members of insects.

-e.g. Beetle is apt to spread over bacterial wilt of cucurbits.

-Likewise other viral diseases of potato, tobacco etc. are brought into transmission by the aphids, fulgorides (Large group of hemipterian insects) and leaf hoppers.

3) Insects injurious to man and domestic animals:

- Insects spread diseases from plant to plant as well as in human and domestic animals.
- e.g. **Malaria** is one of the important human maladies. This disease is caused by the species of **Anopheles mosquitoes.**
- The common housefly (*Musca domestica*) buzzing in and about the house and the earth, is also not less to be feared as one which spreads diseases like dysentery, diarrhoea, cholera and typhoid.
- The insects carrying diseases are the greatest enemies of man, which affecting human welfare.
- The diseases of the domestic animals are also transmitted by certain insects. e.g. **Surra disease** in domestic animals are transmitted by the flies **Glossina and Tabanus** resp.

4) Poisonous insects:

- Some of the insects or larvae produce poisonous secretion, which are injected into the body of man and animals either through a bite or sting.

-The honeybees and wasps thrust their sting into the human body to inject poison. This results in local swelling and irritation.

-The bee venom (apitoxin) is a complex substance possessing a colourless liquid protein, which may produce local inflammation.

❖ Causes for insects to assume pest status:

1) **Weather:** Favourable weather conditions may lead to a rapid multiplication of an insect and the same conditions may turn out to be unfavourable to its natural enemies, giving an added impetus for the growth of insect to become a pest.

2) **Intensive cultivation:** When one or more crops are raised over a large areas, limitation of food gets nullified and there is no competition for food and shelter. This affords conditions favourable for the increase in insect population.

3) Introduction of new varieties: The new varieties of crop plants are generally susceptible to pests whereas types having coarseness or characters near to their wild parents are resistant to pest attack. Some-times, the insects which are considered as minor become major on new varieties.

4) Agronomic practices: Modern agronomic practices like spacing, crop rotations, irrigation and fertilization improve the growth of the crop and make it vulnerable to insect attack and multiplication.

5) Pesticides: Pesticides often kill the natural enemies, induce resistance and resurgence in an insects and lead to emergence of secondary pest problems.

❖ Classification of insect pests based on:

a) Occurrence of pest:

1) **Regular pests:** These insects occur more frequently on a crop and they have a close association with a particular crop. These insect pests are expected to occur on the crops, some-times before harvest.

e.g. Thrips on Chilly, aphids on cotton, fruit borer on Brinjal, Rice stem borer etc.

Chilly Thrips

Aphids on cotton

Brinjal fruit borer

Rice stem borer

2) Occasional pests: Insect pests occur rather infrequently and a close association with a particular crop is absent.

e.g. Rice caseworm, Castor slug caterpiller, Mango stem borer etc.

Rice caseworm

Castor slug caterpiller

Mango stem borer

3) Seasonal pests: The insects which occur mostly during a particular part of a year are called seasonal pests. The incidence of these pests are largely governed by the climatic and weather conditions in a locality.

e.g. Hairy caterpiller on Groundnut, Mango hoppers etc.

4) Sporadic pests: The pests that occur in an isolated localities during some period are called as sporadic pests.

e.g. Coconut slug caterpiller, earhead bug on rice etc.

5) Persistent pests: The pests that occurs on the crops throughout the year and are difficult to control are called as persistent pests.

e.g. Chilly thrips, mealy bugs on Guava etc.

Mealy Bug

6) Potential pests: These pests normally do not cause any economic damage, but may become serious pests resulting from some changes in the ecosystem.

e.g. Armyworm on wheat

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1c. **Classification of insect pests based on:**

a) Occurrence of Pest

b) Intensity of Pest

c) Level of Infestation

d) Food requirement

❖Classification of insect pest based on:

b) Intensity of pest:

- Usually, pest inflict only slight damage on the host and often their effect is indiscernible. Some-times, a major pest of one crop will be minor pest on another crop and this is quite common agriculturally.
- All insect populations rise and fall with changes in the seasons, inter-specific competition, food quality and numerous other variables, it is important to recognize which ones are likely to become pests and to understand which factors might precipitate their explosive growth. Even the worst pest species are not a continuous problem. Their status as pest is usually a function of abundance, distribution or density.

