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COPPICING OF *EUCALYPTUS FASTIGATA* AND THE HYBRID *EUCALYPTUS GRANDIS* X *E. NITENS*

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RESEARCH REPORT

A. COPPICING OF *E. FASTIGATA*

INTRODUCTION

E. fastigata is part of the ash group of eucalypts. It has good solid wood and pulp properties and was incorporated in the New Zealand Eucalyptus improvement programme in the late 1970s (Burger 1990, Kibblewhite and McKenzie 1998).

There is very little mention of coppicing, or vegetative propagation in general, for *E. fastigata* in the scientific literature. Indeed, it is difficult to obtain good rooting with *E. fastigata* cuttings and it appears that cuttings propagation of this species has been abandoned by other organisations. However, we decided to trial starving the stock plants, a method that has proved successful in improving rooting of *E. nitens*, another species that is difficult to propagate via rooted cuttings.

METHODS

Raising of Stock Plants

The stock plants were healthy, 1.5-year-old *E. fastigata* seedlings grown in 10-litre pots. On 23 October 1996, they were cut back to 3-5 cm stumps. Two propagation environments and two nutrient treatments were tested. Twenty-eight of the seedlings were placed into a polythene house and 28 seedlings were transferred outside. Twenty seedlings in each environment were starved and eight were nutrient-fed (control).

On 29 October 1996, leaf shoots started to appear and the control plants were fertilised with Thrive (10 grams per 10 litres of water). On 10 December, iron chelate (at 2 grams per 10 litres) was applied to all seedlings (0.5 litres solution per seedling). Control seedlings were topdressed with 3 grams per seedling of Nitrophoska Blue. On 1 February 1997, control seedlings were given 1 litre of Thrive solution per pot (10 grams of Thrive per 10 litres of water) plus 3 grams Nitrophoska Blue per pot.

Collection of Coppice Shoots and Rooting of Cuttings

On 25 April 1997, the number of useable cuttings per stock plant were counted. For the starved treatment, a total of six cuttings per stock plant were set as clones. For the control, all the cuttings obtained were set as clones. The cuttings were set in BCC-150 containers, with 3 peat: 2 coarse pumice media, and under polythene in a glasshouse with temperature maintained between 10°C minimum and 22°C maximum. The cuttings were misted once a day by hand.

On 18 September 1997, cuttings were assessed for rooting. Analyses of variance were undertaken to test the significance of the two different nutrient treatments in the production of useable cuttings and subsequent rooting.

