

AGROFORESTRY OPTIONS FOR THE WHEATBELT

wheatbelt natural resource management

CARING FOR OUR COUNTRY

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CARING FOR OUR COUNTRY

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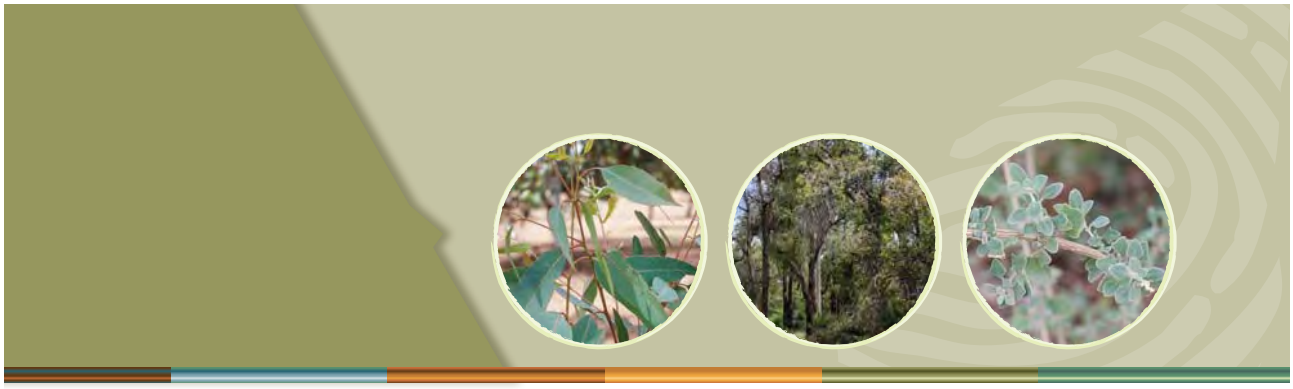
DISCLAIMER



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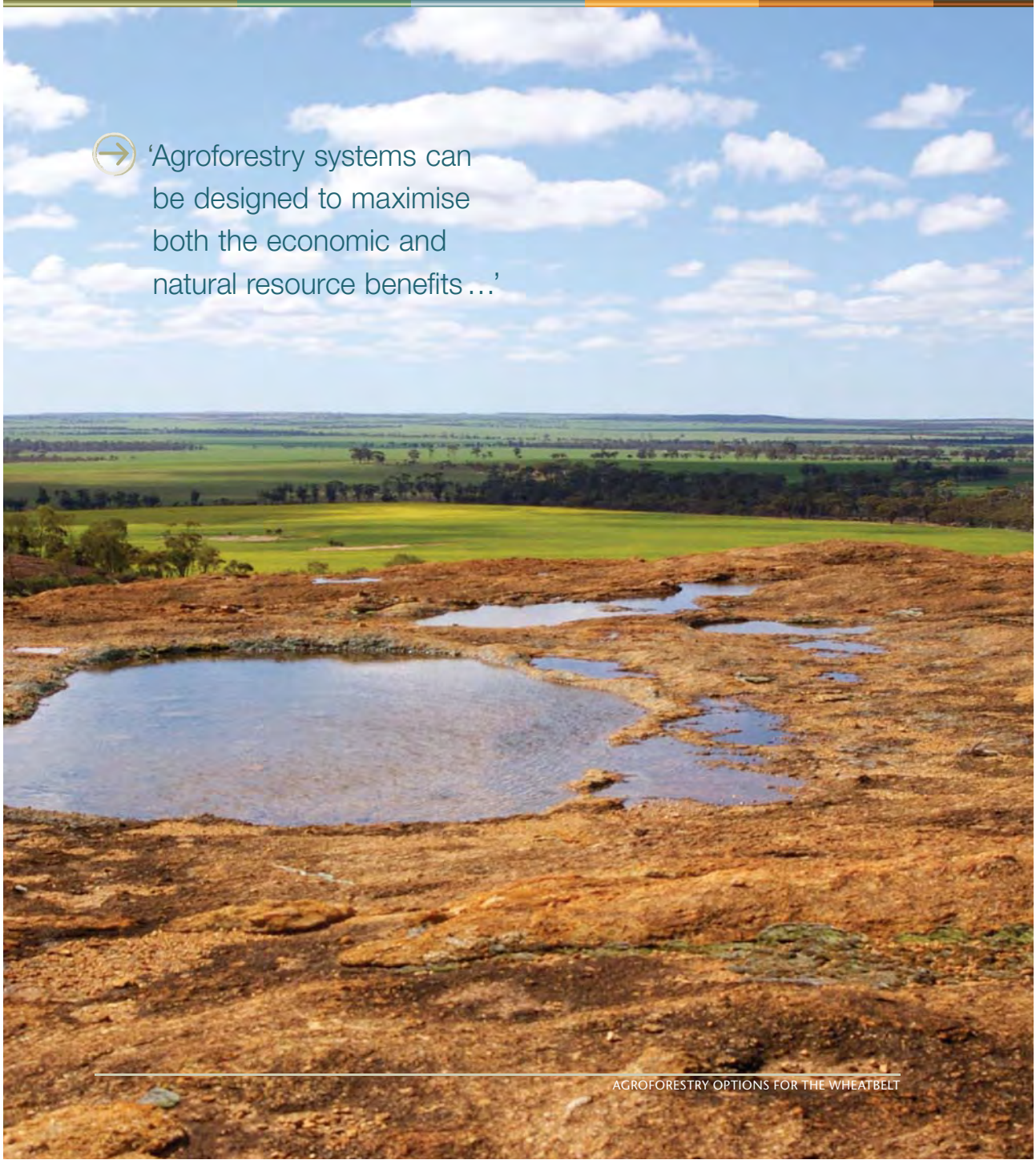
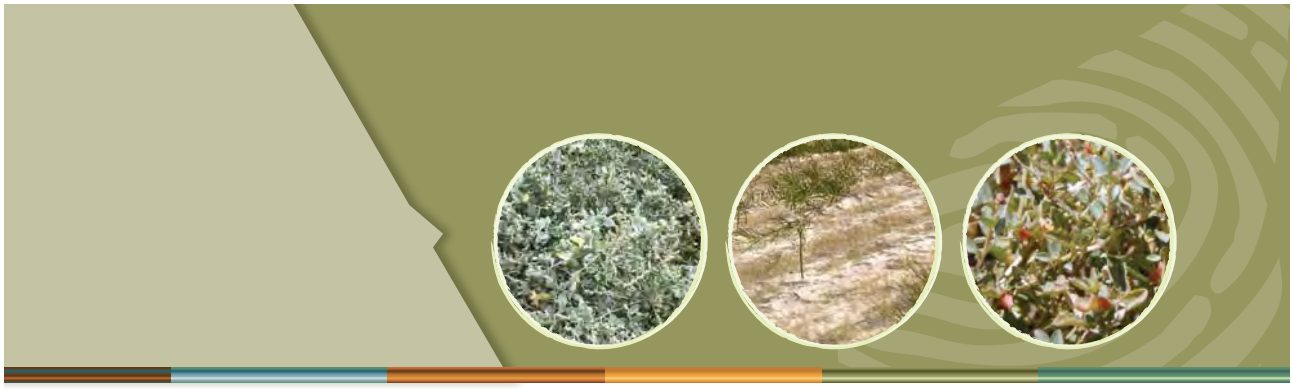


‘Agroforestry systems can be designed to maximise both the economic and natural resource benefits…’



INTRODUCTION

This guide is for land managers, farmers and communities interested in agroforestry-based revegetation options that provide both natural resource and production-based outcomes for the Wheatbelt region of Western Australia. The aim of this guide is to provide information, tips and tricks to successfully integrate agroforestry activities into existing Wheatbelt farming systems and advice on how to gain additional benefit for biodiversity outcomes from this form of on-farm revegetation.

The range of opportunities in agroforestry is continuously increasing with new industries emerging and a growing knowledge of how best to manage and integrate these systems into Wheatbelt farms. At the same time, we are recognising the value that these systems contribute to the health of our natural resources, with many biodiversity, soil and water benefits. This is particularly important given that the Wheatbelt forms part of an international biodiversity hot spot, but is largely cleared and the remaining vegetation is highly fragmented. Agroforestry systems can be designed to maximise both the economic and natural resource benefits and encourage you to incorporate both aspects in your project planning.

Agroforestry and revegetation is for everyone. Whether you are a broadacre farmer or a hobby farmer, at some point you are likely to want or need to do some revegetation on your property. This guide provides step-by-step information on how to plan your activity, organise your seed or seedlings, prepare your site and maintain or manage your project into the future.

The guide also introduces you to the key forms of agroforestry available in the Wheatbelt and provides information on the species used for these activities. However, this is designed purely as an introduction and we recommend you look further into your selected agroforestry option to make sure you have the latest understanding of the industry and on-ground management needs of the system. A key resource is the 'Seedling Selector' App (suitable for iPhone or Android use) which provides an interactive approach to selecting the right species for your site.

Whether you have experience in revegetation or are just starting out, this guide contains information to ensure every planting you do has the best possible outcome, good survival rates and provides benefits to you and the environment far into the future.

If you require any additional information, contact Wheatbelt Natural Resource Management on (08) 9670 3100 or visit: www.wheatbeltnrm.org.au

FIRST STEP: HAVE A PLAN

PURPOSE OF THE AGROFORESTRY ACTIVITY

Before starting your revegetation project it is important to have a holistic plan for your entire property. It can be very costly to rush into a project just to find that the plants have to be removed because a fence is in the wrong place or your machinery size changes.

Many farms that have been in a family for several generations will already have good plans in place but it is important to review your property plan every 3 to 5 years. Things change: your machinery, business and vision for the farm. Knowledge on species and techniques for revegetation improve all the time.

Then map the area on your farm plan and determine the size of the project(s) in hectares.