- Some insects are beneficial at one stage of life and become a pest at another stage. e.g. Many lepidopterans, are a serious pests as larvae, while they may be pollinators in adulthood. Some insects that are considered pests in human settlements / gardens are actually more beneficial insects than pestiferous. e.g. Bees.
- There are numerous examples of relatively minor insect species that have become imporatanet pests as a result of environment change.

In the early 1800's, *Leptinotarsa decemlineata* was an inconsequential beetle that lived in the mid-western United States, where it fed on buffalo buur, unremarkable weed of the family Solanaceae.

- As European settlers emigrated to the mid-west, they introduced Irish potatoes as an agricultural commodity. Within few years, the prairie was dotted with potato fields and the little beetles that lived on buffalo burr soon discovered on this new food source.
- Settlers quickly came to dread this native pest-if destroyed potato fields, spread throughout other potato growing regions and is now recognized world-side as a major pest known as **'The colorado potato beetle'.**

❖ Classification of insect pest based on:

c) Level of infestation:

Insect pests are categorized into two types based on level of infestation-

1. Epidemic pests
2. Endemic pests

1. Epidemic pests:

- A pest that exists permanently in a particular region or population is known as epidemic pest.
- Epidemics of infectious pests are generally caused by several factors including a change in the ecology of the host population, a genetic change in the pathogen reservoir or the introduction of an emerging pathogen to a host population.
- An epidemic pest restricted to one region or location.
- Sudden outbreak of a such pest in a severe form in a region at a particular time.

e.g. Whitefly outbreak in Punjab, Sugarcane wooly aphids in Karnataka etc.

2. Endemic pests:

- A pest that found in one specific location and no where else in the world is known as endemic pest.
- A pest may restricted to a particular region.
- Endemic pest is a characteristic of a particular population restricted to a specific environment or region.
- The geographical isolation of endemic species that populations interbred and evolve to fill roles within the ecosystem that would be taken by other organisms on the mainland.
- Overtime, this leads to the generation of new species and evolved in and s endemic to one specific.

e.g. 70 species of Weta , which are found only in New zealand.

❖ Classification of insect pest based on:

d) Food requirement:

On the basis of food requirement, insect pests may classify as ---

1. Monophagous insects
2. Oligophagous insects
3. Polyphagous insects

1. Monophagous insects:

- These insects depends only one species of plants for whole life-cycle.

e.g. Coffee berry borer- *Hypothenemus hampei*

Paddy stem borer- *Tryporyza incertulus*

Hypothenemus hampei

Tryporyza incertulus

2. Oligophagous insects:

- These insects confined only one family of plants for whole life-cycle.

e.g. *Hypsipyla robusta*- Mahogany shoot borer

Pieris rapae- Cabbage butterfly

Hypsipyla robusta

Pieris rapae

3. Polyphagous insects:

- These insect pests visit the diverse plant species to complete their life-cycle.
- Most of the agricultural pests caused by polyphagous insects.

e.g. *Apate monachus, Schistocerca gregaria, Locusta migratoria* etc.

Apate monachus
(Black borer)

Schistocerca gregaria
(Desert locust)

Locusta migratoria
(Migratory locust)

THANK YOU!

Plant Protection
Section-II
Unit IV: Recent Trends in Pest Management

a): Attractants

b): Repellents

c): Antifeedants

d): Pheromones

e): Chemosterilants

f): Precautionary measures used during pesticide application

1) Attractants

- Chemicals that cause insects to make oriented movements towards their source are called insect attractants.
- Mode of Action:- It influences both gustatory and olfactory receptors

TYPES OF ATTARACTANTS

1. Pheromones:-Chemical that is secreted into the external environment by an animal and that elicits a specific response in a receiving individual of the same species.
2. Food Lures:-These are Chemicals present in plant and animal hosts that attract (lure) insects for feeding. They stimulate olfactory receptors.
3. Oviposition Lures:-These are chemicals that govern the selection of suitable sites for oviposition by the adult female eg:-Corn attaractants for *H. armigera*
4. Poison Baits:-Poison baits are a mixture of food lures and insecticides. The effort is made to make the bait more attractive to insects than their natural food and also a smaller quantity should be able to attract the largest number of insects.

