

SECTION B: Revegetation techniques



1. NATURAL REGENERATION



2. DIRECT SEEDING



3. PLANTING

Introduction to the techniques

Natural regeneration, direct seeding and planting of seedlings are the three main techniques used in revegetation. In different parts of the state, a number of the techniques will have been used for many years, while in others, some of the techniques have only recently been introduced or trialled.

Each technique has advantages and factors to consider when deciding whether it is suitable. Some techniques are specialised for specific environments and purposes while others have broader uses. Often, a range of techniques are applied to the one site. Revegetation is often a 'horses for courses' situation. In reviewing the various options, match your site conditions and project size to suitable technique(s).

This section is designed to provide practical information on the use of each technique, from planning to on-ground works and aftercare. The following techniques have been included:

- 1. Natural regeneration:** Germination of seedlings from seed fall from existing or nearby vegetation, from the soil seedbank or from seeds brought in by birds and animals.
- 2. Direct seeding:** Sowing seeds directly onto the site on which you wish to establish them by mechanical or hand methods.
- 3. Planting:** Planting nursery-grown seedlings such as cell or tube-grown plants by mechanical or hand methods.

A combination of the above techniques is often used to successfully establish vegetation. For example, it is suggested that seedlings should be planted to complement direct seeding (or vice versa) particularly for:

- species that are difficult to grow or known to be unreliable in direct seeding;
- rare or threatened species (usually understorey);
- species for which seed is expensive;
- species that regenerate naturally in autumn or winter, such as Sweet Bursaria, Tree Violet, Prickly Currant Bush and Cypress-pine, if direct seeding is undertaken in spring;
- narrow shelterbelts where regular plant spacing is required;
- farm forestry blocks where buffer-biodiversity strips of indigenous species are incorporated.

Guide to selection of revegetation techniques

SITE INFORMATION AND PURPOSE(S) OF REVEGETATION	REVEGETATION TECHNIQUE				
	Natural regeneration	Direct seeding by machine	Direct seeding by hand	Planting by machine	Planting by hand
Soil type					
Sands	•	•	•	•	•
Non wetting sands	•	With spray mulches, Rodden Scalping Seeder, Rippa Seeder			
Light soils	•	•	•	•	•
Heavy clays	•	Burford or Eco Seeder with gypsum	•		•
Sticky clays	•	•			•
Cracking clays	•	•			•
Heavy wet soils in high rainfall	•	Mouldboard Plough & Rippa Seeder	Mouldboard Plough		•
Saline	•	M-Profile mounding			
Environment					
Flats	•	•	•	•	•
Light granitic hills	•	•	•		•
Rocky or stony country	•	Burford / Hamilton Tree Seeder	•		•
Waterlogged	•	M-Profile mounding			
Hard to access rocky hill tops	•		•		•
Steep hills	•	Burford Tree Seeder, Rippa Seeder, Dozer Terracing	•		•
Intact remnants and ground flora (i.e. low degree of disturbance desired)	•		•		•
Riparian	•		•		•
Isolated dead trees	•	•	•		•
Scale of works					
Broadscale	•	•		•	
Medium (e.g. belts)	•	•	•	•	•
Small scale or spots	•		•		•
Desired end result					
Random or natural	•	•	•		•
Uniform spacings			•	•	•
Input level					
Time efficient	•	•			
Labour efficient	•	•			
Low cost	•	•			
Low equipment input	•	•			
High community involvement			•		•
Low machinery access	•		•		•
Types of species being used					
Rare	•				•
Understorey	•				•
Readily available	•	•	•	•	•

• = technique is relevant / appropriate

Guide to cost comparison of techniques

One factor that will influence which technique or combination of techniques you will choose, is the cost.

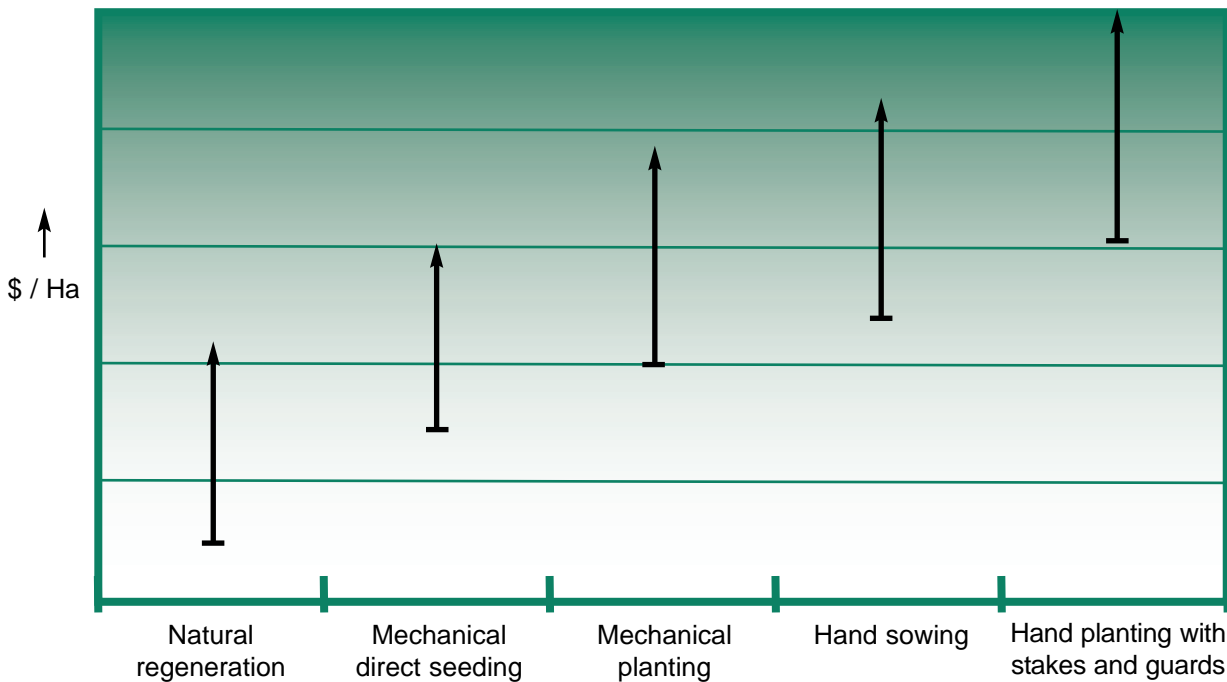
The graph below provides an indication of the most cost-effective options through to the most expensive. Natural regeneration is usually the most cost-effective, followed by the mechanical methods of seeding then planting and finally the hand options. However, the costs can increase for each technique depending on the site conditions, such as difficulty of the terrain and accessibility.

Many revegetation projects will involve a combination of techniques, and this is likely to add to the expense of the works.

Funding assistance

Speak to Greening Australia Victoria or your local Catchment Management Authority about current funding that may be available to support your revegetation project. Fencing often makes up about 80 to 90% of the total costs of revegetation in regional areas. Grant funding commonly assists with the cost of purchasing fencing materials.

Indication of cost per hectare of each revegetation technique





1. Natural regeneration

Natural regeneration is nature's technique for growing plants; it has been going on for about the last 400 million years. Whether canopy trees or understorey species, regeneration is usually the germination of seedlings from seed fall of existing or nearby vegetation. Some species, such as Eucalypts, have several mechanisms of regeneration apart from seeds including lignotubers or from coppice regrowth after felling (Oates & Clarke 1987).

Natural regeneration should be considered the first option for bringing back native vegetation.



Red Gum regeneration on a property in north east Victoria.
[Read Footprints Fact Sheet 21 to find out more.](#)

If remnant vegetation is present, whether as isolated trees in a paddock or grassland along a roadside, it is often the ideal starting point to encourage natural regeneration. For nature conservation on farmland, the priority is to fence off and manage these areas first, including encouraging natural regeneration events.

Natural regeneration is an effective, cheap method of establishing large numbers of plants in a random design. It is an important part of the succession and ecology of vegetation. Below is a summary of uses, advantages and factors to consider when deciding whether natural regeneration is appropriate for your site.

Uses

- Establishment of the original vegetation at a site on a small to large scale.

Advantages

- Genetics are appropriate for the site (except for isolated trees with no out-crossing potential).
- Low cost in terms of labour and dollars.
- Specialised equipment is not usually necessary.
- Can be adapted for large and small scale projects.
- A large number of plants can be produced (they will self-thin over time or can be actively managed for products, such as, firewood).
- Ensures indigenous species are established rather than weeds.
- Plants develop deep, strong root systems which help them establish quickly and withstand drought and wind.
- The random spacing of established plants enables the re-creation of a 'natural' self-sustaining habitat.
- Usually used with remnant vegetation areas and provides further protection for these areas.

Considerations

- Natural regeneration does not occur every year and may require specific events, for example, flooding.
- Trees may not grow exactly where they are needed.
- The final result may be a monoculture of species, perhaps just the canopy layer, and enhancement with understorey species may be required.

Requirements for natural regeneration

Natural regeneration requires:

- a heavy seedfall;
- a good seedbed with high soil moisture;
- the appropriate temperatures for germination (Venning as in Lawrence et. al. 1998).

Seed source

The seed source for natural regeneration can be from:

- parent trees;
- residual native plant seed within the soil, especially those of hard-coated species;
- wind-blown seed, for example, the light, fluffy seeds from daisies such as Dogwood (*Cassinia aculeata* spp.), Wallaby Grasses (*Danthonia* spp.) or Fireweed (*Senecio* spp.) or winged seeds (samara) from plants such as She-oaks, Banksias and Hakeas;
- birds that deposit seeds in an area, for example, from Tree Violets.

Seedbed

A good seedbed can be prepared which will increase the probabilities of a regeneration event occurring (refer to section below, on stimulating regeneration).

Episodic events

Natural regeneration does not occur every year. Many species require a particular climatic event to occur to initiate germination, such as a flood (River Red Gums *Eucalyptus camaldulensis*); a significant rainfall event in summer or a fire (Heathland communities); or some combination of high rainfall and fire. In nature, high rainfall events are often infrequent and if the site is well stocked with trees, the extra soil moisture is used by these standing trees.

Encouraging natural regeneration

Identify areas to try natural regeneration

Opportunities for natural regeneration may exist around isolated old trees in a paddock, along a waterway, in a bushland remnant or roadside reserve. Focus efforts in areas where you are more likely to have success, such as around species that are good regenerators, for example River Red Gums and Manna Gums (*Eucalyptus viminalis*), or in areas where there are fewer or no exotic pastures (Venning as in Lawrence et. al. 1998).



Identify areas to try natural regeneration such as the drainage line, above

Fence off groups of existing indigenous trees and/or understorey to reduce grazing pressure

Without fencing to exclude livestock, new seedlings will not be established. Livestock will eat young seedlings, particularly when there is no other food available, for example, during the autumn feed gap.

Seek advice as to whether a periodic grazing program once the regeneration has established within the fenced area will be detrimental to the vegetation. Certain vegetation types, such as grassy woodlands, are best left ungrazed.

Mature trees will compete with any new seedlings for sunlight, soil moisture and nutrients. Most new plants will grow outside the area shaded and dominated by the mature tree. The fence line should be well beyond the canopy or drip-line of such trees, probably to the south-east (this assumes seed fall in summer, during hot days with a north-westerly wind). The prevailing winds tend to blow the seed out from the base of the parent tree.



Fencing should be well away from the canopy or drip line of the trees as this landholder has done on his property on the urban-rural fringe of Melbourne. [Read about his story in Footprints Fact Sheet 24.](#)



Extend the fence line out to the lee side of the trees so that the seeds fall inside the fenced area but beyond the tree canopy or 'drip-line'.

Techniques to stimulate the regeneration of species

Reduce weed competition

It may be necessary, after fencing and before expected seedfall, to spray with a knockdown herbicide within the fenced area, but at some distance from the remnant trees, to reduce weed competition. This will minimise competition by weeds for soil moisture and increase the probability of the natural regeneration of tree seedlings.

Improving the seedbed

The seedbed can be improved in different ways to suit different species. Light cultivation, scalping, fire and the removal of weeds to increase light and soil moisture may be appropriate options.

Blackwood Wattles (*Acacia melanoxylon*) for example, are known to sucker prolifically when the soil beneath the tree is disturbed by light cultivation. Other species, such as heathland plants and the seed of all hard coated species (Wattles, Sennas, and all Pea flower species) respond well to fire. Spraying of smoked water products may, therefore, help stimulate regeneration of hard-coated seed species. The seedbed, of sites with a Eucalypt overstorey and Fog Grass understorey may benefit from removing the weed layer and opening up the ground layer. This will improve the seedbed and encourage natural regeneration of species such as Wattles.

