

What is thinning?

Thinning is the selective removal of some trees from a stand. This is done because trees compete with each other for three basic resources, light, water and nutrients. Thinning reduces competition and provides more resources for the retained trees. Thinning can either be non-commercial or commercial. Early thinning removes smaller, shaded, poorer formed trees which have little or no commercial value. The trees are thinned to waste. Non-commercial thinning prepares the stand for later commercial thinning. A commercial thinning is where the value of the trees is higher than the cost of harvesting and transporting the wood to the market. Several thinnings may occur, both non-commercial and commercial over the life of the stand.

In plantations grown for solid wood, establishing more trees (800 – 1,200 trees/ha) than are required at final harvest (100 – 300 trees/ha) enables the manager to fully occupy the site with trees at an early age, thereby reducing competition from weeds. It also allows selection of the very best trees for the final crop. Thinning is not often conducted in industrial plantations grown for pulpwood over a 10 – 20 year rotation in Australia.

In most native forest systems, the forest self-thins. The suppressed trees progressively die and stocking may decrease from several thousand trees/ha at regeneration to less than 100 trees/ha at harvest at 80 – 120 years. However some native forest is now thinned in much the same way as plantations to increase production of solid wood.

Some points about thinning

- Seek professional advice - different stands need their own thinning regimes.
- Several thinning operations may occur during the life of the stand.
- Successive thinnings are usually at least 6 years apart.

Why thin?

- Concentrates growth and value on remaining better formed and spaced stems.
- Reduces potential death of trees due to competition from neighbours.
- Thinned trees can be sold - a commercial thinning.
- If done when trees are young, say less than 10 years, thinnings are not saleable making the thinning non-commercial, but the cost is often outweighed by the expected increased revenue when the remaining trees are sold.

It can be seen in **figure 1** that as the thinning intensity increases, the diameter growth of the best 200 trees in the stand also increases. At age 13 years, in the stand thinned to 200 trees/ha, trees increase in diameter by 1.5cm per year (cm/yr) compared with only 0.5cm/yr in the unthinned stand. The resources released at thinning have been concentrated on fewer trees and have added quality and value to the stand. Their higher growth rate means that an earlier final harvest or commercial thinning is possible.

When to thin

The time of thinning is determined by the products to be grown. When thinning is commercial, between 70 and 200 tonnes wood/ha will be removed from plantations of 20ha or greater. If very large fat logs are to be produced thinning will be more intense than for production of a higher number of smaller sized logs. It can be demonstrated that competition may be present from a very early age. Thus trees may respond to thinning in the first two to three years after establishment. If maximising growth was the only objective, frequent thinning coinciding with the onset of competition would be necessary. In practice, thinning regimes are developed to produce predetermined log sizes or to allow a combination of benefits to accrue during the life of the stand.

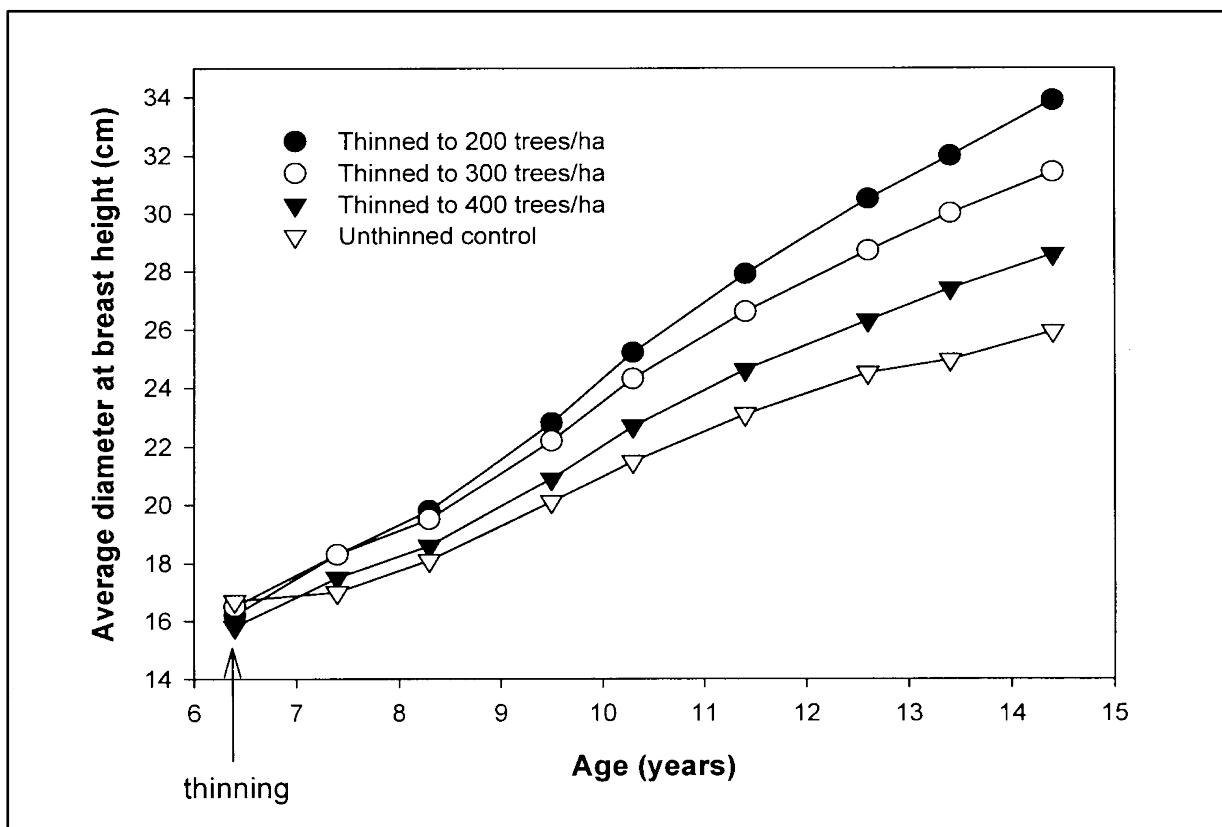
Two examples of regimes are presented here:

