



## Technote 2: Establishment method - using seedlings

It can take several seasons to establish a best practice sandalwood plantation, that is, a plantation that contains a uniform coverage of hosts and sandalwood at the desired densities. Indeed there are few “text book” plantations that have been established within one or two seasons. Most require some work beyond year two on all or part of the plantation to achieve uniformity and desired densities. It should also be noted that when considering establishment one should be aware that different approaches can produce an equally productive result, though often at a different cost.

Currently there are four general methods used to establish sandalwood plantations. The method used to establish over 80 per cent of all plantations has been the planting of host seedling followed by the sowing of sandalwood nuts one or two years later.

### Planting host seedlings

The planting of nursery raised seedlings is by far the most commonly used, most simple and robust way to establish a host resource. Host seedlings are either planted by hand in soil that has been previously prepared by a ripper/moulder or tree planter. Alternatively site preparation and the planting of host seedlings are done in a one-pass operation by a tree planting machine such as a Chatfield’s Ezy Planter, usually during June–August when moist conditions usually prevail. Commercial forestry operators mostly hand plant with a Pottiputki planter or similar device. Teams of planters can cover a large area per day and each planter has a stockpile of seedlings on their hips ready for planting. This type of planter consists of a hollow tube with a duck-bill end that is driven into the ground and levered open to create a hole suitable for the seedling. The seedling is then dropped down the tube into the hole and pressed into place with foot pressure. Soils must be reasonably friable, be ripped or cultivated to allow the duck-bill to penetrate to planting depth. A range of sizes are available for use with different sized seedlings. A practiced operator can plant between 2000 and 5000 seedlings a day using a Pottiputki or similar device. They allow planting without bending down and the duck-bill itself makes the planting hole to fit the seedling, the depth of which can be adjusted by moving the foot plate up or down.

Seedlings can also be fully or partially mechanically planted from specialised tree planters (e.g. Chatfield’s Tree Planter or more recent and more mechanised Chatfield’s Ezy Planter). The quality of the planting operation is usually very good but in some situations the quality of planting is poor - usually due to operator error or due to the size or other characteristics of the seedling. Usually about 10–40 ha are completed per day, though this figure is highly dependent on site conditions (and thus speed of travel), the density of plants to be established, layout, operator competency, characteristics of seedling to be planted and its suitability to machine planting.

## **Weed and Pest Control**

Weeds compete with hosts for moisture, light and nutrient resources. In the water limited environments where sandalwood is being cultivated the level of establishment success is usually governed by the amount of soil moisture that has accumulated in the soil surrounding the seedling. Weed control at least in the year of establishment, and preferably the year before, has a large influence on soil moisture.

The author's approach to weed control starts with a weed assessment and the compilation of a weed inventory during summer, 6 months prior to host establishment. This is one of the most important aspects to effective weed control and adequate resources should be given to this task. It is done by walking over the proposed site and adjacent land, with an observant eye, taking note of what species are/were present and their abundance. Important information can also be gleaned from landholders and other individuals who are familiar with the site. Even during summer it should be possible from residue to determine what the key winter weeds are likely to be and potential levels of abundance. If the assessment is done during a typical dry summer there may not be an abundance of summer weed. Even under such conditions there will be occasional specimens and their presence should be noted and the threat posed duly considered. Use the information obtained to predict the possible extent of the following winter/summer weed load and develop control strategies.

Observing for example one wire weed plant (dead or alive) should always ring alarm bells as one can be guaranteed that disturbing the site (particularly baring off to mineral earth during winter with herbicides) will encourage this species to the detriment of newly established hosts. Knowing that this species is present can then be used to develop a weed control and a site preparation plan that aims to avoid this species from becoming a problem. Often however a weed inventory is not done (or not a thorough one), or the threat is ignored, and the result is usually a somewhat panicked person enquiring about controlling a lawn of wire weed that is in amongst host seedlings, a situation where there are no effective control options that don't adversely affect the newly established hosts.

### ***Weed control the year before establishment***

Fallowing a proposed planting site at least a year before planting using mechanical and or chemical methods is a useful weed control measure and moisture conservation practice. It is however rarely used because very few sites are planned this far in advance.

Knock-down herbicides (usually glyphosate) applied during mid-spring ("spray-topping") can be used to reduce seed-set of annual winter weeds and acts as a short term chemical fallow. Spray-topping kills weeds before they would normally senesce, saving valuable moisture that would otherwise have been used by weeds. Weed residues mulch the soil, protects it, limits moisture loss, and a thick mulch can effectively reduce the germination of summer weeds following any out of season rainfall (particularly wireweed).

### ***Weed and Pest control on sites to be planted with host seedlings***

Before site preparation and the planting of seedlings apply 1–2 kg of simazine (900 g/kg) per ha on the moist ground. If a germination of weeds has already occurred, add as much knockdown herbicide as require to remove germinants (0.5–1.5 L of glyphosate (450 g/L) per ha depending on seedling size and species – refer to label). If the weed burden is high herbicide should be applied several weeks before planting. Adherence to this approach should provide adequate weed control particularly if combined with scalping. The above rates for simazine are applicable for light sandy loams. On sands (particularly pale white/grey sands with little or no organic matter) much lower rates should be used (refer to chemical label) and higher rates on heavy loams.

Soils with a deep topsoil are always the most productive for sandalwood and these soil are ideally suited to scalping. Scalping, that is removal of the top 5–10 cm of soil, reduces the weed burden and is highly recommended. The method can also harvest valuable water and delivers it to where the seedlings are planted. It is usually done just prior to host planting and/or seeding or as a part of a one passes site prep/establishment operation. The operation reduces the weed burden by removing living weeds and more importantly soil contaminated with weed seed away from the planting line, usually 1 m from the rip line. Scalping may also be used to remove non wetting soil and can be designed to harvest water, a very important feature in the water limited environment where sandalwood is being cultivated.

