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Government of SA Natural Resources Kangaroo Island

What are shelterbelts?

Shelterbelts provide shade and wind protection for livestock, mitigate erosion and slow wind speeds across pastures and crops. Native shelterbelts also support many species of animals, helping conserve wildlife and contributing to natural pest control on a farm.

Shelterbelts are strips of woody vegetation usually established between paddocks to reduce windspeeds and provide shade and shelter (Cleugh 2003). Some older shelterbelts were strips of a single species of tree, sometimes non-native trees, often called tree lanes. These tree lanes provide minimal shelter due to the lack of bushy understory, and don't provide the biodiversity benefits of native shelterbelts.

For maximum benefit for shelter, shade and biodiversity benefits, shelterbelts should be planted with a mix of native species, usually both trees and shrubs, and are ideally at least 30 m in width. However, a strip of native plants of *any* size is beneficial. Some landholders have chosen to establish shrub-only shelterbelts which can still reduce windspeeds and provide significant benefits for biodiversity, including for pollinating insects.

Shelterbelts are not a new idea – work by groups such as Landcare and Greening Australia have facilitated the planting of shelterbelts since the 1980s. However, years of monitoring these shelterbelts and observing what does and doesn't work means there is now an extensive body of scientific literature to guide how best to design and plant shelterbelts.is now an extensive body of scientific literature to guide how best to design and plant shelterbelts.

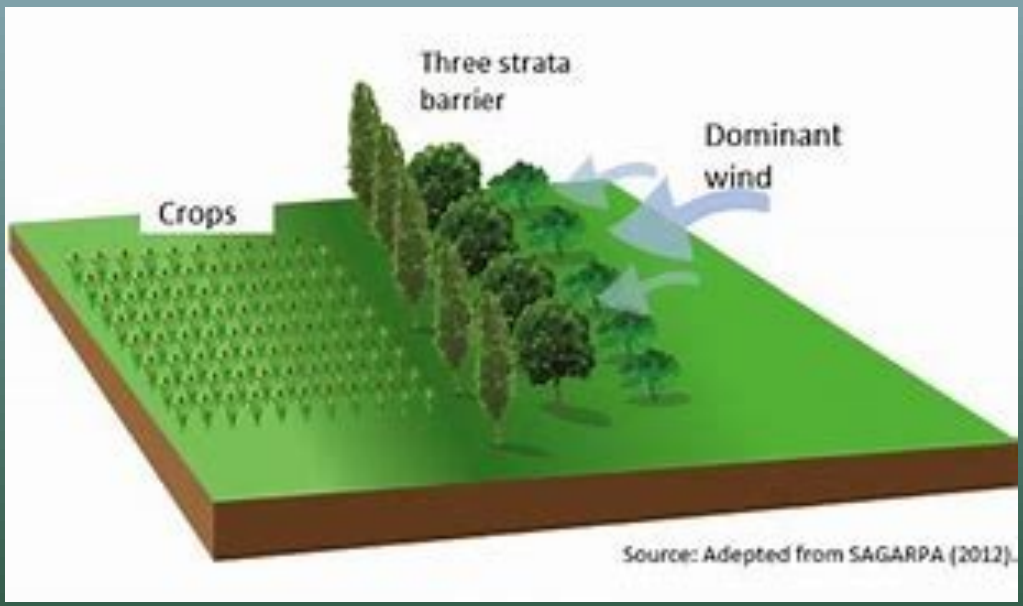
How shelterbelts work

Shelterbelts are vegetative barriers that are designed to reduce wind speed and provide sheltered areas on the leeward (the side away from the wind) and windward (the side toward the wind) sides of the shelterbelt.

As wind approaches the belt, some goes around the end of the belt, some goes through the belt and most goes over the top of the belt.

Air pressure builds up on the windward side and decreases on the leeward side. It is this difference in pressure that drives the shelter effect and determines how much reduction in wind speed occurs and how much turbulence is created.

The amount of air pressure difference is determined by the structure of the shelterbelt. The more dense the shelter, the greater the difference in air pressure.



Why plant native shelterbelts?

