Australian Master Treegrower's Course

Day 5 - Economics & Layout

"Robinson's" Agroforestry Trial, Bowelling

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Robinson's Agroforestry Trial

Aims: 1. To demonstrate the combination of wide-spaced trees for sawlogs with pasture for grazing - a possible strategy for combating salinity.
2. To determine timber yield of several species grown at wide spacing in the 600 mm rainfall zone.

Species planted:

Pinus radiata (Monterey pine) *Pinus pinaster* (Maritime pine) *Eucalyptus saligna* (Sydney blue gum) *Eucalyptus accedens* (powder bark wandoo)	planted 1981
P.radiata (woody cuttings) *P.pinaster* (seedlings - improved stock) *P.halepensis* var *brutia* (seedlings)	planted 1986

Soils:

The soils are yellow brown sands and gravelly sand in the north east, grading to grey gravelly sand in the remainder. In November 1981, Phosphorous levels (Olsen test) ranged between 10.5 and 18.8 p.p.m. (mean 13.5 p.p.m.); while potassium (de Turk test) ranged between 60.2 and 243.3 p.p.m. (mean 110.7 p.p.m.). These levels are acceptable for tree growth.
The duplex (wandoo) soils where most of the *P.pinaster* is planted is generally considered to be unsuitable for this species, as it is too shallow and wet in winter (*P.pinaster* prefers >2 metre deep, sandy soils).

Tree layout:

The 1981 plantings were planted in strips of 4 rows, 20 metres between strips. Trees were planted in rows 4 metres apart with 2 metres between trees in the row (a stocking of 1250 trees/ha within the strips). Orientation of the belts were north/south to maximise grazing potential.

In the 1981 eucalypt area, alternate rows of each species were planted at 4 x 2 metre spacing. The object of this arrangement was to determine whether the form of *E.accedens* will be improved when grown under a canopy of a faster growing species. A small area of only *E.accedens* was planted at this spacing to compare tree form.

Approximately 10 ha of each pine species and 6 ha of eucalypt species was planted.

1986 area. This has two layouts, or planting patterns; a.) single rows 14 metres apart and 1.2 metres between trees (595 trees/ha overall) and 2.) double rows 23 metres between strips with rows 3 metres and 1.45 metres between trees (564 trees/ha overall).

Comment on tree layout:

Tree layout on farmland is generally flexible. However. If the objective of your trees is for commercial purposes, it helps to understand some of the silvicultural requirements of the various species.

For example. If you wish to grow fencepost material from *P.radiata* you will need to plant the trees fairly close, so that branch size is kept small, otherwise pruning will be required to achieve the industry/market specifications. Other considerations are your soil type, rainfall, salinity etc.

Furthermore. If you decide to grow eucalypt sawlogs, you will need to grow at least 1000 trees/ha to achieve some selection of the "target crop trees". This means a tree spacing of 4 x 2.5 metres. Wider spacings will mean less tree selection and larger branch size.

Tree management:

Details of the tree management history for Robinsons are shown in Table 1.

As one of the key objectives of this trial was to produce sawlogs at wide spacing, pruning on time was necessary. Commencement of pruning should occur at an early age (from 3-4 yrs) to:

- minimise the defect or knotty core
- make the pruning operation easier and possibly cheaper, by removing branches when they are small.

Thinning, or culling, at an early age is necessary to remove the non merchantable trees (slower growing and malformed trees) and reduces competition on the crop trees.

Growers of commercial species need to clearly define their objectives during the planning phase, so that future tree management operations are considered, as are the "target logs" to be attractive for these markets.

Table 1. Tree management of 1981 & 1986 plantings of pine & eucalypt species at Robinson's Agroforestry Trial - Bowelling

Planted 1981		I	Planted 1986
Age (yrs)	**Operation**	**Age (yrs)**	**Operation**
	P.radiata		***P.radiata***
3	Culled to 400 spha (non comm.)	5	Culled double rows to 188 & single rows to 196 spha (overall) Pruned to 10cm or half ht.
4	Pruned to 10cm diameter or 60% tree ht.		
6.5	Culled to 200 spha (non comm.)	6	Pruned to 60% of tree ht. (~5m)
7	Pruned to 60% tree ht. (5-6m)	7	Culled to final stocking 140 spha
	P.pinaster		***P.pinaster***
6.5	Pruned to 10cm diameter or 60% tree ht.	5	Pruned to 10cm or 2 metres. Culled to 700 spha (non comm.)
12	Culled to 200 spha (non comm.) and pruned to 2.5-4 metres	8	Pruned to 60-70% of tree ht. (2.5 - 4.4m) Culled to 200 spha (non comm.)
	E.saligna/E.accedens		***P.halepensis***
5	Pruned to half tree ht. and culled poor formed trees	8	Pruned to half ht. or 2 metres Culled rubbish to 550 (single rows)or 750 spha (double rows)
8	Pruned to 7 - 8.5 metres and culled to 200 spha.		

