

# PESTS AND PESTICIDES

## 33.1 INTRODUCTION

The need to produce more food to feed the increasing population will continue. The systems and technologies that are being used now may have to be modified and new technologies adopted in order to ensure that this goal can be achieved. Pests are a major bottleneck in realising this goal. Pesticides will continue to play an important role in protecting the crops from pests in the foreseeable future, as there are no practical alternatives at the moment. However, of late there have been many encouraging developments that give hope for the future.

The old concept of 'immediate kill' or 'kill all' chemicals will have to give way to the concept of chemicals that are less hazardous to natural enemies like parasites and predators and keep pests at manageable levels.

In this lesson you will learn about pests, pesticides and various methods of pesticide application, alongwith dangers associated with the injudicious use of pesticides.

## 33.2 OBJECTIVES

After reading this lesson, you will be able to :

- identify the pests
  - define pest control
  - list various methods of pest control
  - explain chemical control
  - describe the use of pesticides in pest control
  - classify pesticides
  - explain the dangers of using pesticides
  - recall the safe handling of pesticides
  - describe the pest management.
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### 33.3 PEST AND ITS CHARACTERISTICS

If you ever visit a garden or crop field you will come across cuttings on leaf margins, holes in leaves, chewed and damaged parts of stem, flower or fruit in plants, spots on leaves etc. Do you know what are all these due to ? They are due to the attack of various organisms which are known as pests.

A pest is any organism, animal, plant or microorganism that causes damage or annoyance to human beings, their animals, crops or possessions. The word pest is derived from the greek word **pestis** which means to annoy.

**The Organisms designated as 'pests' compete with people for food, fibre and shelter; transmit pathogens; feed on people; or otherwise threaten human health, comfort or welfare.**

Crop pests constitute a major constraint to the increased food production. Crop losses due to pest attack range from 10 to 30 per cent depending on the crop and environment.

### 33.4 MAJOR PEST GROUPS

The major pests of agricultural importance can be broadly divided into the following groups:

**Insects and Mite Pests :** Insect pest and mites cause heavy damage to crops. Out of the over one million species of insects only about 200 species can be termed as serious pests.

**Majority of the insects are beneficial to mankind.**

**Plant Pathogen :** Fungi and various microorganisms such as bacteria and viruses cause diseases in plants and insects. Nematodes are also sometimes classified as pathogens.

**Snails and Slugs :** They are called molluscs and become pests around home gardens, in lawns, greenhouses and ornamental plantings.

**Weeds :** These are the plants that either compete with crop plants thus affecting yield and quality, or may interfere with the use of land and water resources.

**Vertebrate pests :** These are mainly rodents, birds and some other mammals like bats, rabbits etc. that cause damage to crops and stored products.

### 33.5 PEST CONTROL

When you visit a farmer's field and ask the farmer, what he does for protecting his crop from the pests, he will tell various methods which he adopted for protecting the crop. This is the applied control or pest control. Traditionally pest control has meant the use of chemical pesticides. In the present day context pest control includes the use of all those methods which are employed for preventing pests and diseases without disturbing environment.

### 33.6 METHODS OF PEST CONTROL

Important methods of pest control are briefly described below :

**33.6.1 Cultural method :** It refers to manipulation of farm practices to check the pests. Some of the important cultural methods are :

- a. Crop rotations,
- b. Tillage methods (deep summer ploughing),
- c. High seed rate,
- d. Water management,
- e. Manipulation of date of sowing, and
- f. Trap cropping.

**33.6.2 Physical method :** These methods involve modification of physical factors in the environment to minimise or prevent pest problem. Various physical methods are :

- a. Temperature manipulation,
- b. Moisture manipulation,
- c. Light manipulation, and
- d. Use of sound energy.

**33.6.3 Mechanical method :** This refers to the use of mechanical implements/devices/hands for removal or destruction of pests. Some of them are:

- a. Screens, traps, nets and suction devices,
- b. Hooking with iron rod in the bore hole,
- c. Banding with grease or polythene sheets on mango stem,
- d. Covering of fruits, and
- e. Trenching and water barrier-ant pans.

**33.6.4 Legal or regulatory method :** This refers to the legal restrictions proposed by the Central and State Governments to check pest spread.

- a. Inspection and quarantine
- b. Destructive Insect Pests Act

**33.6.5 Resistant Varieties :** Use of resistant varieties help in avoiding or tolerating or recovering from pest attack. Resistant varieties have been identified against different pests in number of crops.

