NON-SELECTIVE WEED CONTROL

R. K. WARD

Rukuhia Soil Research Station, Hamilton

Summary

Because the weedkillers used currently on railway tracks have not proved entirely satisfactory, trial work is still being pursued actively. When economics dictate continued use of a low rate of weed-killing material, the standard of control may decline very sharply through multiplication of a few residual tolerant weed species.

Trials carried out have shown that some long-term soil sterilant type weedkillers, although used in mixtures with foliar absorbed herbicides, may exhibit the same disability, suggesting that higher rates of application of the materials should be resorted to.

Trials are being carried out to discover economical methods of circumventing the necessity to increase the application rates of these costly materials.

In discussing some of the results of this work, methods are suggested for overcoming deficiencies and increasing the duration of effectiveness.

It is concluded that no one chemical will continue economically to give an acceptable degree of total weed control over a prolonged period unless aided by applications of specifics for the control of tolerant weed species.

INTRODUCTION

THE FIRST large-scale use on railway tracks of sodium dichloropropionate/amitrole (denoted subsequently in this paper by D/A) was reported on favourably by Ward (1960). This material is now used on all tracks in autumn in place of chlorate-chloride, a mixture of 60% sodium chlorate with calcium chloride (denoted by chlorate hereafter). That D/A was unacceptable for the replacement of the spring treatment of track with chlorate was due to facts which were then emerging from current studies of the cumulative effects of repeated consecutive applications of D/A to Te Kuiti and Bay of Plenty tracks.

Here the effects of the initial autumn applications of D/A though spectacular enough did not last long. When the time came for the spring treatment, track was badly re-infested with a weed population containing greatly increased proportions of broadleaved and grassy weeds which proved to be resistant to the chemicals. These grew luxuriantly during the summer and in places were greatly augmented by large numbers of summer volunteer weeds. The latter showed less evidence of residual soil toxicity effects than may be derived from chlorate at this time. Because of complaints about gross deterioration in weed control the Te Kuiti trial was terminated after four applications of D/A had been made in two years. The Tauranga trial ran for three years when special measures were necessary to restore control. The problem was examined more critically in comparative trials discussed below.

Where trial work is being carried out on tracks it is necessary to impose the condition that ballast disturbance by maintenance operations must be reduced to the minimum. It was conspicuous that standards of weed control on test lengths generally deteriorated more quickly by comparison with similar lengths not under test.

This is attributed to the persistence of weeding for long after this kind of work had theoretically been superseded. This practice obscured the true picture of the inadequacies of the routine spraying practices that had been adopted as shown in the Annual Report of the Rukuhia Soil Research Station (1963). Other changes which are occurring in track maintenance practice will impose even higher demands upon the weedkillers being employed, and more efficient ones will be required.

It thus seemed logical to resume the earlier studies reported by Ward (1956, 1958) on materials based on soil-sterilant-type chemicals, the cost of which the user had not been prepared to meet until recently. The results of these trials will be discussed and used as a basis for suggestions made either for overcoming their deficiencies without incurring the expense of increased application rates, or for extending the period between applications.

EXPERIMENTAL

Except where stated otherwise, the basic treatments applied in all trials were as follows (quantities are expressed as lb active ingredient per acre):

1. Sodium dichloropropionate 10 lb + amitrole 2 lb
2. Chlorate mixture — Commercial 60% sodium chlorate + 40% calcium chloride. Used as in standard practice:
North Island districts 84 lb sodium chlorate equiv.
South Island districts 67 lb sodium chlorate equiv.
3. (a) Diuron 8 lb + sodium dichloropropionate 10 lb + amitrole 2 lb
(b) Monuron 8 lb + sodium dichloropropionate 10 lb + amitrole 2 lb
(c) Simazine 8 lb + sodium dichloropropionate 10 lb + amitrole 2 lb
4. (a) Diuron 8 lb + chlorate mixture:
North Island 67 lb sodium chlorate
South Island 50 lb sodium chlorate
(b) Monuron 8 lb + chlorate mixture:
North Island 67 lb sodium chlorate
South Island 50 lb sodium chlorate

Wetting agent at 0.05% was added.

RATINGS

Because of marked normal variation in the zonal distribution of growth, both across and along the track, rating based only on counts or percentage cover would be misleading. Numerical ratings were adjusted in relation to the effectiveness of a treatment to restrain encroachment from the untreated edges of the plot and in relation to the probable cost of measures required to control growth of the resistant species remaining afterwards.

CUMULATIVE EFFECT TRIALS

In autumn 1961 six replicated plot trials, laid down throughout the country, were given the first applications of the treatment sequences shown in Table 1.

