RESIDUAL HERBICIDES FOR WEED CONTROL ON RAILWAY TRACK

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Summary: Eight residual herbicides were applied to railway tracks at two sites to evaluate weed control over a three year period. The sites were in a medium to low rainfall zone with gravel ballast and a high rainfall zone with metal ballast to the track.

Generally the herbicides performed similarly at both sites although overall at the high rainfall site with metal ballast the duration of the residual effect was less and the rate of chemical required to achieve acceptable control was greater. Ethidimuron at 3.5, 7.0 and 10.5, Diuron at 12 and bromacil/diuron at 6/6 kg ha^{-1} gave acceptable weed control for at least three seasons at the low rainfall site with gravel ballast. Results were not so clear cut on the high rainfall site with metal ballast. Only Ethidimuron at 10.5 kg ha^{-1} gave three seasons' control. Most other chemicals gave acceptable commercial control; however some failed to give satisfactory season long control at the lowest rates. Results are briefly discussed in relation to weed spectrum, ballast type and rainfall.

INTRODUCTION

Westrail treat almost 5000 km of railway track annually throughout the south west of Western Australia with herbicides for control of weed growth. An amitrole/atrazine mixture has been the standard treatment used, although in recent years some moves have been made to identify specific weed problems and to tailor herbicide recommendations to suit the needs. Atrazine alone, Hexazinone granules and Glyphosate have been used on a limited basis.

The use of long term residual herbicides has not been practised. Indeed, a moratorium on the use of such herbicides exists because of concern relating to damage to native and other vegetation adjoining railway tracks and reserves. Cost and a general lack of information on long term efficacy are other reasons holding back their use.

No previous large scale trials have been conducted in the south west of Western Australia to fully evaluate a range of soil applied residual herbicides. The objective of this trial was to evaluate weed control with a range of residual herbicides and rates on railway track with different ballasts and in different rainfall zones and to determine the length of the effective residual period.

MATERIALS AND METHOD

Sites: The sites were at Piawaning (low rainfall - 392mm ann. av.) with gravel ballast and Muchea (high rainfall 786mm ann. av.) with metal ballast.

Each site was chosen for uniformity with respect to grade, ballast type and expected weed population. Signs were erected to avoid overspraying or mechanical disturbance during the trial period.

Plot size: Each plot was one hundred metres long and 6m wide (3m each side of track centre) with a 20m buffer zone between plots.

Treatment application: Granules were applied with a twin-nozzle applicator, originally developed by Dupont Australia. The wet spray herbicides were applied with a 6m boom spray, using spraying systems nozzles 8003.

Boom height: Ninety-five centimetres above track, giving double overlap at track.

Nozzle spacing: Forty centimetres.

Volume of application: One hundred and forty litres ha^{-1}. No wetting agent used.

Pressure: Four hundred Kpa.

Spraying dates: Muchea site: April 23, 1981; Piawaning site: April 24, 1981. All treatments were applied prior to the growth of any annual winter weeds.

Weed spectrum: Piawaning (gravel ballast). The population of both annual and perennial (including woody shrubs) varied over the trial site.
Annual weeds - annual ryegrass (*Lolium rigidum*), wild oats (*Avena* spp.) and giant brome (*Bromus diandrus*) were the predominant annual grasses at the commencement of the trial. Also present at the final assessment (6/10/83) were wheat (*Triticum aestivum*), shivery grass (*Briza minor*) and silver grass (*Vulpia myuros*). Annual broadleaved weeds present at the commencement of the trial were capeweed (*Arctotheca calendula*), flatweed (*Hypochoeris* spp.) and wild geranium (*Erodium botrys*). At the final assessment, Lupins (*Lupinus* spp.), clovers (*Trifolium* spp.) and wild radish (*Raphanus raphanistrum*) were also present.

The population of perennial and summer growing annual weeds varied over the trial site, consisting mostly of native shrubs (at track's edge), couch (*Cynodon dactylon*), lovegrass (*Eragrostis curvula*), paspalum (*Paspalum dilatatum*), mulla mulla (*Pilotus* spp.), sarsparilla (*Hardenbergia violacea*), afghan thistle *Salsola kali*), windmill grass (*Chloris truncata*) and stinkwort (*Dittrichia graveolens*).

