

EUCALYPTUS FOLIAGE PRODUCTION

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ISBN

September 1999

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Summary

The main objective of this project was to determine, for the main species of Eucalyptus grown in the south west of Ireland (Kerry), the best means of pruning to optimise marketable juvenile foliage production and quality over the crops life cycle. The majority of the trials were carried out in Co. Kerry where a higher concentration of production is located. The favourable climate and light acid soils in this region promote satisfactory growth and enables harvesting to take place from autumn to March which is the premium period.

Results of extensive trials over a four year trial period showed that new plantations should not be pruned until the end of the second growing season to allow the trees to become well established and help build up photosynthetic food reserves and prevent tree losses. However in some situations where very vigorous growth was achieved during the first growing season a very light pruning at 1.3 m high helped stabilise trees. After the second year's growth, pruning back to a height of 1.2 m consistently produced the highest marketable production of quality juvenile foliage of Eucalyptus species *pulverulenta*, *perriniana*, *parvifolia*, and '*Glaucescens*' over the trial period. Pruning back to this level helped develop a single or multiple main stem framework (2-3 stems) for future production purposes, providing a nice manageable tree facilitating not only harvesting but other technical operations such as pruning and spraying.

It was found that more severe pruning, especially back to 15-25 cm from the ground, reduced output and in some cases quality but was responsible for significant tree losses varying from 8-12% in the second growing year to over 30% losses with four year plantations, with further losses of 5-10% expected as well because of very weak plants.

The main recommendations of this study are that no pruning be carried out for the first two growing seasons and thereafter a relatively light pruning of all main framework leaders back to 1.2 m high after the winter period. As the plantations grew older, stronger side branches could be shortened and later still could be removed to facilitate management of the crop.

The light pruning treatments to 1.2 m high in contrast to the most severe pruning regimes produced no significant tree losses in the main production areas in Co. Kerry and would appear to be the most sustainable system of pruning management over the crops life cycle.

Introduction

Production of foliage in Ireland for the home and export markets has grown rapidly in the last five years. This has been due mainly to the growth in the south west of a company-Kerry Foliage which exports 90% of its produce to the U.K and Europe. The mildness of this growing region is ideally suited to the production of a range of high value foliage and flower crops, of which *Eucalyptus*, *Pittosporum*, *Erica* and *Helichrysum* are the most important. Last year, over one million stems were exported and further growth is expected over the next five years.

Eucalyptus is the most important crop, with 60 hectares recently planted using several new species/cultivars not previously grown in this country. The cultural requirements in terms of pruning of these new cultivars was not known at the time of planting of these plantations. Work on pruning of *Eucalyptus gunni*, however, has been the subject of considerable work at UCD, but this species is not presently grown in the south-west.

Meetings called by the Kerry Foliage Group with Teagasc in 1994 required urgent work to be carried out on these new cultivars with a view to developing the most suitable pruning regime to optimise production of marketable juvenile foliage. As plantations of these new cultivars/species had just been planted in 1994 in Co. Kerry, it was decided to carry out investigative work there.

Materials and Methods

These results are from trials laid down in Kenmare, Co.Kerry and at Teagasc Kinsealy Research Centre. Each cultivar was tested separately in large randomised blocks. Trees were spaced 1.2 m apart in rows 1.5 m wide. The various treatments were carried out on individual trees with up to 25 replications in each trial. Growth manipulation by pruning was initially carried out in early May but was brought forward to April for the 1997 trials and late March for the 1998 series of trials.

Recordings were carried out from December to January with produce graded into juvenile and adult foliage and within these categories they were further separated into stems greater or less than 55 cm. A further category of 'sprays' was made for juvenile foliage stems greater

than 55 cm which had at least two side shoots as this is currently the premium grade for the export markets of Europe and the U.K where this produce is marketed.

Produce was categorised depending on whether it arose from the base of the plant (lignotubers) or from the upper parts of the pruned stems. This is an important consideration as it affects the manual harvesting operations and other technical operations such as spraying for pesticides and herbicides.

