PRELIMINARY REVIEW OF EFFECTS OF 2.4.5.T AND DIESELENE ON THE ENVIRONMENT

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This is comprehensive review of current knowledge on the effects of 2.4.5.T.

It indicates that the questions relating to 2.4.5.T and the Environment, have been thoroughly examined (mainly in the U.S.) by both "conservationists" and the manufacturers of 2.4.5.T.

Argument about the effects of 2.4.5.T has gone on since 1968 and has been the subject of a U.S. Senate Committee Investigation. This paper presents the findings, and decisions, made to date.

The following is a brief summary and comment on this review.

1. INTRODUCTION

2.4.5.T - one of the hormone or auxin-type herbicides.

Selectivity - dependent on rates of application.

2.4.5.T acid - insoluble in water.

2.4.5.T esters - oily substance. Emulsifiable in water.

Butyl ester - commonly used.

Butoxyethanol ester - less volatile than butyl ester.

"Technical" or Non formulated ester (not soluble in water).

Vic. Forestry Commission use 2.4.5.T in 2 main applications.

a) Aerial spray on woody weeds (wattles) in young pine plantations.

   1 pound "Technical" butylester in 4 gallons distillate per acre.

b) Basal Bank spray of wattles and Eucalypts. 2% solution of butyl ester in distillate.

2. HISTORICAL

Herbicidal properties of 2.4.5.T were reported in 1944.

First marketed in U.S. in 1944 as "Weedone 2.4.5.T."

In 1968 Bionetics Research Labs. (U.S.A.) showed 2.4.5.T caused birth defects when injected into pregnant rats and mice. Some restrictions on the use of 2.4.5.T in U.S. were announced in October, 1969.

Dow Chemicals queried the results on the grounds that impurities (dioxins) in the sample used by Bionetics may have been the cause of the birth defects, and urged further testing with pure 2.4.5.T.

A Senate sub-committee heard further evidence in April 1970 and decided to restrict the use of 2.4.5.T as follows:

a) Suspension of use of liquid formulations around the home, near lakes and ponds, and on ditch banks.

b) Cancellation of use of non-liquid formulations around the home and on apples, blueberries, barley, corn, oats, rye, rice and sugar cane.

ie. on food crops

c) Defoliation in Vietnam with a 2.4.5.T and 2.4.D mix was to be suspended.

No restrictions were placed on the use of 2.4.5.T for weed and brush control on range, pasture, forest, rights of way and non agricultural land.

In December 1970, the Environmental Defence Fund petitioned the Environmental Protection Agency requesting immediate suspension and cancellation of registration of both 2.4.5.T and D.D.T on the grounds that they cause severe environmental damage and are potential causes of cancer in humans.

The EPA concluded.

a) Threat from 2.4.5.T and its dioxin remains in sharp scientific debate.

b) Present restrictions which obviate direct water contamination and virtually eliminate the threat of dangerous exposure to pregnant women, provide so vast a margin of safety as to permit the benefits from the use of 2.4.5.T for control of unwanted vegetation to be continued pending resolution of the administrative proceedings.

Thus the E.P.A. did not choose to suspend the remaining uses of 2.4.5.T while the administrative review was in progress. This was the situation as at March 18, 1971 with use of 2.4.5.T still not restricted for weed and brush control on range, forest, pasture, rights of way and non-agricultural land other than lands under the control of the Department of the Interior.

3. PRESENT RESTRICTIONS

The restrictions described in the last section which were applied in the United States in April-May 1970 remain in force. In Australia, the Public Health Advisory Committee of the National Health and Medical Research Council in April, 1970 considered the reports on teratogenic effects available then, and decided that further work was required because 2.4.5.T was not specifically incriminated. (However, the NIEHS and FDA reports of April 15 would have incriminated 2.4.5.T). Meanwhile they recommended -

ie. injection of pure 245T been shown to cause birth defects.

(i) use of 2.4.5.T should not be permitted where water contamination could occur.

(ii) all persons exposed to 2.4.5.T in its manufacture and use special precautions such as protective clothing to prevent skin absorption.

(iii) until further evidence is available, special precautions should be taken to avoid exposure of women, particularly those in the child bearing age group, to 2.4.5.T (17)

The Aerial Spray Control Act in Victoria set out compulsory directions to pilots for protection of crops susceptible to hormone type herbicides. It also provides for proclamation of "hazardous areas" on the grounds of the presence of susceptible crops.

None of the regulations are in any way concerned with residues or contamination.

4. EFFECTS ON OTHER ORGANISMS

"The effects of 2.4.5.T on non target organisms have been little researched and the subject is worthy of further work."

In 1954, N.S.W. Dept. of Agriculture reported "all available evidence indicates that 2.4.5.T is harmless to animals including fish and insects and to man. Sheep and cattle that have grazed extensively on plants sprayed with this chemical have shown no ill effects. Excessive amounts may cause injury however and care should be taken to avoid a large intake of these chemicals."

"Even so called "safe" chemicals are usually toxic in high enough proportions."