A trailing V-shaped scalper is the most commonly used implement, producing a scalp approximately 2 m wide. Six and eight foot 3PL grader blades or even road graders are options. When set up correctly, the operation should produce a weed free environment for 12 months and a reduced weed burden may persist for several years (where cutting widths are over 1m). This usually saves at least two applications of herbicide, a saving of about \$100 per ha in 2007 dollar terms.

Scalping shallow duplex soils is not recommended as the process removes all, or the majority of, the lighter textured A horizon from the underlying clay rich B-horizon, providing a less favourable environment for plant establishment. Again, shallow soils, sandy or loamy top soil over clay at a depth of less than 150 mm, are generally very poor soils in which to cultivate sandalwood, thus problems of shallow soils should not be encountered on the deeper soils in which sandalwood plantations should be established.

Where wind erosion is likely to be a problem the scalped lines should not be oriented to the same direction as potentially damaging winds and their width kept to a minimum. On susceptible sites the zone between scalped lines should not under any circumstance be bared off, rather, a medium to thick vegetation cover is desirable. Scalping can enhance the flow of water and care should be taken to avoid water erosion by keeping the grade along the scalped line to less than 0.5 per cent (i.e. less than half a metre of fall over a 100 m of scalped line). Lifting equipment intermittently when scalping downhill can also reduce water erosion.

Most nutrients are held in the soil surface and scalping away the surface soil removes nutrients away from the planting line which may translate into reduced early growth of hosts. This is rarely a problem in medium textured soil that have a clear history of high rates of fertiliser application, but on conservatively farmed or on soil that does not retain nutrients it can be an issue that is easily fixed by placing or banding small amounts of fertiliser (20–60 kg/ha) in the rip line/planting line.

## **Pest Control**

Grazing and or trampling by rabbits, sheep/cattle and kangaroos can cause extensive damage to hosts and/or sandalwood. Plantations are most susceptible during the establishment phase. These pests cause very little damage to plantations that are over 5 years of age. Control options include exclusion via fencing or control by shooting and/or trapping and/or poisoning (rabbits). Before embarking on a control program it is advisable to consult a local biosecurity officer to ensure all legislative requirements are followed. Biosecurity officers can also provide advice on the most appropriate control methods. Baiting (1080 or pindone) rabbits during the autumn before establishment is highly recommended even if rabbit densities are low.

Before and at the time of planting host seedlings, insect control is not usually necessary in the eastern wheatbelt. However control of rutherghlen bugs during early summer may be required.

## **Seedling procurement**

It is important that orders are placed with nurseries as soon as possible after the host mix and quantities are finalised. To be able to supply quality seedlings nurseries usually require orders be placed by December, the year before planting (6–8 months before the seedlings are required for field planting). To supply uncommon hosts, or particular selections of more common hosts (e.g. a local variant), nurseries may need to be informed much earlier so that they can place orders with seed merchants, who in turn may need to be informed up to a year in advance if they do not have the seed in stock.

### **Sowing sandalwood nuts**

When hosts have established (usually one or two years after host establishment), sandalwood seeds are sown in April or May, usually two–four within 0.5 m of the base of every second or third host (assuming hosts seedlings planted at 1200 stems per hectare). Seeds can be heeled in or planted with a spade, though most efficiently and accurately planted with a Pottiputki planter or similar device to a depth of 2–3 cm (measured from soil surface to the top of the sown nut). Germination will depend on quality of the seed used, amount of winter rainfall and the degree to which the hosts compete for soil moisture. Establishment will depend on germinants surviving until they have made root contact with a host before summer. An establishment of between 25–75 per cent can be expected giving about 500 sandalwood trees per hectare, which will require thinning.

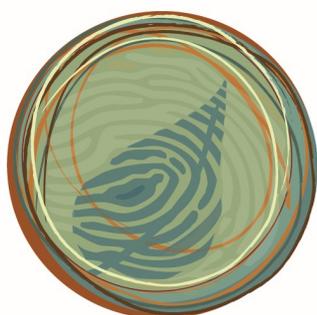
When hedgerows of hosts are established (e.g. via direct sowing) two sandalwood seeds can be planted every 3–6 m amongst the hosts (3–3.5 kg/ha) in plantations where there is 1.5–2 km of row per hectare.

Autumn, usually April, is the optimum time to sow sandalwood seeds in the north eastern wheatbelt of WA. This is because sandalwood germination is optimal when the soil is warm and moist, conditions that usually occur during autumn. Nuts can be planted before April but there is greater risk of moist periods being followed by long dry periods, and in such conditions nuts start to germinate but perish when/if the soil dries out for an extended period. Nuts can also be planted later in the season but soil temperature rapidly declines during autumn and sown nuts have a higher risk of experiencing cool/cold wet conditions, resulting in reduced germination and emergence. Sowing later in the season also shortens the time that germinants have to form functional connections to their hosts. Warm and moist soil conditions also occur during spring but in most situations the soil germinants are unlikely to survive the following dry summer months.

It is best to plant cracked nuts as a more rapid and uniform germination occurs. When planted in early autumn uncracked nuts can however crack naturally as soil moisture levels fluctuate. They can be planted without additional pre-treatments but must be good quality, fresh and ideally supplied from premium cultivated trees (good form + oil content) or local provenance trees.

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