Results

1995 Trials

The first trial was laid down in Kenmare, Co.Kerry in May 1995. Two trials on *Eucalyptus pulverulenta* and *Eucalyptus* and '*Glaucosens*' were laid down in separate plantations, both having completed a year's growth. The height of the plants varied from 1.0 to 1.4 m high before the onset of the trials. Initially the treatments ranged from severe pruning of main branches (25 cm from the ground) to intermediate pruning (60 - 90 cm from the ground) with controls which were lightly pruned at 1.3 m high. In addition, lateral branches were shortened by one half and two thirds, and also removed completely on the lightly pruned treatments. Results are presented in Tables 1 and 2.

With the cultivar *Eucalyptus pulverulenta* (Table 1) the highest output of marketable stems was produced by treatment 4, where leaders very lightly pruned to 1.3 m (some trees were not pruned at all because they had not reached this height). The severe pruning treatments of these young trees reduced marketable foliage in all cases (treatments 1-3). The harder the pruning and the more foliage removed, the greater the output reduction. The output from the severest prunings (treatments 1-3) was significantly less ($p < .05$) than the very light pruning (treatment 4). Any shortening of side branches was equally detrimental. Total output of juvenile stems followed a similar pattern. Tree mortality of 8% was associated with the severe pruning back to 25 cm.

The different pruning treatments did not affect the other categories of foliage to as large an extent. However, in the unmarketable top growth category, side branch shortening, particularly treatment 6, produced higher numbers of unmarketable foliage stems compared with the main stem pruning alone or where the side branches were removed. In summary, pruning of lateral branches and hard pruning of main leaders of young trees to 90 cm or less reduced overall outputs of marketable juvenile foliage compared with the least pruned plants,

which were mostly 1.3 m high. Obviously, young plants, especially evergreens, require as much photosynthetic leaves and stems as possible in this crucial early stage of their development. Side branch pruning of treatments 5, 6 and 7 resulted in lower productivity of marketable stems.

With E.'*Glaucescens*' (Table 2), which is very prone to producing relatively useless adult foliage, the most severe pruning to 25 cm, treatment 1 and, where the side branches were removed on a lighter pruned tree (treatment 6.), produced more marketable (juvenile) stems compared with the rest of the lighter pruned treatments. Even so, productivity was still very low with this cultivar. Side branch shortening pruning enhanced total juvenile production on the lighter pruned treatments. With this cultivar, the most severe pruning (25 cm) stimulated more lignotuber juvenile foliage production. While this trial showed that severe pruning could increase total marketable production, the vigour was markedly reduced and later on over the winter period 12% of the trees perished.

1996 Trials

Trials in 1996 took place on new two year old plantations which had established well and were growing vigorously. In the light of the previous year's trial and from observations carried out during the growing season, it was decided to prune all main leaders to 12-15 cm or 120 cm from ground level and to trim all strong side branches back to 35 cm, but retaining weaker growth to help photosynthesis and strengthen the plants. In addition, summer pruning in August was also carried out, removing approximately half of the current year's growth on side branches to determine if this could increase marketable foliage further. Results are presented in Table 3 for *Eucalyptus pulverulenta* and in Table 4 for *Eucalyptus Glaucescens*.

With *Eucalyptus pulverulenta* the most severe pruning (12-15 cm) produced the lowest amount of marketable foliage. This treatment together with summer pruning on this species did not improve results. All the lighter pruned treatments (3 to 6) resulted in consistently high production. Particularly good was treatment 5 where the main stems or leaders were cut back to 120 cm and any side branches trimmed to 35 cm while retaining other weak or small foliage branches. Eliminating side branches or cutting tight to the main stems (treatment 3) appeared to reduce production significantly ($p < .05$). Where summer pruning was carried out (treatments 4 and 6) the results again appeared beneficial but not significant ($p < .05$). The total production of juvenile stems/tree was closely correlated with the total number of marketable stems per tree. The higher or lightest pruned trees gave the least production from lignotubers.

