

Hazards From Residues Of Herbicides In Water¹

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INTRODUCTION

In the five years since our last Conference, a great variety of useful new developments have taken place such as heart transplants, satellite communications and man's conquest of the moon. At the same time however, we have found it necessary to give serious thought to combatting undesirable developments such as drug-taking in schools, a rapidly increasing road toll and the deteriorating condition of our surroundings, particularly contamination of the air and water.

EXTENT OF HAZARDS

Water is an essential part of all living cells and so the possibility must be recognized of contaminants such as herbicide residues having an effect on various life forms, whether they be humans, stock, wildlife, fish, insects or plants. The specific effects however will depend on the toxicity of the materials, their persistence in water, the level of pollution, the particular use made of the water and also the frequency with which the chemicals are used.

Water supplies can be contaminated directly as a result of using herbicides for controlling weed growth in waterways, and indirectly through drainage water from catchment areas treated with herbicides. These materials are generally relatively harmless to humans, animals and fish, and in contrast to many insecticides, the risk is slight. At the same time, herbicides by their very nature are toxic to plant life including useful plants as well as weeds, and so the risk here is greater.

The greatest hazard from herbicide residues in water is therefore the risk of damage to crops, pastures and other

cultivated plants irrigated with contaminated water. For example, one irrigation with water containing traces of the more common herbicides at concentrations of 0.1-5 ppm can injure many useful plants. The critical level depends of course on the particular herbicide used as well as the plant species.

WATER COMMISSION'S APPROACH

The Victorian Water Commission is currently spending almost \$1/3 million annually on chemical methods of weed control in its channel and drainage systems. This is necessary to ensure that irrigation water is delivered in the quantities required and that drainage water is removed quickly enough to avoid flooding and high water tables.

The program, however, has only been put into operation after many years of investigations to ensure that there are no unforeseen side-effects. Only herbicides which are non-toxic to humans, stock and fish are used, except acrolein which although toxic to fish is not persistent. Other herbicides in use such as amitrole, 2,2-DPA and TCA are non-toxic but are relatively persistent in water, and it has been necessary to determine the degree of contamination of water resulting from their use. For example, when spraying water couchgrass in drains with amitrole, experiments have shown that about 20% of the chemical immediately enters the water.

Field and glasshouse trials are also conducted to determine the susceptibility of crops and pastures to traces of herbicides in irrigation water, after which a pollution limit is set for each herbicide. These limits, which govern field operations, vary from 1/250th to 1/500th of the concentration which in one irrigation causes a visible effect on the most susceptible plant species. The safety factors used are therefore very large, but this is considered necessary because there are many unknowns and our knowledge is not precise.

¹Presented at the 1970 Australian Weed Conference in Hobart, Tasmania.

CONTROLS

Herbicides have been used successfully in Victorian irrigation and drainage systems for almost fifteen years without risk to water users, although not always on the present scale. This result has been achieved by means of a variety of controls which ensure that public health, agricultural and fishing interests are protected while at the same time meeting the water supply and drainage needs of irrigation farmers.

The real basis of the Commission's weed spray program is the information gained from experiments in herbicide effectiveness, degree of pollution, and the effect of herbicide residues on cultivated plants. From the practical viewpoint, however, control of the program is exercised through personnel whose task it is to ensure that the work is done safely as well as effectively. In addition, as a check on the safety of its operations, the Commission has for a number of years made a practice of sampling certain streams for evidence of herbicide residues, usually without traces being found. Safe use of herbicides in Victorian waterways is also achieved through the provisions of the new Fisheries Act. Under this Act, it is an offense to allow any material likely to be poisonous to enter waters containing fish or to mix or dispose of pesticides within one chain of a lake or waterway. Control of weed growth by means of chemicals in any Victorian waters requires the consent in writing of the Director, Fisheries & Wildlife Department. The only exceptions to this requirement are in the case of the Water Commission's weed control operations—provided the Fisheries & Wildlife Department is given the necessary details beforehand—and also any local government agency utilizing herbicides in waterways or storages with the advice of the Water Commission. Close liaison is maintained with the Fisheries & Wildlife Department and it is regularly informed of the quantities of herbicides used as well as any new procedures likely to be adopted.

