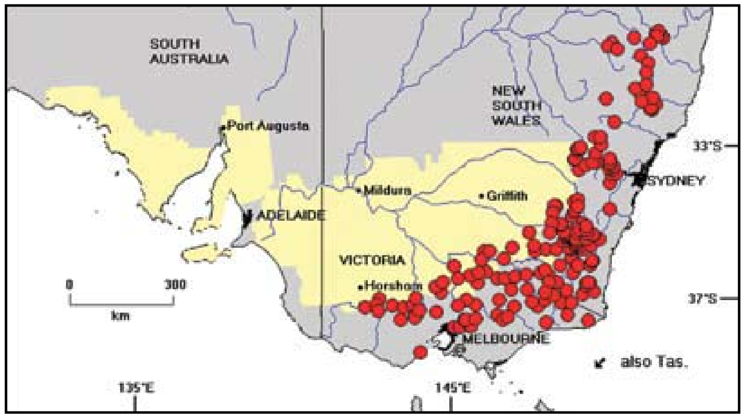
Acacia dealbata Link subsp. *dealbata*

Common Name

Silver Wattle (Standard Trade Name).



Map 15. Distribution of *A. dealbata* subsp. *dealbata*.

Habit

Shrubs or trees 2–15 m tall but attaining 30 m in wetter parts of Tasmania and Victoria, becoming shrubby on drier sites (Entwistle 1996), it develops an erect main stem and, wherever there is sufficient space, a well-developed conical or rounded crown, root suckers freely. Bark smooth but becoming deeply corrugated with age, brown or grey to almost black, often mottled white (due to lichen growth).

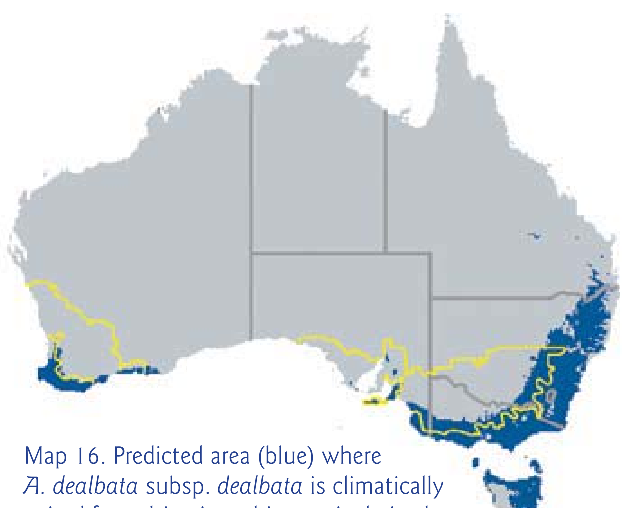
Botanical descriptions and illustrations/photographs are provided by Maiden (1907), Cunningham *et al.* (1981), Costermans (1981), Boland *et al.* (1984), Simmons (1988), Whibley & Symon (1992), Tame (1992), Entwistle (1996), Tindale & Kodela (2001 and 2001a) and Kodela (2002).

Taxonomy

This species belongs to *Acacia* section *Botrycephalae*, a group of 44 mostly arborescent species characterized by having bipinnate adult foliage and flower heads normally arranged in elongated racemes (Orchard & Wilson 2001). These species predominate in temperate areas of eastern and southeastern Australia (Hnatiuk & Maslin 1988, Maslin & Pedley 1988). There are seven species of *Botrycephalae* detailed in this report, namely, *A. baileyana, A. dealbata* subsp. *dealbata, A. decurrens, A. filicifolia, A. leucoclada* subsp. *leucoclada, A. mearnsii* and *A. parramattensis*. A number of recent studies have suggested that species of section *Botrycephalae* are most closely related to certain racemose species of section *Phyllodineae* (foliage phyllodinous) from eastern Australia, see Maslin & Stirton (1998) and Maslin *et al.* (2003) for reviews. Of the phyllodinous species included in this report those having presumed closest affinities to species of *Botrycephalae* include *A. linearifolia, A. neriifolia* and *A. pycnantha*; members of the '*Acacia microbotrya* group' are not far removed from these species.

A study by Tindale and Roux (1969) of flavonoid and condensed-tannin contents of the heartwood and bark of *Acacia* recognized four groups within section *Botrycephalae*; that study grouped *A. baileyana* and *A. dealbata* together. *Acacia dealbata* is similar to *A. nano-dealbata* and, according to Doran and Turnbull (1997) is sometimes confused with *A. leucoclada, A. mearnsii* and *A. silvestris*.

