Radiata Pine

Info Sheet No. 1 – Why Grow Radiata Pine

This series on Radiata Pine has four parts. Each part can be read individually or as part of the series.

1. **Why Grow Radiata Pine?**
2. Establishment
3. Pruning for Clearwood
4. Labour Estimates

WHY GROW RADIATA PINE?

Radiata pine (*Pinus radiata*) originates from 3 small populations in coastal California and 2 small islands off Mexico. As a plantation species it has become the most widely planted softwood species in the Southern Hemisphere. Chile and New Zealand have the largest plantation estates, with well in excess of 1 million hectares each. Radiata pine was introduced to Australia in the 1850's. There are now approximately 750,000 hectares growing mainly in southern Australia. Its outstanding success as a plantation species is due to the following:

1. Australia is relatively free from most natural pests and diseases of Radiata pine.
2. Radiata pine is robust and relatively easy species to grow.
3. Growth rate is rapid on suitable sites.
4. There is a history of breeding for improved characteristics.
5. There is a wealth of scientifically-based information on all aspects of growing Radiata pine more than any other species.
6. There is a well-established market with a wide range of end uses.
7. There are proven economic returns in excess of inflation when grown on suitable sites and appropriately managed.

In Tasmania, landholders and industry have long grown Radiata pine plantations with established domestic and international markets. The current private plantation area of approximately 22,000 hectares represents 28% of the total Radiata pine plantation estate in Tasmania with the balance largely managed by Forestry Tasmania and Timberlands or Norske Skog. While a number of processors in Tasmania have established their own plantations, they also rely on other plantations to meet the majority of their wood supply requirements.

Radiata pine is more tolerant of a wide range of soil types and fertility, temperature, elevation and rainfall than most other tree species. It is a flexible forestry species for landowners throughout most of Tasmania. Radiata pine can be a cost-effective use of marginal land and viewed as superannuation or as a means of adding value to a property.

Farm labour can be used for plantation management when other activities may be quiet, while many landowners find tree growing an enjoyable and rewarding exercise in its own right.

END USES, MARKETS & STUMPAGE

Clearwood Veneer Logs

- Veneer mills slice clearwood logs for appearance grade veneers.
- Processed in 2.7 and 5.4m lengths.
- Minimum Small End Diameter (SED) of 35cm.

Clearwood Sawlogs

- Processed in lengths of 3.7, 4.9 and 5.5m lengths.
- Minimum SED of 35cm.
- Processors may require trees aged 27-34 due to wood quality issues such as density and brittleness.

Knotty sawlogs

- A range of sizes and quality is processed for domestic use and for international export.
- Higher quality knotty sawlogs are commonly processed for structural timber and, to a lesser extent, as appearance grade products for furniture and building products.
- Lower quality knotty sawlogs are usually processed for low value products such as pallet material, or rotary peeled for construction grade plywood.
- Markets for knotty sawlogs, both domestic and export, generally fall into two broad categories depending upon quality. The following figures are a guide only, as different processors vary depending on log and branch diameter specifications. For example, a maximum Large End Diameter (LED) of 70-90cm may be specified, depending upon the purchaser.
  - *Category 1* SED > 30cm with small branches (<5-7cm).
  - *Category 2* SED > 20-30cm and logs with larger branches (>5-7cm).
- Common sawlog lengths are 3.7, 4.3, 4.9, 5.5 and 6.1 metres. Longer lengths of 7-11 metres may attract a premium.
- Other mills can process small diameter knotty sawlogs (15-34cm diameter) in 4.9 and 5.5m lengths.

Preservation Material - (posts & poles, outdoor construction, garden sleepers, etc.)

- Purchased by several mills in the North and North-west of the State. Currently there is a shortage of quality preservation material.

Posts & Poles

- Slow grown timber with small branches, minimum age of 17-18 for strength purposes.
- SED of 50-300mm, with 25mm increments.
- Lengths of 1.8m to 3.0m (0.3m increments), 3.6m, 4.8m and 6.0m.

