observed in the first discharge were 0.2-0.5 and 3-5 ppm in the two channels respectively. The latter figures are an order of magnitude higher than the permitted maximum. However, the high concentrations were attenuated rapidly as discharge increased and contributed relatively little to the total displacement of diuron into the drainage system. Alternative estimates of contamination, obtained by calculating average concentrations integrated over the first 4 hours of discharge and assuming complete mixing, were about 0.1 and 0.5 ppm. In the latter trial, a longer discharge period would be required to further dilute average concentrations to meet the 0.1 ppm tolerance. In practice, however, dilution with untreated water in Mirrool Creek and Barren Box Swamp before re-use is expected to reduce concentrations to negligible levels.

In these two trials, by discharging the contaminated water to waste, about 9% and 61% respectively of the residual diuron was removed to the drainage system and diuron concentrations in the water at the resumption of irrigation were reduced to about 0.04 and 0.25 ppm respectively. The effect of these residue levels on crops, particularly flood-irrigated germinating rice, may need further investigation.

ASPECTS OF THE USE OF ACROLEIN IN WATER

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Acrolein (acrylaldehyde) is widely used by government authorities to control submerged aquatic plants in lakes and irrigation channels. This paper reports on some recent observations on the fate of acrolein in water and summarizes the progress being made towards rationalizing the use of this herbicide with regard to economy and safety.

The reaction of acrolein with water was investigated initially in laboratory experiments in which the processes of volatilization and adsorption were excluded. A metabolite which is relatively non-volatile and non-phytotoxic was detected using a colorimetric reaction which is specific for carbonyl groups. At normal concentrations of acrolein the intermediate product

was transient and no hazards are anticipated in practice. Experimental observations and published reports suggest that polycondensation or reversible hydrolysis to hydroxypropionaldehyde occurs, followed by microbiological oxidation to a carboxylic acid.

The decay of acrolein in buffered solutions approximated to first order kinetics and was pH-dependent, with rate constants of 0.0139 hr^{-1} at pH 6.6 to 0.0182 hr^{-1} at pH 8.6, corresponding to half lives of 50 and 38 hours respectively. In comparison, rates of dissipation observed in flowing water in irrigation channels were an order of magnitude greater, suggesting major losses by volatilization and/or adsorption onto weeds or sediment.

In irrigation channels, the herbicide is usually mixed with the water at a convenient point upstream and allowed to flow over the submerged weed beds. It is proposed that in any given length of channel effective weed control should be achieved by maintaining the product of concentration and contact time above the minimum lethal dose (E_L) and that an addition above this minimum is required to compensate for dissipation. Observations by the United States Bureau of Reclamation (USBR) suggest that acrolein dissipation from flowing water is a first order process. It follows that the theoretical dosage (E_0) required at the injection point may be calculated using equation (1) :

$$E_0 = E_L \exp(Kt) \qquad \text{——— (1)}$$

where K is the first order rate constant for dissipation and t is the time for the herbicide to travel through the treated length.

Values of K obtained for six irrigation channels in Australia agreed quite closely with data from two trials reported by the USBR; the mean was 0.16 hr^{-1}, corresponding to a half-life of 4.4 hours.

Preliminary information on E_L was obtained by calculating the residual dosage at the downstream limit of several successful treatments. The data suggested that the minimum dosage of acrolein required for weed kill was largely independent of the separate values of concentration and time providing the product was maintained at approximately 2 ppm.hr.

It is recognized that several factors (including weed species and density, temperature and turbulence) have not been considered and that experience and intuition are essential in assessing appropriate dosages for particular situations. In

practice, routine weed control in several supply channels in the M.I.A., where ribbonweeds and pondweeds dominate, required acrolein additions three to eight times greater than calculated from equation (1). In contrast, in the irrigation districts of southern New South Wales control of *Elodea canadensis* has been achieved with dosages several orders of magnitude smaller than predicted. Explanations for these discrepancies may be related to differences in weed species in the two areas. Their relative sensitivities to acrolein and effects on the hydrological characteristics of the channels are now being investigated.

