Revegetation guide to the central wheatbelt

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Revegetation Guide to the Central Wheatbelt

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ERRATUM:

The photograph on page 47 labelled *Eucalyptus transcontinentalis* should read *Eucalyptus wandoo* and visa versa. The photograph of buds and fruit are correct as labelled.
Revegetation Guide to the Central Wheatbelt

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Sponsored by Greening Australia (W.A.)
The distribution of the plant associations described in this booklet
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Revegetation guide to the central wheatbelt
INTRODUCTION

“To climb through a wire fence out of a ploughed and sown paddock into a wild wind raked stretch of bushland is to tumble into an order of life unmoulded by man but one which can jolt the mind into a deeper wonderment, not only of this ungarnered territory, but of the whole natural world.”

Barbara York Main  
Between Wodjil and Tor

The rapid development of the central wheatbelt for agriculture over the past century has produced a productive farming landscape, but one which is increasingly subject to degradation. Erosion, salinization, declining soil structure, waterlogging and acidification are all symptoms of this degradation and causes of lost agricultural production. In addition, most of the native vegetation and many of the native animals have disappeared, and the natural heritage of the area resides in small scattered patches that together make up only seven per cent of the wheatbelt region.

Many farmers now recognize that replanting trees and shrubs is an effective means of reversing many of the current trends towards land degradation. However, advice on how to go about revegetation, where to plant and which species to use has been hard to obtain.

This guide is an attempt to redress this by providing lists of local species grouped according to soil types. It also provides a summary of current knowledge of revegetation methods. It has been put together using information from many sources including farmers, foresters, botanists and ecologists. It has been developed as a direct result of a workshop organized by CSIRO Division
of Wildlife and Ecology on re-integrating fragmented rural landscapes.

Eighty-two plant species are briefly described with additional notes on flowering times and seed production. Fifty-five of these plants are also illustrated.

Over half the plants described are plants of the understorey. Although this group is often overlooked, they have an important place in the ecology of the wheatbelt. Above the ground they protect the soil surface and provide food and shelter for birds and other animals. Below the surface they assist the movement of air and water and sustain soil organisms such as fungi and bacteria.

Like trees, they can also act as water pumps, lowering high water tables caused by clearing for agriculture. Used in windbreaks, shrubs have the important role of filling gaps at ground level as trees grow taller.

Throughout this booklet the emphasis is placed on local species. These are usually the best suited to the environment and will grow as well if not better than species from elsewhere. The use of local species also means that revegetation will be of more benefit to the wildlife of the area.

This does not preclude the use of some species from elsewhere. Plants such as tagasaste (Chamaecytisus palmensis) and some exotic saltland species perform a useful role in revegetating degraded land providing they do not become invasive weeds of remnant bush or cropland.

Above all this guide sets out to enable people to become more familiar with the native plants of this region. Whether they are re-planted for practical or aesthetic reasons, all such efforts improve our understanding of this landscape and strengthen our relationship with it.
MATCHING PLANTS TO SOILS

The wheatbelt landscape is one of the earth’s most ancient and weathered surfaces. Unlike many other parts of the world, it has seen no recent volcanoes, glaciers or large silt carrying rivers to rejuvenate its soils with fresh material.

Instead it has been subjected to continual erosion and leaching over thousands of millions of years. Today this landscape can be described by three main landforms; the upland sandplains, the valley slopes and the valley floors. These landforms represent a transition from the coarse textured sands and gravels of the uplands, through the sandy clays and loams of the slopes, to the fine textured clays of the valley floors.

The full picture, however, is not that simple. Within each of these landforms, wind and water have shaped and re-shaped the surface many times resulting in a complex mosaic of different soil types. In response to these varying soils, the native vegetation also forms an irregular mosaic.

In this guide we have selected nine main soil and vegetation groups and named them according to the vegetation most commonly associated with them. Figure 1 shows a stylized cross-section of the wheatbelt landscape with the position of these different associations of soil and vegetation.

For each group, we give an example of the soil profile and a list of plants typical of the original vegetation which are considered suitable for revegetation. Their suitability is partly based on the practicality of obtaining
Figure 1. Stylized cross-section of a typical wheatbelt valley showing the relationships of vegetation types to soils. (Based on Bettenay's landform types which are shown in brackets [Bettenay and Hingston 1961])
and germinating seed, and partly on the range of plant size, shape and function that they represent.

*The nine groups are:*

**Sandplain**
- Wodjil
- Tamma
- Grevillea

**Valley slopes**
- White gum
- York gum
- Mallee
- Salmon gum

**Valley floor**
- Morrel
- Salt lake

Before clearing, the sandplain vegetation covered some 50 per cent of the wheatbelt, the woodlands and mallee of the valley slopes some 40 per cent, and the soils of the valley floor about 10 per cent. 🌿
PLANTS FOR REVEGETATION
Wodjil

The deep yellow sandplain of the uplands, often covered with a thicket of the wodjil group of Acacias which form dense stands over 2 m tall with Allocasuarina and Hakea species. This is the least productive of the wheatbelt soils following clearing.

Example soil profile

Deep yellow sand, sometimes with gravel (usually acidic) over deep yellow sandy clay loam (often highly acidic).

Problems

Plants chosen for revegetation must be adapted to deep acid sands. Wind erosion after clearing is common, leaving little or no organic matter at the surface. A compacted layer below the ploughed surface is also common and this necessitates ripping before planting. Retaining stubble from the previous year’s crop and planting into moist sand will benefit establishment of seedlings.
Plants for revegetation

Trees

* Acacia neurophylla (wodjil) ................................................. 31
* Eucalyptus burracoppinensis (Burracoppin mallee) ... 38
* Allocasuarina acutivalvis (black tamma) ......................... 33
* Hakea coriacea (pink spike hakea) ................................. 49

Shrubs

* Allocasuarina campestris (tamma) ........................................... 32

  * Melaleuca radula (graceful honeymyrtle) ..................... 54
  * Melaleuca uncinata (broombush) ................................. 57

Other species useful for revegetation

* Acacia microbotrya (manna gum) ........................................... 31
* Acacia assimilis (wodjil) ................................................... 28
* Acacia resinomarginea (wodjil) ...................................... 30
* Eucalyptus eremophila (tall sand mallee) ....................... 40
* Eucalyptus hypochlamydea (white flowered mallee) .......... 40
* Eucalyptus oldfieldii (Oldfield’s mallee) ....................... 42
* Grevillea paradoxa (bottlebrush grevillea) ..................... 48

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Birds of the sandplain

* Southern scrub robin (NFS)
* Red-capped robin
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* White-browed babbler
* Broad-tailed thornbill
* Singing honeyeater
* Brown honeyeater
* White-fronted chat
* Zebra finch

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation
Tamma

The shallow gravelly soils of the upland sandplain where wind has removed the sandy surface. Supports dense lower thickets dominated by *Allocasuarina* species.

**Example soil profile**

Shallow pale grey or brown sand, often less than 15 cm deep (neutral to acidic) over cemented gravel (laterite).

**Problems**

The shallow soil in the uncleared state has sometimes been further reduced since clearing. Lack of soil depth means runoff can cause erosion; planting should be on the contour along rip lines or banks to minimize the risk of erosion damage from storms.
Trees

* Allocasuarina acutivalvis (black tamma) ......................... 33
* Allocasuarina corniculata (grey tamma) ......................... 35

Shrubs

* Allocasuarina campestris (tamma) ......................... 32
* Calothamnus gilesii (claw-flower) ......................... 37
* Melaleuca uncinata (broombush) ......................... 57
* Melaleuca conothamnoides (wheatbelt honeymyrtle) ................. 55
* Hakea scoparia ......................... 51

Other species useful for revegetation

* Acacia resinomarginea (wodjil) ......................... 30
* Beaufortia bracteosa ......................... 36
* Grevillea paradoxa (bottlebrush grevillea) ......................... 48
* Grevillea petrophiloides (poker grevillea) ......................... 48
* Melaleuca platycalyx ......................... 54

Birds of the Tamma

* Painted button quail (NFS)
* Common bronzewing
* Red-capped robin
* Western yellow robin (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* White-browed babbler
* Blue-breasted wren (NFS)
* Shy hyacola (NFS)
* Field wren (NFS)

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation
Grevillea

The deep yellow sands of the uplands once carried a great variety of plant species. It represents the more productive of the sandplain soils, and is often suitable for growing lupins. To the west of the area, Banksia and woody pear are common trees. To the east, Acacias become dominant.

