6.5 WEED CONTROL

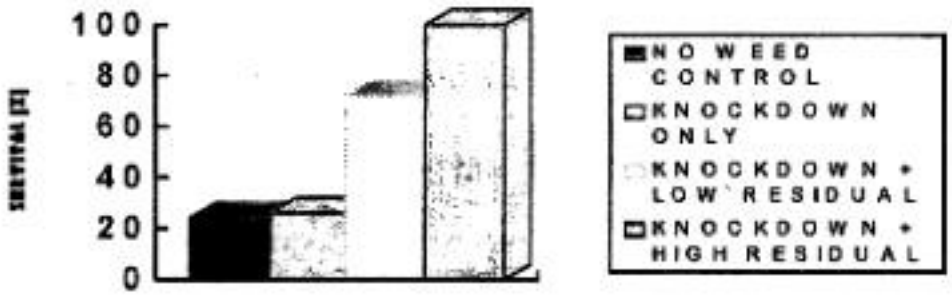
6.5.1 Introduction

6.5.1.1 Discussion

Successful weed control is the single most important aspect of site preparation work to ensure tree establishment and rapid early growth. Failure to achieve good weed control will severely impact on survival and growth rate and this may in turn delay harvest or lead to the site being considered unharvestable.

The aim of weed control is to provide weed free conditions adjacent to the trees for the first year and preferably longer. The significance of this is shown in the following graph from Ray Fremlin's work. Although the species is different, the principals remain the same.

Survival of *P. radiata* relative to different weed control strategies for a moist farmland site (Fremlin, unpublished).



The mortality of trees with inadequate weed control relates to direct competition for moisture, particularly in the first spring and summer. In severe cases trees have been smothered by growth of weeds, lodging over the top of them. Any competition for resources slows the growth of the trees and this in turn makes them more susceptible to grazing damage from stock and insects.

Good weed control reduces the period of time before farmers can reintroduce stock to the paddock. This is a critical part of establishment strategy with oil mallees as they are often not fenced, and rely on being established at the appropriate part of the cropping cycle. This strategy can be compromised if substantial infill planting is necessary the second year to achieve acceptable plant density.

The emphasis of these recommendations is to achieve excellent weed control before any planting begins. With chemical weed control, residual herbicides applied before planting is cheaper, and gives a broader range of weed control than relying on post-planting weed control.

There are various methods of controlling weeds, however the use of herbicides is the most common. Other methods include scalping, furrowlining, cultivation, weed mats and in conjunction with herbicides, grazing, pasture topping etc. These can be combines into an integrated system that does not rely on herbicides alone. Although herbicides remain the main element in a weed control strategy, it is becoming more common for tree growers to use an integrated strategy that combines elements of two or more methods to achieve effective weed control.

6.5.1.2 Pattern of Weed Control

To determine the optimum weed-free area adjacent to a tree has been the subject of study. Research in Western Australia and elsewhere has shown that weed-free strips were generally superior to squares and that optimum strip width on a sandy soil was 2.5 metres, although volume growth after 2 years was not significantly different ($p < 0.05$) when strips were 1 metre or wider.

In establishing oil mallees there is little call for total weed control by broad spraying. Broad scale weed control may be necessary to control some perennial species in advance of planting. This applies to species such as couch, which are serious competitors with trees and very difficult to control after planting. This is a situation most likely to be encountered in the wetter parts of the higher rainfall planting areas.

The advantages of strip weed control are that it

- reduces the amount of herbicide per planted area compared to broad sprayed areas
- reduces the potential for erosion and off target movement of herbicides compared to broad sprayed areas
- has been associated with lower levels of insect damage in tree planting's.

As a general rule strip width should be wider on sandy soils than on heavy soils. The minimum strip width for any soil should be 1.5 metres.

6.5.1.3 Equipment

Landholders are responsible for performing or organizing their own spraying. Using farmer owned and operated spray equipment, some rationalisation of layouts and spray swath width will be necessary. Allow for this at planning stage. Some farmers will have good small spray units for spraying firebreaks but most spraying will be done with broad acre equipment with some sections blocked off.

Good agitation in the mixing tank is critical, especially with higher rates of simazine, which settles to the bottom and leads to unequal distribution of chemical. Although most new agricultural units have good recirculating agitation systems do not assume that equipment designed to handle cropping rates of residual chemicals are going to be adequate for the double or more rates used in tree planting.