TABLE 1: CUMULATIVE EFFECT TRIALS — SEQUENCE ORDER OF REPEAT TREATMENTS

Sequence	1961		1962	
	Autumn	Spring	Autumn	Spring
1	D/A	D/A	D/A	D/A
2	D/A	Chlorate	D/A	Chlorate
3	Chlorate	D/A	Chlorate	D/A
4	Chlorate	Chlorate	Chlorate	Chlorate

Some trials were abandoned after the first retreatment as the result of marked deterioration in control resulting from weed growth potential promoted by dirty ballast and high annual rainfall. These two factors, when occurring together, obscured the effects of all treatments. Even where growth potential was low on good ballast, progressive marginal encroachment was invariably observed.

RESULTS

Rating on an 0 to 10 scale as outlined above gave the results shown in Table 2 (0=nil; 10=excellent).

TABLE 2: RESULTS OF CUMULATIVE EFFECT TRIALS

Sequence No.	Ratings	
	(Northern Districts)	(Southern Districts)
2	5	6
1	3	4
3	2	3
4	2	3

It was only in Canterbury where low rainfall and restricted weed species afford advantages to the weedkillers that deterioration was mainly confined to slow marginal encroachment, and Sequence 2 performed satisfactorily. Elsewhere none of the treatments continued to give satisfactory control over the period of the trial. Autumn applications of D/A gave the best kills of any treatment but did not eliminate paspalum (*Paspalum dilatatum*), *P. distichum*, Indian doubt (*Cynodon dactylon*), tall fescue (*Festuca arundinacea*), white clover (*Trifolium repens*), and sorrel (*Rumex acetosella*) amongst some of the more difficult track weeds. Spring applications were a complete failure on many legumes, both annual and perennial, on the mature grasses mentioned above, and had no residual effect on a large number of summer volunteer grasses and broad-leaved weeds. Autumn applications came too late to halt the seeding of the latter.

Chlorate performed poorly at all times on all grasses, including the commoner pasture species and on perennial clovers. Kills of broadleaved weeds, especially from the spring applications, were better than those given by D/A, and sorrel was better controlled also by chlorate.

CONCLUSIONS

- (1) The spectrum of track weeds killed by D/A when applied at these times is not wide enough to warrant the complete replacement of chlorate, especially for spring application treatment.
- (2) The control of summer volunteer and perennial resistant grasses can be accomplished only by a heavy (15 to 20 lb) additional summer application of sodium dichloropropionate. This may be applied by selective "spotting" and presents an opportunity to apply 2,4-D or 2,4,5-T to control many amitrole-resistant and volunteer broadleaved weeds.
- (3) The results indicate some shortcomings in the use of D/A as a supplement to soil sterilants when applied in the spring, and the need for some alternative contact agent for use at that time.

LONG-TERM SOIL-STERILANT MIXTURE TRIALS

This investigation did not set out to discover how much of any mixture of chemicals was required to maintain total weed control but to find if, with strict limitations on chemicals available, an acceptable degree of control would be maintained over a predictable period of time, say twelve months. Two further problems which have arisen out of the work are, first, what is the most economical

method of extending the duration of effect of initial applications of soil-sterilant mixtures, and secondly, how best to deal with paspalum, *P. distichum*, Indian doubt, and other resistant perennial grasses in northern districts?

Several trials were laid down in the spring of 1961 in which Treatments 3a, 3b and 3c were replicated over several miles of track. In Wanganui, Marlborough and Canterbury, trials were also laid down using Treatments 4a and 4b.

In December 1961 isocil at 5.5 lb and 11 lb was applied to two plots at Morrinsville while trials of this material were greatly extended in the Te Aroha and Marlborough lengths in December 1962. Other comparative studies which are under way are designed to compare mixtures containing simazine/D/A and diuron/D/A with isocil and bromicil and to evaluate paraquat.

This paper will discuss chiefly the results of those trials which have continued since 1961.

RESULTS AND DISCUSSION

Except where paspalum was prominent or in places where poor ballast or excessive wetness affected results, the performance of the basic applications of simazine, diuron, and monuron when mixed with D/A or chlorate easily exceeded requirements in that the overall control persisting at the end of twelve months made it difficult to decide to repeat the applications at that time. The resistance of paspalum to initial treatments of all mixtures in the Hamilton district trials and its subsequent aggressiveness left a worse problem than before, although control of most other weeds proved generally satisfactory. Other species of some importance on tracks showed varying tolerances to the materials applied but none of these species approaches paspalum in resistance to other known weedkillers or in its widespread occurrence in northern districts.

