

Early weed and grass control for plantation establishment in Tasmania

R. Van Schie
Forestry Commission
Box 207 B, Hobart 7001, Tasmania

SUMMARY

Early weed control at establishment is essential for survival of pine and eucalypt seedlings planted on pasture land, and significantly improves early growth of these seedlings on pasture land, and land prone to early grass and broadleaved weed invasion.

Trials with various chemicals have shown that atrazine or simazine alone, at 3 kg a.i./ha, or where necessary combined with amitrole at 0.5 kg a.i./ha, gives 6 to 9 months weed control, and good response from both *P. radiata* and *E. globulus*. Hexazinone, although toxic to *E. globulus*, is safe to use with pine at 3 kg a.i./ha, and gives similar response to that of atrazine and simazine.

INTRODUCTION

The Tasmanian Forestry Commission has a plantation establishment program of approximately 1,500 ha/year. So far 28,500 ha have been established with the older plantings reaching 35 years in age. The species planted is mainly *P. radiata*, but there is no doubt that eucalypt plantations will become important in future.

The majority of the planting has been carried out on average to lower quality eucalypt forest sites, which have usually been heavily cut over for sawlogging in the past. However a larger proportion of future Commission plantings can be expected to be on old pasture land. In addition, private plantation establishment will become important in the future, and glassland will form a significant part of this program.

Site preparation normally involves pulpwood salvage and clear felling, followed by broadcast burning of the slash in February or March. Planting is carried out by hand with 1 year old *P. radiata* open rooted stock.

More recently, where topography permits, more intensive site preparation is carried out including windrowing, disc-ploughing, ripping and ridge ploughing. Fertilizing at establishment, using a hand-applied mixture of N and P, is carried out on selected sites. Secondly, aerial fertilizing at approximately 7 years after planting is done where required.

WEED COMPETITION IN PLANTATIONS

Weed competition has always been a major problem with plantation establishment and is commonly given last priority. Waring (1970) demonstrated that early competition control will maximize early growth

of the planted seedling, particularly when combined with fertilizing. The effect of weed competition on growth and economic return from *P. radiata* plantations in Victoria has been studied by Jack (1970). He has found that 1 and 2 years growth can be lost due to competition at establishment from dense herbaceous weeds. This lost growth is not made up later. On grassland sites weed control is even more important as survival can be very poor. Because of high interest charges, rotation age has an important bearing on the economics of plantation establishment and significant extra expenditure at establishment can be justified on the basis of even 1 or 2 years reduction in rotation.

CHEMICAL WEED CONTROL

Mechanical control of weeds by inter-row ploughing and/or slashing in the first few years after planting is not satisfactory because weeds close to the pine seedlings are not controlled. Cromer (1973), in glasshouse trials, found that atrazine, simazine and propazine were safe with *P. radiata*. Minko (1974) found a significant increase in height, diameter and survival in the first two years after establishment following application of a mixture of amitrole and atrazine.

Chemical control techniques have been developed by Woods (1976), de Boer (1969) and Knowles and Klomp (1975) for use in plantation establishment.

In 1975, trials were started by the Tasmanian Forestry Commission to test the effect of weed control at establishment using herbicides, particularly those with residual properties. Three trials are described:-

EXPERIMENTAL

Long Hill trial

This trial was designed to test the efficiency of various residual herbicides for the control of dolly bush (*Cassinia aculeata*) at establishment. This perennial is present as a scrub species in the native forest, and its seed germinates profusely following site preparation. Fertilizing soon after planting boosts the growth of the dolly bush around the pines which may become suppressed for the first few years. Other herbaceous weeds, including native grasses and broadleaves germinate as well, and compete for available moisture and nutrients.

Three sets of applications of a number of herbicides were made. Application A was done soon after cultivation in April, before weed germination, and only residual herbicides were used. Applications B and C were carried out just prior to and immediately after planting, in August and September respectively. Weed germination had already commenced and a knock-down herbicide was mixed with the residual herbicide.

The following chemicals and rates of applications were used:-

1. Thiazafurion at 6 kg a.i./ha (A)
2. Thiazafurion + amitrole at 6 + 2 kg a.i./ha respectively (B)
3. Atrazine at 5 kg a.i./ha (A)
4. Atrazine + amitrole at 5 + 2 kg a.i./ha (B,C)
5. Atrazine + amitrole at 2 + 2 kg a.i./ha (B,C)
6. Karbutilate at 5 kg a.i./ha (A,B)
7. Dichlobenil at 4 kg a.i./ha (A)
8. Amitrole at 2 kg a.i./ha (C)
9. Simazine + amitrole at 5 + 2 kg a.i./ha (C).

The dichlobenil granules were mixed with sand and hand strewn. The wettable powders were applied in water at the rate of 800 l/ha, using a knapsack sprayer and spraying over the pines.

