

Engineered Woodlands

Information Sheet 1

Tree Establishment

Engineered woodlands are wide-spaced tree plantings engineered to integrate traditional agriculture with income-producing trees (see Figure 1). A whole of paddock approach is taken to locate trees to maximise their benefits in the landscape and minimise the impact on paddock management (see Engineered Woodlands Information Sheet 2 Design).

Wherever possible, additional fencing for the establishment of the trees is avoided to minimise costs. Instead, in grazing situations, grazing animals are excluded during the establishment phase and re-introduced once the trees are large enough to cope with livestock browsing. To minimise the opportunity cost of such an approach, tree establishment practice must aim for rapid seedling growth.

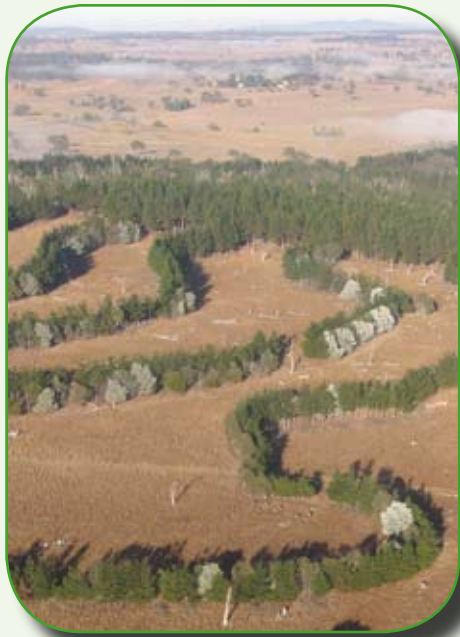


Figure 1. This 12-year-old Engineered Woodland on Jon and Vicky Taylor's property "The Hill", Kentucky, was established with no additional fencing. It includes *radiata* pine for timber, and various native eucalypts and acacias for biodiversity. All species were located to enhance shelter for stock and pastures. Photo by Michael Taylor.

Site selection

Effective establishment and the long-term performance of engineered woodlands can be affected by site selection. Generally, trees grow best on deep, fertile, well-drained soils and poorest on shallow, stony and infertile sites (just like the relationship between soil characteristics and agricultural productivity). On the Northern Tablelands in particular, tree establishment is also slow and/or poor on lower slope positions, black soil flats, frost hollows and anywhere with poor or impeded drainage.

Tree establishment objectives

Once a suitable site has been selected, successful establishment that optimises tree growth can be achieved by having:

1. A planting bed with friable, well-aerated and uncompacted soil
2. Good moisture availability throughout the soil profile
3. No competing weeds and low weed seed burdens in the soil at the time of planting
4. Healthy well-grown seedlings of the correct species available at planting
5. The planting conducted when there is a low risk of climatic extremes
6. Good levels of soil fertility throughout the establishment phase
7. No significant weed cover within 1 m of each seedling **for at least 12 months after planting**
8. Freedom from herbivores of all kinds but especially hares, wallabies, rabbits and livestock in the first growing season.

There are likely to be an array of practices and machinery suitable for achieving the eight points listed

above. How the process is done is not as critical as achieving the eight tree establishment objectives. However, the following 10-step prescription has given good results throughout the northern inland of NSW on most soil types.

A 10-step process for tree establishment

Figure 2 illustrates a timeline for these 10 steps for two environments of the region.

Step 1 Slash

Graze down or slash the site if there are heavy accumulations of herbage – this step makes other site preparation easier but is optional (Figure 3).

Step 2 Fallow

Commence a fallow over the planting beds either with a knock-down herbicide or by cultivation 6 to 12 months prior to planting. **Maintain the planting beds weed free at all times from fallow commencement right up until the time of planting** (Figure 4).

Step 3 Rip

Deep rip the areas destined for tree planting beds to approximately 500–600 mm in depth. Conduct ripping 6 to 12 months prior to planting and when the soil is dry or just moist (never wet) to ensure good soil shatter at depth (Figure 5). Ripping should occur soon after fallow commencement for this reason.

Step 4 Order seedlings

Access suitable seed for the desired species and contract nurseries to grow seedlings (or commence propagation if doing it yourself). This should be done approximately 9 to 12 months in advance of planting but consult with nurseries for their time-frame requirements (Figure 6). For details on species selection, see *Engineered Woodlands Information Sheet 2 Design*.