Muchea - (metal ballast) - Weeds, both annual and perennial, were more uniform over this trial than the Piawaning site. Growth, however, for most species was restricted to the ballast edges due to the poorer growth environment on the metal ballast. Lupins, cereals and some annual grasses did, however, survive on the track area.

Annual weeds - Wild oats were predominant at the commencement of the trial; however, brome grass, annual veldtgrass (*Erharta calycina*) and to a lesser extent annual ryegrass and shivery grass were also present at the final assessment. Broadleaved annuals consisted mainly of lupins, flatweed and clover with little change in weed spectrum over the duration of the trial.

Perennial weeds were generally consistent over the length of the trial but also off the ballast area. Lovegrass, couch, paspalum and to a lesser extent kikuyu (*Pennisetum clandestinum*) were present throughout the duration of the trial.

RESULTS AND DISCUSSION

Yearly assessments were made at each site for the intended three year duration of the trial. Assessments consisted of rating weed growth on the track and ballast edge and noting the weed spectrum present. Weed control was considered reliable and acceptable if better than 85 percent control was achieved at the time of rating.

Control of perennial and summer growing annual weeds was difficult to assess accurately, particularly at Piawaning due to variability over the site. Ethidimuron (at all rates), diuron and bromacil/diuron (at the highest rate) gave reliable control of annual and most perennial weeds for three years, and this only applied at the Piawaning site on gravel ballast where the rainfall was not excessively high (see Table 1). Assessment was more difficult at Muchea with only ethidimuron at the highest rate giving control for three years.

Perhaps the most disappointing aspect of the trial was the poor performance of atrazine, both hexazinone formulations and hexazinone/bromacil/ diuron. Atrazine and these alternative hexazinone formulations, at the low rates, gave unacceptable control of annual weeds at both sites for even one season. Atrazine alone or as an amitrole/atrazine mix is used extensively for weed control on rail track at similar or lower rates than used in this trial. Its poor performance at Piawaning and especially Muchea clearly demonstrated the need for consideration of alternative herbicides, or much higher rates, if season long (and longer) weed control under all situations is required.

Bromacil/diuron, buthadiazol and karbutilate all gave satisfactory season long weed control at Piawaning at all rates, extending into the second year at the higher rates with the exception of karbutilate. At Muchea performance of these herbicides dropped off more rapidly with the low rates failing to give one season's weed control. Diuron and hexazinone performed similarly. All these chemicals tended to be more variable at this site.

Outstanding among all treatments were ethidimuron and diuron (at the higher rates) at Piawaning. After three winters ethidimuron at 3.5 kg ha^{-1} and diuron at 4 and 8 kg ha^{-1} were allowing some return of weed growth. Their performance at Muchea was not so outstanding, particularly diuron where lupins and lovegrass survived after two years.

The performance of diuron is somewhat surprising. Other trials, not on rail track, have indicated only one, or at best, two years' weed control at the highest rates used in this trial. Further work on railway track at different sites is required to verify the results achieved in this trial with diuron.

While the performance of atrazine was poor, it is considered that higher rates should have been trialled. Rates at least equivalent to diuron should have been used.

Type of ballast: - Not only did the metal ballast provide a harsher environment for weed establishment and survival, but it is obviously less suitable for absorbing residual herbicides. Poor weed establishment and survival on metal ballast may be matched by poorer persistence of herbicides. Gravel and earth ballast supports better weed establishment and also has the capacity to retain herbicides for a longer period. Perennial weeds also found it difficult to become established on metal ballast. Only the larger seeded more vigorous weeds such as lupins and cereals can readily survive in metal ballast while gravel favours establishment of both small and large seeded species.

Rainfall - The amount and incidence of rainfall determines whether annual or perennial weeds are the more important. The higher rainfall site of Muchea favoured growth of perennials, at the ballast edge, to a far greater extent than at Piawaning. Despite the lower rainfall, growth of annual weeds generally tended to be more prolific at Piawaning, but this was probably a site and seasonal factor. Faster breakdown of residual herbicides also occurs under wetter conditions.

Consideration of ballast type, extent and spectrum of the weed problem and the rainfall must be considered when choosing a herbicide for weed control on rail track in order to obtain satisfactory results.

The use of Glyphosate may be most appropriate where perennials are a particular problem.

