

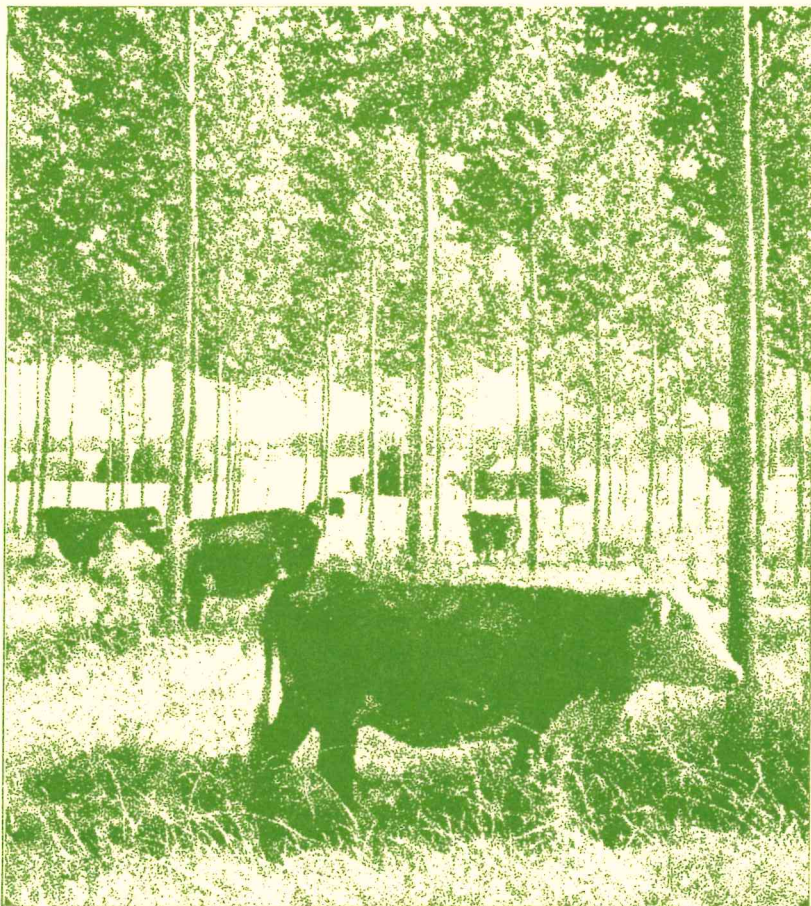
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AGROFORESTRY

an alternative approach to farming



How to grow radiata pine on farmland in W.A.
with pasture or another crop.



Department of Conservation and Land Management, W.A.

Agroforestry

Combining a softwood timber crop with other forms of agriculture on the same land can make fuller use of available space, soil, and water, and lead to higher productivity from farms. This is known as agroforestry, and it can take many forms.

This brochure outlines a program for growing radiata pine on farmland in W.A. in conjunction with either pasture or another crop.

The main objectives are to produce high quality timber while maintaining adequate pasture for grazing or fodder cropping until the timber is harvested.

Before You Start

Local rainfall and soils will determine if pine can be grown successfully, and the species best suited to the area.

Rainfall

Radiata pine grows best in areas where the average annual rainfall is at least 750 mm, however if trees are planted a reasonable distance apart there is less demand on the available water and 600 mm a year may be adequate. In the cooler areas of W.A., particularly along the south coast, an even lower average may do, but seasonal reliability is important.

Soils

Loams and sandy loams, preferably at least 90 cm deep above rock or clay, are most suitable for radiata pine.

Shallow sandy soils, heavy clay, and poorly drained areas inhibit deep root growth, which in turn may lead to slower growth and trees blowing over.

Infertile deep white sands are better suited to growing *Pinus pinaster* and wet sites are best planted with *Pinus taeda*.

Please note: Obtain advice about suitability of soils from the Department of Conservation and Land Management (CALM) before starting to plant pine. Addresses are listed at the end of this pamphlet.

Preparing the Ground

Before planting young pines some site preparation is needed to ensure that they survive and grow well.

