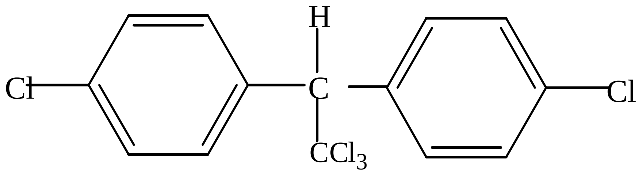
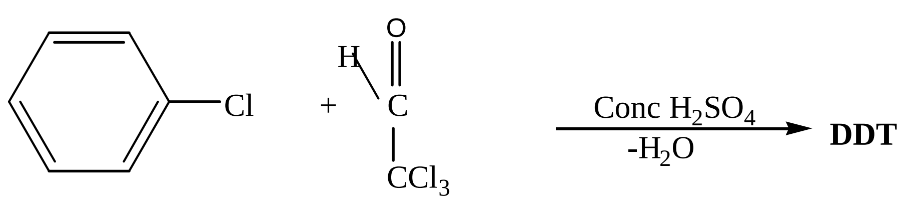


Structure of DDT

Zeilder prepared DDT without an idea of its potential insecticidal properties. This property was discovered later by Paul Miller in 1939. He discovered that DDT was very effective against mosquito housefly and bed bugs. In other word, DDT was found to be a broad spectrum insecticide, it is not selective. This earns him a Nobel prize in 1948.

Preparation of DDT

DDT is readily prepared from phenyl chloride and 1,1,1-trichloroethanal (chloral). DDT was the first synthetic insecticide known. The reaction is illustrated below



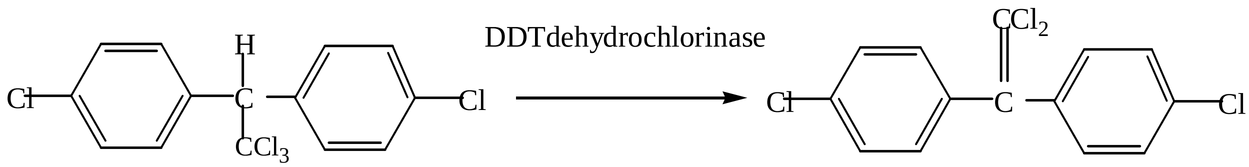
DDT is abroad spectrum organochlorine insecticide. It has several methods of synthesis. It has been used specifically for soil insect control, malarial eradication through killing of mosquitoes. It is also used for the control of termites.

Physical properties of DDT

A technical grade DDT is a volatile waxy solid with melting points of 90oC. The para-para DDT is a white powder with a melting point of 110^{o}C, insoluble in water.

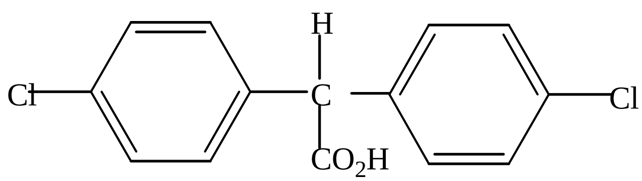
Insecticidal properties of DDT

DDT has broad spectrum insecticidal activities, killing variety of insects and used specifically against mosquito-transmitting malarial parasites and other flies that transmits typhoid. Despite its broad spectrum insecticidal usage, DDT is known to be insoluble in water; hence it does not get degraded fast in the environment, resulting into partitioning into the body fat. This has led to the total ban of DDT in advanced countries; though it is still widely used in developing nations, where environmental control and monitoring is not effective. A major disadvantage of DDT and its analogue is that it is readily detoxified by some insects that are resistant to it; e.g. DDT can be converted easily to Diphenyl dichloro ethylene (DDE). This conversion is aided by an enzyme known as DDTdehydrochlorinase e.g.



DDT DDE

Once DDT is converted to DDE, it becomes inactive. In other words, certain insects have developed enzymedehydrochlorinase. In mammals and birds, DDE is further converted to diphenyldichloroacetic acid (DDA).

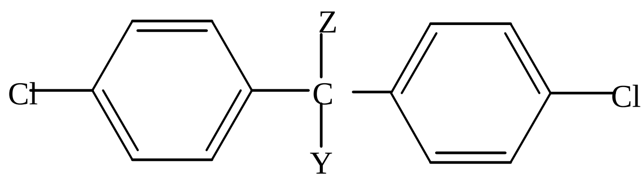


DDA

Mode of actions of DDT
Insecticidal activity of DDT is due to the fact that they interfere with the transmission of nerve impulses in insects, thereby interrupting or upsetting the K^+ and Na^+ balance of their nerve membrane.

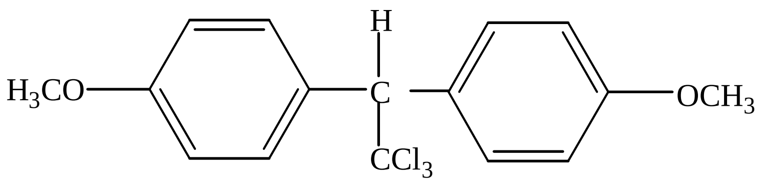
Toxicology of DDT
Organochlorine varies widely in their toxicological activities, and acute toxicity to mammals and insects. Some acute oral doses of LD_{50} are known. Action of DDT in mammal is through disruption of the nerve connection and since they are slowly metabolized and lipophilic, they partition into the body fat, hence frequent exposure must be avoided. There have been reported cases of accidental killing of birds, fish and other non-targeted species such as egg shell thinning in species near the top of the food chain.