Step 5 Mound

Form up the planting beds into mounds (see Figure 7, and Box 1). Mounding is highly recommended in wet areas and high rainfall areas (i.e. much of the tablelands). Mounding is optional or undesirable on well-drained sites or on sites where moisture availability may be low during the early establishment phase (especially freer draining soils on the Northern Slopes).

Step 6 Cultivate

If Step 5 produces a very cloddy surface or is omitted, cultivate the planting bed and prepare to a good tilth (see Box 2). The mounding operation alone (Step 5) should achieve reasonable tilth if conducted well after the initial fallow has commenced, say 6 to 12 weeks (Figure 7). However results vary with soil type and moisture conditions. Cultivation dries soil and brings to the surface otherwise buried weed seed. For these reasons, it should be conducted early in the fallow period

for most soils or during winter when evaporation is low. The fallow can then be maintained by herbicide application to conserve soil moisture.

Step 7 Apply residuals

Apply a residual herbicide (see Box 3) such as simazine, terbutylazine, Goal®, Forest MixWDH® (pines only) and EUCMIXpreplant WDH® (some eucalypts only) about one month prior to planting. Consult the product label for rates, application technique, species tolerance and safety considerations. This step should only be contemplated if the soil surface is well prepared, bare of litter and dead herbage and preferably moist. Most residual herbicides function poorly if applied to cloddy or rough surfaces or sprayed onto accumulated dead plant material. If applied correctly, this step should maintain planting beds weed free for 3 to 9 months after planting. **Caution:** residual herbicides may not be safe to use with some *Acacias*, *Casuarinas* or some shrub species. They are often registered for

use with a limited number of species only (usually *Pinus* and/or *Eucalyptus*). Other species should be trialled for tolerance on your soil type. **If in doubt, omit this step.**

Step 8 Plant

Plant seedlings, install tree guards if required (for protection from rabbits or hares) and water seedlings in. Spring is the preferred planting period on the tablelands. Autumn through to early spring is the lowest risk planting period for the slopes (Figure 8).

Step 9 Fertilise

Fertilise the young trees about a month after planting. If planted in autumn or winter wait until early spring for this step. Use a multi-nutrient horticultural blend, a 'starter', or a nitrogen phosphorus fertiliser such as DAP to give the trees a good start (50–100 g per seedling applied 200–300 mm from the base of the seedling to avoid burning). Chicken manure or commercially available composted pellets such as Dynamic Lifter is also

Figure 2. A generalised time-line of planting bed preparation and establishment practice for a tree planting.

