

SYNTHETIC ORGANIC INSECTICIDE

First synthetic organic compound to be used as insecticides are **alkyl thiocyanates**

Chlorinated Hydrocarbons (Organochlorines):

They are also known as chlorinated synthetics or chlorinated organics or chlorinated hydrocarbons. The important organochlorines are DDT, DDT analogues, Chlorinated terpenes and Cyclodienes.

1. DDT:

- DDT was first synthesized in 1874 by Othmar Zeidler.
- In 1939 a Swiss entomologist, Paul Muller, found its insecticidal property for the first time. This discovery brought the 'Nobel Prize' for medicine to Paul Muller in 1948 for the life saving discovery.
- Dichloro Diphenyl Trichloroethane (DDT) is stomach and contact insecticide.
- It has got long residual action.
- It is also non-phytotoxic except to cucurbits.
- Due to low cost of DDT and effectiveness against a variety of insects particularly against house flies and mosquitoes, it is much popularized but due to **long residual life and accumulation**, it is banned in several countries.
- The acute oral LD50 for rats is 113-118 mg/kg.
- It does affect the nervous system preventing normal transmission of nerve impulses. DDT causes a violent excitatory neurotoxic system in most insects which are having uncoordinated movement and DDT **Jitters Effect (tremor of the entire body)**.
- DDT is active as pp-DDT (65-80%) and op-DDT (15-21%)

DDT analogues:

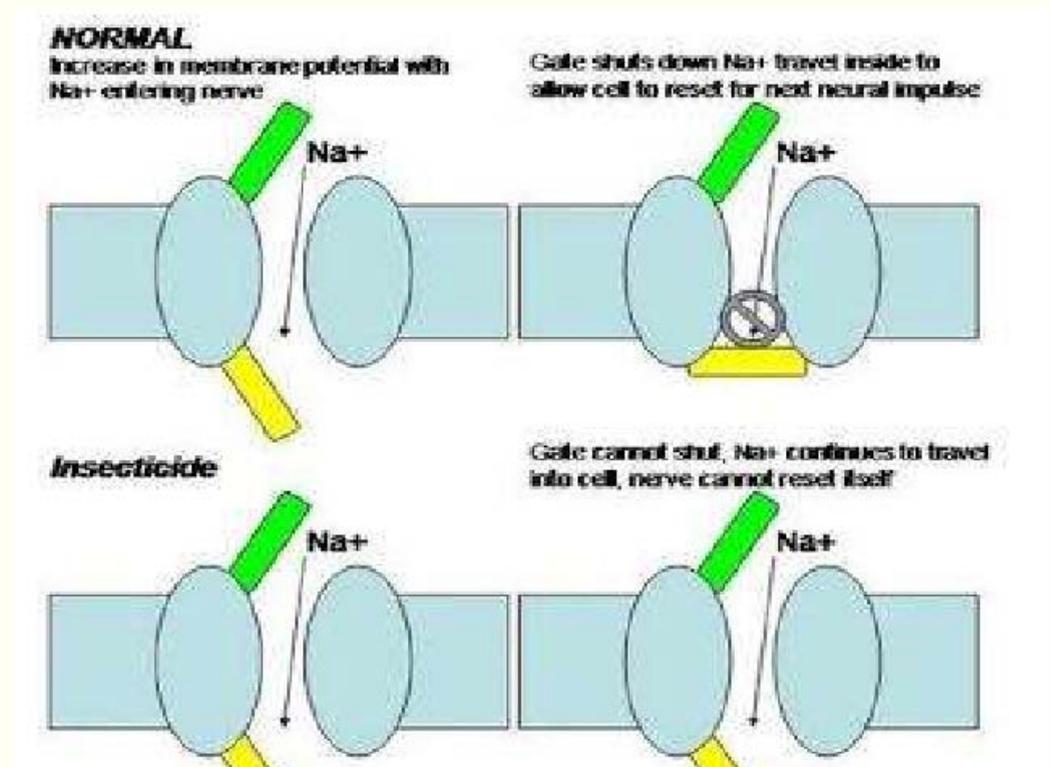
- Methoxychlor, DDD (Rothane- Safe to fish) or TDE, Perthane and Nitroparafin analogues (Prolan + Bulan = Dilan) and Dicofol (Effective for mites).

2. Hexa Chloro Cyclohexane (HCH):

- It was first synthesised by Michael Faraday in the year 1825.
- The gamma-isomer of BHC has the insecticidal activity.
- BHC is a stomach and contact insecticide.
- It is persistent and non-phytotoxic except cucurbits.
- It has been extensively used as soil insecticides particularly to control termites, white grubs and cutworms.
- Highly purified product containing 99% of gamma isomer of HCH is known as lindane, this name was proposed in 1949 after **Vander Linden**, a German chemist who isolated this isomer in 1912.