Controlling problems with secondary salinity was a primary reason for many farmers planting trees in the 1980s and 1990s. These days, the integration of shelter and shade into farming systems is often a strong motivation, as well as improving the aesthetics of a farm and providing habitat for native wildlife.

Such species are adapted the region; its soils, climate and natural variations of these that occur. Even where site conditions have changed dramatically, there are still many local species that will grow and prosper.

They are more likely to reproduce when conditions are suitable.

Planning and planting shelterbelts

Establishing shelterbelts and other plantings is a long-term investment in a farm's future. So it makes sense to take advantage of the insights gained from previous planting experience – and from the twenty years of research undertaken by Sustainable Farms ecologists.

When designing and planting a shelterbelt, here are some factors to consider.

Where in the landscape can your shelterbelt have the greatest positive impact?

- Is there an exposed paddock that requires more shelter for stock? Shelterbelts can significantly reduce wind speeds, with benefits for pasture production, lamb survival and stock weight gain.
- Could planting along a drainage line help minimise erosion? Easily eroded areas may be stabilised through the establishment of a fenced planting.
- Are there other planted areas or patches of remnant bush that a new shelterbelt could help "connect"? Connected areas have greater combined value for wildlife.
- Could your new shelterbelt be established around an existing paddock tree? Large old trees give new plantings a head start, and in turn planting around a large old tree will help prolong its lifespan.
- Don't plant shelterbelts in native grassland, as these areas are extremely rare and valuable.

SUSTAINABLE FARMS

Choosing the right location

The location of shelterbelts will determine their level of effectiveness. Think about the location of a shelterbelt that will provide the maximum benefit for:

- stock
- crops
- pasture
- wildlife.

The direction of prevailing and other winds and the location of stock and crops that require protection are major deciding factors on the orientation of shelterbelts. Shelterbelts should be placed perpendicular to problem winds.

No single orientation of a shelterbelt will provide protection from all winds. Therefore several belt orientations will provide greater shelter.

A consideration for the siting of shelterbelts is the ability to move livestock into sheltered areas during adverse conditions. It can be difficult to move stock in a direction that opposes the wind direction. You should weigh this against potential reduction in protection if the belt is not perpendicular to the problem winds.

During summer, shelterbelts can protect pasture and crops from moisture losses by reducing the impact of hot drying winds. Shelterbelts can also reduce erosion by wind during summer months when soils can be bare. Ideally, belts should form a grid using north-south and east-west orientations. This will provide shade for stock at different times of the day and protection from winds coming from all directions.

Alternatively, cornered windbreaks provide protection from winds that come from a range of directions. Therefore a windbreak established in a right angled corner protects a larger area from a range of wind directions.

North-south orientated windbreaks will prevent permanent shading of pastures and crops as they will receive sunlight at different times of the day.

Incorporating remnant vegetation will provide a cost-effective belt and one that enhances biodiversity.

Designing an effective shelterbelt

When designing a windbreak, consider the following elements:

- height
- length
- density
- location
- number of rows
- the species to be used.

Maximise height

The height determines the distance of the protected area, so it's important to maximise the height of the shelterbelt.

Use the tallest suitable shelter species in at least one row of the belt to increase the effective windbreak area. The species you use for the taller row can be something that's fast growing, to achieve maximum height quickly.

Maximise length

Longer windbreaks are more effective than short ones.

Wind has a tendency to flow around the ends of a shelterbelt and increase turbulence at that point. So, to reduce overall turbulence, create a shelterbelt that's as long as possible.

For maximum efficiency the uninterrupted length of the windbreak should be at least 10 times its height.

Avoid gaps

Avoid creating gaps in your shelterbelt, as they can make it less effective. It's possible for gaps to actually increase wind speed because the wind accelerates as it funnels through (this is often called wind tunnelling).

When a gaps in a break is necessary, such as for gateways, you can add a small strip of island shelter in front of the gap (figure 1) or stagger rows to create an angled gap (figure 2). This should prevent possible wind tunnelling.

Density of plants

Density is the proportion of solid material, such as foliage and branches within a windbreak. Using species with dense foliage, having more rows or spacing plants closer together can increase windbreak density.