**33.6.6 Biological method :** This method refers to the use of natural enemies viz. parasites, predators and microbes or pathogens (bacteria, virus, nematodes, fungi, protozoa etc.) to suppress pest species.

Biological control programme can be carried out in the following ways :

- a. Conservation and encouragement of indigenous natural enemies
- b. Importation of exotic natural enemies, and
- c. Mass rearing and releases of parasites/predators and microbes.

**33.6.7 Novel method :** Recently some new methods of pest control have been developed to make pest control eco-friendly. They are :

- (i) Semio-chemicals (behaviour modifying chemicals e.g. pheromone, kairomones etc.), and

(ii) Insect growth regulators (e.g. juvenile hormones, chitin inhibitors).

**33.6.8 Chemical Control :** The use of chemicals for the control of pests is known as chemical control. Pesticides are the chemicals used to kill or repel or attract, or sterilize pests.

Pesticides are without any doubt an effective means of killing pests quickly and on demand. No other control method provides users with an immediate and visibly effective means of response. Over the years, the injudicious use of pesticides has resulted in a number of serious detrimental side effects.

**33.6.9 Botanicals :** These include plant products with a potential to control pests.

Many plant products (leaf extracts, oils and cakes) have the property of inhibiting the development of pests and diseases. The plant extracts and oils are sprayed on the crops.

Neem oil, neem cake and other neem based formulations have been found effective against pests.

### 33.7 USE OF PESTICIDES IN PEST CONTROL

The development of effective, economical pesticides has had a profound effect on man's continual battle with pests. In many cases pesticides have been incorporated as tools in well planned pest control programmes without serious hazards to humans or to the environment. Application of pesticides must be done at proper time, at right rate by using

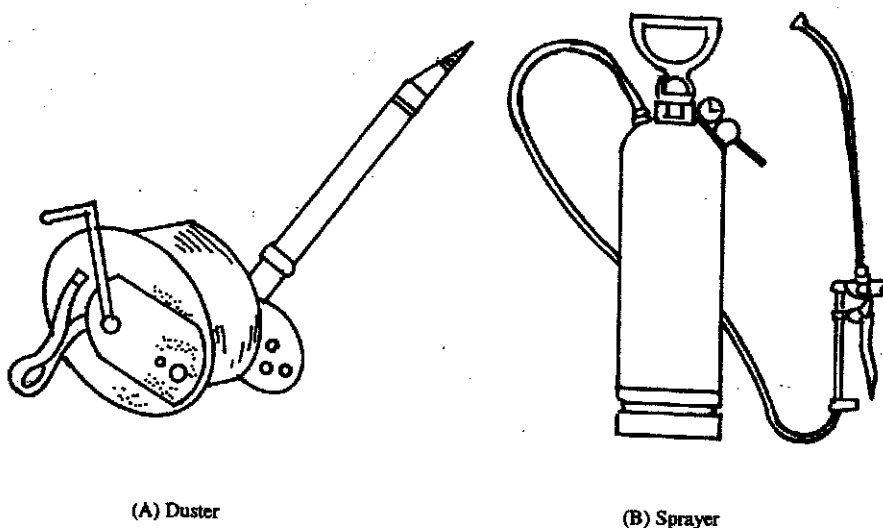


Fig. 33.1: Equipments for applying insecticide  
A – Duster, B – Sprayer

suitable equipment. This means using the proper sprayer duster or other equipment for the formulation used and the type of coverage or delivery desired (Fig. 33.1).

The Indian Insecticide Act, 1968 has a scheduled list of pesticides made in India.

**Our country has installed capacity/infrastructure for synthesis of 62 technical pesticides although some of them are synthesized from intermediates which are important even today.**

The pesticides are applied on seeds, foliage and other parts or in soil against different pests and diseases. The various methods of pesticides application are :

### 33.7.1 Seed treatment

The pesticides are applied on the seeds to eliminate seed borne diseases or soil/seedling pests. Pesticides may be applied as a dry or wet treatment. For example seed treatment of sorghum by carbofuran seed powder.

### 33.7.2 Foliar application

The pesticides are commonly sprayed or dusted on the aerial plant parts, for example foliar application of pesticides on the leaves for the control of leaf spots of groundnut. Spraying is done by using sprayers or dusting carried out by dusters. Sprayers and dusters can be manually operated or power operated. Dusting is carried out in the morning hours, with practically no air stream. Spraying must not be done against air flow.