Be careful to avoid damaging the roots of trees when disturbing the soil.

Many mature trees such as Eucalypts and She-oaks, actually prevent the regeneration of seedlings in the area surrounding the existing trees through a process called allelopathy. Allelopathy is where the leaves on the trees and on the ground exude chemicals that inhibit seedling germination.

It is only after the removal of these chemical exudates, by scalping the top layer of soil or by a flood event, that the seedlings are able to germinate.

Timing these stimulation techniques with good rainfall years and soil moisture, and good flowering-seed set and seedfall is recommended to increase the probability of regeneration.

Fire may assist regeneration on some sites:



Photo and above: Friends of Balcombe Park



Coast Tea-tree and Coastal Wattles dominated the vegetation in this urban parkland (top). Following the undertaking of an ecological burn (centre) and post-burn weed control, the diversity of heathland species has increased significantly (right).



Manage the regenerating area for pest animals and weeds

As with any form of plant establishment, pest animals and weeds should be monitored and controlled as needed. For example, it may be necessary to control grazing pressure from rabbits and hares and damage from insect attack.

Incorporate 'non living' elements into the regeneration area

Dead trees, fallen logs, rocks and leaf litter are all important components of functioning habitats - forming shelter, nesting sites, perches and food sources for an array of wildlife species including birds, lizards and insects. They also create environments for non-vascular plants to grow on, or in, such as mosses, lichens and fungi.



Photo: D. McBeath



Photo: C. Dennis

McBeath's grassy woodland remnant prior to fencing to exclude livestock (top) and following fencing. Note the build up of logs and leaf litter just over 12 months later.

Read about landholder experiences with natural regeneration in Footprints Fact Sheets 6, 7, 21, 23 and 24.



2. Direct seeding

Direct seeding involves the sowing of treated seeds directly onto a site to achieve germination and establishment and can be carried out mechanically or by hand.

Direct seeding as a regeneration method has been naturally occurring for millions of years by Australian flora and has been used, from as early as the 1870s for shelterbelt and woodlot plantations in south-west Victoria. In other parts of the state, direct seeding by landholders is a relatively new technique. Below is a summary of uses, advantages and some the factors to consider in deciding whether the direct seeding technique is appropriate for your situation and site.

Uses

- Direct seeding has many applications, both for broadscale vegetation establishment and for spot sowing by hand.

Advantages

- This technique involves a plant growing from seed rather than propagated material. Direct seeded trees and shrubs develop deep, strong root systems that help them establish quickly and withstand drought and wind.
- The patchy spacing of established plants enables the re-creation of a 'natural' self-sustaining habitat.
- If conditions are not favourable for seeding, for example, too dry, the seed can be stored for future sowing. Seedlings are harder to look after until the next season.
- Mechanical direct seeding is the most efficient technique for broad scale revegetation.
- Mechanical direct seeding is cost effective and labour efficient. Assuming the appropriate site preparation is completed, it is possible, with current technology, for one person to revegetate 10 to 15 hectares in one day (approximately 30 to 45 kilometres of seed line).



Direct seeding on a broadscale in central Victoria using the Burford Tree Seeder

Considerations

- Mechanical direct seeding relies on a greater amount of seed than techniques based on nursery grown seedlings. Commonly, about 1 to 1.2 kilograms of mixed seed is required per hectare to establish approximately 3,000 seedlings, whereas you need 100 grams of seed to grow 3,000 seedlings in a nursery (shortage of seed can be an issue).
- At this stage, not all species can be successfully direct seeded in the field.
- Whilst the labour requirement at the time of seeding is low, the seed collection process does require considerable labour, particularly if collecting seed yourself. A purchased seed mix for direct seeding would currently cost about \$150 to \$200 per kilogram.

There are many ways to direct seed native vegetation. The section below will outline some of the methods of direct seeding both by various machines and by hand. The first part will look at direct seeding by machine and will include steps for successful direct seeding by machine, some of the different machines available and their features and specialist direct seeding techniques, including m-profile mounding, mouldboard ploughing, deep scalping of steep slopes, applications to assist mechanical direct seeding in difficult soils, hydro-seeding and aerial seeding.

Direct seeding by machine

Steps for successful direct seeding by machine

1 PLANNING

- Determine purpose/s of revegetation
- Prioritise site selection
- Assess the site
- Select species
- Develop seeding design
- Select machinery for seeding
- Acquire the resources



Photo: R. Dadds

Soil preparation

Different sites and direct seeding machines may require different site preparation, for example, mound if required in saline or waterlogged sites.

Above all, a weed-free site with good soil moisture to depth is needed for successful sowing.



Photo: C. Dennis

2 PREPARING THE GROUND

Weed control

Ensure all weeds are controlled before seeding and ideally sow into bare ground. Good weed control creates a reservoir of moisture which is available for newly germinated seedlings.



Photo: K. Walsh

3 PEST ANIMAL MANAGEMENT

Prior to sowing, fence sites to protect them from grazing by livestock and undertake pest management to eradicate vermin such as rabbits and hares.



Photo: R. Dadds

4 SEED

Sourcing seed

Plan ahead for seed collection, which usually occurs in summer. However, some native plant fruits are not ripe in summer, for example, Sweet Bursaria, Red Gum and Manna Gum. Monitor local species populations to determine the ripeness of the fruits, for example, gum nuts or capsules. There can be seasonal variations in fruit ripening, for example during a drought year compared to an average rainfall year.

Use seedbanks for species which may not set seed that year or if you are unable to collect your own.



Photo: D. Walters

Species mix

Aim to utilise as many as possible of the indigenous species that would have naturally occurred on your site. This will maximise the recreation of as much of the structural and floristic diversity present in the original vegetation. You may prefer to exclude rare or difficult to grow plant species from your mix and instead plant nursery-grown seedlings of these species. This will ensure that valuable seed is not wasted and that such species will establish more reliably on your site.

Include greater proportions of large-seeded legumes (colonisers) in the mix. The colonisers play an important role early on in the development of vegetation communities and ecosystems - they grow quickly under sunny

conditions, often providing the ideal protection and environment to aid the establishment of longer-lived, slower-growing species.

Calculating seed quantities

As a general rule:

In low rainfall (semi-arid) areas up to 500 grams of mixed viable seed per kilometre of seedline is used, with the aim of establishing 1,000 plants per kilometre.

In higher rainfall areas up to 300 grams of mixed viable seed per kilometre of seedline is used with the aim of establishing 1,000 plants per kilometre.

When direct seeding on saline soils, 600 to 700 grams of mixed viable seed per kilometre of seedline is used due to the soil conditions and the lower germination rate of species.

Rigorous research was undertaken in south-west Victoria in the late 1980s to work out the quantities of seed required for a range of species, based on seed viability and establishment success (refer to Bird 1992 under Shelterbelts in Section C). Where such information is known, the following formula can be used to determine how many grams of seed for each species is needed per kilometre of seedline (g/km).

Calculating seeding rates

$$\text{g/km} = \frac{\text{plants/km}}{\text{viable seeds/g} \times \% \text{ field survival}}$$

Plant density can be referred to as plants per kilometre or plants per hectare, commonly densities are 1,000 seedlings per kilometre or 3,000 seedlings per hectare. Seek local advice on the planting design, this may determine the densities to aim for.

To work out the number of plants per hectare use the following formula:

Seeding rows:

$$\text{Plants/ha} = \frac{\text{plants/km} \times 10}{\text{row spacing (metre)}}$$

To work out the number of plants per kilometre use the following formula:

Seeding belts:

$$\text{Plants/km} = \frac{\text{plants/ha} \times \text{width of belt}}{10}$$

(Formulas above from Dalton 1993)



Photo: GAV

Seed treatment

Maximise successful germination by treating seed appropriately, if required at all. Direct seeding machinery can be set up to deliver smoke water, wetting agents or mulches and gypsum.

Germination testing of individual seedlots is useful (contact your local seedbank). Always sow fresh, viable (living) seed.



Photo: GAV

Leaching seed

5 SEEDING

Timing of seeding



Photo: J. Robinson

Sow into moist soil (as pictured above) if possible. Below is a general guide of when to sow:

Medium to high rainfall areas - spring sowing

Semi-arid areas - autumn/winter sowing

Frost prone areas - spring sowing

Machinery



A variety of direct seeding machinery is available. They all use, essentially, the same process: scalping 25 to 50 millimetres of topsoil to form a weed free strip, cultivate the scalp line to create a seedbed, deposit seed in or on the seedbed and, except in sticky wet soils, use a press wheel to ensure good seed to damp soil contact.

The machinery selected should suit the site conditions (flat, rocky, hilly), soil type and the availability of 4WD ute or tractor.

Bulking agents

While not necessary for most direct seeding machines, a bulking agent may be required for seeders with large seed boxes and imprecise seeding mechanisms or for use with mouldboard plough direct seeding. This will aid seed flow and enable more even distribution of seed. Seed is 'bulked' with material such as chick crumble, sand or sawdust before sowing. The closer the bulking agent is to the size and density of the seed the better; this will avoid the two separating in distribution.

Machine calibration

A key activity in direct seeding is the calibration of seed flow to ensure that seed is sown at the right rate. To calculate the seed flow, depending on which machine you are using, this will involve either timing the seed flow for one minute or turning the seed mechanism drive wheel for a known number of revolutions (determined by the drive wheel circumference).

Calibrate direct seeding machinery after any treatments are added to the seed mix (such as Magnesium Carbonate for ants) to avoid changes to the rate of seed flow.

Sowing depth

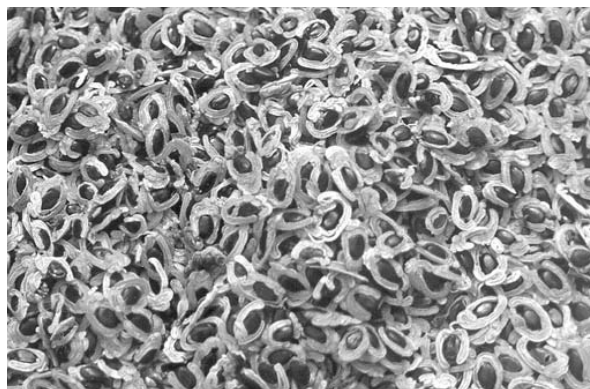


Photo: J. Harlock

For optimum results sow at the appropriate depth for the seed, this will depend on seed size (refer to Bonney 2001 *Germination Pathway*).



Photo: J. Harlock

If the direct seeding machine you are using has two or three seed boxes, which allow different depths of sowing, sow large seeds at no more than 15 millimetres deep and sow small seeds on the surface. The use of the press wheel on machines will ensure good seed to soil contact.

Direct seeding hints

Check that seed is flowing out of the seedbox at the end of each run; seedboxes do clog, so check regularly.

In steep areas where seeding on the contours is not possible, to prevent possible water erosion along scalp lines, lift the seeder out of the ground every 7 to 10 metres or so. Alternatively, have a person, on site while seeding, to push a plug of newly scalped soil back into the line to stop water movement.

Machine clean up

When using borrowed machinery or equipment, to avoid the possibility of weed or disease transfer between properties or regions, please pay particular attention to washing down the machinery or equipment upon completion of your job.

6 SITE MAINTENANCE

Inspect the seeding from about three weeks after sowing, for signs of germination (of good and bad seedlings), pests and diseases. Maintain fences. Take action against pest plants and animals as required.



7 MONITORING

Be patient. Do not write off sites as failures, it can take three years! Take a camera when visiting the site and record the change over time from a fixed point.

Document the species sown, rates and techniques used, and record germination success. This is of interest to you, but is also particularly important information to help refine direct seeding rates when sowing different species and developing strategies to promote germination.



Read about landholder experiences with direct seeding by machine in [Footprints Fact Sheets 1, 2, 3, 4, 5, 8, 9, 10, 13, 15, 18, 19, 20, 26, 27, 28, 29, 30, 31, 33, 36, 38, 39, 40.](#)

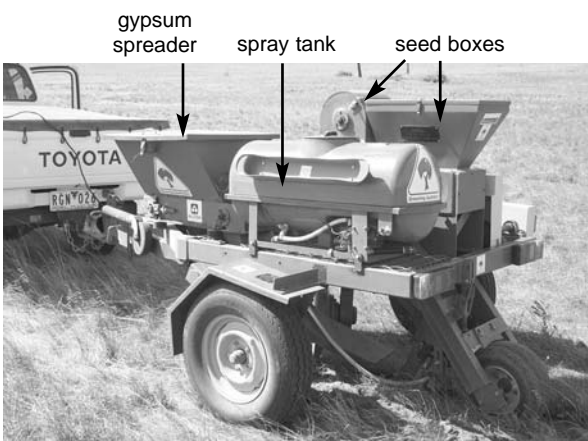
General purpose direct seeding machines

There are a range of direct seeding machines available to direct seed native vegetation. This section provides details on a number of general purpose machines and their features.