Results of similar treatments on *Eucalyptus 'Glaucescens'* differed from those of *Eucalyptus pulverulenta*. In contrast (Table 4), this cultivar responded to severe pruning treatments such as cutting back to 12-15 cm (treatment 1) and the removal of strong side branches on the main stems of the higher pruned trees (treatment 3), with the highest productivity in terms of total marketable stems/tree. These all produced consistent high numbers of juvenile foliage stems as well. Summer pruning enhanced productivity on these treatments also. Furthermore, severe pruning (treatments 1 and 2) and elimination of strong side branches in the higher pruned trees (treatments 3 and 4) produced a dramatic reduction of top growth adult foliage. This was very evident in all plots at harvest. In fact, the severe pruning almost eliminated adult foliage completely and results were highly significant ($p < .05$) compared with treatments 5 and 6.

1997 Trials

Results of pruning carried out in 1997 (fourth growing season) are presented in Table 5 for *Eucalyptus pulverulenta*, Table 6 for *Eucalyptus 'Glaucescens'*, and Table 7 for *Eucalyptus perriniana*.

With *Eucalyptus pulverulenta* results were quite similar to the 1996 trial in many respects. The highest production of total marketable and total juvenile foliage production was again obtained from the lighter pruning of leaders, to 120 cm from the ground (treatments 3 and 4). There was no benefit (in contrast to results from younger plantations) where side shoot foliage was left on these stems. The lowest productivity was given by the most severe pruning to 10-15 cm (treatment 1). A new treatment (2), pruning to an intermediate stage (60 cm from the ground), while producing marginally higher output than treatment 1 appeared to be significantly lower ($p < .05$) than the higher pruned treatments. This trial also clearly demonstrated that with three year old trees, severe pruning produced maximum foliage from basal lignotubers, while this balance was shifted to top growth from each of the pruning treatments more than 60 cm high from ground level.

With *Eucalyptus 'Glaucescens'* the number of pruning treatments was reduced relative to those of 1996. Because of strong tree vigour, it was decided to prune to three heights of 10-15 cm, 60 cm and 120 cm high from ground level and eliminate all side branches. Trees were mostly vigorous with very few weak shoots.

The two most severe prunings from ground level of 15 cm and 60 cm (treatments 1 and 2) produced almost no adult foliage, and while the higher pruned treatment (3) produced significantly more ($p < .05$), this was still very low at 1.57 stems/plant. All the treatments produced almost identical productivity of total marketable stems/tree with no significant difference between them. However, the higher pruned treatment to 120 cm high produced significantly more juvenile stems than the other two treatments, with the most severe treatment (1) producing the overall lowest productivity.

Results for *Eucalyptus perriniana* (Table 7) showed that severe pruning produced the poorest productivity. Apart from the lowest productivity in terms of marketable juvenile stems/tree (> 55 cm long) or total juvenile foliage stems/tree, the quality of resultant foliage was poor, with the leaves spotted and both stems and foliage having more pest damage (*psyllids*).

The best treatment which produced the highest productivity was the light pruning to 1.2 m and retaining any weak growth on the main stem structure. As expected, more adult foliage was associated with the lighter pruned treatments (3, 4 and 5).

1998 Trials

Trials in 1998 had various pruning regimes superimposed on *Eucalyptus* species *pulverulenta*, *perriniana* and the cultivar '*Glaucescens*', and with summer pruning carried out in late August.

Results for *Eucalyptus pulverulenta* (Table 8) were very similar to 1997 trials where the highest output of both marketable and adult stems per tree was associated with the lighter or higher pruned treatments to 1.2 m high. These were significantly ($p < .05$) better than the two severe pruning treatments (1 and 2) which were pruned back to 15-20 cm from the ground. In addition, mortality was very high from these severely pruned trees, with 30% dead trees and a further 5 - 10% with fungus visible on the stumps and other signs of decay. Summer pruning was not beneficial.

With *Eucalyptus 'Glaucescens'* (Table 9) similar results were achieved, with the highest output (though relatively small) being produced from the higher pruned treatments. As with *Eucalyptus pulverulenta*, mortality was again very high with both severe pruning treatments (1 and 2), having 17% and 15% dead trees recorded, together with an additional 6% and 10% of trees showing signs of decay respectively.