Determine what you want to achieve by revegetating an area—it could be one or a combination of several of these objectives:

SALINITY MANAGEMENT

SHADE AND SHELTER FOR LIVESTOCK

FODDER FOR LIVESTOCK

CARBON SEQUESTRATION

OTHER TREE CROP RESOURCES (E.G. SANDALWOOD)

WIND AND/OR WATER EROSION CONTROL

WILDLIFE HABITAT AND DISPERSAL CORRIDORS

HARVESTING FIREWOOD AND TIMBER

For each outcome there are different species to suit the task. These species will range from forage shrub monocultures of improved varieties to biodiverse corridors using locally collected seed. The options presented in this guide focus on revegetation activities that have a production-based outcome.

PLANTATION DESIGN

Most of the options from the previous section can be planted in either a block or belt configuration and will be governed by the needs, soil type(s) and size of the site as well as your own needs.

BLOCK PLANTINGS

Block plantings are usually better suited to areas that are:

- of a consistently (agriculturally) unprofitable soil type/s; and/or
- subject to salinity in situ or are acting as a water recharge area, causing salinity further downslope.

Large areas of deep white sands high in the landscape are sometimes planted out in blocks to utilise water and prevent increasing salinity in the valley floor below. These areas can also prevent these sands from 'blowing' and eroding.

BELT PLANTINGS

The advice on how many rows in the belt and the distance between these has changed over time. In the end your decision will probably depend on:

- machinery and paddock size if you are a broadacre farmer; or
- the purpose of your planting if you are a smaller landholder.

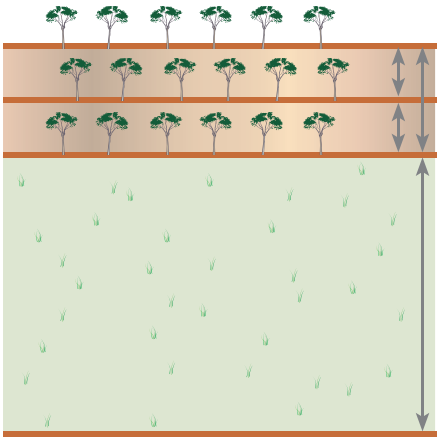
HOW TO DESIGN A WINDBREAK

There are two design principles to follow when designing your windbreak:

1. windbreak structure; and
2. windbreak layout.

Four to five rows of trees are best for windbreaks. Plant smaller, shrubby species on the outside rows, particularly on the side where the prevailing winds come from. The best windbreak orientation is at right angles to the prevailing winds. Unfortunately, damaging winds often come from different directions in different seasons and you may want to include two windbreaks in a paddock to achieve maximum benefits.

A badly designed windbreak can cause more damage than the benefits it provides (for example, if it causes wind to tunnel along the base of trees, eroding soil and channelling winds). Windbreak belts can make ideal wildlife corridors when planted along fencelines which connect remnant vegetation.



HOW TO CREATE A WILDLIFE CORRIDOR

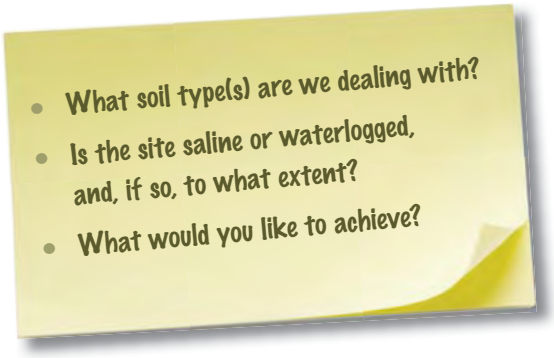
A belt that is working primarily as a wildlife corridor should be at least 20 metres wide. This will allow enough shelter for fauna which do not like to move through sparse vegetation. To achieve the greatest biodiversity outcome, plant a mixture of species including understorey, middle and overstorey species, using seed collected from remnant vegetation nearby. This can often be complementary to your agroforestry activity to improve the biodiversity outcomes—but make sure you choose the right species. Pest and weed management in corridors is also important to achieve biodiversity outcomes.

Monitor the success of your corridor by recording the number of fauna species that you see using the corridor and, if possible, count or estimate the number of individuals of each species.

TECHTIP **Remember to calculate the alley (the distance between belts) to suit multiple runs with your machinery. If in doubt, make the alley wider.**

SELECTING THE RIGHT PLANT FOR THE JOB

Selecting the right plant for the job is essential. To narrow down the list of species suitable for the chosen site the next set of questions that need to be considered are:



For support in selecting the right species for your project refer to the glossary of species at the back of this guide.

FOR THE TECHNICALLY SAVVY

Download the '**Seedling Selector**' App (available on iPhone and Android). This application ('App') uses site details (soil type, rainfall, waterlogging or salinity, and drainage) along with the motivation for the revegetation, to select species which suit both the end use and the site. In areas where rainfall is expected to decline it is beneficial to incorporate some species from lower rainfall zones as a way of building resilience into your revegetated area.

FOR WEB-BASED HELP

See the *Atlas of Living Australia* (http://www.ala.org.au). This website allows you to do a search of your planned revegetation area and will generate a list of species that were originally found there. This species list can be used as a guide for what you should consider planting for greatest biodiversity outcomes.

TECHTIP

Remember: a hostile site will not only grow a poor crop, it will also grow poor plants. Don't choose the worst site for your project and expect spectacular growth rates. Choose your species carefully to match the capability of the site as well as your aspirations.

TYPES OF AGROFORESTRY SYSTEMS

When selecting your desired agroforestry system consider both the economics of the activity and how well it will integrate into your existing farming system. This is also important from an on-going management point of view, as many of these activities will only provide financial rewards when appropriately managed.

There are many supporting resources out there to assist you with this decision. For example, the '**Farming Landscapes for the Future Tool**' (FLFT) will allow you to compare the economic potential of sandalwood, oil mallees, traditional cropping rotations or livestock production, based on different soil types and climatic patterns across the Wheatbelt. There are also industry associations affiliated with many of these activities who can provide further information and help support your project (see 'Further Resources').

Selecting a system is the same as selecting a crop, except selecting an agroforestry system is making a much longer term decision. The same care in paddock preparation, weed and insect control, and species selection needs to be taken to ensure an equally rewarding outcome.

TIMBER

Timber crops are an option for production in the higher rainfall areas of the Wheatbelt as they can provide both an economic return and an environmental service to the region.

Selecting the right species, provenance and site are essential to any successful planting. Thinning, form pruning and clear wood pruning requirements will vary depending on the species planted, however these treatments are essential to allow the trees to achieve any commercial value.

For tips on how to do this, go to www.avongro.com.au/video.

Planting at high density will encourage upright growth.

It is important to understand the potential pests at your site prior to planting, and begin controlling these pests as they can

have a detrimental effect on plantations. Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears. Plantation design and location are essential to allow for harvesting and maintenance operations. Planting design to also benefit biodiversity should consider structural and species diversity and connection with existing vegetation.

SANDALWOOD

Sandalwood is a popular forestry option for the Wheatbelt. It is a hemi-parasitic tree, dependent on nutrients from host plants to survive and grow. The best hosts are nitrogen-fixing trees, especially the wattles. Sandalwood is direct seeded when the host trees are 1–2 years of age (approximately 1 m tall).

Sandalwood shows large potential on soils that are less profitable for cropping. Host plants can be established by either direct seeding or planting seedlings with success. Weed and pest control is essential for any successful revegetation project.
Stock will cause damage and death to the sandalwood, so care is needed when introducing stock to established plantings. Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears.

Plantation design and location are essential to allow for harvesting and maintenance operations. Planting design to also benefit biodiversity should consider structural and species diversity and connection with existing vegetation.

For more information go to www.sandalwood.org.au.

BRUSHWOOD

Brushwood or broombush is an agroforestry option on land that is not highly productive for conventional agriculture. Brushwood can be grown on sites that are marginally saline, and seasonally waterlogged, although as conditions decline productivity will be reduced. Harvested brushwood is used in the production of brushwood fencing panels.

The preferred material for brushwood fencing typically has long, thin straight stems with a smooth, dark bark. The site conditions will affect the growth rate and

form of the shrubs. Stock will cause damage and death to young brushwood plants, so care is needed when introducing stock to young plantings.

Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears. Plantation design and location are essential to allow for harvesting and maintenance operations. Planting design to also benefit biodiversity should consider structural and species diversity and connection with existing vegetation.

OIL MALLEE

Oil mallees are commonly planted in the Wheatbelt, as they are largely unpalatable to sheep and so can be planted in paddocks without the need for fencing.

Mallees coppice (re-sprout from the lignotuber) readily after harvest, fire or other damage.

Oil mallees may be planted for a variety of outcomes including environmental services, harvested biomass, and carbon sequestration. Planting design will strongly influence establishment, management and harvesting capability.

With careful monitoring, stock can be introduced to oil mallee belt plantings fairly quickly following establishment. Block plantings can be established in areas that are less profitable for cropping or difficult to use for other activities. Belt plantings are more common in agricultural systems as they allow for cropping and grazing in the inter-row. Belts will need to be spaced to allow for machinery to have easy access between the rows and around the edge of paddocks. Long belts should have breaks at intervals to allow for access between the inter-rows for machinery and sheep management.

Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears. Plantation design is essential to allow for harvesting and maintenance operations. Planting design to also benefit biodiversity should consider structural and species diversity and connection with existing vegetation.

For more information go to: www.oilmallee.org.au.

BIOMASS AND CARBON

Block plantings can be planted in areas that are unprofitable for cropping or difficult to use for other activities. Belt plantings are more common in agricultural systems as they allow for cropping and grazing to occur in the inter-row. Belts will need to be spaced to allow for machinery to have easy access between the rows and around the edge of paddocks.

This measurement will be based on the largest machine. Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears. Plantation design is essential to allow for harvesting and maintenance operations.

Planting design to also benefit biodiversity should consider structural and species diversity and connection with existing vegetation. The best species for biomass and carbon are those which are well adapted to the site conditions, and are fast growing.

FORAGE SHRUBS

Forage shrubs can provide valuable green feed for livestock during the summer/ autumn feed gap, and during periods of drought. If forage shrubs are planted in saline areas, ensure livestock have access to good quality water as they will require fresh water to flush the high salt content from their bodies.

