

Toxicity Profile

- The toxicity profile or toxicological profile of a substance is indicative of the harmful nature of the substance. It is determined on the basis of the different levels of exposure of the substance resulting from different routes of entry.
- At present, the use of pesticide is more of a **necessity** rather than an option.
- If pesticides are not used against vectors of diseases, then the result will be devastating both for human and animal health and for the economy of the country.
- Despite several benefits, pesticides have a major impact on the environment and human and animal health.

ORGANOPHOSPHATES

- The term “**organophosphate**” is generally understood as an organic derivative of **phosphoric acid** or **similar acid**.
- In **pesticide toxicology**, it means **organophosphorus anticholinesterases**.
- It does not include **glyphosate** as it does not have insecticidal action.
- Organophosphates are used on **arable crops**, in **horticulture**, and as **ectoparasiticides**.

ORGANOPHOSPHATES

- Organophosphate insecticides, such as diazinon, chlorpyrifos, disulphoton, azinphos-methyl, and fonofos, have been used widely in agriculture as pesticides.
- They inhibit **acetylcholinesterase**, thereby affecting neuromuscular transmission
- **Chlorpyrifos**
- As other organophosphate compounds, chlorpyrifos inhibits acetylcholinesterase enzyme, thus acting on the nervous system.
- This pesticide has been found to be moderately toxic to humans.

Chlorpyrifos

- Chlorpyrifos exposure leads to neurological effects, development disorders, and autoimmune disorders.

Table 1 Organophosphate mammalian toxicities (mg/kg of body weight)

<i>Common name</i>	<i>Rat oral LD₅₀</i>	<i>Rabbit dermal LD₅₀</i>
Acephate	1,030–1,447	>10,250
Azinphos-methyl	4	150–200 (rat)
Chlorpyrifos	96–270	2,000
Diazinon	1,250	2,020
Dimethoate	235	400
Disulphoton	2–12	3.6–15.9
Ethoprop	61.5	2.4
Fenamiphos	10.6–24.8	71.5–75.7
Malathion	5,500	>2,000
Methamidophos	13 (female only)	122
Methidathion	25–44	200
Methyl parathion	6	45
Naled	191	360
Oxydemeton-methyl	50	1,350
Phorate	2–4	20–30 (guinea pig)
Phosmet	147–316	>4,640
Profenofos	358	472

Source Fishel (2013a)

Chronic toxicity

Chlorpyrifos

- Dogs fed technical chlorpyrifos for 2 years showed 3.0 mg/kg/day **increase in liver weight**.
- Signs of **cholinesterase inhibition** occurred at 1 mg/kg/ day.
- When rats and mice were fed technical chlorpyrifos for 104 weeks, apart from **cholinesterase inhibition no other adverse effects were observed** (USEPA 1989d).
- Moderate **depression of cholinesterase** was observed in rats when they were fed 1 and 3 mg/kg/day dose of chlorpyrifos for a 2-year period.

Dichlorvos

- Dichlorvos is an organophosphate insecticide. It is used to control **household, public health, and stored product insects**.
- Effective against **mushroom flies, aphids, spider mites, caterpillars, thrips, and whiteflies**, it is also used against parasitic worm infections in dogs, livestock, and humans.
- As other organophosphates, it also affects **acetylcholinesterase** thus disrupting the nervous system.

Chronic toxicity

Dichlorvos

- The **cholinesterase activity** in the **plasma, red blood cells, and brain** of rats **decreased** substantially when they were exposed to air concentrations of 0.5 mg/L dichlorvos for a 5-week period.
- In a 2-year feeding study, dogs were given 1.6 or 12.5 mg/kg/day of dichlorvos dietary doses.
- It was observed that their **red blood cell cholinesterase** activity decreased and **liver weight and liver cell size increased**.
- The dietary fluid in the lungs build up when the animals were chronically exposed to dichlorvos.

Fenthion

- Fenthion is an organophosphate insecticide used against **sucking and biting insects**. As other organophosphate pesticides, it **inhibits the function of cholinesterase**.
- Apart from being used against insects, it is also used to **control birds**, particularly weaver birds, as it is highly toxic to birds.
- Fenthion is **moderately toxic via the oral and dermal routes**, and only **slightly toxic via inhalation**.

Chronic toxicity

Fenthion

- When rats were fed 12.5 mg/kg/day of fenthion, within four weeks **weight loss** and **85% inhibition of normal brain cholinesterase activity** were observed.
- At a dose of 2.5 mg/kg/day, less severe but still detectable decreases were noticeable
- Dogs fed 1.25 mg/kg/day of fenthion for 1 year showed neither **weight loss nor decreased food consumption**

Malathion

- Malathion is a **low human toxicity pesticide** and it was one of the earliest pesticides developed.
- Malathion is used against **mosquitoes, flies, household pests, and animal parasites**.
- Malathion is **slightly toxic** via **both oral and dermal routes**. Effects of malathion are similar to those observed with other organophosphates, except that larger doses are required to produce them
- Reports suggest that **single doses of malathion** are likely to affect immune system response

Chronic toxicity

Malathion

- In a study conducted on humans, volunteers were fed very low doses of malathion for 11–12 months.
- They showed **no substantial effects** on **blood cholinesterase activity**.
- For a period of over 2 years, rats were fed a dietary dose of 5–25 mg/kg/day of malathion.
- Apart from the **depressed cholinesterase activity**, no other symptoms were observed in them.
- When for eight weeks rats were fed **small amounts of malathion**, no adverse effects were observed in their whole-blood cholinesterase activity