The use of open rooted seedlings in farm tree plantations

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Summary. Low cost tree establishment is vital for Australian Landcare. Trials were carried out with open rooted transplants of a range of native species, raised in Speedling trays and then transplanted into a field nursery. After mechanical root pruning on three occasions, trees were lifted and planted at several sites in Tasmania. Establishment was good at all sites, with losses of around 15% after the first summer, comparable to that from more expensive tubestock. Most species produced acceptable growth without plastic tree guards provided seedlings were well grown in the nursery.

Introduction

Effective establishment of large numbers of trees is a vital component of Landcare (3). Trees should be seen as part of an integrated ecosystem (2), with specific roles including watercourse and dam protection; control of erosion and salting; as a wildlife habitat, for shade, shelter, fodder or timber; and for landscape and hence farm value enhancement. Trees planted on a farm can serve in several of the above roles for maximum benefit and cost-effectiveness. The two recognised methods of establishing farm trees (5) are either the planting of seedlings raised in containers in a nursery or direct seeding into the final site. The former is reliable, but high cost and high labour requirement limit the number of trees that can be planted.

Tubestock seedlings can suffer from several root deformation problems (4). These deformations include "J" roots, and girdling of the tap root by lateral roots. These root deformations can lead to tree death. Improved nursery techniques and tube designs (e.g. "root trainers") can reduce deformation. Plastic tree guards have been shown to be beneficial for slimline tubestock survival and growth over a range of conditions (I) since they protect the tree from wind and browsing whilst allowing radiation through for photosynthesis.

Direct seeding is the main alternative currently used (2, 5). A range of machinery and techniques have been devised, from broadcast seeding after mouldboard ploughing through to pre-ripping, herbicide treatment and machine seeding. Results can be variable as seed lots vary greatly in germination and vigour and young seedlings are very vulnerable to water stress, weed competition and insect attack.

An alternative technique being tested in Tasmania involves the planting of open rooted stock, where seedlings are grown in field nurseries, mechanically root pruned, lifted and transplanted to the final site. This technique has been used with deciduous trees for centuries. In Australia, production of open rooted evergreen trees is largely confined to *Pinus* sp., whereas eucalypts have previously been raised in paper pots. Forest interests in Tasmania are currently producing several open rooted species using Speedling technology where patented nursery trays have cells with an inverted pyramid shape. Species include *E. globulus, E. regnuns , E. delegalensis* and *E. Miens.* Seed is sown into 198 celled Speedling trays containing peat moss. When speedlings are approximately 10 cm in height they are mechanically transplanted into raised field beds.

A programme of lateral root pruning, undercutting and root wrenching commences when seedlings reach 200-250 mm in height. This operation is repeated at 14 to 21 day intervals throughout the growing season. This root conditioning encourages the development of a compact fibrous root system. Stems are topped at 300mm on several occasions during the growing season. Topping increases the root to shoot ratio and reduces transpiration. After lifting from the field nursery, the seedlings can be hand or machine planted into sites previously prepared by ripping and herbicide treatment. Under forest conditions open rooted trees withstand browsing and wind damage, and can reach 3 m in height within two to three years, without tree guards.

While the above forest nursery techniques have proven successful in >750mm annual rainfall areas, there are no reports of the suitability of open rooted technology for establishment of a range of species for farm revegetation in drier areas such as Eastern Tasmania (around 500mm annual rainfall) where frequent water stress conditions combine with weed competition, browsing, pest damage and wind, to give a much harsher environment. This paper describes early stages of a project to investigate the potential use of open rooted seedlings in the establishment of trees on farm, initiated by Greening Australia with financial support from Australian Newsprint Mills Ltd. and Forest Resources Ltd.

Methods

Seed of nine species was collected from representative sites in the Midlands of Tasmania with an annual rainfall of about 500mm. Speedlings were raised by Hills Transplants Pty Ltd, Devonport. Tasmania and were transplanted into a field nursery at Westerway in the Derwent Valley during December 1991. All seedlings received the same management as commercial forest seedlings.

Three Landcare groups participated in the field trials, Bothwell, Lower Macquarie (Cressy) and Coal Valley. A total of 7 farms planted 500 - 2000 trees each for a range of purposes including shelter belts. erosion control and dam protection. The planting rows (4 m apart) were pre-ripped to about 300-500 mm in the autumn. Glyphosate and simazine were applied prior to planting. Trees were planted 3 m apart using a tractor-mounted forest seedling planter.

Seedlings of several species were grown in slimline tubes 50mm x I 25mm and planted at four of the above trial sites for comparison. Trees were planted at the University Farm (Coal Valley) on 23 July. Cressy area on 25 August and Bothwell on I September, 1992 (Table 1).

Table I. Species and numbers planted, with percent loss two months and six months (2m and 6m) after planting

	Bothwell/Cressy			University Farm		
		Loss (%)			Loss (%)	
Species	No.	2m	6m	No.	2m	6m
Acacia mearnsii	197	2.5	28	465	0.4	15
A. pravissima	414	2.4	15	213	0.5	10
Allocasuarina littoralis	223	3.1	17	74	4.0	57
Eucalyptus ovata	874	0.9	12	495	1.0	9
E. pauciflora	197	1.5	6	181	0.5	36
E. rodwayii	671	0.7	6	110	0.0	22
E. rubida	59	3.4	22	79	0.0	32
E. viminalis	277	2.2	19	173	1.2	13
Leptospermun lanigerum	628	0.5	16	134	1.5	16
Total	3540	1.4	13	1924	0.8	18
Tubestock	273	1.4	15	96	0.0	16

At the University Farm a small hand planted trial (192 trees) was established on the same day as the main planting of open rooted seedlings to more accurately compare open rooted seedlings with tubestock. Four species (Table 2) were allocated to main plots, with a factorial combination of treatments in four subplots; open rooted or tubestock, with or without a plastic sleeve guard. Each subplot contained two trees and there were six replications. Trees were scored three times for survival and vigour, on a scale from 0 (death) to 5 (fully vigorous, healthy seedling).