With *Eucalyptus perriniana* (Table 10) which had no severe pruning carried out, the removal of all side branches at pruning time (treatments 1 and 2) produced yields significantly less than treatments 3 and 4, where weak side branches were left on the trees. Summer pruning was not beneficial.

Kinsealy Trial (*E parvifolia*)

The production from *Eucalyptus parvifolia* trial at Kinsealy was very poor, probably due to the exceptionally wet cold summer, which prevailed. Most of the treatments produced juvenile foliage less than 55 cm long (Table 11). Several of the plants showed chlorosis which in contrast to the trials in the south west of the country (Kerry) were grown on medium heavy texture with a pH of over 7.5. The winter was exceptionally wet and these factors may account for the high mortality, which occurred. This was worse (29%) on the most severely pruned trees (10-15 cm from ground level) but also occurred on trees pruned to 60 cm (20%) and to a much lesser extent (13%) on those pruned lightly to 1.2 m high.

Discussion

These results represent significant progress in knowledge in relation to pruning young plantations and management of *Eucalyptus pulverulenta*, *perriniana* and '*Glaucescens*'.

Eucalyptus pulverulenta and *perriniana* were relatively uniform and produced mostly juvenile foliage. The results showed that young trees were best left un-pruned for the first two growing seasons, apart from a light pruning of leaders over 130 cm high. This stabilised trees and helped form a main framework for future production. Thereafter, trials showed that light pruning of main leaders back to 120 cm produced maximum marketable juvenile foliage stems over 55 cm long. It was also important, particularly in the early years, to leave as much weak side branches on this framework for photosynthetic purposes. In the interests of overall management, strong growing side branches had to be shortened and the results showed that minimal shortening (pruning by a third) of these were tolerable but more severe shortening drastically reduced output. There was an interaction of this treatment with age of plantation, as four year old trees tolerated more severe side branch shortening. Summer pruning in August did not significantly increase production of marketable foliage.

Eucalyptus 'Glaucescens' was extremely variable, showing many very different genotypes present with a strong tendency to produce a lot of 'adult' foliage. While results were less

consistent it was shown that this cultivar responds to a more severe pruning regime, to maximise production: either severe pruning of leaders or light pruning of leaders with removal of all side branches. However, in view of high plant mortality associated with severe leader pruning (15-25 cm from ground level), this practice cannot be recommended for this cultivar, tested and a higher or lighter pruning regime to 1.2 m high is recommended also.

Table 1—Effect of pruning on foliage stems/tree of *Eucalyptus pulverulenta*, Kenmare 1995

No.	Treatment	Basal lignotubers			Top Growth			Total marketable stems
		Marketable		Unmarketable	Marketable		Unmarketable	
		Sprays	Singles		Sprays	Singles		
1	Main stem pruned back to 25 cm.	1.7	1.2	0.5	1.2	5.3	0.3	9.4
2	Main stem pruned back to 60 cm.	1.2	2.0	1.5	1.4	7.4	1.9	12.0
3	Main stem pruned back to 90 cm.	1.4	1.3	1.4	1.5	9.1	1.8	13.0
4	Main stem pruned back to 130 cm.	1.3	4.4	1.1	1.1	11.2	4.3	18.0
5	Main stem pruned back to 130 cm, side branches pruned by one third.	2.7	6.0	1.4	1.5	3.9	5.1	14.1
6	Main stem pruned back to 130 cm, side branches pruned by two thirds.	3.0	3.0	1.0	1.5	5.2	12.6	12.7
7	Main stem pruned back to 130 cm, side branches removed completely.	1.7	2.4	1.0	1.5	4.0	3.4	9.6
	F-test	*	*	NS	NS	**	***	*
	SE (df=113)	0.42	1.04	0.47	0.43	1.56	1.30	1.77

Table 2—Effect of pruning on foliage stems per tree of *Eucalyptus glaucescens*, Kenmare 1995