Acacia dealbata comprises two subspecies, subsp. *dealbata* and subsp. *subalpina*. Subspecies *subalpina* (which is not detailed in this report) is distinguished by its generally smaller



Map 16. Predicted area (blue) where *A. dealbata* subsp. *dealbata* is climatically suited for cultivation; this area is derived from a bioclimatic analysis of the natural distribution (red circles, Map 15), see also Table 5. Target area shown in yellow.

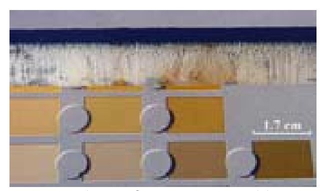
Figure 7. *Acacia dealbata* subsp. *dealbata*

A – Excellent growth form at Christmas Creek, Victoria. (Photo: M.W. McDonald)

B – Plants in open sites near Glen Innes, N.S.W. (Photo: B.R. Maslin)

C – Stem base variation, single-stemmed (left) & stem branching at ground level (right). (Photos: B.R. Maslin)

D – Spreading growth form in open site at Ben Lomond, N.S.W. (Photo: J. Williams)



E – Wood core from 7.5 year old plant. (Photo: P. Macdonnell)

F – Branch showing racemose inflorescences & greyish bipinnate leaves (Photo: B.R. Maslin) leaves and smaller stature, it occurs outside the target area at higher altitudes from near Canberra to northeast Victoria. Intermediates occur between the subspecies (Kodela 2002).

Distribution and habitat

Acacia dealbata subsp. *dealbata* occurs on the Great Divide (mainly tablelands and foothills) from the Ben Lomond Range in northern New South Wales to the Grampians in western Victoria; it is also common in Tasmania. The main area of occurrence of this subspecies is to the south and east of the target area but it reaches the temperate periphery of the region in New South Wales and Victoria. *Acacia dealbata* is naturalized in parts of southwest Western Australia and southern South Australia (in the Adelaide Hills and around Penola, fide Whibley & Symon 1992). Tindale & Kodela (2001) provide maps of both the native and naturalized distributions of this subspecies. *Acacia dealbata* has been introduced into many countries abroad including Chile, China, France (and other parts of southern Europe), Ethiopia, India, Japan, Kenya, Nepal, New Zealand, North Africa, South Africa, Sri Lanka, Uganda, West Africa, Zambia and Zimbabwe (see CAB International 2000 for further details) and in some of these regions has become naturalized (see **Weed potential** below).

In western New South Wales subsp. *dealbata* occurs as scattered plants or in small clonal clumps in river red gum forests fringing the Murray River, usually on the higher levels of clay banks (Cunningham *et al.* 1981).

As summarised by Boland *et al.* (1984) and Doran & Turnbull (1997), *A. dealbata* occurs in topography ranging from high plateaus to deep mountain valleys where it grows in hilly country, often on steep slopes and along stream banks, usually in dry sclerophyll forest or woodland. It is found on a variety of substrates (including basalt, granite and sandstone) and its soils range from deep and fertile forest podsolics, clays and gravelly clays of moderate drainage to well-drained stony slopes, volcanic brown earths and lateritic krasnozems. Along the Great Divide subsp. *dealbata* occurs between 350–1000 m elevation while in Tasmania it grows between 50–600 m. It generally occurs at higher elevations than *A. mearnsii* and *A. decurrens* (Anderson 1968). Further details of its ecology are given in Boland *et al.* (1984), Doran & Turnbull (1997) and CAB International (2000).

Flowering and fruiting

Flowers mainly from August to October (but can extend from July to November) and mature seeds are produced mostly between November and January (or sometimes to March). It takes 5–6 months from flowering for seeds to mature (Boland 1987); the seed drops soon after maturity. According to Stelling (1998) *A. dealbata* produces large seed crops every 2–3 years and the plants mature early with seed set at 4–5 years of age. Upon shedding the seed remains viable in the ground for many years.

Biological features

A fast growing and frost hardy species (Simmons 1988) that root suckers freely and can coppice from cut stumps (Campbell *et al.* 1990). It regenerates readily following fire and often forms fire-induced thickets by prolific root suckering. According to Doran & Turnbull (1997) this species grows best in cool climates with annual rainfall in the range 750–1000 mm. See below under **Cultivation** for further details. *Acacia dealbata* has a lifespan of up to several decades (Stelling 1998).