- Thinning in pruned plantations, and
- Thinning in native forest.

For thinning regimes for shelterbelts see *Information Sheet No 2 - Farm Shelter*. Consult Private Forests Tasmania for advice on a thinning regime which is suitable for your stand and meets your financial and other objectives.

Figure 1: Thinning response in a plantation of *Eucalyptus nitens*.

The stand was thinned at age 6 years. The response is shown by tree diameter growth measured at breast height over bark (DBHob at 1.3m height above ground) of the best 200 trees in four treatments. Note that one stand was thinned to 200 stems/ha. The unthinned stand initially had 900 trees/ha though self-thinning had reduced its stand density to 725 stems/ha at age 13 years (Gerrand et al. 1997, Medhurst unpublished data). Similar responses are observed in *Pinus radiata*.



Which trees should be thinned?

- Remove poorly formed, forked or diseased trees first, then the smaller trees.
- Maintain an even spacing between the remaining trees for equal light, soil moisture and nutrient allocation.
- Don't over thin - the remaining trees may bend or blow over.
- For commercial thinning, a row of trees (out-row) may be removed to assist with machinery access.
- Thinning and pruning must be considered together. Avoid thinning out trees that have been pruned - the pruning effort will be lost. Thinning should be done just before or just after pruning.

Thinning in a pruned plantation

Indicative ages and rules for pruning pine and eucalypts to 6 metres are described in *Information Series No 7 - Pruning*. The table below (**Table 1**) provides a thinning regime to match this pruning schedule.

The regime in **Table 1** was developed for stands of *E. nitens* and *E. globulus* (modified from Gerrand *et al.* 1997) but is also suitable for *P. radiata*. For slower growing pines and blackwood, it may be necessary to wait longer before thinning can commence but the same rules can be followed.

The regime includes one non-commercial and one commercial thinning. The non-commercial thinning removes any large competitors adjacent to trees selected for pruning, and at the same time provides more even spacing between large trees. Suppressed or poorly formed trees unsuitable for commercial thinning are also thinned to waste. These trees decay rapidly. The commercial thinning concentrates the returns in one operation. At 10 to 15 years the average tree size is about 18m high and 18cm DBHob, suitable for pulpwood and poles.

An alternative strategy is to conduct one non-commercial thinning then two commercial thinnings, one at 10 to 12 years, and one later at around age 20 years. Trees at second thinning will have a higher value if markets other than pulpwood are available. One advantage of two thinnings is that the stand is opened up less drastically on each occasion and therefore is less prone to windthrow. More trees should be harvested in the first than the second thinning because susceptibility to windthrow increases as the trees grow taller.

Table 1: Indicative ages and stand conditions for thinning in a pruning regime on high quality sites.

Thin at age (years)	Stand Conditions	Operation
5 to 6	<ul style="list-style-type: none">• 800-1,200 trees/ha• 250 pruned trees/ha• DBHob of pruned trees 11-13cm• Height of tallest trees greater than 12m	<ul style="list-style-type: none">• Selectively thin to waste (using chainsaw or chemical injection) trees competing with the pruned trees and suppressed stems.

		<ul style="list-style-type: none"> Retain 750 trees/ha including 150-250 pruned trees/ha.
10 to 15	<ul style="list-style-type: none"> Standing volume 150-300m³/ha 	<ul style="list-style-type: none"> Commercially thin 90-180m³/ha for poles or pulpwood. Retain 150-250 pruned trees only.
35 to 50	<ul style="list-style-type: none"> Average DBHob 45-60cm 	<ul style="list-style-type: none"> Clearfall for solid wood products.