Direct seeding machines are commonly mounted on tractor linkage or drawn by 4WD vehicles. The critical issue is ensuring the machine is suited to the site conditions and that it is set up to provide the right seedbed and seed placement. Direct seeding of native vegetation has also been undertaken using existing farm machinery, including grain air seeders (refer to **Footprints Fact Sheet 38**), conventional pasture drills (refer to **Footprints Fact Sheet 15**) and rabbit bait layers (refer to **Footprints Fact Sheet 29**). The following general purpose machinery is available to landholders and the community through the Alcoa Revegetation Assistance Scheme: Burford Tree Seeder (formerly known as the Rodden Tree Seeder), Hamilton Tree Seeder, Rippa Seeder and Eco Seeder. Contact Greening Australia Victoria to hire or source the machinery listed.

Burford Tree Seeder

Designed by Rod Burford from South Australia.



The Rodden III Tree Seeder is out of production and is now known as the Burford Tree Seeder

Soil type and environment

Developed for use on a variety of soil types and climatic conditions. Not preferred for very rocky environments or confined spaces, for example, in narrow belts you need to sow before fences are erected.

Ground preparation required

Weed control to retain soil moisture to depth.

Features

- Up to four seed boxes enabling a wide range of seed to be sown to the right depths.
- Fitted with gypsum spreaders, and spray tanks to apply herbicides, smoke water and liquid mulches while operating.
- Self contained hydraulics for height adjustment.
- High precision placement of seed.



Hydraulics operated from cabin using battery powered motor

Method of sowing

Lightly scalp soil using disc to remove weed seed and create a microenvironment suitable for germination. Large seeds are sown behind a drill boot to ten millimetres deep. Fine seeds are surface sown behind two finger tynes. A press wheel follows to establish seed-to-soil contact. The wheel can be pinned up in sticky soil conditions.

Operation

Towed by a 4WD vehicle. Hydraulics operated from cabin using a battery-powered motor.

Transport

Easily transported from site to site.

Hamilton Tree Seeder

Designed by Keith Cumming from Hamilton, Victoria.



Photos: GAV

The Hamilton Tree Seeder scalps the soil and sows the seed in one pass. Inset: Germination of direct seeding using the Hamilton Tree Seeder at Stawell

Soil type and environment

Most soil types and light, heavy or rocky and steep terrain. Works best in high rainfall areas.

Ground preparation required

Weed control to retain soil moisture to depth.

Features

- Single seedbox can disperse very small to large seeds, single species or in mixes.
- Three point linkage provides manouverability and the ability to lift over rocks or rocky barriers.
- Ability to easily sow discontinuous lines.
- The flow rate of the seed box is controlled by a variable speed gear box which allows fine tuning of the rate of seed sowing.
- Moderate to high precision placement of seed.

Method of sowing

Lightly scalp soil with mouldboard action to remove weed seed, cultivate scalp line with twin offset tynes and create a microenvironment suitable for germination. A press wheel follows to establish seed to soil contact. The wheel can be pinned up in sticky soil conditions.

Operation

Used with a three point linkage tractor. Seeder can attach to either category one or two linkage arms.

Transport

Transported on a light made-to-fit box trailer.

Comments

Light-weight machine making transport easier; with the ability to easily lift over rocks using linkage it is excellent for rocky areas.

Rippa Seeder

Built by Barry Stirling from South Australia.



Photo: GAV

The Rippa Seeder in action in West Gippsland

Soil type and environment

Built to cope with steep, rough environments and able to rip and sow in stony ground (Casey & Chalmers 1993).

Ground preparation required

Weed control to retain soil moisture to depth. The V-shaped scalping blade at the front removes weeds and the seed is then dropped on the ground behind, followed by a spring loaded press wheel. The spring loaded downward pressure of the press wheel assists germination by pressing the seed in firmly.

Features

- Revolving drum seedbox with split bin which allows poorly cleaned seed to be used as well as sowing different sized seed at the same time.
- Three point linkage and design provides excellent manouverability.
- Seeder is multipurpose - it can become a self-centring ripper that does not require lifting out of the ground to turn corners.
- Broad scalping means it is suitable for sites with non-herbicide weed control.
- Moderate to high precision placement of seed.

Method of sowing

800 millimetre wide V-blade scalps soil to remove weed seed; large seeds are sown behind shallow ripper shank in centre, fine seeds are surface sown from second hose. A press wheel follows to establish seed-to-soil contact.

Operation

Used with a three point linkage tractor, bulldozer.

Transport

Transported on a custom built trailer.



Photo: GAV

Eco Tree Seeder

Eco Tree Seeder

Designed by Richard Weatherly, Mortlake, Victoria.

Soil type and environment

Machine operates in a wide variety of soil types.

Ground preparation required

Weed control to retain soil moisture to depth.

Features

- Front scalping disc, cultivating discs, mouldboarding and mounding option.
- Single seed box.
- There is a precision disc that can be fitted if exact seed placement is needed.

Bulking agent

Seed delivery on this machine requires a bulking agent, commonly chick crumbles.

Method of sowing

Lightly scalp soil to remove weed seed using disc; cultivation of scalp line using offset small discs to create a microenvironment suitable for germination. A press wheel follows to establish seed-to-soil contact. The wheel can be pinned up in sticky soil conditions.

Operation

Used with a three point linkage tractor.

Transport

Transported on a custom built trailer.

Comments

No ripper function available.

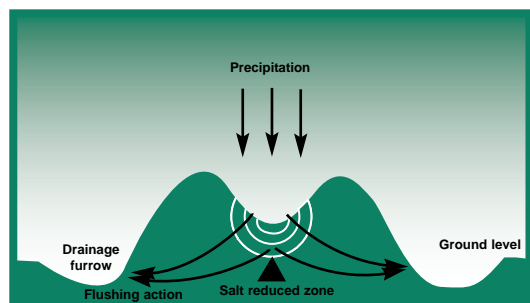
Specialist direct seeding techniques

There are a number of direct seeding techniques suited to particular environments or purposes. This section outlines six of these specialist techniques; m-profile mounding, mouldboard ploughing, deep scalping of steep slopes, applications to assist mechanical direct seeding in difficult soils, hydro-seeding and aerial seeding.

Specialist machinery available under the Alcoa Revegetation Assistance Scheme includes the Saltbush Seeder and Rodden III Scalping Seeder. Machinery for the other four techniques is not available under the Scheme, as this work is usually contracted out.

M-profile mounding

M-shaped profiles are a form of mounding for mechanical direct seeding in saline or waterlogged sites. The dish or dip in the mound allows rain to accumulate and as the water drains into the mound the salt is carried with it. This 'freshens' the soil (Casey & Chalmers 1993) diluting the salts where the seed or seedling is to be established. Specialist direct seeders such as the Saltbush Seeder are available for this technique, see below.



M-profile mound

Diagram reprinted from *Tree Tops: the tree planting book for farmers*, with kind permission of the publisher Kondinin Group. Phone 1800 677 761 for further information on Kondinin Group products and services.

The following information is a summary of the uses, advantages and factors to consider when using this technique.

Uses

- In saline or waterlogged sites.

Advantages

M-shaped seedbeds are advantageous as they:

- keep the seed above the natural surface thereby avoiding water logging;
- increase the catchment area for rainfall, thereby increasing the amount of moisture available to the seedling;
- leach salt from the mound resulting in a seedbed of lower salinity than the surrounding soils.

Considerations

- Use the specialist direct seeding equipment built for this purpose.
- Follow the step by step checklist for mechanical direct seeding on page 70.

M-profile mounding direct seeding machinery: Saltbush Seeder

Designed by David Millsom, Greening Australia Victoria, Lindsay Ezard, Department of Natural Resources and Environment and farmers from Kerang with experience in direct seeding of saltbush. Kerang Engineering constructed the machines.



Photo: D. Millsom

The Saltbush Seeder creates the m-profile for sowing in heavy soils in semi-arid areas and saline depressions

Soil type and environment

Seeding of saltbush in heavy soils in semi-arid areas and saline depressions.

Ground preparation required

Weed control to retain soil moisture to depth.

Features

- Single pass for seedbed preparation and seeding; accuracy adequate for broadacre use.

Method of sowing

Creates an 'm' profile mound onto which seeds are sown.

Operation

Requires a tractor with remote hydraulics.

Transport

Ten minutes to convert to road towing position.

Comments

Must be adjusted to suit the site. The saltier and wetter the site, the higher the mound formation needed.

Read about landholder experiences with m-profiling in Footprints Fact Sheet 38.



Photo: GAV

Mouldboard ploughing involves completely turning over the soil sod

Mouldboard ploughing

In the high rainfall areas of Victoria (800 to 1000 millimetres per year), in particular South Gippsland and the Otways - Heytesbury area (south west Victoria), direct seeding using mouldboard ploughs is a reliable, efficient, low cost way to establish native vegetation.

Mouldboarding involves using two to three curved ploughs, in sequence, to completely invert or turn over the soil in sods about ten centimetres thick, burying existing grasses and weed seeds. As there is an art to getting the soil to invert properly, contractors are usually used to carry out the ploughing. It results in a rough, weed free surface ready for broadcasting seed. Below is a summary of the uses, advantages and factors to consider when using this technique.

Uses

- For the establishment of native vegetation in areas of high rainfall and heavy wet soils.

Advantages

- Mouldboarding combats high rainfall by creating a variety of niches so that the seedlines do not fill up with water.
- The uppermost layer of soil is buried with its load of weed seed which assists with weed control.
- The technique creates a variety of niches, which in turn creates favourable conditions for a range of germinating seeds.
- Broadcasting of seed can be random, sown in rows for a more uniform effect or in specific spots along the seed line.
- Mouldboarding can stimulate natural regeneration, for example, of Wattles.
- If native vegetation is nearby the ploughed site can provide a seedbed for wind blown seed.

Considerations

- You need specialist equipment and environments to use this method.
- There is a high level of disturbance created by completely inverting the soil.

Steps for successful mouldboard ploughing

1 PLANNING



Photo: K. Walsh

- Determine purpose/s of revegetation
- Prioritise site selection
- Assess the site
- Select species
- Develop seeding design
- Source contractor for mouldboard ploughing
- Acquire the resources

2 PREPARING THE GROUND

Weed control



Photo: K. Walsh

Ideally, commence weed control at least twelve months before sowing.

Jan-Feb: Ensure the grass is short by grazing or slashing

Autumn: First spray of knockdown herbicide

Spring: Second spray of knockdown herbicide one week before sowing

Residual herbicides should not be used as

site preparation for this technique as seed may come into contact with the herbicide and be killed.

Soil preparation

No pre-sowing soil preparation required. The soil is prepared by the mouldboard ploughing process itself.

3 PEST ANIMAL MANAGEMENT



Photo: K. Walsh

Prior to sowing fence sites to protect them from grazing by livestock and undertake pest management to eradicate vermin such as rabbits and hares.

4 SEED

Sourcing seed



Photo: J. Heffcock

Plan ahead for seed collection, which usually occurs in summer. However, some native plant fruits are not ripe in summer, for example, Sweet Bursaria, Red Gum and Manna Gum. Monitor local species populations to determine the ripeness of the fruits, for example, gum nuts or capsules.

There can be seasonal variations in fruit ripening, for example during a drought year compared to an average rainfall year.

Use seedbanks for species which may not set seed that year or if you are unable to collect your own.

Species mix

Aim to utilise as many as possible of the **indigenous** species that would have naturally occurred on your site. This will maximise the re-creation of as much of the structural and floristic diversity present in the original vegetation.

Include greater proportions of large-seeded legumes (colonisers) in the mix. A good mix of seeds would be 15% Eucalypts, 40% Wattles and 40% others, for example, She-oaks, Tea-tree (*Leptospermum* spp.), Dogwood, Paperbarks, rushes and Kangaroo Apple.

Calculating seed quantities

The amount of seed needed can be calculated using a seeding rate of two to three kilograms per hectare, that is, two to three kilograms per 10,000m³.

Seed treatment

Maximise successful germination by treating seed appropriately, if required at all.

Germination testing of individual seedlots is useful (contact your local seedbank). Always sow fresh, viable (living) seed.

Timing of seeding

Most mouldboard plough sowing is undertaken in spring, however, machinery access to the site will usually dictate the timing.

5 MOULDBOARD PLOUGHING

The next 4 steps should be carried out on the same day.