No.	Treatment	Basal lignotubers				Top Growth				Total marketable stems	Total juvenile stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Spray	Single	Juv.	Adult	Spray	Single	Juv.	Adult		
1	Main stem pruned back to 25 cm.	1.66	0.43	3.1	0.14	0.09	0.09	0.01	11.3	2.28	5.48
2	Main stem pruned back to 60 cm.	0.71	0.26	2.16	0.01	0.17	0.29	0.36	14.6	1.44	3.97
3	Main stem pruned back to 90 cm.	0.45	0.11	1.26	0.01	0.01	0.3	1.42	18.6	0.85	3.54
4	Side branches shortened by one third on a 130 cm high tree.	0.19	0.05	0.14	0.28	0.38	0.19	4.52	6.9	0.81	5.48
5	Side branches shortened by two thirds on a 130 cm high tree.	0.14	0.19	0.81	0.52	0.09	0.0	7.7	2.9	0.43	8.95
6	Side branches removed completely on a 130 cm high tree.	0.52	0.14	1.05	0.33	1.5	0.09	2.85	2.3	2.29	6.12
7	Main stem pruned back to 130 cm.	0.0	0.0	0.33	0.23	0.09	0.27	3.8	13.4	0.6	4.5
	F-Test	**	NS	*	NS	***	NS	***	***	**	*
	SE (df=113)	0.284	0.137	0.609	0.15	0.233	1.22	0.93	1.855	0.39	1.22

Table 3—Effect of pruning on foliage stems /tree of *Eucalyptus pulverulenta*, Kenmare 1996

No.	Treatment	Basal lignotubers				Top Growth			Total marketable stems	Total juvenile stems
		Marketable		Unmarketable		Marketable		Unmarketable		
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.		
1	Pruning main stem/stems back to 12-15 cm, retaining any weak growth.	2.8	2.4	5.4	10.0	2.5	5.4	10.1	13.1	28.5
2	As for No. 1 above with summer pruning at end of August.	2.0	1.9	3.5	10.25	2.8	3.6	10.2	10.3	24.0
3	Pruning main stem/stems back to 120 cm and strong side branches eliminated, but retaining weak growth.	1.6	3.2	8.1	12.2	2.2	8.1	12.2	15.1	35.4
4	Pruning main stem/stems back to 120 cm as for No. 3 above, with summer pruning at end of August.	2.2	2.3	10.4	12.1	4.1	10.7	12.1	19.4	42.2
5	Pruning main stem/stems back to 120cm and strong side branches trimmed to 35 cm, but retaining any weak growth.	1.6	2.0	13.4	15.2	5.0	13.4	15.2	22.1	50.7
6	As for No. 5 above, with summer pruning at end of August.	1.8	1.4	17.8	18.9	5.6	17.8	18.9	26.7	63.3
	F-test	NS	NS	***	NS	**	***	NS	***	***
	SE (df=75)	0.545	0.605	1.69	2.5	1.191	1.698	2.505	2.115	4.66

Table 4—Effect of pruning on foliage stems/tree of *Eucalyptus glaucescens* Kenmare 1996

No.	Treatment	Basal lignotubers				Top Growth				Total juvenile stems	Total marketable stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.	Adult		
1	Pruning main stem/stems back to 12-15cm, retaining weak growth.	1.06	0	1.81	0.12	2.87	0.62	10.44	0.94	16.75	4.5
2	As for No. 1 above, with summer pruning at end of August.	1.88	0.06	2.69	0	2.0	1.87	12.5	1.06	20.3	5.12
3	Pruning main stem/stems back to 120 cm and strong side branches eliminated, but retaining weak growth.	0.87	0.5	1.87	0	2.31	2.31	15.56	2.3	22.93	5.50
4	As for No. 3 above, with summer pruning at end of August.	1.62	0.1	1.31	0	3.56	1.87	19.56	1.37	28.06	7.19
5	Pruning main stem/stems back to 120cm and strong side branches trimmed to 35 cm, but retaining any weak growth.	0.18	0	0	0.06	0.5	2.75	19.44	10.8	22.8	3.4
6	As for No. 5 above, with summer pruning at end of August.	0.81	0.25	0.5	0.56	0.5	1.25	16.69	11.7	20.0	2.8
	F-Test	NS	NS	**	NS	*	NS	*	***	NS	*
	SE (df=75)	0.338	0.126	0.503	0.213	0.747	0.518	2.377	1.370	2.72	0.904