Example soil profile

Deep yellow sand, up to several metres deep (neutral to acidic) over deep yellow sandy clay.

Problems

This soil is prone to wind erosion and, like the wodjil soil, often has a compacted layer caused by cultivation. Hillside seepage of groundwater, causing salinity, can occur on this soil after clearing on the lower slopes where the depth of sand over clay reduces. Stubble retention and planting into moist sand will help establishment of seedlings.
Plants for revegetation

Trees

Actinostrobus arenarius (sandplain cypress) ............... 33
Allocasuarina huegeliana (rock oak) ....................... 35
Banksia attenuata (slender banksia) ...................... 37
Eucalyptus leptopoda (Tammin mallee) ................... 43
Eucalyptus burracoppinensis (Burracoppin mallee) .... 38
Xylo melum angustifolium (sandplain woody pear) .... 59

Shrubs

Allocasuarina campestris (tamma) ......................... 32
Melaleuca conothamnoides (wheatbelt honeymyrtle) .... 55
Grevillea pritzelii (black toothbrush grevillea) ....... 49
Grevillea eriostachya (flame grevillea) ................. 49
Verticordia spp. (featherflower) ......................... 59

Other species for revegetation

Acacia acuminata (jam wattle, raspberry jam) ....... 29
Acacia saligna (golden wreath wattle) ................. 33
Callistemon phoeniceus (lesser bottlebrush) ......... 37
Calytrix leschenaultii (star flower) ................. 36
Eucalyptus camaldulensis* (river red gum) ........... 40
Grevillea pterosperma (desert grevillea) 48
Hakea platysperma (cricket - ball hakea) .......... 50
Leptospermum erubescens (tea tree) ........ 53

* From outside the region.

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation

Birds of the sandplain

* Painted button quail (NFS)
* Common bronzewing
* Southern scrub robin (NFS)
* Crested bellbird (NFS)
* Field wren (NFS)
* Broad-tailed thornbill
* Singing honeyeater
* White-eared honeyeater
* Brown honeyeater
* White-fronted honeyeater (NFS)
* Tawny-crowned honeyeater (NFS)
White gum

This soil group often occurs on the slopes below breakaways that mark the eroded edge of the uplands. These are shallow eroded soils that commonly carry the wandoo or white gum. Moving east, the inland wandoo (Eucalyptus capillosa) replaces the more familiar wandoo or white gum (Eucalyptus wandoo). This group merges into York gum, mallee or salmon gum downslope.

Problems

Sometimes the surface soil is stripped almost down to the white kaolinitic subsoil. The shallow soil and slope combine to cause considerable run-off and erosion; ripping on the contour is required before planting. Some form of disturbance of the soil surface, such as scarifying, is often required to provide an adequate seed bed.
Trees

*Eucalyptus capillosa* (inland wandoo) ............................................. 41
*Eucalyptus wandoo* (wandoo, white gum) ........................................ 47
*Eucalyptus subangusta* (black marlock) ......................................... 47
*Acacia acuminata* (jam wattle, raspberry jam) ............................... 29

Shrubs

*Melaleuca uncinata* (broombush) .................................................. 57
*Acacia hemiteles* (tan wattle) ....................................................... 29
*Cassia nemophila* (desert cassia) .................................................. 39
*Allocasuarina campestris* (tamma) ................................................ 32
*Acacia merrallii* (Merrall’s wattle) ................................................ 31

Other species useful for revegetation

*Acacia acuaria* ............................................................................. 28
*Acacia erinacea* (spiny wattle) ....................................................... 28
*Acacia microbotrya* (manna gum) ................................................ 31

*Callistemon phoeniceus* (lesser bottlebrush) .................................. 37
*Olearia muelleri* (goldfields daisy-bush, dusky daisy-bush) .......... 57

**Birds of the woodlands**

- Mountain duck
- Wood duck
- Black-shouldered kite
- Wedge-tailed eagle
- Little eagle
- Peregrine falcon
- Nankeen kestrel
- Bush stone curlew (NFS)
  * Common bronzewing
  * Carnaby’s cockatoo (NFS)
  * Purple-crowned lorikeet (NFS)
  * Red-capped parrot (NFS)
  * Western rosella (NFS)
  * Regent parrot (NFS)
  * Pallid cuckoo
  * Fan-tailed cuckoo
  * Barking owl (NFS)

For complete list see BIRD LIST p. 90
NFS: not frequently seen
* dependent on native vegetation
York gum

This soil group occurs where the old soil mantle has been stripped from the bedrock and a shallow soil has formed over the granite. It often occurs near granite outcrops.

Example soil profile

Shallow brown sandy loam, usually less than 30 cm over shallow sandy clay over granite. (Surface: neutral to alkaline.)

Problems

These were among the first soils to be cleared for farming and are relatively fertile, only presenting problems for revegetation when they are shallow. Run-off from granite outcrops causes water erosion and recharge to saline groundwater, making revegetation of these rocky areas a high priority. Weed control is necessary. Ripping should be practised and if winter waterlogging is a problem, a gradient of 1.5 per cent should be used in rip lines or planting beds. Mounding will be needed on flat sites prone to long duration waterlogging (see Figure 3, page 69).
Trees

Eucalyptus loxophleba (York gum) .................. 43
Acacia acuminata (jam wattle, raspberry jam) .......... 29
Allocasuarina huegeliana (rock oak) .................. 35
Acacia microbotrya (manna gum) .................... 31

Shrubs

Kunzea pulchella (granite kunzea) ................... 50
Calothamnus gilesii (claw-flower) .................... 37
Allocasuarina campestris (tamma) ................... 32
Melaleuca uncinata (broombush) ..................... 57
Leptospermum erubescens (tea tree) .................. 53
Hakea recurva ......................................... 51

Other species useful for revegetation

Acacia acuaria .......................................... 28
Eucalyptus camaldulensis* (river red gum) .......... 40
Grevillea paniculata .................................... 48
Melaleuca radula (graceful honeymyrtle) ............ 54
Santalum spicatum (sandalwood) .................... 58
Rhagodia preissii ....................................... 56
Callistemon phoeniceus (lesser bottlebrush) .......... 37

* From outside the region.

Birds of the woodlands

* Pallid cuckoo
* Fan-tailed cuckoo
  Tree martin
* White-winged triller
* Red-capped robin
* Jacky winter (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* Weebill
* Western warbler
* Broad-tailed thornbill
* Chestnut-rumped thornbill

For complete list see BIRD LIST p.90
NFS not frequently seen
* dependent on native vegetation
Mallee

This soil type is more prevalent in the southern and eastern wheatbelt. The distinctive sand over clay soil carries a variety of the mallee form of eucalypts. This group merges with the York gum, salmon gum and sandplain groups.

Example soil profile

10-50 cm of brown sand over red/brown clay, often with a cemented hardpan between the sand and clay layers. (Surface: neutral to alkaline.)

Problems

Wind erosion is the main problem with this soil type, as with most sandy surfaced soils. A cemented hardpan of precipitated silica often lies at the boundary between the sand and the clay and can cause waterlogging in winter after clearing. Where waterlogging is a problem, ripping and then planting into a mound will help to overcome this (see Figure 3, page 69).
Trees

* Eucalyptus sheathiana (ribbon bark gum) .................. 44
* Eucalyptus transcontinentalis (redwood) .................. 47
* Eucalyptus erythronema (red flowered mallee, white barked mallee) ............................................. 41

Shrubs

* Acacia hemiteles (tan wattle) ................................. 29
* Olearia muelleri (goldfields daisy-bush, dusky daisy-bush) ................................................................. 57
* Enchylaena tomentosa (ruby saltbush) .................. 39
* Melaleuca uncinata (broombush) .......................... 57
* Melaleuca acuminata ........................................... 53

Other species useful for revegetation

* Eucalyptus eremophila (tall sand mallee) ............... 40
* Eucalyptus loxophleba (York gum) .................... 43
* Acacia acuminata (jam wattle, raspberry jam) ........ 29
* Callistemon phoeniceus (lesser bottlebrush) .......... 37

Birds of the Mallee

* Mallee fowl (NFS)
* Common bronzewing
* Purple-crowned lorikeet (NFS)
* Pallid cuckoo
* Fan-tailed cuckoo
* Horsfield’s bronze cuckoo
* Boobook owl
* Tawny frogmouth (NFS)
* Owlet nightjar
* Tree martin
* White-winged triller
* Red-capped robin
* Hooded robin
* Western yellow robin

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation
Salmon gum

These are the heavy wheatbelt soils most suited to cereal growing: red and brown soils of the lower slopes and valley floors. They merge with York gum and mallee soils upslope and saline soils downslope.

