



## Paulownia

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*This Agriculture Note describes the characteristics, site requirements and wood quality of Paulownia as a farm forestry species.*

Paulownia is a deciduous tree capable of achieving very high growth rates under favourable conditions. It has been cultivated in China for at least 2,300 years, and was introduced into Japan and Korea over 1,000 years ago. There are nine recognised species of paulownia, of which two are currently being grown for commercial purposes in Australia.

Paulownia has been widely promoted in Australia as a fast growing, short-rotation timber crop. The only substantial planted areas are located in northern New South Wales and Queensland, with several Victorian plantations failing to meet expectations. Research on the suitability of paulownia as a plantation species is limited, and very little growth data is currently available.

Figure 1 (below) shows two year old paulownia grown on an irrigated site in North East Victoria. The trees were raised in a nursery bed, and planted out as poles when six months old. Tree form was very poor, and although the trees grew quickly virtually none were suitable as sawlogs.



Figure 1. Paulownia: after 18 months in the ground in NE Victoria (A. Lyons)

### Natural occurrence

Paulownia occurs naturally in China, Taiwan, Cambodia, Laos and Vietnam. Its natural distribution ranges from tropical through to cool temperate climates, on sites with average rainfall ranging from 500 mm to over 2,000 mm per annum. It occurs from just above sea level up to an altitude of 2,400 m.

The nine species of paulownia are very similar in appearance and timber properties. *Paulownia tomentosa* and *Paulownia fortunei* are currently being grown in Australian plantations. As yet, there are no scientifically designed trials to determine the most appropriate species, hybrids or provenances for different sites across Australia.

### Site requirements

Paulownia may tolerate a range of environmental conditions, however it has three very important requirements for growth:

- deep, well drained soils
- high summer rainfall or irrigation is essential
- sunlight

A mean annual rainfall of 800 mm or more is recommended for plantation sites. Irrigation is required on low rainfall sites and in winter rainfall areas, involving a significant capital investment. To ensure maximum growth, irrigation may be necessary for the entire length of the rotation. High summer humidity is also required, as hot dry winds can damage trees.

Paulownia will tolerate a range of soil types however deep fertile soils are required for optimum growth. Loose sandy loams or loams are preferable. Plantation sites must be well-drained, as paulownia does not tolerate waterlogging. Trees may defoliate and even die after being waterlogged for as little as 3-5 days. Hence, sites where the water table is less than 1.5 m below the surface are unsuitable for paulownia. Saline soil or water may also impair growth.

Paulownia is generally intolerant of low light levels, and grows best in full sun. For optimum height and diameter growth a mean daily temperature of around 24-29°C is required. Paulownia varies in cold resistance, with some species being able to withstand temperatures as low as -20°C when fully dormant. Heavy spring frosts may kill young growing shoots or damage tree stems, severely affecting growth and tree form. Paulownia requires a

sheltered site because persistent winds can cause permanent bends in tree trunks, making them unsuitable as sawlogs. Strong winds may damage or even break established trees. Young seedlings have exceptionally large leaves that are more susceptible to damage from frost, wind and hail.

### Growth rates

The growth of paulownia is very dependant on site conditions and the age of tree. One example presented by the Chinese indicates that paulownia may reach 40-50 m in height and have a diameter of greater than 2 m when mature, but trees of this size under cultivation are rare. Rapid early growth rates have been observed, but may not be sustained as the tree ages. In the first year of growth trees may reach 4-6 m in height, growing another 2-3 m in the second year. Paulownia growing on good sites in China and Japan may be 10 metres high with a clear bole of 5 m and diameter of 22 cm at breast height in 4 years. At these sites it is usual for trees to have a diameter of 45-50 cm at 10 years of age, with production of 12 m<sup>3</sup>/ha/year. Paulownia plantations in Queensland and New South Wales are being managed to produce sawlogs over a 10-15 year rotation.

### Management

Paulownia requires intensive management if grown for timber production. To gain a high price for the timber a large diameter clearwood log is required. Pruning of branches is essential to maximise the amount of clearwood, however may have a slight negative impact on growth. Trials conducted in North East Victoria showed very poor tree form and required heavy pruning. Loss of the main leader is a common problem, with corrective pruning necessary to maintain a straight stem.

Paulownia is intolerant of weed competition, requiring thorough weed control during the first few years of growth. Application of NPK fertiliser is also essential during establishment to promote rapid growth. Further fertiliser applications may be necessary once the trees are established, depending on site fertility.

Paulownia grows from coppice very well. If original plants are weak or have a crooked main stem, cutting back to ground level may allow a single straight stem to develop as a complete shoot.

### Pests and disease risks

Disease problems are common in Asia and the United States however have not yet been clearly determined in Australia. Paulownia is susceptible to witches' broom disease, affecting the branches, trunk, flowers and shoots. This disease affects paulownia trees of all ages, impairing growth or even killing young trees. Witches' broom does not appear to be present in Australia, however is a serious problem in China, Japan and the United States.

Anthraxnose and *Sphaceloma paulowniae* are common diseases in China and the United States, infecting saplings and young trees. Mistletoe infestation also causes considerable damage in China.

Attack by leaf-eating insects, borers and scale insects may damage Paulownia. Severe insect defoliation was reported to be a problem in Queensland plantation trials.

### Wood quality

The wood is pale yellow to pale red in colour, with a gradual transition from sapwood to heartwood. The timber has a low density (260-330 kg/m<sup>3</sup> at 15% moisture content) is soft but straight grained, and odourless. While it is light and has a low density, it is relatively strong per unit weight. The wood has excellent thermal and electrical insulation properties, and is easy to air dry. It is not suitable for use as building components that require high strength, due to the low density.

Paulownia timber has excellent working characteristics, being easy to plane, saw or carve. The soft timber is prone to surface bruising, and needs to be handled carefully during manufacture and use. It does not hold nails very well, with alternative joining techniques required. Paulownia timber has a tendency for sapstain following green milling, and may be prone to surface discolouration.

### Drying characteristics

The timber dries well, and does not warp, crack or deform easily. A one-inch board may be dried to 10% moisture content in 25 days at normal room temperature. After drying, timber is very stable if there is no pith contained in the piece.

### Uses

Markets for paulownia timber have yet to be developed in Australia. The main consumers are China and Japan, with the timber grown commercially in a number of countries. The premium Japanese market for paulownia requires large diameter logs with consistent growth ring width of 10 mm. To date most Australian grown paulownia would not meet this criterion. Alternatively, it is proposed that Australian grown paulownia would replace imported rainforest timbers such as Meranti in the local market. In China, paulownia timber is used in a variety of applications. These include:

- furniture,
- shipbuilding,
- aircraft,
- packing boxes,
- coffins,
- paper,
- plywood,
- joinery and
- mouldings.

Green leaves have a high food value, and may be fed to stock or used as compost.

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