Fertiliser has been applied at intervals during the period as a broadcast operation of 200 kg/ha of superphosphate or Super/potash. It is recommended that trees receive fertiliser regularly.
Hay was cut for the first 4 years between the tree belts over an area of about 13 ha. Hay production over the first three years was:

Year	Hay type	No of bales	Bales/ha
1981	pasture	1300	100
1982	oaten	2400	185
1983	oaten	1164*	90

* production loss by kangaroos

As the tree belts were not fenced, some returns were possible during the early years. Obviously for cropping/grazing land, tree arrangement will alter.
The site has been regularly grazed with sheep for the past 8 years. However, in 1983, sheep were introduced and there was considerable damage to the 1981 *P.pinaster* as the trees were too small for grazing, and which subsequently affected their growth and form.
Grazing of treed areas can commence from about age 4-5 years. However, if rough barked eucalypt species are planted, it is strongly recommended that these areas be NOT grazed (by any stock), as they will be ring barked and die.

Growth Data:

Growth data for 15.2 year old pine and eucalypt species is shown in Table 2. The older *P.radiata* at 178 trees/ha is on line to produce about 1.2 m3/tree by age 20, at which age it could be thinned.
E.saligna may also be ready for harvesting by age 20-25 years, which will produce about 1 m3/tree by this time.
P.pinaster may not necessarily be planted on these soils, and the growth rates reflect this.

Table 2. Growth data for 15.2 year old species at Robinson's Agroforestry Trial, Bowelling.

Species	Diameter (cm)	Height (m)	Total vol./ha (m3/ha) (within strips)	Total vol./tree (m3/tree)	Trees/ha (w/s)
P.radiata	41.3	19.9	162	0.94	178
P.pinaster	33.5	12.2	59	0.37	161
Euc.saligna mixed	38.2	18.3	60	0.70	223
Euc.accedens mixed	16.2	11.7	11	0.09	223
Euc.accedens only	18.4	10.6	36	0.10	355

Thinning scenario for *P.radiata* at age 20:

Thinning the 4 row belts (100 trees/ha) at age 20 will give a return to the grower of approximately $4,600/ha.

Assumptions:

Mean tree volume @ 1.2 m3
Mean log length pruned @ 6 metres (mid log @ 40 cm diameter)
Volume of pruned log = 0.83 m3 (for sawlog) = $41.60
Volume of unpruned log = 0.40 m3 (for chip) = $4.50
CALM Stumpages (See Table 4) - Sawlog (400-449mm) @ $50 m3;
Industrial wood @ $11.40 m3 (assumed as merchantable)

An example of costs and returns from a wide-spaced pine regime are shown in Table 3.

Table 3. Tasks, approximate costs and returns of the forestry component of wide-spaced radiata pine (Moore et al, 1991).

Tree age (years)	Operation	Cost ($/ha)	Returns ($/ha)
0	Weed control (strips 1.5m wide, 10m apart)	$20*	
	Seedlings (670/ha)	$75**	
	Planting	$45#	
	Fertilising (150 g Super Copper Zinc per tree)	$35	
4	Cull to 150 trees/ha	$60	
	Prune	$75	
5	Prune	$120	
6	Prune (with 'squirrel')	$225⊗	
18-20	Thin the crop (leave 50 trees/ha)		$2,000 to $6,000
30	Harvest final crop		$3,500 to $10,000
	Total	$655	$4,500 to $13,000

Note:

* based on contract price of $40/hour
** based on cost of 11 cents/seedling
# based on hand planting rate of 1,500/day and wage rate of $10/hour
⊗ based on hire rate of $15/hour for 'squirrel' x $15/hour for operator (pruning 20 trees/hour)

Reference

Moore, R., Jenkins, P., Anderson, G. and Scott, P.(1991). Agroforestry with widely-spaced pine trees. Department of Agriculture, W.A. Bulletin No 4176.