In pastured land grass and weeds must be controlled. First, graze the area heavily: this will greatly reduce the amount of herbicide needed. A mixture of amitrole and atrazine should then be sprayed in a 1.5 m wide strip to give effective control along the planting lines. Do this either two weeks before, or immediately after planting. Application rates will depend on the type of soil and the type and size of weeds present. Application rates are given below. Further details are available from CALM advisory officers.

Height of weeds at time of spraying	Herbicide mixture (litres/hectare)	
	Amitrole liquid herbicide (knockdown) 250 g/l	Flowable atrazine (residual) 500 g/l
Less than 5 cm	2.4	3 - 7 depending on
5 - 10 cm	4.0	the amount of late
10 - 20 cm	6.4	germinating species
greater than 20 cm	9.0	that are expected

Calibrate boomspray to deliver 200 - 300 l/ha.

Add wetting agent at a rate of one l/ha.

On most pastured sites weed control is the only preparation needed, but if the soil is heavily compacted ripping along the planting lines will break up the subsoil, allowing the pine roots to penetrate more easily. Deep ripping (to about 1 m) is more effective than shallow ripping. In steep country take care that ripping does not lead to gully erosion.

Wet areas should be drained or mounded. A special mounding plough or a three-point-linkage grader blade are both effective for mounding.

If farmland is being developed from native bush it is more practical to clean up and level the area before the pines are planted. The standard of development will be determined by the intended agricultural use of the land.

Rabbits should be kept in check. They can severely damage and kill young pines by gnawing the bark and growing tips.

Planting

Careful planting will ensure the survival of more young pines, and give better early growth.

Plant between May and July, but make sure that the soil is moist below the surface before starting.

The seedlings are despatched from the nursery in hessian bags, and these should be kept moist until the pines are planted. To prevent drying out they are best stored in the shade, out of strong winds. Bury the bags in soil and keep damp if you intend to delay planting for any length of time.

Planting can be done either by hand, using modified spades called 'planting spears', or by planting machines. Planting machines can be purchased, hired, or constructed on the farm. Many models are available and can be inspected at field days.

The trees can be arranged in many ways, but the final choice will be determined by the intended agricultural use, the topography of the site, and personal and aesthetic considerations. Single rows, double rows and clumps are all acceptable as planting patterns, but seedlings should be at least 1.5 m apart, and at least 10 m should be allowed between rows.

Make sure that the soil is compacted firmly around the seedlings to avoid air pockets forming near the root system: these can kill young trees.

For every tree wanted in your final crop it is necessary to plant between five and seven seedlings. This gives a large enough selection from which to choose the best timber producing trees. To maintain a reasonable balance between agricultural production and timber production this program recommends approximately 100 trees per hectare in your final crop, in which case it is necessary to initially plant between 500 and 700 seedlings per hectare.

New tree breeding programs, and the use of clone cuttings from selected parent trees, are improving the average quality of young pines supplied for planting on farms. Using high quality cloned stock can reduce the ratio between planted seedlings and crop trees from 7:1 to 3:1. This, in turn, will significantly reduce the amount of work needed to look after your crop.

Fertilizing

Fertilizer should be applied to each tree after planting. Use Super Copper Zinc A, or AGRAS No. 2 with minerals, and apply at a rate

between 100-150 g per tree. To get the maximum benefit, and to avoid burning the young seedlings, fertilizer should be placed at least 15 cm from the tree, and buried rather than spread over the ground.

Looking After Your Pine Crop

Trees must be pruned and thinned on time. Delaying or avoiding these important tasks will result in lower quality timber and less pasture, both of which will decrease profitability.

Thinning

Your original seedlings need thinning out as they grow. By the time the trees are around six years old, and about 10 m tall you should have only the best 100 trees per hectare left as your final crop.

Start culling the inferior trees at about three years old. At this age undesirable characteristics can be recognized. Crooked trunks, large branches, forked or multi-stemmed trees, and poor growth are all undesirable. Look for straight trunks, fine branches, and narrow, healthy crowns in the trees you are going to keep as your crop.