Encourage operators to use adequate safety gear when handling, mixing and spraying chemicals. This includes gloves and breathing protection. The long-term health effects of many of these products are still unknown.

6.5.2 Weed Control-Types and Timing

6.5.2.1 Pre Season Weed Control

Reducing weed burden a year in advance can significantly reduce chemical usage in the year of planting. It is helpful for some of the problem weeds like ryegrass.
Three options are available:

- Spray topping the paddock in the previous season.
- Reducing the seed burden through grazing.
- Fallowing (care must be taken with this option as there is high potential for erosion)

6.5.2.2 First Year Weed Control Options - Non Chemical

1. Mechanical-cultivation

Ploughing will kill most weeds but there are few circumstances where cultivation alone will provide sufficient control for an entire season. Control is influenced by timing and frequency of cultivation. In experimental plots sufficient density of weeds recovered, irrespective of treatment, to significantly impact on survival, although weed composition was altered to the extent that low rates of herbicide could be used. This has yet to be verified.

Ploughing may encourage a more complete germination of residual seed and may have to be done two or three times to have the best effect. This introduces problems, as access to the site through winter may be difficult and compaction increases next to the trees from repeated traffic. Late germinating plants such as rye grass are not usually controlled.

Ploughing may leave the area prone to wind and water erosion.

2. Mechanical-scalping

Scalping is performed with a tree planter or grader blade. This technique removes a strip of the topsoil (A1 horizon) that contains the weed seeds leaving a weed-free zone in which to plant the tree, and can provide very effective weed control. It may also have other benefits, such as-

- removing non-wetting soil
- collecting water on drier sites.
- Reduced dependence on chemicals
- The work can be done at the same time as the planting (subject to suitability of the site to this technique-see for example limitations in the ripping section of this manual).

The reliance on furrowlining and scalping to provide effective weed control in all conditions should be treated with caution, however. Disadvantages and potential problems with scalping include-

- Removal of nutrients and organic matter, which may need compensating for
- Loss of soil depth on shallow duplex soils, and the exposure of clay on heavy soils, as this may lead to waterlogging problems
- Exposure to water and wind erosion. The potential for erosion should be carefully considered before opting to scalp or furrowline. Alignment of rows on any soil should be on or close to the contour.
- It is difficult to successfully control deep-rooted weeds such as couch and dock.
- On sandy soils particularly, there is a tendency for weed seed to blow into the scalped area or furrow, germinate there and develop into significant competition to the trees.

Scalping will create a bund of top soil to the sides of the planting lines. This overburden contains an abundance of weed seeds, which will germinate and need monitoring for subsequent competition with the trees. These ridges of soil may make harvester operations more difficult and may need to be flattened once the trees have established. This may be incorporated into mechanical weed control in the second year.

Scalped sites should be monitored and spring weed growth controlled as necessary. (See section on integrated weed management).

3. Mechanical-Grazing

Grazing alone does not control weeds to the extent that is necessary, and is dangerous amongst young trees. However, a pasture that is heavily grazed prior to planting will enable significant reductions in the rate of knockdown herbicide to be applied. Unfortunately, there are some exceptions to this rule. For example, to successfully control dock a large leaf area is necessary in order for sufficient chemical to be absorbed to kill the large root system.

4. Mechanical-Weed mats.

In environmentally sensitive areas weed mats offer an alternative to chemicals or cultivation. The cost to purchase and install weed mats precludes the technique for large-scale planting's. It has been estimated that the use of weed mats will more than double the establishment cost of trees.

5. Biological weed control.

There are various plant-specific predators and diseases that show some potential for controlling pest weeds. While biological agents may be useful to control 'environmental' weeds, the reality is that these will, at best, form a component of an integrated weed management strategy that incorporates a 'suite' of techniques without reliance on any one.

6.5.2.3 First Year Weed Control Options - Chemical

Discussion

It is usual when establishing plantations to mix a knockdown herbicide with a residual herbicide and apply the mixture using a boomsprayer prior planting the trees.

Most knockdown herbicides used by plantation growers are broad spectrum, although there are now some herbicides that have specific or selective activity.