Example soil profile

Red, brown or grey loam (alkaline, pH 7-8) over red, brown or grey clay, with distinctive white nodules of calcium carbonate at depth. Subsurface sometimes saline.

Problems

Salt in the clay at depth and rising water tables have caused secondary salinity. Consequently salt tolerant plants are required for revegetation of some salmon gum soils. Weed control is necessary on these more fertile soils. These soils are often dispersive and formation of surface crusts can also be a problem. The long term solution to crusting is to increase the organic matter content by retaining stubbles. Mounding the soil before planting will help to overcome any waterlogging and will leach the seedbed of salts (see Figure 3, page 69).
Trees

Eucalyptus salmonophloia (salmon gum) ....................... 45
Eucalyptus salubris (gimlet) ................................. 45

Shrubs

Acacia hemiteles (tan wattle) ................................. 29
Acacia colletioides (wait-a-while) ......................... 29
Acacia merrallii (Merrall’s wattle) ......................... 31
Cassia nemophila (desert cassia) ......................... 39
Melaleuca adnata ............................................. 52

Other species useful for revegetation

Acacia acuaria .................................................. 28
Acacia erinacea (spiny wattle) ............................... 28
Acacia microbotrya (manna gum) ......................... 31
Atriplex amnicola (river saltbush) ......................... 35
Atriplex nummulario* (old man saltbush) .............. 34
Eucalyptus sargentii (salt river gum) ...................... 45
Eucalyptus camaldulensis* (river red gum) .............. 40
Melaleuca cymbifolia ......................................... 54
Maireana brevisfolia (small leaved bluebush) ........... 53
Rhagodia preissii ............................................. 56
Santalum acuminatum (sweet quandong) ................. 56

* From outside the region.

Birds of the woodlands

- Pallid cuckoo
- Fan-tailed cuckoo
- Tree martin
- White-winged triller
- Red-capped robin
- Jacky winter (NFS)
- Rufous whistler
- Grey shrike-thrush
- Crested bellbird (NFS)
- Grey fantail
- Weebill
- Western warbler
- Broad-tailed thornbill
- Chestnut-rumped thornbill

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation
Morrel

The morrel soils are fine powdery loams and clays originally blown from the floors of dry salt lakes. They are usually found between the salmon gum soils and the salt lakes and make up no more than 5 per cent of the wheatbelt.

Example soil profile
Brown or grey fine textured loam (alkaline, pH 8-9) grading into brown clay.

Problems

These are saline soils that are found close to salt lakes and swamps, and before clearing carried a woodland of salt tolerant trees. Salt tolerant species are required. A mounded bed for seeds and seedlings will both leach salts and trap water for the seedlings (see Figure 3, page 69).
Trees

Eucalyptus longicornis (red morrel) ......................... 43
Eucalyptus yilgarnensis (yorrell) ......................... 46
Eucalyptus myriadena ......................................... 42

Shrubs

Acacia colletioides (wait-a-while) ......................... 29
Atriplex paludosa (marsh saltbush) ....................... 34
Enchylaena tomentosa (ruby saltbush) ................. 39
Melaleuca pauperiflora (boree) ......................... 55

Other species useful for revegetation

Acacia leptospermoidea ........................................ 30
Acacia multispicata ........................................... 30
Atriplex amnicola (river saltbush) ....................... 35
Atriplex nummularia* (old man saltbush) ............. 34

Eucalyptus camaldulensis*
(river red gum) .............................................. 40

Melaleuca cymbifolia .......................................... 54
Rhagodia preissii ............................................. 56

* From outside the region.

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation

Birds of the woodlands

* Pallid cuckoo
* Fan-tailed cuckoo
* Tree martin
* White-winged triller
* Red-capped robin
* Jacky winter (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* Weebill
* Western warbler
* Broad-tailed thornbill
* Chestnut-rumped thornbill
Saltlake

This soil group represents the old drainage lines, now filled in and reduced to a string of salt lakes. The fringes of salt lakes were the best grazing areas before sown pastures, and carried stands of saltbush and bluebush.

Example soil profile

Sandy loams or clays, neutral to alkaline, with a water table within 1 m of the surface.

Problems

Most of these soils are waterlogged as well as saline. Where the original covering of shrubs has gone, the soil needs to be mounded before planting. Niche planting methods which create a raised bed leached of salts give good results (see Figure 3, page 69). A good supply of soil water in summer means rapid growth of salt tolerant plants.
Trees

Eucalyptus sargentii (salt river gum) ....................... 45
Casuarina obesa (swamp oak) .............................. 39

Shrubs

Atriplex amnicola (river saltbush) ......................... 35
Atriplex paludosa (marsh saltbush) ......................... 34
Halosarcia spp. (samphire) ................................. 51
Maireana brevifolia (small leaved bluebush) ............ 53
Melaleuca uncinata (broombush) ......................... 57
Melaleuca hamulosa ........................................ 55
Melaleuca thyoides .......................................... 57

Other species useful for revegetation

Atriplex bunburyana (silver saltbush) .................... 34
Atriplex semibaccata (creeping saltbush) ................. 34
Atriplex nummularia* (old man saltbush) ................. 34
Atriplex vesicaria (bladder saltbush) ...................... 36
Eucalyptus kondininensis (Kondinin blackbutt) ....... 40

* From outside the region.

For complete list see BIRD LIST p. 90
NFS not frequently seen
* dependent on native vegetation
IDENTIFYING PLANTS

When trying to identify a plant, look first at the form it takes (height, width and shape) and see if it matches an illustration or description. Next look at the size and shape of the leaves (Note: Acacias only have true leaves as seedlings. As adults these are replaced by flattened stems, called phyllodes, that look like and take on the role of leaves).

Then, if the plant is flowering, compare flower shape and colour with descriptions or illustrations. Flower buds are illustrated in the case of eucalypts.

Finally, if fruit and seeds are present, compare them with illustrated examples.

Of the many hundreds of plants native to this region of Western Australia, only a small selection are represented here. Many others not described here may also be suitable for revegetation.
Descriptions of species listed (* illustrated)

*Acacia acuaria*. Dense shrub to 2 m high with short (1 cm), close, spiny phyllodes. Flower heads yellow and globular. Flowers from August to October.

*Acacia acuminata* (jam wattle, raspberry jam). Spindly shrub or tree to 6 m tall with yellow cylindrical flowers. Flowers from July to October. Seed collection in November and December.

*Acacia assimilis* (wodjil). Dense shrub to 3 m high with light green narrow needle-like phyllodes with white hairy tips. Flower head yellow and globular. Flowers in August and September.

*Acacia colletioides* (wait-a-while). Dense spiny shrub or tree to 4 m tall with yellow globular flowers. Flowers in August and September. Seed collection in November. Germination greatly enhanced by heating in oven to 150°C for 10 minutes.

*Acacia erinacea* (spiny wattle). Low shrub to 0.5 m high with short spiny branches and flat greyish phyllodes. Flower heads yellow and globular. Flowers in August to September.

*Acacia hemiteles* (tan wattle). Shrub, 1-2 m tall with rigid curved grey-green phyllodes and globular yellow flowers. Flowers September. Seed collection November.
**Acacia leptospermoide**s. V-shaped shrub to 1.5 m high with flat narrow phyllodes to 1.5 cm long. Flower heads bright yellow and globular. Flowers in July and August.

*Acacia merrallii* (Merrall’s wattle). Shrub, 0.5-1.5 m tall with short, broad greyish phyllodes and globular yellow flowers. Flowers in September and October. Seed collection in November and December.

*Acacia microbotrya* (manna gum). Bushy tree to 5 m high with blue-grey phyllodes and pale yellow globular flowers. Flowers from April to July. Seed collection in October and November. Germination improved by heating to 100°C for 10 minutes.