Table 5: Effect of pruning on number of foliage stems/tree of *Eucalyptus pulverulenta*, Kenmare 1997

No.	Treatment	Basal lignotubers			Top Growth			Total marketable stems	Total juvenile stems
		Marketable		Unmarketable	Marketable		Unmarketable		
		Sprays	Single	Juvenile	Sprays	Single	Juvenile		
1	Pruning main stem/stems back to 10-15cm, retaining weak growth and pruning strong side branches back to 35 cm.	7.8	1.4	7.0	0.1	0.05	0.1	9.4	16.35
2	Pruning main stem/stems back to 60cm, retaining weak growth and pruning strong side branches back to 35 cm.	0.7	0.6	1.7	5.6	5.5	12.10	12.4	26.2
3	Pruning main stem/stems back to 120cm, retaining weak growth and pruning strong side branches back to 35 cm.	0.9	0.31	0.76	10.4	7.97	13.61	19.6	34.03
4	Pruning main stem/stems back to 120cm and eliminating all side branches.	1.35	1.30	2.15	7.2	11.9	15.05	22.05	38.95
	F-Test	***	NS	***	***	***	***	***	***
	SE (df=113)	0.635	0.44	0.75	0.96	1.12	1.60	1.83	3.20

Table 6: Effect of pruning on number of foliage stems/tree of *Eucalyptus glaucescens*, Kenmare 1997

No.	Treatment	Basal lignotubers				Top Growth				Total marketable stems	Total juvenile stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.	Adult		
1	Pruning main stem/stems back to 10-15 cm and removing all side branches.	6.23	0	10.92	0	0.04	1.18	1.164	0.14	6.37	18.45
2	Pruning main stem/stems back to 120cm and removing all side branches.	0.40	0.06	1.37	0.33	5.2	1.17	38.53	1.57	6.83	46.73
3	Pruning main stem/stems back to 60 cm and removing all side branches.	6.33	0.3	29.5	0.1	0	0	0	0	6.63	36.13
	F-Test	***	NS	***	NS	***	NS	***	***	NS	***
	SE (df=57)	0.409	0.12	1.462	0.061	0.338	0.597	1.921	0.2	0.74	2.644

Table 7—Effect of pruning on foliage stems /tree of *Eucalyptus Perriniana*, Kenmare 1997

No.	Treatment	Basal lignotubers				Top Growth				Total marketable stems	Total juvenile stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.	Adult		
1	Severe pruning main stem/stems back to 10-15cm and leaving weak growth.	1.55	0.25	1.8	0.0	0.0	0.0	0.0	0.0	1.75	3.6
2	Pruning main stem/stems back to 35 cm and leaving weak growth.	0.35	0.25	1.7	0.0	2.5	1.3	8.3	0.0	4.45	14.5
3	Pruning main stem/stems back to 120cm and leaving weak growth.	0.3	0.0	0.6	0.0	4.75	1.6	16.9	2.05	7.7	24.2
4	Pruning main stem/stems back to 120 cm and eliminating all side branches.	0.6	0.1	1.45	0.0	4.65	3.4	21.7	0.35	8.7	31.8
	F-Test	**	NS	NS	-	***	***	***	*	***	***
	S.E. (df=74)	0.245	0.121	0.574	-	0.51	0.595	2.018	0.538	0.954	2.399

Table 8—Effect of pruning on foliage stems /tree of *Eucalyptus pulverulenta*, Kenmare 1998