The most common residual herbicides used for tree establishment belong to the triazine group, of which atrazine, simazine and hexazinone are the most widely used. It is this group of herbicides that is currently under scrutiny because of alleged toxicity to humans; but more because of their solubility in water and hence the danger of contaminating groundwater and surface water bodies. Studies are underway to determine if these herbicides, under forestry use patterns, constitute a hazard to groundwater and surface water. Should these herbicides be lost to tree growers and alternative chemicals are used, the cost of establishing trees will increase substantially.

The sulfonyurea group is becoming more widely used for tree establishment, although mainly in mixtures with other herbicides. Similarly the grass-specific herbicides are widely used and work is continuing in an attempt to develop a prescription to overspray native species, soon after planting, to provide broad-spectrum control of weeds. Chemicals that appear to have potential in 'cocktail' mixes to control broadleaf weeds include: oxyfluorfen, metosulam, and sulfometuron-methyl.

'Cocktails' of different herbicides, mixed together to suit specific conditions, is the likely direction future weed control research will take. This is not an area to be taken lightly, however and operators should always check compatibility with other chemicals and check labels for specific exclusions.

It is common practice with farmers to attempt effective weed control with one or two applications of knockdown herbicide. This should de discouraged, disadvantages of this approach being-

- it will not deal with later germinating weeds such as Rye grass and Radish.
- There is a reliance on the farmer going over the site twice at a time of year when there is pressure on from the cropping program.

Hand planting seedlings through a Simazine layer can be done with minimal problems, but disturbance by a tree planting machine will result in unwanted weed germination.

To maximise the efficiency of chemical use, don't apply chemicals to stressed weeds.

Rip lines that are collapsing may carry excessive simazine down into the root zone of the trees. If rip lines are open they should be treated before planting (seeing ripping). If not discovered until planting time ensure that trees are planted to the side of the rip line.

6. Chemical-Pre planting weed control - Pre emergent

Residual chemical used at the break of the season is the cheapest tested chemical option. Rates will depend on the soil type and the rainfall of the area.

7. Chemical-Pre planting weed control - Post emergent

Knockdown and residual

The most common mix is flowable Simazine (residual) plus Glyphosate (knockdown).

The rates of residual chemical vary between soils and rainfall areas. Lower rates are used on leaching sands and very dry areas, and higher rates on heavier soils and wetter sites. As a guide, the lowest recommended rate of flowable simazine is two litres (1kg active) ingredient), the highest rate recommended is 5 litres (2.5kg active ingredient) per hectare. Higher soil pH increases the residual life of Simazine.

Rates of 0.5-2 l/ha of Glyphosate have been used, rates of determined be weed type and size. Follow the label direction to determine rates for local conditions.
Knockdown chemicals must be applied in good weather conditions. Ensure that the dew has dried before starting to spray and do not apply if rain is likely within two hours of completion of spraying.

To overcome antagonism between chemicals and maintain the effectiveness of the Glyphosate the addition of sulphate of ammonia is recommended. The sulphate of ammonia is added at 2% volume per volume to the tank mix. Boost, Liaise and Ammo are commercial preparations, or your can prepare your own (2% v/v of a 2% wt/vol solution of sulphate of ammonia.) eg. For a 1000 l spray tank, need either 20 litres of Boost, Liaise or Ammo or 400g sulphate of ammonia dissolved in 20 l of water.

The residual chemical can be topped up later in the season if weeds like ryegrass are expected to germinate late. This can be sprayed over the seedlings., and can be applied even in light rain. Do not overspray trees in warm weather.

Many other herbicides have been without adversely affecting trees but are unlikely to be as reliable or cheap as this mix.

