TOLERANCE OF WEEDS OF WASTE AREAS TO RESIDUAL-TYPE HERBICIDES

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Summary

This paper is an extension of tabulated data presented previously (Ward, 1963) on weed tolerance to residual herbicides and to mixtures containing additive translocated herbicides. An endeavour has been made to augment results secured in total weed control on railway tracks by drawing on information derived under various conditions by other workers. When viewed from this wider angle, the degree of variation noted in the performance of residuals leads to the conclusion that there is much need for further study to be directed towards the timing of initial treatment and the maintenance aspects of total weed control. It is considered that the basic economic period of protection to be aimed at between applications of residuals for total weed control should be limited to 12 months.

The toxicity of the uracils is notably greater than that of either triazine or urea-type residuals now in use.

INTRODUCTION

IN PRESENTING a useful summary of the principles of total weed control, Woodford and Evans, 1962, suggest that the cost of initial treatment of established vegetation could vary from £20 to £80 per acre, the aim being "to clear the ground of vegetation within 2 or 3 years". In this country there would be few prepared to meet the higher quoted figure or to wait so long for the result. This attitude aided by high paspalum (*Paspalum dilatatum*) tolerance to triazines and ureas came early to influence the work on residuals, resulting in an almost general acceptance of the practice of using additives mixed with the residual application. Data relating to tolerance of weeds to straight residual applications at economical rates are therefore restricted and this has determined the form of presentation used in the tabulation.

DISCUSSION

The performance of a residual herbicide may vary greatly in relation to soil, climatic conditions and time of application, as well as in relation to weed potential represented both by species present as established plants or as seeds. Categories shown in the tabulation must therefore be interpreted broadly in the light of these variables, and with due regard to the effect of the additive used.

Some records studied during the compilation of the data indicate a need for clearer appreciation of objectives in studies on long-term total weed control. For instance, one writer is critical of a 5 lb treatment producing a result of 85% bare ground 12 months later. While there are few data relating to the effects of repeat or maintenance treatments, there are instances of the recording of

results from heavy applications of residuals enduring over periods of two years or more. In practice the cost of these applications is prohibitive and the data secured are therefore of restricted value. When the period of protection aimed for is unduly extended, the initial cost must be high, else there is risk of the survival of one or more resistant species. Unless this situation can be overcome by means of an interim selective spot treatment, such plants become more firmly established with the passage of time and will recolonize the area.

The data presented are based on the thesis that the most economic and practical basis for many total weed control projects is to aim for an acceptable degree of control over a period of 12 months. It would be necessary to attain practically a complete kill from the outset, aided if necessary by the use of specific additives. At the end of 12 months, ground cover could be as high as 50% or more, provided the growth consisted of seedling or immature susceptible plants. On the other hand, the emergence of a tolerant species might determine the need for an interim application of a contact or translocated herbicide to deal with such short-lived seasonal volunteers. If seed production and vegetative propagation on the area are excluded, maintenance is a declining problem.

The occurrence of a number of subtropical tolerant species, especially grasses, particularly in northern districts, may dictate the adoption of summer timing of applications. There is no chemical by means of which *Paspalum* may be eradicated economically. Compared with triazines and ureas, uracil materials exhibit marked superiority in toxicity in that reduced application rates, without the assistance of additives, effectively kill most grasses as well as broad-leaved weeds. Some comparative work has indicated that residuals used without additives may produce acceptable knock-down effects on established growth, but this can be anticipated only when the range of species present is restricted. The final effects are slow to appear, but might be accelerated if volume rates of application could be raised to 100 gal per acre or higher.

MATERIALS APPLIED AND RATES OF APPLICATION

Data used in the tabulation are drawn from the results of trials in which simazine and diuron were applied at rates in the order of 8 to 10 lb (all rates in lb active ingredient per acre), together with additive in the form of sodium dichloropropionate (DA) 8 to 10 lb and amitrole (A) 2 lb. The uracils, isocil and bromacil, were applied without additive at rates in the order of 5½ lb to 8 lb; 2,4-D was applied at 1 to 2 lb; amitrole and paraquat up to 2 lb. Most applications were made at volume rates of 30 to 50 gal per acre. In the railway trial work surfactant at the rate of 0.05% was added to the spray solution, and most paraquat applications contained 0.05% of non-ionic surfactant.

First railway trial applications were made mainly in late spring and summer months in order that rapidly growing tolerant summer annuals would receive foliar application of the additive materials. Late autumn applications have often reflected marked leaching or deactivation effects over the wet winter and spring months, resulting in poor residual effects on heavy spring and summer growth. Most species have individual germination and growth seasons, hence the performance of a residual herbicide will vary according to time of application relative to all species present. For instance, if application is made at the end of the growth season of any annual weed, that species will not re-emerge for six months, and will thus exhibit an apparent susceptibility which in fact does not exist.