Your design should usually aim for a medium density of around 40 percent to 60 per cent.

A very high-density shelterbelt will provide a high level of shelter but over a shorter distance. They can also result in more wind turbulence because very dense windbreaks force wind to be pulled down on the leeward side.

With a medium density, more air passes through the shelterbelt, reducing wind turbulence and extending the down-wind protected area.

Your shelterbelt should have an even density from the ground level to the top. If the belt doesn't provide ground-level shelter, wind will tunnel through the gaps at the bottom. To achieve even density, use shrubs and ground cover species as well as taller species.

Rows of plants

Shelterbelts with multiple windbreak rows are less susceptible to the impacts of gaps and non-uniform growth. They're also more likely to achieve a greater overall height. You should tailor the number of rows in your shelterbelt design to your objective.

An effective windbreak design often consists of 2 to 4 rows, using taller species that provide the benefits of a tall belt combined with shrub species that provide shelter lower down. These types of belt can provide significant benefits while not requiring large areas of land to be removed from direct productivity purposes.

Including a row of fast growing species can provide quicker benefits and also protect species that are slower to establish. This row can later be removed if desired.

Belts with 1 or 2 rows can be effective and economical if they are well designed and use appropriate species. The effectiveness of these belts depends on high survival rates of plants. They may be significantly less effective if the form of the species varies significantly.

Single row species can be effective if they're established using a species that has a uniform foliage density from ground level to the top of the belt.

Increasing the number of rows can provide other benefits, even if they don't offer more protection of land. Some of these are:

more biodiversity

a haven for stock in extreme weather conditions (though stock will damage the belt and should usually be kept out)

timber production (timber belts consist of a row or rows of timber species combined with lower growing shrub species).

SUSTAINABLE FARMS

Plant location and angles

A common misconception is that a sloping cross-section profile enhances windbreak effectiveness. Steep-sided belts shelter a larger area because they can provide a greater height barrier and a lower density on the windward side. But sloping profiles on the windward side can actually reduce the distance over which protection is provided.

Aim to place taller species in the centre of a belt with lower growing species on each side. This design is better several reasons:

Large tree branches are less likely to fall and damage fences.

Smaller trees and shrubs won't be shaded out by the taller species.

It creates a more habitable environment for wildlife.

Spacing between plants

When deciding the spacing between plants, consider the time it will take for the plants to reach the desired density level and the size of the species selected. Keep the following tips in mind:

Space rows between 2 to 4 metres apart to allow the plants to grow relatively unrestricted (medium to tall trees are usually spaced 3 to 4 metres apart, large shrubs can be spaced between 2.5 to 4 metres, and smaller growing shrubs are generally placed 1.5 to 2.5 metres apart)

In belts with fewer rows, place plants closer together to increase density and provide protection more quickly.

Stagger trees in alternate rows to improve density and reduce gaps.

Leave at least 2 metres between the first row of plants and the fence to prevent stock from grazing on the plants.

Species selection

The species you select for your shelterbelt should provide the height, growth rate and density characteristics suitable for the belt's purpose.

When selecting plant species, consider the following points:

Locally native species generally have higher survival and establishment rates.

Locally native species provide valuable habitat for local wildlife species.

Species that will grow tall on the site should be used for one or more rows. Noting the height and health of particular tree species in the area can identify these species.

Species with an appropriate foliage density that complements the height and density of other selected species to obtain even and suitable density should also be used.

The growth rate of species should be taken into consideration. Where the effects of shelterbelts are required quickly, you can use fast-growing species.

The use of species that regenerate naturally on the site may be useful where this is desirable.

Having too many different species can reduce the uniformity of the shelterbelt. Generally people use 1 species per row or species with similar or compatible growth forms.

You might choose to use species that provide timber for firewood fence posts or commercial uses may be desired. But using a shelterbelt for timber production may require more specific management practices.

Fodder species can be used in a shelterbelt to provide a food source. These plants can be grazed directly by stock or cut and provided to stock. Removing fodder from the belt can compromise its ability to provide shelter.