Genetics

Chromosome number: $2n = 26$ (B. Briggs in Tindale & Kodela 2001).

Acacia dealbata occasionally hybridizes with *A. baileyana* (Tindale & Kodela 2001) and possibly also with *A. pataczekii* (Maslin 2001); it is also recorded as hybridizing with *A. mearnsii* in cultivation in South Africa (see *A. mearnsii* for references). A European garden hybrid involving *A. dealbata* and *A. podalyriifolia* has been described as *A.* x *hanburyana* (Maslin 2001).

Cultivation

The following information on the establishment, management and yield of this species is taken from Doran & Turnbull (1997) and CAB International (2000).

Establishment

There are no standard nursery practices for *A. dealbata*. A number of trials have been established in Australia and overseas but all differed in their nursery practise, details of which can be found in Midgley & Vivekanandan (1987), Fangqiu *et al.* (1998), Thinh *et al.* (1998), Mitchell (1998), Bird *et al.* (1998) and Searle *et al.* (1998).

Propagation is by seed previously immersed in boiling water for 1 minute to break seed-coat dormancy. Germination rate averages about 75% and there are about 50-55,000 viable seeds/kg. The seed are then either directly sown into containers or into beds to produce bare rooted seedlings. It is common practice to sow two seeds per container which are later thinned out or transplanted into another container, depending on germination success. According to Stelling (1998) *A. dealbata* establishes well when direct-seeded.

Kube & Brown (1996) established that the ideal height for seedling establishment in the field in Tasmania is around 30 cm with a collar diameter of 7 mm. These larger plants had a greater survival, less foliage loss and better form than smaller seedlings. Topping the seedlings in the nursery appears to accentuate form problems and therefore should be avoided. Seedlings take 4–5 months before being large enough for planting. Containerized stock probably need to be grown in large pots (250 cubic centimetres) as Ryan *et al.* (1987) found for other *Acacia* species.

In Sri Lanka, rapid root development is a problem in the nursery as acacias are sensitive to root wrenching. High nursery mortality was recorded where a single heavy wrenching was given rather than several lighter root prunings (Midgley & Vivekanandan 1987). Most *Acacia* species, including *A. dealbata*, appear to be quite sensitive to transport damage (associated with root damage) and the use of planting boxes is recommended.

Due to the susceptibility of its foliage to desiccation, leading to poor growth and survival, *A. dealbata* should be established during wetter months to avoid dry periods (Kube & Brown 1996). Large seedlings which retained all their foliage had a high survival and growth rate and developed a single stem. However, seedlings with more than 66% foliage loss had poor survival and growth and often developed multiple stems (Kube & Brown 1996). Initial stocking rates should be high if survival problems are anticipated.

When introducing *A. dealbata* to new areas seedlings will benefit from inoculation with appropriate rhizobia and mycorrhizal strains (Hopmans *et al.* 1983, Roughley 1987, Reddell & Warren 1987). Roughley (1987) found that 75–100% of rhizobium strains will nodulate *A. dealbata*. New introductions to Sri Lanka demonstrated good nodulation (Midgley & Vivekanandan 1987) and Fangqiu *et al.* (1998) note that seedlings grown for trials in China produced root nodules within three months. Inoculation techniques in the nursery are described by Doran (1997).

Although *A. dealbata* can fix atmospheric nitrogen, application of fertilizer will increase growth rate, especially on marginal sites. Many nurseries have a general purpose fertilizer in the soil mix as well as adding to the plants in the nursery. Seedlings should also be fertilized in the field with a general N:P:K fertilizer but caution should be taken as most *Acacia* species grow in infertile soils and high levels of nutrients may reach toxic levels (Tame 1992). Examples of the use of fertilizer with acacias are given by Midgley & Vivekanandan (1987), Doran (1997) and Bird *et al.* (1998).

Form pruning is required 1–2 years after planting (2–3m height) (Kube *et al.* 1997). This is particularly important if foliage loss has occurred after planting as it can often cause loss of apical dominance and consequently seedlings produce numerous shoots from the base of the seedling. These shoots often persist and, without form pruning, are likely to produce trees with multiple leaders making the timber unmerchantable.

An important aspect of silviculture for this species is weed control (Doran 1997). Better survival and growth rates were attained when competition, especially with weeds, was eliminated (Midgley & Vivekanandan 1987, May 1999).