No.	Treatment	Basal lignotubers				Top Growth				Total marketable stems	Total juvenile stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.	Adult		
1	Main stem/stems pruned back to 15-20 cm and retaining weak growth, with summer pruning.	1.50	1.05	1.85	0.4	2.4	1.95	3.95	0.4	7.9	13.7
2	As for No. 1 above but without summer pruning.	1.3	0.75	2.2	0.0	2.2	1.65	5.0	0.0	5.9	13.1
3	Main stem/stems pruned back to 120 cm, leaving weak growth but removing strong side branches, and summer pruning.	0.2	0.6	0.2	0.0	10.15	7.25	8.9	2.1	18.2	27.35
4	Main stem/stems pruning back to 120cm and eliminating all side branches.	0.0	0.1	0.0	0.0	6.25	10.8	14.5	0.1	17.15	31.70
5	As for No. 3 above but without summer pruning.	0.35	0.15	0.3	0.0	11.0	9.9	10.05	1.05	21.4	31.75
6	Main stem/stems pruned back to 120 cm, as for No. 4 above, with summer pruning.	0.15	0.4	0.4	0.0	6.35	7.05	14.3	0.0	13.95	28.65
	F-Test	**	NS	*	*	***	***	***	*	***	***
	S.E. (df=95)	0.358	0.284	0.53	0.096	1.013	1.343	1.697	0.539	1.955	2.979

Table 9—Effect of pruning on foliage stems /tree of *Eucalyptus glaucescens*, Kenmare 1998

No.	Treatment	Basal lignotubers				Top Growth				Total Juv stems	Total Marketable stems
		Marketable		Unmarketable		Marketable		Unmarketable			
		Sprays	Singles	Juv.	Adult	Sprays	Singles	Juv.	Adult		
1	Pruning main stem/stems back to 15-20cm, retaining weak growth, with summer pruning.	0.53	0.17	0.31	0.35	2.53	0.23	2.94	1.17	7.16	3.47
2	Pruning main stem/stems back to 15-20 cm and retaining weak growth.	0.17	0.17	0.89	0.82	2.11	0.17	4.12	1.53	7.41	2.64
3	Pruning main stem/stems back to 120cm, removing all side branches, with summer pruning.	0.23	0.12	1.19	0.0	3.71	0.47	30.88	8.47	35.41	4.52
4	Pruning main stem/stems pruning back to 120 cm and removing all side branches.	0.06	0.11	1.56	0.0	4.23	0.53	25.35	4.8	30.59	4.91
	F-Test	NS	NS	NS	NS	NS	NS	***	NS	***	NS
	S.E. (df=67)	0.161	0.099	0.34	0.306	0.779	0.144	3.19	2.85	3.565	0.79

Table 10 - Effect of pruning on foliage stems /tree of *Eucalyptus piriniana*, Kenmare 1998

No.	Treatment	Top Growth				Total Marketable stems	Total Juvenile stems
		Marketable		Unmarketable			
		Sprays	Single	Juvenile	Adult		
1	Pruning main stem/stems back to 120cm and removing all side branches, with summer pruning.	10.1	5.40	20.85	0.4	15.5	36.35
2	Pruning main stem/stems back to 120 cm and removing all side branches.	9.3	5.85	19.9	1.35	15.15	35.05
3	Pruning main stem/stems back to 120cm and leaving weak growth, with summer pruning.	12.8	9.6	26.5	8.30	22.4	48.9
4	Pruning main stem/stems back to 120 cm, leaving weak growth.	13.9	9.95	29.0	8.85	23.85	52.85
	F-Test	NS	*	NS	*	*	*
	S.E. (df=57)	1.56	1.440	3.01	2.219	2.625	4.751

Table 11 - Effect of pruning on foliage stems /tree of *Eucalyptus parvifolia* Kinsealy 1998

No	Treatment	BASAL LIGNOTUBERS				TOP GROWTH				Total Mark.	Total Juv.
		Marketable		Unmarketable		Marketable		Unmarkable			
		Sprays	Single	Juv.	Adult	Sprays	Single	Juv.	Adult	Mark	Juv.
1	Main stem/stems pruned back to 15-20 cm; removal of all side shoots.	1.8	0.3	2.03	0.11	0.36	0.29	4.04	0.49	1.16	7.20
2	Main stem/stems pruned back to 15-20 cm; leaving any weak branches.	0.7	0.1	0.53	0	0.89	0.68	7.95	0.79	2.42	10.89
3	Main stem/stems pruned back to 60 cm; removal of weak branches.	0.2	0	1.05	0.05	1.47	0.53	11.11	1.42	2.16	14.32
4	Main stem/stems pruned back to 60 cm; all side branches retained.	0	0	.05	0.05	1.58	0.53	17.11	0.89	2.10	19.26
5	Main stem/stems pruned back to 120 cm; all side branches retained.	0	0	0.26	0	1.74	0.42	13.95	2.84	2.26	16.47
6	Main stem/stems pruned back to 120 cm; all weak side branches retained.	0	0	0	0	3.0	1.47	21.58	3.32	4.47	26.05
	F-test (df=89)	NS	NS	*	NS	NS	NS	**	NS	NS	**
	SE	0.22	0.11	0.509	0.053	0.6	- 344	3.21	0.94	0.87	3.64

