Information Series

No. 1 - Selecting Species and Site

Generally, for best tree growth, climate and soil type should match that required by the tree species in its natural environment. Where conditions differ substantially from these, tree survival and growth will often, but not always, be reduced.

When selecting species consider those for which markets exist and are within your ability to manage. Usually species can be quickly selected and the challenge is to find suitable land on which to grow them. When choosing sites, try to identify factors that restrict tree growth. The ideal site has no limiting factors. Once a match is found between a species and a site, the silvicultural regime, costs, wood and cash flows can be estimated.

Species requirements are provided in the *Information Series, Sheet No. 14 - Tree Species List*, or in other publications. Species requirements and growth can sometimes be confirmed by local observations.

Factor	Influence on tree survival and growth
Temperature	Minimum temperatures and frequency of frosts must be considered. Inland species provenances often tolerate frosts better than coastal ones. Elevation is often used to determine frost tolerance. Generally the higher a tree naturally grows, the higher its frost tolerance.
Moisture Availability	Trees require moisture throughout spring, summer and autumn to grow. The ability of soil to hold moisture is important especially where summer rainfall is infrequent or low. Sites with perched water tables or fairly stable local water tables may favour tree growth in low rainfall areas. Soils containing organic matter and clay hold water better than sands. Water requirements may be supplemented by irrigation, ground water or use of sites with wetter (southern) aspects.
Drainage	Tree roots need oxygen for growth. Avoid seasonally water logged sites unless the species chosen requires, or is tolerant of, such conditions for growth. Water logged sites are difficult to establish and logging may cause deterioration of soil and water quality. Caution should be exercised where water tables markedly rise and fall during the year because tree roots will either be unable to access water or be drowned.
Rooting Conditions (Effective Rooting Depth)	Tree roots need to be able to explore soil over a large area and to a considerable depth. Tree roots occupy about the same space as the trunk and branches of a tree. Soil depth should, if possible, exceed 50 centimetres for good tree growth. Avoid hard pans or heavily compacted soils unless you can deep rip or cultivate them. Avoid soils with lots of rock or very heavy clays.
Nutrient Availability	Nutrients, particularly phosphorous, nitrogen and organic carbon, need to be available in the top 10 centimetres for good tree growth. (Even so, starter fertilisers are often applied at planting to promote initial tree growth). Sites with a long history of heavy fertiliser use may require specially bred tree stock to avoid abnormal growth due to high site fertility.

Weeds	Sites with lots of different weeds or heavy weed cover can be difficult and costly to establish to trees and maintain. Land free of persistent woody weeds (e.g. gorse) is easy to plant to trees and pasture grasses are easily and cheaply controlled.
Other Factors	
Aspect	Aspect influences temperature, moisture availability and effects of wind. Exposed aspects have greater impact on tree growth.
Trafficability	A good access route, capable of carrying about 40 tonnes, is needed between the farm gate and proposed site.
Flood Hazard	Avoid sites prone to flooding.
Erosion and Landslide Hazards	Avoid sites prone to erosion or be prepared to tailor operations to minimise erosion.
Slope	Steep slopes are more costly to establish, road and harvest. Try to minimise slopes.
Vermin	Sites close to populations of rabbits, wallabies and possums will need vermin control. Small numbers of vermin can do a lot of damage to young trees. If you can't control the vermin, don't bother planting trees.
Fire Hazard	Sites should be surrounded by a trafficable firebreak and be laid out to facilitate fire-fighting, e.g. close to water supplies.
Location	Land should be located close to existing industry processing plants and/or export ports or other large plantations. Remember, transport costs are based on a cents per tonne, per kilometre basis.

When assessing soil suitability, dig holes as deep as possible (50cm or more) to look at soil structure, amount of silt, sand and clay, amount of rock, evidence of compacted layers and hard pans, drainage, plant root depth and general soil health.

Before planting familiarise yourself with the Forest Practice Code to ensure machinery operations at times of planting and harvesting meet environmental requirements.

MATCHING SPECIES TO SITES

What is site quality?

When choosing tree species for commercial tree farming site quality needs to be taken into account. Site quality determines how much wood is produced in a set time period and is influenced by factors such as altitude, rainfall and soil properties.

A useful measure of site quality is the amount of wood produced each year, and this is usually expressed as the peak mean annual increment (MAI) in cubic metres of wood per hectare per year (m^3/ha/yr). In Tasmania, plantations established and grown on sites with a potential MAI of more than 15 m^3/ha/yr are most likely to give a financial return. There may be very good reasons, such as erosion or salinity control, for planting trees on areas that are less productive.

What quality of site is required?