SUSTAINABLE FARMS

Preparing the site

Thorough site preparation will help the shelterbelt establish and reach an ideal height. In the longer term, there is less work involved in the establishment of a belt on a site that's been well prepared.

Fence shelterbelts

- Maintain fences around shelterbelts. Research shows that heavily grazed shelterbelts are less valuable for birds and reptiles.
- Gates are important to allow access for feral animal and weed control. Extra gaps between mature trees are also important to facilitate access betFence shelterbelts
-

Weed control

Thorough weed control and ripping is vital to site preparation.
Undertake weed removal well before planting or direct seeding to allow moisture to be held within the soil.
On some sites, deep ripping of the site will also improve the water availability for tubestock plantings and should also be undertaken in advance. Ripping also promotes deep, strong root growth.
Mounding the site may be an important preparation technique for sites prone to waterlogging or cracking.

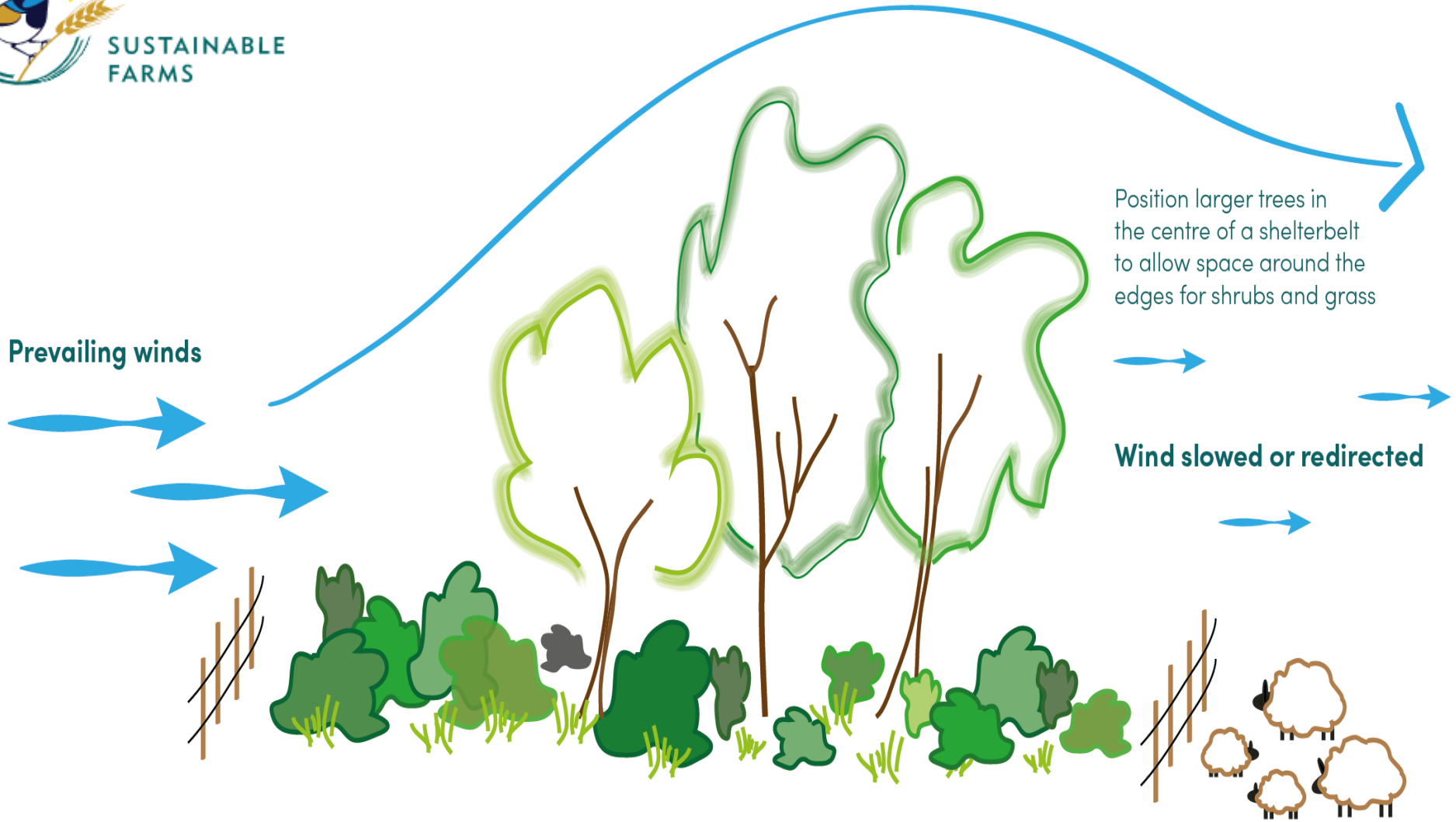
Animal control

Young plants in a shelterbelt are vulnerable to damage by grazing animals, including:

pest animals
native animals
stock animals.

Young trees are susceptible to grazing by rabbits and hares, while native species such as kangaroos and cockatoos may also damage young plants. Stock can damage fences to graze on plants.
Make sure you place rabbit-proof netting around the site to protect it from reinvasion after pest animal

SUSTAINABLE FARMS



Connect planting to other areas of vegetation

Connected plantings support more species of birds than isolated plantings, This effect is most obvious where plantings are narrow and linear.

Whether or not a species can survive in the long term often depends not only on whether they have access to habitat, but also where patches of habitat are connected to enable animals to move between them.

Large plantings support more bird species than small plantings. But small plantings are still better than no plantings.

Plant as big as you can from the beginning. Expanding the width of shelter belts to increase their effectiveness and value for wildlife does not usually increase fencing costs by a significant amount;

Plant in gullies and around watercourse

Sustainable Farms research shows clearly that plantings in gullies or flat areas tend to support more species of birds than those on slopes or ridges.

Plantings that incorporate water bodies are great for bird breeding

How shelter belts support biodiversity

- Shelterbelts can help provide food and habitat for animals like superb parrots, flame robins, speckled warblers and squirrel gliders – all of which are threatened by extinction.