**Acacia multispicata**. Dense shrub, 1-2 m high with curved needle-like phyllodes, 3-6 cm long with acute tips. Flower heads yellow and cylindrical. Flowers in August and September.

*Acacia neurophylla* (wodjil). Tall shrub or tree to 5 m high with broad many-veined bright green phyllodes and yellow cylindrical flowers. Flowers in September and October. Seed collection in November and December.

**Acacia resinomarginea** (wodjil). Multistemmed shrub, 1-6 m high with long narrow square-edged phyllodes. Flower heads yellow and cylindrical. Flowers in September and October.
Acacia merrallii

Acacia microbotrya

Acacia neurophylla
*Acacia saligna* (golden wreath wattle). Shrub or tree to 5 m high with long hanging phyllodes with a prominent midrib. Phyllodes usually larger towards the base of the plant. Large yellow globular flower heads. Flowers in August and September.

*Actinostrobus arenarius* (sandplain cypress). Pine-like conical shrub to 5 m tall with grey-green foliage. Mature unopened female cones can be collected in any month.

*Allocasuarina acutivalvis* (black tamma). Shrub or small tree, 3-8 m tall with erect branches. Flowers mainly winter/spring. Mature unopened cones can be collected in any month. Cones will open following collection.

*Allocasuarina campestris* (tamma). Shrub, 1-3 m high. Flowers mainly winter/spring. Mature unopened cones can be collected in any month.
*Allocasuarina corniculata* (grey tamma). Shrub, or small tree 2-4 m tall with spiny cones. Flowers mainly winter/spring. Cones can be collected in any month.

*Allocasuarina huegeliana* (rock oak). Tree, 4-10 m tall with drooping branches. Flowers mainly winter/spring. Mature unopened cones can be collected in any month.

*Atriplex amnicola* (river saltbush). Shrub, usually spreading, to 1.5 m high. Leaves are spear shaped, usually 1 to 3 cm long. Flowers in August. Seed collection in summer. (NOTE: *Atriplex* species have separate male and female plants).

*Atriplex bunburyana* (silver saltbush). Erect shrub up to 1 m high. Leaves are narrow, oval and up to 2 cm long with a bluish scale. Seed is usually ripe by late December.

*Atriplex nummularia* (old man saltbush). Erect shrub to 2 m tall. Flowers from August to October. Leaves are 2-4 cm long and irregular in shape. Seed collection late summer.

*Atriplex paludosa* (marsh saltbush). Erect shrub to 1 m high and wide. Flowers from September to April. Leaves are green on the upper surface and silvery beneath. Seed collection in summer.

*Atriplex semibaccata* (creeping saltbush). Prostrate shrub to 15 cm high and 1.5 m wide. Leaves less than 1.5 cm long. Fruits, produced in summer, are red, diamond shaped and succulent, 2 to 5 mm wide.
Allocasuarina corniculata

Allocasuarina huegeliana

Atriplex amnicola
**Atriplex vesicaria** (bladder saltbush). Low growing, brittle shrub to 0.8 m. Leaves are oval, grey, about 1 cm long and have a grey mealy covering.

*Bankia attenuata* (slender banksia). Tree to 10 m tall with bright yellow cylindrical flower heads. Flowers in October and November. Mature unopened cones may be collected in any month.

**Beaufortia bracteosa.** Low shrub to 80 cm high with small spreading leaves and small reddish-purple bottlebrush flowers. Flowers from August to December.

*Callistemon phoeniceus* (lesser bottlebrush). Dense shrub to 4 m high with scarlet bottlebrush flowers from August to December. Found along fresh creek-lines and fresh-water depressions.

*Callothamnus gilesii* (claw-flower). Erect shrub to 2 m tall with bright red claw-like flowers. Flowers from July to December. Unopened mature fruit can be collected in any month.

**Calytrix leschenaultii** (star flower). Erect shrub to 60 cm high with small leaves and purple star flowers. Flowers from June to October.
*Cassia nemophila* (desert cassia). Shrub, 1-3 m tall with thin divided leaves and yellow flowers. Flowers from July to September. Mature, dry but unopened pods can be collected in October and November.

*Casuarina obesa* (swamp oak). Tree to 12 m tall. Mature unopened cones can be collected in any month.

*Enchytraea tomentosa* (ruby saltbush). Felted greyish shrub to 1 m tall with bright red berries. Flowers from May to November. Fruit can be collected when ripe (red), in October and November.

*Eucalyptus burracoppinensis* (Burracoppin mallee). Spreading mallee, 3-6 m tall with large creamy flowers from June to December. Unopened mature fruits can be collected in any month.

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**Eucalyptus burracoppinensis**

**Fruit**

**Buds**
Cassia nemophila

Casuarina obesa

Enchytraea tomentosa
Eucalyptus camaldulensis (river red gum). Not native to the wheatbelt. Tree to 30 m high with smooth white bark often with red-brown blotches. White flowers. Flowers from January to March.

*Eucalyptus capillosa* (inland wando). Tree to 30 m high with white bark, mottled with grey. The fresh bark, following shedding, has an orange tinge. White flowers from February to April. Unopened mature fruit can be collected in any month. This species has a more eastern and northern distribution than *Eucalyptus wando.*

Eucalyptus eremophila (tall sand mallee). Mallee to 6 m high with smooth, often coppery, bark and erect glossy leaves. Pendulous horn-shaped buds. Cream to yellow flowers. Flowers from August to December.

*Eucalyptus erythronema* (red flowered mallee, white barked mallee). Small tree, 2-6 m tall with red or pink (occasionally cream) flowers from August to December. Unopened mature fruits can be collected in any month.

Eucalyptus hypochlamydea (white flowered mallee). Mallee to 7 m high with narrow glossy leaves and in the northern wheatbelt, a stocking of rough bark 1-2 m high (absent elsewhere). The buds are diamond shaped and in dense clusters. White flowers. Flowers from November to January.

Eucalyptus kondininensis (Kondinin blackbutt). Tree to 15 m high with rough dark bark on the lower half of the trunk and smooth greenish or coppery above, with ribbed cap-shaped bud caps. Glossy leaves. Flowers from October to December.
Eucalyptus capillosa

Eucalyptus erythronema
*Eucalyptus leptopoda* (Tammin mallee). Mallee, 3.5-6 m tall with slender stems. Creamy flowers from September to March. Unopened mature fruits can be collected in any month.

*Eucalyptus longicornis* (red morrel). Tall tree, 18-30 m tall with rough grey bark. White or cream flowers from November to March. Unopened mature fruits can be collected in any month.

*Eucalyptus loxophleba* (York gum). Tree, 6-13 m tall, occasionally a mallee, with rough bark on trunk and lower branches, smooth greenish stems above. White flowers from August to December. Unopened mature fruit can be collected in any month.

*Eucalyptus myriadena*. Tree or mallee to 10 m tall with rough flaky bark to 2 m then smooth above, and very glossy leaves. White flowers from November to April. Unopened mature fruits can be collected in any month.

*Eucalyptus oldfieldii* (Oldfield’s mallee). Mallee or tree to 6 m high usually with flakey grey bark to 2 m, then smooth. Dull greyish leaves. Fruit globular, bud caps conical, often beaked. White flowers from July to November.
Eucalyptus leptopoda

Eucalyptus longicornis

Eucalyptus loxophleba
*Eucalyptus salmonophloia* (salmon gum). Large tree, 20-25 m tall with smooth bark (pink in summer) and white flowers from August to March. Unopened mature fruits can be collected in any month.

*Eucalyptus salubris* (gimlet). Tree, 15-20 m tall with smooth coppery bark and fluted stems. White flowers from November to March. Unopened mature fruits can be collected in any month.

*Eucalyptus sargentii* (salt river gum). Tree, 8-11 m tall with a short main trunk. Cream flowers from August to December. Unopened mature fruits can be collected in any month.

*Eucalyptus sheathiana* (ribbon bark gum). Mallee or tree to 8 m tall, often with bark stripping in ribbons. Cream flowers from March to August. Unopened mature fruits can be collected in any month.
Eucalyptus salmonophloia

Eucalyptus salubris

Eucalyptus sargentii
*Eucalyptus subangusta* (black marlock). Formerly *E. redunda* var. *subangusta*. Mallee to 4.5 m tall with light brown-grey bark peeling in ribbons. Creamy yellow flowers from December to March. Unopened mature fruits can be collected in any month.