Grazing is an essential management tool to get the greatest benefit from your forage shrub planting. Forage shrubs recover well from rotational grazing, and this is the preferred method of grazing which allows the plant time to recover.

Established plantings provide excellent shade and shelter for livestock, particularly during lambing and off-shears. When planning site layout, consider vehicle access and ability to view stock easily.

Research has shown that when 10–20% of the whole farm area is planted to forage shrubs, this can increase profitability of a mixed crop–livestock farm, based on unproductive cropping soils being planted to fodder shrubs. Incorporating structural and species diversity, and connection with existing vegetation can enhance the biodiversity benefits associated with your forage shrub planting.

INTEGRATED SYSTEMS

Many of the agroforestry options can be integrated to produce options that have multiple benefits. One example of this is the system proposed by Greening Australia that uses a mix of species to produce grazing, biomass and biodiversity outcomes.

The system uses belts containing 4 to 6 rows of mixed fodder species from ground cover, small to medium shrubs and some small to medium trees. The belts are generally sown on the contour with an inter-row space of at least 10 m for stock and vehicle movement. The inter-row is also important to supply high carbohydrate feed such as cereal or dry pasture to complement the high protein feed available from the fodder shrubs.

The system's design is very flexible and can be modified to meet farm management requirements, however the technical team recommend that block plantings are avoided or restricted to small areas as experience indicates that stock can become difficult to muster in this style of design.

Economic modelling (CSIRO, GAWA) shows that converting unproductive areas to fodder shrubs can significantly increase net profitability of the overall farm enterprise. The increase in profitability is made through savings due to reduction in supplement fodder required to be kept or purchased and time saved by not having to hand-feed stock. It is estimated that in the central Wheatbelt the area per farm required to be converted to achieve this is between 15 to 20% depending on location and soil type etc.

Greening Australia has placed a strong emphasis on using locally adapted Western Australian species with proven fodder value. The overall process of shortlisting a trial species list has been guided by screening work conducted by the CSIRO ENRICH project across southern Australia and monitoring work by DAFWA in the rangelands of Southern WA.

Biodiversity is a key component of the system with between 10 to 20 different species included at each site and approximately 10% of the overall mix being small to medium trees and shrubs to provide shade, shelter and habitat. High sequestering carbon species can also be included to increase the biomass potential of the system depending on the needs of the farmer.

PLANTING FOR BIODIVERSITY

For optimal biodiversity benefits from your revegetation, use local species that are found on similar soil types.

Consider any soil characteristics which may be limiting (e.g. pH, waterlogging or EC).

Optimise structural characteristics by including ground cover, shrubs and trees based on bushland in similar situations.

Try to include a range of flowering times and types as food source for native fauna. For functionality as a wildlife corridor the minimum width should be 20 m.

In the planning and preparation stage, identify any weed and feral animal issues and begin management prior to planting. Plan your revegetation activity to provide multiple benefits to the farm (e.g. wind break, soil protection, local ground water management, and/or some of the farm forestry options).

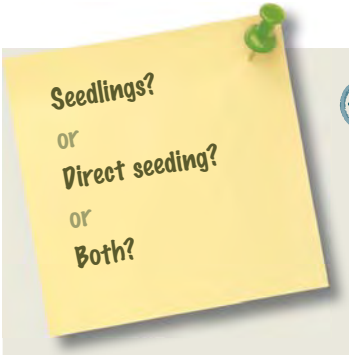
Some native plants are toxic to livestock and incorporation of these species into your revegetation area needs to be approached with caution.

Revegetation can be achieved by planting seedlings or by direct seeding. Generally, direct seeding is more economical (but can be less reliable for a novice), with greater success on lighter soil types. Some species are best propagated from cuttings (but will be expensive to purchase), while others germinate well from seed.

For more information on the best establishment method for your project contact the Regional Landcare Facilitator at Wheatbelt NRM.

CAUTION **Some species are poisonous to stock and other non-indigenous animals. Take care to avoid these species in your revegetation project.**

SEED VERSUS SEEDLINGS



To make a decision on these questions consider your skills and knowledge. A project using seedlings alone is best for people starting out on revegetation or if you are using seedlings from plants which are rare or threatened, or those with seed that is difficult to collect or have poor germination and viability.

Direct seeding can be highly successful but it requires a certain degree of skill, knowledge and specific equipment. If you are a planting novice and prefer to attempt the project yourself then seedlings will give a better success rate.

If you have access to and can afford to bring in an experienced contractor, you may like to attempt a project that either wholly or partially uses seed.

Tree nurseries grow their seedlings in 'cell' trays. The trays come in a variety of sizes and each nursery has their own preference so it's best to check with them to work out your numbers—they will expect your order to be in multiples of their trays.

These seedlings will fit easily down a pottiputki tube or tree planter, are light for the volume of seedlings, and have become the norm for large-scale projects.

CAUTION

Even for small projects don't be tempted to buy seedlings in individual pots and/or to dig individual holes. This is time-consuming and often will not achieve the desired results.

HOW MANY SEEDLINGS TO ORDER?

Greening Australia WA developed an excellent table to calculate the number of seedlings required for a revegetation project.

Use this table to calculate the number of stems per hectare (SPH) based on the distance between rows and between trees along the row.

Distance between trees along rows (metres)

Distance between rows (metres)	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5
1.5	26667	13333	8889	6667	5333	4444	3810	3333	2963	2667	2424	2222	2051	1905	1778	1667	1569	1481	1404	1333
1.75	22857	11429	7619	5714	4571	3810	3265	2857	2540	2286	2078	1905	1758	1633	1524	1429	1345	1270	1203	1143
2	20000	10000	6667	5000	4000	3333	2857	2500	2222	2000	1818	1667	1538	1429	1333	1250	1176	1111	1053	1000
2.25	17778	8889	5926	4444	3556	2963	2540	2222	1975	1778	1616	1481	1368	1270	1185	1111	1046	988	936	889
2.5	16000	8000	5333	4000	3200	2667	2286	2000	1778	1600	1455	1333	1231	1143	1067	1000	941	889	842	800
2.75	14545	7273	4848	3636	2909	2424	2078	1818	1616	1455	1322	1212	1119	1039	970	909	856	808	766	727
3	13333	6667	4444	3333	2667	2222	1905	1667	1481	1333	1212	1111	1026	952	889	833	784	741	702	667
3.25	12308	6154	4103	3077	2462	2051	1758	1538	1368	1231	1119	1026	947	879	821	769	724	684	648	615
3.5	11429	5714	3810	2857	2286	1905	1633	1429	1270	1143	1039	952	879	816	762	714	672	635	602	571
3.75	10667	5333	3556	2667	2133	1778	1524	1333	1185	1067	970	889	821	762	711	667	627	593	561	533
4	10000	5000	3333	2500	2000	1667	1429	1250	1111	1000	909	833	769	714	667	625	588	556	526	500
4.25	9412	4706	3137	2353	1882	1569	1345	1176	1046	941	856	784	724	672	627	588	554	523	495	471
4.5	8889	4444	2963	2222	1778	1481	1270	1111	988	889	808	741	684	635	593	556	523	494	468	444
4.75	8421	4211	2807	2105	1684	1404	1203	1053	936	842	766	702	648	602	561	526	495	468	443	421
5	8000	4000	2667	2000	1600	1333	1143	1000	889	800	727	667	615	571	533	500	471	444	421	400
5.25	7619	3810	2540	1905	1524	1270	1088	952	847	762	693	635	586	544	508	476	448	423	401	381
5.5	7273	3636	2424	1818	1455	1212	1039	909	808	727	661	606	559	519	485	455	428	404	383	364
5.75	6957	3478	2319	1739	1391	1159	994	870	773	696	632	580	535	497	464	435	409	386	366	348
6	6667	3333	2222	1667	1333	1111	952	833	741	667	606	556	513	476	444	417	392	370	351	333
6.25	6400	3200	2133	1600	1280	1067	914	800	711	640	582	533	492	457	427	400	376	356	337	320
6.5	6154	3077	2051	1538	1231	1026	879	769	684	615	559	513	473	440	410	385	362	342	324	308
6.75	5926	2963	1975	1481	1185	988	847	741	658	593	539	494	456	423	395	370	349	329	312	296
7	5714	2857	1905	1429	1143	952	816	714	635	571	519	476	440	408	381	357	336	317	301	286
7.25	5517	2759	1839	1379	1103	920	788	690	613	552	502	460	424	394	368	345	325	307	290	276
7.5	5333	2667	1778	1333	1067	889	762	667	593	533	485	444	410	381	356	333	314	296	281	267
7.75	5161	2581	1720	1290	1032	860	737	645	573	516	469	430	397	369	344	323	304	287	272	258
8	5000	2500	1667	1250	1000	833	714	625	556	500	455	417	385	357	333	313	294	278	263	250

To ensure you get the right species for your project it is important to order your seedlings well in advance. The earlier you place your order the more likely it is that you will get good robust seedlings of the species and quality you need. Seedling orders should be placed with your local nursery during September–October. There are now many experienced growers in the Wheatbelt. Wherever possible support your local nursery and benefit from their advice.

TECHTIP Whether using seedlings or seed, allow plenty of lead-up time.

SOURCING SEED

This can often be left to your reputable contractor to organise, provided you give them plenty of lead-up time to source the correct range of species. Place your seedling order with your local nursery early (September–October)—this way you have a better chance of the nursery being able to source difficult to find seed in time for sowing (November–December).

CAUTION **Seed collecting requires a licence and permission from landholders, whether private or government.**

Like any crop, native seed quantity varies from year to year based on rainfall. A drought one year can greatly reduce seed supply in some species three years later. Securing a supply of seed should be considered well in advance to sowing.

In the Wheatbelt, 80% of native species require seed collection during summer, and some species may only have seed available for a very short period of time.