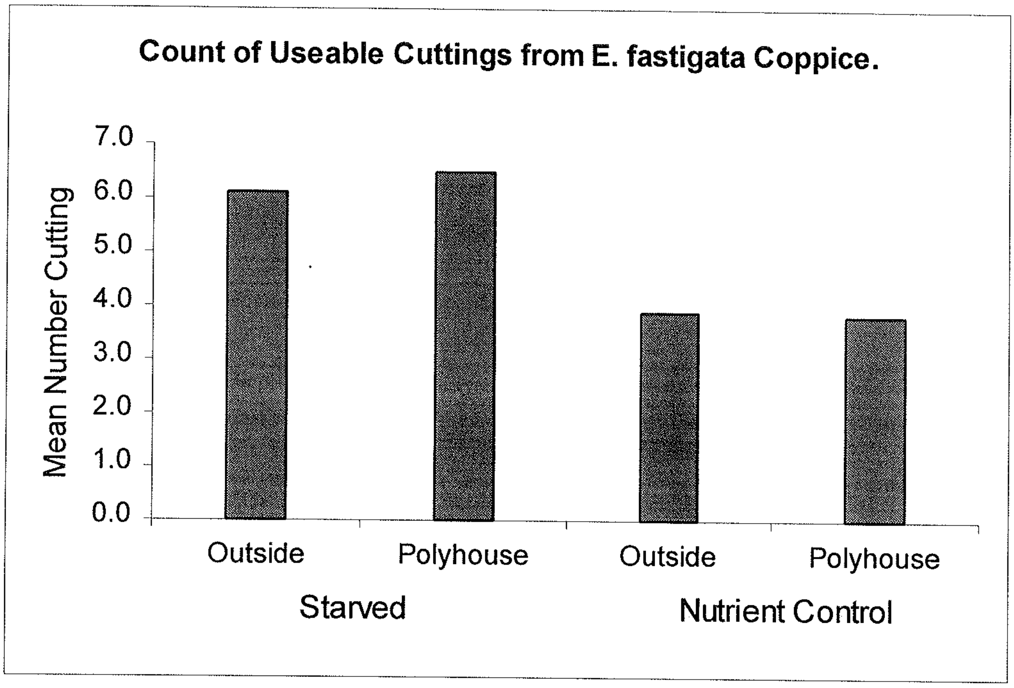
RESULTS AND DISCUSSION

The numbers of useable cuttings obtained from coppice of topped seedlings are given in Table 1. Means, standard deviations and the ranges have been calculated for the two different environments and the two different nutrient treatments. The data are summarised in Figure 1. It is clear that starving the stock plants results in better production of useable coppice, with an average of 6.3 cuttings for the starved stock plants compared with an average of 3.8 cuttings for the control (statistically highly significant, $p < 0.0001$). It must be noted that some stock plants produced low numbers (2 or 3 cuttings) no matter what treatment they were subjected to. The propagation environment (outside or in a polythene house) proved to have less effect on coppice production and was not statistically significant.

Table 1. Count of Useable Cuttings from *E. fastigata* Coppice

	Starved		Nutrient Control	
	Outside	Polyhouse	Outside	Polyhouse
	6	7	4	3
	8	6	3	3
	3	3	6	5
	5	8	2	2
	2	8	6	4
	8	7	3	4
	7	8	3	6
	7	9	4	3
	7	4		
	8	8		
	10	7		
	9	5		
	6	10		
	3	6		
	7	8		
	4	7		
	11	3		
	3	6		
	2	3		
	6	6		
Mean	6.1	6.5	3.9	3.8
Std Dev	2.6	2	1.5	1.3
Range	2–11	3–10	2–6	2–6

Figure 1. Count of Useable Cuttings from *E. fastigata* Coppice.



With the rooting of the cuttings, the better treatment was the starving of the stock plants. Cuttings from coppice of starved stock plants had 31% and 40% rooting for the two different growing environments; while cuttings from the coppice of the nutrient control had 18% and 14% rooting for the outside and polyhouse environments, respectively (Tables 2a and 2b).

Table 2a. Rooting of *E. fastigata* Cuttings from Starved Stock Plants

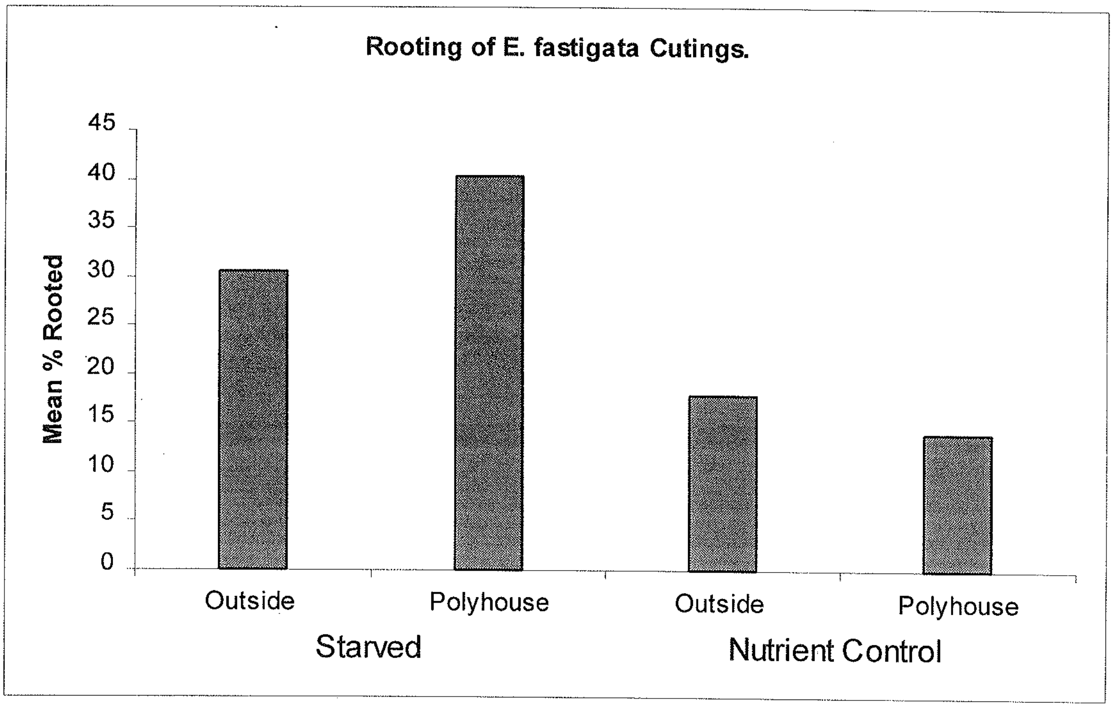
Starved			
Outside		Polyhouse	
Number Set	Rooted	Number Set	Rooted
6	3	6	0
6	0	6	5
6	4	6	6
6	4	6	4
6	0	6	0
6	3	6	1
6	0	6	2
6	1	6	2
6	3	6	3
6	0	6	4
6	4	6	0
6	0	6	2
Mean % rooted	30.6%		40.3%
Range	0 - 66.7%		0 - 100%