*Eucalyptus transcontinentalis* (redwood). Tree, 15-21 m tall, sometimes a mallee, with blue-green leaves. Pale yellow flowers from August to November. Unopened mature fruits can be collected in any month.

*Eucalyptus wandoo* (wandoo, white gum). Tree to 30 m tall with white bark mottled with grey. White flowers from October to April. Unopened mature fruits can be collected in any month.

*Eucalyptus yilgarnensis* (yorrell). Formerly *E. gracilis* var. *yilgarnensis*. Tree or mallee to 10 m tall with rough flakey grey bark for 2 m then smooth above. White flowers from March to September. Unopened mature fruits can be collected in any month.
Eucalyptus subangusta

Eucalyptus transcontinentalis

Eucalyptus wandoo
**Grevillea eriostachya** (flame grevillea). Erect shrub or tree 2-6 m tall with yellow or orange flower spikes August-November. Seed can be collected in November and December but may be difficult to germinate.

**Grevillea paniculata.** Round shrub, usually to 1.5 m high but occasionally to 2.5 m, with slender light green leaves twice divided into three segments. White flowers with strong honey-vanilla odour. Flowers in August and September.

**Grevillea paradoxa** (bottlebush grevillea). Erect shrub to 2 m high with narrow rigid spiny many-times divided leaves and pink-red bottlebrush-like flowers. Flowers from August to November.

**Grevillea petrophiloides** (poker grevillea). Shrub to 3 m high with long finely-divided leaves on the lower part of the plant and pink poker-like flowers held above on erect leafless stems. Flowers from July to November.

**Grevillea pritzelii** (black toothbrush grevillea). Dense, sometimes spreading shrub, 1-2 m tall with black toothbrush flowers, mainly August-October. Seed can be collected in November and December. May be difficult to germinate.

**Grevillea pterosperma** (desert grevillea). Dense shrub, 3-4 m high with long narrow leaves and dense silky white flower heads. Flowers from August to November.

**Hakea coriacea** (pink spike hakea). Dense shrub, 3-4 m tall with red, pink or cream flower spikes 8-12 cm long in July to September. Mature unopened fruit can be collected in any month.
Grevillea eriostachya

Grevillea pritzelii

Hakea coriacea
*Hakea platysperma* (cricket ball hakea). Rigid shrub, 1-4 m high with thick needle-like leaves 8-13 cm long and round woody fruit 5 cm diameter. Creamy flowers. Flowers from July to September.

*Hakea recurva*. Shrub or tree to 7 m tall with needle-like leaves. Cream flowers from July to September. Ripe fruit can be collected in November, before opening and seed release.

*Hakea scoparia* Erect shrub 1-2 m tall with long grooved leaves and pinkish flowers from July to September. Mature unopened fruit can be collected in any month.

*Halosarcia* spp. (samphire). Erect or spreading shrub to 1 m tall, with succulent segmented stems. Flowering occurs throughout the year. Mature green seed heads can be collected late summer.

*Kunzea pulchella* (granite kunzea). Shrub to 3 m high with silky grey-green leaves and vivid scarlet flowers. Flowers from September to November. Mature unopened fruit can be collected in any month.
*Leptospermum erubescens* (tea tree). Shrub to 3 m tall with greyish leaves and white or pinkish flowers from August to November. Unopened mature fruits can be collected in summer.

*Maireana brevifolia* (small leaved bluebush). Shrub to 1 m tall with small succulent leaves. Flowers from November to July. Ripe seed is best collected February, March and sown within one year.

*Melaleuca acuminata*. Erect shrub, 1-2 m high with white flowers in September and October. Unopened mature fruit can be collected in any month.

*Melaleuca adnata*. Rigid shrub to 2 m tall with leaves opposite, in pairs at right angles to each other. White flowers from September to February. Mature unopened fruit can be collected in any month.
Leptospermum erubescens

Maireana brevifolia

Melaleuca acuminata

Detail

Seeds

Fruit

53 Revegetation guide to the central wheatbelt
*Melaleuca conothamnoides.* (wheatbelt honeymyrtle) Spreading shrub to 1 m tall. Mauve flowers from October to November. Mature unopened fruit can be collected in any month.

Melaleuca cymbifolia. Much-branched shrub to 2.5 m high with small leaves 4-6 mm long and few white flowers on the ends of the branches. Flowers from September to November.

*Melaleuca hamulosa.* Shrub to 4 m tall with white or mauve flowers from October to December. Unopened mature fruit can be collected in any month.

*Melaleuca pauperiflora* (boree). Shrub or tree, 2-5 m high with papery bark. White flowers from September to December. Unopened mature fruit can be collected in any month.

Melaleuca platycalyx. Sprawling shrub to 1 m high with leaves 8 mm long, with prominent centre and marginal veins. Mauve flowers and fruit usually in pairs on opposite sides of the branches. Flowering from September to December.

*Melaleuca radula* (graceful honeymyrtle). Shrub, 1-2 m high with mauve-white flowers from August to November. Unopened mature fruit can be collected in any month.
Melaleuca conothamnoides

Melaleuca hamulosa

Melaleuca pauperiflora
*Melaleuca thyoides.* Shrub, 1-4 m tall with minute leaves. Cream flowers from August to November. Mature unopened fruit can be collected in any month.

*Melaleuca uncinata* (broombush). Shrub, 1-5 m tall with yellow flowers from August to November. Mature unopened fruit can be collected in any month.

*Olearia muelleri* (goldfields daisy-bush, dusky daisy-bush). Shrub to 1 m high with white to pale mauve flowers from July to August. Seed collection in September and October.

*Rhagodia priessii.* Spreading shrub to 1.5 m tall, although on sandplain in the northern and southern wheatbelt it can be an erect shrub to over 2 m. Oval shaped, fleshy leaves 4-5 cm long. Seed contained in small bunches of bright red fruit which mature in early summer. Separate male and female plants.

*Santalum acuminatum* (quandong, sweet quandong). Rough barked tree, 2-6 m high with rounded canopy of yellow-green leaves. Bright red fruit, globular pitted stone. Fruit and kernel edible. Flowers from October to February.

*Santalum acuminatum*
Santalum spicatum (sandalwood). Rough barked tree or shrub to 4 m high, with grey-green leaves. Green-brown fruit with smooth globular stone. reddish green flowers from February to May.

*Verticordia* spp. (featherflowers). Erect shrubs, usually less than 1 m tall. Flowers usually white, pink or yellow in spring or early summer. Seed collection (dried flowers) late spring or summer. Species include *V. chrysantha*, *V. acerosa*, *V. densiflora*, *V. eriocephala* (formerly *V. brownii*) and *V. drummondii*. May be difficult to germinate.

*Xylomelum angustifolium* (sandplain woody pear). Tree to 7 m tall with cream flowering spikes from December to February. Unopened mature fruits can be collected in any month. 🌿
Verticordia eriocephala

Xylomelum angustifolium

Flowers and fruit
SEEDS AND SOWING

- Seed supplies
- Seed collecting
- Germination
- Ground preparation
- Seed mixtures
- Seedlings
- Sowing time
- Insects and rabbits
- Fencing

Allocasuarina huegeliana

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Revegetation can be achieved by planting seedlings or by direct seeding. Direct seeding is more economical but less reliable. The techniques for achieving reliable establishment from direct seeding in low rainfall areas have still to be developed. In general, better results are achieved with direct seeding on sandy soils than on heavy soils, and better results are achieved with large seeded species such as *Acacias*.

Successful establishment depends on good site preparation, viability of seed, appropriate seed treatment, appropriate depth of seeding, weed control, pests and of course, the season.

This section deals briefly with each of these factors. For more complete information see 'Collection of Seed of Native Plants' by Joanna Seabrook and 'Growing Trees for Farms, Parks and Roadsides - a revegetation manual for Australia' by Julianne Venning.

Whichever method of revegetation is used, the first step is obtaining sufficient seed of the right species.
Seed supplies

Seed can either be bought from seed merchants (listed under 'Seedsmen' in the yellow pages) or collected locally. When buying seed it is best to ask for a local provenance, meaning seed that was collected from the same area in which you will be planting. You should also ask when the seed was collected as some seed, especially eucalypts, loses its viability with time.