A few rules of thumb can be used as starting points to consider whether Tasmanian sites are

likely to be suitable. Sites of minimum quality to grow trees commercially have the following characteristics:

- Mean annual rainfall greater than 800mm.
- Less than 800m above sea level (asl).
- Soils deeper than 65cm.
- No frost hollows or waterlogged areas.

These sites often will have previously carried native forest taller than 34m (100 f).

Best growth of all the major plantation species will be obtained under the following conditions:

- Mean annual temperature greater than 11°C.
- Sites below 300m in altitude.
- Mean annual rainfall greater than 1,200mm.
- Sites which are highly fertile.
- Soils which are well drained.

Like any crop, the best economic returns will be obtained from planting on the best sites. Other factors such as marketing and price should also be considered.

What species to choose?

In Tasmania four species are commonly used in commercial plantations. These are radiata pine (*Pinus radiata*), blue gum (*Eucalyptus globulus*), shining gum *(Eucalyptus nitens*) and to a lesser extent Blackwood (*Acacia melanoxylon*).

Summary of responses to extremes

Survival will be affected by environmental stresses such as frost, drought and salinity. **Table 1** gives the relative tolerance of the commercial species to extremes. Blackwood is more tolerant of poorly drained conditions than the other species.

Table 1: Summary of Responses to Extremes

Species	Tolerance of dry site	Tolerance to frost	Tolerance of waterlogging	Tolerance of poor nutrition	Tolerance of salinity
Pinus radiata	√	√	x	~	x
Eucalyptus globulus	~	x	~	x	~
Eucalyptus nitens	x	√	x	x	?
Acacia melanoxylon	x	x	√	?	x

√ = tolerant, ~ = intermediate tolerance, x = intolerant, ? = unknown

Growth rate is also a factor to take into consideration. On the best quality sites the growth rate of radiata pine (typically an MAI of *ca.* 35 m^3/ha/yr) is often lower than that of the gums

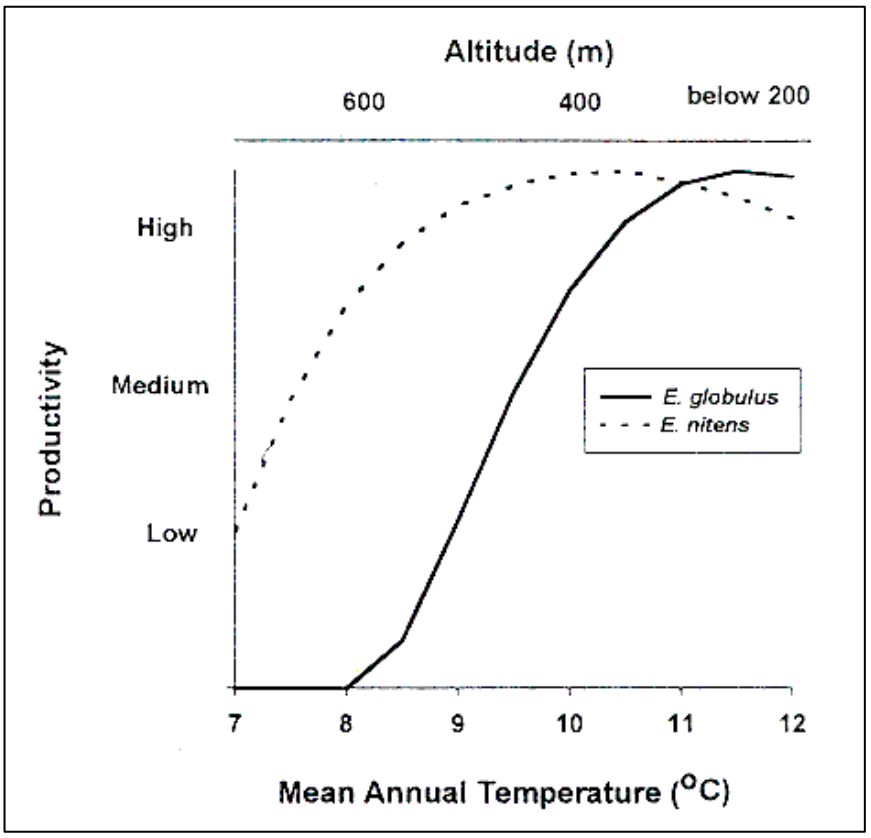
(typically an MAI of *ca.* 40 m^3/ha/yr). However, radiata pine is tolerant of sites of lower nutrition and generally will grow better than other commercial species on low quality sites (those not affected by waterlogging or salinity). If you are planting eucalypts in frost free areas, the higher yield of pulpwood per unit volume of wood and the better timber properties of blue gum usually mean it is preferred to shining gum. Little is known about growth of Blackwood in plantations, as commercial plantations are a recent development.