SEED COLLECTION TIPS

- Collect seed from the nearest healthy intact population of the species containing at least 100 individuals in close proximity.
- Collect seed from the upper outer branches of a tree as it is more likely to be out-crossed (not inbred).
- Collect from trees separated by some distance (e.g. 100 m for eucalypts) because nearby trees will have a higher degree of genetic similarity.
- Collect your seed from a similar position in the landscape (e.g. don't collect seed from a gully when your planting will be on a ridge). It is better to match for site (ecological position) than to automatically choose the closest local native seed source.
- Don't over collect from a single tree as this may kill the tree or reduce its ability to produce seed in the future.
- Record the GPS position of the plants and keep this with the seed so you can track the provenance, and go back to that area in the future if it is a useful stand.
- Conduct viability tests on your seeds to calculate the sowing rate required to germinate sufficient seedlings.

Go to http://florabank.org.au for some simple techniques to assist.

SEED PURCHASING TIPS

When ordering seed from a commercial seed supplier, ask these important questions:

- What is the viability (%) of the seed?
- Where has the seed come from (its provenance)?
- What is the age of the seed and how has it been stored?
- When comparing seed prices, remember that 0.5 kg of 90% viable seed is worth much more than 1 kg of seed with just 10% viability.

SEED QUANTITY

Estimating the quantity of seed needed for a revegetation project is complex because there are many variables that you should consider including:

- planting method—direct seeding or seedlings grown in a nursery;
- distance between planting rows (often 3–5 m);
- desired stem densities of trees, shrubs and ground cover;
- seed viability which varies between species, seasons and whether germinated in the nursery or paddock; and
- size and longevity of species—short-lived and small species are usually planted at higher densities than long-lived and large trees.

SEED PREPARATION

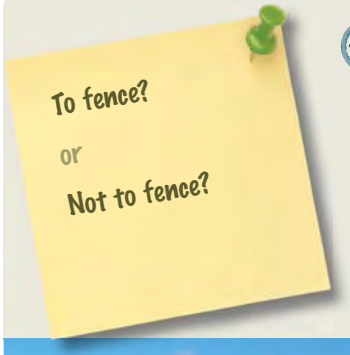
Some seeds will require treatment before seeding to overcome natural germination inhibitors and increase the chances of germination. There are many forms of treatment—for example, hard-coated seed species such as Acacia and Senna should be scarified (by cutting or sanding), or placed in boiling water (most Acacias), or very hot water, each for a different length of time, then rinsed in cold water. A soak in diluted smoke water for 20–30 minutes can also help break dormancy. Water-treated seeds should then be dried to at least a flowable state to allow easy transport through the seed box. Other species may need to have awns, wings or appendages removed in order to travel through the seeder.

The CSIRO Publishing book *Growing Australian Native Plants from Seed* is a good source of pre-germination treatment information. The Australian Native Plants Society also has an informative website on seed preparation for sowing: http://asgap.org.au.

TECHTIP **Some species require specific treatments to enable the seed to germinate successfully.**

PREPARATION FOR PLANTING

TO FENCE OR NOT TO FENCE?



Some sites will require fencing, others may not. If you have stock then fencing is almost always a must, unless you can fit the stock exclusion period into a cropping only rotation. If you don't have stock and never plan to have any, then you may be able to get away without this expense.

However, fencing takes time and should be scheduled for immediately after planting (to allow for easy machinery movement at planting time).

It is rarely economical or practical to fence narrow belts. The Oil Mallee Association of Australia have worked with farmers over many years to develop a methodology that enables belts to be established without the need for fencing by fitting in with the annual cropping calendar of broadacre farmers.

While this methodology has been developed using mallees, other species can be suited to this system although for some species stock would need to be excluded from the site longer.

HOW TO ESTABLISH WITHOUT FENCING

- Choose a paddock that will be going into crop.
- Spray the whole paddock as for the crop.
- Seed crop.
- Into the newly sown crop, mark out lines for the tree belts using GPS on the tractor and a simple ripper towed behind a ute.
- Plant seedlings along the marked lines once the crop seeding program is complete – using a one-pass tree planter.
- Maintain the paddock as you would normally, and monitor young seedlings for insect attack, treat as required.
- Harvest crop as usual.
- By late autumn the following year, sheep can be allowed into the paddock to graze the stubble—but monitor the site as hungry sheep will eat even mallee seedlings! (For other more palatable species it may be necessary to keep stock out for longer.)

Remember you will require access to the site for site preparation and planting, but for large sites it's good to get this big job under way.

If you are inexperienced in fencing it will pay in the long run to bring in an expert. Fencing requires strength, experience and specialised equipment.

CAUTION **Ungrazed sites can become fire hazards. Controlled grazing can help reduce fire risk.**

TECHTIP **Consider access for machinery when planning your fence.**

PRE-PLANT PEST CONTROL

It is disheartening and costly to find that all your hard work has been eaten out by rabbits. Use the summer months (December to April) to reduce any rabbit numbers near the proposed planting site. Rabbits do not respect property boundaries so sometimes it may be necessary to discuss your rabbit control program with your neighbour.

Kangaroos and 'twenty-eight' parrots can also impact on planting success, so consider these critters and evaluate if they may impact your planting.

It is also important to control red legged earth mite (RLEM), caterpillars and grasshoppers as early as possible, as they can be fatal to seedlings, especially when the emerging cotyledon first appears.

CAUTION **Many rabbit control programs involve the use of poison. Ensure your neighbours are aware that you are using them as the poisons not only kill rabbits but also dogs and other non-indigenous animals.**

PRE-PLANT WEED CONTROL

Weed burden at a site can be the number one cause for failure, as the weeds outcompete the seedlings for light, nutrients and water. Weeds have to be controlled around the seedlings, preferably up to 1 metre away. Once the seedlings are planted, it is often too late to start with any comprehensive weed control program, so this should be done during May–June to give the seedlings the best start.

While timely mechanical methods and grazing in the year leading up to planting can be used to reduce the amount of chemicals required, the most efficient and proven method for large-scale projects in the WA Wheatbelt is the use of herbicides.

USING HERBICIDES—IMPORTANT STEPS

- Get specific advice for your site, soil type and species of weeds present.

  Spray prior to planting with a knockdown (glyphosate) and a residual (e.g. Simazine). (Simazine is ideally applied to bare moist soil. Wait until 30 days have passed after residual herbicide application by which time, in the absence of rain, the herbicide will begin to break down. So in dry years, use of residuals may be wasted as they are only activated in the presence of soil moisture.)
- If required, a secondary spray during the year after planting may be required. Seek advice on what herbicide may be used, and at what rate.
- Follow all safety and manufacturer's instructions.

On sites prone to wind erosion, only spray out the area where the seedlings will be planted. The inter-row weeds will act as protection for seedlings.

Residual herbicides should **not** be used at all at sites which are dependent on natural regeneration.

Note: Keep the unsprayed area far enough away from seedlings so they are not competing for moisture and nutrients.

SITE PREPARATION

Rip or mound?

One-pass operation?

Prepare site first and then hand plant or direct sow?

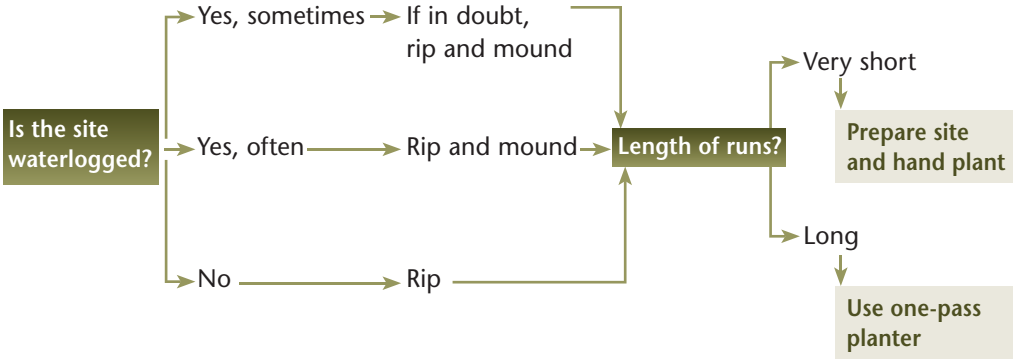
The most common method in the Wheatbelt is the one-pass tree planter that scalps away weed burden, rips and/or mounds, and plants the seedling all in a one-pass operation. These can often be hired from the local Shire.

However, in some cases, a site will instead be 'prepared' (i.e. ripped and/or mounded and sprayed or scalped for weed control) and then hand planted or direct sown.

Site preparation activities must adhere to the requirements of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and the *Soil and Land Conservation Act 1945*.

Operation of site preparation equipment should avoid riparian zones.

PREPARATION DECISION-MAKING



RIPPING

Whether machine or hand planting, deep ripping has become standard practice in the WA Wheatbelt.

Deep ripping during the drier months to 0.5 m will allow a soil fracture up to 1.5 m to occur. Depending on soil type, this deep ripping will enable the newly planted seedlings the opportunity to send roots deeper and faster into the soil profile, enabling the seedling to have more access to soil moisture.

MOUNDING

In waterlogged sites it is necessary to get in before the site is too wet. Often these sites are deep ripped and then a mound formed on top of the rip. The seedlings are planted at the top of the mound, ensuring they are out of the water while they are young and vulnerable but allowing their roots easy access down through any potential hard pan. Beware that sheep can get stuck in the dips next to the mounds—check your livestock regularly.

CAUTION **Lambing ewes can get stuck in the dips next to mounds and can die because they cannot get out.**

PLANTING

WHEN TO PLANT?

The planting window in the WA Wheatbelt is quite narrow and with changing rainfall patterns is becoming challenging. Seedlings need to be planted after good rains, and with good follow-up rains expected. Seedlings need moisture when they are planted but planting too late in the winter can mean fewer follow-up rainfall events to bed in your seedlings before the long, hot summer.

However, there are some things you can do to help.

1. Make sure you rip early to ensure that any rainfall that occurs is concentrated in the rip lines.
2. Before you plant your seedlings, make sure they have had a good soaking. Water the seedlings as soon as they arrive on-farm, and give them a good watering twice daily until they are planted—ensuring they are planted within 3 days of leaving the nursery.
3. There are also machines being developed that will water the seedling when planted. This can be vital to ensure the seedling is well bedded in at the time of planting when rainfall has not been adequate, or the chance of follow-up rains are slim.