RESULTS

Health of pines

The "knock-down" herbicide amitrole, either on its own, or mixed with a residual herbicide, had an immediate effect on the pines. Tips turned chlorotic, and this effect lasted for up to 6 months, however, all trees recovered.

Both thiazafurion and karbutilate killed the pines at the concentrations used. With thiazafurion this occurred regardless of time of application because of its very long residual effect. Death was usually preceded by a period of poor growth. With karbutilate death was quicker.

Atrazine, dichlobenil and simazine at 5 kg a.i./ha caused deaths above acceptable levels when applied prior to planting. This may have been due to soil disturbance at planting allowing contact between pine roots and chemicals. Atrazine, at 2 kg a.i./ha is safer to use prior to planting. Both the lower concentration of atrazine and simazine, and to a certain extent atrazine at the higher concentration, gave acceptable results when applied after planting.

Weed control

Thiazafurion and karbutilate gave control for more than 12 months. Dichlobenil gave fairly poor control, probably because of its application in granular form. The amitrole treated areas were rapidly reinvaded because it is not a residual chemical. Reinvansion was mainly from grass and flatweeds, but not dolly bush. Atrazine and simazine controlled weeds for about 12 months.

The after-planting application appeared to give better and longer control. This may be due to less disturbance of soil after spraying, and less leaching over the winter period immediately following the autumn application.

Growth of pines (Table 1)

The results with thiazafurion and karbutilate are excluded

Table 1. Height increments of *P. radiata* 24 months after treatment - Long Hill trial

| Treatment | Height increment (cm) | | |
|--------------------------------------|-----------------------------------|---------------------------------|------------------------------|
| | Spraying 4 months before planting | Spraying just prior to planting | Spraying just after planting |
| Control | 95.1 | 103.9 | 100.3 |
| Atrazine/amtrole 5 + 2 kg a.i./ha | 115.0 | 158.1 | 167.8 |
| Atrazine/amtrole 2 + 2 kg a.i./ha | | 166.7 | 175.0 |
| Simazine/amtrole 5 + 2 kg a.i./ha | | | 165.2 |
| Amitrole 2 kg a.i./ha | | | 138.9 |

because of poor survival of the pines. Similarly, dichlobenil is not considered further because of poor weed control. There was a significant growth response to weed control with atrazine in all applications, but the best response was obtained when application was made just before or after planting. The response is similar for atrazine at 2 kg a.i./ha and 5 kg a.i./ha, but the higher concentration produced significant toxic effects in the pines. It is reasonable to assume that simazine will give similar results, as similar increments to those obtained with atrazine were obtained with simazine in the after-planting application.

Amitrole alone gave a good response but it was not as large as, nor was it expected to last as long as, that obtained with the residual herbicides.

The results confirm that growth increments of *P. radiata* are improved significantly with full weed control using residual triazines. Apart from the benefit conferred by the control of the weed, pines growing on triazine treated soil appeared to have greener, fuller and more developed crowns. There is evidence to suggest that triazines enhance the nitrifying processes in the soil, increasing the available nitrogen (Cvetkova, 1966).

Wilmot trial

This trial was designed to test various herbicides for the establishment of *P. radiata* on old pasture land. The old pasture had been disced and ridge-ploughed prior to planting and fertilizing. Grass germination occurred almost immediately after ploughing, and the fertilizing accentuated the competition around each seedling. At

time of spraying, grass was 10 to 30 cm high and in many cases overtopping the pine seedlings.

The following treatments were applied:-

1. Amitrole at 2 kg a.i./ha
2. Amitrole at 1 kg a.i./ha
3. Hexazinone at 2 kg a.i./ha
4. Hexazinone at 4 kg a.i./ha
5. Atrazine + amitrole at 5 + 2 kg a.i./ha respectively.

The herbicides were applied in water, using a knapsack sprayer, at 800 l/ha. Spraying was done in November 1976, 5 months after planting.

Eight months after treatment the following results were apparent (Table 2).

More than half the pine seedlings on the unsprayed plots disappeared. The remaining seedlings were spindly and badly overtopped by the grass.

The amitrole spraying had very little effect on the grass, killing the grass tips only and no effects could be seen 2 months later. It appears that high concentrations of amitrole are required for effective control of grass. There was significant tip chlorosis of the pines at the higher concentration.

The amitrole/atrazine mixture and hexazinone gave good control of weeds with a similar growth response from the pines, which was almost three times that of the untreated control. More importantly there was greatly increased survival. Although the higher concentration of hexazinone will give a much longer period of weed control, there was some evidence of toxicity to the pines. Both the amitrole and atrazine mixture and the lower hexazinone + concentrations gave similar weed control and growth response, but as with the Long Hill trial the atrazine at 5 kg a.i./ha may be too toxic for the pines.

Sorrel (*Rumex acetosella*), which is present as a minor component of the pasture, appears to reinvade the sprayed areas at a faster rate than the grass. This is more noticeable at the higher concentration of atrazine. Reinvansion may not be as rapid in the hexazinone treated areas.