Table 2b. Rooting of *E. fastigata* Cuttings from Nutrient Control

Nutrient Control			
Outside		Polyhouse	
Number Set	Rooted	Number Set	Rooted
4	0	3	1
3	2	3	0
6	2	5	1
2	0	2	0
6	1	4	1
3	0	4	0
3	0	6	0
4	1	3	1
Mean % rooted	18%		14%
Range	0 - 66.7%		0 - 33.3%

The difference in rooting in the two different environments was not statistically significant, but the difference for the two nutrient treatments was significant at p = 0.005. Again, it must be noted that even for the best treatment combination (starved stock plants in raised in polyhouse), there were clones that totally failed to root. The data is summarised in Figure 2. The interaction between the nutrient treatments and stock plant environments was not statistically significant.

Figure 2. Rooting of E. fastigata Cuttings.



CONCLUSIONS

It is recommended that *E. fastigata* stock plants are starved of nutrients before topping to enhance production of useable coppice. There is some evidence that raising the starved stock plants in a polyhouse environment results in slightly better coppice production and improved rooting percentages, but the differences were not statistically significant. The best treatment combination was starved stock plants raised in the polyhouse (an average of 6.5 useable cuttings produced per stock plant, with 40% of these cuttings subsequently rooting). In contrast, the worst treatment combination was the nutrient control raised in the polyhouse (an average of 3.8 useable cuttings produced per stock plant, with 14% of these cuttings subsequently rooting).

We would expect greater success with further optimisation of the variables important to coppicing and rooting. More research is needed on identifying the optimal window in time for topping of stock plants, and subsequent coppicing; and in the production of quality root systems, including treatments that promote rooting.

B. COPPICING OF *E. GRANDIS X E. NITENS*

INTRODUCTION

The *Eucalyptus grandis x E. nitens* hybrid is currently being trialed in New Zealand (McConnochie and Shelbourne 1996). It is hoped that a desirable combination of parental characteristics will provide a superior eucalypt for New Zealand conditions, particularly warmer coastal areas. However, methods for vegetative propagation of *E. grandis x E. nitens* must be developed if this hybrid is to be planted extensively in New Zealand. The seed is expensive to produce and the hybrid progeny is highly variable. Clonal propagation will, therefore, be the most effective method of capturing favourable hybrid gene combinations.

Operational use of the hybrids will initially be dependent on the development of cost-effective techniques of vegetative multiplication from seedling material. A pilot nursery trial was reported previously to the Eucalypt Breeding Co-operative by Dibley and Aimers-Halliday (1997). This proved that *E. grandis x E. nitens* could be successfully propagated using rooted cuttings derived from coppice of 2-year-old seedlings. The hybrid behaved more like the *E. grandis* parent in its ability to coppice and produce rooted cuttings.

The starving of the stock plant and two-stage topping, which are necessary for obtaining coppice with *E. nitens,* gave poorer results for the hybrid in the pilot trial. Rooting percentages ranged from 0 to 100% depending on clone; the clones with characteristics more like *E. nitens* (the majority of the hybrid clones in the experiment) having poorer rooting than clones with characteristics more like *E. grandis.* Overall rooting success was only 26%, but 16 out of the 135 clones (12%) had 70% rooting or better.

The additional step to clonal forestry would require clonal testing of hybrid offspring with the maintenance of juvenility or eventual rejuvenation, probably by coppicing. Therefore, the development of coppicing techniques for rotation-age trees is important. The purpose of this report is to present the results of a coppicing trial in a young stand of *E. grandis x E. nitens*.

Clonal Forestry and Genetics Tree Improvement staff from ***Forest Research*** visited the *E. grandis x E. nitens* trial at Knight's Block (Tamurenui) and then the Te Teko Seed Orchard hybrids in September 1996. These trees were planted in November 1994.

The trees in Knight's Block were recommended for a coppicing trial. However, compared to the trees in the Seed Orchard, those at Knight's Block were in poor health. The hybrids in particular were very unhealthy with many dead. Of those that were alive, a lot were losing their leaves. There were, however, some healthy trees at Knight's Block. Of the 475 hybrids planted, 175 were alive and 93 were considered to be of reasonable health.