Pulpwood

- A domestic pulpmill produces pulp for paper products.
- Minimum age 15, with 17-18 year old trees preferred.
- SED of 10cm to a LED of 40cm.
- 2.4m to 11.0m lengths.
- Stumpage of $5 or less per cubic metre.
- Export pulpwood markets can be cyclical, depending upon international markets, exchange rates, and shipping costs, etc.

Future Markets

Despite a large Radiata pine resource, particularly on mainland Australia and overseas, there is some concern regarding future shortfalls of quality pruned and unpruned sawlogs here in Tasmania. It is expected that high quality Radiata pine plantations will be readily marketable, with timber prices traditionally keeping pace with inflation.

WOOD PROPERTIES & PROCESSING

The wood properties of Radiata pine include:

- Light straw-coloured softwood species with medium density.
- Excellent machining, painting and staining properties.
- Good strength to weight ratio, nail holding and gluing ability.
- Relatively easy to saw and dry with suitable equipment.

Unfortunately, on-farm processing for high value end uses is generally not possible. Although logs can be sawn with portable equipment, air-drying is not feasible due to the development of 'blue stain'. Blue stain is a fungus that results in a light blue colour developing within the wood. Although mechanical properties are unaffected, this staining is unacceptable for appearance grade products. Kiln drying to lower moisture content following sawing is required to prevent this staining.

TREE & WOOD QUALITY

Establishment and management practices impact upon tree and wood quality. The marketability and returns at harvest can be determined by tree and wood quality.

TREE QUALITY CHARACTERISTICS

Volume of clearwood - determined by the size of the defect core following pruning and the diameter of the tree at harvest.

Straightness - bends or sweeps in trees will reduce available log lengths and the output of timber products.

Lack of forking - forking can result in crown breakage and reduced log diameters above the fork.

Branch size - increased branch sizes result in a downgrading of log quality due to reduced strength and appearance characteristics.

Branch distribution - greater numbers of branches for a given log length can reduce strength and appearance characteristics.

Reduced straightness, forking, large branches and an increase in the number of branches will all increase harvesting costs and reduce the stumpage (farm gate price) paid to the grower.

WOOD QUALITY CHARACTERISTICS

Wood density is a significant aspect of wood quality, as it relates to stiffness and strength. Wood density increases with tree age. There is an increase in wood density geographically from south to north. Wood density also decreases when grown at higher elevations. Despite differences in wood density between latitude and elevation, it is the variation in tree age that is most significant for wood density and subsequent wood quality. Growth rate and rotation age will have the greatest impact upon wood density.

Stiffness is the ability of a piece of timber to support a load while minimising deflection or bending. Stiffness is less important for appearance grade products in comparison with structural products.

Strength is the ability of a piece of timber to support a load without breaking. It is important for structural framing and some appearance grade products where strength is required, such as some furniture components.

Stability is the amount of distortion and defects introduced during the processing stages of sawing and drying and movement of timber components in finished products: variation in timber dimensions occurs with changes in moisture content of the surrounding environment. Stability can be significantly reduced by the presence of compression wood and '*corewood*'.

Compression wood is the formation of denser, darker wood within trees under environmental stresses. Leaning trees can develop enormous weight imbalances, imparting pressure on the stems and root systems. Softwood species develop compression wood within the stem on the underside of the lean to counteract the weight imbalance. In effect, the compression wood is attempting to 'push' on the underside of the lean to counteract the weight. By comparison, hardwood species develop tension wood on the upper side of a lean, attempting to 'pull' against the lean.

Compression wood may also form within stems in response to the following:

- Excessive wind sway, particularly following heavy thinning.
- Unbalanced crowns due to uneven spacing within a stand.
- Excessively large branches.

Spiral grain is where the grain direction spirals around the stem rather than being orientated vertically. The incidence of spiral grain decreases with tree age and is generally confined to the *'corewood'*. Stiffness and stability is reduced significantly by spiral grain.

