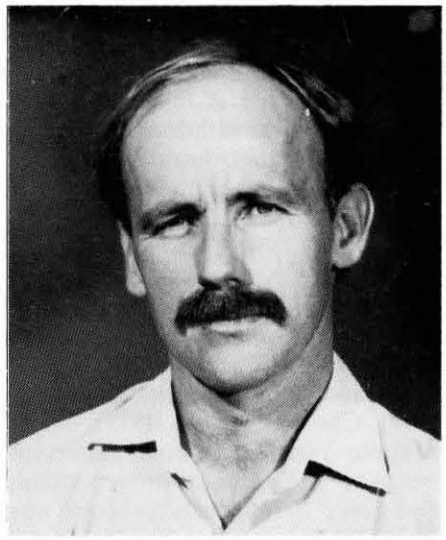
RESEARCH REPORTS



Diphenamid, bifenox and oryzalin as pre-emergent herbicides in a radiata pine nursery

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Summary

Diphenamid, bifenox and oryzalin were applied to radiata pine (*Pinus radiata* D. Don) seedbeds soon after sowing, and assessed for weed control and their effect on germination and height growth of the seedlings. At the rate required to control weeds (2.5 to 5.0 kg ha^{-1}) oryzalin significantly reduced pine seedling survival. Diphenamid at 14 kg ha^{-1} and bifenox at 3 kg ha^{-1} provided good weed control with no significant crop damage, and both would be acceptable alternatives to the current standard pre-emergent treatment of propazine at 1 kg ha^{-1} plus chlorthal at 10 kg ha^{-1}.

Introduction

At the Forestry Commission nursery in Canobolas State Forest near Orange, New South Wales, more than four million radiata pine seedlings are produced annually with weed control based on pre-emergent application of propazine (1 kg ha^{-1}) and chlorthal

Effect of pre-emergent herbicide treatment on weed growth in radiata pine seedbeds at Canobolas 14 weeks after treatment. Left: plot treated with diphenamid at 14.0 kg a.i. ha^{-1}. Right: Unsprayed plot.

(10 kg ha^{-1}). While this mixture is both effective and economical it was considered prudent to identify possible substitutes, since it is common for herbicides to be withdrawn from the market for public health and other reasons.

Three alternative pre-emergent herbicides (Table 1) were tested for efficacy and safety to the crop in 1980. Diphenamid and bifenox performed well in trials on *Pinus* species in New Zealand (Van Dorsser, 1973), Australia (Bacon, 1979) and the United States (South, 1977; Gjerstad *et al.*, 1979), while oryzalin controls several important weeds at the Canobolas nursery (Allen and Lowe, 1978). Each herbicide was applied at three rates to weed free seedbeds soon after sowing, in a replicated trial containing both unsprayed and standard propazine plus chlorthal treatments as controls.

Methods and materials

The soil at the Canobolas nursery is a krasnozem, Gn4.11 (Northcote, 1971), derived from Tertiary volcanics. Using the methods of Lambert (1976), the pH (1:1 in water) was estimated at 5.2, the organic matter content at 2.59% and the cation exchange capacity at 13.25 meq%. Hydrometer analysis (Lambert op. cit.) after overnight shaking indicated a clay content of 28.8%.

Size graded non-stratified pine seed was sown into open drills with a Stanhay seeder on 27 August 1980. These drills were covered with washed river sand. Seedbeds were 1.4 m wide, raised, and contained seven seed lines 19 cm apart. Herbicides were applied on 11 September 1980 in 280 L ha^{-1} of water, using a pressurized knapsack sprayer and 1.5 m boom with three Spraying Systems 8002E nozzles. No wetting agent was used.

Treatment plots were 9 m lengths of nursery bed, and each treatment was replicated three times in a randomized block layout. Each herbicide was applied at the three rates shown in Table 1. The seedbeds were moist at the time of treatment and received 26 mm of rain in the 14 days after treatment. No artificial irrigation was used in this period.

In December 1980 (14 weeks after treatment) the total above ground biomass of weeds in all plots was harvested, except for unsprayed plots and those treated with oryzalin at 1.25 kg a.i. ha^{-1}, where this was impractical because of the amount of weed growth; in these treatments weeds were harvested from randomly located 1 m^2 quadrats. All weeds were identified, counted and the above ground parts oven dried at 70°C for 36 hours. Tree seedling survival was recorded at the same time. The trial was then hand weeded and kept weed free until April 1981 when the height of the surviving pine seedlings was assessed.

Results and discussion

The best weed control in terms of both dry weight of weeds (Table 2) and weed numbers (Table 3) was given by bifenox at 6.0 kg ha^{-1}, but at this rate bifenox significantly ($P < 0.05$) reduced pine seedling survival compared to the routine control (Table 2). Diphenamid at 28.0 kg ha^{-1} also controlled the weeds well but appeared to reduce seedling survival.