To collect your own seed you will need to know where to find the species and when the seed will be ready to collect. Flowering and seeding times of individual species are given in this guide but these can vary. Seeding is more prolific in some years than others and in many species it is particularly good following heavy summer rains.
Seed collecting

* Please note that a permit from the Department of Conservation and Land Management is required to collect seed from any public land, or private land if the seed is to be sold.

The seeds we are dealing with fall into three main groups: (1) those where the seeds are released quickly over a short period, for example the native legumes (*Acacia* and *Cassia*); (2) those where the seeds are released over a prolonged period, for example the saltland plants (including saltbush and bluebush), and (3) those where the seed is retained on the plant in woody fruit for a considerable period, like the eucalypts (gums), *Banksia* and *Hakea*.

1. Plants whose seed is released quickly. These include the native legumes, whose seed is found in pods (the *Acacia*, *Cassia* and pea-flowered plants). The seed needs to be collected when the pods are dry but not yet open, as the seed is scattered as soon as the pods split. The best time is generally two to three months after flowering but timing will vary with the season, being early in dry years and later in wet years. Alternatively, seed can be collected as it falls by spreading shade-cloth under shrubs or trees which have pods beginning to ripen.

2. Plants whose seed is released over a longer time period, but must be collected before it has been dispersed. The salt tolerant shrubs such as *Atriplex* and *Maireana* (saltbush and bluebush) are included in this group; once the seed matures on the bush it will gradually be dispersed by wind and rain. Saltbush seed matures from late autumn to winter and is gradually shed as the papery bracts ripen and dry; hence seed collection is usually in summer. Two related plants, *Enchylaena* and *Rhagodia*, have their seed encased in small red or yellow berries, and these can be collected from late spring. Saltbush, bluebush and *Rhagodia* have separate male and female plants.
The *Santalum* species (sandalwood and quandong) also fall into this group; although their nuts are woody, they do not remain on the plant, but fall to the ground below and can be collected at almost any time.

3. Plants whose seed is retained on the plant in woody fruit. This group can be subdivided into two further groups: (a) those whose fruit will open easily after collection, and (b) those with fruit which do not open without treatment of some type.

(a) Fruit which easily open. The fruits of *Eucalyptus*, *Melaleuca*, *Leptospermum* and *Calothamnus* (gums, honeymyrtles, paper barks, tea trees and claw flowers) are included in this group. They can be collected at any time of year, although the best time is usually two to four months after flowering has ended.

A mature fruit, ready for picking, is one that is firm and woody but still closed. Looking down at the nut, faint lines may be visible, indicating the position of the valves which will eventually open (see Figure 2, page 67). Placed in a paper or calico bag, these fruit will slowly open and shed their seed.

The cones of *Casuarina* and *Allocasuarina* (sheoak, rock oak and tammas) will also open and shed their seed soon after picking.

With this group it is worthwhile looking at the fruit as you collect it, as some of the older fruit may have opened and already shed its seed.

(b) Plants with woody fruit whose seed is not easily released: *Banksia*, most *Hakea* and the woody pear (*Xylolemum*) are included here; their fruit can be collected at any time of year while woody but still closed. (The fruit normally remains closed while still on the plant, only opening when the branch dies or fire...
kills the plant, however some *Hakea*, like *Hakea recurva*, open of their own accord and release their seed.)

When the fruit is collected, it will often open slowly and shed its seed, especially if stored in a warm place. Keeping them in a shade-cloth or calico bag on a tin roof is a good way to hasten opening. Charing the outside of *Banksia*, *Hakea* and woody pear nuts in a fire will speed up the process even more.

**Group 1 plants:** Acacia, Cassia.

**Group 2 plants:** Atriplex, Calytrix, Enchylaena, Grevillea, Hakea recurva, Halosarcia, Maireana, Olearia, Rhagodia, Santalum, Verticordia.

**Group 3a plants:** Actinostrobus, Allocasuarina, Beaufortia, Callistemon, Calothamnus, Casuarina, Eucalyptus, Kunzea, Leptospermum, Melaleuca.

**Group 3b plants:** Banksia, most Hakea, Xylomelum.
Germination

Some plants have specific needs for germination which require pre-treatment. Most notable are the legumes which require scarification or weakening of the seed coat to allow water to penetrate. This can be achieved by immersing the seed in boiling water for 2-10 minutes (less for small seeded species, more for large seeded species, but do not heat jam tree seeds, *Acacia acuminata* or *Cassia*). Alternatively, commercially supplied seeds can be scarified mechanically using abrasion, such as rubbing between sheets of sandpaper. Do not both scarify and heat seeds.

Sandalwood and quandong seeds also require special pre-treatment. Usually, the hard woody nuts are cracked slightly in a vice, but do not remove the kernel. A fungicide is often used to prevent the germinating seed from developing fungal rot.

*Grevillea* and *Verticordia* are often difficult to grow from seed and in commercial production are usually propagated from cuttings. They are worth persisting with, however, for their colourful display and in the case of *Grevillea*, their valuable source of nectar for honeyeaters and insects, which in turn provide food for birds and other invertebrates.

![Figure 2. Fruit of Eucalyptus leptopoda showing the valves opened and unopened.](image-url)
Ground preparation

Whether planting seedlings or direct seeding, ground preparation is essential to enable plants to be well enough established to survive the first summer. The simplest way to perform the operations listed below is to carry them out in one pass with a purpose built tree seeder.

1. **Ripping** to allow the tap root to penetrate hard subsoil or a compacted layer caused by cultivation.

2. **Weed control** to eliminate competition from annual grasses and weeds. Tree planters achieve this by scalping the top few centimetres of soil for a width of 50 cm each side of the rip line (see Figure 3, page 69). This removes weeds and weed seeds and helps to act as a micro-catchment for harvesting water. The only other effective method is to use herbicides.

3. **Press wheels** improve the placement of seed and seedlings by ensuring firm contact with moist soil. An alternative to press wheels with direct seeding is to drag a light chain, a piece of carpet or green branches over seed dropped on the surface. This will just cover the seed without burying it too deeply.

4. **Mounding** is necessary instead of scalping with soils that are saline or sites that become waterlogged (see Figure 3, page 69). Planting or seeding onto a mound raises the plants above waterlogged soil and allows rain to leach some of the salts. Press wheels are still an advantage on mounds.
Figure 3. Creating niches for seeds and seedlings using mechanical tree planters (a) scalping for weed control and water harvesting (b) mounding for waterlogged and saline areas.
Seed mixtures

The composition of seed mixtures depends on the seed size and viability of each species. The following example of a sowing mix illustrates the large difference in seed size between species and gives an indication of the proportions necessary for a stand of trees with a shrub understory.

Successful establishment has been achieved with sowing rates from 200g to 500g per kilometre of row, or 400g to 1kg per hectare. (With rows spaced 5 m apart, 2 kilometres of row occupies one hectare.)

A bulking agent such as fine dry sand or fine sand and sawdust is needed when using small seeds. Direct seeding with combines has been successful; vermiculite, branflakes or chick pellets can be used as the bulking agent. Where combines are used the seed bed needs to be prepared first, for example, by scarifying and controlling weeds with herbicide.

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eucalyptus</td>
<td>125</td>
</tr>
<tr>
<td>Acacias</td>
<td>200</td>
</tr>
<tr>
<td>Melaleucas</td>
<td>50</td>
</tr>
<tr>
<td>Allocasuarinas</td>
<td>125</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>500</strong></td>
</tr>
</tbody>
</table>
Seedlings

Seedlings are best planted when about six to seven months old. If they have been grown in peat pots, the bottom of the pot should be removed before planting to encourage the tap root to escape from the pot. Older stock raised in plastic pots tends to become pot bound. This can be overcome by pinching out the bottom of the root ball.

Bare rooted seedlings are an alternative to potted stock. Raised in the ground in the open, they have their roots and tops mechanically pruned prior to transplanting. They have the advantages of being older and hardier than potted stock, do not suffer from being root bound and are less expensive. The disadvantage is that only a limited range of species is available at present.
Sowing and planting time

Sowing and planting is best carried out as early as possible in the growing season, that is June/July. Later planting may not give enough time for adequate root establishment.
Insects and rabbits

After all the work required to establish young seedlings in the ground, many are destroyed each year by rabbits and insects. Rabbits can be deterred by a baiting programme the previous autumn. Insect pests are less easily controlled. Redlegged earth mite and cutworm can do considerable damage immediately after emergence. They can be controlled with the same methods used for their control in pastures, (see Insects and allied pests of extensive farming, Western Australian Department of Agriculture, Bulletin 4185).