Plough



Photo: K. Walsh

There is an art to inverting the soil properly. Use a skilled contractor to undertake the mouldboard ploughing.

A single pass with a mouldboard plough will invert the soil with sods about ten centimetres thick and create a rough weed free surface. The seeds from pasture weeds are buried.

Roll



Photo: K. Walsh

Mouldboard ploughing creates air gaps. Roll at this stage to eliminate air pockets and leave the surface rough to provide niches for the germinating seeds.

Use tractor wheels, a four wheeled motor bike, paddock rollers (pictured) or drag branches over the site.

Sow



Sowing takes place as soon as the site is ploughed. Ensure soil is still moist and friable for sowing and does not have a glazed crust.

Mix seed with a bulking agent, such as coarse damp sand, to assist with coverage (ten parts sand to one part seed).

Broadcast the seed by hand or using a lawn seed spreader in the furrows and selvage (refer to Direct seeding by hand section). It is necessary to come back and sow the edges of the site.

Natural results can be achieved by broadcasting across the entire area or more uniform results can be achieved by ploughing and seeding in rows.

Roll (as required)

Roll the site to provide good seed to soil contact.

6 SITE MAINTENANCE

Inspect the seeding from about three weeks after sowing, for signs of germination (of good and bad seedlings), pests and diseases. Maintain fences. Take action against pest plants and animals as required.



7 MONITORING



Be patient. Do not write off sites as failures, it can take three years! Take a camera when visiting the site and record the change over time from a fixed point.

Document the species sown, rates and techniques used, and record germination success. This is of interest to you, but is also particularly important information to help refine direct seeding rates when sowing different species and developing strategies to promote germination.

Further information

Contact the Gippsland or South West staff of Greening Australia Victoria (via the Head Office Ph 03 9450 5300) or contact the Department of Primary Industries Office in Gippsland on Ph 03 5662 9920.

Read about landholder experiences with mouldboard ploughing in Footprints Fact Sheets 9, 11 and 14.

Deep scalping of steep slopes

Steep and high rainfall areas, like the agricultural land in the Strzeleckis Ranges of West Gippsland, pose a challenge for revegetation. The reasons include:

- the steep terrain limits machinery access, both for site preparation and carrying out mechanical direct seeding;
- hand planting (which still requires site preparation) is labour intensive and tiring!;
- machinery must cope with heavy soils and the slope;
- there is a considerable weed seedbank in the soil to tackle;
- the deep, fertile soils and high rainfall means that weeds, as well as native species, grow quickly.



Photo: B. Teesdale

Steep slopes of the Strzelecki Range in Gippsland.

Deep scalping using bulldozers



Photo: B. Teesdale

Bulldozers have been used to deep scalp the slopes for hand sowing.

Deep scalping with a bulldozer has been used with success in the Strzelecki Ranges. However, because of the high level of disturbance to the site, it is critical that a thorough investigation is undertaken of other revegetation options and an assessment of the existing features of the site that may be compromised by such a technique. This technique may have applicability in other steep slope areas of Victoria, for example, the Otways. Below is a summary of the uses, advantages and factors to consider when using this technique.

Uses

- For former pasture land on steep slopes in a high rainfall and heavy soil environment (currently being trialled in the Strzelecki Ranges).

Advantages

- One pass weed control and seedbed preparation (the bulldozer blade removes the weed layer and creates the surface for sowing).
- Covers large areas in a short time.
- Thick band of seeds can be sown.
- Early indications show that direct seeding is a very cost-effective method of revegetation for the steep slopes country.

Considerations

- **CAUTION:** This is a skilled operation that requires highly experienced operators of the machinery, who are familiar with the terrain.
- Work along the contours to reduce the erosion potential.
- Avoid drainage lines and gullies.
- Access for machinery onto the site will play a large part in determining the seeding time.
- There is a high level of disturbance.
- Continued monitoring of the bulldozing sites is occurring and the potential use of the Rippa Seeder is being considered. This seeder works on the same principle of scalping but will distribute the seed at the same time. Other machines, such as the Delva Plough or a grader blade may be options.

Department of Primary Industries staff, involved in revegetation in the Tambo Valley, have found excavators just as useful as bulldozers in their steep and/or rocky country. Costing approximately the same amount, preparation of the seedbed using excavators has the advantage of not leaving a continuous line in which water can travel.

Steps for successful deep scalping of steep slopes

Follow the steps for successful direct seeding by machine on page 70 and note the following:

PREPARING THE GROUND

Weed control

The bulldozer blade prepares the seedbed and provides the weed control in the same pass. No other form of weed control is needed prior to bulldozer works.

Soil preparation

Seedbed preparation: The key to the deep scalping technique is to remove the top layer of weeds and soil.



Photo: B. Teesdale

Scalping depth and angle: The site should be scalped ten centimetres (four inches) in depth to effectively remove the weed roots. The blade should be driven at a slight angle to push the weed heap to the side of the sowing 'row' and create a terracing effect **along the contours** of the hillside.

Terracing effect: Approximately one metre intervals are made in between the scalped rows and are heaped with the weed and soil. The principle of the terracing effect is that the rain hits the slope and soaks down into the heaped area and underneath; the weed roots remain intact helping to bind the soil together. By scalping with the contours of the land, the natural slope is maintained and excessive water is soaked into the pile. Drainage lines are NOT terraced and are hand planted instead.



Photo: B. Teesdale

SEEDING

Timing



Photo: B. Teesdale

Timing will be dictated largely by access of machinery onto the site.

Sowing of the seed takes place as soon as possible after scalping. Two kilograms of mixed seed are sown per hectare.

A bulking agent or filler, such as chick crumble or sawdust, is mixed with the seed to assist with seed coverage across the site. The mixture is then broadcast by hand walking along the contours.

On average, two hectares per day, per person can be undertaken when broadcasting seed (refer to Direct seeding by hand section).

MONITORING

Also monitor for erosion and turbidity in nearby waterways.

Further information

Contact the Gippsland staff of Greening Australia Victoria (via the Head Office Ph 03 9450 5300).

[Read about landholder experiences with deep scalping in Footprints Fact Sheet 12.](#)

Applications to assist mechanical direct seeding in difficult soils

Some soils pose a challenge for direct seeding. Their properties and the environment that they are in, have, in the past, resulted in low rates of seedling establishment. Two products, soil wetting agents and spray mulches that may be applied to the site whilst direct seeding to overcome these problems are outlined below.

It is best to trial the use of such applications by seeding an area, with and without the application, to determine if there is a marked difference and whether it is worthwhile for the particular conditions at hand.

Soil wetting agents

Soil wetting agents can be beneficial in different soil types, such as non-wetting sands. The objective of the agents is to break down water repellants and allow the soil to 'wet up' from the surface down, following rainfall events. Soil wetting agents can be easily applied using a single spray nozzle and standard 'tray-mate' spraying unit. Sprayers can be mounted to direct seeding machines or the towing vehicle. Some direct seeding machines, such as the Burford Tree Seeder, already have a spray tank facility. Soil wetting agents have been extensively used in south-eastern South Australia and, in recent years with good results, in the Wimmera.

Contact your local agricultural product supplier to obtain soil wetting agents.

Spray mulches

In some soils, such as non-wetting sands which are prone to wind erosion, the application of spray mulch may be advantageous. The mulch improves the establishment of vegetation by stabilising soil and conserving moisture and reducing evaporation and protecting the seed from insect predation (for example, ants).

The mulch is applied over the seeded row as a spray and dries forming a crust. The material remains intact but is thin enough for the seedlings to emerge through (Dalton 1993).

Water-based bitumen is one product that has been used with success, particularly for fine seeded species such as Eucalypts (Dalton 1993). Be aware that if bitumen is used, it is very messy to work with, sets rapidly, it may block hoses, is usually only available in large quantities and will require effort to transport.

Machinery used for spray mulches

Some direct seeding machinery can be set up with a bitumen spray tank to apply bitumen in the same pass as the seeding.

Rodden III Scalping Seeder



The Rodden III Scalping Seeder applying bitumen mulch in the Wimmera

Photo: J. Robinson

Three-point linkage seeder designed for low rainfall areas and non-wetting sands.

Soil type and environment

Low rainfall areas and non-wetting sands.

Ground preparation

The machine's heavy blade forms a metre wide weed-free scalp line and water harvesting.

Features

- Water-based bitumen mulch overspray system can be attached.

Method of sowing

The machine scalps very radically, therefore take great care to manage the erosion potential. Also, if used with care, this technique can be part of a non herbicide vegetation establishment regime.

Operation

Medium sized three point linkage tractor.

Transport

Transported on its own custom built trailer.

Comments

Accuracy is dependent on maintaining an even ground speed.

Further information

Contact the Wimmera staff of Greening Australia Victoria (via the Head Office Ph 03 9450 5300).

[Read about landholder experiences with spray mulches in Footprints Fact Sheet 28.](#)

Hydro-seeding



Hydro-seeding to establish grass coverage

Photo: GAV

Hydro-seeding is a system of establishing vegetation in a quick and uniform manner. It is particularly useful for the even coverage of areas that are hard to access with other machinery, for example, steep road batters. The technique involves mixing the material to be sown with water in the hydro-seeding machine and applying it to the soil surface using a high pressure jet. There are two main processes used, hydro-mulching and hydro-seeding and mulching.

Hydro-mulching

The seed is mixed with a cellulose fibre mulch and water to form a slurry which is then applied to the site.

Application

- Open areas, parks, reserves etc.
- Slopes less than one in three when mulch binders are not being used. Binders can be added to hydro-mulch in steeper areas.

Advantages

The cellulose gives initial surface erosion control, helps to hold in moisture and insulates the soil which moderates soil temperature and promotes germination (Pearce 1986 and BWD Hydraulic Seeding Pty. Ltd. 1).

Hydro-seeding and straw or bitumen mulch

This process has two steps. First the hydro-seeder applies the seed and water mix to the site. A separate machine then, either applies a hay or straw mulch or a straw/bitumen mulch over the hydro-seeded area.

Application

- Roadside batters, embankments, river banks, restoration after engineering works.
- Straw/Bitumen Mulch is more often used on slopes up to a maximum of 1½ to 1 as long as the surface is fairly uneven (not cut smooth by a grader).

Advantages

This mix reduces the impact of rain on the site, provides a longer period of erosion control, holds moisture in and moderates the soil temperature. It remains intact while the roots of the plants develop and also helps to protect the soil and seeds from erosion and predation by birds and insects. (Pearce 1986 and BWD Hydraulic Seeding Pty. Ltd. 2).

Further information

Hydro-mulching and Hydro-seeding and Straw/Bitumen Mulch fact sheets produced by BWD Hydraulic Seeding are recommended.

Aerial seeding

'Aerial sowing is the spreading of seed from an aircraft on to a prepared seedbed in order to regenerate the site after timber harvesting' (Fagg 2001 p.8).

While this technique can cover large areas in a short amount of time, it is a specialised and expensive operation compared to the other techniques mentioned in this document. It may be the best option for large-scale revegetation in rocky, hilly areas that are not trafficable by machinery and difficult for walking, for example, the escarpment country in the Rowsley Valley near Bacchus Marsh.

Further information

Eucalypt Sowing and Seedfall, Native Forest Silviculture Guideline No. 8 by Fagg is recommended. Contact the Department of Primary Industries, Forestry Section Ph 13 61 86.

Direct seeding by hand

Direct seeding by hand is another option for native vegetation establishment and can be used for a range of purposes and in many different situations. This section looks at a number of the options of hand sowing available: broadcast sowing, spot sowing, niche seeding, brush matting and 'lay and spray'. In general, the principles for all are similar in that each method prepares a germination bed and the seed is then applied to the area. Below is a general summary of the uses, advantages and factors to consider when deciding whether to direct seed by hand.

Uses

- Suits revegetation projects from a small to large scale, particularly those that are inaccessible by machine or require minimal disturbance.

Advantages

- Low-cost technique for establishing native vegetation.
- Suitable for small and remote areas.
- Equipment is simple, portable and inexpensive.
- Useful where machinery is unsuitable, for example, rocky, steep hills.
- Involves little in the way of soil disturbance and allows for more controlled placement of plants within a site.
- Can be used to complement other methods of establishment such as regeneration, direct seeding or planting.
- Useful for the establishment of understorey plants.
- Depending on the technique and seasonal conditions, the seed can be sown while the seedbed is being produced.

Considerations

- More labour intensive.
- Be aware of potential health and safety concerns, for example the constant bending

and straightening of the back required by some techniques.