Bifenox at 3.0 kg ha^{-1} and diphenamid at 14.0 kg ha^{-1} were selective and provided reasonable weed control. While these treatments did not seem to have any significant advantage over the standard propazine plus chlorthal mixture they would be acceptable alternatives. Diphenamid appeared to give better control of grass weeds than either bifenox or the standard propazine plus chlorthal treatment, but poorer control of *Polygonum aviculare* L. (Table 3), the most troublesome weed at Canobolas. Neither chemical had any effect on the pine growth (Table 2) even at high rates, which suggests that they might be applied safely after crop emergence. This could be important with bifenox, which has only a short (7 to 12 days) half-life in the soil but has useful activity against emerged weeds (Weed Science Society of America, 1979). Bifenox and diphenamid would probably be suitable for other radiata pine nurseries, but since the soil at Canobolas is unusually heavy, local trial work would be required to define appropriate rates.

Oryzalin appears to have no potential for pre-emergent weed control in radiata pine nurseries, since at a selective rate (1.25 kg ha^{-1}) weed control was very poor.

Table 1 Pre-emergent herbicide treatments tested in a radiata pine nursery

Treatment	Rate (kg a.i. ha^{-1})	Commercial product and formulation
Diphenamid	7.0	Dymid 800 g kg^{-1} wettable powder
	14.0	
	28.0	
Bifenox	1.5	Modown 400 g L^{-1} flowable
	3.0	
	6.0	
Oryzalin	1.25	Surflan 50 500 g L^{-1} flowable
	2.5	
	5.0	
Propazine + chlorthal	1.0 + 10.0	Gesamil 500 g kg^{-1} wettable powder Dacthal W75 750 g kg^{-1} wettable powder

Table 2 Effect of the treatments on dry weight of weeds and number of pine seedlings 14 weeks after treatment and on height of surviving pine seedlings 30 weeks after treatment

Treatment	Rate (kg a.i. ha^{-1})	Mean dry weight of weeds 14 weeks after treatment (g m^{-2})	Mean number of pine seedlings m^{-1} of row 14 weeks after treatment	Mean height of surviving pine seedlings 30 weeks after treatment (cm)
Diphenamid	7.0	66.3	30.7	21.3
	14.0	49.1	31.0	25.2
	28.0	19.5	18.5	23.7
Bifenox	1.5	51.5	32.6	24.8
	3.0	18.8	28.9	29.5
	6.0	6.0	16.1	28.7
Oryzalin	1.25	265.7	28.8	16.2
	2.5	70.8	24.5	26.3
	5.0	13.3	16.7	26.6
Propazine + chlorthal	1.0 + 10.0	19.1	36.3	28.8
Nil	–	786.5	28.2	9.1
LSD ($P = 0.05$)		135.5	10.6	7.8

Table 3 Effect of the treatments on mean number of weeds per square metre of seedbed 14 weeks after treatment

Weed species	Treatment and rate at kg a.i. ha^{-1}										
	Diphenamid			Bifenox			Oryzalin			Propazine + chlorthal	Nil
	7.0	14.0	28.0	1.5	3.0	6.0	1.25	2.5	5.0	1.0 + 10.0	
Broadleaves											
Trifolium subterraneum L.	0.48	0.11	–	4.03	1.00	0.35	11.72	2.44	1.00	1.72	17.66
Polygonum aviculare L.	7.43	4.79	0.24	2.35	0.13	0.02	8.80	3.92	0.39	0.13	61.00
Rumex acetosella L.	0.04	–	–	–	–	–	–	–	0.13	–	4.33
Chondrilla juncea L.	0.39	0.70	1.52	0.02	0.65	1.18	3.21	1.42	0.85	1.43	–
Solanum nigrum L.	0.11	0.15	0.09	–	–	–	0.33	0.04	–	–	–
Modiola caroliniana (L.) G. Don	0.02	–	–	–	–	–	–	–	–	–	–
Anagallis arvensis L.	0.02	–	–	0.02	–	–	–	–	–	–	–
Chenopodium album L.	–	0.04	–	–	–	–	–	–	–	–	3.33
Chenopodium spp.	0.04	–	–	–	–	–	–	–	–	–	–
Echium lycopsis L.	0.02	–	–	0.07	0.04	–	–	–	–	–	0.66
Echium vulgare L.	0.02	0.33	0.02	0.15	0.09	–	–	–	–	–	1.33
Plantago lanceolata L.	–	–	–	–	–	–	–	0.02	–	–	0.33
Unidentified spp.	0.22	–	–	–	–	–	–	–	–	–	–
Grasses											
Echinochloa crus-galli (L.)Beauv.	0.06	–	–	0.50	0.15	0.02	0.06	0.02	–	0.22	11.66
Paspalum dilatatum Poir	–	–	–	–	–	–	–	–	–	–	0.33
Setaria spp.	–	–	–	–	0.06	–	0.09	–	–	0.02	1.67
Unidentified spp.	0.04	–	–	0.39	–	0.02	–	–	–	–	0.33
Total number of weeds	8.89	6.12	1.87	7.53	2.12	1.59	24.21	7.86	2.37	3.52	102.63
LSD (P = 0.05) 11.17											

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