Yield

Acacia dealbata produces wood suitable for high quality pulp (Logan 1987). Batchelor *et al.* (1970) found that pulpwood rotations of 15–20 years were feasible on suitable sites in Australia, but *A. dealbata* had a limited life span of 20–40 years on harsher sites. Although *A. dealbata* is known to grow fast in native forests, wood yields are highly variable (Brooks & Brown 1996). Best annual growth rates recorded in Tasmania were 23 cubic metres per hectare at age 10 years (Kube *et al.* 1997). In New Zealand, a stand gave an estimated annual volume growth (under bark) of 46 cubic metres per hectare and averaged 16 m in height at age 8 years (Frederick *et al.* 1985). In China, the annual biomass production was estimated to be 15–20 tonnes/ha dry matter at age 5 years; in a species trial in subtropical Guangdong, *A. dealbata* provenances averaged 5 m in height at 18 months (Yang *et al.* 1991). The annual net production in a 4-year-old stand in Japan was 17–30 tonnes per hectare (Takashi & Ikuo 1973).

Trials in Western Australia by Barbour (2000) that included 12 bipinnate acacias showed substantial provenance differences in survival and growth. At Darkan (650 mm mean annual rainfall) 2 year old plants of *A. dealbata* were ranked, in terms of height attained, sixth (Errinundra provenance) and twenty fifth (Captains Flat provenance) overall; 5-year-old plants of this species were ranked eleventh and were amongst the poorest performers. Provenance differences among populations of *A. dealbata* were not as marked at two other more mesic trial sites (Busselton, Mt Barker) discussed in this same report. In these trials *A. dealbata* was out-performed by *A. decurrens, A. fulva* and *A. mearnsii* across all sites.

In trials involving 16 acacias at two site in Victoria, *A. dealbata* was amongst the best performiong species (Bird *et al.* 1998). At age 34 months, the mean height of the best provenance was 4.9 m with a mean diameter of 79 cm. The mean annual rainfall at these sites was 700 mm.

Provenance

Although there is interest from many countries there are no large scale commercial plantations of *A. dealbata* (Neilsen *et al.* 1998) and consequently there has been little research carried out on provenance variation or breeding.

Given the wide range of environments in which *A. dealbata* occurs, it is likely that genetic variation will be important in the utilisation of this species (Kube *et al.* 1996), and that provenance research and tree breeding will make economic gains for growth rates, wood properties, tree form and resistance to the fireblight beetle; this could increase the plantation potential of *A. dealbata* (Kube *et al.* 1996, Neilsen *et al.* 1998).

Recently trials by Kube *et al.* (1996) and Neilsen *et al.* (1998) have been established in Tasmania and although conclusive recommendations cannot yet be made preliminary results indicate that there may be important variation both between and within provenances. Neilsen *et al.* (1998) found variation in growth at regional, provenance and family level with the majority of variation for growth rate occurring at the family level. Kube *et al.* (1996) found a heritability of 0.21 for height growth of *A. dealbata* at age 16 months.

Pests and diseases

Lee (1993) provides a summary list of diseases recorded on *A. dealbata* in several parts of the world. Various fungi have been reported as causing serious losses to *A. dealbata* stock in the nursery (Ito &

Shibukawa 1956 and Terashita 1962). The species is subject to fireblight beetle (*Pyrgoides orphana*) in Australia (Simpfendorfer 1992), a defoliator which limits its use as a plantation species. The sapwood is susceptible to *Lyctus* attack. The above information is taken from Doran & Turnbull (1997); see CAB International (2000) for further details.

Weed potential

Within Australia *A. dealbata* has become naturalized in parts of southwest Western Australia and southern South Australia and overseas in parts of South Africa (Ross 1975 and Henderson 2001), New Zealand (Pollock *et al.* 1986) and India (Troup 1921). In South Africa it is a Declared Weed in the West Cape Province and a Declared Invader (category 2) elsewhere in the country. Attempts at control of *A. dealbata* in South Africa have included the use of herbicides; also, a seed-feeding weevil, *Melanterius* sp., is currently under investigation as a biocontrol agent of this species (see Dennill *et al.* 1999). On account of its strong suckering propensity *A. dealbata* is frequently difficult to eradicate when clearing (Anderson 1968). It is often seen in dense stands on recently disturbed land (Simmons 1988).

