

— POSTER —

Changes in Crown Productivity and Stem Growth of *Eucalyptus nitens* in Response to Green Pruning

L. Pinkard, C. Beadle, N. Davidson and M. Battaglia

Cooperative Research Centre for Temperate Hardwood Forestry, Locked Bag 2, Sandy Bay, 7004, Australia.

Introduction

Eucalyptus nitens is grown extensively for pulpwood in south eastern Australia. Its usefulness for sawn timber production is lessened by retention of dead lower branches, a trait resulting in an increased likelihood of undesirable timber qualities such as a large knotty core, loose knots and fungal damage. Green pruning has been used to overcome these problems in other species (Luckhoff, 1967; Sutton and Crowe, 1975). As green pruning inevitably results in a reduction in the photosynthetic capacity of the crown, the pruning regime adopted should be designed to ensure rapid recovery of growth (Luckhoff, 1967): inappropriate pruning regimes may significantly decrease growth (Karani, 1975; Dakin, 1982; Majid and Paudyal, 1992). The purpose of the work described here was to determine the growth responses of moderately or severely pruned *E. nitens*, and to explain these responses in terms of changes in crown productivity. The results will be used to prescribe pruning regimes for this species.

Methods

Three-year-old *E. nitens* (mean height 8.8 metres) were subjected to either moderate (50%) or severe (70%) lineal green crown removal, or were left unpruned. All pruning was from below. Diameter, height, green crown

length and dominance status were measured prior to pruning and at 3-monthly intervals following pruning. CO₂ assimilation rate was measured in different canopy zones of 9 trees, using an Analytical Development Corporation LCA2 infra-red gas analyser (open flow system) with a leaf chamber illuminated at a photon flux density of 660 mmol m⁻² s⁻¹. Measurements were made at monthly intervals on 3 leaves in each zone on the northern (sun) side of trees. At the same time, foliar N concentration and stem taper were measured.

Results

50% lineal green crown removal did not affect the growth of *E. nitens*. As little as 2 months after pruning, however, 70% defoliation had resulted in significant decreases in mean height and diameter increment, which were still apparent after 10 months. The effect was more pronounced on diameter than height (Fig. 1). No changes in dominance or stem taper were observed during this period.

Maximum CO₂ assimilation rate of the remaining canopy of all pruned trees exhibited a gradual increase. Significant differences appeared earliest in the oldest leaves. After 10 months, significantly greater photosynthetic rates were measured in most zones of both pruning treatments (Fig. 2). Quantum efficiency was not affected.

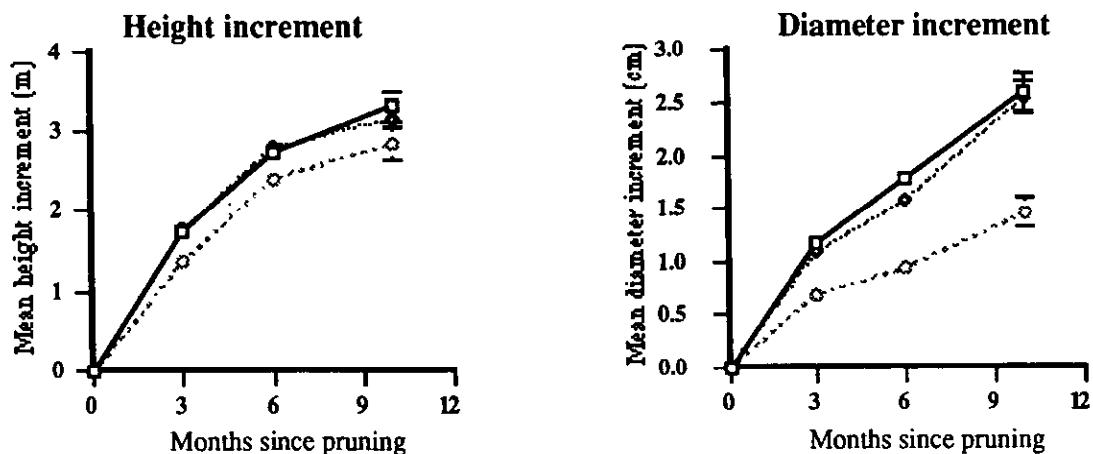
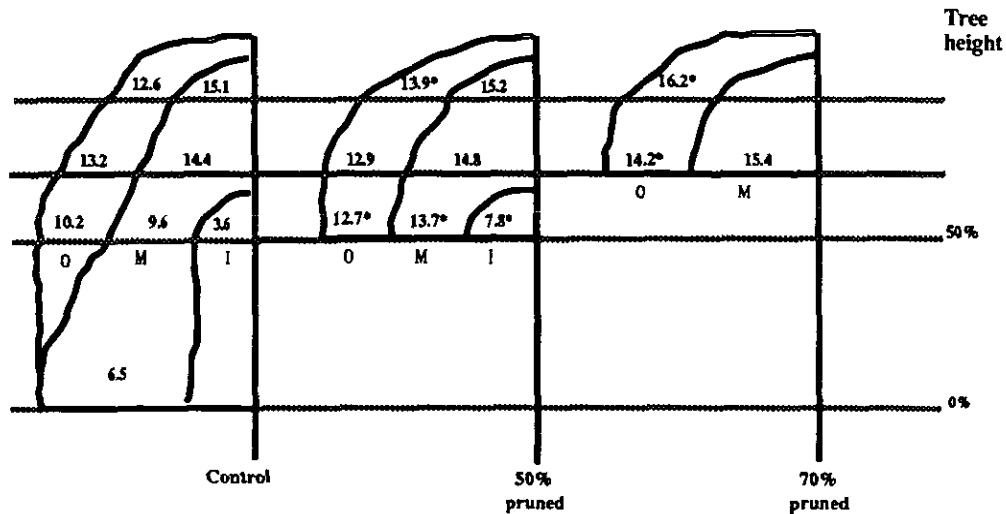