ADVANTAGES

- Target specific
- Doesn't disrupt eco-system
- Can be used for mass trapping
- Do not cause environmental pollution

DISADVANTAGES

- Insects can always find untreated hosts
- It is not a sole source of insect control

2) Repellents

- Chemicals which cause insects to move away from their source are referred to as repellents (or) Chemically that prevent insect damage to plants (or) animals by rendering them unattractive, unpalatable (or) offensive are called repellents.
- Mode of Action:- Influences both gustatory & olfactory receptors.

TYPES OF REPELLENTS

Physical repellents

- Contact stimulus repellents
  eg:- Wax or Oil
- Auditory repellents
  amplified sounds
- Barrier repellants
  eg:-Tar bands or Mosquito nets
- Visual repellents
  eg:- Yellow light
- Feeing repellants
  eg:-Antifeedants

Chemical repellents

- Plant origin eg:-
  Oils from Citronella, Camphor, Cedarwood & Lemon-grass
- Synthetic repellents
  eg:-Dimethyl pthalate, Napthalene, Bordeaux mixture & Smoke

3) Antifeedants

- These are the chemical substances that inhibit feeding of insects when applied on the foliage without impairing their appetite and gustatory receptors or driving them away from the food.
- They are also called Gustatory repellants/ Feeding deterrents / Rejectants.
- Since insects do not feed on treated surface, they die due to starvation.

❖ Mode of action:

- They inhibit gustatory (taste) receptors of the mouth parts

GROUPS OF ANTIFEEDANTS

A. Triazines

eg:- Acetanilide

B. Organotins :- Compounds having tin

eg:-Triphenyl tin acetate

C. Carbamates :- Sub-lethal doses of thiocarbamates

eg:- Baygon

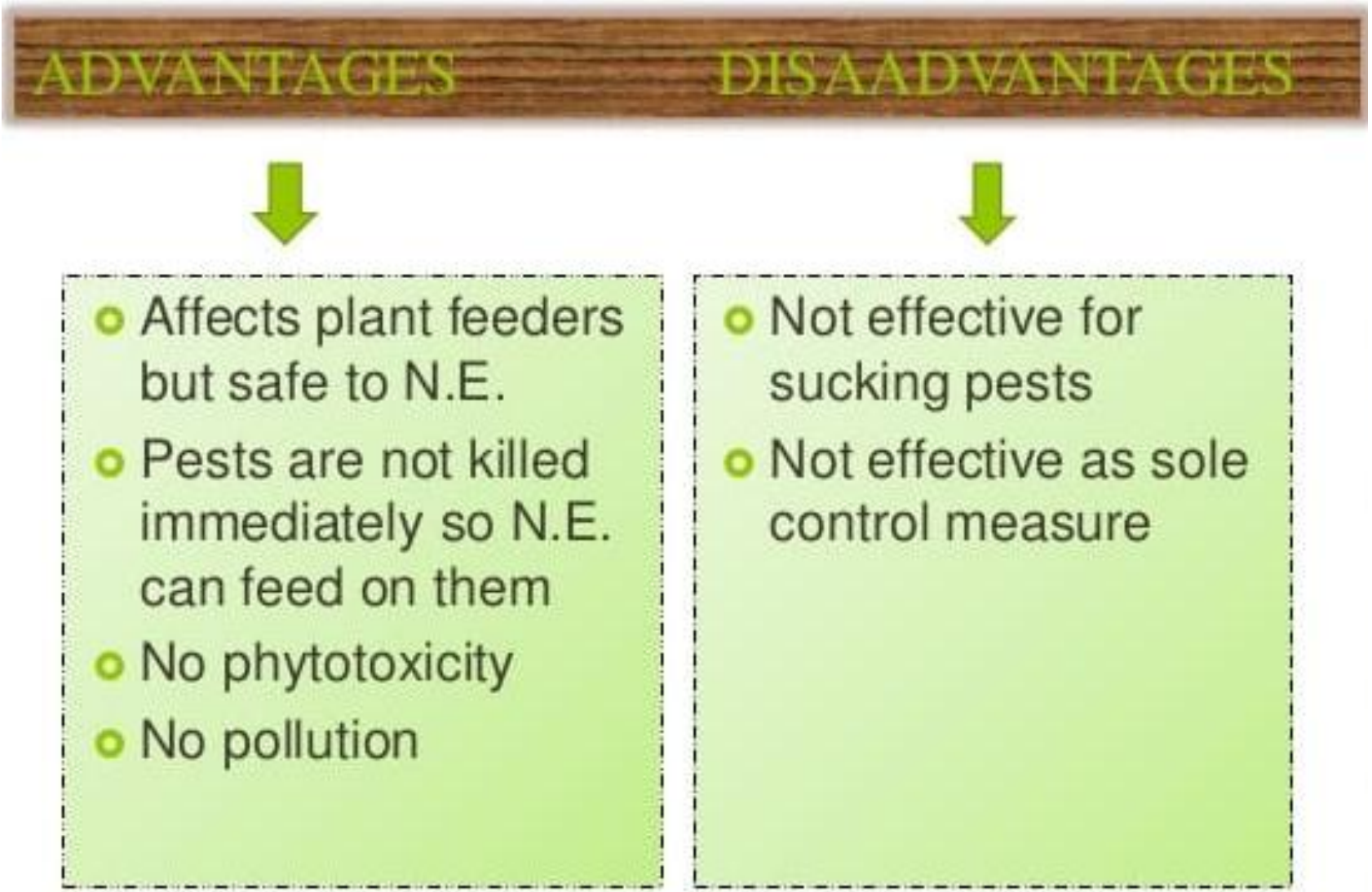
D. Botanicals :- Anti-feedants from non-host plants