CONCLUSIONS

Where it is desired to avoid annual spraying with short term residual herbicides, ethidimuron at 7.0 kg ha^{-1} could be expected to give three years' control of annual and most perennial weeds on gravel ballast tracks in the wheat belt areas of Western Australia. Diuron at 12 kg ha^{-1} on the results of this trial would be expected to give similar results under the same conditions. Bromacil/diuron at 6/6 kg ha^{-1} gave poorer but satisfactory control over the same period. Two years' weed control could be expected from diuron at 8 kg ha^{-1}, ethidimuron at 3.5 kg ha^{-1}, bromacil/diuron at 4/4 kg ha^{-1} and buthadiazol at 7.5 kg ha^{-1}.

Further trial work is required in high rainfall areas involving different ballast and weed spectrum. All things considered, ethidimuron at 7.0 kg ha^{-1}, bromacil/diuron at 6/6 kg ha^{-1}, buthadiazol at 11.25 kg ha^{-1}, karbutilate at 12 kg ha^{-1} and diuron at 12 kg ha^{-1} could be expected to give two years' control and were clearly superior to other treatments and rates.

The good performance of diuron, especially at Piawaning, needs to be verified in the light of shorter residual effects experienced in most other trials.

While tree damage was not seen at these sites due to lack of nearby trees, the use of long term residual herbicides can cause serious damage to adjoining desirable vegetation, and in such situations alternative herbicides should be used.

The weed control advantages of using a long term residual herbicide were clearly demonstrated in this trial. Economic and careful site assessments are required to see if these herbicides can be successfully introduced for weed control on railway track in Western Australia.

ACKNOWLEDGEMENTS

The assistance and cooperation of Westrail in maintaining the trials and for providing transport for inspections is greatly appreciated. Spraying was carried out by Maxwell, Robinson and Phelps whose assistance is also appreciated. The advice, assistance and provision of chemicals by the following companies are also gratefully acknowledged: Bayer Australia Pty Ltd, DuPont Australia, Ciba Geigy and Velsicol.

Table 1. Herbicide and rates indicating the period of acceptable annual weed control at each site.

HERBICIDE AND RATE, kg ha^{-1}	PIAWANING (low rainfall gravel) Seasons			MUCHEA (high rainfall metal) Seasons		
	One	Two	Three	One	Two	Three
Hexazinone liquid[1] 1.0	-	-	-	-	-	-
Hexazinone liquid 2.0	*	-	-	-	-	-
Hexazinone liquid 4.0	*	-	-	*	-	-
Hexazinone granules[2] 1.0	-	-	-	-	-	-
Hexazinone granules 2.0	*	-	-	-	-	-
Hexazinone granules 4.0	*	-	-	*	-	-
Hexazinone/bromacil/diuron[3] 0.5/0.25/0.25	-	-	-	-	-	-
Hexazinone/bromacil/diuron 1.0/0.5/0.5	*	-	-	-	-	-
Hexazinone/bromacil/diuron 2.0/1.0/1.0	*	-	-	*	-	-
Bromacil/diuron[4] 2.0/2.0	*	-	-	-	-	-
Bromacil/diuron 4.0/4.0	*	*	-	*	-	-
Bromacil/diuron 6.0/6.0	*	*	*	*	*	-
Ethidimuron[5] 3.5	*	*	*	*	-	-
Ethidimuron 7.0	*	*	*	*	*	-
Ethidimuron 10.5	*	*	*	*	*	*
Buthadiazol[6] 3.75	*	-	-	-	-	-
Buthadiazol 7.5	*	-	-	*	-	-
Buthadiazol 11.25	*	*	-	*	*	-
Diuron 4.0	*	-	-	-	-	-
Diuron 8.0	*	*	*	*	-	-
Diuron 12.0	*	*	*	*	*	-
Karbutilate[7] 4.0	*	-	-	-	-	-
Karbutilate 8.0	*	-	-	*	-	-
Karbutilate 12.0	*	-	-	*	*	-
Atrazine 3.2		-	-	-	-	-
Atrazine 6.4	*	-	-	-	-	-

1 Velpar L
2 Velpar 20G
3 Dybar 10/10G
4 Krovar WP
5 Ustilan WP
6 VEL 5026 WP
7 Residone WP