TOLERANCE OF NURSERY SEEDLINGS OF FOREST TREE SPECIES TO POST-EMERGENCE HERBICIDES

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SUMMARY

In eleven trials at two nursery sites, the tolerance of *Pinus radiata*, *Acacia melanoxylon*, *Cupressus macrocarpa*, *C. lusitanica* and *Eucalyptus fastigata* seedlings to post-emergence applications of the herbicides clopyralid, methabenzthiazuron and terbuthylazine was evaluated. Seedling tolerance was assessed by comparing height growth and survival with that of seedlings treated with current methods of post-emergence weed control (either herbicides or hand weeding). None of the herbicides significantly affected growth of any tree species. Significantly fewer *C. lusitanica* seedlings survived when treated with methabenzthiazuron 4 weeks after emergence, than when treated with terbuthylazine.

Keywords: herbicides, forest nursery, seedling tolerance

INTRODUCTION

Weed control is essential to maximise the production of bare-rooted tree seedlings in forest nurseries. This is achieved through post-sowing pre-emergence application of residual herbicides, followed after the crop has emerged, by post-emergence herbicide applications and hand-weeding. The number and timing of post-emergence weed control operations depends on environmental conditions, weed species, herbicide, and management practices employed in raising the seedlings. Post-emergence herbicide applications are best made before weeds appear, but in many cases weeds become established, and must be controlled by hand-weeding or the use of selective herbicides with foliar activity. Many herbicides in current use, eg. propazine, chlorthal dimethyl and pendimethalin, do not adequately control emerged weeds and others, eg. oxyfluorfen, may scorch the foliage of crop seedlings. Trials were undertaken to establish the tolerance of seedlings of several tree species to foliar active post-emergence herbicides which control a range of seedling weeds.

METHODS

Eleven trials were established between 1991 and 1993 to evaluate the tolerance of *Pinus radiata*, *Acacia melanoxylon*, *Cupressus macrocarpa*, *C. lusitanica* and *Eucalyptus fastigata* seedlings to a post-emergence application of either clopyralid (Versatill), methabenzthiazuron (Tribunil) or terbuthylazine (G2ardoprim), herbicides which have foliar activity (Tables 1-3). Trials were established in the Forest Research Institute nursery or the Ngongotaha nursery (trials 6 and 8), in the vicinity of Rotorua, on Ngakuru sandy loam soils. Seed was sown in nursery beds using standard techniques. Post sowing pre-emergence herbicide applications of chlorthal plus propazine at 5+0.5 kg/ha were made to *P. radiata* seedlings (except trial 1 where terbuthylazine at 1.5 kg/ha was used), oxyfluorfen at 0.48 kg/ha to *Cupressus* species, nitrofen at 7.0 kg/ha to *E. fastigata* and pendimethalin at 1 kg/ha to *A. melanoxylon* immediately after sowing. Trials were laid out in a randomised block design with four replicates (three for trial 3) of each treatment. Herbicides were applied at various rates (Tables 1-3) in 450 litres/ha water, either 4, 8, 11 or 16 weeks after emergence, to 3 x 1 m plots using a CO₂ pressurised hand sprayer fitted with two 80015 nozzles.

Proc. 47th N.Z. Plant Protection Conf. 1994: 117-120

Treatment comparisons were made against control plots treated with propazine or a mixture of chlorthal plus propazine for *P. radiata* (Table 1) and oxyfluorfen or chlorthal plus propazine for *Cupressus* species (Table 2). Herbicides were applied to control plots at the same time as test treatments were applied. Hand-weeding is commonly undertaken in *Acacia* and *Eucalyptus* species, and hand-weeded plots to which no post-emergence herbicides had been applied, were used as controls with these species (Table 3).

Tolerance of seedlings was determined by visual inspection for herbicide damage over 3 weeks following spray application, and by measuring heights of a sample of 30 to 50 seedlings per plot. In the trials to evaluate the effect of clopyralid on *Cupressus* species (trials 7 and 9) and in the *E. fastigata* and *A. melanoxylon* trials (trials 10 and 11), growth increment following herbicide application was measured. The period between herbicide application and measurement varied (Tables 1-3). Seedling mortality was assessed either by counting the number of survivors, in an identified set of seedlings in each plot, or comparing the number of seedlings in the middle two rows of each plot. Height measurements and mortality data were subjected to analysis of variance.

RESULTS AND DISCUSSION

No visual signs of damage resulted from post-emergence applications of clopyralid, methabenzthiazuron or terbuthylazine, except that the leaves of *E. fastigata* treated with clopyralid curled slightly at the edges. Some transient damage occurred to the terminal leaves of *C. macrocarpa* and *C. lusitanica* seedlings treated with 0.48 kg/ha of oxyfluorfen.

None of the treatments significantly affected growth (height or increment) of any tree species when compared with that of the standard treatment (Tables 1-3).

There were no significant differences in seedling mortality between treated and control plots in any trial. In the 1993 trials there were significantly fewer (8.2%) seedlings in *C. lusitanica* plots treated with methabenzthiazuron, than in plots treated with terbuthylazine, although neither differed significantly from the control. Seedling counts were not made in the *E. fastigata* trial, but there was no mortality.