A Typical Culling Program

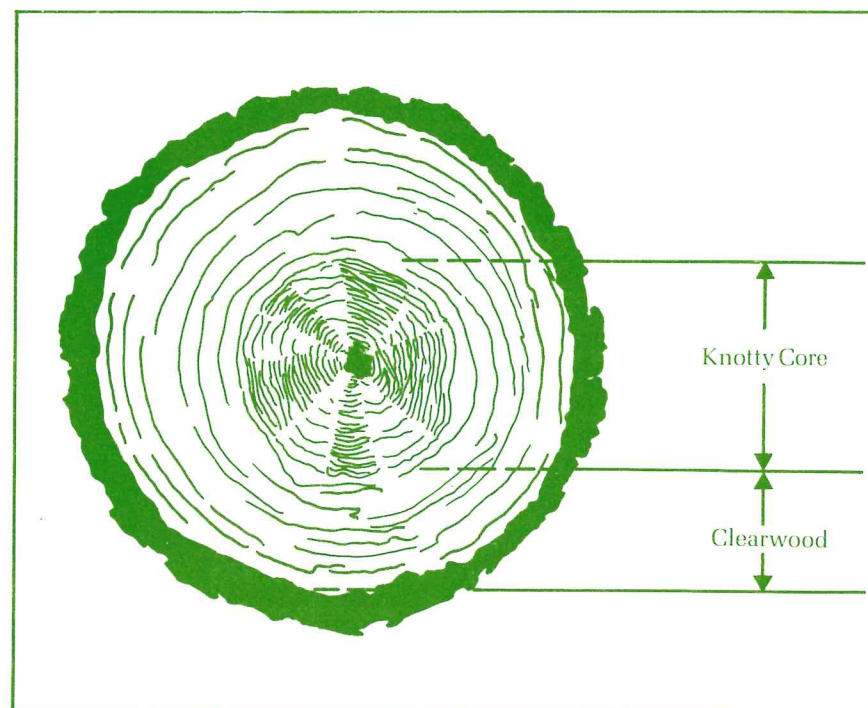
Age (Years)	No. Trees/ha		Tree Spacing
	Seedlings	Cuttings	
0	670	300
3	300	150
4-5	150	150
6	100	100

Poorly formed trees are gradually culled to leave 100 crop trees. The figures are a guide only and need not be rigidly followed.

Pruning

Pruning the lower branches from the pines allows more light to the ground for pasture growth, makes it easier to manage stock, and reduces the risk of fire damaging the growing crown of the tree. Most importantly, correct pruning reduces the size of the knotty core in a log, and produces the maximum volume of knot-free wood ('clearwood').