### 33.7.3 Soil application

The pesticides can be applied in the soil along with the seeds or in the soil around root zone of plants to protect them against soil borne diseases or soil pests. The soil application of pesticides is expensive and should be restricted to affected areas in the field. Phorate and carbofuran are common insecticides used in the soil.

### 33.7.4 Granular application

Granules of pesticides are applied in the soil as soil dressing to plants, on water surface by spreading and in leaf whorls e.g. endosulfan granules.

### 33.7.5 Seedling root dip

Roots of seedlings are dipped in pesticides solution before planting to control early stage pests especially in rice e.g. Chlorpyrifos, carbofuran etc.

### 33.7.6 Fumigation

It is carried out to control pests in storage godowns. Fumigants are available in solid and liquid formulation e.g. methyl bromide, HCN, celphos.

### 33.7.7 Baiting

Baiting is done to control rodents and cutworms. The pesticide (poison) is mixed with food material preferred by the pest and kept for their feeding e.g. Zinc phosphide.

Pesticides are sold in different formulations like dust, granules, sprays, water soluble powder, fumigant etc. Formulation helps in easy application and performance of pesticides.

## INTEXT QUESTIONS 33.1

1. What is pest ? Give major pest groups.

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2. Define pest control and give novel methods of pest control.

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3. What do you understand by seed treatment ?

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4. How will you explain baiting ?

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5. What are cultural control methods ?

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### 33.8 CLASSIFICATION OF PESTICIDES

Pesticide is derived from the words "pest" and "cide", a Latin derivative meaning "Killer". A chemical pesticide, then, is a chemical preparation used to kill or in some other way diminish or stop the actions of a pest. Pesticides like drugs are beneficial to man when properly used; when misused they may be extremely dangerous. Some examples of pesticides are DDT, BHC, Malathion, Thiram, 2-4-D. Pesticides can be classified in various ways :

#### 33.8.1 Classification based on target organisms

Most of the pesticide names are specific to the pest for which they are intended to control.

<b>Acaricides</b>	:	For the control of mites and ticks.
<b>Birds</b>	:	For the control of birds.
<b>Bactericides</b>	:	For the control of bacteria and bacterial diseases of plants.
<b>Fungicides</b>	:	For the control of fungi.
<b>Herbicides/Weedicides</b>	:	For the control of weeds.
<b>Insecticides</b>	:	For the control of insects.
<b>Molluscicide</b>	:	For the control of snails and slugs.
<b>Nematicides</b>	:	For the control of nematodes.
<b>Rodenticides</b>	:	For the control of rodents (rats and mice etc.)

#### 33.8.2 Classification based on the mode of action

Based on the mode of action pesticides (insecticides) are grouped as :

- Physical poisons (e.g. heavy oils, tar oils etc.),
- Protoplasmic poisons (e.g. mercury, copper, arsenics etc.),
- Respiratory poisons (e.g. HCN, CO etc.), and
- Nerve poisons (e.g. organophosphates and carbamates).

### 33.8.3 Classification based on the mode of entry

Based on the mode of entry pesticides (insecticides) are grouped as :

- a. Stomach poisons : Enter the body through the mouth of the pest. Examples are dieldrin, sulphur, lead arsenate etc.
- b. Contact poisons : Enter the body through the contact of cuticle of the pest. Examples are pyrethrum, nicotine, BHC, DDT etc.
- c. Fumigant poisons : Enter the body through the respiratory system of the pest. They are volatile poisons. Examples are hydrogen cyanide, methyl bromide, carbon tetrachloride etc.
- d. Systemic poisons : These are translocated inside the plant body through xylem after the application on absorptive surfaces of plants like leaves, roots etc. Examples are phorate, carbofuran, aldicarb, methyl demeton etc.

### 33.8.4 Classification based on chemical nature

The classification of pesticides based on their chemical nature is rather complex. Modern pesticides are in general organic chemicals. They include pesticides of synthetic origin and plant origin. However, some inorganic compounds are also used as pesticides. The organic pesticides can be further sub-divided into the classes based on their molecular structure (Fig. 33.2).

Insecticides, fungicides and herbicides (weedicides) are important pesticides, Hence their classification has been included here.