5. NATURE OF UPTAKE AND METABOLISM PROCESSES

(1) <u>In Plants</u>

2.4.5.T may be absorbed through the leaves, stem or roots of a plant. Following application, the chemical may take one or two hours to pass through the outer layers, but once the plant has been entered movement is fairly rapid. Chemicals applied in the soil are absorbed by the roots and moved in the transpiration stream to the rest of the plant; from the leaves the chemical spreads through the plant with the sugars manufactured there, to the points where these materials are used. It is the ready translocation of 2.4.5.T and the related herbicides that makes them suitable for low volume application. (1)

(2) <u>Animals</u>

Considerably less is known of the actual metabolism of 2.4.5.T in animals than is the case in plants. As far as uptake is concerned, the most important mechanism is by eating foliage which has been sprayed with the chemical is used, and its behaviour in the environment. (38) The same paper reaches the following conclusions with regard to animal exposure :

(a) Dairy and beef animals allowed to forage on treated grasses will ingest highest concentrations of 2.4.5.T shortly after application.

(b) Because of degradation, growth dilution and other factors, residues of 2.4.5.T will be markedly reduced in a few days to a few weeks after application.

(c) The herbicide is rapidly excreted - there is no accumulation in animal tissues.

(d) There is no detectable residue in milk; therefore man will not be exposed to 2.4.5.T through consumption of meat or milk from animals foraging on treated grasses.

6. NATURE OF BREAKDOWN PRODUCTS

The breakdown of 2.4.5.T, apart from metabolic breakdown as described in the previous section, is not well documented. It is known that 2.4.5.T is much more persistent in the soil than the related compound 2,4-D, probably because of the metachlorine blocking side chain metabolism as discussed earlier : it may persist for up to 9 months (1). However, this detoxication period is variable, and may be complete in as little as a few weeks, depending on climatic conditions and populations of soil micro-organisms. (38).

It has been shown that 2.4.5.T is extensively absorbed by forest floor material (38), thus when used in forest environments, this is where much of the breakdown takes place. Micro-organisms in the litter layer apparently play a major role in breakdown. Winston and Ritty (25) have found that 2.4.5.T is decomposed by soil and litter bacteria to form carbon dioxide, inorganic chloride and water, with no organic end products of degradation.

7. CONSEQUENCES OF USE IN FOREST AREAS

The most important use of 2.4.5.T is in connection with the establishment and release of conifers on forest land. For these purposes, 0.5 to 4 pounds of 2.4.5.T per acre are applied, usually as low volatile esters dissolved or emulsified in diesel oil or water. (38) Forests Commission use in Victoria is 15 fluid oz. of the technical butyl ester (one pound acid equivalent) in 5 gallons of distillate per acre. (3)

A consideration of the consequences of spraying involves three strata : the air layer, the vegetation layer and the soil layer. (42)

The air layer receives spray material dispersed by the wind as fine droplets, and also spray material volatilised while falling or from intercepting surfaces. The important consequence of these losses, otherthan the reduction in material reaching the vegetation layer, is the possibility of pollution or damage to agricultural land from the settling of the drifting spray. Norris (42) points out that more intense use of herbicides on forest lands will require considerable research to determine the hazard presented by drift and volatilisation.

While nearly all herbicide intercepted by vegetation will eventually enter the forest floor, some remains for a short time at least in material which might be browsed by animals. The toxicity of the chemical, as discussed earlier, renders it highly unlikely that any animal would ever consume sufficient active ingredient to suffer any harmful effects. The rapid removal of 2,4,5-T from the system makes chronic toxicity unimportant. (38).

Some herbicide from a spraying operation is bound to eventually enter streams, either by direct application, by surface flow, or by leaching. Norris (42) has said that stream contamination is the most important expression of environmental contomination in the forest because the water is the habitat for many biological communities and because water represents a critical commodity to downstream users. Thus many studies have concentrated on stream contamination. (42, 38, 41, 43). Norris' conclusions (42) are fairly generally agreed :

(1) Some herbicide will appear in nearly all streams which flow through or by treated areas.

(2) The maximum concentration is a function of the proportion of the watershed treated, the amount of live stream included in the unit, the ratio of the surface area of the stream to its volume, and the degree to which brush overhanging the stream intercepts spray materials.

(3) The length of persistance is a function of the hydrologic nature of the area treated.

(4) Nearly all the herbicide found in the stream results from the direct application of spray materials to the surface of the water.

The study byRugner et al (43) concluded that phenoxy herbicides can safely be used on riparian vegetation on public water supply watersheds without causing contamination, as long as caution is used, to prevent spilling herbicide mix or putting an undue amount of spray on water surfaces.

Tarrant and Norris (41) consider the effect of dieseline separately. The studies they mention lead to the conclusion that it also is perfectly safe as a carrier, as long as prescribed dosages are observed, as a result of rapid and extensive fixing in the soil, and rapid dilution of the fraction that actually enters waterways.

On the whole, the likely consequences of spraying a forest area with 2.4.5.T in dieseline are :

(1) some loss due to drift and volatilisation, which must be considered when deciding whether the area can safely be sprayed.

(2) killing of susceptible plant species.

(3) adsorption and subsequent breakdown of a large proportion of the spray in the soil and litter, over a period of 1 to 9 months.

(4) a certain amount of uptake by browsing animals soon after spraying, but not in sufficient quantities to be harmful to them.

(5) some stream contamination, mostly as a result of direct application to the water surface, and lasting only a short time until extreme dilution has removed all hazard from the contamination.