Seed coating and bulking agents

For some hand sowing methods, seed may be coated with a 'sticker' (e.g. egg-white based sticker) to increase its size and weight thereby increasing the distance of spread (Fagg 2001).

If a seed coating is not available, or suited to the method of hand sowing, a bulking agent may be used to enable more even distribution of seed, by diluting the seed lot. Bulking agents can also help control the rate of seed being sown, either by hand or hand operated equipment. Chick crumble, sand or sawdust can be used. However, the closer the bulking agent is to the size and density of the seed the better; this will avoid the two separating during distribution (Fagg 2001).

The following section will outline selected hand sowing methods.

Broadcast sowing

Hand broadcasting



Hand broadcasting seed across a mouldboard ploughed site

Hand broadcasting involves casting seed by hand across the prepared seedbed, sometimes called 'feeding the chooks'.

A seed coating or bulking agent can be used to assist distribution. If neither are used, make a small cup and use that to help ensure the same weight of seed is being broadcast across the revegetation site. While a simple technique, be aware that it will take longer and seed distribution will be less even than using a spinner (described below) and the results can be patchy.

Read about landholder experiences with hand broadcasting in Footprints Fact Sheet 14.

Spinner



Photo: GAV

Using a spinner to direct seed by hand

Hand cranked spinners can be used to sow seed evenly across larger revegetation sites. The speed of sowing depends on the walking and cranking pace and the size of the opening from the hopper, while the width of sowing will depend on whether the seed is coated or not and how fast it is cranked (Fagg 2001). Some calibration will be required and fluffy seeds, like Daisy-bushes (*Olearia* spp.) and Cassinia that may block up the spinners should be sown by hand.

Contact your local agricultural product supplier to obtain a seed spreader; it is an adaptation of a hand fertiliser spreader.

Read about landholder experiences with spinners in Footprints Fact Sheet 11.

Spot sowing

Spot sowing refers to using a measured amount of seed and sowing that in specific spots within a revegetation site. In other words, sowing discrete spots rather than spreading the seed across the whole site.

Ideal for small areas or for sowing seed that is expensive or not available in large quantities, spot sowing can have a higher establishment rate than broadcasting because the spot has been particularly selected or prepared (Fagg 2001). However, to reduce competition avoid areas of well-established vegetation. Methods for spot sowing include: rake hoe, Doyle Seeder, seed-a-metre and hand held seed dispensers.

Rake hoe

The rake hoe method involves the hand scalping of the top soil with weed seeds from a spot, light cultivation and the sowing of seed into that spot. A rake hoe, a tool normally used to make fire trails, can be used to create the clearing; they are available from hardware stores.



Photo: GAV

Scrape the seedbed



Photo: GAV

...and then rake to prepare the soil

Steps involved when using a rake hoe

- Control weeds in a 1 to 2 metre diameter circle and conserve moisture by chemical or manual means.
- One to three weeks after weed control, scrape/scalp the area using the hoe side of the rake hoe to remove dead weeds and trash.
- Use the rake side to lightly cultivate the surface soil.
- Apply a measured amount of seed to each spot (always sow into a moist seedbed).
- For fine seed, such as Eucalypts and Tea-tree, use the flat end of the rake hoe to tamp the soil and firm in the seed.
- For larger seeds, such as Wattles and She-oaks, rake the area again and then tamp down with the flat end of the rake hoe. Ideally, bury larger seeds to a depth of about twice their size.

(Steps adapted from the State Tree Centre *Tree Facts* 1991).

Doyle Seeder

The Doyle Seeder, developed by Denis Doyle in Alexandra, is a modification of a long-handled, three pronged garden hoe. The hoe has a lidded, plastic, pipe cylinder attached and a small seed-release slide operated by a hand lever. The pronged hoe cultivates the seedbed and the hand lever releases the desired amount of seed from the pipe onto the seedbed (Fagg 2001).

Contact Greening Australia Victoria for details of suppliers.

Seed-a-metre (marketed as the Weed-a-Metre)

Originally developed for dispensing granules of herbicide, this tool has been used for surface sowing of fine seeds, such as Eucalypts, in forestry situations. The cone shape facilitates the spreading of seeds over a circle diameter of 1.5 metres (Fagg 2001). This method requires a pre-prepared seedbed and is probably unsuitable for large-seeded species, such as Wattles.

Contact Greening Australia Victoria for details of suppliers.

Hand held seed dispensers

Hand held seed dispensers that apply measured quantities of seed onto the prepared seedbed, are available. Contact Greening Australia Victoria for details of suppliers.

Read about the use of a seed dispenser for revegetation in Footprints Fact Sheets 19.

Niche seeding



Successful niche sowing in south-west Victoria

Niche seeding is a hand, direct seeding technique whereby a small hole is created in the soil into which pre-germinated (primed) seed is sown.

The huge advantage of this technique comes from the priming. The seed is brought to the point just before root emergence and then sown; this encourages rapid germination of the seeds and gives the plant the chance to exploit the available resources before the weeds. Its chance of being eaten is also reduced! There are a number of considerations to take into account when using primed seed. Refer to Section A, under Seed for more information.

The other advantage of this technique is that the hole into which the seed is sown provides a microenvironment for the seed; weeds have been removed from the immediate germination area and highly fertile media can be placed into the area ready for sowing seed.

Successful species for niche seeding

Silver Wattle (*Acacia dealbata*), Black Wattle (*Acacia mearnsii*) Golden Wattle (*Acacia pycnantha*), Yellow Gum (*Eucalyptus leucoxylon*), Mountain Ash (*Eucalyptus regnans*), Tea-trees (*Melaleuca* spp.), Bottlebrushes (*Callistemon* spp.), She-oaks (*Allocasuarina* spp.), Hop Bush (*Dodonea viscosa*), Hemp Bush (*Gynatrix pulchella*), Golden-tip (*Goodia lotifolia*), Austral Indigo

(*Indigofera australis*) and grasses such as, Wallaby Grass (*Danthonia* spp.), Tussock Grasses (*Poa* spp.), Weeping Grass (*Microlaena stipoides*) and Spear Grasses (*Stipa* spp.). All have been tried with success.

Further trialling across a range of soil and climatic conditions is encouraged.

Equipment needed for niche seeding

- Plastic resealable bags/sealed plastic bins.
- Perlite or similar germination medium (finer grain sizes preferable).
- Guards (as needed); milk cartons or cardboard tubing is ideal.
- Fresh viable seed.

Steps for successful niche seeding

1 PLANNING

- Determine purpose/s of revegetation
- Prioritise site selection
- Assess the site
- Select species
- Develop seeding design
- Acquire the equipment and resources

2 PREPARING THE GROUND

Weed control and soil preparation

Ensure all weeds are controlled before seeding and ideally that you are sowing into bare ground. Good weed control creates a reservoir of moisture which is available for newly germinated seedlings.

Usually about one metre diameter circles are adequate or prepare larger areas if closer sowing is required.

3 PEST ANIMAL MANAGEMENT

Prior to sowing fence sites to protect them from grazing by livestock and undertake pest management to eradicate vermin such as rabbits and hares.

4 SEED

Sourcing seed

Plan ahead for seed collection, which usually occurs in summer. However, some native plant fruits are not ripe in summer, for example, Sweet Bursaria, Red Gum and Manna Gum. Monitor local species populations to determine the ripeness of the fruits, for example, gum nuts or capsules. There can be seasonal variations in fruit ripening, for example during a drought year compared to an average rainfall year.

Use seedbanks for species which may not set seed that year or if you are unable to collect your own.

Species mix

Aim to utilise as many as possible of the **indigenous** species that would have naturally occurred on your site. This will maximise the recreation of as much of the structural and floristic diversity present in the original vegetation. You may prefer to exclude rare or difficult to grow plant species from your mix and instead plant nursery-grown seedlings. This will ensure that valuable seed is not wasted and that such species will establish more reliably on your site.

Include greater proportions of large-seeded legumes (colonisers) in the mix.

Calculating seed quantities

To determine how many viable seeds there are per gram of different species consult a local species list such as Dalton (1993), Appendix 1, 'Number of Seedlings Per Gram of Seed' or in Bird (1992) *Trees and Shrubs for South-West Victoria* or the Greening Australia Victoria Seed Germination Data Sheet Series 1 - 9 (Refer to Section C).

The number of seeds required for niche direct seeding will also be dependent on the species, rainfall and local conditions.

In general, in higher rainfall areas sow larger

seed such as legumes, at three to four seeds per hole and ten to fifteen seeds in drier, low rainfall areas. For fine seeds such as Eucalypts, fifty plus seeds may need to be sown per spot (again, more or less depending on the circumstances).

Seed treatment

Maximise successful germination by treating seed appropriately, if required at all.

Germination testing of individual seedlots is useful (contact your local seedbank). Always sow fresh, viable (living) seed.

Prime the seed

Use a clear resealable plastic bag or plastic container and fill with a quantity of the germination media.

Mix the seed germination medium through and seal tightly, taking care not to expel all of the air.

Store the seed for approximately five days (as a general rule, seed can be primed about five days to sowing. Wattles can be primed ten days before sowing).

Check occasionally to see that there is sufficient moisture but do not drown the seed!

Note: It is not advisable to 'push' the seed too far into the germination process. Sow the seed before the emergence of the radical (first root). If the radical has emerged, it will probably be damaged by niche seeding. The objective at this stage is to 'awaken' the seed, not create a seedling.

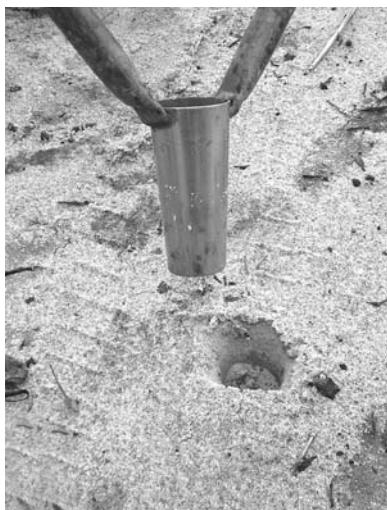
5 SOWING

Timing of sowing

Sow into moist soil if possible. As a guide:

Medium to high rainfall areas - spring sowing
Semi-arid areas - autumn/winter sowing
Frost prone areas - spring sowing

Prepare hole



Prepare a hole (niche) by taking a core of soil out, ideally using a Hamilton Treeplanter (cell size) to a depth appropriate for the soil conditions. As a guide this is usually 25 to 30 millimetres, however, the aim is for the seed to be placed in the soil profile area with the most nutrients, that is, the top layer. In poor soils, this layer may be very thin and therefore the hole may need to be shallower.

A gauge can be attached to the Treeplanter to act as a guide for hole making, this will speed up the process.

Sow



Place approximately two centimetres by two centimetres mix of media into the bottom of the hole.

Firm in



Gently firm down the media with a 'tamping stick', for example, a broom handle or stake to ensure the seed is making good soil contact, but not so hard that the seed is damaged.

Watering and guarding

Watering and guarding is optional. If guarding, the use of a tube or cylinder, such as a milk carton, enhances germination by preventing wind from drying the seedbed. It can also help prevent soil or other debris covering the seed and assist in keeping the seed in place if there is a heavy rainfall.

If light is an issue, consider using a clear guard, such as a length of coil of PVC water pipe, approximately ten millimetres in height (note this will need to be removed later on).

For small projects, a non-chemical form of weed control such as mulch mats which suppress weed growth can be used to surround the niche.

6 SITE MAINTENANCE

Inspect the seeding from about three weeks after sowing for signs of germination (of good and bad seedlings), pests and diseases. Maintain fences. Take action against pest plants and animals as required.

Prickly species, such as Hedge Wattle, have been sown with palatable species, such as She-oaks, to reduce animal browsing.

Do not be concerned if there are multiple seedlings growing in each spot as these will either self thin over time or you can selectively prune unwanted stems as required.

7 MONITORING

Be patient. Do not write off sites as failures; it may take three years! Take a camera when visiting the site and record the change over time from a fixed point.

Document the species sown, rates and techniques used, and record germination success. This is of interest to you, but is also particularly important information to help refine direct seeding rates when sowing different species and developing strategies to promote germination.

[Read about niche seeding being used in revegetation in Footprints Fact Sheet 19.](#)

Brush matting

Brush matting is another method of vegetation establishment and is commonly used for small scale, intensive strategies, in coastal environments as a way to hold the soil together, to limit beach access and to reduce erosion.

The technique involves cutting branch material, 'brush', at a time when the fruits are ripe, and laying it on a bare or prepared area. The branches are then pinned down to hold it in place. Over time, the fruits open and drop their seeds resulting in regeneration. At the same time, the erodible soils are stabilised and people are deterred.

