

25.CARBAMATES – CHARACTERISTICS, PREPARATION AND USE OF – CARBARYL, CARBOFURAN, CARBOSULFAN AND ALDICARB

Carbamates

Mode of action – carbaryl, carbofuran, methomyl, aldicarb and bendiocarb characteristics and use persistence in plant, soil and water.

Carbamates are derivatives (esters) of carbamic acid. Several carbamates are systemic, transported in the xylem. It is possible to control pests on shoots and roots which are otherwise difficult to reach. Hence, they are used as soil insecticides and nematicides (aldicarb, carbofuran, oxamyl etc.). Commercial products available are grouped into three groups.

1. N, N-dimethyl carbamates of enols and hydroxy heterocycles
2. Phosphocarbomates
3. Oxinecarbomate

Mechanism of action

The mechanism of action of the insecticidal carbamates is identical to that of the organophosphates, *viz.*, inhibition of the enzyme cholinesterase. This enzyme has the function of hydrolyzing the post synaptic effector, acetylcholine into choline and acetic acid.

Inhibition of acetylcholinesterase (ACHE) leads to a buildup of acetylcholine in the post synaptic membrane and hence to a permanent nerve stimulation with lethal results. This stimulation of insects manifests itself in uncontrolled movements and paralysis.

A) Carbaryl (Sevin, Hexavin, Ravyon)

(Naphthyl carbamate, 1-Naphthyl-N-methyl carbamate)

LD₅₀: 850 mg.

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. Carbaryl is produced by any of the general methods of preparation of carbamates, like reacting 1-naphthol with methyl carbamoyl chloride at room temperature.

The rate of reaction is increased by removing the HCl that is formed with a stream of air or nitrogen.

Pure compound of carbaryl is obtained by reacting 1-naphthol with methyl isocyanate.

Carbaryl is also synthesized by reacting 1-naphthylchlorocarbonate with methylamine in the presence of HCl acceptors.

Carbaryl is a white crystalline compound with M.P. 142° C. 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 Brodeaux Mixture.

B) Carbofuran (Furadan)

(2, 3, dihydro 2, 2 dimethyl 7, benzofuranyl)

Broad spectrum insecticide, nematicide and miticide.

LD₅₀: 8-14 mg/kg rat.

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, broad spectrum insecticide. It is stable in acid and neutral media but unstable in alkaline medium. Sparingly soluble in water; but soluble in organic solvents. 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 sulphonylated 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.

LD₅₀: 209 mg

The carbomates, carbofuran, carbosulfan and aidicarb are valuable nematicidesss. Carbosulfan formulated as granules is used in vegetables. eg. brassicas, carrots and turnips.

D) Aldicarb (Temik)

2-Methyl-2-(methylthio) propanol 0-Methylamino carbonyl oxime)

Systemic insecticide, acaricide, nematicide for soil use; only available as granules to reduce handling hazards.

LD₅₀: 0.93 mg/kg rat.

Used for cotton, sugarbeet and ornamentals. Aldicarb is extremely toxic and is absorbed through skin. It is therefore marketed as a granular formulation.

White crystalline substance m.p. 100°C. Sparingly soluble in water prepared by reacting corresponding oxime with methyl isocyanate.

Aldicarb is a carbamate of carbamoyl oxime group. 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.