CHAPTER 7 - PRUNING AND THINNING

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Pruning

In order to produce clearwood, branches must be removed from the first six-eight metres of the eucalypt tree bole. There is a perception that eucalypts are self-pruning, but this is true only of naturally regenerating stands with an initial stocking rate in the order of 20,000 stems/ha. In planted stands with standardised spacing (1,111 stems/ha), most of the lower branches are retained. At 2,000 stems/ha branch size is severely restricted and reduces, but does not eliminate the need for pruning.

Pruning for clearwood should be done at regular intervals. Branches should be removed before their diameter exceeds 2.5 cm. Form pruning to remove forks and ramicorns should also be carried out while they are young and on a regular basis (this is most likely to be required in *E. fastigata* and for some stringbarks). Because the danger of fungal infection through cut surfaces is very real, pruning should only be done in fine weather. This will allow the stubs to dry out quickly and will reduce the probability of spore germination and penetration. It is most important that any unusually large and steep-angled branches above the pruned height are removed.

Sawing studies with *E. nitens* in Tasmania have concluded that pruning is essential for production of timber with high-quality appearance. Also in Australia, it has been shown that tree growth is reduced if more than 40% of the green crown is removed during pruning. Removal of less than 50% of the green crown did not affect tree dominance, but other studies have suggested that dominance may be reduced by frequent pruning. South African work indicates that no more than 33% of the green crown should be removed.

In Tasmania it was found that rapid occlusion of the pruned branch stub decreases the risk of infection of the pruning wound. Elsewhere it has been reported slightly higher decay levels may result from pruning during spring and summer than pruning in autumn or winter.

A New Zealand study has shown that decay within the stem progresses upwards and downwards as well as inwards towards the pith. No outward movement towards the wood laid down after pruning was detected. Rot-causing organisms entering through the pruning wound are likely to stay within the defect core and it is important to ensure that this core is kept as small as possible.

Well pruned *E. globoidea* tree, Canterbury

E. pilularis, Bay of Plenty

Excellent pruned and thinned *E. fastigata* stand, Poverty Bay

Some factors affecting branch control and defect core in *Eucalyptus saligna*

Branch growth and development in 10- to 12-year-old *E. saligna* was examined for three silvicultural systems, i.e., pure plantations, mixed plantation with radiata pine and group plantings in indigenous scrub. Although some suppression of branch growth was evident, differences within and between silvicultural systems were confounded by age, site, and fertiliser effects and it was not possible to ascribe these differences to tree or stand parameters. For *E. saligna,* branch control by natural branch shed (self-pruning) will apparently be insufficient in each of the three silvicultural systems studied to obtain a branch-free length of bole in which the defect core is confined within a central (brittle heart) core of wood weakened by growth stresses. Artificial pruning must remain the final means of ensuring that the defect core is contained within the brittle heart core for trees grown in intensively managed plantations.

The rapid height growth rate of *E. saligna* in many New Zealand plantations suggests that pruning lifts to the desired log length could be carried out less frequently than is current practice for radiata pine. Single-lift pruning to log length may even be feasible. Further critical evaluation of single-lift pruning could yield considerable practical and economic advantages.

Source: Glass 1985

E. nitens pruning study

In 1992 a trial was established on farmland at Millers Flat, Central Otago, comparing the effect of initial stocking on quality of *E. nitens* crop trees and the effect of pruning frequency and intensity on stem diameter over stubs (DOS) and tree growth.

Treatments applied in a factorial design were:

(i) Stocking/thinning: Trees were planted at rates of 600 or 300 stems/ha, then thinned to 200 stems/ha by age 4 years, and to 100 stems/ha by age 5-7 years.

(ii) Pruning frequency and intensity: Trees were pruned either annually or biennially from either age 3 (radical pruning) or age 4 (conservative pruning) until age 7. Biennial radical pruning took place in years 3, 5 and 7; biennial conservative pruning in years 4, 6 and 7.