## 33.9 CLASSIFICATION OF INSECTICIDES

Most classification are now based on chemical nature, the following does not list all of the insecticides, but is given as an example of chemical classification.

### Chemical group

#### (i) Inorganic compounds

Lead arsenate

Paris green

Sulphur

Zinc phosphate

#### (ii) Organic compounds

##### a. Botanicals

Pyrethrum

Rotenone

Nicotine

##### b. Chlorinated hydrocarbons

DDT, BHC, Lindane

Endosulfan

# PESTICIDES

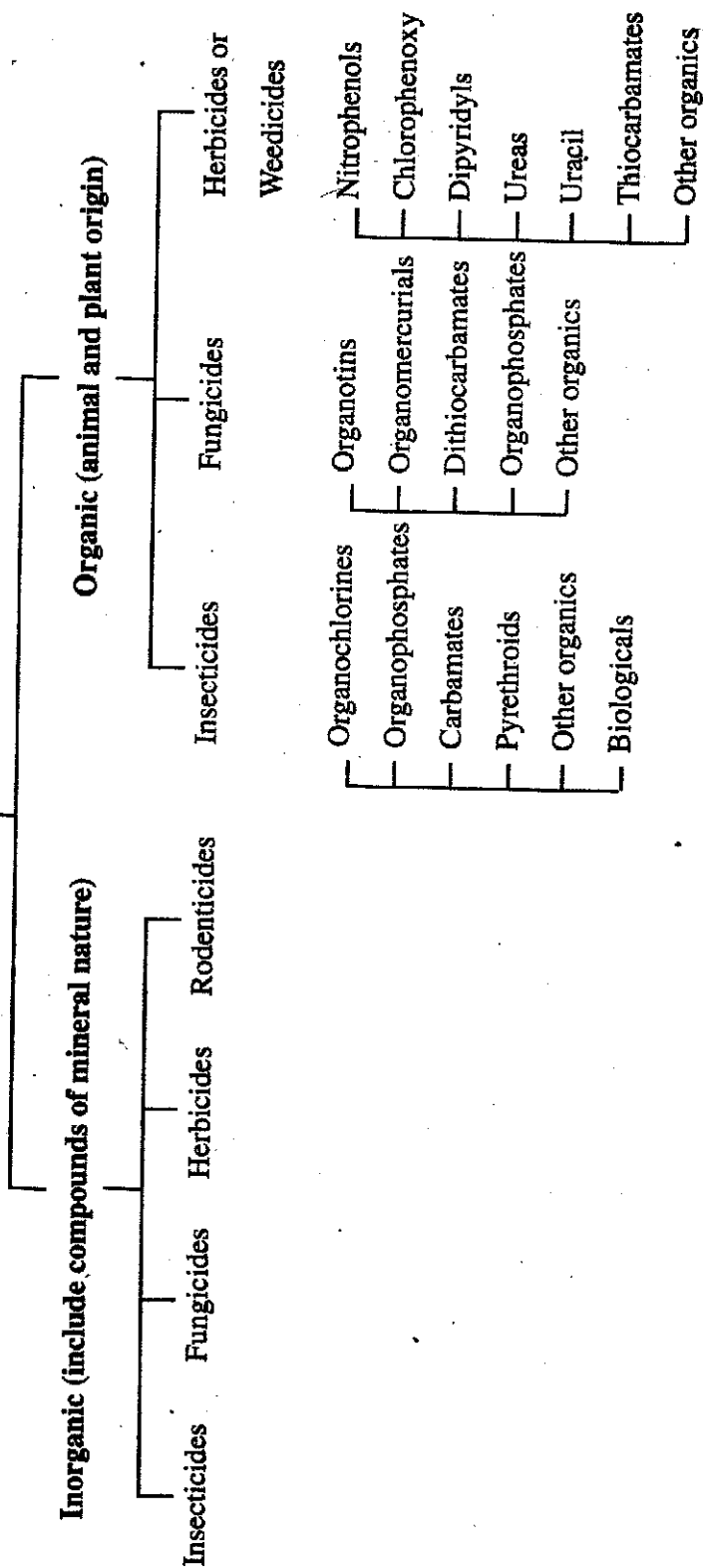


Fig. 33.2. Classification of pesticides on chemical nature

- c. **Organophosphates**  
Malathion, Phorate  
Chlorpyrifos, Quinalphos  
Methyl demeton
  
- d. **Carbamates**  
Carbaryl, carbofuran  
Aldicarb
  
- e. **Synthetic pyrethroids**  
Fenvalerate, Permethrin  
Cypermethrin
  
- f. **Miscellaneous**  
Dinitros  
Petroleum oils
  
- g. **Biologicals (biopesticides)**  
*Bacillus thuringiensis* spores.  
N.P.V., milky white disease spores.