Internal checking is where splits/checks develop within the timber during the drying process and can be a major cause of downgrade in clearwood. It can be controlled to some extent by careful drying regimes. Sites subject to drought, waterlogging or frost may increase the incidence of internal checking.

Needle fleck is where small dark spots form within the timber at the base of stem needles. They can be avoided by ensuring that all stem needles are removed during pruning operations.

Heartwood generally begins to form around age 12-14, developing at approximately half an annual growth ring per year. It forms a darker pink/brown colour. It is more difficult to treat with preservatives and has different drying and pulping qualities than the desirable sapwood.

Colour can be affected by the presence of heartwood and compression wood. For appearance grade products, the consistent colour of the sapwood is important.

Resin pockets can severely downgrade the value of sawn timber and veneer for appearance grade products. Research in NZ indicates they are more commonly associated with low stockings in areas subject to strong wind exposure. Pruning and thinning have also been linked with a higher incidence of resin pockets. External resin bleeding not associated with bark damage or pruning may be indicative of internal resin pockets.

Bark encased knots are also referred to as 'black knots' and form following the death of a branch. Bark at the base of a dead branch is retained while the stem wood grows over the dead bark and branch base. The knots can become loose and even fall out of the sawn product. They are often detrimental to both structural and appearance grade knotty products.

Corewood is also known as 'juvenile wood' or the 'juvenile core', it is generally considered to contain the first 10 growth rings. At the base of the tree, 'outerwood' will begin to form at approximately age 10. The incidence of spiral grain and particularly low-density wood is generally considered to be confined to the corewood.

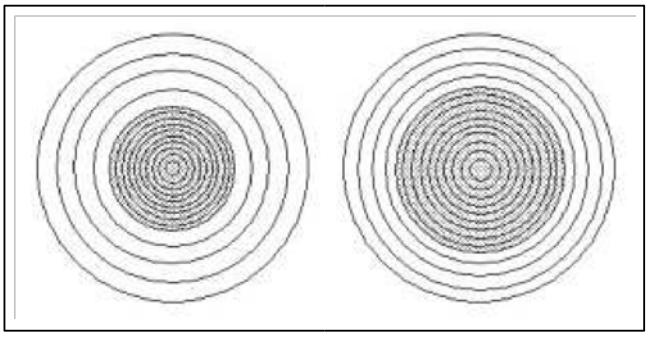

Diagram 1

Corewood (represented by the shading in diagram 1) is shown within trees of similar diameter. A greater recovery of 'outerwood' with improved wood quality characteristics can be sourced from the tree on the left. On lower quality sites, the proportion of corewood is usually small due to slow growth.

On fertile sites, particularly at low stockings with short rotations, the juvenile core can account for a substantial volume within the pruned butt log. Silvicultural techniques can be employed to increase the proportion of outerwood with improved wood quality and subsequent value to the grower when grown on fertile sites.

AIM TO GROW A QUALITY PRODUCT

Small-scale forestry has some disadvantages when compared to larger industrial scale forestry, including:

- A lack of volume to enable negotiation on price and the timing of sales; and
- Relatively high harvesting costs due to smaller areas and/or steeper slopes.

Smaller growers should aim to ensure the production of a consistent, high quality product and, where possible, coordinate harvesting schedules with other growers in the area. Processors are more likely to accept harvesting and price negotiations if confident that the wood quality meets or exceeds their expectations, as improved wood quality enables a greater proportion of the processed timber to be sold for higher prices.

Advantages of Small-scale Forestry

Private foresters have the opportunity to produce high quality products to very specific standards largely because smaller farm-scale operations can utilise timely management that is difficult to achieve with larger industrial scale plantings adapted from [1].

Even if high quality farm-grown plantation trees do not attract a premium, compared to standard industrial plantation trees, high tree and wood quality will improve marketability. The ability to sell plantation trees at a time that suits the landowner is valuable and high standards of management should command a premium.