Effect of altitude and temperature on growth

- At altitudes above 400m (at mean annual temperatures below 10°C) the growth of blue gum may be severely affected by frost, and for Tasmanian conditions either shining gum (**see Figure 1**) or radiata pine are better choices.
- In Tasmania, generally radiata pine can be planted up to 600m asl, and on sheltered sites up to 800m asl and still give a commercial yield but frost hollows must be avoided.
- All species perform well at low altitudes, other factors not being limiting.

In **Figure 1** the curves show the possible relationship between mean annual temperature and the productivity of *E. globulus* (blue gum) and *E. nitens* (shining gum). Altitudes correspond approximately to the mean annual temperatures in Tasmania.

Figure 1: Effect of altitude and temperature



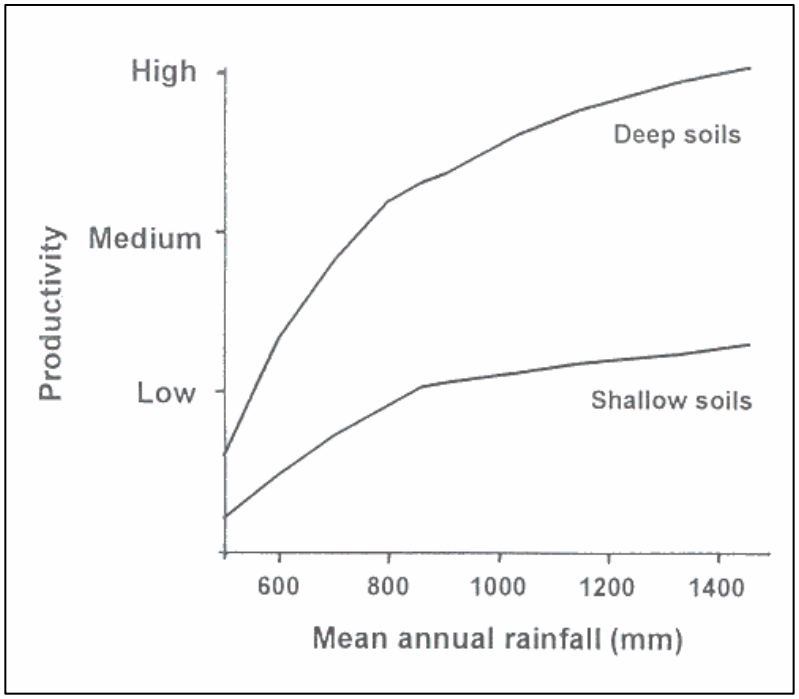
Effect of rainfall

- Growth of blue gum is less severely affected by mild drought than is shining gum and consequently may be the better choice if a eucalypt plantation is being established in low rainfall areas.

- If the mean annual rainfall is below 800mm, it is unlikely that either of the gums will produce a plantation which will yield an economic crop based on timber value alone except on deep soils **(see Figure 2).**
- The effects of mean annual rainfall on site productivity are strongly influenced by soil depth. Deep soils store water that trees draw on during dry periods.
- The growth of radiata pine is less adversely affected by dry conditions than that of either of the gums.
- Radiata pine is the best choice for sites below 900mm in rainfall.
- Heavy snow fall may cause damage to plantations.

In **Figure 2** the curves show the effect of mean annual rainfall on the productivity of *E. globulus* (blue gum). Curves are provided for deep soils (1m of well structured, rock free clay loam) and for shallow soils (0.5m of medium clay with 30% by volume rocks).

Figure 2: Effect of rainfall



Effect of soil nutrition

- Growth of all plantation species is depressed by poor soil nutrition. Fertiliser is routinely applied to most commercial plantings not planted in improved pasture (see *Information Series, Sheet No. 5 – Plantation Establishment Summary*).
- Radiata pine is less sensitive to site fertility than the two eucalypt species and is therefore a better choice on sites of marginal fertility.
- The effect of poor nutrition on wood yield may be more severe than is suggested from calculations of growth alone because sick and stressed trees are more prone to disease, deformity and insect attack.

Effect of interacting stresses

Be very careful planting areas subject to more than one growth stress. Growth is greatly reduced when there are two or more damaging climatic effects (e.g. frost and waterlogging or

drought and cold).

Growth models

Several models of site productivity now exist for making predictions about plantation performance on sites where plantations have not been grown previously. If there are no plantations close by that can be used to gauge likely future growth of your plantation, you could consider using one of these site productivity models.

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