- In a farming landscape, patches of native vegetation are often disconnected from other patches. Shelterbelts provide habitat and can help connect other areas of vegetation, helping support native wildlife.
- Shelterbelts also provide a different *kind* of habitat compared to old growth and natural regrowth woodland.
- A farm with both shelterbelts and remnant woodland is likely to support more species than a farm with just one of these vegetation types.
- By supporting more wildlife and increasing biodiversity on a farm, shelterbelts help provide ecosystem services like pollination and natural pest control.

Incorporate established trees in your planting

Including large old trees in a planting creates a 150-year head start. Suddenly, birds that rely on large old trees (such as for hollows, fallen timber or copious amounts of nectar) can utilise that planted area immediately, rather than waiting for the trees to mature.

Plant an understory

Including an understory and native groundcovers creates more layers of vegetation. This means there is more habitat for different species of birds.

Plantings with an understory are less likely to support large numbers of noisy miners. Noisy miners are a native honeyeater, but they are very aggressive to other birds and, given the chance, will drive other birds away.

The diversity of small bush birds will be significantly reduced if there are big populations of noisy miners. Planting an understory will help ensure the shelterbelt doesn't support noisy miners, enabling many small native birds to thrive.

SUSTAINABLE FARMS

Will shelterbelts and extra plantings turn a farm into a fire trap?

Some farmers are concerned that more trees on a farm could increase the fire risk. However, research by leading fire scientists (Collins *et al.* 2014; Jenkins *et al.* 2019) shows that adding plantings to a farm landscape very rarely elevates fire intensity above suppressible levels.

In slowing and interrupting wind, shelterbelts may help slow fire, particularly fast-moving grassfires. Windspeeds can be important drivers of fire behaviour and the ability of shelterbelts to check these speeds can be critical.

It is however important to consider planting design and location in the landscape in the context of fire.

- As well as gates, it's important to leave occasional gaps between large trees to allow emergency access between paddocks.

- Don't plant too close to homesteads and other built infrastructure. Studies of house loss show that property damage is reduced where vegetation is more than 30 metres from a house (Gibbons *et al.* 2012).