Direct seeding can be a bit more forgiving. Seed will generally sit below the soil surface and send out fine roots to find and tap into moisture before putting on too much leaf growth. The more leaves, the more the seedling will transpire and lose water.

ESTABLISHMENT METHODS

By now you will be organised to either:

- use a one-pass tree planter to plant seedlings; or
- prepare the site and bring in hand planters; or
- have the site sown directly with an appropriate seed mix.

Alternatively you may choose to plant a reduced density of seedlings by machine or hand and direct seed the remainder. Note that 'hand planting' does not mean planting with a shovel or trowel—investigate other methods such as using a pottiputki. With the correct expertise and advice it is possible to do direct seeding and machine plant also in a one-pass operation.

Most Shires have a one-pass tree planter for hire. Bookings are often required as everyone will want to use them at the same time. Make sure you have access to a tractor of the appropriate size and someone to plant with you.

Large-scale planting to manage erosion, Hyden.

THE ONE-PASS TREE PLANTER

A one-pass tree planter:

- can scalp away the top few centimetres of weed burden (not just the actual weeds but also seed in the top few centimetres of soil);
- deep rips as it goes;
- can mound if you need it to;
- has shelves for the seedlings;
- has a covered seat for the planter;
- has press wheels to press in the seedling (like tramping them in with your boots); and
- has an adjustable chain that measures the distance between the seedlings in the rows.

The most time-consuming but vitally important part of the operation is to set-up the tree planter properly so that the rip is deep enough and the seedlings are planted at the correct depth. Don't rush this part. It may take time and will need to be adjusted for each site where conditions vary. If necessary, get advice.

DIRECT SEEDING

Direct seeding will often give a more diverse result and can be cheaper than seedlings alone, however it does require specialist skills and equipment. Ensure the seed mix is thoroughly mixed through so you don't end up with patches of the same species. Some seeds are lighter than others and can float to the top of the mix with the movement of the machinery.

TECHTIP

A direct seeding mix can contain more than 25 different species but will only make up 5% of the overall mix. The rest is a special fertiliser (low phosphorus) and vermiculite.

Like the one-pass tree planter, direct seeding machines scalp the rows.

A lot of work has been done on direct seeding of native species for our wheatbelt conditions by Dr Geoff Woodall of the University of Western Australia. See *Improving the Direct Sowing of Commercial Native Plants in Agricultural Lands of Southern Australia*, RIRDC Publication No. 10/061 for a full report on this work.

Direct seeding of sandalwood.

TREE GUARDS

Tree guards are commonly used for smaller projects, where the effort of putting tree guards on is warranted. There are a wide range of tree guards that can be used. For large-scale farm projects these are never practical. They rarely stop grazing animals as animals can still browse the tops of the plants.

Often in the hot Wheatbelt conditions tree guards can actually increase the heat around the seedlings and cause them to burn and dehydrate. In addition to the added cost in time and money, non-biodegradable tree guards need to be removed once the seedlings reach the top of the guard.

Their main advantage is that they mark where seedlings are if the site becomes overgrown with weeds and can protect seedlings from herbicide spray drift and rabbits.

In frost-prone sites they can also protect the seedlings from frost. However frost may not be such a problem if your seedlings are robust and healthy and hardened off at the time of planting.

SEEDLINGS

HEALTHY SEEDLINGS

Your seedlings should:

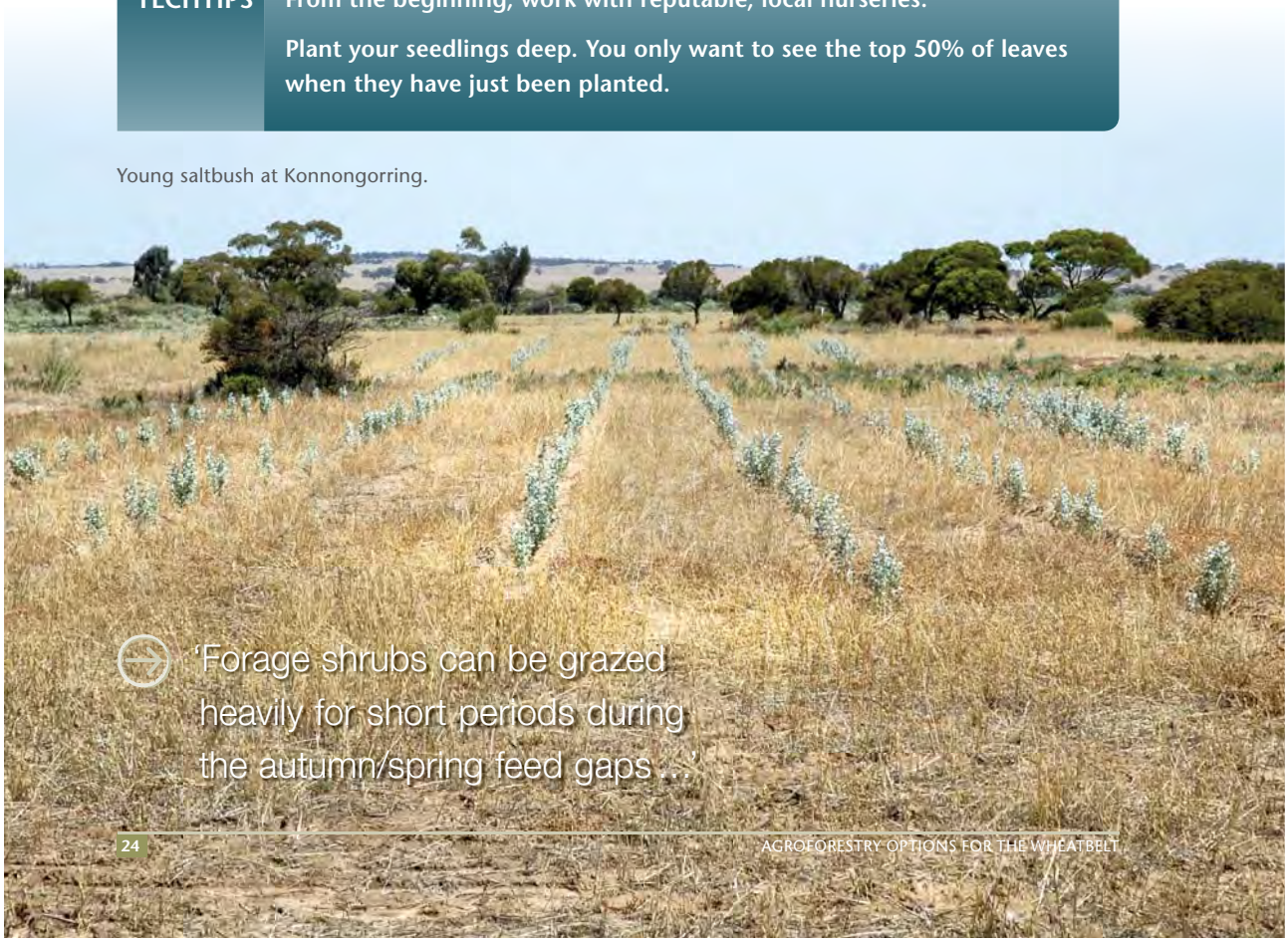
- **be at least 7.5 cm tall, but not so tall that they will not fit through your planter;**
- **have been graded to be of uniform size;**
- **be hardened off;**
- **look healthy and vigorous;**
- **be disease and weed free;**
- **have good root development; and**
- **be 'popped out' of their trays and ready for planting.**

TECHTIPS

From the beginning, work with reputable, local nurseries.

Plant your seedlings deep. You only want to see the top 50% of leaves when they have just been planted.

Young saltbush at Konnongorring.



'Forage shrubs can be grazed heavily for short periods during the autumn/spring feed gaps …'

MAINTENANCE AND MANAGEMENT

MANAGEMENT PLANS

A management plan is particularly useful to guide future management actions which will result in a more productive revegetation. A map should be included which may be updated from time to time to reflect changes in the revegetation plans for your property. You may require town planning approval for revegetation activities (plantations) and often a plantation management plan and map is required for the purposes of gaining necessary planning approval. The management plan should take into consideration the impact of plantation activities on local roads, rail, environment, drainage and infrastructure.

See 'Appendix 1: How to create a Management Plan'.

