Lecture 18 CHEMICAL CONTROL - DEFINITION - HISTORY AND DEVELOPMENT - TOXICITY PARAMETERS - IDEAL QUALITIES OF AN INSECTICIDE

Chemical Control: Management of insect pests using chemical pesticides is termed as chemical control.

Pesticides: Chemicals which are used to kill pests

History of insecticide development

Year		*Chemicals*
900	-	Arsenites in China (Inorganic compound)
1690	-	Tobacco used in Europe (Plant/natural product)
1787	-	Soaps used in Europe
1867	-	Paris Green in US
1874	-	DDT synthezized by Zeidler
1883	-	Bordeau in France
1925	-	Dinitro compounds (First synthetic organic insecticide)
1932	-	Thiocyanates
1939	-	DDT insecticidal property discovered by **Paul Muller of Switzerland**. Paul Muller awarded Nobel Prize in 1948 for discovering insecticidal property of DDT
1941	-	**BHC** in France and UK (in 1942) (BHC is presently called as HCH)
1944	-	Parathion (**Organo phosphate**) discovered by **Gerhard Schrader** in Germany
1945	-	**Chlordane (Cyclodian compound)** in Germany
1947	-	**Carbamate insecticides** in Switzerland
1962	-	Rachel Carson's Silent Spring appears (US) (This is not a chemical. The book ' Silent Spring' created awareness about ill effects of pesticides)
1967	-	First JH mimic (Juvenile Hormone mimic) used in US (Insect growth regulator)
1970	-	Development of synthetic pyrethroids (UK) (Fast degradation) (Effective at very low doses)
1980	-	Discovery of avermectins (derived from bacteria). Effective at low dose. Fast degradation.
1990	-	Discovery of newer groups like (1) **Neonicotinoids** (Imidacloprid), similar to natural nicotin, (2) **Spinosyns** (e.g. Spinosad) derived from actinomycet

TOXICITY PARAMETERS

Toxicity of a given chemical to an organism can be measured using various parameters as listed below.

1) LD_{50} or Median lethal dose

LD_{50} is defined as the amount of insecticide per unit weight which will kill 505 of the particular organism or insect. LD_{50} usually expressed as mg/kg body weight or g/larva or adult insect.

2) LC_{50} or Median lethal concentration

Defined as the concentration of insecticide required to kill 50% of the given organism or insect. This is used when the exact dose per insect is not known, but the concentration is known.

LC_{50} is expressed in PPM (1/1,000,000) or Percentage (1/100)

3) LT_{50} (Median lethal time)

LT_{50} is defined as the time required to kill 50% of the population at a certain dose or concentration.

LT_{50} expressed in hours or minutes. LT_{50} is used in field studies and also for testing insect viruses (NPV).

4. KD_{50}: Median knockdown dose
5. KT_{50}: Median knockdown time
} Dose of insecticide or time required to knockdown 50% of the insects

KD_{50} and KT_{50} are used for evaluating synthetic pyrethroids against insects.

6. ED_{50}: Median effectivedose
7. EC_{50}: Median effective concentration
} These terms are used to express the effectiveness of insect growth regulators (IGR)

ED_{50} and EC_{50} are defined as the dose or concentration of the chemical (IGR) required to affect 50% of population and produce desired symptoms in them.

Toxicity terms used to express the effect on mammals

1.	Acute toxicity	:	Toxic effect produced by a single dose of a toxicant
2.	Chronic toxicity	:	Toxic effects produced by the accumulation of small amounts of the toxicant over a long period of time
3.	Oral toxicity	:	Toxic effect produced by consumption of pesticide orally
4.	Dermal toxicity	:	Toxic effect produced when insecticide enters through skin
5.	Inhalation toxicity	:	Toxic effect produced when poisonous fumes of insecticide are inhaled (fumigants)

Other terms : Acute oral, Acute dermal, Acute inhalation toxicity, etc.

Ideal Qualities of an Insecticide

An ideal insecticide should posses the following qualities

Kill the target insect effectively and quickly

Be less toxic to natural enemies

Be less toxic to honey bees, soil microorganisms

Be less toxic to fishes and mammals

Less hazardous and less toxic during handling or accidental consumption by human beings

Quickly degradable in environment and should be less persistent (Residues should be very less)

Should not cause resurgence of the target insect (i.e. Increase in population of target insect) e.g. Chlorpyriphos causes resurgence of BPH on rice.

Should not cause outbreak of secondary pest on a minor pest by killing the natural enemies

Should have a complex mode of action against which resistance development will take more time. e.g. Azadirachtin from neem tree has complex action

Should have a longer storage life or shelf life

It is advantageous to select an insecticide which can kill a relatively broad spectrum of target pests

It should be cost effective (High benefit/Cost ratio) and safe to use (High benefit/Risk ratio)

Various generations of insecticides

	Generation	Year	Compounds
1.	First generation insecticide	1939-1942	BHC and DDT
2.	Second generation insecticide	1944-1947	Organophosphates and Carbamate
3.	**Third generation insecticide**	1967	Hormonal insecticides, JH mimic insect growth regulators
4.	Fourth generation insecticide	1970s	Synthetic pyrethroids