Cross section of a Pine Log

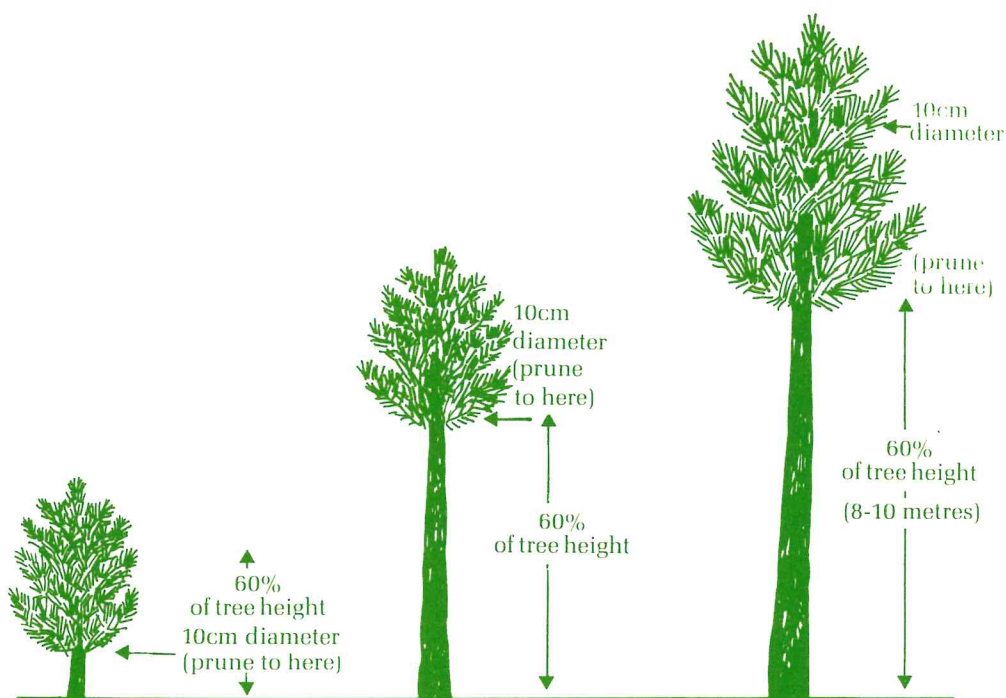


Young trees should be pruned in autumn or early winter. Spring or summer pruning can place the trees under stress and slow their growth.

The first pruning is usually necessary three years after planting.

How to Prune

- Remove all branches with long handled secateurs or jacksaw where the trunk is 10 cm in diameter or more (but never prune more than 60 per cent of the tree's total height). Use home-made calipers to measure the 10 cm.
- If a whorl of branches is immediately above the 10 cm diameter mark, then remove that whorl.
- Remove any forks or steeply angled branches.



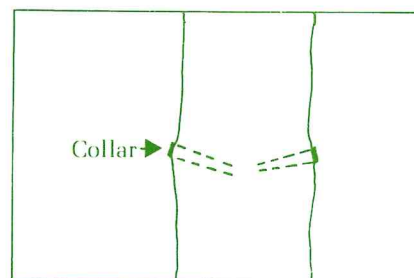
Points to note

When removing branches take care not to damage the wrinkly wood around the base of the branch (the 'collar'). The collar contains the tissue which produces new wood cells, and if too much of it is removed or torn the pruning will take longer to heal and open the tree up to attack by fungi, as well as lowering the quality of the timber.

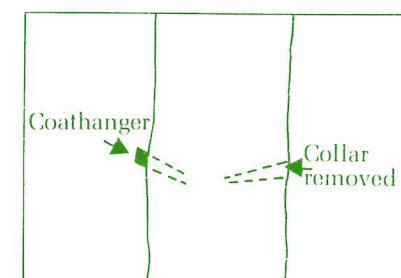
Branch stubs ('coathangers') should not be left on the tree. It takes a long time for the tree to grow over these stubs, and incorrect pruning will lower the quality of the timber (See diagram for the correct method).

REMEMBER: Always prune on time. Delays can cause the knotty core to increase in size, and allow large branches to develop which are both difficult and expensive to remove.

Correct Pruning



Wrong



Tools

Tools for pruning include:-

- small hand shears
- light chainsaw
- extended hand shears
- sawblades on long poles ('polesaws')
- modified orchard pruning platform ('squirrel')
- ladders and jacksaws
- hydraulic or pneumatic shears powered from a tractor.

Your choice of equipment depends on the size of the job and the labour available.

Dealing With Waste

The debris produced by thinning and pruning will cover pasture and can make managing stock more difficult, however, if this tree tending program is followed no more than 10 per cent of the ground will be covered.

Debris can be stacked in rows near the trees, and then removed or mulched, but these measures are usually unnecessary if the program is on schedule.

Debris also has some advantages: it provides shelter at ground level for stock and pasture; and while fresh it makes useful feed for sheep. Young green pine needles have more feed value than dry annual pastures, and can be used to supplement dry feed in autumn.

Farming Amongst Pines

Young pines are very susceptible to damage by stock during the first two years of growth, and we recommend growing fodder or cash crops between the pines during this period, rather than grazing stock.

Pasture will deteriorate without grazing, so cutting earlier for silage could be better than hay, however, crops such as oats or vetches can make excellent hay.

Fertilizer applied to crops will give sufficient nutrients for the pines, however legume-based pastures should be included in a cropping program in order to provide adequate supplies of nitrogen.