Isocil at 5.5 lb in a 50 in. rainfall area was the most toxic and persistent material. It killed seedlings and retarded the growth of mature plants of paspalum. Indian doubt was controlled well and other summer grasses did not volunteer during the following summer. It killed semi-mature gorse at the 11 lb rate, presumably by foliar absorption. Apart from the presence of a few composite species there was nothing to justify respraying plots after twelve months and after eighteen months there has been no marked deterioration of control apart from paspalum and some composites. It appears promising for the control of fern (*Pteridium esculentum*).

Monuron/D/A: It is unnecessary to spend time on this material as diuron performed rather better and is available at approximately the same cost. Under Canterbury and Marlborough conditions, when monuron was applied with chlorate, it performed at least equally as well as with D/A. Chlorate improved the kills of sorrel and ribgrass plantain (*Plantago lanceolata*).

Diuron/D/A: This material performed no better when mixed with D/A than with chlorate under Canterbury and Marlborough dry conditions. Compared with simazine/D/A it gave better kills of grasses, legumes and sorrel. It failed on paspalum, *P. distichum*, Indian doubt, ribgrass plantain, *Veronica* spp. and a few less important or less widely distributed species. The toxic effects of diuron on grasses in particular persisted longer under adverse ballast and moisture conditions than did effects of monuron and simazine.

Simazine/D/A: This mixture performed satisfactorily in general and its effect persisted for longer than twelve months. However, the initial kill of tall fescue, cocksfoot and sorrel was not always complete and unkilld plants would be still more resistant after twelve months. The mixture appears to be less effective against grasses, including browntop (*Agrostis tenuis*), and encroachment by grasses from the sides was more marked than in the case of

diuron. A number of legumes common on tracks showed tolerance to the material, and black medick (*Medicago lupulina*) and tares (*Vicia* spp.) were early volunteers. Simazine mixture failed to kill or control paspalum, *P. distichum* and Indian doubt, and crabgrass (*Digitaria sanguinalis*) volunteered in the spring following treatment.

CONCLUSIONS

It would appear unwise to switch the time of application to the autumn since winter rainfall leaching effects would quickly reduce efficiency and result in heavy spring and summer growth.

Results showed that for each material there was a range of tolerant species which multiplied between times of treatment. Some of the treatments gave control for more than twelve months. If the rate of application were decreased, to reduce this control period to twelve months, it is likely that the range of tolerant species would be increased, and further, that after repeated application of the same material control would be progressively lost.

There is room for doubt as to what proportion of the ultimate weed kill secured from the mixtures can be attributed to the action of the D/A components in those mixtures.

In Canterbury, Marlborough and Hawke's Bay it is probable that applications of these soil-sterilant-type materials may give adequate control over periods up to two years, provided a selective spot application of sodium dichloropropionate and 2,4-D or 2,4,5-T is made during the second autumn.

In wetter districts, such as Wanganui, where there is no paspalum, a selective spot application of D/A or sodium dichloropropionate and 2,4-D would be required in the spring following initial treatment with soil-sterilant and a second spot application in the autumn. Thus one full treatment and two partial treatments would cover a period of two years.

In paspalum areas leaching is a problem additional to that presented by the weed itself, and at this stage it is unlikely that there can be any savings made in the number of sprayings or in the cost of weedkilling until paspalum is completely eradicated. As heavy summer applications of sodium dichloropropionate are necessary for this and for control of other resistant grasses, it is recommended tentatively that the basic treatment with soil-sterilant and sodium dichloropropionate should be deferred until summer following spring treatment with a suitable contact material. If this treatment secures a complete kill of paspalum it should then be possible to maintain control by annual summer treatment with the soil sterilant mixture, augmented by an occasional spot application of amitrole or 2,4-D.

At this stage the possibilities of isocil and bromacil are more obscure, but it seems likely that they also will require to be augmented from time to time with selective spot applications of other chemicals to cope with resistant weed species.

The regular cutting back of growth overhanging the sprayed width of track is an essential prerequisite to efficient spraying of weedkillers to secure their best performance.

REFERENCES

- Rukuhia Soil Research Station, 1963: *Ann. Rep. 1962-63*. In the press.
- Ward, R. K., 1956: Railway Track Trials. *Proc. 9th N.Z. Weed Control Conf.*, pp. 25-28.
- 1958: Weed Control with New Chemicals for Weeding Railway Tracks and Industrial Areas. *Proc. 11th N.Z. Weed Control Conf.*, pp. 90-95.
- 1960: Total Weed Control. *Proc. 13th N.Z. Weed Control Conf.*, pp. 66-70.