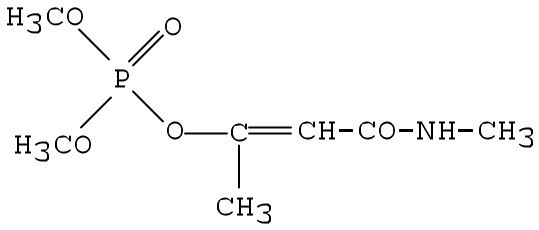
## 23.ORGANOPHOSPHATES – CHARACTERISTICS, PREPARATION AND USE OF MONOCROTOPHOS, PHOSPHAMIDAN, MALATHION AND CHLORPYRIPHOS

### a) Monocrotophos (Azodrin)

Derivative of phosphoric acid

Monocrotophos (Dimethyl-1 methyl-2-methyl carbamoyl-venyl phosphate)



(Monocrotophos)

$LD_{50}$: 21 mg/g

### b) Phosphamidon (Dimecron)

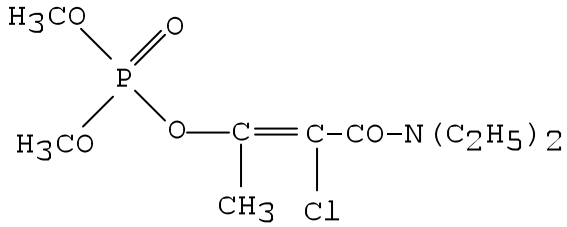
(2-chloro-2diethyl carbamyl-1-methylvinyl dimethyl phosphate)

### 1. Derivative of Phosphoric Acid

Phosphamidon is produced by reacting equimolecular quantities of trimethyl phosphite with boiling solution of diethylamide of dichloroacetic acid in chlorobenzene.

$$(CH_3O)_3P+CH_3CO\ C\ Cl_2\ CON(C_2H_5)_2 \rightarrow (CH_3O)_2\text{-}P\text{-}O\text{-}\underset{\displaystyle O}{\underset{|}{C}}=\underset{\displaystyle CH_3}{\underset{|}{C}}Cl\text{-}CON\text{-}(C_2H_2)_2+CH_3Cl$$

Phosphamidon is very similar to mevinphos in toxicity has a broad spectrum of activity against biting and sucking pests and spider mites.



$LD_{50}$: 10 mg

Pure phosphamidon is colourless. Commercial product is bright violet due to the presence of a dye. B.P. 70°C, with a faint pleasant odour.

Highly soluble in water, alcohol, acetone, slightly soluble in saturated bydrocarbons like hexane and insoluble in kerosene. Does not clogg the nozzles and hence suited to ultra low volume and low volume sprays.

- Phosphamidon is stable in neutral and weak acidic aqueous solutions.
- It is rapidly hydrolysed in alkaline medium.
- Stable for 2 years when stored in closed containers.
- It is compatible with most pesticides except alkaline ones.
- When mixed with captan it is synergistic. Toxicity is reduced when mixed with copper oxychloride.
- When insects feed on this, the choline esterase is inhibited and the insect gets killed.
- Used as a systemic to control sucking pests in cotton.

**c) Malathion**

(0, 0-dimethyl S-(1, 2, dicarbethoxy) ethyl phosphorus dithioate)

Derivatives of Dithiophosphoric acid

Dithiophosphoric acid + Maleic acid → Malathion

Malathion is obtained by addition of dimethyl dithiophosphoric acid to maleic acid ester in the presence of basic catalyts.

Malathion was introduced in 1950 by the American Cyanamid company. It is an important and widely used contact insecticide and acaricide for the control of aphids, red spidermites, leafhoppers and thrips on a wide range of vegetable and other crops. It was important in the history of development of OP insecticides since it was the first member with a broad spectrum of contact insecticidal activity combined with the remarkably low mammalian toxicity ($LD_{50}$: 1300 mg/kg rats). Malathion is also valuable to control insect vectors eg. Mosquitoes and can be used as a substitute for organochlorine insecticides.

Pure malathion is a colourless liquid boiling at 120°C. It is sparingly soluble in water but highly soluble in most of the organic solvents except in saturated bydrocarbons.

Malathion on prolonged heating at 150°C is isomerised and goes over to thiolo isomers.

**d) Chlorpyriphos (Dursban)**

(0, 0-diethyl 0-(3, 5, 6 trichlorophyridine-2 yl phosphorothioate)

**Derivative of Thiophosphoric acid**

Chlorpyrifos is used for mosquito control but may also be employed against ectoparasites on domestic animals.

$LD_{50}$: 135-163 mg/kg rat oral.

Metallic ions in soils often interact with organophosphorus insecticides; the cupric ion is a very effective calalyst for the degradation of some organophosphorus esters, such as diazinon and chlorpyrifos.

Chlorpyrifos has low acute mammalian toxicity in the 2000-5000 mg/kg range. Many organophosphorus insecticides contain heterocyclic moieties with nitrogen heterocycles. The only important pyridine derivatives are chlorpyrifos and chlorpyrifos methyl. Chlorpyrifos is a very valuable contact insecticide some 3500 tonnes were used in USA in 1982. It has a wide spectrum of activity, by contact, ingestion and vapour action. It is moderately persistant and retains its activity in soil for 2-4 months and is valuable against mosquito and fly larvae, cabbage root fly, aphids and codling and winter moths on fruit trees.

Chlorpyrifos has become one of the most widely applied insecticides in homes and restaurants against cockroaches, and other domestic pests. It is a comparatively safe insecticide. Chlorpyrifos methyl ($R=CH_3$) is quite volatile and is used to control insects in grain stores.