Wood

The heartwood varies from light-brown to pinkish (Boland *et al*. 1984). Green density of the wood is about 800 kg/m^3 while air-dry density ranges from 540 to 720 kg/m^3 (Bootle 1983). The basic density is given as 570 kg/m^3 by Ilic *et al.* (2000) and 553 kg/m^3 by Clark *et al.* (1994).

Utilisation

The following information on the utilisation is taken largely from the summaries provided in Doran & Turnbull (1997) and CAB International (2000).

Wood

Acacia dealbata is recognised as a very good quality pulpwood in Tasmania (Batchelor *et al.* 1970, Logan 1987). Its kraft pulping and papermaking properties make it suitable for a range of paper and paperboard products such as linerboards, bag and wrapping papers, white boards and writing and printing paper. It has the levels of brightness required for some high grade papers (Clark *et al.* 1994), and it has lower alkali requirements than most eucalypts (Phillips *et al.* 1991). The wood has good glueing properties and has minor usage for clothes pegs, shoe heels and wood wool; it provides a satisfactory fuelwood but compared with many other Acacias is rather poor in this regard (Boland *et al.* 1984):

In Tasmania, *A. dealbata* is not a valuable commercial species but it is harvested from natural stands as a minor species (Kube & Brown 1996). ANM Newsprint Mill at Boyer uses about 12,000 tonnes of *A. dealbata* wood annually and about 500 cubic metres/year are sold as sawlogs and craftwood.

Land use and environmental

Acacia dealbata has been used to control soil erosion and its prolific seeding and root suckering facilitates its use in this regard. In New Zealand this was one of the drought tolerant *Acacia* species used for hillside stabilisation, gully erosion control and for windbreaks (Sheppard *et al.* 1984, Sheppard 1987, Pollock *et al*. 1986). It has also been used to stabilise eroded hill slopes in the Nilgiri Hills in India (Troup 1921, Streets 1962) and in Sri Lanka for afforestation of marginal upland areas (Midgley & Vivekanandan 1987). However, due to its invasiveness *A. dealbata* has now become a weed in some of these regions.

Various studies show that nitrogen levels in the soil are increased where *A. dealbata* is planted. Chau *et al.* (1985) noted that in its area of occurrence the nitrogen fixation carried out by *A. dealbata* played an important role in the nutrient cycling of the forest. Frederick *et al.* (1985) showed that the top 40 cm of soil of an *A. dealbata* stand contained over 60% more nitrogen than under *Pinus radiata* and 40% more than under *Eucalyptus regnans*. Furthermore the nitrogen cycling through the litterfall was more than twice as large in the *A. dealbata* leaf litter compared with the other species. It was found that the net annual accumulation of nitrogen for the *A. dealbata* was 280 kg/ha, thus improving the nitrogen status of the soil considerably. Stelling (1998) also reports that *A. dealbata* is an ideal 'nurse crop' for use with slow growing eucalypts or other long-lived species in mixed woodlots.

Tannin

It yields 16–36% tannin but is regarded as inferior to both *A. mearnsii* and *A. decurrens* as a source of tanning bark (Anderson 1968).

Gum

It produces a gum arabic substitute (Doran & Turnbull 1997); details of gum properties are given in Anderson *et al.* (1973).

Fodder

The species is not especially known in Australia for its animal fodder value, although it is reportedly used for this purpose in the Nilgiri Hills of southern India (Doran & Turnbull 1997).

Wildlife value

Acacia dealbata is an important source of winter carbohydrate for petaurid arboreal marsupials including Leadbeater's possum (*Gymnobelideus leadbeateri*), the sugar glider (*Petaurus breviceps*), the squirrel glider (*Petaurus norfolcensis*), the mahogany glider (*Petaurus norfolcensis*) and the yellow-bellied glider (*Petaurus australis*) (Smith 1982, Henry 1985, Menkhorst *et al*. 1988). Smith & Lindenmayer (1992) found that Acacia gum may contribute up to 80% of the Leadbeater's possum's daily energy requirements. Lindenmayer *et al*. (1994) showed that the sugar content of *A. dealbata* gum was 48.6%. *Acacia dealbata* is a valuable source of pollen for bees (Clemson 1985).