GRAZING FORAGE SHRUBS

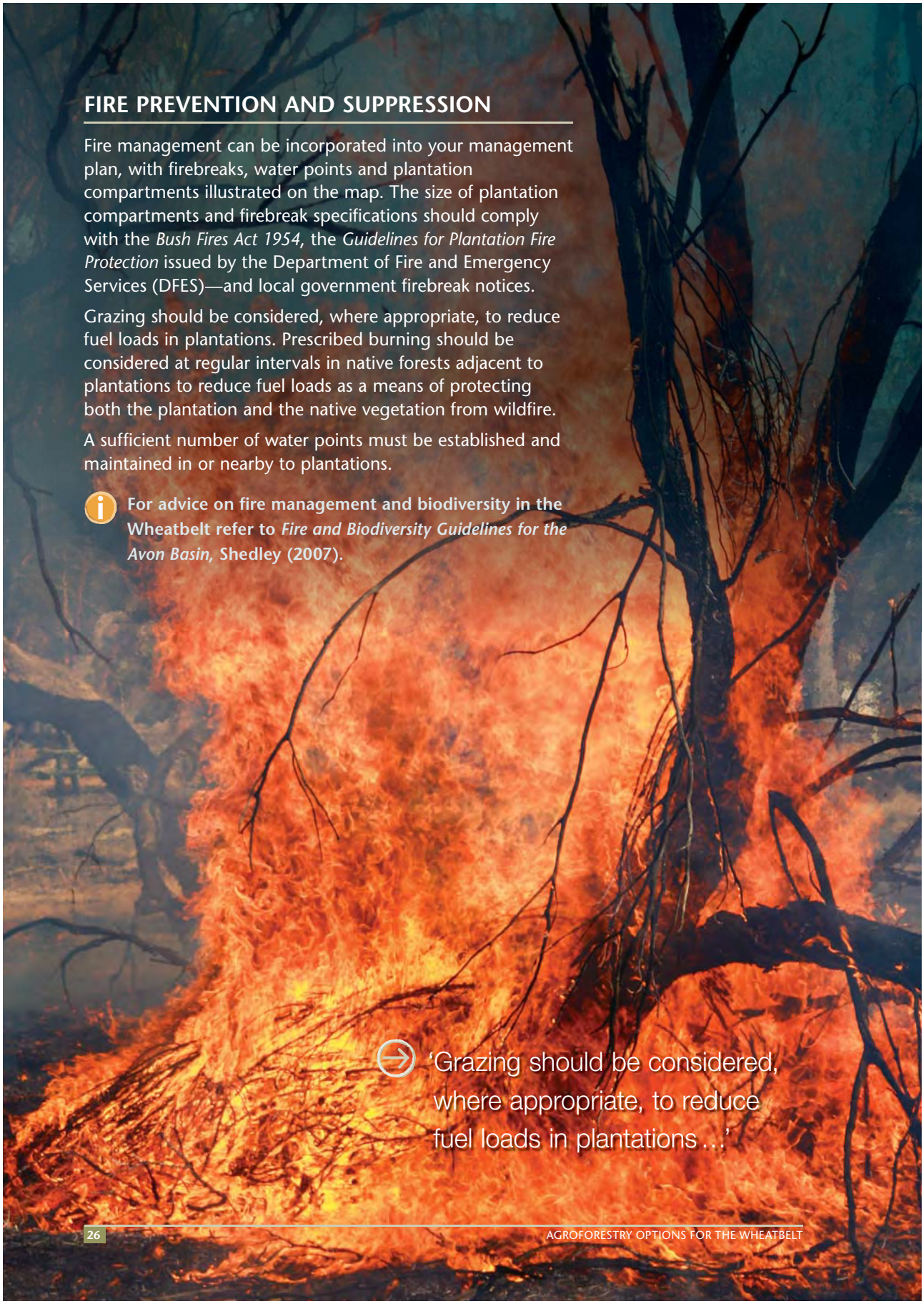
During autumn, high quality and quantity of forage is a precious commodity, as the feeding value of pastures begins to decline, winter lambing flocks experience greater shortfalls and require supplementary feeding, and this is where forage shrubs fit well into the farming system. Forage shrubs can be grazed heavily for short periods (4–6 weeks or until 80% defoliation) during the autumn/spring feed gaps. Supplementary feed will also need to be given to sheep to achieve weight maintenance. Supplementary feeding of barley or oats is recommended at approximately 200 g/head/second day or hay (*pers. comm.* Hayley Norman 2013). Sheep need to be excluded from the forage shrub area to enable the plants to regenerate as continuous stocking will cause death of forage shrubs.

VERTEBRATE PEST CONTROL

Both native and feral animals can cause damage to your revegetation activity, and close monitoring of the site before and after planting will allow you to determine if control measures need to be taken to protect your resource. Control of animals (native and feral) must adhere to the *Wildlife Protection Act 1950* and the *Agriculture and Related Resources Protection Act 1976*. Native vertebrates (kangaroos) that impinge on the productivity of your planned revegetation activity should be controlled under damage permits issued (if required) by the Department of Environment Regulation using methods stipulated on the permit.

Rabbits can cause major damage to a planting by eating the young seedlings after planting. Rabbits should be controlled before establishment where necessary. A wide range of control measures can be undertaken including, baiting, ripping, gassing, and release of calicivirus (RCD)—must be done by a licensed pest control officer.

Damage to timber plantations by birds may be addressed by the use of deterrents or a combination of control strategies. Plantings for timber production can be greatly affected by birds, as the birds nip off the growing buds at the top of the tree, which affects the growth and form of the tree. Keep a close eye out for damage to young trees, where the aim of the planting is timber production. Where control of protected species becomes necessary, permits must be obtained from the Department of Environment Regulation.



FIRE PREVENTION AND SUPPRESSION

Fire management can be incorporated into your management plan, with firebreaks, water points and plantation compartments illustrated on the map. The size of plantation compartments and firebreak specifications should comply with the *Bush Fires Act 1954*, the *Guidelines for Plantation Fire Protection* issued by the Department of Fire and Emergency Services (DFES)—and local government firebreak notices.

Grazing should be considered, where appropriate, to reduce fuel loads in plantations. Prescribed burning should be considered at regular intervals in native forests adjacent to plantations to reduce fuel loads as a means of protecting both the plantation and the native vegetation from wildfire.

A sufficient number of water points must be established and maintained in or nearby to plantations.

For advice on fire management and biodiversity in the Wheatbelt refer to *Fire and Biodiversity Guidelines for the Avon Basin,* Shedley (2007).

'Grazing should be considered, where appropriate, to reduce fuel loads in plantations …'

INSECT CONTROL

Plantations should be monitored regularly for insect pests, particularly at times when insect pests are known to be active. Insects can entirely defoliate plants in the field, and can cause widespread death and damage to plants. Insect damage is particularly a risk immediately after planting when seedlings are small and highly nutritious.

To minimise risk to a plantation a pesticide can be sprayed during the knockdown spray. If required pesticides can be applied after planting, however this can be difficult and costly.

WEED CONTROL

Weed control can be a useful tool for improving the growth rate of revegetation in the year following planting. While the best form of weed control is done prior to establishment, a second spray can be done in the following autumn/winter to reduce competition for moisture and light.

Particular care should be taken to select the right herbicide and rate of application for spraying over or around young trees.

Contact Wheatbelt NRM for assistance.

THINNING AND PRUNING

To increase the diameter growth on selected trees the competition from adjacent trees needs to be reduced—this is known as thinning. Timber plantations should be thinned to maintain stand health and to increase yields of high-value products where this is an objective of the owner, and the thinning is considered to be economically viable.

In order to benefit from good growth and diameters achieved when seedlings are planted at a low stocking rate, pruning is often essential to produce a high quality timber. Branches on the trunk of a tree reduce the timber strength, pulping quality and appearance value of the tree.

A well-pruned tree produces a log with a core of knotty timber containing the pruned stubs, which is surrounded by high quality knot-free wood, known as clearwood. Pruning is done to meet specific sawn timber objectives or for access, fire control and visibility.

It is recommended that records of pruning and thinning operations be maintained.

APPENDIX 1

HOW TO CREATE A MANAGEMENT PLAN

When creating a whole of property plan it is important firstly to take fixed features into account like high and low points, water courses and boundaries. There is often little you can do about these, so map them first.

Then identify and map paddocks and add in information on their dominant soil types.

MAP WEATHER PATTERNS

The overall plan also needs to take into account where the predominant and damaging (hot and cold) winds come from so that you can plan in protection for certain paddocks and infrastructure.

WHAT IS YOUR PROJECT TRYING TO ACHIEVE?

Using this framework, build your revegetation projects around the needs of the various sites and around your farming business. Each site may have a different purpose: some for controlling environmental issues only while others may be tree crops with a potential income in the future.

THINK LONG-TERM

Look at general infrastructure that will need to be replaced in the coming years and plan your revegetation projects to align with these.

PLAN YOUR PROJECTS IN MANAGEABLE 'CHUNKS'

When planning a revegetation project, think of your property as a whole but plan your revegetation program over several years. In years where funding is available, then perhaps more of your plan can be implemented. In other years, budget for smaller plantings that you can easily achieve yourself so that the overall program does not come to a standstill.

FIRE MANAGEMENT PLAN

Part of your overall plan should include a Fire Management Plan. This plan will indicate how to prevent a fire from spreading, water availability at the site, and how to access plantings in case of a fire. And importantly, an escape route for people and livestock if required.

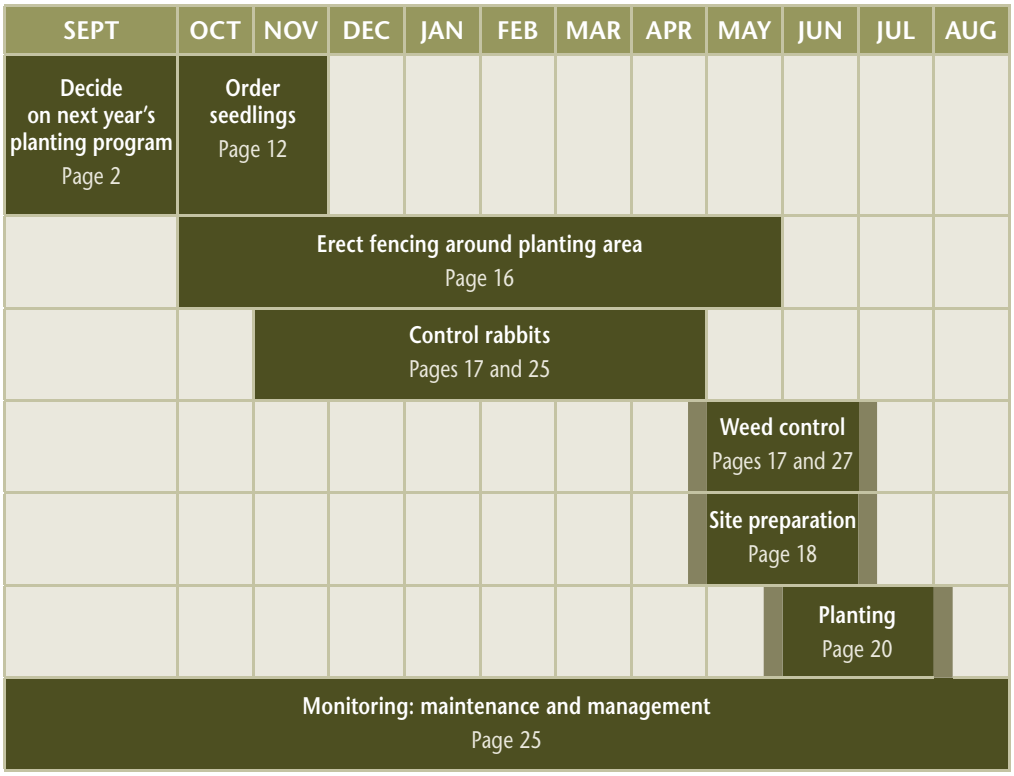
FORESTRY HARVEST ACCESS

When planning for a farm forestry tree crop, remember to allow for access to harvest. The very back, hard to reach paddock is often not the most viable when it comes to harvesting your trees.