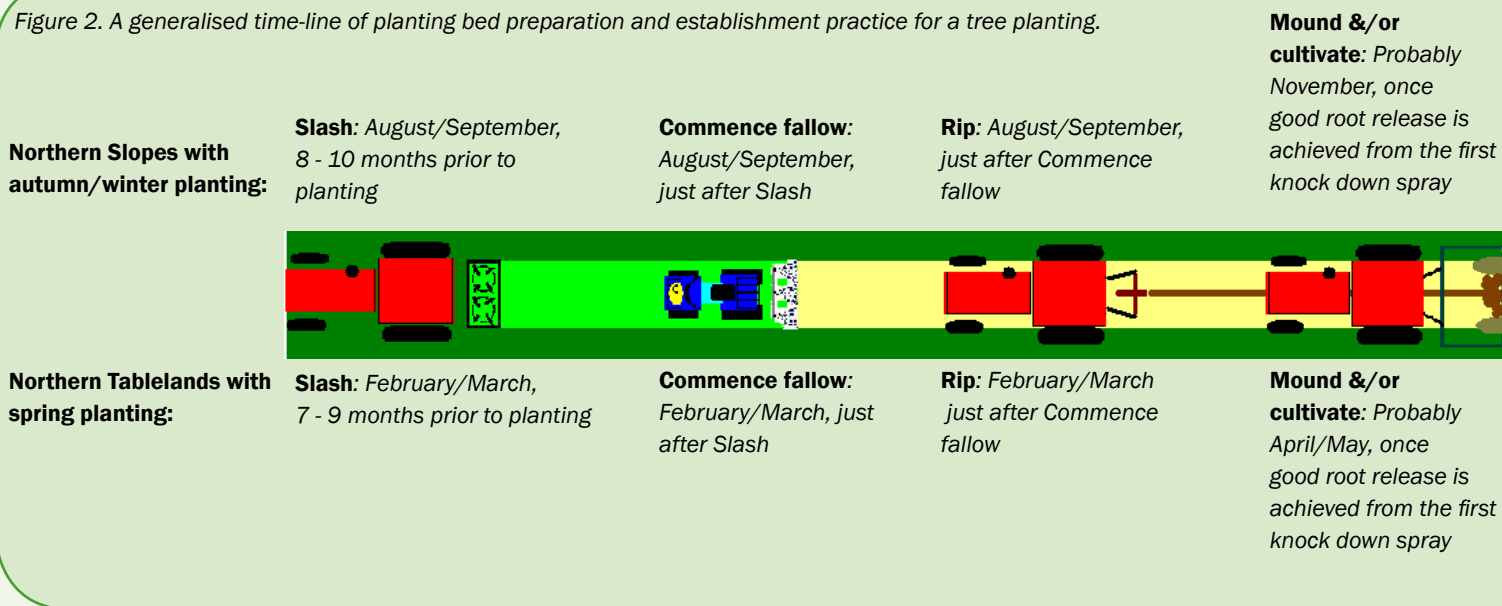


Figure 3. Slashing dense herbage is the first step in tree planting bed preparation at an engineered woodland on "Winterville" Tenterden.



Figure 4. These single-tyne linkage deep rippers are adequate for most sites.



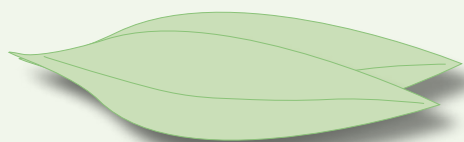
Figure 5. A site in the early stages of bed preparation, the first fallow knock-down spray is taking effect and the site has been deep ripped.

suitable (200–300 g per seedling applied 200–300 mm from the base of the seedling to avoid burning). A pinch of slow release fertiliser at planting is inadequate for rapidly growing species and probably a waste of effort.

Step 10 Post-plant weed control

Keep the area around tree seedlings (minimum 1 m radius) weed free for at least 12 months or until such time as the canopy of the tree shades weeds out from this area (see Box 4). **This step is the one most often left out by tree growers in our region, yet it is probably the most important step to optimise the growth of farm planted trees.**

Appropriate knock down and residual herbicides can be applied as shielded sprays (no contact with foliage of the tree seedling) after planting, before or whenever weeds germinate.



Box 1 - Mounding

The photographs below show a three-point linkage moulder that is very robust and does an excellent job in planting bed preparation. These machines are available for hire through the Armidale Tree Group and the Northern Inland Forestry Investment Group, and some tree nurseries and planting contractors can make them available as well.

On some soils and sites on the northern slopes where too much soil drainage is undesirable, mounded planting beds are not recommended. However, even in these cases, primary planting bed preparation can still be achieved using three-point linkage moulders. The beds are simply harrowed or cultivated flat after mounding to give a level bed. As with any cultivation (see Box 2), mounding should be done sensibly with due regard for soil erodibility.



Above. A three-point linkage moulder in the air (left) and in action (right).

Maintain fallow:

At all times from commencement of fallow until planting, whenever weeds emerge

Apply residuals:

March/June, 1 month prior to planting

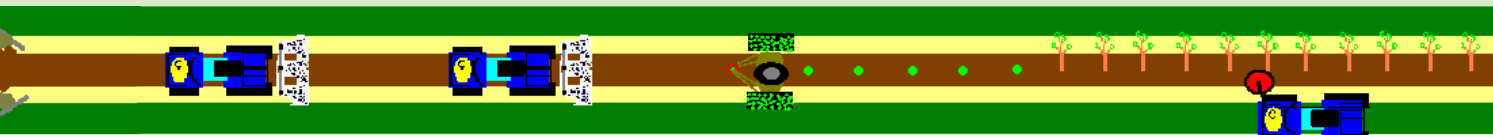
Plant: April to early August, in response to a good rain event, when soil profile has sufficient moisture

Fertilise:

August/September

Post-plant weed control:

For the first 12 months after planting. Critical in the first 2 months. Monitor weed competition weekly.



Maintain fallow:

At all times from commencement of fallow until planting, whenever weeds emerge

Apply residuals:

September/October, 1 month prior to planting

Plant: October/November, in response to a good rain event, when soil profile has sufficient moisture

Fertilise:

November/December

Post-plant weed control:

For the first 12 months after planting. Critical in the first 2 months. Monitor weed competition weekly.



Figure 6. Tree seedlings require 3 to 8 months to grow to 'plant-out' size, depending on the species and time of year germinated. To ensure adequate numbers of the species of choice, they must be ordered well in advance of planting time.



