

CHAPTER 9

HERBICIDES

SECTION I - GENERAL

901. Introduction.

- a. A herbicide is any preparation used to kill or inhibit the growth of plants. The term includes defoliants, desiccants, plant growth regulators and soil sterilants. Militarily, herbicides have been used against forest croplands and brush along roads and rivers and around military establishments.
- b. A wide variety of chemical substances have been used as herbicides. This chapter will deal with those substances that have been used in admixtures. See Table 9-I.
- c. There is very little likelihood of human beings or animals being poisoned as a result of dioxin-free non-cropland vegetation control. In spraying operations from aircraft, flag-men and women on the ground probably receive relatively high doses, yet a serious case of acute herbicide poisoning has never been confirmed. Poisoning may, however, result from accidental or suicidal ingestion of large quantities of undiluted herbicides. Also important is the fact that toxic residues of these herbicides will not accumulate sufficiently in meat animals to pose a hazard in humans.

Table 9-I. Composition of Herbicides

Name	Composition
Compound one	27.7% sodium cacodylate 4.8% cacodylic acid 67.5% water and sodium chloride
Compound two	10.2% tri-isopropanolamine salt of 4-amino-3,5,6-tri-chloropicolinic acid 39.6% tri-isopropanolamine salt of 2,4-dichlorophenoxyacetic acid (2,4,D)* 50.2% unidentified by manufacturer other than for the presence of water and a surfactant
Compound three	50% n-butyl ester of 2,4-D* 30% n-butyl ester of 2,4,5-tri-chlorophenoxyacetic acid (2,4,5-T*) 20% isobutyl ester of 2,4,5-T*
Compound four	50% n-butyl ester of 2,4-D* 50% n-butyl ester of 2,4,5-T*

* 2,4,-D and 2,4,5,-T may be contaminated with dioxins, some of which are very toxic. Dioxins have been incriminated as a cause of severe choracne in man.

SECTION II - 2,4-D AND 2,4,5-T**902. Toxicity.**

- a. The risk of human and animal toxicity from the use of 2,4-D (2,4-dichlorophenoxyacetic acid) and its various esters and salts is low. A useful generalisation for this compound is that the toxicity of its derivatives is about the same as that of the acid equivalent.
- b. 2,4,5-T(2,4,5-trichlorophenoxyacetic acid) is an important chlorophenoxy herbicide widely used as its ester in combination with an ethanolamine salt. From animal studies, it is generally considered to be slightly more toxic than 2,4-D. The biochemistry of 2,4,5-T is probably similar to that of 2,4-D.

903. Biochemistry.

Since 2,4-D and its salts, esters, and amides are used for the control of broad leaf plants, its dietary and accumulative effects in the body are important. Long term feeding studies in animals have revealed no evidence that 2,4-D accumulates in the body. The biochemistry of 2,4,5-T is probably similar to that of 2,4-D.

904. Mechanism of Action.

The mode of action of 2,4-D is not known. Animals killed quickly by large doses of 2,4-D are thought to die of ventricular fibrillation. Animals poisoned less severely develop a characteristic myotonia which, however, has not been observed in humans. The mode of action of 2,4,5-T is also not known.

905. Signs and Symptoms.

- a. Ingestion of a toxic dose of 2,4-D causes gastroenteric distress, diarrhoea, mild CNS depression, dysphagia, and possibly transient liver and kidney damage. Some people have developed neuropathy as a result of skin contact with the compound. Some hours after exposure to the 2,4-D ester or the dimethylamine salt, pain, paraesthesia, and paralysis may develop. The disability may be protracted and recovery incomplete. However, the number of people who have developed neuropathy after exposure to 2,4-D is extremely small compared to the number of exposures that have occurred.
- b. The signs and symptoms of 2,4,5-T poisoning are probably similar to those of 2,4-D poisoning.

906. Treatment.

If a toxic dose of 2,4-D or 2,4,5-T has been ingested, further absorption should be prevented by gastric lavage or inducing emesis and administration of activated charcoal. Supportive therapy should be given.

SECTION III - CACODYLIC ACID

907. Toxicity.

The toxicity of cacodylic acid, or dimethylarsenic acid, in humans is not known. However, the experience of workers in a chemical company who have had repeated exposures over long periods of time confirms the observation on rats that the toxicity of these compounds is relatively low.

908. Biochemistry.

- a. Cacodylic acid is a desiccant that causes leaf drop and death in certain hardwood species. Like 2,4-D and 2,4,5-T, its dietary and cumulative effects are important.
- b. The military herbicide "Compound 1" contains 4.8% cacodylic acid with a trivalent arsenic content of less than 0.1 %. Cacodylic acid has medicinal properties similar to those of inorganic arsenic to which it is partially reduced in the body. However, no reduction to trivalent arsenic occurs.

909. Mechanism of Action.

The pharmacologic action of cacodylic acid is intimately related to its biochemistry. The effects of cacodylic acid are essentially those of inorganic arsenic. However, because conversion to arsenic is very slow, its action is more prolonged and considerably less toxic. The local irritant effects of cacodylic acid are minimal compared to those of arsenic. Cacodylic acid is judged as essentially non-irritating to both skin and eyes.

910. Signs and Symptoms.

Ingestion of a toxic dose of cacodylic acid by humans may cause slight burning of the mouth and throat, gastroenteric pain, vomiting, diarrhoea, haematuria, albuminuria, dehydration, jaundice, oliguria, and collapse. CNS symptoms (headache, dizziness, and hyperexcitability) may be present, obscuring gastroenteric complaints. Shock may develop as a consequence of paralysis and increased permeability of the capillaries.

911. Treatment.

Following ingestion of a toxic dose of cacodylic and further absorption should be prevented by gastric lavage, emesis or activated charcoal. Fluids should be given to combat dehydration.

SECTION IV - PICLORAM

912. Toxicity.

Picloram (4-amino 3,5,6-trichloropicolinic acid) is one of the constituents of Compound 2. The major constituent is 2,4-D. Based on the criterion that an acute oral toxicity of 5000

mg.kg⁻¹ or greater in warm-blooded animals is non-toxic, picloram would be rated accordingly, and Compound 2 would be rated as mildly toxic. The data from extensive animal studies on the acute and chronic toxicity of picloram and Compound 2 suggest there would be little direct hazard of these formulations to humans.

913. Mechanism of Action.

The fate of picloram following ingestion has not been studied extensively and the pharmacology of picloram is unknown.

914. Signs and Symptoms.

As Compound 2 contains 2,4-D isopropyl amine salt, ingestion of a toxic dose would probably produce the same signs and symptoms as are produced by 2,4-D herbicide. Prolonged contact of Compound 2 with human skin will cause mild to moderate erythema. Contact with the eyes can also be irritating.

915. Treatment.

Should ingestion of a toxic dose of picloram occur, further absorption should be prevented by gastric lavage or emesis and by administration of activated charcoal, together with supportive therapy. Washing with soap and water in the event of accidental exposure is recommended. The eyes should be washed thoroughly with water in the event of contamination.