### 33.10 CLASSIFICATION OF FUNGICIDES

They may be classified on the chemical nature of the active ingredients.

- a. **Copper fungicides**  
Bordeaux mixture (Copper 1 kg. lime 1 kg. water 100 litres),  
Copper oxychlorid
- b. **Sulphur fungicides**  
Sulphur dust, wettable sulphur
- c. **Organomercuric compounds**  
Ceresan
- d. **Non-mercurial organic compounds**
  - (i) Dithiocarbamates – Dithane, Thiram, Zineb
  - (ii) Organic nitrogen compounds – Karathane, Captan
- e. **Miscellaneous**  
Tin compounds – brestan and Du-ter  
Nickel chloride

## Antibiotics

## f. Systemic fungicides

Benomyl compound

Carboxin and oxycarboxin

**33.11 CLASSIFICATION OF HERBICIDES (WEEDICIDES)**

These chemicals eliminate weeds and can be classified as follows based on their mode of action.

- (i) Selective herbicides : They kill weeds by contact. Examples are 2-4-D, dalapan, isoproturon etc.
- (ii) Non-selective herbicides : These chemicals kill the leaves, Examples are paraquat, pentachlorophenol etc.

**INTEXT QUESTIONS 33.2**

1. Tick mark (ü) the correct answer.
  - i) Insecticides are used against
    - a. Rats
    - b. Virus
    - c. Snail
    - d. Insects
  - ii) A chemical which kills fungi is
    - a. Insecticide
    - b. Acaricide
    - c. Fungicide
    - d. Rodenticide
  - iii) Bordeaux mixture contains
    - a. Copper
    - b. Zinc
    - c. Iron
    - d. Mercury
2. Indicate whether the following statements are true (T) or False (F)
  - i) Phorate is an organophosphate insecticide T/F
  - ii) Weedicide is used for the control of weeds T/F
  - iii) Ceresan is a copper fungicide T/F
  - iv) Captan is a systemic fungicide T/F
  - v) 2-4-D is used for killing weeds T/F

3. Give examples of organophosphate insecticides.
4. What are herbicides ?

### 33.12 DANGERS OF USING PESTICIDES

**Injudicious use of pesticides has resulted in a number of serious side effects and problems.**

Over the years, the injudicious use of pesticides has resulted in a number of serious detrimental side effects and problems. They are :

- Development of resistance in pests to pesticides.
- Pest outbreaks have increased.
- Secondary pests have attained the status of a serious pest.
- Destruction of beneficial organisms like honeybees, pollinators, parasites/predators etc.
- Contamination of soil, water and air.
- Incidence of the high amounts of pesticide residues in food, fodder and vegetables.
- Adverse affect on the survival of fish and soil microorganism.
- Presence of DDT and its derivatives in human milk and fat tissues.

### 33.13 SAFE HANDLING OF PESTICIDES

Necessary activities for safe handling of pesticides are:

- All pesticides should be stored in their original containers and at safe places away from the reach of children.
- Avoid spillage during opening the bags or containers.
- Spraying should be done in the windward direction.
- Wear protective equipments (body wear, goggles, gloves, mask, respirator, footwear etc.) while applying pesticides.
- Never eat, drink or smoke during mixing or applying pesticides.
- Read the label and leaflet and the manufactures instruction carefully.
- In case of pesticide poisoning take immediate step to obtain medical help; and remove the contaminated clothing and wash the patient thoroughly. Save container, label and leaflets to show the doctor.
- Use antidote in case of pesticide poisoning. Antidotes are drugs and chemicals which counteract the affect of pesticides. Some of the antidotes are Atropine, Barbiturates, Parlidoxime (2-PAM), Calcium gluconate, Amyl nitrate etc.

### 33.14 INTEGRATED PEST MANAGEMENT (IPM)

**IPM is an environmentally sound alternative to the sole use of chemicals.**

IPM emphasizes the need for simpler and ecologically safer measures for pest control to reduce environmental pollution and other problems caused by excessive and indiscriminate use of pesticides. IPM can be defined as : "A pest management system that in context of associated environment and population dynamics of pest species, utilizes all suitable techniques in as compatible a manner as possible, and maintains the pest populations at levels below those causing economic injury".

