Lecture (3)

2- **Organophosphates:**

The organophosphates pesticides (OP_S) were originally developed as a by-product of research into nerve gases which was carried out during World War II and they work by inhibition of the enzyme cholinesterase. They are a large group of pesticides that are prepared from a small number of intermediates by combination with a wide variety of chemical industry.

Organo-phosphorous compounds can kill by contact, systemic or fumigant action or a combination of the three. They affect the nervous system by disrupting an enzyme that regulates acetylcholine, a neurotransmitter. Being a nerve poison they can cause acute toxic reactions in humans.

The main characters of Organophosphates:

1- Highly toxic to mammals but they are usually non-persistent and hence are less of a threat to the environment than organochlorines.
2- They should be handled with care since doses may be cumulative.
3- The fast breakdown of organophosphate pesticides (insecticides) is an advantage as far as the principles of IPM are concerned but it also means that the timing of application is critical to ensure an efficient kill.
4- They therefore require an effective monitoring and action threshold strategy in order to ensure timely application and maximum economic return.

Organophosphate insecticides have been used to control a wide range of pest insects:

1- Blowfly (diazinon).
2- Locusts and grasshoppers (Fenitrothion).
3- Aphids (dimethoate).
4- Lepidopterous pests (malathion).
5- Houseflies (dichlorvos).

3- Carbamates:

*** These are derivatives of carbamic acid which have been developed more recently than the organophosphates:**

1- Their mode of action is basically the same as that of OPS.
2- They affect the activity of acetylcholinesterses.
3- However, in the case of carbamates the enzyme inhibition is more easily reversed and the insect can recover if given too low a dose.

*** Carbamates have a broad spectrum of activity and usually act by:**

1- Contact or 2- Stomach action, 3- A few possess systemic activity (e. g. aldicarb and carbofuran) being available only as granules.

The problem with organophosphates and carbamates is that they affect an important neurotransmitter common to both insects and mammals. This neurotransmitter, acetylcholine, is essential for nerve cells to be able to communicate with each other. Acetylcholine released by one nerve cell initiates communication with another nerve cell, but that stimulation must eventually be stopped.

To stop the communication, acetylcholine is removed from the area around the nerve cells, and an enzyme, acetylcholinesterase, breaks down the acetylcholine. Organophosphates and carbamates block the enzyme and disrupt the proper functioning of the nerve cells. Hence, these insecticides are called acetylcholinesterase inhibitors.

Structural differences between the various organophosphates and carbamates affect the efficiency and degree to which the acetylcholinesterase is blocked.

Nerve gases are highly efficient and permanently block acetylcholinesterase, while the commonly used pesticides block acetylcholinesterase only temporarily. The toxicity of these pesticides presents significant health hazards, and researchers continue to work to develop new insecticides that have fewer unintended consequences.

A) Carbaryl (Sevin, Hexavin, Ravyon):

It is Broad spectrum contact insecticide, non-systemic used in cotton, fruits, vegetables, forage crops etc. Also to control of earth worms. Carbaryl, introduced by American Union Carbide Company in 1956 was the first successful commercial carbamate. it

is highly soluble in organic solvents; resistant to the action of water at room temperature and also to light and oxygen of air. In alkaline medium, it is rapidly hydrolysed and so it is not compatible with compounds of alkaline nature like Bordeaux Mixture.

B) Carbofuran (Furadan):

Broad spectrum insecticide, nematicide and miticide. LD50: 8-14 mg/kg. Can be incorporated in soil at 6-10 kg/ha for control of soil insects and nematodes. It has high mammalian toxicity but is rapidly metabolized to non-toxic products in plants and animals. It is a systemic carbamate. It is stable in acid and neutral media but unstable in alkaline medium. It is compatible with non-alkaline pesticides and fertilizers. It is not phytotoxic to rice. Carbofuran when applied to soil is absorbed by plant roots and distributed to stems and leaves and metabolized to non-toxic compounds in 30 days. Carbofuran present in soil is degraded by hydrolysis depending on soil pH and clay content. Toxic residues do not remain in the soil for long.

C) **Carbosulfan**:

Carbosulfan, a sulphanylated derivative of carbofuran acts as a contact and systemic insecticide. It can be applied to the foliage or soil as a nematicide. It has a lower mammalian toxicity. The carbomates, carbofuran, carbosulfan and aidicarb are valuable nematicides. Carbosulfan formulated as granules is used in vegetables. eg. Brassica, carrot and turnip plants.

D) Aldicarb (Temik):

It is a Systemic insecticide, acaricide, nematicide for soil use; only available as granules to reduce handling hazards. LD50: 0.93 mg/kg. Used for cotton, sugar beet and ornamentals. Aldicarb is extremely toxic and is absorbed through skin. It is therefore marketed as a granular formulation. It is effective for control of aphids, nematodes, flies beetles, leaf miners, thrips and white flies on a wide range of crops. Aldicarb is readily translocated in plants after soil application where it is metabolized to the sulphoxide and the sulphore which are also active.