TABLE 1: The effect of three post-emergence herbicides, applied at different times, compared to that of standard treatments, on the height growth of *P. radiata* seedlings in five trials¹.

Trial No	Treatment	Rate kg ai/ha	Application date	Spray time ²	Assessment date	Height (cm)
1	terbuthylazine	1.5	31.12.91	8	12.3.92	26.7
	chlorthal+propazine	5.0+0.5	31.12.91	8	12.3.92	27.0
2	terbuthylazine	1.5	5.2.93	11	15.4.93	20.6
	chlorthal+propazine	5.0+0.5	5.2.93	11	15.4.93	22.0
3	methabenzthiazuron	1.4	5.2.93	11	19.6.93	28.2
	chlorthal+propazine	5.0+0.5	5.2.93	11	19.6.93	27.4
4	methabenzthiazuron	1.4	16.12.93	4	5.5.94	29.7
	propazine	1.0	16.12.93	4	5.5.94	30.5
5	clopyralid	0.3	16.12.93	4	5.5.94	31.5
	propazine	1.0	16.12.93	4	5.5.94	30.8

¹Within any one trial, there was no significant difference in growth between the control treatment (chlorthal+propazine or propazine) and the herbicide under evaluation ($P=0.05$).

²Weeks after emergence that spray treatment was applied.

TABLE 2: The effect of three post-emergence herbicides, applied at different times, compared to that of standard treatments, on the growth of seedlings of two *Cupressus* species in four trials¹.

Trial No	Treatment	Rate kg ai/ha	Application date	Spray time ²	Assessment date	Growth (cm)
<i>Cupressus macrocarpa</i>						
6	methabenzthiazuron	1.4	17.11.93	4	3.5.94	32.9
	terbuthylazine	1.5	17.11.93	4	3.5.94	35.6
	oxyfluorfen	0.48	17.11.93	4	3.5.94	31.3
7	clopyralid	0.3	15.2.94	16	4.5.94	14.1 ³
	chlorthal+propazine	7.0+1.0	14.2.94	16	4.5.94	13.0 ³
<i>Cupressus lusitanica</i>						
8	methabenzthiazuron	1.4	17.11.93	4	3.5.94	34.8
	terbuthylazine	1.5	17.11.93	4	3.5.94	39.1
	oxyfluorfen	0.48	17.11.93	4	3.5.94	36.6
9	clopyralid	0.3	15.2.94	16	4.5.94	15.0 ³
	chlorthal+propazine	7.0+1.0	14.2.94	16	4.5.94	15.7 ³

¹ Within any one trial, there was no significant difference in growth between the control treatment (oxyfluorfen or chlorthal+propazine) and the trial treatment ($P=0.05$).

² Weeks after emergence that spray treatment was applied.

³ Height increment.

TABLE 3: The effect of post-emergence herbicides, compared to that of hand-weeding, on the percentage height growth increment of *E. fastigata* and *A. melanoxylon* seedlings in two trials¹.

Trial No	Treatment	Rate kg ai/ha	Application date	Spray time ²	Assessment date	Growth ³ %
<i>Eucalyptus fastigata</i>						
10	methabenzthiazuron	0.70	12.3.93	16	27.5.93	121
	terbuthylazine	0.75	12.3.93	16	27.5.93	104
	clopyralid	0.90	12.3.93	16	27.5.93	126
	Hand-weeded				27.5.93	129
<i>Acacia melanoxylon</i>						
11	methabenzthiazuron	1.40	15.2.94	16	4.5.94	101
	terbuthylazine	1.50	15.2.94	16	4.5.94	95
	Hand-weeded				4.5.94	87

¹ Within any one trial, there was no significant difference in growth between the hand-weeded treatment and the herbicide under evaluation ($P=0.05$).

² Weeks after emergence that spray treatment was applied.

³ Height increment divided by height at spraying x 100.

Tolerance of *P. radiata* to methabenzthiazuron at 3 kg/ha has been reported elsewhere (van Dorsser 1981). As well as exhibiting foliar activity, this herbicide has residual activity against seedling broadleaf weeds. Terbuthylazine has foliar and residual activity against many broadleaf and grass seedlings. However, application of terbuthylazine to *Eucalyptus* species should be undertaken with caution, as tolerance will vary with species. Severe scorching and death has been observed in *E. nitens* seedlings treated with terbuthylazine at 1.5 kg/ha (W. Brown, pers comm.).

No analysis of weed control was undertaken. In both trials 8 and 11, terbuthylazine gave better control of broadleaf weeds (predominantly legumes) than methabenzthiazuron. In the 1992 *P. radiata* trials, plots treated with terbuthylazine were infested only with Jersey cudweed (*Gnaphalium luteo-album*), a weed not controlled by this herbicide.

ACKNOWLEDGMENTS

The technical assistance of staff of the Plant Protection Chemistry Group, and Mr. W. Brown, Nursery Manager, NZ FRI is gratefully acknowledged.

REFERENCES

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