Figure 7. Planting beds at "Kyabra" Kentucky being prepared using a three-point linkage moulder.



Figure 8. Eucalyptus seedlings in Hiko cells being hand planted into a well prepared, weed-free planting bed at "Blaxland" Wollun.

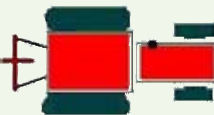
Box 2 - Cultivate with care

Cultivation of the planting beds gives a well aerated friable bed that allows easy seedling planting and prepares the soil for residual herbicides. However it is not desirable on some soils – highly erodible sandy soils are not suitable for cultivation and need only be deep-ripped and knock-down spray followed. They are also not suitable for residual herbicides. Indeed even ripping should be conducted with caution on such soils and should be done either along the contour or, on sloping ground, done for short runs only (<20 or 30 m). Leave sections of soil undisturbed for 2 m or so between each subsequent rip (see diagram below). Short-run cultivation (or mounding) should be conducted on any soil or slope combination that has a high erosion risk (e.g. any granite derived soil).

Some soils, especially some of the red-brown earths of the northern slopes, are hard-setting on the surface after cultivation and wetting. Cultivation may need to be done (or re-done) on these soils just prior to tree planting rather than just at the start of the fallow.

Below: Tractor preparing tree planting beds with a deep ripper on an erodible site.

Soil disturbed for short runs of 20-30 m,
or less on highly erodible soils



Gaps of 2-3 m of undisturbed soil.

Gaps staggered if desired to ensure continuity of tree cover for wind shelter.

Non-chemical establishment practice & weed control

Excellent tree establishment can be achieved without herbicides if necessary. However non-chemical means often come with higher labour inputs and cost. The 10-step process is still appropriate, however in the case of Step 2 the fallow is maintained with cultivation alone; Step 7 is omitted; and Step 10 must be achieved with mulches or weed mats.

If using mulches they must be free of seeds, applied to create a very thick layer (75 mm minimum), and be spread to maintain weed free conditions for at least a meter diameter surrounding each seedling. Be prepared for significant expense if the mulch is purchased off-farm and spread by hand. Fast degrading mulches such as leguminous hays or leaf-litter mulches may need re-application during the growing season

to be effective in weed suppression. More lignified mulches especially saw dusts will create a significant nitrogen draw-down in the soil surface and will need a compensatory fertiliser. They have also been credited with increased frost damage to seedlings. The use of mulches however, minimises bare soil, improves soil moisture conservation and enhances rainfall infiltration. Box 5 shows a new and novel approach to producing and applying mulch cheaply (but as yet unproven).

Weed mats function similarly to mulches and are usually more easily installed. Jute weed matting is readily commercially available, is biodegradable in 18 months or so, and is very effective when large squares are used or when the whole planting bed is covered. Small pieces (e.g. 30 cm x 30 cm squares) should be avoided as they are inadequate for weed control on their own. Unfortunately effective weed matting can be more expensive than the seedlings themselves (sometimes double the cost).

Box 3 - Residual herbicides

Some skill is necessary for the effective use of residual herbicides.

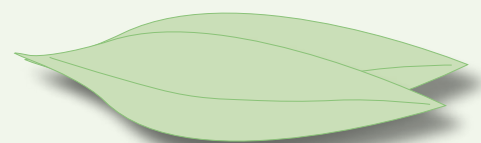
Some need particular soil surface conditions and wetness and most need incorporation into the soil surface by rainfall or shallow cultivation (but not Goal®).

Always check the product label for directions regarding this. Most do not work effectively on sandy soils with low organic matter and are easily leached away.

On appropriate soils, and when they work effectively, they can give a great competition-free start to newly established tree seedlings and save considerable time and effort in post-plant weed control.

It should never be assumed, however, that they will automatically work as expected.

Weed emergence should be carefully monitored after tree planting so that if the residuals fail, prompt action using shielded sprayers (Figure 9) can keep weeds under control.



Box 4 - Post-planting weed control

Good weed control after planting is not a common practice in past landcare type tree plantings on farms in the Northern Inland of NSW. This has led to a paradigm which considers tree establishment complete once the last seedling has been guarded and watered.

Weed control after planting is in fact the most important establishment activity to minimise the risk of losses due to dry weather and to maximise the growth rate of the seedlings (see Figures 10 & 11).

Failure to achieve good post-planting weed control in the case of an engineered woodland paddock can double or triple the time it will take for a return of routine grazing.