Other polychlorobiphenyl insecticides



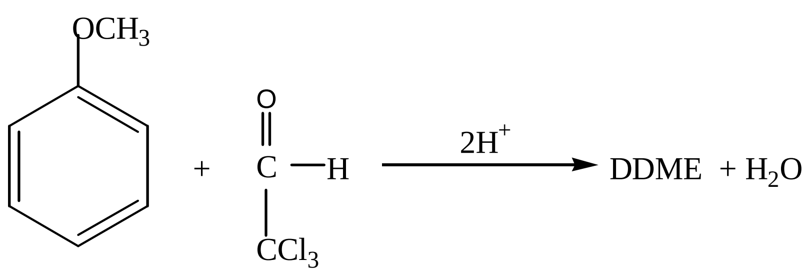
Y =CCl_2, Z = H= DDE

Y = CO_2H , Z = H =DDA
Y =CCl_3, Z = H+ = DDT
Y = C=O-OC_2H_5, Z = OH = Dicofol



DDME

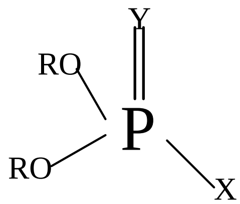
DDME is called methoxylchloro. Its preparation is via condensation of chloral and methoxyl benzene (anisole):



DDME has low mammalian toxicity and has been found to be more active in the control of insects that attack livestock, fruits and vegetables. It has low mammalian toxicity, with lower tendency to be stored in the body fat of animals. This is as a result of their high solubility in water. It is a pro-organochlorine insecticide known for its less toxicity compare to DDT. Hence, DDME is a good insecticide for livestock treatment. The presence of methoxyl group surrounding the side chains of the benzene ring, account for its high solubility. DDME is resistant to heat, UV radiation and oxidation.

ORGANOPHOSPHATES

General feature of organophosphate insecticide is represented thus:

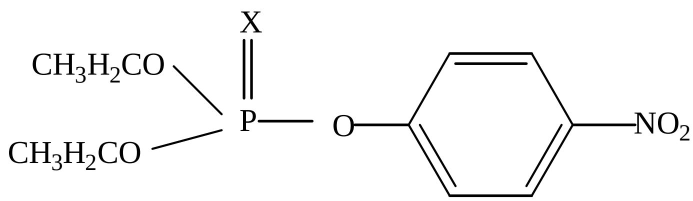


R = Alkyl group
X = Phenyl group

Key

Y =O = Paroxon,
Y = S = Parathion

Specific examples are illustrated below:



O,O-diethyl-4-nitrophenylphosphoroparoxon, X = O

X = S - Parathion

X = O - Paraoxon

Organophosphorous insecticides many organic compounds based on the fact that they are simple esters of monophosphorous compounds. Over 100 organophosphorous compounds have been marketed. They were developed by German scientists after the Second World War. Different members of organophosphorous insecticides possess different physical and chemical properties. They vary widely in solubility in water, but in most cases they are very soluble in water. They equally vary in their stability and toxicity to mammal. The wide spectrum of their physicochemical and biological properties made them to be widely useful in agriculture and natural hygiene. Some are used as fumigants; others are used as contact poison and for crop protection in their early growing season. In most cases, they are used n plants such as sorghum, corn, cotton, rice, wheat, barley and soybeans. They are equally used in crop fruits and vegetables for foliage and root protection. In veterinary outlook, they are used against ectoparasites control in cattle and sheep, in the form of ear tag, spray or dip. As a result of their environmental acceptability, they have specific modes of actions. They are relatively unstable in biological systems (not persistent).

Chemistry of Organophosphate

The phosphorous atom is electrophilic, owing to the depolarization of P=O bond and partly due to the electron-withdrawing nature of para - nitro phenyl moiety. This enhances its high solubility in water.

Mode of action of Organophosphate insecticide

The nature of the phenyl group arising from the electron-withdrawing property of the phenyl group makes the phosphorous atom electrophilic, hence its ability to phosphorylate nucleophile such as co-enzyme A and also, the 4-nitro phenyl moiety is a good leaving group.

Toxicology of Organophosphorous insecticides

Mechanism of action of organophosphorous insecticides in mammals and insects are similar. Poisoning action is caused by toxification of the acetycholine stearase . Killing in animal is due to paralysis of striated respiratory centre. However, the most effective antidote is to organophosphate poisoning is atropine, which blocks acetycholine receptors of the motor end of plate of the para sympathetic nervous system, that controls the respiratory muscle. Generally, organophosphorous are less toxic compare to organochlorine insecticide. The y do not persist in the environment and are water – soluble compare to DDT.