·Pyrethrum- From *C. cinerarifolium*

.Neem

.Apple factor

.Solanum alkaoids- Leptine, Tomatine & Solanine



N.E.: Natural Enemies

4) Pheromones

"Pheromones are the chemicals or a mixtures of chemicals that are released to exterior by an organism and cause one or more specific reactions in a receiving organism of the same species."

- Semiochemicals:- They are chemicals that mediate communication between organisms.
- It is classified into two groups:-

  i. Pheromones:- Intra-specific

  ii. Allelo-chemicals:- Inter-specific

--Pheromones are also called Ectohormones.

--The term "pheromone" was given by Karlson and Butenandt in 1959 when they identified it in Silkworm moth.

❖ Classification of Pheromones:

- Primer pheromones:- A chain of physiological changes is triggered off in the receiving animal. They act on gustatory receptors.
  eg:-Caste discrimination & reproduction in social insects.
- Releaser pheromone:-An immediate and reversible behavioural change is produced in the receiving animal.

  i. Sex Pheromone

  ii. Aggregation Pheromones

  iii. Trail Pheromones

i) **Sex pheromones:** A substance released by one sex which triggers off a series of behaviour patterns in the other sex of the same species, and thus facilitates mating is called a sex pheromone, sex attractant or sex lure.

In majority of cases, females produce the sex pheromone, however, in certain species of insects, the males are known to produce the sex pheromones, which attracts the female.

e.g. the cotton ball weevil, *Annthonomus grandis* Boheman

ii) **Aggregation pheromones:** This is a substance produced by one or both sexes and brings both the sexes together for feeding, reproduction and protection or combinations thereof.

The best known example of females of the bark beetle, *Dendroctonus frontalis* (Zimmerman) and males of the phloem beetle, *Ips confuses* (Le Conte).

iii) Trait / Alaram Pheromones: This is a substance produced by an insect to repel and disperse other insects in the area. It is usually released by an individual when it is attacked.

Alaram pheromones have been reported in *Homoptera*, *Isoptera* and *Hymenoptera*. The pheromone is produced by a variety of organs such as pair of cornicles or siphuncli near the tip of the abdomen in aphids, cephalic glands in termites, sting apparatus and mandibular glands in worker bees.

ADVANTAGES

- Non-pollutant and economically accepted.
-Required in minute quantities.
- Species specific.
- Labour saving method

DISADVANTAGES

-Sex specific
-- Requires knowledge and expertise
- Not act as a short term control measure

5) Chemosterilents

" Chemosterilents are the chemicals which deprive insect species of their ability to reproduce."