The 'brush' implies the type of plant, and commonly, in coastal areas local Tea-trees (Myrtaceae family) have been used. Where the branches are cut, the original plant is able to re-sprout.

A responsible approach to the pruning involved with brush matting is encouraged, for with no weed control the probability of success is lower than with other techniques.

'Lay and spray'

One technique that has been used, in particular, to establish Kangaroo Grass is the lay and spray method.

Immediately after harvest (when the seeds are ripe, usually in January) Kangaroo Grass hay is spread out onto a site. The seeds drop and are screwed into the soil, after rain, by their awns. The site is sprayed with herbicide in winter, after the tall perennial weeds have grown through, and the hay is then burnt at the earliest opportunity in spring. Kangaroo Grass seeds begin to grow in November.

This technique is only suitable for smaller sites. The availability of efficient, native grass seed harvesters, for example, the Bandicoot Native Grass Seed Harvester, in recent years, in a number of locations, has meant that sizeable amounts of Kangaroo Grass and other native grasses are now more readily available. Trialling of the sowing of native grass seed through conventional pasture drills is advancing and it is likely that in the immediate future, we will have the ability to re-establish native grasses on a large scale. However, our native grasslands and grassy woodlands are extremely depleted. If we are to make a serious attempt to re-instate areas of these habitats, seed production areas will be required for many of the native grassland species and the lilies, peas, daisies, orchids and sundews.



3. Planting

The planting of indigenous seedlings can be undertaken by machine or by hand. While there is an increase in labour, time and money with this technique compared to natural regeneration and direct seeding, a high level of efficiency can be achieved with the use of planting equipment and when planting is preceded by good planning and ground preparation. Importantly, there are also social and educational benefits to be gained from the hands-on involvement that this technique offers at the planting stage.

This section will include information on planting by machine or hand, steps to follow for successful planting and planting machinery and equipment.

Planting by machine



Photo: GAV

The Waikerie Planter in action

Mechanical planters work on the principle of opening the soil with a broad tyne or shank so that a plant can drop into the space. Press wheels then push the soil back around the plant as the machine travels forward. Different machines are able to plant different seedling stock, including cells, tubestock and open-rooted seedlings. Below is a summary of the uses, advantages and factors to consider when using this technique.

Uses

- Used primarily for large-scale vegetation establishment on flat to undulating country.

Advantages

- Mechanical planting provides an efficient option for large-scale revegetation in the right conditions - flat to undulating country with friable soil conditions.
- Suitable for planting plants grown from cuttings or tissue culture or open-rooted seedlings.
- It is particularly suitable for projects which require regular, known, spacings of tree seedlings, such as farm forestry or narrow shelterbelts.
- For use in planting selected, high performance, provenance seedlings which would be too wasteful of seed or too expensive to direct seed.
- Can commonly achieve planting rates of 500 to 1,000 plants per hour.
- Enables older or infirm people to participate in planting.
- Some machines water-in planted seedlings.
- Much less tiring than manual planting.

Considerations

- Good soil preparation is crucial.
- Maximum sub-soil moisture conservation is critical.
- Mechanical planting machines work extremely well where very friable soil conditions are present. If the soil has not been sufficiently cultivated and is still cloddy, some seedlings will not be correctly planted and can be left lying on the soil surface. Cultivation to achieve soil conditions, similar to rotary hoeing, is recommended.
- The site should be assessed; mechanical planters work best on relatively level sites and along long, straight runs.
- If planting less than 10,000 cells, reconsider this option as 2,000 plants can be established in one day, per person, by hand techniques, for example, using planting tools such as Pottiputkis used with kidney-shaped planting boxes.

- Health and safety issues need to be considered. For example, using the Youman Tree Planter requires the operator to bend forward and sideways. To avoid possible back ache regular changing of operators is suggested.
- Usually suitable for projects with a narrow species range.

Read about landholder experiences with mechanical planting in Footprints Fact Sheets 2, 16, 28, 30 and 32.

Planting by hand



Greening Australia Victoria's annual Spring Planting Festival encourages community involvement in revegetation (above) as do the Hindmarsh Planting Weekends in rural Victoria.

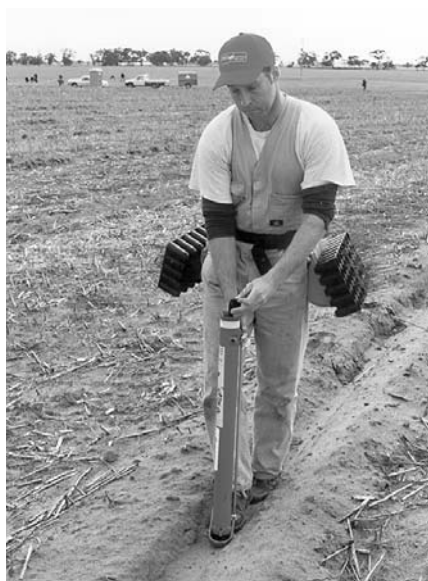


Photo: R. Dordts

Seedlings, whether bare rooted, cells or tubes can be established by hand operated tools in a wide variety of conditions. Planting by hand also provides a high level of community involvement in revegetation activities, providing an enjoyable social and educational experience. Below is a summary of the uses, advantages and factors to consider when using this technique.

Uses

- Revegetation of areas hard to access by machine.
- Small to large scale works.
- Fosters community involvement in revegetation.

Advantages

Hand planting is a technique most suited to revegetation projects that:

- require selected plants at regular spacings, for example, farm forestry;
- require species that are difficult to direct seed;
- are establishing species for which there is a limited seed supply; hand planting can be valuable in setting up seed production areas to rectify this problem for the future.
- aim to provide a high level of community education at the planting stage;
- are inaccessible by machinery;
- are of a small scale;
- use a wide range of species;
- are planting specimen trees.

Considerations

- There is greater time involved and a higher cost associated with plant production, time and equipment compared to direct seeding.
- Logistics of material and people access across the site.
- Reduced efficiency for large scale revegetation.

Read about landholder experiences with hand planting in Footprints Fact Sheets 17, 18, 19, 22, 25, 26, 30, 31, 34, 35 and 37.

Steps for successful planting by machine or by hand

1 PLANNING



- Determine purpose/s of revegetation
- Prioritise site selection
- Assess the site
- Select species
- Develop planting design
- Select machinery/equipment for planting
- Acquire the resources

2 PREPARING THE GROUND



Photo: R. Talbot

Weed control

Ensure all weeds are controlled and ideally plant into bare moist ground. Good weed control

creates a reservoir of moisture in the planting area which is available for use by the seedlings.

Soil preparation

Different sites and planting machines/equipment will require different site preparation. Well-prepared weed-free soil is essential for most sites.

3 PEST ANIMAL MANAGEMENT



Photo: R. Talbot

Prior to planting fence sites to protect them from grazing by livestock and undertake pest management to eradicate vermin such as rabbits and hares.

4 SEEDLINGS



Sourcing seedlings

Choose plant material of a high quality (see Section A under Seedlings).

Place plant orders well in advance - at least twelve months before planting. This will allow nurseries to obtain the right seed and have plants grown to the right stage.



If placing a large order consider spreading the 'risk' over a number of nurseries; nursery 'disasters' can happen, for example, frost events and poor or no germination.

Consider the length of time the plants are left in the container - too long and they may be pot bound.

Choose plants that have been grown in conditions that help to prevent root circling or that reduce the damage to the root, for example, air pruning and ribbed pots.

Refer to Greening Australia Victoria's nursery listings for suppliers of seedlings in your area. 'Indigenous Nurseries of Melbourne's Port Phillip and Westernport Regions' and 'Farm Tree Nurseries and Growers in Rural Victoria'. Details are provided in Section C.

Species mix

Aim to utilise as many as possible of the **indigenous** species that would have naturally occurred on your site. This will maximise the recreation of as much of the structural and floristic diversity present in the original vegetation. Include greater proportions of legume (colonisers) in the mix.

Calculating plant quantities

The ratio of trees to shrubs and ground cover plants, and their densities will depend on the type of vegetation community being created. As a general rule, for what were originally forest environments, a 20% overstorey of trees and an

80% understorey of shrubs and ground covers is suggested. However, for native grasslands or grassy woodlands, the diversity of species is in the ground flora alone, rather than the canopy layer.

It is best to seek local advice to determine the most appropriate spacing of plants for the vegetation community that you are creating.

As a general guide for spacings:

Canopy trees = 1 per 5m²

Shrub layer = 1 per 2-3m²

Ground covers/grasses = 4-5 per 1m²

5 PLANTING



Timing of planting

Plant into moist soil if possible - moist site conditions suggest that weed control measures have been taken!

Guide to Timing:

Medium - high rainfall areas - spring planting

Semi-arid areas - autumn/winter planting

Frost prone areas - spring planting

Watering and guarding

Watering at planting is advantageous to remove air pockets from the roots, to help overcome any transplant shock and to establish good root to soil contact. (**In wet sites, watering may not be necessary**). Refer to Section A under Revegetation for more information.

If guarding, ensure they are anchored securely. The diagrams on page 106 provide the correct technique for hand planting seedlings.

Machinery and equipment

Select the machine or equipment to suit the environment, soil types and to match the plant container size. Refer to the detail on machinery and hand tools available to follow.

Machine and equipment clean up

When using borrowed machinery or equipment, to avoid the possibility of weed or disease transfer between properties or regions, please pay particular attention to washing down the machinery or equipment upon completion of your job.

6 SITE MAINTENANCE



Photo: R. Dordts

Inspect the planting site and seedlings for signs of pests and diseases and take action as required. Replace and remove guards as needed and maintain fences.

In exceptionally dry years or low rainfall areas, for example, the Mallee, consider a second watering over the summer period.

7 MONITORING



Take a camera when visiting the site and record the change over time from a fixed point.

Keep records of other observations, for example, of birds and other animals that use the site. This will provide good 'bench marks' for measuring the success of future revegetation projects, particularly those that have biodiversity conservation/enhancement as an objective. This will also provide an increased sense of satisfaction from the work involved with revegetation.

Similarly, it is often useful for future reference to keep a record of the species planted, dates of activities and documents such as nursery invoices.

Mechanical planting machinery

Bushplanter



Photo: GAV

The Bushplanter is a versatile and commonly used mechanical planter that has been adapted from horticulture.

Ground preparation required

Well-worked, friable, fine tilth to a greater depth than the cell tray height.

Soil type and environment

Works in a range of soil types if the soil is well prepared and friable.

Features

- Planting mechanism uses simple 'pockets' on revolving chains for spacings thirty centimetres and up.
- Dual seating for two operators.
- Chain drive mechanism carries the plant and drops them at pre-set intervals.
- Comfortable upright planting position for operators.
- Automatic watering available.

Capacity

Capable of planting from two to thirty thousand plants per day depending on the site and plant spacings.

Plant stock

Suited to plant cell tray or plug grown plants and open rooted seedlings.

Operation

Three point linkage tractor.

Transport

Transported on custom built trailer.

[Read about landholder experiences with the Bushplanter in Footprints Fact Sheets 2 and 16.](#)

Waikerie Tree Planter



Photo: GAV

The Waikerie Tree Planter is a mechanical planter used for cell tray seedlings in specific soil types.

Ground preparation required

Bare earth. No active root systems in soil. As for direct seeding, no cultivation.

Soil type and environment

Sand or loamy soil types. Not suitable for heavy soils or for 'fluffy' soils that are cultivated.

Features

- Simple rotating-table planting mechanism.
- Twin sets of press wheels for seedling bedding-in.
- Up to 1,000 plants can be loaded on the carrying racks on the machine.
- Comfortable upright planting position for operator.

Plant stock

Cell grown at least 15 to 20 centimetres tall with well developed root systems, that is, potting media does not collapse when seedling removed from the cell.

Operation

Medium sized three point linkage tractor (reasonable three point linkage lift capacity required as this is a heavy machine).

Transport

Transporting - allow half an hour to move from transport to operation mode.

Comments

Will not work in the range of soils that the Bushplanter does. Does not work well out of a straight line.

[Read about landholder experiences with the Waikerie Tree Planter in Footprints Fact Sheets 28 and 30.](#)

Youman Tree Planter



Photo: GAV

The Youman Tree Planter is a simple to use, sturdy multi-functional planter.

Ground preparation required

Ripped and cultivated to produce friable soil conditions.

Soil type and environment

Works in rocky to swampy areas. Soil should be loose enough to easily back fill around the

planted seedlings and not cloddy to allow effective firming-in by press wheels.

Features

- Depth control from tractor seat - no adjusting of depth wheels.
- Large carrying trays for large capacity of works.