SITE PRODUCTIVITY

The following table is a guide to the potential site productivity for Radiata pine plantations in Tasmania. The most limiting factor on any site determines the likely productivity class. The most accurate estimate of productivity can be gained by measuring growth of existing adjacent or nearby plantations with similar land attributes.

LAND ATTRIBUTES	Class 1A MAI >30	Class 1B MAI 20-30	Class 2 MAI 15-20	Class 3 MAI 10-15	Class 4 MAI<10
Productivity	Very High	High	Medium	Low	Very Low
Elevation (m)	<500	500 - 600	600 - 700	600 - 700	>700
Mean Annual Rainfall (MAR) (mm/year)	>1100	800 - 1100	600 - 800	600 - 800	<600
Drainage	Rapid	Moderate	Imperfect	Poor	Very Poor

Soil Profile Effective Rooting Depth (ERD) Stone	>80cm <10%	>80cm 10-30%	45 - 80cm 30-50%	20 - 45cm 50-90%	<20cm >90%
Nutrient Status Phosphorus - P (ppm) Nitrogen - N (%)	 >250 >0.2	 100 - 250 0.1 0.2	 100 - 250 0.1 - 0.2	 <100 <0.1	 <100 <0.1

MAI (Mean Annual Increment) the volume of wood in cubic metres produced per hectare per year (m^3/ha/yr).

Elevation above sea level can be used as a guide to the average temperature and length of the growing season (both decrease with increasing elevation) and the incidence and severity of frosts (increased with increasing elevation).

Mean Annual Rainfall (MAR) is a measure of moisture availability. It can be affected by other factors such as soil type and depth (water holding capacity), aspect and slope.

Drainage is an indicator of the extent of waterlogging, as it is detrimental to the growth of trees. Ripping and mounding may reduce the extent of waterlogging during the establishment phase.

Soil profile is determined by the Effective Rooting Depth (ERD) and the percentage of stone content within the ERD zone. ERD is the depth to which a physical barrier impedes deeper root development, such as bedrock, solid clay subsoils, waterlogged zones or stone horizons containing little or no fine earth. Deep ripping can shatter compacted subsoils or cemented pans to increase the ERD in some conditions.

Nutrient status can be determined by soil analysis of the top 10cm of mineral soil. The most widespread limiting nutrients in Tasmania are phosphorus (P), measured as parts per million (ppm), and nitrogen (N), although other nutrients may be limiting in some soil types. Fertilisation can offer a significant increase in growth on many soil types if lack of nutrients is the most limiting factor to site productivity.

Position in the landscape may impact upon the previous land attributes:

- Sites with poor cold air drainage, resulting in lower temperatures and frost hollows, can occur even at relatively low elevations close to the coast.
- Northern aspects will have higher temperatures than southern aspects.
- Southern and westerly aspects usually experience greater wind exposure than northern and eastern aspects.
- The soil profile, nutrient status and moisture availability are often greater at lower positions within the landscape.

REGIME OPTIONS for Radiata Pine

Clearwood Production

Clearwood can be grown on low to very high productivity sites. Clearwood regimes are recommended over other regimes for high to very high productivity sites because of the premium for clearwood logs, economic returns and final cash at harvest.

Knotty Sawlog

The production of knotty sawlogs is generally suited to low to medium productivity sites. Moderate growth rates are suited to growing structural timber with good strength properties. Knotty sawlogs can be grown on high to very high productivity sites and may suit landowners who are not prepared to undertake pruning operations. Fast growth rates can reduce strength properties for structural purposes.

Preservation Material

The growing of Radiata pine for posts and poles should be restricted to low to very low productivity sites. High to very high quality sites have growth rates that are too rapid for the production of strong posts and poles.
In Tasmania, rainfall is often the limiting factor to tree growth on sites with less than 1,100mm annual rainfall.