The main purpose of IPM programme is to :

- i) reduce crop losses.
- ii) increase farmers income.
- iii) reduce pesticide use by applying them judiciously. i.e. need based application.
- iv) keep pest numbers below harmful levels.
- v) protect and conserve environment.
- vi) reduce pesticide residues, particularly on export products.
- vii) increase involvement of farmers in IPM decision making.

### 33.15 WHAT YOU HAVE LEARNT

- The characteristics of pests and their important groups.
- Organisms designated pests compete with people for food, fibre and shelter; transmit pathogens; feed on people; or otherwise threaten human health, comfort or welfare.
- Pest control includes use of all those methods which are employed for preventing pests and diseases without disturbing environment.
- Use of chemicals for the control of pests is known as chemical control.
- Pesticides are chemicals used to kill or control pests.
- Pesticides can be applied through seed treatment, foliar sprays, soil application, granular application, seedling root dip, fumigation, baiting etc.
- Cultural methods involve modification of farm practices to make them unfavourable for pests.
- Physical methods involve the modification of physical forces like temperature, moisture, light etc. for the pest control.
- Mechanical methods involve use of mechanical forces or manual labour either for destruction or exclusion of pests.
- Biological control has emerged as a major pest control method.
- Entry of pest into country or new areas can be prevented legally with the help of pest Acts.
- Pesticides can be classified on the basis of target organisms, mode of entry, mode of action and chemical nature.
- Pesticides can be insecticides (against insect), acaricides (against mites), rodenticides (against rats) etc.
- Pesticides are still used as major tool in pest control.

- Pesticides should be handled carefully to avoid health hazards and environmental pollution.
- IPM means combination of feasible control methods in a judicious manner to bring down pest population below economic levels.

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### 33.16 TERMINAL EXERCISE

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1. Tick mark (ü) the correct answer.
    - i. Which of the following is the cultural method of pest control ?
      - a) Manipulation of temperature
      - b) Covering of fruits
      - c) Deep summer ploughing
      - d) Hooking
    - ii. Which one of the following is the systemic fungicide ?
      - a) Brestan
      - b) Copper carbonate
      - c) Malathion
      - d) Benomyl compound
  2. Fill in the blanks
    - i) Pesticides used to kill rodents are known as \_\_\_\_\_
    - ii) Organic insecticides originates from animal and \_\_\_\_\_
    - iii) The poison mixed with food material is termed as \_\_\_\_\_
    - iv) Control measure planned by man is termed as \_\_\_\_\_
    - v) Biological control refer to the use of \_\_\_\_\_
  3. List out the methods of pest control.
  4. What is pesticide ? Name few pesticides.
  5. What is the chemical control ?
  6. How do you use the pesticides ?
  7. What is the biological control ?
  8. Classify the pesticides on the basis of target organisms.
  9. How will you classify the insecticides ?
  10. Classify the fungicides.
  11. What are the dangers of using pesticides ?
  12. What are the precautions to be followed while applying pesticides ?
  13. What is an antidote ? Give two examples.
  14. Define IPM.
  15. What is the main purpose of IPM programme.
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**CHECK YOUR ANSWERS:****KEY TO INTEXT QUESTIONS 33.1**

1. Refer to 3.3; 3.4
2. Refer to 3.5; 3.6.7
3. Refer to 3.7.1
4. Refer to 3.7.7
5. Refer to 3.6.1

**KEY TO INTEXT QUESTIONS 32.2**

1. i) d  
ii) c
2. i) True  
ii) True  
iii) False  
iv) False  
v) True
3. Refer to 3.9
4. Refer to 3.11

**TERMINAL EXERCISE**

1. i) c.  
ii) d.
2. i) Rodenticides  
ii) Plants  
iii) Bait  
iv) Pest control  
v) Natural enemies
3. Refer Section 3.6
4. Refer Section 3.8
5. Refer Section 3.6.8
6. Refer Section 3.7
7. Refer Section 3.6.6
8. Refer Section 3.8.1
9. Refer Section 3.9
10. Refer Section 3.10
11. Refer Section 3.12
12. Refer Section 3.13
13. Refer Section 3.13
14. Refer Section 3.14
15. Refer Section 3.14