Wingless grasshoppers, locust and seed harvesting ants can also be a threat to revegetation projects but their control is more difficult. Persistence has been the most effective solution and has least side effects on native fauna, given the nature and frequency of insecticide applications required for the control of these pests.
Fencing

Stock must be excluded from newly planted areas. This usually makes fencing the single biggest cost in revegetation. Low cost electric fencing using as few as three, two or even one strand has been used successfully (see Department of Agriculture Farmnote 32/89 ‘Electric fencing: Simple electric fencing to protect bush areas on farms’ and Bulletin 4131, ‘Electric fencing’).

An alternative that has been used successfully in establishing windbreaks across the middle of large paddocks is to exclude stock until the trees are 14 to 18 months old, and then graze at high stocking rates for short periods. The stock will tend to eat pasture or crop residues first, but must be watched very closely and removed when they begin to browse on the young trees. This approach is suitable where there are large numbers of trees evenly spread over a paddock (more than 40 to 50 per hectare) but not for isolated plantings.

Fencing alone can be an effective form of revegetation by excluding stock and allowing natural regeneration. By carrying in cut branches with mature fruit, and thereby increasing the seed supply, regeneration can be cheaply and actively encouraged (see CALM Info-Sheet 1/87).
DESIGN AND LOCATION OF REVEGETATION

- Drawing a plan
- Special purpose planting:
  - Planting on saltland
  - Reclaiming sandplain seeps
  - Planting to control recharge
  - Windbreaks
  - Wildlife habitat and corridors
Revegetation is carried out for a variety of reasons.

- Reclaim already degraded areas.
- Prevent further degradation, such as water and wind erosion, salinity and waterlogging.
- Beautify the landscape.
- Provide habitat for wildlife.
- Increase the productivity of farm land by providing windbreaks and shelter belts for plants and animals.
- Provide a future renewable source of income (e.g. firewood, honey, wildflowers).

Revegetation often has one of these aims specifically in mind, and the design is then determined principally by that aim.

However, more appropriate designs will fulfil several of these objectives simultaneously. This is best done by first taking into account the important features of a site before planting or even ordering trees and shrubs (see Figure 4, page 78).

- The shape of the land and its drainage pattern (Topography).
- The location of fences, dams, roads and buildings (Structures).
- The location of existing patches of bush and planted trees and shrubs (Vegetation).
- The changes in soil type and the most obviously degraded areas (Soils).
- The direction of the most damaging winds (Orientation).
- The movement of subsurface water (Hydrology).
Drawing a plan

The comments that follow are directed primarily at revegetation of farmland but also apply to revegetation of other wheatbelt land such as roadways and town sites.

It is a complex process to take all the important factors into account, and then plan a revegetation programme that does not compromise the running of a farm or any other form of land use.

In the book ‘Design with Nature’, Ian McHarg describes a systematic way of considering such a range of factors. It is a process that applies equally at the scale of a farm, a mine site, a city or a catchment and is now widely used in Australia for planning land use.

Step 1

The most useful way to start is with a birds-eye view. The best way to do this is to study aerial photographs at a scale of 1:10,000. The information on topography, drainage, structures (such as fences and dams), existing vegetation, soils and land degradation can then be marked onto a series of transparent sheets. In this way several factors can be considered at once by combining several layers and looking at the interactions. Alternative plans that unite these elements and solve several problems simultaneously can then be roughly sketched out.

Step 2

As most revegetation will require fencing, consider whether the existing fencing is in the most appropriate place in terms of soil type boundaries, drainage lines and slope before making it even more permanent by planting along it.
Figure 4. The base plan showing drainage, structures, vegetation, major problem areas and aspect.
5. Wide spaced wind breaks to prevent erosion, limit recharge and increase crop and pasture yields

3. Protecting existing remnants and connecting with corridors

2. Fencing to soil type

1. Using drainage lines as corridors and paddock boundaries

4. Salt tolerant trees and fodder shrubs

Figure 5. A revegetation plan.
Designs that take this approach will result in a gradual change from a landscape divided on a rigid grid pattern to one where patterns of land use more closely follow natural features.

Step 3

Having examined the existing fencing in detail, the following design sequence will help to give direction to a plan over the years that it will take to implement (see Figure 5, page 80).

1. **Reinstate** all the drainage lines, first with fencing then with planting. This can form the backbone for revegetation on individual farms and throughout whole catchments.

2. **Re-orientate** paddock boundaries along the most appropriate lines, whether that is on the contour, along drainage lines, along ridges, along soil type boundaries or at 90 degrees to the most damaging winds.

3. **Protect and connect** existing remnant vegetation patches using new paddock boundaries, drainage lines and shelter belts as the corridors.

4. **Reclaim** areas affected by salinity, wind erosion and water erosion. Firstly by fencing, secondly by earthworks where it is necessary to control water, and finally by planting or seeding.

5. **Prevent** degradation by planting windbreaks, controlling runoff and by planting to prevent recharge of ground water and subsequent salinity.

By keeping these five objectives in mind, the various types of planting can be united to form a connected mosaic across the whole farm, and eventually across the broader landscape.
Special purpose planting

Planting on salt land, planting windbreaks or planting areas specifically for wildlife requires careful selection of species, layout and establishment method.

**Planting on saltland**

Reclaiming salt scalds and areas prone to waterlogging requires first that the area be fenced off from stock, second that excess water be diverted and third it be ripped and mounded. Planting or seeding into a depressed niche on top of a mound lifts the young plants above the worst of the salinity and waterlogging (Figure 3, page 69). Some thought should also be given to diverting runoff away from the planted area using banks or drains.

Seedlings are a more reliable way of revegetation than direct seeding in such harsh environments, although considerable success has been achieved with direct seeding where careful attention has been given to site preparation, seed quality and seed placement (see Department of Agriculture Farmnote 44/86, ‘Saltland management - revegetation’).

Several planting patterns are possible. Reclamation of saline areas has been successfully demonstrated using wide spaced rows of salt tolerant trees planted on mounds. Rows 30 m apart with trees every 5 m in each row gives a population of 80 trees per hectare. This configuration has been used in the wheatbelt to lower saline watertables and is flexible in that it allows grazing or cropping between the rows once the watertable has been lowered sufficiently.
An alternative configuration is to plant salt tolerant shrubs such as *Atriplex* and *Maireana* in rows at closer intervals (3 to 5 m) aiming for a population of about 1,000 plants per hectare. Such areas present a useful source of feed in autumn and early winter.

A combination of these two approaches can also be used.

**Reclaiming sandplain seeps**

Sandplain seeps often occur where the depth of sand over clay reduces on moving down the valley slope, and water moving on top of the clay seeps through to the surface. They can be dealt with by planting six to eight rows of trees and shrubs upslope from the seep with planting arranged on the contour. As a guide, a ratio of 1:5 between the area of trees and the area of salt affected land has been shown to be effective in the central wheatbelt within about five years. In these saturated conditions, trees from outside the area have often performed better, notably *Eucalyptus camaldulensis* (river red gum) and *Eucalyptus cladocalyx* (sugar gum).

**Planting to control recharge**

The lighter textured sandy and gravelly soils (wodjil, tamma, grevillea, York gum and mallee) are the soils that contribute most to recharge of groundwater. It should be possible to prevent further salinity in the valleys and lower slopes that results from this recharge by planting trees and shrubs.

However, the question remains, how many trees, what type and where should they be planted. To answer that question, the hydrology of a large area needs to be understood. Treatments can then be designed on a catchment basis and applied to individual farms. At present that understanding exists for only a few catchments. In the meantime, the following approximations may serve as a rough guide.
The density of trees or shrubs required to minimize recharge of groundwater will depend on rainfall and soil type, the type, age and health of trees and whether or not they are harvested for timber or forage. As an approximation, however, the tree density required will depend on the amount of annual rainfall that is not used by crops and pastures each year, and which enters the groundwater system causing waterlogging and salinity.

The amount of recharge has been estimated at between 5 and 10 per cent of annual rainfall for south-western Australia. The amount will vary depending whether the area is under crop or pasture.