Chlorinated Terpenes:

Toxaphene (1948 by Parker and Beacher) and Strobane



3. Cyclodienes

- First synthesized by Kurt Alder and Otto Diels (Nobel Prize in Chemistry in 1950)
- Prepared by Diels Alder reaction.
- Neurotoxicants, disturb the balance of sodium and potassium ions.
- Results tremors, convulsions, prostration and ultimately the death.
- Longer stability in the soil, control of soil inhabiting insect pests.
- Some of the compounds are chlordane (1945), aldrin and dieldrin (1948), heptachlor (1949), endrin (1951)(Most toxic) and endosulfan (1956).
- Used for termite control as they are most effective, long lasting and economical insecticides but now banned by GOI.

Aldrin:-

Recommended for the control of termites.

Formulations: EC 30%, Granule 5% and Dusts 5%.

Trade names: Aldrex, Aldrosol, and Aldrite

Dieldrin:-

Formulations: Dust 2%,

Trade names: Quintox, Alvit

Heptachlor:-

Contact poison with fumigant action

Formulations: EC 20%, and Dust 5%

Endosulfan:_

Effective against defoliators, borers, sucking insects and mites

It is highly toxic to fish (**Safe for Honeybees**)

Trade names:Thiodan, Endocel, Endodhan, Endotaf

Monocyclic	HCH & Lindane
Bicyclic	Toxaphene
Polycyclic	Aldrin
Heterocyclic	Endosulfan & Dieldrin

Organophosphate:

1. The biological activity of these compounds was first discovered by **W. Lange and Krueger in 1932.**
2. OP compounds as insecticides were mainly due to the work of **Gerhard Schrader in 1937 in Germany.**
3. **First OP compound is Parathion** and the first commercialised compound is TEPP (Tetra Ethyl Pyro Phosphate) followed by **Schradan**, the first systemic insecticide.
4. Two most important properties are higher potency and low residual life.
5. Inhibit the cholinesterase (Ch E) enzyme leading to blockage of synaptic transmission of nerve impulses.

- 1) **Malathion:** contact and stomach insecticide and acaricide Trade names: Cythion and Himala (Short residual period-7 days, that's why recommended for vegetables and in godowns) (**Safest**)
- 2) **Methyl parathion:** Contact and stomach poison with slight fumigant action Trade names: Folidal, Metacid, Paratox, Dhanumar
- 3) **Diazinon:** contact persistent insecticide with nematocidal properties Trade names: Basudin
- 4) **Dichlorvos(2,2-Dichloro Vinyl Dimethyl Phosphate - DDVP)-** Has fumigant action due to high vapour pressure it has got strong penetrating power Recommended for leaf miners and leaf webbers Trade names: nuvan, vapona, Doom, Divap
- 5) **Fenitrothion:** It acts as contact and stomach poison and a selective acaricide • Trade names: Sumithion, Folithion

- 6) Quinolphos:** It is having acaricidal properties, Trade names: Ekalux, Shakthi Quick, Quinguard, Quinaltaf
- 7) Chlorpyrifos:** Very effective against sucking and chewing pests • Recommended for seed treatment against white grub and termites Trade names: Dursban, Chloroban, Durmet, Radar
- 8) Phosphomidon:** Trade names: Demecron, Sumidon, Chemidan
- 10) Monocrotophos:** Trade names: Monocil, Nuvacron, Monophos
- 11) Methyl demeton:** Trade names: Metasystox and Dhanusyatax
- 12) Dimethoate:** widely used against sucking insect pests of various crops Trade names: Rogor, Celgor, Novogor
- 13) Triazophos:** It has insecticidal, acaricidal and nematocidal properties with translaminar action. Very effective against variety of pests particularly Lepidoptera larvae on fruits and vegetables
- 14) Phorate:** Granular formulation having Systemic action.
- 15) Ronnel:** Systemic and effective against parasites of cattle (Screw worm, sucking lice)

Carbamate:

1. Derivatives of carbamic acid. (Dithiocarbamic acid- Carbothion)
 - (Synthetic derivative of Physostigmine- Eserine, principal alkaloid of Calabar bean, *Physostigma venenosum*)
1. Insecticidal and a few are effective molluscicides
2. Carbamate insecticides interfere in cholinergic transmission, enters the synapse and inhibits the acetylcholine-esterase causing prolonged stimulation resulting into the failure of the nerve or effector tissue
3. Carbamates have an analogous action, carbamylating rather than phosphorylating the enzyme and the che recovers more readily from carbamates than from organophosphates thus, unlike, organophosphates.
4. They are known as **reversible inhibitors**.
5. First carbamate insecticide: **Isolan**

1. **Carbaryl:** Compatible with many pesticides except Bordeaux mixture lime sulphur and urea Trade names: Sevin
2. **Propoxur (Arprocarb):** Have good knock down properties, effective in controlling house hold pests such as cockroaches, crickets, flies etc. Trade names: Baygon
3. **Carbofuran:** Insecticide, miticide and nematocide, recommended as soil insecticide against plant sap sucking and borer pests, Trade names: Furadan
4. **Carbosulfan:** Recommended as seed dresser insecticide, Trade name: Marshal
5. **Thiodicarb:** Insecticide with ovicidal properties and molluscicide, Trade name: Larvin
6. **Aldicarb:** It is systemic pesticide usually applied in soil as seed furrow, band or broadcast treatments either pre-plant or at planting as well as post emergence, Trade names: Temik
7. **Methomyl:** Very effective against a wide variety of pests particularly army worms, cabbage semilooper, Okra stem fly, fruit borers, leaf defoliators, cotton boll worms, etc. Trade names: Lannate, Dunnate