PESTS & DISEASES

Although *Pinus Radiata* is generally a very hardy species, some pests and diseases can impact upon health and productivity. A wide range of fungi and insects can infect Radiata pine throughout Tasmania.
Most are of relatively minor significance. The following are some of the more common and damaging pests and diseases.

Dothistroma Needle Blight

Present in all Radiata pine stands in high rainfall (>1,200 mm/year) areas, particularly at higher altitudes. The disease is common in young trees, with resistance developing with age. Needles of all ages can be affected. Reddish coloured bands can be observed on the needles. Needles turn brown and are cast. Infection progresses from the base of the tree to the crown. Defoliation reduces volume production. Increasing airflow through thinning and pruning can reduce incidence of the disease. Severe infestations can be controlled by aerial application of copper fungicides.

Spring Needle Cast

A significant disease of Radiata pine in Tasmania which is caused by a range of fungi. It mainly develops on higher elevation sites (>400 m) with high rainfall (>1,200 mm/year). Symptoms appear at the time of canopy closure. The current season's needles (<1 year old) turn red-brown and are cast, resulting in partial defoliation of affected trees and tree suppression. The proportion of trees affected within a stand increases with increasing

altitude and rainfall. Onset of the disease can be delayed by thinning prior to canopy closure. There are currently no control methods.

Cylaneusma Needle Cast

Occurs in all areas of Tasmania and is of moderate significance. Young needles are infected, turning yellow then yellow-brown before being cast in their second or subsequent years. Affected needles occur in the lower crown and the disease progresses further up the crown, with increasing severity. It is rare in trees less than 3-4 years of age. There are currently no control methods.

Sirex Wood Wasp

Females of the wood wasp (*Sirex noctilio*) lay their eggs in the sapwood of standing trees and introduce a wood-decay fungus. Affected trees are those that are under stress through competition, primarily in unthinned stands subject to drought, poor nutrition, defoliation or damage due to wind or hail. Tree mortality is common, although usually concentrated on smaller diameter trees. Good plantation management (e.g. appropriate thinning) minimises the risk.

Phytophthora Root Rot

The soil-borne fungus *Phytophthora* causes infection and rotting of the roots. Mortality is usually restricted to trees less than 3 years of age. A minor problem within Tasmanian plantations, damage is restricted to areas that are flat (<5% slope) with poor drainage. Avoid planting on high-risk sites.

Armillaria Root Rot

The fungus *Armillaria* causes infection and decay of the bark and sapwood of the roots and lower stem. It is widespread throughout Tasmanian plantations, especially those established on ex-forest sites. Mortality of trees less than 4 years of age can occur, although it is usually insignificant. Stump removal from previous tree crops can be used to limit impact.

FURTHER ASSISTANCE

Private Forests Tasmania provides planning, technical and financial advice on all aspects of plantation establishment, management and harvesting. Field days are held to discuss and demonstrate establishment and management. Private Forests Tasmania offices are located in Burnie, Launceston and Hobart.
Information can also be obtained from the following websites:
Private Forests Tasmania www.pft.tas.gov.au
Australian Forest Growers www.afg.asn.au
Farm Forest Line www.farmforestline.com.au

FURTHER READING

Maclaren, J.P., (1993), Radiata Pine Growers' Manual, FRI Bulletin No. 184, New Zealand Forest Research Limited.

TAS Land & Forest, (2003), Management Regimes for Low Rainfall Radiata Pine Plantations, Report for Private Forests Tasmania. This report outlines potential regimes, growth rates and markets for Radiata Pine plantations grown on low rainfall sites (<1100mm annual rainfall) in Tasmania.

REFERENCE

[1]Laffan, M.D., (1997), Site Selection for hardwood and softwood plantations in Tasmania. A methodology for assessing site productivity and suitability for plantations using land resource information, Soils Technical Report No. 3, second edition, Forestry Tasmania and Forest Practices Board, Tasmania.

ACKNOWLEDGMENT

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