Insecticide Toxicology (Ent-714) Credit Hours 3(2-1)

Lecture # 5 Delivered by Dr.Hassan Yasoob

Topic- Theory and Principles of Bioassay

HISTORY

The earliest record of the use of insecticides dates back to the writings of Greeks, Romans and Chinese, some three thousand years back. • The toxic nature of arsenicals was known to Greeks and Romans during first century. • A. D. Pliny (25-79 A.D) mentioned several pesticides in his teachings and many more contemporary workers of that time like use of one chemical or the other for controlling the pests.

WHAT IS TOXICOLOGY?

"Toxicology is the branch of medical science that deals with the nature, properties, effects and the detection of poison. It is, therefore, the science of poisons" (Du Bois and Geiling, 1959). • Fogleman (1963) defined toxicology as "the study of limits of the biological effects of a chemical or mixtures of chemicals."

Industrial toxicology:

It deals with the safety of industrial workers from the toxic effects of poisons. • Environmental toxicology: It deals with the metabolism, transport, translocation and physico- chemical transformation of poisons in all forms of biological systems. • Medical toxicology: It deals with the effects of poisons in man. • Veterinary toxicology: It deals with the effect of poisons on domesticated animals. • Insect toxicology: It deals with such poisons which are used in killing trisects without appreciable effect on mammals.

SCOPE OF INSECT TOXICOLOGY

Insect toxicology plays an important role in controlling insect pests in the field of agriculture, forestry and public health. • Toxic chemicals so far are the

main defence against pest attacks. • No doubt there are a number of other control measures but none of them match in their efficacy, speed, stability and cost of operations with chemical control measures. • In view of these facts, the science of insect toxicology promises a better and brighter scope.

Principles of Insect Toxicology

►Organisms which are harmful to man or its property are called Pests.

►Chemicals which kill these pests by their chemical action are collectively termed as Pesticides.

The pesticides include:

(1)Acaricides For the control of mites and ticks

(2) Algicides For the destruction of algae and other aquatic vegetation
(3)Bactericides For the control of bacteria and bacterial diseases of the plants

(4) Arboricides For the destruction of undesirable arborial and bush vegetation
(5)Fungicides For the control of fungi (6) Herbicides For the control of weeds

(7)Insecticides For the control of Insects (8) Molluskicides For the control of mollusks (9) Nematicides For the control of Nematodes.

(10) Rodenticides For the control of rodents

They control large populations of insect pests effectively and immediately.Use of insecticides is the first line of defense in controlling the insect outbreaks. They control large populations of insect pests effectively and immediately.

Main principles of insect toxicology

1. Insecticides be able to strike the weakest link of the pest; Life cycle; Behavior of the pest be known.
2. Assessment of loss, nature and extent of damage and the economics involved in it be Properly calculated.
3. Proper selection of insecticide or combination of insecticides be made prior evaluation.

4. Insecticides should be of such nature and quality that they bring about least distruption in the eco-system and remain restricted in the area where they are used.
5. LD50- This value represents the lethal dose of the poison per unit weight which will kill 50 per cent population of test animals. It is expressed as milligrams per kilogram of body weight.
6. LC50- The lethal concentration of toxic compound mixed in external medium i.e. water that kills half of the Population of test animals.
7. KD50- It represents the median knockdown dose sufficient to kill 50 percent population of test animals.
8. LT50- This term represents the lethal time required to kill 50 per cent population of test animals at a certain dose or concentration.
9. KT50- It represents the median knockdown time required to kill 50 per cent of test animals for a given dose.
10. ED50- The dose of such a chemical which brings sterility in 50 per cent population in test animals will be the value of ED50.
11. EC50 :It is the concentration of chemical resulting sterility in 50 percen of test animals.
12. Toxicity - Ability of a chemical to bring about changes in the biological system of the target animal. Acute toxicity – It is the acute stage of poisoning due to the application of a single dose.
13. Chronic toxicity- It is the condition of toxicity which lasts for the entire life of the target animal and has the accumulating effect of small repeated doses. Hazard- It is the probability of being harmed due to the use/ exposure / handling of the toxic substance. Risk- It is the degree of physical, biochemical and histochemical changes acceptable in terms of usefulness of a chemical and its possible effects on Public health.

TOXICITY TESTS AGAINST INSECTS

BIOASSAY:

It is the combination of 2 words: Bios-life; assay- determination. Thus bioassay stands for determination of relative toxicity of insecticides by studying and examining their effects on living organisms.

►According to Finney (1952) the term biological assay should be understood to mean “the measurement of the potency of any stimulus

physical, chemical or biological, physiological or psychological by means of the reactions which it produces in living matter.

Principle of bioassay

The principle of bioassay is to compare the response of insects from treated samples to those from a series of standards under the same conditions. • The response may be based on knock down, mortality, photomigration etc. • The words ‘symptoms and ‘effect’ have been used several times without a precise indication of their meaning. • “Symptom” signifies any particular change in behavior visible to an observer whereas the “effect” includes any abnormal condition, generally leading to death.

Factors affecting bioassay

Biological: It is true that the selection of test insect for bioassay depends on their susceptibility to toxicant yet factors such as stage of the insect, sex, size etc.

Physical and Chemical: Physically Contamination with toxic or non-toxic material may interfere with the process of bioassay.Chemically Some insecticides Are more volatile (viz. phosdrin aldrin, lindane etc.) and get vaporised readily.

Basic Criteria for Test Insect in Bioassay

Availability of test insect:

It is extremely difficult to have bioassay programme on the basis of insect trapped from field. Rearing of test insect is therefore, an essential pre-requisite for any bioassay programme. Food: On plant food limited number of test insect is obtained around the year. Artificial diet has overcome this difficulty. Sensitivity: The test insect should be sensitive enough to the insectical response e.g. Drosophila, housefly, mosquito larvae. Easy handling: The test insect must be such which could be handled easily.

Bioassay procedures:

a) Film or residue deposit method: The test insects are exposed to the film of the container.

b) Aqueous solution method: The solution of insecticide in a measured quantity is mixed with water in a suitable container. Aquatic organisms such as mosquito larvae, crustaceans, fishes etc. are released in it.

c) Topical application method: Topical application on the test insect is by means of topical applicator.With this equipment relatively small amount of toxicant can be applied on the body of the insect.

d) Injection method: The toxicant is directly injected in the body system of organism by hypodermic needle.

e) Sandwitch method: Amount of insecticides is put in between two leaves and the test insect is allowed to feed on it. Generally done for leaf eating caterpillars.

f) Dipping method: The maggots are picked up with forceps and dipped in the insecticidal solution.

g) Leaf dipping method: The leaf containing insects is dipped in the insecticidal solution of known strength.

h) Fumigation method: For some stored grain pests the grains are subjected to fumigation by suitable preparation of the insecticide for a specified duration.