For paraquat, data have been drawn largely from Matthews (1964). For other alternative treatments reference can be made to Matthews (1960), or to Woodford and Evans (1962).

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KEY TO CLASSIFICATION USED IN TABLE 1

The following categories relate to response of established plants to initial treatments:

S — Mostly killed in all stages of growth; good control.

I — Many killed; control inadequate because of recovery; requires increased rate of treatment.

R — Few, if any killed; requires alternative treatment.

Two-lettered symbols indicate intermediate effects, due to variable conditions or stages of growth.

The following categories relate to tolerance of seedlings or shoot regrowth, subsequent to initial treatment:

V — Survival of seedlings volunteering or shoot regrowth less than six months after initial treatment; may require selective spot treatment.

v — Seedlings do not establish until after six months or more. Probably controllable by annual maintenance treatment.

O — Very few, or no seedlings up to 12 months after initial treatment.

Note: When frequent regular inspection of residual-treated plots is carried out, it may often be noted that successive crops of seedlings appear and later die. Unless these species are identified and recorded, the true picture cannot be gleaned of the weed potential of the area and the tolerance of species.

Letters following weeds names indicate growth habit. A — annual; B — biennial; P — perennial.

TABLE 1: RESPONSE OF ESTABLISHED WEEDS AND SPEED OF REGENERATION FOLLOWING INITIAL TREATMENTS WITH RESIDUAL AND ADDITIVE HERBICIDES

Weed Species	Simazine plus D/A	Diuron plus D/A	Uracil alone	2,4-D	A	D	Alternative Treatment
1. BROAD-LEAVED WEEDS							
<i>Acaena</i> spp., P*							
(piripiri: A. Sheep's burr)							
<i>Achillea millefolium</i> , P	S	O	S	O	S	—	
(yarrow)	I	V	S	v	SI	IR	2,4,5-T
<i>Amaranthus deflexus</i> (?), P	R	V	R	V	R	IR	
(perennial amaranth)	S	v	S	v	S	IR	
<i>Anthemis cotula</i> , A	S	O	S	O	S	IR	
(stinking mayweed)							
<i>Aster subulatus</i> , AB							
(sea aster)							
<i>Bidens</i> spp., A	:	O	:	O	:	IR	
(beggar's ticks)							
<i>Calystegia sepium</i> , P	I	V	I	V	I	SI	2,3,6-TBA
(greater convolvulus)	IR	V	IR	V	:	IR	
<i>Cardaria draba</i> , P	S	v	S	v	S	—	
(hoary cress)							
<i>Carduus</i> spp., AB	SI	v	SI	v	SI	—	
(thistles)							
<i>Centaurea nigra</i> , B	SI	v	SI	v	SI	—	
(knapweed)							
<i>Chrysanthemum leucanthemum</i> , P	SI	v	SI	v	SI	—	
(oxeye daisy)	R	V	R	V	:	IR	
<i>Cichorium intybus</i> , P	IR	V	IR	V	IR	—	
(chicory)							
<i>Cirsium arvense</i> , P	S	V	S	v	S	—	
(californian thistle)							
<i>Conium maculatum</i> , BP	R	V	R	V	R	—	
(hemlock)							
<i>Convolvulus arvensis</i> , P	RI	V	RI	V	:	IR	
(bindweed)							
<i>Coriaria</i> spp., P							
(tutu scrub)							

(Amitrole-ammonium thiocyanate mixture; 2,3,6-TBA)

<i>Daucus carota</i> , B (wild carrot)	SI	V	SI	v	SI	O	I	IR	—
<i>Echium</i> spp., A (bugloss)	S	v	S	v	SI	V	I	:	—
<i>Epilobium</i> spp., A (willow-herbs)	SI	v	SI	v	SI	V	SI	IR	—
<i>Erechtites</i> spp., A (fireweed)	SI	V	SI	V	SI	V	I	I	—
<i>Erigeron</i> spp., A (fleabanes)	S	O	S	O	S	V	SI	S	—
<i>Erodium</i> spp., A (storksbills)	S	V	S	v	S	O	SI	S	—
<i>Euphorbia</i> spp., A (spurges)	S	v	S	v	S	I	I	S	—
<i>Foeniculum vulgare</i> , BP (fennel)	I	V	I	v	SI	O	S	IR	—
<i>Fumaria muralis</i> , A (fumitory)	S	V	S	V	S	v	IR	S	—
<i>Galium</i> spp., A (bedstraws; cleavers)	S	V	S	V	S	v	R	SI	—
<i>Geranium</i> spp., A	S	V	S	v	S	O	I	I	—
<i>Hypericum perforatum</i> , P (St. John's wort)	S	v	S	v	S	O	I	S	—
<i>Hypochoeris radicata</i> , B (catsear)	S	v	S	v	S	V	SI	S	—
<i>Juncus</i> spp., A (rushes, annuals)	S	:	S	:	S	O	S	SI	—
<i>Lathyrus latifolius</i> , P (everlasting pea)	R	V	R	V	R	V	IR	R	—
<i>Leucopogon fraseri</i> , P	R	V	R	V	:	:	R	R	—
<i>Lotus pedunculatus</i> , P (lotus major)	SI	V	S	v	S	O	IR	IR	—
<i>Lotus</i> spp., A (birdsfoot trefoils)	S	v	S	v	S	O	S	S	—
<i>Lupinus</i> spp., AP (lupins)	S	v	S	v	S	v	SI	SI	—
<i>Malva</i> spp., A (mallows)	S	v	S	v	S	O	I	SI	—