With an annual rainfall of about 350 mm in the wheatbelt, this means planting enough trees to intercept and use between 17.5 and 35 mm each year. This amounts to between 175,000 and 350,000 litres of water per hectare.

Assuming that healthy four to five year old eucalypts will use about 10,000 L of water each year (25 to 30 L per day), that would require 18 to 35 trees per hectare.

The effectiveness of those trees will depend a great deal on their location, but this target may be useful until better information comes to hand.

It should be possible to lay out planting at this density of 18 to 35 trees per hectare so that it causes minimal disruption to cropping or grazing. In fact it may give a boost to crop and pasture growth when laid out as windbreaks. This population of trees can be achieved using either of the windbreak patterns described in the next section.

Planting fodder shrubs such as *Acacia saligna* and tagasaste on sandy soils will also help to control recharge. The usual planting pattern is 1 m between plants in rows 5 to 10 m apart, giving a population of 1,000 to 2,000 shrubs per hectare.
Windbreaks

The effectiveness of windbreaks is related to their height and structure. The shelter effect generally extends downwind for 10 to 25 times the height of the trees.

This can increase crop and pasture yields over the paddock by as much as 10 per cent, even allowing for reduced yields immediately adjacent to the trees. Lambing percentages have also been increased by similar amounts.

The most effective windbreaks are porous, with 50 to 60 per cent holes, but should not have large gaps, particularly at ground level. Solid impermeable windbreaks can result in turbulence occurring downwind.

Ideally several rows of trees and shrubs should be used. This makes them valuable as corridors for small birds and animals, and means some trees can be harvested without affecting windbreak structure. Cut stumps of many eucalypts will coppice, giving sustainable production as well as protection near the ground.

Two examples of windbreak layout are given below.

Example 1

Three row mixed *Acacia* windbreak.

Mature height: 4 to 5 m.

Spacing between plants: 3 m.

Spacing between rows: 3 m.

Spacing between windbreaks: 100 m.

Number of trees required per hectare of paddock: 60.
Example 2

Three row mixed *Acacia*, *Melaleuca*, *Eucalyptus*, *Allocasuarina*, *Leptospermum* windbreak.

Mature height: 8 to 12 m.

Spacing between plants: 4 m.

Spacing between rows: 5 m.

Spacing between windbreaks: 200 m.

Number of trees required per hectare of paddock: 45.

Example 1 has the advantage of being quick to establish and suited to direct seeding. It has the disadvantage of being short lived (15 to 20 years) but could be regenerated from seed by burning.

Example 2 has the advantage of being longer lived and having more value to wildlife but requires establishment from seedlings.

It may be possible to manage both systems without fencing using short grazing rotations at high stocking rates (see notes on Fencing). Otherwise an additional 200 m of fencing per hectare (example 1) or 100 m of fencing per hectare (example 2) is required. This is based on the fencing required for windbreaks across a 100ha paddock.
Wildlife habitat and corridors

Revegetation can have a significant effect on wildlife if it is well planned. By using predominantly native species and including a variety of flowering trees and shrubs, the value of such areas for a range of birds and other animals is increased.

All of the above special purpose planting can play a useful role as wildlife habitat and as corridors that connect existing remnants. Many small animals and birds will not cross open ground, so providing for their needs of food and shelter can make most planting useful as corridors. This usefulness will be greatest where the remnants to be connected are large (e.g. 50 ha) and they are fairly close together, but any provision of links between remnants will be beneficial. Their usefulness as corridors will be greatly enhanced if they are wide (10 to 20 m) rather than narrow (5 m). Providing groups of the one type of flowering tree or shrub at intervals along a corridor will encourage birds to visit regularly. This simulates the way many species occur in the wild and will increase the value of such planting as corridors.
Birds that use vegetation in each category

* Denotes species dependent on remnant native vegetation; NFS denotes species not frequently seen and considered to be of vulnerable status.

**Wodjil**

* Southern scrub robin (NFS)
* Red-capped robin
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* White-browed babbler
* Broad-tailed thornbill
* Singing honeyeater
* Brown honeyeater
  White-fronted chat
  Zebra finch

**Tamma**

* Painted button quail (NFS)
* Common bronzewing
* Red-capped robin
* Western yellow robin (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* White-browed babbler
* Blue-breasted wren (NFS)
* Shy hylacola (NFS)
* Field wren (NFS)
* Broad-tailed thornbill
* Spiny-cheeked honeyeater
* Singing honeyeater
* Brown honeyeater
* Zebra finch

**Grevillea**

* Painted button quail (NFS)
* Common bronzewing
* Southern scrub robin (NFS)
* Crested bellbird (NFS)
* Field wren (NFS)
* Broad-tailed thornbill
* Singing honeyeater
* White-eared honeyeater
* Brown honeyeater
* White-fronted honeyeater (NFS)
* Tawny-crowned honeyeater (NFS)

**White gum and salmon gum**

Mountain duck
Wood duck
Black-shouldered kite
Wedge-tailed eagle
Little eagle
Peregrine falcon
Nankeen kestrel
Bush stone curlew (NFS)
* Common bronzewing
* Carnaby’s cockatoo (NFS)
* Purple-crowned lorikeet (NFS)
* Red-capped parrot (NFS)
* Western rosella (NFS)
* Regent parrot (NFS)
* Pallid cuckoo
* Fan-tailed cuckoo
  Barking owl (NFS)
  Barn owl
* Tawny frogmouth
* Owlet-nightjar
* Spotted nightjar (NFS)
  Tree martin
* White-winged triller
* Red-capped robin
* Jacky winter (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* Weebill
* Western warbler
* Broad-tailed thornbill
* Chestnut-rumped thornbill
* Varied sittella (NFS)
* Red wattlebird (NFS)
* Spiny-cheeked honeyeater
* Singing honeyeater
* White-eared honeyeater
* Yellow-plumed honeyeater (NFS)
* Brown-headed honeyeater
* Brown honeyeater
* White-fronted honeyeater (NFS)
* Mistletoe bird (NFS)
* Spotted pardalote (NFS)
* Striated pardalote

York gum and morrel

* Pallid cuckoo
* Fan-tailed cuckoo
* Tree martin
* White-winged triller
* Red-capped robin
* Jacky winter (NFS)
* Rufous whistler
* Grey shrike-thrush
* Crested bellbird (NFS)
* Grey fantail
* Weebill
* Western warbler
* Broad-tailed thornbill
* Chestnut-rumped thornbill
* Yellow-rumped thornbill
* Varied sitella (NFS)
* Red wattlebird (NFS)
* Spiny-cheeked honeyeater
* Singing honeyeater
* White-eared honeyeater
* Yellow-plumed honeyeater (NFS)
* Brown-headed honeyeater
* Brown honeyeater
* White-fronted honeyeater (NFS)
* Mistletoe bird (NFS)
* Spotted pardalote (NFS)
* Striated pardalote
Mallee

* Mallee fowl (NFS)
* Common bronzewing
* Purple-crowned lorikeet (NFS)
* Pallid cuckoo
* Fan-tailed cuckoo
* Horsfield's bronze cuckoo
* Boobook owl
* Tawny frogmouth (NFS)
* Owlet-nightjar
* Tree martin
* White-winged triller
* Red-capped robin
* Hooded robin
* Western yellow robin (NFS)
* Jacky winter (NFS)
* Golden whistler (NFS)
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* Weebill
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* Red wattlebird (NFS)
* Spiny-cheeked honeyeater
* Singing honeyeater
* White-eared honeyeater (NFS)
* Yellow-plumed honeyeater

**Salt lake**

* White winged wren
* White-fronted chat
* Black swan
* Mountain duck
* Grey teal
* Hooded dotterel
* Red-capped dotterel
* Black winged stilt
* Banded stilt

**Increaser species**

_Birds that have benefitted from agricultural development:_

- Crested pidgeon
- Galah
- Stubble quail
- Kookaburra
- Banded plover
- Domestic pidgeon
- Black-faced cuckoo-shrike
- Striated pardalote
- Pied butcher bird
- Australian magpie lark
- Little crow
- Australian magpie
- Straw-necked ibis
- White-faced heron

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FURTHER INFORMATION


Denmark Soil Conservation Advisory Committee (1989). Simple electric fence to protect bush areas on farms. Western Australian Department of Agriculture Farmnote 32/89.


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