Early growth response of radiata pine to grass control and superphosphate in the Strzelecki Ranges

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SUMMARY

A field experiment is described which evaluated the growth response of *Pinus radiata* to chemical grass control and superphosphate. The study was undertaken on a site with a dense grass sward and a relatively high and uniformly distributed rainfall. A strip application of a commercial preparation containing 12% amitrole and 48% atrazine at 2.33 kg per planted ha soon after pine planting resulted in a 3 to 4 fold increase over control in mean tree volume after three years growth. Superphosphate application with or without chemical grass control was not associated with a growth response. Though an economic analysis was not feasible, the results indicated that chemical grass control is justified during *P. radiata* establishment on sites where grass competition is severe.

INTRODUCTION

About a third of the annual radiata pine (*Pinus radiata*) planting program by the Forests Commission, Victoria is undertaken on purchased farmland and the remainder on converted native forest areas. In the Strzelecki Ranges large areas of previously cleared farmland have recently been purchased for planting. Vegetation varies considerably and in some cases the land has partially or fully reverted to scrub with perennial weeds such as dogwood (*Cassinia aculeata*), varnish acacia (*Acacia verniciflua*) and bracken *Pteridium aquilinum*. More commonly however the vegetation is a mixture of native grasses and introduced pasture species.

Studies in low-rainfall areas (e.g. less than 700 mm) have shown that survival and early growth of radiata pine are substantially increased by controlling grass competition at establishment (Woods, 1976). The response of radiata pine to grass control in higher rainfall areas such as the Strzelecki Ranges has not, however, been well defined. A field study was undertaken to investigate this problem, and an evaluation of the response of radiata pine to superphosphate included. This report presents results of the study after three years growth.

MATERIALS AND METHODS

The study was undertaken on purchased property in the Parish of Callignee in the Yarram Forest District. The area has a cool climate with a mean annual rainfall of around 950 mm. The following monthly averages (in mm) from January to December measured at the Callignee Meteorological Station show that the rainfall is fairly evenly distributed: J 53, F 54, M 68, A 61, M 97, J 106, J 100, A 83, S 108, O 75, N 73, D 71. Soils are moderately deep, brown clay - loams derived from mesozoic sediments.

In February 1974 the property which was previously used for grazing and carried mainly Yorkshire fog (*Holcus lanatus*), perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*) and clover (*Trifolium* spp.) was cultivated with a three furrow disc plough followed by offset discing. Height-graded radiata pine seedlings raised in the Trentham nursery were planted at a square espacement of 2.1 m in August 1974 on a site of uniform and gentle slope. Four treatments were applied in early November 1974 to 9 tree x 7 tree plots arranged in a 4 x 4 Latin Square design. A two-row planted and untreated strip surrounded each plot. The treatments were:

1. Control
2. Superphosphate at 170 g/tree
3. Commercial preparation containing 12% w/w amitrole and 48% atrazine) at 2.33 kg per planted ha, and
4. Treatments 2 and 3 combined

The superphosphate was placed in a small heap on the soil surface 15 cm downhill from each seedling (spot application). The herbicide was applied, using a knapsack, to 1 m strips along the planting lines. An even coverage was obtained using approximately 40 ℓ of water per plot to which was added 57 ml of surfactant.

Heights and diameters (30 cm above ground) of all trees on each plot were measured in September 1977. The product of height in cm and stem sectional area in cm^2 (hereafter termed volume) was then computed for each tree. Woods (1976) has shown that this is closely related to oven dry weight for young radiata pine. A statistical examination was made using the mean tree volume of each plot.

RESULTS AND DISCUSSION

At the time of planting a moderage grass sward existed on all plots. On unsprayed areas this continued to develop, competing with radiata pine seedlings for moisture, nutrients and light during late summer and autumn. On strips sprayed with herbicide an effective grass kill was observed and strips remained largely free of grass until early autumn. Negligible discolouration of the seedlings due to amitrole was observed, this being consistent with the relatively low application rate of herbicide used in the study.

Mortality was not markedly affected by any treatment (Table 1). Although the herbicide had little effect on mortality in this experiment, the effect of grass control may vary considerably under different seasonal and site conditions. Mortality was higher than expected in all treatments and this was attributed to browsing by rabbits despite temporary fencing of the experiment.

The effects of the treatments on mean tree volume after three years growth are also given in Table 1. An analysis of variance on mean tree volume per plot showed that the treatments had a highly significant ($P<0.001$) effect on early growth. This was due to the herbicide treatment which resulted in a 3 to 4 fold increase in mean tree volume over either control or superphosphate. There was no significant response to superphosphate, and there was

no evidence of an interaction between superphosphate and the herbicide.

Table 1. Effects of treatments on mortality and mean tree volume after three years growth

Treatment	Mean mortality (%)	Mean tree volume* (cm^3)
Control	21	1440
Superphosphate	17	1460
Amitrole/atrazine	16	4906
Superphosphate + amitrole/atrazine	14	4763

* $\frac{\Sigma \Pi r^2 h}{n}$ where r = radius of tree at 30 cm above ground, h = tree height and n = number of trees per treatment

The substantial response to grass control reported here was obtained with a single application of the amitrole/atrazine mixture at a relatively low rate soon after planting. As a result of the low rate of atrazine applied, weed-free conditions along the sprayed strips were maintained only until late summer and the young trees experienced some competition during autumn. It is likely therefore that a slightly higher application rate of atrazine would have further increased the growth response to grass control. Unfortunately commercial preparations that contain a fixed ratio of amitrole and atrazine provide no flexibility in varying the application rate of the individual active ingredients, and hence the "tank mix" approach is preferred.

It is not clear from this study whether the growth response to grass control was due to reduced competition for nutrients, moisture, light or a combination of these factors. It is likely however that part of the response can be attributed to improved nitrogen nutrition of the pine since there is evidence that s - triazines such as atrazine increase the availability of soil nitrogen, increase nitrate reductase activity and increase protein synthesis (Woods, 1976). Although the study area receives a relatively high and well distributed rainfall, it remains possible that soil moisture becomes a limiting factor for radiata pine growth during the warm months, especially where a dense grass sward exists. The results of this study indicate that competition for soil moisture rather than nutrients was an important factor since the soils are very fertile, especially in phosphorus as evidenced by a lack of response to superphosphate. Allelopathy may also have contributed to poor growth on control plots.

No conclusions can be drawn as to the economics of chemical grass control in areas such as the Strzelecki Ranges, It is far too early to extrapolate the growth results reported here through the rotation so that costs and returns can be calculated. The plots are however large enough to be measured over a long period. The

substantial early growth response to grass control noted is nevertheless extremely encouraging, and operational grass control using amitrole/atrazine mixtures is now practiced by the Forests Commission during radiata pine establishment on sites where grass competition is severe.

It is concluded that strip spraying at the rate of 2.33 kg per planted ha with the commercial preparation used in this trial resulted in substantial early growth responses in radiata pine planted in the Strzelecki Ranges on sites with a dense grass sward. On the other hand, a spot application of superphosphate with or without grass control does not significantly increase the early growth of radiata pine planted on these sites.

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REFERENCE

Woods, R.V. (1976).- Early silviculture for upgrading productivity on marginal *Pinus radiata* sites in the south-east region of South Australia. Woods and Forests Department, South Australia. Bulletin 24, pp 90.