It appears that grass control in *P. radiata* plantations established on old pasture land can be successfully achieved by spraying either with hexazinone at 2 to 3 kg a.i./ha, or atrazine/amitrole at less than 5 + 2 kg a.i./ha. At these concentrations both growth and survival of the pines are significantly improved, without toxic side-effects.

Table 2. Height increments of *P. radiata* 8 months after treatment - Wilmot trial

| Treatment | Height increment (cm) | Sick (%) | Dead or missing (%) | Weed cover 12 months after spraying |
|---|-----------------------|----------|---------------------|--|
| Control | 13.1 | 7 | 67 | Dense grass to 80 cm tall |
| Amitrole 1 kg a.i./ha | 13.6 | 10 | 29 | Dense grass up to 60 cm tall |
| Amitrole 2 kg a.i./ha | 19.3 | 7 | 32 | Dense grass up to 40 cm tall |
| Hexazinone 2 kg a.i./ha | 33.2 | 1 | - | 80% reinvasion with short grass and sorrel |
| Hexazinone 4 kg a.i./ha | 30.7 | 5 | 10 | 25% reinvasion with short grass and sorrel |
| Atrazine/ amitrole 5 kg and 2 kg a.i./ha | 30.3 | 8 | 1 | Sorrel and grass up to 20 cm tall |

Levendale trial

This trial was designed to test various herbicides for the establishment of *E. globulus* plantations on old pasture land. The area had been giant-disked in January 1976. It was planned to rotary hoe and mound plough prior to planting in October, but the ground remained too wet. At the time of spraying the area had been re-invaded with a medium to dense cover of grass from 8 to 30 cm high.

The following treatments were applied:-

1. Glyphosate at 0.5 kg a.i./ha
2. Glyphosate at 1.5 kg a.i./ha
3. Hexazinone at 2 kg a.i./ha
4. Hexazinone at 4 kg a.i./ha
5. Atrazine + amitrole at 5 kg + 2 kg a.i./ha respectively.

The herbicides were applied in water, using a knapsack sprayer, at 800 l/ha. Spraying was done in mid-November 1976 prior to planting. Planting was done in mid-December 1976, in the sprayed lines, with 1 year old, paper potted *E. globulus* seedlings.

Nine months after spraying it was obvious that hexazinone was too toxic for the *E. globulus* seedlings. Although there was excellent control the majority of the seedlings had been killed by the chemical (Table 3).

Table 3. Height increments of *E. globulus* 9 months after treatment - Levendale trial

| Treatment | Height increment (cm) | Dead (%) | Weed cover 9 months after spraying |
|--------------------------------------|-----------------------|----------|--|
| Control | 3.7 | 7 | Dense 50 - 80 cm tall grass |
| Glyphosate 0.5 kg a.i./ha | 21.0 | 4 | Approx. 100% cover of grass up to 20 cm tall |
| Glyphosate 1.5 kg a.i./ha | 37.4 | 2 | 50 - 100% reinvasion with grass up to 20 cm |
| Atrazine/amtrole 5 + 2 kg a.i./ha | 44.9 | - | 40 - 80% reinvasion with short grass |
| Hexazinone 2 kg a.i./ha | - | 65 | 40 - 80% reinvasion with short grass |
| Hexazinone 4 kg a.i./ha | - | 95 | 0 - 20% reinvasion with short grass |

Only the higher concentration of glyphosate gave good weed control and growth response of *E. globulus*, and then only on the areas with shorter and less dense grass. There is no residual effect with glyphosate.

The amitrole + atrazine mixture proved the superior treatment for all sites, giving healthy, much branched seedlings, and with only a limited reinvasion from grass and broadleaved weeds. Seedling increment was up to 8 times that of the overtopped and spindly plants on the controls, while survival was 100%.

It appears, therefore, that *E. globulus* seedlings can be successfully established on grassland by spraying before planting with atrazine/amtrole mixture at 5 kg + 2 kg a.i./ha. Hexazinone was unsafe, while glyphosate was reasonably successful at higher concentrations, and lower densities of grass.

PRACTICAL APPLICATION

Spraying is now recommended at establishment of *P. radiata* plantations on old pasture land, or on land prone to grass and broadleaved weed invasion in the first year after planting. Atrazine or simazine at 2.5 kg a.i./ha is used, combined where necessary, with amitrole at 0.5 kg a.i./ha; and applied in water at 500 l/ha. Hexazinone, at 3 kg a.i./ha, is also recommended and will be useful as a post-planting application to control the slower germinating weeds (Cameron and Stokes, 1977). However it is more expensive than the atrazine + amitrole treatment.

Spraying is carried out with a tractor mounted boom sprayer,

but trials are planned for ultra low volume application, both as a tractor mounted operation to reduce the volume applied, and as a hand operation for more difficult terrain.

ACKNOWLEDGEMENT

Permission by the Tasmanian Forestry Commission to publish these results is acknowledged.

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