Additional treatments established on a less productive site at the edge of the trial area were:

(iii) Trees planted at 600 stems/ha and subjected to the conservative biennial pruning regime but no thinning.

(iv) Trees planted at 300 stems/ha and thinned to 70 stems/ha.

Results at age 9 years

- Conservative pruning had no detectable effect on tree growth.
- Radical pruning reduced growth but recovery was usually apparent during the subsequent year.
- Radical annual pruning caused the loss of one year's growth when compared with conservative biennial pruning.
- Radical annual pruning was the only pruning treatment that caused a growth loss when compared with Treatment (iii).
- No difference in tree size was observed between thinning treatments.
- In unthinned plots, competition reduced stem diameter growth after age 6.
- Height growth was greater in unthinned plots.

Source: Hay *et al.*, 2007

Thinning

The number of trees planted and grown to harvest must be related to the product required. An initial stocking rate of 1,111 stems/ha is suitable for most purposes. This is high enough to allow for some establishment failures, as well as the culling of individual substandard trees. Management of stands for sawn timber or veneer will be different from that suited to pulpwood production.

Stands of *E. nitens*, *E. regnans* and *E. fastigata* grown for pulpwood (maximum stand wood volume) on a 10-15 year rotation do not require thinning. A regime suited to pulp production could involve the planting of 1,000 stems/ha with no further treatment apart from application of fertiliser, until clearfelling at age 12-15 yrs. Studies from Kinleith forest indicated 70% of the basal area is accumulated by the top 300 stems/ha from a stand with stockings around 1,000 stems/ha. This means a large proportion of the stand is not contributing to stand productivity.

For sawlog production one or more thinnings are required to reduce the stocking rate to levels that will enhance growth of individual stems. The first thinning to waste at about age five can remove unthrifty and malformed trees. Subsequent thinnings follow selection criteria for crop trees (spacing, form and size). For long rotations (40-50 years) to produce very large trees, low stockings (around 100 stems/ha) are best, while medium stockings (200-300 stems/ha) should produce sawlogs on a medium-length rotation (25-30 years).

Thinning is usually timed to coincide with canopy closure i.e. as soon as the crowns of the trees begin to touch each other. Stems grow more evenly in an open stand; close proximity can lead to tree suppression or death.

Growth response of *Eucalyptus regnans* dominant trees to thinning in New Zealand

Quarter-sawing helps to reduce drying degrade in *E. regnans*, and large sawlogs with a minimum small-end diameter of 40 cm are recommended in order to use this technique. The growth rate of dominants will determine the time taken to grow trees capable of producing these large logs.

A trial with initial stockings of 2,500, 1,111, and 625 stems/ha, thinned between ages 5 and 12 years, with two unthinned treatments, was analysed at age 19 years to determine the effect of stocking on growth of dominant trees. Stocking was not the main influence, although diameter of dominant trees tended to be greater in treatments with lower initial and final stockings.

Source: McKenzie and Hawke 1999

Branching patterns and knot defects in *E. regnans* second logs

In order to increase understanding about the effect of tree spacing on branch characteristics and therefore on stemwood defects, data were collected from *E. regnans* stands growing at three sites in the North Island. The stands were aged between 12 and 22 years and represented a range of final crop stocking (50-1,500 stems/ha) and stand management regimes (untended, pruned and thinned). Intensive examination of 73 trees across ages and sites focussed on the portion that would produce the second log, i.e., stem height 6-12 m.

Branching data were obtained by climbing or from felled trees. Each branch and each outwardly visible defect related to branching was classified as live branch, dead branch, partly occluded branch stub, occluded branch stub, or trace. Branch diameter and angle and the height and location of each defect on the stem were recorded.

Destructive sampling of 12-year-old trees confirmed that nearly all defects visible on the outside of the stem were associated with an internal wood defect.