Plant stock

Fifteen centimetre forestry tube and bare-rooted seedlings.

Operation

Three point linkage tractor.

Transport

Easily transported.

Comments

- Operator required to crouch over the 'planting shoot', where the plants are placed in the plough line at the desired intervals; suggest regular changing of operator to mix up tasks.
- If plants are to be evenly spaced, the appropriate length of chain can be dragged behind the planter to indicate spacing.
- To improve efficiency and help the planter operator keep up with the machine, remove well-watered trees from the tubes and repack them, bare-rooted, into boxes

Hand planting equipment

There are a range of tools available which will increase the efficiency of planting seedlings by hand. This includes a variety of designs available to suit different sites, soil types and purposes of vegetation establishment.

Fundamental to the efficient use of most of the manual planting tools is site preparation. This generally means moist soil to depth, for ease of use of tools, as well as for plant survival and growth. Similarly, friable soil conditions, for example, produced by ripping are ideal when using most manual planting tools. If ripping is not possible or recommended, for example, for cracking clay soils, planting will be less efficient (slower), and survival and initial growth rates of seedlings will probably also be reduced.

Contact Greening Australia Victoria to hire or source the equipment listed.

Planting tubes

Pottiputki



Pottiputki and kidney tray



Photo: GAV

The Pottiputki and kidney tray is an efficient planting system

The Pottiputki has been developed by Lannen Plant Systems.

Description

- Simple, efficient hand planting tube for one person.
- Developed using the technology of the overseas forestry industry.

Features

- Requires no bending, stooping or kneeling by the operator.
- Commonly used with Lannen kidney-shaped planting box (where seedlings are pre-lifted from trays by nurseries) or Hiko bracket and belt hip carrier (where seedlings are planted direct from cell-tray containers).

Soil type and environment

- Well prepared ground, for example, pre-ripped to create loose, friable soil.
- In very high rainfall sites, the plant may be 'punched' into non-ripped soil using this implement.

Capacity

- More than 2,000 plants per day using skilled operators (Blue Gum contractors would each commonly plant 6,000 per day).

Plant stock

- Tubes are available in sizes to suit most containerised plants.
- Several thousand seedlings can be transported bare rooted and planted.

Comments

- The use of kidney trays or bracket-and-belt hip carriers with the Pottiputki enable large numbers of plants to be carried comfortably on the hip and make planting easier and faster. Bracket-and-belt hip carriers are commonly used when few species are being planted; kidney trays are preferred if a broad range of species is included in the revegetation.
- For sites where residual or pre-emergent herbicides have been used, the placement of seedlings in the soil by Pottiputkis ensures that there is no contact between seedling roots and the herbicide.

Read about landholder experiences with Pottiputkis in Footprints Fact Sheets 18, 26, 30, 31, 35 and 37.

Plug removing planters

Hamilton Treeplanter



Hamilton Treeplanter in action

The Hamilton Treeplanter has been developed by Keith Cumming, Hamilton, Victoria.

Description

- Consists of a handle, shaft, footrest and a tube or cell shaped structure at the base.

Features

- Creates hole the right shape and depth for the seedling - the depth is slightly longer than forestry tubes or cells to allow for covering of potting media with soil from the planting site which avoids capillary drying out of potting media and plant roots immediately after planting.

Soil type and environment

- Avoid using in heavy clays. There is a risk of 'glazing' the sides of the plant hole and causing boxed roots in these conditions.

Site preparation required

- Ideally intended for use in herbicide sprayed ripelines. If ripping is not possible or recommended, use will be less efficient and survival and initial growth rates will probably also be reduced.

Capacity

- Four hundred trees per day, per person.

Plant stock

- Range of cells, up to tubestock.

Comments

- Ideal for community plantings as a two person operation, where one person makes the holes and another person plants.
- More labour intensive than the Pottiputki and involves bending to plant when used by a single operator.
- Care must be taken to water plants in well to remove air pockets and thoroughly cover potting media with soil. This will block the air flow down the plant and avoid capillary drying out of the potting mix. If planting into a mulched site, clear a space in the mulch first and then use the planter to create a hole in the soil.
- The Hamilton Treeplanters come in a variety of sizes to match the seedling size being used, for example, from cells to tubestock.

- For sites where residual or pre-emergent herbicides have been used, the placement of seedlings in the soil by a Hamilton Treeplanter ensures that there is no contact between seedling roots and the herbicide.

Read about landholder experiences with Hamilton Treeplanters in Footprints Fact Sheets 17, 22, 25, 26, 35 and 37.

Hand augers*

Gumbo Planter

The Gumbo Planter has been developed by Andy Marshall, Rokewood.

This mini auger is designed for use in heavy cracking or sticky clay soils where other tools, such as the Hamilton Treeplanters, plug up. Comes with small, pointed, T-shaped tools for roughing hole sides if glazed.

Hamjam Borer



Hamjam Borer

The Hamjam Borer has been developed by John Van Denham.

It consists of a handle, shaft and foot plate with spikes and rotating cutting blade/bit. Stand on the foot plate, push spikes into the ground and rotate the handles to create a rough hole with non-glazed sides. Several cutting blade/bit sizes are available.

Mechanical Augers*



Mechanical auger used to create holes for planting

A powered hole digger for use by one or two operators. A variety of bit sizes are available for different sized holes. Commonly used for planting cell-raised, native grass seedlings. Available from most major hardware stores.

***Note: Ensure the sides of the hole are not glazed - the auger should tear the sides of the hole rather than glaze the sides.**

Water injector augers or jets



Photo: GAV

Water injector auger

Powered by a fire-fighter pump and water tank, this hand held 'injector' is charged up with water and blows holes into the soil, ready for planting. It also has the added benefit of loading up the soil profile with water. Once the holes are created, they can then be planted. This method is particularly useful in dry conditions, hard to access sites such as riparian environments, in lighter soils or for planting 'long-stem' seedlings in creek beds prone to flooding.

Read about landholder experiences with water injector augers in Footprints Fact Sheets 30, 31 and 34.

Mattocks



Mattock

- Mattocks can be a useful tool for small-scale hand planting projects.
- They serve a similar function to ripping when used to make planting holes considerably larger than the seedling rootball, breaking up heavy, compacted or sticky soils. This enables easy, rapid root growth, laterally and to depth.
- Mattocks are a superior choice over the Hamilton Treeplanters for use in sticky clays, particularly where mechanical ripping and cultivation is not possible. However, they should not be used on sites where residual or pre-emergent chemicals have been used as the seedling roots will come into contact with the chemical in the soil.
- Mattocks can cause back pain and, with hard pointed ends, should be used with care and away from other people.
- Available from most hardware stores.

Planting spades

Planting spades are used mainly in the forestry industry for planting open-rooted pine trees. They can also be used for open-rooted native seedlings. Check supplies with major hardware stores.

Steps for hand planting tubestock

The following example outlines the steps involved for planting tubestock into a mulched site.



Clear mulch.



Select Treeplanter to match seedling pot size and prepare the hole.



Gently squeeze container to loosen, invert and support stem to allow plant to slide out.



Plant, ensuring that the seedling is planted below the surface of the ground. Ensure plug of soil is put back around the plant, ensuring no

potting mix is exposed (to avoid capillary drying out of the potting media/seedling root area, immediately after planting).



Firm in.



Bring back mulch around plant (keeping stem clear of mulch).



Water in at planting to establish good root-to-soil contact (if site requires this).



Guard as necessary.

SECTION C:

Contacts for further advice, information, resources and reading

There is a wealth of expertise and information available to assist you with your revegetation project. This section aims to help you locate local advice, equipment and further reading.

Advice and information

Organisation

Greening Australia Victoria

Greening Australia Victoria works in partnership with landholders, community groups, industry, natural resource management agencies and government to help create sustainable and productive landscapes throughout the state.

The organisation provides services in vegetation planning, supply, establishment, management and training for local and regional areas.

Contact Details

Staff are based in regional locations across Victoria and can be contacted via the **State Office** on phone **03 9450 5300**.

Website: <http://www.greeningaustralia.org.au>

Email: general@gavic.org.au



Hire of Machinery & Equipment

Greening Australia Victoria hires revegetation machinery and equipment through the **Alcoa Revegetation Assistance Scheme**, including direct seeders, mechanical planters, hand planting tools and seed collection equipment. You need a standard fifty millimetre tow ball to transport a direct seeding machine.

The **Community Equipment Support Scheme**, operating from the Port Phillip region with support from Parks Victoria, hires Tool Trailers and/or individual tools for revegetation.

Equipment Care and Hygiene: Users must adhere to the Conditions of Use provided with the equipment. Due care should be taken to avoid the possibility of weed or disease transfer. Please wash down the machine or equipment upon completion of use.

Contact Greening Australia Victoria for booking information and hire rates.

Organisation	Contact Details	
Department of Sustainability and Environment and Department of Primary Industries Region offices to contact for: -Flora and fauna information -Seed collection permits -Pest plant and animal information -Regional Chemical Standards Officers -Program information e.g. the Catchment Management Activity System	Customer Service Centre	Ph 13 61 86 http://www.dse.vic.gov.au http://www.dpi.vic.gov.au
	Gippsland North East North West Northern Irrigation Port Phillip South West	Ph 03 5172 2111 Ph 02 6055 6111 Ph 03 5430 4444 Ph 03 5833 5222 Ph 03 9296 4400 Ph 13 61 86
BushTender Trial	Project Manager	Ph 03 9637 8360
The Living Systems Project	Education Officer Project Leader	Ph 03 5333 6825 Ph 03 9412 4585
Land for Wildlife	State Coordinator	Ph 03 5430 4363
	Alexandra Bairnsdale & Orbost Ballarat Benalla Bendigo Horsham Mildura Port Phillip (Greater Melbourne) Portland St Arnaud Swan Hill Wodonga Yarram Central Gippsland	Ph 03 5772 0257 Ph 03 5152 0410 Ph 03 5333 6967 or 03 5333 6928 Ph 03 5761 1526 Ph 03 5430 4368 Ph 03 5362 0765 Ph 03 5022 4324 Ph 03 9785 0134 Ph 03 5523 3232 Ph 03 5495 1700 Ph 03 5036 4824 Ph 02 6055 6173 Ph 03 5183 9103 Ph 03 5172 2111
Native Vegetation Officers	State Coordinator	Ph 03 9412 4542
	Corangamite East Gippsland Glenelg-Hopkins Goulburn Broken Mallee North Central North East Port Phillip & Western Port West Gippsland Wimmera	Ph 03 5233 5506 Ph 03 5152 0652 Ph 03 5573 0705 Ph 03 5784 0600 Ph 03 5051 4576 Ph 03 5422 7304 Ph 02 6056 6220 Ph 03 9296 4660 Ph 03 5662 9920 Ph 03 5362 0746
Waterwatch	State Coordinator	Ph 03 9412 4072

Organisation	Contact Details																				
<p>Landcare (Victoria)</p>	<p>Statewide Landcare Facilitator (at the Department of Sustainability and Environment) Ph 03 9412 4785</p> <p>Victorian Landcare Gateway (provides links to Landcare in each region) http://www.landcare.net.au/vic</p> <p>Regional Landcare Co-ordinators (hosted and managed by the Catchment Management Authorities)</p> <table border="0"> <tr><td>Port Phillip</td><td>Ph 03 9785 0117</td></tr> <tr><td>Corangamite</td><td>Ph 03 5253 9131</td></tr> <tr><td>Glenelg-Hopkins</td><td>Ph 03 5571 2526</td></tr> <tr><td>Wimmera</td><td>Ph 03 5662 4555</td></tr> <tr><td>Mallee</td><td>Ph 03 5022 4331</td></tr> <tr><td>North Central</td><td>Ph 03 5440 1820</td></tr> <tr><td>Goulburn Broken</td><td>Ph 03 5761 1673</td></tr> <tr><td>North East</td><td>Ph 02 6043 7619</td></tr> <tr><td>East Gippsland</td><td>Ph 03 5153 0462</td></tr> <tr><td>West Gippsland</td><td>Ph 03 5382 1544</td></tr> </table>	Port Phillip	Ph 03 9785 0117	Corangamite	Ph 03 5253 9131	Glenelg-Hopkins	Ph 03 5571 2526	Wimmera	Ph 03 5662 4555	Mallee	Ph 03 5022 4331	North Central	Ph 03 5440 1820	Goulburn Broken	Ph 03 5761 1673	North East	Ph 02 6043 7619	East Gippsland	Ph 03 5153 0462	West Gippsland	Ph 03 5382 1544
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West Gippsland	Ph 03 5175 7800 http://www.wgcma.vic.gov.au																				