To minimise the workload of post-planting weed control:

1. Make use of residual herbicides wherever possible
2. Make use of mechanised shielded spray equipment such as bike-mounted dome sprayers (see Figure 9)
3. Ensure plenty of space between tree rows to allow machinery access
4. **Most importantly of all, ensure spray control is done when weeds are small!**

Failure to heed point 4, especially if weeds exceed seedlings in height, can make post-planting weed control a huge and unpleasant task (Figure 12).

It can be more time consuming and labour intensive than even the tree planting operation itself. In wet summers such as the 2007/2008 season, summer active weeds can grow from small seedlings to being too big for easy control in as little as three weeks. In such conditions, the planting beds should be monitored for weeds weekly and appropriate action taken promptly.



Figure 9. A quad bike mounted shielded sprayer such as this makes post-planting weed control easier. Photo by Caroline Street.

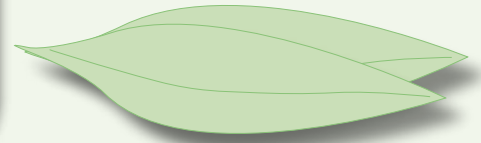


Figure 10 (above) & Figure 11 (below). The photos show five month old Shining Gum in the engineered woodland at "Kobada" Woolbrook. The planting beds above have been kept largely weed-free since planting by repeated shielded knockdown sprays over summer. The beds below missed early post-plant weed control and were overgrown with couch grass which was then sprayed out. This spray was better late than never but compare the growth of these seedlings to the ones above!





Figure 12. The small seedling (at arrow) is 7 months old and has had no effective post-planting weed control. The significant weed problem that now exists will be a huge job to bring under control.

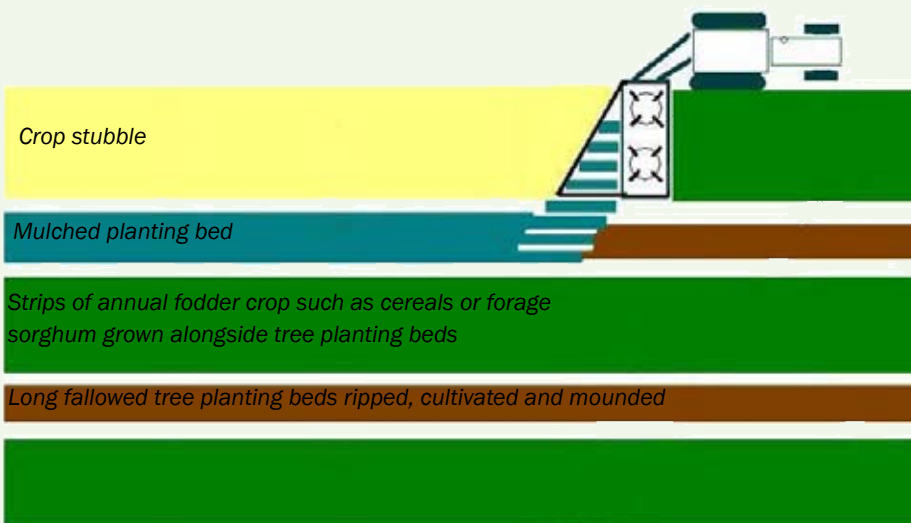
Box 5 - On site mulches

On-site mulches are grown along-side and between the tree planting beds during the fallow period (see diagram below).

High biomass crops such as cereals (grown over the winter for spring-planted trees), and forage millets and sorghums (grown over the summer for winter planted seedlings), are likely to be the most suitable.

Prior to seed set, the crops are mown or slashed and the material is raked onto the nearby planting beds which have been prepared as per the 10 step process (except that Step 7 is unnecessary and Step 9 may be achieved with the crop mulch).

Provided the season allows – the crops should provide a large amount of very suitable mulch.



Above. The layout and use of on-site mulches which are likely to be much more cost effective than mulches purchased off-farm. A crop is mown or slashed before seed is set and deposited as mulch on the tree planting beds a month or so before tree planting.

This brochure was produced by the Engineered Woodlands Project - an initiative of the Northern Inland Forestry Investment Group.

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Text adapted and updated by Shane Andrews from "A Manual for Planted Farm Forestry for the Northern Inland of New South Wales" by Shane Andrews, David Carr & Helen Ward, Northern Inland Forestry Investment Group and Greening Australia, 2004. Readers are referred to this publication for more detailed information. It is available from the Northern Inland Forestry Investment Group website www.nio.com.au. Follow the project link.

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