The appointment of the Victorian Government's Pesticides Review Committee in 1966 was undoubtedly one of the most valuable steps taken in recent years to ensure that pesticides are properly utilized. This committee, which consists of representatives of the Departments of Health, Agriculture, Lands, Fisheries & Wildlife, Water Supply and the Soil Conservation Authority, meets regularly and concerns itself with both the public and departmental use of pesticides. For example, it considered and approved the Water Commission's proposal to control water couchgrass in drains by means of amitrole as well as the use of diuron and 2,2-DPA. The Committee also maintains close liaison with the Technical Committee on Agricultural Chemicals which consists of representatives from each State as well as the National Health and Medical Research Council and the Commonwealth Department of Primary Industry. In this way all interests are adequately protected.

OVERSEAS ATTITUDE

In general, the attitude in other countries towards contaminants in water such as herbicide residues is similar to that in Australia, being a blend of caution, scientific reason and public opinion together with the occasional inconsistency. Systems of control may differ in detail but the same purpose is being served.

In the U.S.A. for example, the Federal Committee on Pest Control is responsible for approving the weed control programs of Federal agencies such as the Bureau of Reclamation. The States also exercise some control over

the use of herbicides and occasionally the requirements are more strict. Contamination of domestic water supplies with herbicides is usually not permissible, but there is a trend towards establishing tolerances for some herbicides in water.

Why there should not already be limits for residues of herbicides in water as there are for pesticides in foods is difficult to understand. There is a great need for establishing such limits rather than adopt the negative approach of automatically prohibiting the use of herbicides wherever water is used for human consumption, fishing or irrigation. Quite obviously, while the treatment of an entire farm dam with a particular herbicide could be hazardous, the use of the same herbicide around a boat launching ramp at the edge of a large reservoir need not constitute a hazard in any way. In other words, the quantity of herbicide used must be related to the quantity of water it is likely to contaminate and other practical considerations.

Recently in the United Kingdom, the Ministry of Agriculture, Fisheries and Food issued a "Code of Practice for the use of Herbicides on Weeds in Watercourses and Lakes." This document provides guidelines for the selection and safe use of herbicides in water supplies, and also outlines responsibilities under appropriate acts. Herbicides approved for aquatic use under the Pesticides Safety Precautions Scheme can be used for control of weeds in domestic water supplies, provided the river authority concerned is satisfied that there are no hazards involved.

REDUCING HAZARDS

A certain way to avoid hazards from residues of herbicides in water is of course not to use herbicides at all. Water, however, is usually a necessity, not simply a luxury, and so there will be a constant need to control weed growth in water supplies using whatever means are most effective.

The fact that consideration must be given to residues of herbicides in water at all, results largely because it has been necessary to use in the aquatic environment herbicides developed for terrestrial weed control. While this may do credit to our resourcefulness, it also highlights our lack of understanding of the properties required of an aquatic herbicide. It may also indicate some lack of appreciation of the great use that would undoubtedly be made of more suitable aquatic herbicides.

The ideal aquatic herbicides should be quickly degraded in water and be harmless to humans, animals, aquatic life and cultivated plants. They should perhaps also be relatively insoluble and have a density which allows the particles or droplets of chemical to settle out and become attached to the submerged leaves. The development of herbicides with some or all of these properties would contribute greatly towards the reduction of hazards from residues in water and might well eliminate them completely.

Although a considerable amount of experience has now been gained in the safe use of herbicides in irrigation and drainage systems in Victoria, it should not be assumed that the same conditions and precautions apply to the use of herbicides in farm channels and drains. The main problem in the farm situation is that residues of herbicides may be present in the first flush of water through a treated channel, and it is unlikely that this water could be discharged onto crops or pasture without risk of injury. Similarly, it would be unwise for a water supply authority to accept contaminated water into streams without at the same time being able to control the contamination level. The use of her-

bicides in farm channels therefore requires a much closer study in an effort to develop ways of reducing hazards to a minimum. It seems likely that the best materials for these situations will be specially developed herbicides which leave no residues in the water under normal conditions of application.

In the absence of specifically aquatic herbicides, the development and use of improved mechanical weed cutters and more efficient spraying equipment should reduce the problem of herbicide residues in water. Other avenues of research which could prove beneficial include the temporary use of herbicides to permit the establishment of

tolerable plant species, and also the investigation of biological means of control, for example, the Chinese grass carp. The effect and practicability of removing plant nutrients from water and the possible utilization of aquatic plants as stock feed also warrant some investigation.

In the future, as the demands on our water supplies increase, all effective means of aquatic weed control available are certain to be needed if lakes and waterways are to serve the required purposes, and at the same time residues of herbicides in water are to be kept within acceptable limits.