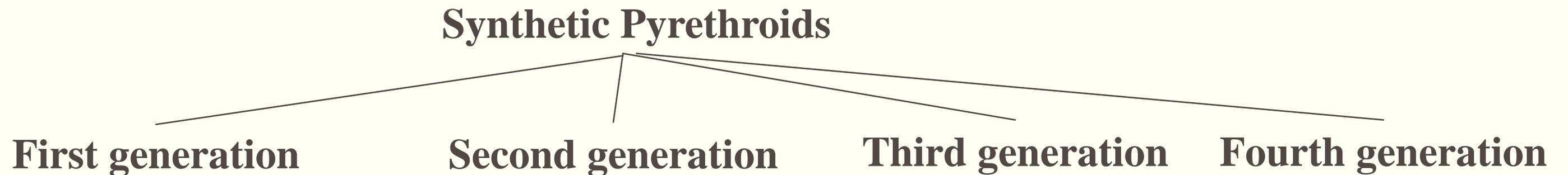
Synthetic Pyrethroids

- Synthetic pyrethroids are plant derivative pyrethrum as insecticides but are more stable in light and air.
- **Allethrin** was first synthetic analogue of pyrethroids.
- They act on tiny channel through which sodium is pumped to cause excitation of neurons and prevent the sodium channels from closing resulting in continual nerve transmission, tremors and eventually death.
- They have extremely high insecticidal activity at extremely low doses and are bio-degradable in nature.
- More effective for lepidopterous pests, beetle, leaf miner and bugs against eggs, larval and adult stages.
- They have antifeedant and repellent properties.
- They are not readily washed off from the plants by rain due to lipophilic characters.
- These synthetic pyrethroids are very less toxic to mammals and having a quick knock down activity to insects.
- Very low application rate of synthetic pyrethroids as compared to conventional insecticides brings reduced environmental pollution.

- First Synthetic Pyrethroid: Allethrin
- First Photostable Synthetic pyrethroid: Permethrin
- High mammalian safe: Bioresmethrin
- Effective against Soil pest (**Tefluthrin**), all stages of insect (**Cypermethrin**), mites (**Fluvalinate**), stored-grain pest (**Deltamethrin**) and termites (**Bifenthrin**)
- Safe to bees (**Fluvalinate**) and Fish (**Etofenprox**)

Limitations

1. A major limitation of synthetic pyrethroids is that these are generally not effective as soil insecticide.
2. Even at low dosages kill non target species.
3. Synthetic pyrethroids cause resurgence of several groups of insect pests especially whiteflies and aphids.
4. Rapid development of resistance to synthetic pyrethroids in many insect species. This may be due to high selection pressure exerted by high mortality caused by synthetic pyrethroids
5. Synthetic pyrethroids are poor acaricides



First generation:

It is of low toxicity to people and other mammals because they are rapidly broken down in the body, decompose quickly in sunlight and air and thus pose little risk in the environment. All pyrethroids are toxic to aquatic animals

1) Allethrin

Contact, stomach and respiratory action and bring quick knock down of flies and mosquitoes, applied with Piperonyl butoxide

Trade name: Pynamin

Second generation:

These pyrethroids decompose rapidly in sunlight. They thus pose little threat to the environment, but for the same reason they are not suitable for agricultural use.

1) Resmethrin

Trade name: NRDC – 104, SBP-1382, and FMC – 17370

2) Bioresmethrin: stereoisomer of resmethrin

Trade name: NRDC-107, FMC –18739, and RU-1148

3) Bioallethrin(d-trans –allethrin)

Third generation:

Do not decompose in sunlight and contain some of the most powerful insecticides. Not highly toxic to people or other mammals mainly because they decompose rapidly in the body

- 1) Fenvalerate: Trade names: Fenvel, Bilfen, Belmark, Sumicidin, Pydrin
- 2) Permethrin: First agricultural pyrethroids because of their exceptional insecticidal activity (0.11 kg a.i/ha) and their photo stability, Trade names: Ambush , pounce , pramex

Fourth generation:

Most resistance to exposure to sunlight and air and, therefore are more persistent. This group is more toxic to people than other pyrethroids and therefore requires more care in use

- 1) λ cyhalothrin: Trade names: Kung-Fu, Karate, Matador, Samurai
- 2) Cyfluthrin: Used in public health situations and for structural pest control Trade names: Contur, Laser, Responsar, Tempo
- 3) Cypermethrin Trade names: Cyper guard, Cymbush and Cyper kill
- 4) Fenpropathrin: Have acaricidal or miticidal property, Trade names: Danitol, Rody and Meothrin
- 5) Flucythrinate control insect pests in apples, cabbage, field corn, head lettuce and pears Trade names: AASTAR, AC 222705, Cybolt, Fuching Jujr, OMS 2007, and Pay-Off.
- 6) Decamethrin (Deltamethrin): proved effective even against insects resistant to conventional insecticides