Thinning in native forest

Four types of thinning have been identified by Sustainable Timbers Tasmania (Forestry Tasmania 1998). See **Table 2**. These are designed to reduce tree stocking without inducing regeneration. Either early age (5 to 15 years) or mid-age (15 to 25 years) spacing is usually applied to overstocked stands. These are non-commercial. This is followed by one of two commercial thinnings at 25 to 40 years or greater than 40 years. There are 90 to 250 trees/ha left for a final harvest.

How to thin

How your stand is thinned will depend on the size of the trees and if the thinning is commercial or to waste.

Outrows

Access to plantations and native forest is essential for commercial thinning operations. In mechanical harvesting systems, the occasional row of trees (called an outrow) is removed to provide this access. In plantations, particularly those that have been pruned, ideally every 4th or preferably 5th row is removed. 3rd row outrows are undesirable in stands managed for solid wood as they remove too many trees of good size and form (outrows should be selected prior to pruning as trees in this row will not be selected for retention).

In native forest the trees are not in rows. In cable thinning operations, outrows have a width of approximately 5m and the machine has a reach of 15m either side of its centre. Outrows should be placed accurately and at right angles to the contours to facilitate controlled removal of logs.

Commercial thinning

Two approaches are used, either ground-based or cable thinning. Ground-based operations are done on slopes of up to 25%, often by an excavator with a reach of approximately 8m. Cable thinning can be done on steeper slopes. Both systems are suited to commercial thinning. From the outrow, the machine or cable can remove selected trees from each side of the outrow. Some machines can remove bark and cut the log to lengths at the stump, while other machines need to carry trees out of the stand for processing. In native forest, logs are often pulled or taken out of the forest along snig tracks. These are usually straight and have a similar function to outrows. Consult Private Forests Tasmania for advice on approaches that are suitable for your forest.

Waste or non-commercial thinning

Waste thinning can be done by a chain saw or even ground-based machinery but increasingly chemical means are used as they are the most cost effective, produce manageable slash and minimum damage to retained trees. The preferred method is stem injection of a suitable herbicide. Glyphosate is recommended and hand-held devices attached to a backpack are commercially available. The amount of chemical required to kill the tree increases with tree size. With glyphosate 360, it is given in 1ml hits per 5cm of DBHob at injection points placed evenly around the stem.

Table 2: Indicative ages and criteria for thinning in native forest.

Where < is less than, and > is greater than

Thin at Age (years)	Type of thinning	Stand conditions	Operation
5 - 15	Early age spacing DBHob <20 cm	>2,500 trees/ha	Selectively thin to 800-1,100 trees/ha co-dominant and dominant trees
15 - 25	Mid-age spacing	>1,500 trees/ha DBHob >5 to <30cm	Selectively thin to 500-700 trees/ha co-dominant and dominant trees
25 - 40	Commercial thinning	>500 trees/ha DBHob 20-25cm to >40 cm	Selectively thin to 100-250 trees/ha
> 40	Mature age commercial thinning	>100 trees/ha DBHob 30-40cm to >40cm	Selectively thin to 90-110 trees/ha

Damage from thinning

Damaging the stem or the crown of crop trees during the thinning operation will reduce the quality (and value) of the thinned stand. For this reason, the utmost care needs to be taken to minimise damage at thinning. Bark damage provides an entry point for wood decay pathogens and crown damage will reduce a tree's ability to respond to thinning. Damage can occur when falling trees, and in the case of commercial thinning, when removing the logs from the stand. Damage can be minimised by:

- directionally falling trees to avoid crop trees; and
- if commercially thinning, falling trees in a pattern to make collection by a harvesting machine or removal by cable easy.

Watch out for!

- Do NOT damage any remaining trees when falling or removing thinned trees from the stand.
- The dead branches and stems following thinning can cause a fire hazard once dry - maintain adequate firebreaks around the block and avoid burning nearby. Livestock can be forced to graze green radiata pine needles without ill effect.
- To get best results, the remaining stem growth should be monitored.

Cost

For waste thinning, the cost has to be borne by the owner and traded off against an early thinning response and being able to both commercially thin and to harvest the final crop sooner.

For commercial thinning, the volume removed must more than offset the cost. Income in mid-rotation offsets the silvicultural costs that have been borne to that date as well as increasing the value of the retained trees from the thinning response.

Table 3: Labour requirements to thin a stand (at about 5-10 years).

Average tree diameter (cm)	Number of trees felled	Hours Required (man-hours per hectare)	
		Easy conditions	Difficult conditions
14	300	5	8
	500	7	12
18	300	4	7
	500	8	13
22	300	4	7
	500	8	14

REFERENCE

Gerrand, A.M., Neilsen, W.A. and Medhurst, J.L. (1997) - Thinning and pruning eucalypt plantations for sawlog production in Tasmania. *Tasforests* 9, 15-34.

MacLaren, J.P. (1993) - Radiata pine grower's manual. FRI Bulletin No 184. New Zealand Forest Research Institute.

Sustainable Timbers Tasmania, Forestry Tasmania (1998) - Thinning regrowth eucalypts. Technical Bulletin No. 13. 60 pp.

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