APPENDIX 2

SCHEDULE OF ACTIVITY

PRINT OR COPY THIS PAGE AND PUT ON YOUR FRIDGE!



APPENDIX 3

WHEATBELT AGROFORESTRY SPECIES LISTS

TIMBER OPTIONS FOR THE WHEATBELT

Maritime pine

Pinus pinaster

A conifer 2–40 m high from the Mediterranean. Cones 15–30 cm long with numerous scales. Found on slopes, edges of tracks and disturbed land in the South-West.

It grows on poorer soil types. Sand to sandy gravel. Avoid shallow duplex soils on sand over gravel as they have a higher drought risk.

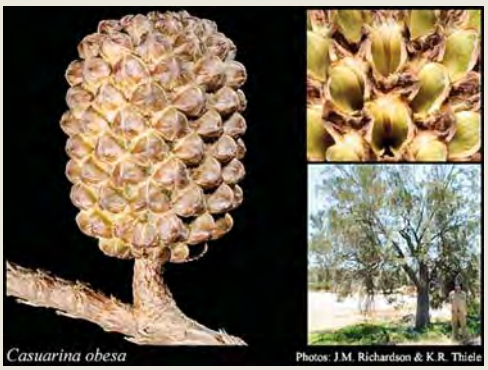
PHOTO BY DROW MALE VIA WIKIMEDIA COMMONS.

Swamp sheoak

Casuarina obesa

A native tree 1.5–10 m high. Flowering January to December. Found growing on sandy, clay and often brackish or saline environments along rivers, creeks and salt lakes.

It grows on heavy soil in the valley floor. Can grow on brackish to saline areas.



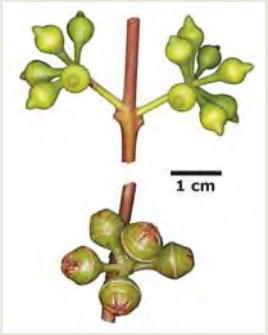
TIMBER OPTIONS FOR THE WHEATBELT (continued)

River gum

Eucalyptus camaldulensis

A Eucalypt native to the arid and semi-arid area of Australia, it can grow to 45 m. It has smooth bark, ranging from white to red-brown in colour, which is shed in long ribbons. It is fast growing and has a habit of dropping limbs.

It grows mainly on alluvial soils, but can grow on heavy clays.



Sugar gum

Eucalyptus cladocalyx

A tree to 15 m high with smooth bark, mottled grey in colour. It is found on flats and gentle slopes with shelly sand over clay soils or brown clay loams.

It grows on a wide variety of soil types. Gravels, clay loams, sandy loams, and sands. Grows poorly on very fine sands. Tolerates mild salinity but not waterlogged sites—prone to frost for the first 5 years.

Spotted gum

Corymbia maculata

A tall tree native to eastern Australia. It grows to 45 m; it has powdery bark which is white, grey or pink, often with characteristic 'spots'. It has small white flowers winter to spring.

It grows on a wide variety of soils. Slates, sandstones, but best on well-drained, moderately heavy soils.

Flat topped yate

Eucalyptus occidentalis

A tree to 20 m high, fibrous and flaky rough bark. Found on sandy or clayey soils on low-lying wet areas, around salt lakes or alluvial flats.

It grows in heavy soils on the valley floor. Can grow in saline areas up to 200mS/m^2.

FORAGE SHRUB OPTIONS FOR THE WHEATBELT

River saltbush

Atriplex amnicola

A native spreading shrub to 1.7 m high. It is found around salt lakes, floodplains and coastal dunes. River Saltbush is highly salt tolerant and is used in the rehabilitation of salt-affected areas. Once established it will survive partial inundation, but total immersion will cause plant death. It recovers well from grazing and is favoured by sheep.

It grows on white-grey sand to sandy clay.

Old man saltbush

Atriplex nummularia

A bushy shrub found across Australia, it is a multi-stemmed shrub that grows up to 3 m. Commonly planted to address salinity and as a source of stock fodder, it is relatively fast growing, and is adapted to alkaline soils. It can be grown on sites affected by salinity and periodic inundation.

It grows on sand, loam duplex and heavy clay soils.

Wavy leaf saltbush

Atriplex undulata

An erect sprawling shrub from Argentina it grows well on salt-affected soils and establishes readily from seed in the field. Found growing on flats and roadside drainage areas, it grows to 1 m high and 2 m wide.

It grows on sandy duplex soils.

FORAGE SHRUB OPTIONS FOR THE WHEATBELT (continued)

Grey saltbush

Atriplex cinerea

Occurs on coastal dunes of southern Australia, it is a perennial shrub with prostrate and erect forms. The prostrate form can grow to 8 m in diameter and 0.5 m high. Its leaves are 2 cm long, grey-green with a sheen on the upper and lower surfaces. The erect form has greyer leaves. Found on saline sand, coastal areas, limestone cliffs and salt lakes. The species is variable in palatability and recovers well from grazing.

It grows on sand to sandy duplex soils.

Creeping saltbush

Atriplex semibaccata

Native largely to eastern Australia, with small populations in WA, it is commonly found in coastal regions. It is a prostrate growing ground cover that grows to 1.8 m wide. It is found growing around saline flats and lakes. It produces small red berries that are edible and can be used to make jam.

It grows on sand, loam and clay soils on saline flats.

Mealy saltbush

Rhagodia parabolica

A perennial shrub found growing in drier areas of Central, Southern and Eastern Australia, growing on rocky hillsides and creek banks. It is moderately tolerant of saline soils. It recovers well from grazing, but does require adequate time to re-grow before the next grazing. Lower palatability than Old Man Saltbush, but has moderate protein and digestibility.

It grows on sand, sandy loam and clay loam soils.

SANDALWOOD HOST OPTIONS FOR THE WHEATBELT

Jam

Acacia acuminata (Narrow Phyllode)

Jam is an excellent long-term host for sandalwood. The Jam species is also quite variable and it is important to use the most suitable variant. This variant is most suited to the eastern Wheatbelt.

It grows on loamy sands over clay duplex soils.

Jam

Acacia acuminata (Typical Variant)

Jam is an excellent long-term host for sandalwood. Jam is also quite variable and it is important to use the most suitable variant. This variant is most suited to the western Wheatbelt, on red-brown loams.

It grows on loamy sands over clay duplex soils and red-brown loams.

Silver wattle

Acacia lasiocalyx

An open, often weeping shrub or tree to 7 m tall, it flowers July to October and is commonly found on granite hills and outcrops, but also on sandplains and on laterite in mallee woodland and heath in the Wheatbelt and Goldfields region.

It grows on sandy duplex soils.

SANDALWOOD HOST OPTIONS FOR THE WHEATBELT (continued)

Rock sheoak

Allocasuarina huegeliana

A dioecious tree to 10 m with dark bark, it produces red/brown flowers from May to December. This species is associated with granite and is widely distributed through the Wheatbelt and Goldfields region.

It grows on red-brown loams.

Manna wattle

Acacia microbotrya

A branchy shrub or tree to 7 m, its distribution extends from the Murchison to Katanning. It is a widespread and variable species. It grows on a variety of habitats but often on clay loam or sandy loam flats, often near watercourses.

It grows on red-brown loams.

Tan wattle

Acacia hemiteles

A dense spreading shrub to 2 m high, it flowers from May to October and is found on a variety of soil types. It is naturally distributed from Morawa to Coolgardie. It is a good coloniser of disturbed or burnt ground, and is therefore seen in mining areas.

It grows on yellow sandy soils.

Acacia assimilis subsp. *assimilis*

A dense shrub or tree to 4 m. It is common from Mullewa to Norseman. It grows in sandy duplex soils, overlying laterite or granite.

It grows on sandy duplex soils.

Acacia acuaria

A rounded or diffuse to spreading prickly shrub to 2 m high with yellow/orange flowers June to September. It grows on a variety of soils around sandplains and salt lakes.

It grows on red-brown loams.

Acacia aestivalis

An erect bushy shrub or tree to 4 m, producing yellow flowers. It is common from Geraldton to Southern Cross, growing on clay, clay loam and sandy soils. It is found growing on low-lying flats and on roadsides.

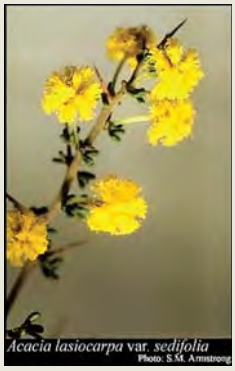
It grows on red-brown loams.

SANDALWOOD HOST OPTIONS FOR THE WHEATBELT (continued)

Acacia lasiocarpa var. *sedifolia*

A dense spreading shrub to 1 m high, producing yellow flowers from June to September. It is found on rocky clay, lateritic gravelly soils and sandy soils throughout the Wheatbelt.

It grows on red-brown loams.



Acacia resinimarginea

A shrub or tree to 7 m, with straight trunks which produces yellow flowers from August to October. Most commonly found on yellow/brown sandy soils of the eastern Wheatbelt from Perenjori to Kambalda and Leonora. Often it is found in pure stands.

It grows on yellow sandy soils.

Acacia neurophylla subsp. *neurophylla*

A diffuse, low spreading, dome or flat-topped shrub to 2 m high, it flowers from July to September. It grows on sand, laterite and sandy loam soils on undulating plains, rises and near granite outcrops. It is naturally distributed from Geraldton to the eastern Goldfields.

OIL MALLEE OPTIONS FOR THE WHEATBELT

Eucalyptus loxophleba subsp. *lissophloia*

A mallee species endemic to WA, it can grow to 12 m high. It has smooth bark and produces white flowers. It is found growing in the Wheatbelt and Goldfields regions.

It grows on a range of soils—sands, duplex and clays. Some salt and waterlogging tolerance, it grows best on well-drained sites and heavy clay loam sites.