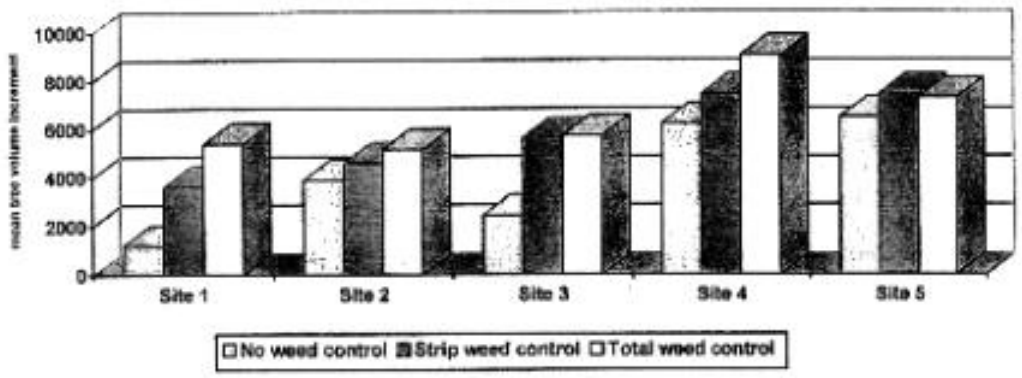
8. Chemical-weed control - Post emergent- Post planting
Sometimes the initial period of weed control is unsuccessful and weed control is needed to prevent competition with seedlings in the late spring period. Grass selective herbicides appear to be safe over oil mallees. Note that excessive use of grass selectives may cause herbicide resistance to develop in Ryegrass.

The broad leaf herbicides are undergoing additional trial work for overspraying at the moment. Lontrel has been used without problems. Results of this work will be issued as soon as available.

6.5.2.4 Second Year Weed-Control

Discussion
There is evidence that weed control in the year after planting is beneficial in some instances (See Ray Fremlin's graph below). Initial establishment remains the most important factor in weed control. Do not rely on second year weed control to patch up a poor first year job. The weed control in the first year will determine survival.

Response to second year weed control *E. globulus* on different soils.



Site 1	Quartz grit over sandy loam
Site 2	Deep leached sand
Site 3	Yellow sand over lateritic gravel
Site 4	Gravelly sandy loam over clayey loam
Site 5	Sandy loam over clayey loam

Second year weed control is recommended in all pine plantations and in *E. globulus* plantations that have not performed well in the first season. The slow growth rates of oil mallees compared to *E. globulus*, and the low rainfall where we are establishing these trees suggests that the oils will benefit considerably from second year weed control.

Second year weed control will achieve optimum results if the treatment is applied in May or June. Treatment of pasture weeds after the end of August is usually a waste of resources.

6.5.2.5 Second Year Weed Control Options - Non-Chemical

9. Mechanical

Timely cultivation between rows of oil mallees can eliminate a good percentage of the weeds and reduce competition. This will be better suited to some soils types than others. Good results have been observed in gravel soils. There will still be weeds against and between the trees and these may need to be sprayed out if they are considered to be a source of noxious weed seed likely to impact on crops in the adjoining paddocks. Radish is a good example of this.

6.5.2.6 Second Year Weed Control Options - Chemical

10. Pre-emergent

Overspraying with Simazine up to 5 l/ha is possible over 1 year old oil mallees as a general purpose weed control. This rate must be adjusted in line with soil type and rainfall. Do not overspray in hot weather.

11. Post emergent
Once weeds have germinated, Simazine will have no effect and the choice of chemicals is limited.

Grass selective chemicals such as Verdict, Fusilade and Sertin will eliminate most of the grasses. Bladex and Lontrel will work on most of the broad leaf species. Do not use any wetting agents when overspraying. Do not use Lontrel if the temperature is above approx 20-22°C.

6.5.2.7 Spraying Alleys for Cropping

Spraying for cropping may have an adverse affect on oil mallees through drift contact or root absorption. See the management section of this management.

6.5.2.8 Integrated Weed Management

The aim of integrated weed management (IWM) is to apply a combination of options for controlling weeds with the objective of reducing the reliance on herbicides. IWM does not mean the replacement of herbicides with other techniques, although there are some examples where this has been the case.

Examples of IWM in plantation forestry include the use of grazing and scalping to reduce or eliminate the use of knockdown herbicides and reduce the rates of residual herbicides.

Cultivation alters the weed spectrum, and timing of cultivation has been shown to be important to prevent weed development to the extent that on some soil types only very low rates of residual herbicide are required to provide weed free conditions around the tree.

Pasture topping in the season prior to plantation establishment has been shown to reduce seed loads of rye grass which could eliminate the need for post-plant applications of herbicide.

Attention to detail with site preparation will provide an environment that enables maximum tree growth, such that the need to apply herbicides in the second season after planting can be reduced or eliminated.

PAPERS ATTACHED
Herbicide recommendations for use in *Eucalyptus globulus* plantations in Australia.