Other uses

Acacia dealbata is widely grown as an ornamental within Australia and overseas on account of its attractive silvery foliage and its prolific flowers (but suckering may cause problems in cultivation). The cultivar, 'Kambah Karpet', is a prostrate ground cover (Tame 1992). In southern Europe *A. dealbata* is known as 'mimosa', and here it is also used commercially in the cut flower trade (Boland *et al.* 1984). The flowers are used for perfume production and French manufacturers recognise the extract for its ability as a blender and 'smoothing agent' for synthetics and as a fixative in high grade perfume (Poucher 1984, Boland 1987). Details of the industry are given by Guenther (1952). Wool may be dyed with *A. dealbata* leaves to yellow-fawn or green depending on the mordants used (Martin 1974). Aborigines reputedly used this species for making boomerangs, as a food (the gum) and for medicinal purposes (bark infusions in hot water as a remedy for indigestion) (Stelling 1998). The gum is highly soluble in water and was reputedly dissolved in boiling milk and taken for dysentery and diarrhoea, with good results, by European settlers (Stelling 1998).

Potential for crop development

Acacia dealbata subsp. *dealbata* is regarded as having moderate prospects as a crop plant for high volume wood production in the area covered by this study especially cooler, moister regions. Subspecies *dealbata* is a vigorous, long-lived taxon which typically shows very fast early growth. It is ranked as category 2–3 and has potential for development as a phase crop and possibly also as a long cycle crop (see Table 6). It develops good to reasonable quantities of woody biomass but plant form can be variable (see below). The wood is pale coloured, of low density and has been shown to be suitable for producing high quality pulp. The propensity for *A. dealbata* to vigorously root-sucker in nature may or may not be advantageous in cultivation, it depends whether or not this attribute is required (or expressed) for the system in which it is placed. A possible constraint in developing *A. dealbata*, at least as a phase crop, is its reported ability to set prolific quantities of seed at a relatively early age. Such phenological precocity will lead to the creation of a soil seed bank that may cause weed problems in adjacent or subsequent annual crops. (Alternatively young seedlings may possibly be treated as a form of green manure.) One way of avoiding soil seed build up is to harvest plants prior to them producing appreciable quantities of pods, but this would also require that sufficient woody biomass had been produced by that time. Perhaps the successful crop development of this subspecies will depend upon locating non- (or low-propensity) suckering forms or those which commence fruiting from a later age, >5-6 years. Although *A. dealbata* is reported to coppice from cut stumps it is probable that growth would be insufficiently frequent or vigorous to sustain the species as a coppice crop. For example, trials in Western Australia by Barbour (2000) showed that 62 month old plants of *A. dealbata* showed no sign of coppicing (or root suckering) 12 months after harvest.

Acacia dealbata displays a somewhat variable growth habit (excellent on wetter sites but can become shrubby in drier sites). Provenance variation in growth form and, based on existing trial results, in survival and growth rates, can be expected to be substantial for plants grown in the target area. Also, as *A. dealbata* is subject to defoliation by fireblight beetles this is likely to limit its use as a plantation species. Inoculation of seedlings with appropriate symbionts should be undertaken when introducing the species to new areas.

Attempts should be made to harvest this species for biomass production on five to ten year rotations as vigour and wood quality are likely to decline beyond this period based on ornamental trees cultivated in the Canberra area. To achieve this the spacing of plants may be a critical factor and therefore trials are warranted to investigate this effect.

Acacia dealbata has demonstrable weed potential, both within Australia and abroad. However, it is not known if this will be a major problem in the drier environments of the present target area. Nevertheless, caution is needed if any wide-scale use of this species is undertaken, and such use must be accompanied by a thorough weed risk assessment (see also discussion on possible weed reduction strategies under **Weed potential of *Acacia* in target area** in the introduction to this report).

The area predicted to be climatically suitable for the cultivation of *A. dealbata*, based on its natural climatic parameters, is shown on Map 16. This analysis indicates that subsp. *dealbata* is not well-suited for cultivation in drier parts of either the eastern or western target areas. It predicts that climatic conditions in the higher rainfall zones on the periphery of the target area in New South Wales, Victoria, South Australia and Western Australia are well-suited to its growth. Within the eastern area, valley soils on upland sites that receive greater than 500 mm mean annual rainfall should be targeted for this species. It may be advantageous to cultivate subsp. *dealbata* on run-on sites in these areas to supplement rainfall. *Acacia dealbata* should tolerate a relatively wide range of soil types and frosty conditions within this zone. Provenance variation in this species for survival and growth will be substantial based on results of previous trials.