Organisation	Contact Details	
Environment Australia	Community Info Unit	Ph 1800 671 717 http://www.ea.gov.au
Natural Heritage Trust		http://www.nht.gov.au
Bushcare	State Bushcare Coordinator	Ph 03 9412 4539
Local Government	<p>Contact your local environment officer at the shire or council.</p> <p>A statewide local government contact is the MAV (see below)</p>	
Municipal Association of Victoria (MAV)	Environment Resource Officer	Ph 03 9667 5555 http://www.mav.asn.au
Contacts for more information on traditional Aboriginal Owners and people responsible for Cultural Heritage	<p>Mirimbiak Nations Aboriginal Corporation</p> <p>National Native Title Tribunal</p> <p>Aboriginal Cultural and Heritage Organisations</p> <p>Kulin Nation</p> <p>North West</p> <p>North East</p> <p>Gippsland</p> <p>South West and Wimmera</p> <p>Aboriginal Affairs Victoria (AAV)</p>	<p>Ph 03 9321 5300</p> <p>Ph 03 9920 3000</p> <p>Ph 03 9793 1735</p> <p>Ph 03 5033 0666</p> <p>Ph 03 5869 3353</p> <p>Ph 03 5136 5152</p> <p>Ph 03 5562 3458</p> <p>Ph 03 9637 8000 http://www.dvc.vic.gov.au/aav.htm</p>
Indigenous Land Management Facilitator for Victoria	Greening Australia Victoria	Ph 03 9450 5300
Trust For Nature		Ph 1800 99 99 33 http://www.tfn.org.au
Parks Victoria		Ph 13 19 63 http://www.parks.vic.gov.au
Field Naturalists Club of Victoria		Ph 03 9877 9860 http://www.vicnet.net.au/~fncv
Green Corps		Freecall 1800 077 700
Conservation Volunteers Australia		Ph 1800 032 501 or Ph 03 5333 1483 http://www.conservationvolunteers.com.au
Chemical Information Service		Ph 03 9210 9379

Quick find help list

Topic referred to in Section A and B	Contact point / references suppliers
1. PLANNING	<p>Obtaining local advice for your area Contact Greening Australia Victoria, the Catchment Management Authority, Department of Primary Industries Office or Landcare Group.</p> <p>More information about your site can be obtained from: Victorian Resources Online http://www.nre.vic.gov.au/vro</p> <p>Whole farm planning Contact Greening Australia Victoria or the Department of Primary Industries for local courses, or your local TAFE College or Training Body.</p> <p>Video and Booklet - <i>On Borrowed Time: A Guide to the Potter Farm Plan</i>, 1990, The Ian Potter Foundation, Melbourne. Available from Trust for Nature. Ph 1800 99 99 33 or 03 9670 9933.</p> <p>Australian Master Tree Grower Course For course details in Victoria phone Greening Australia Victoria or the Department of Primary Industries in your area or visit: http://www.mtg.unimelb.edu.au</p> <p>Aerial photographs Contact the Department of Sustainability and Environment's Land Information Centre (Melbourne) on Ph 8636 2827, or Vic Image (South Melbourne) Ph 9682 3330, or United Photo Graphics Services (Melbourne) Ph 9877 3922, or the following website: http://www.land.vic.gov.au</p> <p>Site assessments Contact local groups and organisations, such as, Greening Australia Victoria, Field Naturalists, Land for Wildlife or local Landcare groups for details of local experts to assist with identification of flora and fauna on your property.</p>

Topic referred to in Section A and B	Contact point / references suppliers
<p>1. PLANNING (cont.)</p>	<p>Environmental Management Systems Environmental Management Systems in Agriculture Ph 03 9637 8463</p> <p>The following websites provide background information:</p> <p>Rural Industries Research and Development Corporation http://www.rirdc.gov.au/ems</p> <p>Department of Agriculture, Fisheries and Forestry Australia http://www.affa.gov.au (search for EMS)</p> <p>Department of Primary Industries and Department of Sustainability and Environment http://www.dse.vic.gov.au (search for EMS)</p> <p>Biodiversity Action Planning Download or request a copy of the following publication from the Department of Sustainability and Environment:</p> <p>Platt, S. J. and Lowe, K. W. (2002). <i>Biodiversity action planning: action planning for native biodiversity at multiple scales - catchment, bioregional, landscape, local</i>, Department of Natural Resources and Environment, Melbourne.</p> <p>Available at http://www.dse.vic.gov.au (search plants and animals/native plants and animals/biodiversity/rural landscapes)</p> <p>This site also provides biodiversity overviews for specific bioregions; and landscape plans for specific landscape zones within each relevant bioregion.</p> <p>Ecological Vegetation Classes Contact the Parks, Flora and Fauna Division of the Department of Sustainability and Environment, Ph 13 61 86 or speak to the Native Vegetation Officer at the Department of Primary Industries for your region (see contacts).</p> <p>The following website provides background information: Department of Primary Industries and Department of Sustainability and Environment http://www.dse.vic.gov.au (search for Ecological Vegetation Class)</p>

Topic referred to in Section A and B	Contact point / references suppliers
<p>1. PLANNING (cont.)</p>	<p>Resourcing a project Budget: Contact your nearest Catchment Management Authority to find out about funding incentives and grants.</p> <p>Training, Skills and Knowledge: Contact Greening Australia Victoria or your local Landcare group for upcoming field days or training days.</p> <p>Materials: Contact Greening Australia Victoria for listings of indigenous nurseries, seed collectors and seedbanks or for information on revegetation suppliers.</p> <p>Labour: Link in to local programs such Landcare, Green Corps, Conservation Volunteers Australia or community planting events and regional programs that may be able to generate or assist with supporting your revegetation.</p>
<p>2. PREPARING THE GROUND</p>	<p>Pest plant advice Contact your local Pest Plant and Animal Officer at the Department of Primary Industries. Useful information can also be found on the Department of Primary Industries and Department of Sustainability and Environment website http://www.dse.vic.gov.au (search under Plants and Animals to Pest Plants and Animals to Pest Plants to Pest Plant Notes).</p> <p>Farm Chemical Users Permit Contact your local TAFE College or University, private providers or the Chemical Information Service on Ph 03 9210 9379.</p> <p>Agricultural Chemical Users Permit To apply for an Agricultural Chemical Users Permit you need to have completed an approved training program. For an application form contact the Department of Sustainability and Environment, Ph 13 61 86.</p> <p>First aid courses St John Ambulance Australia (Victoria) Inc. Ph 03 9696 0000 http://www.sjaa.com.au</p>

Topic referred to in Section A and B	Contact point / references suppliers
<p>2. PREPARING THE GROUND (cont.)</p>	<p>Soil preparation The type of soil preparation will be linked to the site conditions and revegetation technique selected. Seek local advice from Greening Australia Victoria, Department of Primary Industries, local Landcare Groups experienced with the local conditions and equipment. 'Dial Before You Dig' : Ph 1100</p>
<p>3. PEST ANIMAL MANAGEMENT</p>	<p>Pest animal advice Contact your local Pest Plant and Animal Officer at the Department of Primary Industries. Useful information can also be found on the Department of Primary Industries and Department of Sustainability and Environment website http://www.dse.vic.gov.au (search under Plants and Animals to Pest Plants and Animals to Pest Animals to Pest Animal Notes).</p> <p>Fencing & tree guards Contact your local Department of Primary Industries office, Greening Australia Victoria or Landcare Group about local contractors and suppliers.</p>
<p>4. SEEDS & SEEDLINGS</p>	<p>Seedbanks and seed collectors Contact Greening Australia Victoria for a copy of the 'Seedbanks and Seed Collectors in Rural Victoria' listing or download a copy from the website http://www.greeningaustralia.org.au (and click on the Victorian website to Vegetation Services to Nursery Lists). Contact your regional seedbank.</p> <p>Guidelines and seed information FloraBank Guidelines: Download from http://www.florabank.org.au</p> <p>Seed collection permit Permits (free) are available from the Department of Sustainability and Environment, Ph 13 61 86.</p> <p>Training in seed collection Contact Greening Australia Victoria</p> <p>Seed pre-treatments Talk to your local seedbank (contact Greening Australia Victoria for a copy of the 'Seedbanks and Seed Collectors in Rural Victoria' listing or http://www.greeningaustralia.org.au or refer to Bonney (2001) or Ralph (1997) (Details in references).</p>

Topic referred to in Section A and B	Contact point / references suppliers
<p>4. SEEDS & SEEDLINGS (cont.)</p>	<p>Indigenous nurseries Contact Greening Australia Victoria for a copy of the 'Farm Tree Nurseries and Growers in Rural Victoria' listing and 'Indigenous Nurseries of Greater Melbourne 2002' listing or visit http://www.greeningaustralia.org.au (click on Victoria to Vegetation Services to Nursery Listing).</p> <p>Seed data management Contact Greening Australia Victoria to purchase a copy of the 'Seed Supply System' and 'Seed Collectors Record Book'.</p> <p>Seed collection equipment Contact Greening Australia Victoria and enquire about equipment available for hire through the Alcoa Revegetation Assistance Scheme or Community Equipment Support Scheme.</p>
<p>5. NATURAL REGENERATION, DIRECT SEEDING AND PLANTING</p>	<p>Advice Contact Greening Australia Victoria, the local Department of Primary Industries office or Catchment Management Authority. Other organisations or programs that may be able to provide advice on remnant protection include Trust for Nature and Land for Wildlife.</p> <p>Mechanical and hand tools Contact Greening Australia Victoria and enquire about equipment available for hire through the Alcoa Revegetation Assistance Scheme or Community Equipment Support Scheme.</p> <p>Labour support Contact Greening Australia Victoria, Green Corps, Conservation Volunteers Australia, or the local Catchment Management Authority for potential support.</p>
<p>6. SITE MAINTENANCE</p>	<p>Seek local advice from the Department of Primary Industries, Greening Australia Victoria or Landcare group.</p>
<p>7. MONITORING</p>	<p>Contact your local Department of Primary Industries office, Catchment Management Authority, Landcare group, Waterwatch, Field Naturalists Club or Greening Australia Victoria about what monitoring programs you could link in to.</p> <p>For further information on spatial and database recording of information and the Catchment Activity Management System (CAMS) contact the Department of Sustainability and Environment on 03 5833 5297.</p>

Helpful notes series

Greening Australia Victoria has two sets of case studies as well as other related publications available on their website:

Bushcare Demonstration Sites series numbers 1 - 28 <http://www.greeningaustralia.org.au> (click on Victorian link)

Footprints Fact Sheets series numbers 1 - 40 <http://www.greeningaustralia.org.au> (click on Victorian link)

(The Footprints Fact Sheets are also available from Greening Australia Victoria by mail)

The Department of Primary Industries and Department of Sustainability and Environment has a comprehensive Information Notes Series available from: <http://www.dse.vic.gov.au/notes/>

Notes include information on: Trees and Native Vegetation, Land for Wildlife, Weeds, Soil and Water, Flora and Fauna, Forests, General Farming and Landcare groups.

Notes under the heading Trees and Native Vegetation and subheading Native Vegetation and Growing Trees include:

Indigenous plants, Native vegetation, Shelterbelts, Establishment, Pests & diseases, Planning revegetation, Trees causing damage.

Land and Water Australia: National Riparian Lands Program has the following fact sheets available to download from the website below:

Riparian Management Fact Sheets 1 - 11 <http://www.rivers.gov.au/publicat/factsheets.htm>

References and further reading

* References referred to in text.

STATEWIDE & REGIONAL REVEGETATION INFORMATION

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Department of Natural Resources and Environment. (2002). *Victoria's Native Vegetation Management - A Framework for Action*, DNRE, Melbourne.

Regional

Contact your local Catchment Management Authority for copies of your Regional Catchment Strategy and Native Vegetation Plan.

Corangamite

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North Central

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Southern Riverina

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Goulburn Broken

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This publication is available from the following website <http://www.gbcma.vic.gov.au/revegetation/>

Gippsland

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Notes:

Revegetation Techniques is a 'how to' guide for establishing native plants from seed or seedlings. The information is based on what has worked at a practical level for landholders, community groups, land management agencies and project managers.

It covers the steps involved in a revegetation program, from planning and preparation to monitoring and then outlines the different techniques available to direct seed or plant seedlings. Natural regeneration, mechanical and hand methods of revegetation are described and a comprehensive resource section is provided.

Revegetation Techniques aims to complement regional guides that identify the local species and vegetation communities that should be replaced in an area.

Designed to accompany this guide is the *Footprints Fact Sheets* series of case studies. These describe landholder experiences with revegetation and provide on-ground examples of many of the techniques outlined in this guide.

www.greeningaustralia.org.au