Conditions were generally cool and moist at each site from planting to the first recording two months later. At the University Farm (Table 3), soil moisture deficit would have built up over the spring and summer. with signs of water stress appearing by December. Weed control was generally adequate. although

Hogweed *(Polygonwn aviculare),* which is resistent to simazine, was becoming competitive at the University Farm by the second recording.

Table 2. Scores for survival and vigour (scale 0-5) of four species in the University Farm trial. Numbers in brackets indicate deaths

Time of scoring and treatment	*Acacia mearnsii*	*Allocasuarina littoralis*	*Eucalyptus ovata*	*Eucalyptus viminalis*	Mean
17.9.92					
open, unguarded	1.0	3.2 (1)	3.3	3.5	2.7
open, guarded	1.7 (1)	4.1	4.3	3.3	3.3
tube, unguarded	3.3	3.2	3.2	4.7	3.6
tube, guarded	5.0	4.7	4.8	4.7	4.8
mean	2.7	3.8	3.9	4.1	3.6
29.12.92					
open, unguarded	1.7	1.5 (4)	3.4	3.9	2.6
open, guarded	1.8 (1)	3.1 (1)	4.3	3.6	3.2
tube, unguarded	3.1	2.3 (2)	3.4	3.9	3.2
tube, guarded	4.5	3.0 (1)	4.5	4.5	4.1
mean	2.8	2.5	3.9	4.0	3.3
6.5.93					
open, unguarded	2.0 (1)	0.7 (6)	1.8 (3)	3.3 (1)	1.9
open, guarded	2.6 (2)	2.7 (1)	2.9 (2)	2.2 (4)	2.6
tube, unguarded	3.2	0.7 (5)	2.5 (2)	2.3 (4)	2.2
tube, guarded	4.3	2.3 (2)	2.9 (1)	4.0 (1)	3.4
mean	3.0	1.6	2.5	3.0	2.5

Table 3. Monthly rainfall and pan evaporation (mm). University Farm 1992-93

	Month									
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Rain	68	44	65	49	31	21	24	64	36	8
Evaporation	48	53	65	108	102	127	149	162	101	64

Results and discussion

Most open rooted seedlings survived well in the field plantings, with overall losses (Table I) after two months (around I%) and 6 months (around 15%) comparable with that of tubestock. Early losses during cool, moist conditions would have been mainly due to poor planting, seedling damage or possible simazine contamination, whereas losses after 6 months represented also the effect of warm dry conditions compounding any earlier problems.

A few of the dead trees were observed to have root deformation, some at the Speedling stage. There were no consistent differences between species at the different sites. The highest losses (57%) were from *Allocasuarina littoralis* at the University Farm, where the seedlings planted were very small after slow growth in the nursery, clearly a longer period in the nursery is required for such species.

In the trial at the University Farm (Table 2) there were substantial treatment differences at the first recording date. Growth and survival of A. *mearnsii* was best when grown as tubestocks protected by tree guards. With respect to *E. ovata* no substantial differences were recorded between open rooted and tubestock but guards appeared beneficial as they did in *Allocasuarina. E. viminalis* showed some benefit from use of tubestocks but no effect of guarding.

The second recording, after three dry months, (Table 3 with evaporation greatly exceeding rainfall) gave similar results to the first recording. Most eucalypts were making good growth but there were a number of deaths in the *Allocasuarina,* and growth was generally slow. Effects of water stress became apparent on some trees, although not with any differential effect on species or treatments.

The third recording was after a generally dry summer, with one wet week in February. Some seedlings had died in most treatments, except for *Acacia* grown from tubestock. Overall, least losses and best growth were recorded from guarded tubestock, but differences between other treatments were small. The small *Allocasuarina* seedlings suffered heavy losses without guards, whether from tubestock or open rooted. *E. viminalis,* on the other hand, gave nearly as good results from open rooted, unguarded seedlings as from guarded tubestock, which currently cost about four times as much to produce and plant.

Results of survival over the next year are required before more definite conclusions can be drawn, but clearly the open rooted technique has promise and the value of guarding needs to be questioned. It may be cheaper to not guard, and replace missing trees if necessary, even if growth is slower in the early stages.

Where trees are required quickly for example to shelter intensive crop production, guarded tubestock may still be worthwhile.

Further work is in progress or planned on the open rooted system, for farm as well as forest plantings. This includes the use of different types of Speedling trays, with treatments such as copper carbonate to reduce root deformation. Direct seeding in the nursery after priming seeds with polyethylene glycol to give more even germination has the potential to drastically reduce costs. Different forms and rates of antitranspirants and root dips are being trialled to reduce transplanting shock, as it is critical to minimise delays between lifting and planting with the current system. Sowing times need to be established for different species to reach an optional size for field planting. In the field, different herbicide rates and types need to be trial led.

References

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