

PERCUT-By name, N. A.
PLAINTIFF'S
EXHIBIT
1240
18-3-27-85

MONSANTO AUSTRALIA LIMITED - SUBMISSION OF EXPOSURE

SECTION A

The interest of Monsanto Australia Limited ("Monsanto") relates to Agent Orange (AO) (not including Agent Orange II). AO was the name given to a mixture of equal parts by weight of the phenoxy herbicides 2,4-D and 2,4,5-T.

The phenoxy herbicides 2,4-D and 2,4,5-T were not new compounds when used in South Vietnam (SVN). This submission will give a summary of the history, chemistry and physical properties of these compounds and the contaminant of 2,4,5-T viz. 2,3,7,8 Tetrachlorodibenzo-para-dioxin (TCDD).

It will deal in detail with the exposure of Australian Personnel during their time of service in SVN.

It should be emphasised that man is in continual contact with toxic agents. They are in the food he eats, the water he drinks and the air he breathes. Depending on the physical and chemical properties of the toxic agents, they may be absorbed by the gastro-intestinal tract, lungs, and skin. The body has the ability to metabolise and to excrete these compounds through the urine, bile and air. However, if the rate of absorption exceeds the rate of excretion a toxic compound accumulates to a concentration in the body, at which toxic effects may occur. It should be remembered that such common place foods as salt and water can be toxic to man, e.g. under normal environmental conditions a water intake of more than 8 litres/day by a healthy man has proved to be fatal.

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A.2 History

The discovery of 2,4-D (2,4-dichlorophenoxy acetic acid) as a herbicide during World War II precipitated the greatest single advance in the science of weed control and one of the most significant in agriculture (Peterson 1967). The history of 2,4,5-T (2,4,5 trichlorophenoxy acetic acid) closely parallels that of 2,4-D since Porkony reported the synthesis of both compounds in 1941. In 1942 Zimmerman and Hitchcock reported that 2,4-D and its derivatives were the most active compounds in inducing cell elongation (growth) and formative effects in plants with extremely low dosages and were the first to establish certain substituted phenoxy compounds as plant growth substances. The selectivity of 2,4-D for removal of broad-leaved weeds in lawns and field without injury to established grasses was established in 1944. Kraus and Mitchell (1947) found that 2,4,5-T and 2,4-D were extremely phytotoxic to greenhouse grown broad-leaved plants such as sugarbeet, radish, rape and kidney bean, whereas cereal crops were insensitive to the herbicide, indicating selectivity.

The phenoxy herbicides are synthetic plant growth regulators which mimic the properties of a naturally occurring plant growth regulator, indoleacetic acid. The phenoxy herbicides enter the plant in an imperfect and uncontrolled way. They interfere with the regulation of growth processes normally governed by the plants own naturally occurring growth hormones (Bovey and Young, 1980). The phenoxy herbicides interfere with cell division (mitosis) and cell enlargement, food utilization and various other processes necessary to stabilize plant life. To date scientists do not know the precise mode of action of either synthetic or natural plant growth regulators. It is known that phenoxy herbicides are far more toxic to plant than to animals. Plant growth regulating compounds act on plant cell compounds such as cellulose and lignose cellulose which are not present in animals.

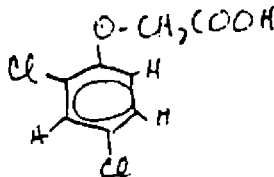
It could be reasonably claimed that almost every wheat farmer in Australia has used 2,4-D at some time over the past 30 years. Similarly, most graziers and dairy farmers in NSW, Victoria and Queensland would have used 2,4,5-T in the control of lantana, blackberry and gorse over this period.

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A.3 2,4-Dichlorophenoxyacetic Acid (2,4-D)

A.3.1 The Chemical and Physical Characteristics

The chemical, 2,4-Dichlorophenoxyacetic acid, commonly known as 2,4-D has the structural formula



The empirical formula is C₈H₆Cl₂O₃. The molecular weight is 221.04. The chemical is a crystalline, colourless and odourless (when pure) compound. The melting point is 141°C and the boiling point is 160°C at 0.4mmHg. The pure chemical is soluble in water at 556 ppm at 20°C, soluble in alkali, highly soluble in benzene carbon tetrachloride and other organic solvents. The chemical is stable in solutions as well as in the crystalline state although slight decomposition will occur with irradiation. Solubility will vary considerably depending on the nature of the manufactured salt. (unclear)

Presently, the preferred process of manufacture ^{begins with direct} ~~is~~ the gradual chlorination of phenol. This leads to a product which is predominately 2,4-Dichlorophenol at a temperature slightly above 43°C. Under normal manufacturing conditions a product which is 92-98% pure may be obtained, with the major contaminants being 2,6-Dichlorophenol and ~~0.5%~~ 2,4,6-Trichlorophenol. However, in the second step of manufacture, known as the condensation step, monochloroacetic acid is reacted with the 2,4-Dichlorophenol to achieve the end product. This condensation step is carried out under alkaline conditions and the waste products of manufacture from 2,4-D have been shown to contain 2,7-Dichlorodibenzo-p-dioxin at concentrations of approximately 300 ppm (Goulding et al 1972). The purity of technical 2,4-D was examined by Woolsen (1973) with 28 samples of 2,4-D. Only one sample gave a positive finding for

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any dioxin and this represented a response for hexachlorodioxin at a level of less than 10 ppm. Studies by Cochrane (1980) have demonstrated that commercial 2,4-D contain not only the expected 2,7-dichlorodibenzo-p-dioxin, but also contains lesser amounts of trichloro and tetrachloro-dioxin. Importantly, the 2,3,7,8-TCDD is not a contaminant of 2,4-D.

A.3.2 Uses

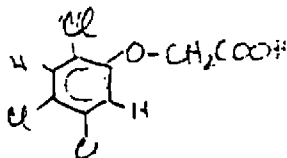
2,4-D has been extensively used as a herbicide for broadleaf plants and as a plant growth regulator. Wheat production is one of its major uses. It is also used in parks, gardens and along railway and roadway corridors as well as a growth regulator in citrus crops.

In 1973, approximately 40-50 million pounds of 2,4-D were used in the U.S.A. Approximately two-thirds was used in agriculture and the remainder for non-agricultural uses. (Bovey and Young - 1980).

A.4 2,4,5-Trichlorophenoxyacetic Acid (2,4,5-T)

A.4.1 The Chemical and Physical Characteristics

The chemical 2,4,5-Trichlorophenoxyacetic acid, commonly known as 2,4,5-T has the structural formula:



The pure acid is a white crystal and has a molecular weight of 255.49. The melting point is 156.6°C. Its solubility in water is 278 ppm at 25°C. It is also soluble in acetone, ethanol, ether and alkaline solutions. The esters of 2,4,5-T are emulsible in water and soluble in most oils, while its amino salts are soluble in water but insoluble in petroleum oils.

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