2. TECHNIQUES OF WEED CONTROL IN RELATION TO LAND USE

(a) In crops and sown pastures

Activated carbon and ash carbon in agriculture	J. Toth and P.J. Milham	2(a)-1
The control of weeds in a crop situation by suppression of seedling emergence with sterilized soil, and its possible agronomic applications	J.F. Gage	2(a)-2
Annual weed competition in wheat crops	G.J. Wells	2(a)-4
Control techniques to counteract the persistence of annual ryegrass	G.A. Pearce	2(a)-5
An index of competition + HOE 23408 - a new approach to annual ryegrass control	T.G. Reeves	2(a)-7
Glyphosate for sod-kill in minimum tillage wheat	A.A. McNeill and E.G. Cuthbertson	2(a)-8
Has HOE 23408 a place in advancing seeding dates?	I.P. Anderson and H.R. Joiner	2(a)-9
Silverleaf nightshade population in relation to winter cropping	E.G. Cuthbertson	2(a)-11
Chemical control of silverleaf nightshade in winter annual pastures	A.R. Leys and E.G. Cuthbertson	2(a)-13
Weed control and row cropping studies in dryland grain sorghum in north west New South Wales	J.F. Holland and D.W. McNamara	2(a)-14
Herbicide efficacy in lupins and chickpeas under dryland conditions	A.R. Leys and E.J. Corbin	2(a)-16
The response of lupins to post-emergence application of carbetamide	E.G. Cuthbertson	2(a)-17

Bentazon - a breakthrough in the control of Datura in soybeans	W.L. Felton	2(a)-19
The influence of weed spectrum and soil type on the choice of system for weed control in direct-seeded tomatoes	K. Zimmerman and J. Toth	2(a)-21
Weed control in oilseed rape	A.R. Leys and B.D. Hill	2(a)-22
Field populations of doublegee seed - some observations on the effect of ley farming	D.J. Gilbey	2(a)-24
Competition effects on Chinese scrub ingress into pasture	B.C. Curnow and H.R. Jones	2(a)-25
The concept of the anti-herbicide	D.J. Swain	2(a)-26
Soursob - the yellow peril?	D.N. McKenzie	2(a)-28
The effect of nutrition on crop tolerance to herbicides	R.A. Drew	See 1 - 1
Effect of subterranean clovers on production of bulbs of soursob	J.R. Peirce	See 1 - 7
The effect of weeds on sugar-cane culture	L.G. Tilley	See 1 - 11
Dissipation of atrazine in irrigated Riverina soils	D.J. Swain	See 1 - 13
The effects of cultural practices on the incidence of weeds in rice in New South Wales	D.J. Swain	See 1 - 14
Diuron residues in irrigation water	K.H. Bowmer and J.A. Adeney	See 1 - 16
Aspects of the use of acrolein in water	K.H. Bowmer	See 1 - 17
Recent trends in the biological control of weeds in Victoria	L. Schmidl	See 2(b)-13

Morphology of the underground parts of silverleaf nightshade	E.G. Cuthbertson	See 3 - 7
Silverleaf nightshade - another perennial problem	D.N. McKenzie	See 3 - 9
The onset of competition by Datura species in soybeans	W.L. Felton	See 4 - 9
Competition between wheat and wild oats	O. Cartledge, B.J. Wilson, B.J. Radford, F.B. Watkins and S.R. Walsh	See 4 -10

(b) In rough grazings and non-agricultural situations

Bracken control in pastures with asulam	P.F. Jacklin	2(b)-1
Horehound control in marginal grazing land	T. Suckling, J. Twentyman and C. Piggin	2(b)-2
Control of Harrisia cactus by dichlorprop and fenoprop: formulation studies	G.J. Harvey	2(b)-4
Hexaflurate: a new herbicide for control of Harrisia cactus	G.J. Harvey	2(b)-5
Comparison of costs of alternative methods of controlling Harrisia cactus	T.R. Armstrong	2(b)-6
Alternatives to herbicide for introduction of improved perennial grasses on non-arable land	P.M. Dowling	2(b)-8
The control of weeds and the associated introduction of native species at Organ Pipes National Park	R.G. Yorston, R.D. Macaulay and R.C. Anderson	2(b)-10
Integrated control of Elodea	K.H. Bowmer, G.R. Sainty, K. Shaw, B.T. Steer and E.M. O'Loughlin	2(b)-11

Recent trends in the biological control of weeds in Victoria	L. Schmidl	2(b)-13
A review of the establishment of *Octotoma scabripennis* and *Uroplata girardi* on lantana in Queensland	B.W. Willson	2(b)-15
The problem of roadside Johnson grass control	J.M. Marley	See 1 - 9
The reproductive efficiency of spiny emex	P.W. Weiss	See 3 - 12
Some biological aspects of bracken in Victoria	J.H. Combellack	See 3 - 18
The effect of asulam on bracken, with particular emphasis on rhizome morphology and subsequent pasture development	R.J. Martin	See 3 - 19
Weed control in intensive pine afforestation practice in South Australia	R. Boardman, D.B. Boomsma and P.G. Zed	See 4 - 13
Boneseed, an alien invader of Australian bushland	D.W. Lane	See 4 - 14
The lovegrass dilemma on the Northern Tablelands of New South Wales	B.D. Scarsbrick	See 5 - 19