Such chemicals when administered orally to the insects or by contact with them, produce irreversible sterility without affecting their mating behaviour or length of life to a significant level. The eggs may not be laid, if laid may not hatch, larvae may not pupate or pupal development will be incomplete.

TYPES OF CHEMOSTERILENTS

There are three types of chemosterilents:

1) Alkylating agent

2) Antimetabolites

3) Miscellaneous groups

1) Alkylating agents:

- They are mostly aziridine derivatives and contain apholate, tepa, metepa and thio-tepa.

- These chemicals induce permanent sterility in both the sexes.

- They are readily absorbed through the skin and are extremely toxic to mammals.

2) Antimetabolites:

- These chemicals are structurally related to biologically active substances.

- Three groups of antimetabolites are more important.

e.g. i) Purine compounds: 5-fluoro-uracil, 5-fluorooorotic acid and 5-bromouracil. Ii) Pyrimidine analogues: 2-amino-4-methyl-pyrimidine and iii) Folic acid analogous: aminopterin, amithopterin and methotrexate.

- The antimetabolites are not as potent as alkylating agents.

- Females are more susceptible than males.

3) Miscellaneous groups:

- This group contains chemosterilents which are structurally unrelated. One category contains non-alkylating analogous of aziridinyl compounds e.g. Hempa (Hexamethyl phosphoramide) and Hemel (Hexamethyl melamine).
- They are effective as male housefly chemosterilents.
- The other category includes triphenyltin derivatives suchas triphenyltin hydroxide, triphenyltin chloride and triphenyltin acetate.
- They sterilise both the sexes but females are more sensitive.

ADVANTAGES

-Offer the possibility of 99% pest control.

- Applied orally, topically, by injection, as dust, sprays, fumigants etc.

- Offer sterility in wild populations in the field itself, which is not possible with irradication.

- Cheaper method.

DISADVANTAGES

-Display strong mutagenic and carcinogenic action in humans and in higher animals.

- Cause hazard to man and environment.

Precautionary measures used during pesticide application

Pesticides being toxic to human beings and domestic animals. So, should be handled with care. The following precautions should always be taken.

- **Storage:** The pesticides should always be stored in their original containers and kept in a locked cupboard where they are out of reach of the children and domestic animals. It should be kept away from food or foodstuff and medicines.

- **Supervision:** Insecticides are highly toxic and should be handled under the supervision of trained personnel. The instructions found on the labels should be carefully read and strictly followed.

- **Evacuation:** During spraying or dusting farmers, labours, grazing animals etc. should be evacuated from the victinity.

- **Separate instruments:** Instruments like knives, scissors etc. used for opening tins and packages of insecticides should be kept separately and should not be used for any other purpose. Formulations should be mixed using long wooden handles and definitely not by hands. Sprayer nozzles should not be blows by mouth if they get blocked while spraying.

- **Personal apparel:** Face masks and respirators should be worn to avoid inhalation of poisons and gloves and goggles should be used to avoid contact with poisons. Separate cloths should be worn during the application of insecticide. The cloths should be changed and washed after application.

- **Washing of equipment:** Washing of equipment after use and containers in or near wells or streams should be avoided.

- **Personal precautions:** Inhaling of pesticide sprays or dusts and smoking, chewing, eating or drinking while mixing or applying the chemicals should be avoided. Particles or drops of pesticides which may accidents get into eyes should be flushed out immediately with large volumes of clean water.

- Disposal: Empty tins or packages of insecticides should be disposed or taken to safer places. It is better to burried under the soil.

- **Re-entry period:** Field workers should strictly observe the safe re-entry period after an insecticide application.

- **Antidotes:** Antidotes are normally mentioned on the insecticide packaging. They should be kept ready at hand and their proper use known before hand in case they may be needed due to accidental poisoning.

- **Do not spray against the direction of wind.**

- **The workers or labours do not work more than 8 hours per day in contact with pesticides.**

- **Most of the chemicals are inflammable, so do not spray the pesticides near open flame.**

THANK YOU