Stock may be introduced at the end of the second year, but watch closely for signs of tree damage. Slight nibbling of the branches is acceptable, but stripping off the bark or breaking the growing tips is serious. If trees are damaged change the stock being grazed amongst the pines. Restricting the paddock from grazing may be necessary. In general, poddies cause less damage than older cattle, lambs are better than mature sheep, and ewes are better than wethers.

The quantity of pasture available for grazing will depend on the number of trees you have, the height of pruning, and the amount of debris on the ground. A high stock carrying capacity can be expected under 100 trees per hectare at 10 years old, but this will gradually diminish as the pasture deteriorates under older and taller trees.



Harvesting Your Timber Crop

Trees will usually be large enough to harvest at anytime between 18 and 40 years of age. The older trees are more valuable, not only because they are larger, but also because the logs contain a smaller proportion of knotty, immature wood.

There is a great flexibility as to when trees can be felled for timber, depending whether the emphasis is on agricultural or timber production. A reasonable balance would be achieved by thinning out half the trees at 18 years old. This will open up the area and rejuvenate the pasture, as well as providing the first returns from your timber crop.

Felling and transporting the logs can be done either by yourself, or by a logging contractor. If you lack the necessary equipment or experience to handle large logs it is advisable to get a contractor to do the job. The log purchaser will usually bear the costs of harvesting.

Logs can be milled either on site using a portable spot mill, or at a sawmill.

Debris created by the harvesting should be pushed into heaps, and burnt during winter.

Managing Your Pine Crop

(All figures are approximate)

Age of Trees (Years)	Operation	Cost (\$/ha)	Returns (\$/ha)
0	Weed control (strips 1.5 m wide, 10 m apart)	\$ 15 *	
	Seedlings (670/ha)	\$ 35 **	
	Planting	\$ 36 †	
	Fertilizing (150 g Super Copper Zinc per tree)	\$ 27	
3	Cull your crop (leave 300 trees/ha)	\$ 30	
	Prune	\$ 25	
4	Cull (leave 150 trees/ha)	\$ 20	
	Prune	\$ 50	
5	Prune	\$ 75	
6	Cull (leave 100 trees/ha)	\$ 20	
	Prune (with "Squirrel")	\$100 \$	
7	Prune	\$100	
8	Prune	\$100	
9	Prune	\$100	
10	Prune	\$100	
18	Thin your crop (leave 50 trees/ha)		\$ 1 000 to \$ 3 000
30	Harvest your final crop		\$ 3 500 to \$10 000
TOTAL		\$833	\$ 4 500 to \$13 000

NOTE: * based on contract price of \$35/hour
 ** based on cost of 5¢/seedling. If cuttings are used, only half the number are required but cost is about 20¢ each. Therefore the cost using cuttings will be about \$70/ha.
 † based on hand planting rate of 1500/day and wage rate of \$10/hour.
 \$ based on hire rate of \$10/hour for the "Squirrel", \$10/hour for operator and pruning rate of 20 trees/hour.

These estimates indicate that tree tending costs average about \$8-10 per crop tree (assuming 100 crop trees per hectare). These costs will vary from farm to farm depending on the conditions and exact methods used. Delaying tree tending will invariably result in increased costs and lower returns from grazing and timber. The returns will vary greatly depending on soil quality and amount of rainfall.

Profitability

A study of the economics of agroforestry at Manjimup indicated that, in the long term, agroforestry programs can be twice as profitable as grazing alone. The disadvantage is the long wait for returns from the timber crop. This can be largely offset by planting only a small proportion of the farm at any one time, and staggering later plantings to spread out the effect of lost grazing. For more details refer to 'An economic study of agroforestry in the Manjimup region, Western Australia', by G. Malajczuk *et al.* published by the Forests Department of W.A. and available from CALM.

The value of pine sawlogs is also expected to increase as the demand for sawn timber rises, and the amount of hardwood available for milling decreases.

Further Information

Advisory officers from CALM can give you further advice on agroforestry, and will be pleased to discuss any of the matters raised in this pamphlet.

The Department of Agriculture can offer assistance on farming problems.

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Further Reading

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