Conclusions

The main objective of this project was to determine the most satisfactory method of growth regulation by means of pruning to optimise marketable juvenile foliage production and quality over the expected life cycle of Eucalyptus crops. Foliage production is a rapidly growing sector of the amenity industry in Ireland, with the largest concentration of production in Co. Kerry. The climate here produces high growth rates and the mild winter enables harvesting to take place from autumn to March, which is the premium period. Results have shown that:

- Severe pruning of new plantations back to 15-25 cm, before trees had two years' growth completed, produced plant losses of 8 - 12 % and reduced output of marketable foliage and tree vigour.
- Severe pruning produced plant mortality over the four years' trials. In 1998 trials, losses were particularly high, varying from 17 - 30%, with additional losses of 5 - 10% expected from decaying trees.
- New plantations of *Eucalyptus pulverulenta*, *Eucalyptus 'Glaucescens'* and presumably other species also should not be pruned at all for their first growing season in order to build up as strong a tree as possible. Where growth, however, exceeded 130 cm in the first growing season a very light pruning of leaders to 130cm was beneficial. It helped to stabilise trees and to form a single or multiple (2-3 stems) main branch/stem framework for production purposes. This provides a nice manageable tree, facilitating harvesting and other technical manual operations such as pruning and spraying.
- Different Eucalyptus cultivars differed in their response to different pruning regimes carried out thereafter.
- Cultivars not prone to producing adult foliage, such as *Eucalyptus pulverulenta* and *Eucalyptus perriniana*, had the greatest marketable foliage output consistently from treatments which received a light pruning of the main leaders/stems back to 120 cm. While the trees were young it was also important to leave as many side branches on the tree as possible. In the interests of tree management the strongest side branches had to be shortened later in the crop's life but the trials showed conclusively that production was reduced significantly with severity of side branch pruning with trees up to 3 years old.
- Reduction in output always accompanied severe pruning of main branch framework back to 60cm or less;
- A second pruning (summer) carried out in August by removing half of the current year's growth gave variable results. However, further work is required on this aspect, with pruning carried out earlier in the season.

- The severity of pruning could be used to influence the proportion of produce occurring from the basal lignotubers or from top growth.
- Older trees (4 years old) which were lightly pruned to 120 cm could tolerate more severe side branch shortening.
- Eucalyptus cultivars prone to developing relatively useless adult foliage such as *Eucalyptus 'Glaucescens'* (this cultivar also showed enormous plant variation), produced also the highest productivity from the lighter pruned treatments. While this cultivar responded better to severe pruning in terms of juvenile foliage production, severe pruning was also accompanied by plant mortality and this treatment would not be sustainable over the crops life cycle.
- Pruning the main branch framework lightly to 120cm with strong side branches removed but retaining weak growth, gave consistently the best output of marketable foliage.
- Summer pruning by removing half the current year's growth marginally increased total juvenile marketable production. Further work needs to be carried out on this aspect.
- With increased age of the plantation (4years old) the higher pruned trees which had all side branches removed, produced more marketable output compared with the severely pruned (15-20 cm) treatments These also produced much more juvenile foliage output. The severe pruning treatments drastically reduced adult foliage production.
- Trials with a *Eucalyptus perriniana* initiated in 1997 in Co.Kerry and on *E. parvifolia* at Kinsealy indicated that the pruning treatments which produced maximum foliage production for *Eucalyptus pulverulenta* are best for these species also.
- Results showed that for *E. perriniana* and presumably for other species/cultivars that pruning should be delayed till March as earlier pruning carried out in January February led to high mortality.

Publications:

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