SOILGUIDE

A HANDBOOK FOR UNDERSTANDING AND MANAGING AGRICULTURAL SOILS

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8.10 BLUE GUMS: SOIL AND CLIMATIC REQUIREMENTS

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Tasmanian blue gums (*Eucalyptus globulus*) are native to the east coast of Tasmania, Flinders Island in Bass Strait, the southern and highland areas of Victoria and parts of New South Wales. They are a relatively new commercial crop in WA with the first plantations and shelterbelts established on private land in 1988 (Inions 1991).

Integrating a commercial tree crop into farming systems is attractive from the view of both enterprise diversity and development of sustainable farming systems. The trees have a comparable economic return to traditional agricultural pursuits (Eckersley 1990), but also have secondary benefits such as reducing groundwater recharge, providing stock shelter, control of erosion, waterlogging and salinity, plus off-site benefits such as reduced stream salinity and eutrophication (Bartle 1989).

Root growth

There is a dense surface root development within a radius of up to 12 m. Well structured clayey subsoils encourage deep roots to penetrate more than 8 m. The roots of seven year-old blue gums have been shown to extract moisture from the phreatic zone at 6 m (Greenwood *et al.* 1985).

Climatic requirements

In general, *E. globulus* requires a minimum rainfall of 600 mm per annum in regions with a Mediterranean climate, like south-western Australia. They have been planted in areas with less than 600 mm average rainfall, however production is likely to be poor and the trees prone to drought death.

Blue gums will grow if the air temperature is above 5°C so they are able to continue growing throughout WA winters. Growth is very active in summer, usually only limited by the amount of stored soil water. Blue gums are mildly frost tolerant and frosts in WA are unlikely to be a problem.

SUMMARY OF SOIL REQUIREMENTS

Water availability is the critical requirement for growing blue gums successfully through to maturity. They are sensitive to water stress, especially during the peak growth period from two to six years (leaf area index 4-5). Widespread tree deaths on shallow soils following the summer drought of 1993-94 emphasised water availability as the critical factor for growth and survival in the Mediterranean climate of WA. Blue gums are also sensitive to excess water or waterlogging, especially when combined with salinity.

The solution is to equate the long-term water demand of the trees with the water supply in dry years, remembering tree survival is of paramount importance.

The following site selection guidelines are recommended:

- All soils should be deeper than 2 m. Soil depth is defined as the depth of the sand and clay horizons overlying basement rock (i.e. granite, gneiss, dolerite, spongeolite, limestone) or saprolite (partially weathered rock), whichever is shallower. As saprolite may be penetrated by rotary drills, inspection via coring or backhoe pits is recommended to assess likely root penetration. Laterite (ironstone, ferricrete) boulders and gravel are treated as soil and not basement rock. Laterite can occur as a continuous sheet (duricrust, laterite cap) and backhoe inspections are necessary to determine whether this can be penetrated by roots.
- Poor growth is expected on soils with a sandy horizon (available soil water storage <70 mm/m) that is deeper than 2 m, so avoid these sites (Edwards and Harper 1996). The exception is deep sand in water-gaining areas.
- The effect of waterlogging has not been resolved. General indications are that sites that are waterlogged for several months each year (but dry in summer), which cannot be surface drained and which have duplex profiles with gleyed subsoil clays should not be planted.
- Avoid marginally saline sites with EM38 readings of >50 mS/m, or >25 mS/m on deep sands (Bennett and George 1995).
- The possibility of future salinity should be assessed by drilling to 6 to 10 m. Sites where the watertable is within 4 to 5 m and saline (>1000 mS/m) should be avoided.

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Soil factors affecting the productivity of blue gums

Blue gums are a new crop and research is continuing on their tolerance to many soil conditions.

Soil conditions	Tolerance
Soil water deficit	Blue gums are sensitive to moisture stress and are poor at reducing transpiration when the moisture supply becomes limiting. Moisture demand is controlled by planting configuration (strips vs. blocks, stand density), nutrition (more fertile sites have larger canopies) and potential evaporation (latitude, aspect, distance from coast). Trees grown on sites with poor fertility (especially nitrogen) have smaller canopies, lower growth rates, lower transpiration and therefore greater ability to survive drought. However, their productivity is also reduced. In general, the larger the soil volume available for root growth the better. Soils formed on deeply weathered laterite profiles promote tree survival more than soils formed on fresh rock e.g. granite (R. Harper, unpublished data). When groundwater of suitable quality is within the root zone, the moisture supply is greater than simply rainfall plus soil water storage. If groundwater is to be a major source of water for the trees, then consider the following: • Determine whether groundwater is confined to a localised area. Blue gums will lower the watertable and have been known to dry up perched watertables. In one example, the trees subsequently died from moisture stress, because their roots could not penetrate an organic hardpan, which was initially below the watertable. • Ensure the watertable will not rise to within 0.5 m of the surface during winter and kill tree roots. • Test the salinity of the groundwater (EC suitable if <1000 mS/m).
Waterlogging	Sensitive to waterlogging in the top 0.5 m. If waterlogging occurs for more than two to three months a year, trees may die. Mounding along the tree lines can reduce the effect of waterlogging.
Soil salinity	Low tolerance. Growth is suppressed above 50 mS/m (as measured with an EM38) on finer textured soils and above 25 mS/m on coarse-textured soils (Bennett and George 1995). Blue gums can be used for lowering watertables, because they are 'phreatophytes' (plants whose roots reach the watertable). For example, the evapotranspiration from seven year-old blue gums with access to fresh groundwater was about four times the annual rainfall (Greenwood *et al.* 1985).
Acidity: minimum pH_{Ca}	Good, will grow into acid kaolinitic clayey subsoils.
Alkalinity: maximum pH_{w}	Prefer neutral to acid soils, but exact tolerance to alkaline conditions is unknown. Appear to grow well on Spearwood dunes with alkaline subsoils, where soil depth is not constrained by limestone.
Key nutrient requirements	*Nitrogen.* Highly responsive. In plantations on infertile sites, an initial application of DAP (50 kg/ha) is followed by 200 kg/ha every second year. Fertiliser responses do not occur on fertile ex-pasture sites. *Phosphorus.* May be required on sites with <10 ppm bicarbonate P. If applying N and P, ensure trace elements are adequate, otherwise higher growth rates from the additional N and P can induce trace element deficiencies. *Potassium.* Only likely to be required on leached sands (<20 ppm bicarbonate K), however, these soils are generally unproductive due to poor water relations. Symptoms of major nutrient deficiencies and critical nutrient tissue concentrations are summarised in Dell *et al.* (1995).
Compacted soils	Will restrict root growth, which is critical when roots need to exploit sufficient soil to extract subsoil moisture during the first summer. It is essential to plant the seedlings along rip lines.
Root growth into clayey subsoils	Good, providing there is no shallow perched watertable. In a well structured clayey subsoil, roots have been observed at more than 8 m (Greenwood *et al.* 1985). Where the clayey subsoil is massive or weakly structured roots have difficulty penetrating.
Soil properties affecting germination	Not applicable (always propagated by seedlings).
Erosion risk	Generally wind stable, although can be prone to windthrow in soils that have restricted the rooting depth. Strategically placed tree-belts can act as windbreaks. Water erosion can occur along tree lines at establishment, if trees are not placed on the contour.