METHODS

On 7 October 1996, all the hybrid trees were released with 60 ml Gardoprim and 20 ml Gallant per litre at 50 ml per spot. The trees were released again when Tasman Forestry Ltd. sprayed Roundup around the fence-line and around all the trees in the trial area on 10 October.

On 21 October 1996, all but five trees from each family (healthy and unhealthy), were felled at about 15 cm above ground to induce coppicing. The five remaining trees in each family were topped high so that at least one branch with live leaves was left on the tree to 'condition' the tree

before cutting it lower to induce coppicing. On 9 December, the conditioned trees were topped to about 15 cm.

The stumps were inspected at least weekly for the first signs of coppice formation.

When most of the trees had commenced coppicing to some degree (by 30 January 1997), the number of possible cuttings was counted for each stump. The coppice was assessed as being collected early, on time, or late by the growth of the coppice shoots. Some trees failed to coppice, or the coppice died before harvesting on some trees, and this was recorded when the coppice was collected.

The specifications for these cuttings were;

cutting length 70- 120 mm
cutting diameter 2-4 mm
1 or 2 leaf nodes
at least some degree of lignification of the stem.
a minimum of disease present in the cutting.

These specifications were drawn-up using information from the previous seedling coppice trial (Dibley and Aimers-Halliday 1997) and communication with propagators working with the hybrid in South Africa.

RESULTS AND DISCUSSION

The development of coppice was variable with some plants producing shoots up to approximately 75 cm, while with other clones, the shoots had barely begun to elongate. Often stems had elongated so that it was impossible to get cuttings of the usual specifications because the internode was too long to get 80 mm cuttings with two nodes, or because, many thin shoots of less than 3 mm were produced. Much of the coppiced material produced at this site was unlignified and too soft for cuttings.

Table 3 shows that there was large variation in the number of useable cuttings and the development of the coppice in individual trees both within families and between families. Of the 175 trees that were felled, only 50 produced more than ten cuttings. The variation between families in the mean number of cuttings obtainable can be seen in Table 4. An analysis of variance showed no significant effects for the different families, two topping treatments, and interaction.

There was a very weak positive correlation between stump diameter and the number of cuttings produced (significant at $p = 0.02$, r-squared = 0.028).

Table 3. Mean Number of Cuttings Collected From Each Family and the Condition of the Coppice Material When Collected

Family	Topping Height (High, Low)	Number Observations	Mean Total Cuttings	Status of Coppice				
				Early	On Time	Late	Dead	No Coppice
101	H	5	13.4	4	1	0	0	0
	L	21	23.3	5	7	3	3	3
102	H	1	13.0	1	0	0	0	0
	L	6	6.0	4	1	0	0	1
103	H	8	9.3	6	0	0	0	2
	L	20	16.7	4	11	2	0	3
109	H	3	0.0	1	0	0	0	2
111	H	5	19.2	4	1	0	0	0
	L	4	30.0	1	2	1	0	0
202	H	8	22.1	5	1	2	0	0
	L	20	33.2	2	8	8	1	1
203	H	6	16.8	3	2	0	1	0
	L	11	7.5	3	3	0	0	5
204	H	5	9.0	2	2	0	0	1
	L	35	20.9	11	17	4	1	2
208	H	3	17.0	1	2	0	0	0
	L	9	9.2	5	2	1	0	1

Table 4. Mean Number of Available Cuttings by Family

Family	Mean Number of cuttings
101	18
102	10
103	13
109	0
111	25
202	28
203	12
204	15
208	13

Topping the trees in stages to reduce the shock of having all their foliage removed at one time seemingly reduced the number of available cuttings (Table 5), though this difference was not statistically significant. With the high-cut treatment, the second cut to induce coppicing was three weeks after the first cut. The lower number of cuttings produced on these trees may be a reflection of the lesser time allowed between felling and coppice collection.

Table 5. Mean Number of Available Cuttings by Topping Height

Topping Height	Mean Number of cuttings
High	14
Low	19

CONCLUSIONS

It is difficult to make any definite conclusions about this coppicing trial, such as determining the best topping method, because of the large amount of spurious variation due to the patchy, poor health of the stand. However, it is clear that most young hybrid trees will readily coppice. More extensive research is needed to determine the ideal window in time for coppicing. In this trial, the coppice shoots were wilting badly during the early morning collection in January 1997, making them unsuitable for rooting. Much of the coppice was unlignified and too soft for cuttings. More research is also needed on defining the ideal specifications for cuttings.

Using rooted cuttings from field coppice to establish stool beds in a nursery would probably be the best means of propagating hybrid clones. Cost-effective management, for both propagation and general health, would be easier with the closer monitoring and intensive care that is possible in a nursery system.

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