CHAPTER – 1

HISTORY, PRINCIPLES AND SCOPE

I. HISTORY

With the improvement in agricultural practices during the passage of time from the aboriginal civilization to the present day age of advanced scientific knowledge and technology, a steady rise in the production of agricultural commodities has been registered. Since production and protection always go together, a need to protect the agricultural produce, particularly of those commodities which form the basis of man's subsistence, was felt. Several methods of protecting the agricultural produce from the ravages of insect pests were devised, out of which the most effective and quickest method has been the use of insecticides. 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 referred to the use of one chemical or the other for controlling the pests. In view of these facts the history of the use of pesticides, including insecticides, has been divided in the following major eras:

1. Era of Natural Products:

This was the period from the early civilization of man till the beginning of nineteenth century. It is also called the age of arsenicals, petroleum oils, soaps and botanicals which were the chief agents of controlling the pests. Among botanicals, pyrethrum was introduced in 1818 in Europe from Persia. The use of nicotine in the form of tobacco juice was recommended as early as in 1763 by Erasmus Darwin. They were mostly stomach poisons causing diarrhoea and paralysis in the target organisms.

2. Era of Fumigants, Inorganic and Petroleum Products:

This is also termed as pre-DDT era. During this period i.e. from 1854 to 1939 paris-green, lead arsenate, calcium arsenate etc. were used as insecticides. Paris-green was adopted in 1865 against colarado beetle; lead arsenate in 1892 as orchard spray; and calcium arsenate in 1907 as crop dust in U.S.A. Rotenone, the fish poison, was introduced as an insecticide in 1927. In nutshell the insecticides used before

second world war were mostly inorganic chemicals. They were generally inhibitors of carbohydrate oxidation.

3. The DDT Period:

In 1939 at Basle in Switzerland the insecticidal properties of DDT (dichloro diphenyl trichloroethane) were discovered by Muller. This marked a new era in the chemical control of insects. In 1942 BHC (benzene hexachloride), yet another organochlorine, was discovered in French and English laboratories, simultaneously. Many other allied compounds, such as lindane, chlordane, toxaphene etc. came to market by the end of the year 1948. All these insecticides are neurotoxic causing nervous disruption and ultimately bringing death to the target insects.

4. Organophosphate Period:

Organophosphate compounds, acting as insecticides, appeared in 1945. Parathion and malathion were the common products from Germany while diazinon was from Switzerland. Scores of organophosphorus compounds such as demeton, dichlorvos, phorate etc. followed which proved effective insecticides. In action the organophosphorus compounds are also nervous disruptors.

5. Carbamate Period:

In 1953 in U.S.A. a carbamate insecticide under the trade name 'Sevin' was introduced, which marked yet another phase in the history of insecticides. This group of insecticides is comparatively limited and all of them are N-methylcarbamates. Like organophosphorus insecticides they are also nervous disruptors.

It may be pointed out that DDT period was short–lived but the period of organophosphate and carbamate insecticides still continues even though lately many more groups of new insecticides have come up.

6. New Groups of Insecticides:

Since 1969 three other groups of insecticides have been introduced. These are generally designated as third generation pesticides.

(i) Formamidines:

The insecticides of this group are sympathomimetic agents. They inhibit the enzyme monoamineoxidase which remove neurotoxic amine such as serotonin (5-hydroxytryptamine). Galecron is the repre-

sentative insecticide of this group which is being commonly used these days.

(ii) Hormone mimics:

Mimics of Juvenile hormone, for example Altosid an American product, act as insecticide. They disrupt the metamorphosis of the insects and bring about deformities and ultimately death. It is a potential group of insecticide which appears to have promising future in the field of agriculture.

(iii) Chitin synthesis inhibitors:

A dutch product (diflubenzuron), which has been derived from urea, commonly known as Dimilin, is a new entrant in the insecticidal arena. It inhibits the formation of chitin and thus makes the insect defenceless and liable to death. Since dominance of the class Insecta is mostly due to the presence of cuticle and since the major contributor of the cuticle is chitin, its inhibition evidently renders the insect as a helpless organism.

(iv) Synthetic pyrethroids:

Fenvalerate, deltamethrin, tralomethrin, phenothrin, permethrin and cypermethrin are the main pyrethroids of this group. These are synthetic products of recent origin. They are neurotoxic and are being manufactured under different trade names: Sumicidin, Ambush, Cymbush, Permasect etc.

II. 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." Sun (1968) modified the definition further; "It is the study of economic poisons, their effects, mechanism of action and metabolism of toxicant in insects". In order to facilitate the study of poisons the science of toxicology has been divided into many sub–branches prominent among them are:

(1) *Industrial toxicology:* It deals with the safety of industrial workers from the toxic effects of poisons.

(2) *Environmental toxicology:* It deals with the metabolism transport, translocation and physico–chemical transformation of poisons in all forms of biological systems.

(3) *Medical toxicology:* It deals with the effects of poisons in man.

(4) *Veterinary toxicology:* It deals with the effect of poisons on domesticated animals.

(5) *Insect toxicology:* It deals with such poisons which are used in killing insects without appreciable effect on mammals.