Figure 1. Mean height and diameter increment following pruning.
 □ = unpruned; ◇ = 50% pruned; ○ = 70% pruned

Figure 2. Mean photosynthetic rate ($\text{mmol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$) measured at a photon flux density of $660 \text{ mmol m}^{-2} \text{ s}^{-1}$, in leaf zones of pruned and unpruned trees, approximately 10 months after pruning. I=inner (old) zone, M=middle (mature) zone, O=outer (apical) zone. * indicates values differ significantly from those recorded in the control.



There was no corresponding change in foliar N concentration or in nitrogen-use efficiency.

Mean crown length of unpruned trees increased by only 1 m over the 10-month period because natural crown lift occurred at a rate similar to height growth. Over this period, canopies of 50% pruned trees doubled in length, and those in the 70% treatment trebled in length.

Discussion

E. nitens can withstand more intensive pruning than other species, many of which exhibit significant growth losses following removal of between 20 and 40% of the green canopy (Sutton and Crowe, 1975; Karani 1978; Dakin, 1982; Majid and Paudyal, 1992). *E. nitens* is a fast-growing species, and can quickly increase canopy length and hence leaf area following pruning. This, coupled with the increased photosynthetic rates measured in the canopies of pruned trees, may explain the absence of reduced growth with up to 50% lineal green crown removal. There may, however, be longer-term effects on dominance.

The photosynthetic response measured in this experiment is one commonly reported following partial defoliation (Trumble *et al.*, 1993). The lack of a relationship between photosynthetic rate and N content suggests that N was not a factor influencing this response. As has been suggested by many authors, the photosynthetic response may have been due to altered source/sink relationships (Wareing and Patrick, 1975; Trumble *et al.*, 1993). This is presently being investigated.

Acknowledgements

This research was funded by the Forest and Forest Industries Council of Tasmania.

References

- Dakin, A. J., 1982. Pruning trial with Sugi. *New Zealand Journal of Forestry*, 27(1): 89-100.
- Karani, P. K., 1978. Pruning and thinning in a *Pinus patula* stand at Lendu Plantation, Uganda. *Commonwealth Forestry Review*, 57(4): 269-278.
- Luckhoff, H. A., 1967. Pruning of *Eucalyptus grandis*. *Forestry in South Africa*, 8: 75-85.
- Majid, N. M. and Paudyal, B. K., 1992. Pruning trial for *Acacia mangium* Willd. plantation in Peninsular Malaysia. *Forest Ecology and Management*, 47: 285-293.
- Sutton, W. R. J. and Crowe, J. B., 1975. Selective pruning of radiata pine. *New Zealand Journal of Forest Science*, 5(2): 171-195.
- Trumble, J. T., Kolodney-Hirsch, D. M. and Ting, I. P., 1993. Plant compensation for arthropod herbivory. *Annual Review of Entomology*, 38: 93-119.
- Wareing, P. F. and Patrick, J., 1975. Source-sink relations and the partition of assimilates in the plant. *Photosynthesis and productivity in different environments* Ed. J. P. Cooper. Cambridge University Press, pp.481-499.