TABLE 1 — contd.

Weed Species	Simazine plus D/A	Diuron plus D/A	Uracil alone	2,4-D	A	D	Alternative Treatment
<i>Medicago lupulina</i> , A (black medick)	S	V	S	O	S	R	—
<i>Melilotus</i> spp., A (melilots)	SI	V	S	O	S	S	—
<i>Mentha pulegium</i> , P (pennyroyal)	SI	V	SI	V	S	I	—
<i>Pastinaca sativa</i> , BP (wild parsnip)	R	V	:	:	IR	R	—
<i>Plantago</i> spp., P (plantains)	S	O	R	S	O	IR	—
<i>Portulaca oleracea</i> , A (purslane)	IR	V	IR	:	O	R	—
<i>Prunella vulgaris</i> , P (self-heal)	I	V	I	S	SI	SI	—
<i>Pteridium esculentum</i> , P (bracken fern)	R	V	R	SI	V	IR	IR
<i>Ranunculus repens</i> , P (creeping buttercup)	IR	V	I	I	IR	R	—
<i>Rumex</i> spp., P (sorrel; docks)	IR	V	IR	I	I	I	—
<i>Senecio jacobaea</i> , ABP (ragwort)	R	V	R	R	SI	IR	—
<i>Taraxacum officinale</i> , P (dandelion)	I	V	I	O	SI	IR	—
<i>Trifolium arvense</i> , A (haresfoot trefoil)	S	V	S	O	S	R	—
<i>Trifolium repens</i> , P (white clover)	I	V	SI	I	IR	IR	(Resistant to paraquat)
<i>Veronica arvensis</i> , A (speedwell)	S	V	S	O	I	S	—
<i>Vicia</i> spp., A (tares)	S	V	S	O	S	S	—
<i>Wahlenbergia gracilis</i> , P	R	V	:	:	:	R	—

2. GRASSES AND SEDGES

<i>Agropyron repens</i> , P (couchgrass)	IR	V	IR	V	I	V	—	I	I	IR	
<i>Agrostis</i> spp., P (browntop; creeping bent)	SI	V	SI	V	S	V	—	—	SI	IR	
<i>Bromus cartharticus</i> , AB (prairie-grass)	S	V	S	V	S	V	—	—	S	IR	
<i>Carex</i> spp., AP (sedges)	R	V	R	V	S	:	I	:	IR	R	
<i>Cynodon dactylon</i> , P (bermuda-grass)	IR	V	IR	V	SI	V	—	R	IR	R	
<i>Dactylis glomerata</i> , P (cocksfoot)	SI	V	SI	O	S	O	—	:	SI	SI	
<i>Digitaria sanguinalis</i> , A (crab-grass)	R	V	IR	V	SI	O	—	R	I	:	
<i>Echinochloa crusgalli</i> , A (barnyard grass)	S	O	S	O	S	O	—	:	S	:	
<i>Eleusine indica</i> , A (crowfoot)	I	V	I	V	S	V	—	R	I	:	
<i>Festuca arundinacea</i> , P (tall fescue)	SI	V	S	V	S	O	—	:	I	IR	
<i>Festuca rubra</i> var. <i>fallax</i> , P (chewings fescue)	SI	V	SI	V	S	:	—	R	SI	SI	
<i>Holcus lanatus</i> , P (yorkshire fog)	S	O	S	O	S	O	—	:	S	S	
<i>Lolium perenne</i> , P (perennial ryegrass)	SI	V	SI	V	S	V	—	R	SI	SI	
<i>Paspalum</i> spp., P (paspalum; mercergrass)	R	V	R	V	RI	V	—	R	R	R	Very high rates of D
<i>Pennisetum clandestinum</i> , P (kikuyu-grass)	R	V	R	V	S	(short growth)	—	R	R	R	High rates D