The number of branches (average 55 per 6 m log length) was consistent over five of the six stocking levels investigated and it was concluded that stocking rate did not influence branch initiation. However the type of defect was affected by stand treatment, the number of dead branches, partly-occluded branches and traces all varying significantly. Australian reports of eucalypt crowns containing a mixture of both live and dead branches were confirmed for *E. regnans* under New Zealand conditions.

Although the size of both live and dead branches was influenced by stand stocking rate, larger branches at lower stockings, the relationship with stem diameter at breast height (1.4 m) was much stronger, with larger trees having larger branches. Growth models based on stem diameter were developed as a basis for prediction of mean branch diameter (live and dead branches). Branch Index, (defined as the mean diameter of four branches selected as the largest in each radial quadrant of the stem), branch basal area (particularly total branch basal area/tree) and crown length also showed a strong relationship with stem diameter.

Graphic analysis showed a pattern of branching in which clear lengths of stemwood are formed longitudinally and radially between knots. No regular pattern was apparent.

A Clear Length Index (CLI) was used to assess and compare the length of stem between branch defects. At a height of 6-12 m, 82% of the stem was found to be free of all defects and 95% was free of branch-related defects. Trees from stands with a higher mean stem diameter tended to have greater lengths of clear stem at this level. Use of the AUTOSAW computer model to simulate sawing of the 6-12 m log indicated that the relationship between percentage of defect-free lengths and mean stem diameter of the tree stand was not particularly strong.

The clear wood sheath over an occluded branch stub was usually wider for smaller branches.

Conclusions

- Second log pruning is strongly recommended for *E. regnans*.
- Branching characteristics of *E. regnans* can be used in the evaluation of trials aimed at improvement of timber quality.
- Silvicultural regimes for *E. regnans* should be aimed at growth of large logs rather than the restriction of branch growth.

Source: Nicholas 1999

Recommended regimes

A proposed silvicultural schedule with three pruning and two thinning operations (Table 15) is based on an initial stocking of 1,000 stems/ha, allowing for adequate final crop tree selection. Table 16 provides a simpler and more direct regime recommended for *E. regnans*. It may also be applicable to similar fast growing eucalypts of good form.

Table 15: Proposed conservative silvicultural regime for eucalypt sawlogs (initial stocking 1000 stems/ha)

Predominant Mean Height (m)	Pruned height: (m)	Stems/ha	Thin to: (stems/ha)
7	2.5	500	*
10	4.0	250	500
14-16	6.0-8.0	200	200

Source: Hay *et al*, 2005

*At this stage a "thin from below" to remove seriously malformed and small trees may be applicable. Depending on form, a form prune may also be warranted.

Table 16: Proposed direct silvicultural regime for *E. regnans* sawlogs (initial stocking 800 stems/ha)

Age (years)	Pruned height (m)	Stems/ha	Thin to (stems/ha)
6	6.0	200	200
10	10	200	

Source: Nicholas,1999

Depending on form, a form prune may also be warranted.

Pruning of eucalypts should be undertaken during periods of dry weather as a precaution against the entry of *Chondrostereum purpureum* (silverleaf) through the pruned branch stub. It is also important at each pruning lift not to remove more than 40% of the green crown.

For timber production, a large, fast-grown tree and quarter sawing can minimise the effect of internal growth stresses on conversion and on board degrade. To allow for quarter sawing, logs should be large with a minimum small-end diameter of ca. 40 cm.

Key Points

- Eucalypts require pruning for clearwood production.

  No more than 40% of the green crown should be removed during pruning.

- Pruning should be done in dry weather to minimise entry of decay organisms.
- Thinning regimes will vary with end-product (sawlogs, veneer, pulpwood).
- Final crop stocking of 200 stems/ha is recommended to produce large diameter butt logs.

Suggested reading:

Gerrand *et al.* 1997

Hay *et al.* 2005

McKenzie & Glass 1989

McKenzie & Hawke 1999

Mohammed *et al.* 2000

Nicholas 1992

Nicholas 1999

Pinkard & Beale 1998, 2000a &b