Eucalyptus kochii subsp. *plenissima*

A mallee or tree endemic to WA, it grows to 12 m high, it has hard rough bark , grey on the lower half, smooth pink above. It produces white flowers December–February. It is found growing on a wide range of soil types and landscape positions.

It grows on reddish sands and sandy loams but will also grow in heavier clays. Minimal salt and waterlogging tolerance.

Eucalyptus borealis

A tree endemic to WA, it is commonly found in the northern Wheatbelt growing on red sand, yellow sandy loam, red loamy clay and limestone soils. It has rough grey bark and green to bluish green leaves.

It grows on red sands to heavier loamy clays. Minimal salt and waterlogging tolerance. It grows best on well-drained sites.

OIL MALLEE OPTIONS FOR THE WHEATBELT (continued)

Eucalyptus angustissima subsp. *angustissima*

A small tree that is endemic to WA from southern coastal and subcoastal areas. It is a mallee eucalyptus that grows from about 1 to 4 m. The bark is smooth or matt, mottled grey and very white/grey or light grey-brown.

Grows on red sands to heavier loamy clays. Minimal salt and waterlogging tolerance. Best on well-drained sites.

Eucalyptus polybractea

A mallee endemic to the eastern states, with naturally occurring populations near Bendigo in Victoria, and West Wyalong in NSW. It tolerates a range of soils, but prefers well-drained soils. It is suited to the wetter areas of the Wheatbelt. The bark is smooth, and fibrous near the base.

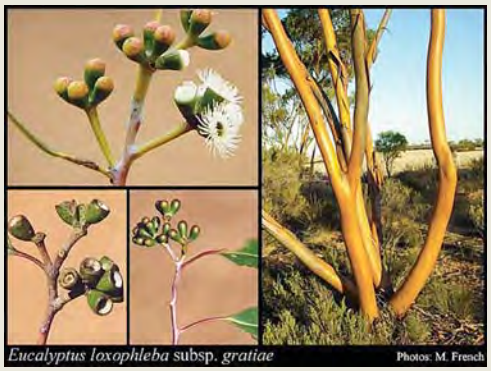
It grows on a range of soils—sandy duplex to heavy clays. Some waterlogging tolerance but grows best on well-drained sites. Not suitable for lighter country in dry areas or areas of variable to low rainfall.

PHOTO BY JOHN MOSS VIA WIKIMEDIA COMMONS.

Eucalyptus gratiae

An erect, spreading mallee endemic to WA it grows to 8 m high. It has smooth bark, grey-brown over copper, with a rough basal stocking. It grows on a range of soil types from Quairading to Lake Grace.

It grows on a range of soils—sands, duplexes and clays. Some waterlogging tolerance, best on well-drained sites.



BRUSHWOOD OPTIONS FOR THE WHEATBELT

Melaleuca atroviridis

A shrub to 6 m with papery bark which peels at the base and is smooth, reddish brown above the base. Native to the Wheatbelt there are two forms to choose from. One is found around salt lakes and claypans and does not coppice (regrow) when cut. The other is found growing on yellow sandy soils (Wodjil) and will coppice when cut. When selecting seed for harvestable brushwood plantations be sure to select seed from the coppicing form.

It grows on sandy soils.

Melaleuca uncinata

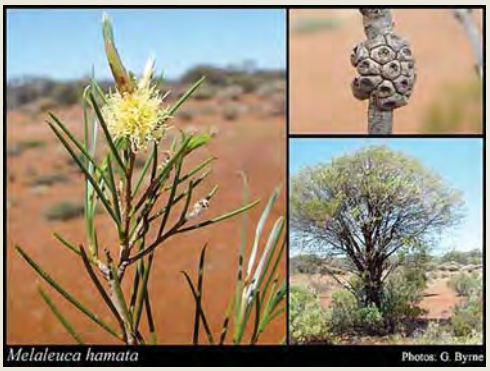
A shrub or tree to 5 m high. It is found on sandplains, winter-wet depressions and saline flats. It produces white-cream-yellow flowers February–March or July–December. It is harvested from the wild and grown in plantations for brushwood fencing.

It grows on duplex, deeper loam and sandy loam soils.

Melaleuca hamata

An erect tree or shrub to 4 m. Native to the Wheatbelt, it is found growing on loam, gravel and granite soils. It produces yellow flowers during spring.
It is harvested from the wild and grown in plantations for brushwood fencing.

It grows on loam, gravel and granite soils.



BIOMASS OPTIONS FOR THE WHEATBELT

Eucalyptus loxophleba subsp. *lissophloia*

A mallee species endemic to WA, it can grow to 12 m high. It has smooth bark and produces white flowers. It is found growing in the Wheatbelt and Goldfields regions.

It grows on a range of soils—sands, duplex and clays. Some salt and waterlogging tolerance, it grows best on well-drained sites and heavy clay loam sites.

Eucalyptus kochii subsp. *plenissima*

A mallee or tree endemic to WA, it grows to 12 m high, it has hard rough bark, grey on the lower half, smooth pink above. It produces white flowers December-February. It is found growing on a wide range of soil types and landscape positions.

It grows on reddish sands and sandy loams but will also grow in heavier clays. Minimal salt and waterlogging tolerance.

Eucalyptus borealis

A tree endemic to WA, it is commonly found in the northern Wheatbelt growing on red sand, yellow sandy loam, red loamy clay and limestone soils. It has rough grey bark and green to bluish green leaves.

It grows on red sands to heavier loamy clays. Minimal salt and waterlogging tolerance. It grows best on well-drained sites.

Eucalyptus angustissima subsp. *angustissima*

A small tree that is endemic to WA from southern coastal and subcoastal areas. It is a mallee eucalyptus that grows from about 1 to 4 m. The bark is smooth or matt, mottled grey and very white/grey or light grey-brown.

Grows on red sands to heavier loamy clays. Minimal salt and waterlogging tolerance. Best on well-drained sites.

Eucalyptus polybractea

A mallee endemic to the eastern states, with naturally occurring populations near Bendigo in Victoria, and West Wyalong in NSW. It tolerates a range of soils, but prefers well-drained soils. It is suited to the wetter areas of the Wheatbelt. The bark is smooth, and fibrous near the base.

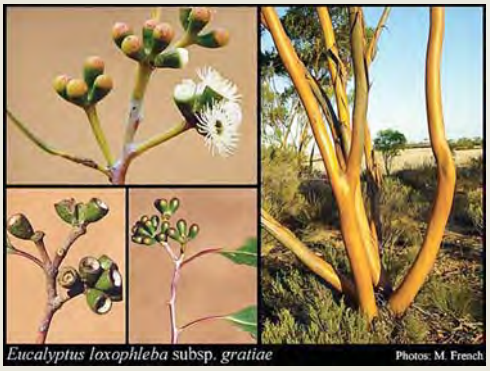
It grows on range of soils—sandy duplex to heavy clays. Some waterlogging tolerance but grows best on well-drained sites. Not suitable for lighter country in dry areas or areas of variable to low rainfall.

PHOTO BY JOHN MOSS VIA WIKIMEDIA COMMONS.

Eucalyptus gratiae

An erect, spreading mallee endemic to WA it grows to 8 m high. It has smooth bark, grey-brown over copper, with a rough basal stocking. It grows on a range of soil types from Quairading to Lake Grace.

It grows on a range of soils—sands duplexes and clays. Some waterlogging tolerance, best on well-drained sites.



Golden Wreath Wattle

Acacia saligna subsp. *Lindleyii*

A widespread shrub or tree endemic to WA. Its habit can be quite variable ranging from being low shrubs less than 1 m tall or large shrubs 2–4 m tall or small trees up to 8 m tall. Usually found growing in depositional sites.

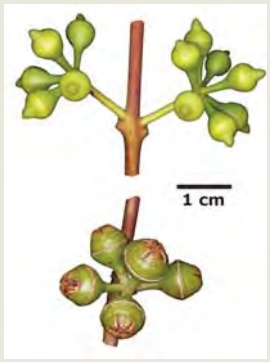
It grows on a range of soils—sands to clays.

River Gum

Eucalyptus camaldulensis

A Eucalypt native to the arid and semi-arid area of Australia, it can grow to 45 m. It has smooth bark, ranging from white to red-brown in colour, which is shed in long ribbons. It is fast growing and has a habit of dropping limbs.

It grows mainly on alluvial soils, but can grow on heavy clays.



FURTHER READING

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USEFUL WEBSITES

Atlas of Living Australia	http://www.ala.org.au
Australian Forest Growers	http://www.afg.asn.au
Australian Sandalwood Network	http://www.sandalwood.org.au
AVONGRO	http://www.avongro.com.au
Department of Agriculture and Food, WA	http://www.agric.wa.gov.au
Department of Environment Regulation	http://www.der.wa.gov.au
Department of Parks and Wildlife	http://www.dpaw.wa.gov.au
Forest Products Commission	http://www.fpc.wa.gov.au
Greening Australia	http://www.greeningaustralia.org.au
Northern Agricultural Catchments Council	http://www.nacc.com.au
Oil Mallee Australia	http://www.oilmallee.org.au
South Coast Natural Resource Management	http://southcoastnrm.com.au
South West Catchments Council	http://swccnrm.org.au
Wheatbelt NRM	http://www.wheatbeltnrm.org.au

For further assistance or advice contact Wheatbelt NRM on 9671 3100 or visit: www.wheatbeltnrm.org.au

Across the agricultural landscape of the Wheatbelt, opportunities exist for land managers to improve both the biodiversity value and production value of the land by integrating agroforestry options. Economic benefits can be realised through the production of timber and firewood, sandalwood, brushwood, oil mallees, biomass and carbon, forage shrubs and biodiverse planting when well-planned and implemented. These systems can also be used to revegetate degraded land or poorly performing paddocks, and when strategically placed on your farm, can enhance biodiversity by providing corridors and extending remnant vegetation. This guide contains information to assist you in designing and implementing your agroforestry option and introduces you to a range of suitable plant species, from forage to forestry.

Whether you have experience in revegetation and agroforestry systems or are just starting out, this guide contains information to ensure every planting you do has the best chance of success.