Unlike built assets like fences and infrastructure, natural assets have the capacity to regrow. Many Australian native plants will regenerate after a fire, and the seeds of species such as Acacias will readily germinate after fire. Healthy natural assets of all types are also more likely to bounce back than those in poor condition. For example, dams or riparian areas with good fringing vegetation are less vulnerable to pollution by ash and soil run-off following fire events.

Note 7 — 1999

native shelterbelts

BENEFITS FOR WILDLIFE

'An area of living trees, or shrubs, or both, established and maintained for the protection of grazing animals from adverse climatic conditions. Shelterbelts may also serve as windbreak…'

'A single or multiple row of trees, or a strip of retained natural vegetation. It may be used for various purposes, including stock shelter and shade; or timber production…' (Brouwer and Dutton 1992)

value of native shelterbelts

This note outlines some of the advantages of having native shelterbelts on your property, as opposed to shelterbelts of exotic or non-local native tree species. Recommendations are provided for designing, locating and managing of native shelterbelts.

Some of the advantages of well designed native shelterbelts are:

- protection of livestock from the extremes of temperatures and harsh winds—in wet and cold conditions, shelterbelts can assist in reducing the loss of stock during calving and lambing offshears (*Farming for the Future* 1999);
- protection of crops and pastures—shelterbelts assist in crop and pasture production by reducing plant and soil moisture loss caused by extreme winds;
- provision of habitat for local fauna and flora;
- improvement to the aesthetic value of the property;
- prevention of soil and wind erosion;
- protection from fire— a shelterbelt can reduce wind speed, which affects the rate of fire spread. They can also deflect burning debris around the home and filter out sparks (Petris 1992).

advantages of selecting locally native species

By choosing local native species for shelterbelts in preference to exotics and non-local natives, you will establish superior habitat for wildlife. Local native species also surpass alternatives in a range of other qualities:

- ADAPTED TO LOCAL CONDITIONS

  Local native plants are likely to be better adapted to the local environment, including the soil and climatic conditions (Stelling 1998). They are more likely to readily establish and regenerate than those from alternate sources—requiring less management. Exotic and non-local plants are more prone to local pests and diseased than well-adapted, local native plants.

- PERMEABILITY

  Shelterbelts need to be semi-permeable in order to reduce windspeed without creating turbulence. Impermeable barriers (such as rows of cypress trees) can create turbulence on the downward side, reducing their effectiveness as windbreaks and may even serve to increase windspeed.

  Mature cypress and pine trees generally exclude native understorey plants, and the gap between the ground and the lowest branches can act as a wind channel. In contrast, most native plant communities include understorey species, such as grasses and shrubs. For best results, shelterbelts should have several rows of native trees, shrubs and grasses.

Conservation PARTNERS PROGRAM

- ## COST AND LABOUR

  The cost of establishing native shelterbelts varies depending on the circumstances. With techniques such as direct seeding, native shelterbelts can be established at a lower cost than exotic species or nursery grown plants. Local native species often regenerate naturally (avoiding long periods without shelter) and do not require high maintenance such as summer watering that exotic species may require (Stelling 1998).

- ## LANDSCAPE AND CONSERVATION VALUES

  Use of local native trees, shrubs and grasses helps to maintain the character of the natural landscape and is of great benefit to the local fauna providing food and shelter areas. Local natives can help retain or regain a sense of local identity, improving the aesthetic values of properties and rural landscapes (Stelling 1998).

- ## NATURAL PEST CONTROL

  Areas of local native plant species can attract native wildlife that prey upon pasture, tree and crop insect pests (Williams, J in Stelling 1998). Native wildlife also carry predatory parasites and diseases that can assist in lowering pests numbers. This is a good complement or alternative to pesticides, which are costly and can be extremely harmful to native wildlife.

  A diverse shelterbelt habitat, consisting of a variety of native plant species including trees and a healthy understorey, will help in natural pest control. Many native farmland birds and bats feed on insects (Williams, J in Stelling 1998):

  'honeyeaters generally inhabit the understorey, including shrubs amongst eucalypts, and are able to consume 24-36 kg of insects per hectare per year' (Farming for the Future 1999).

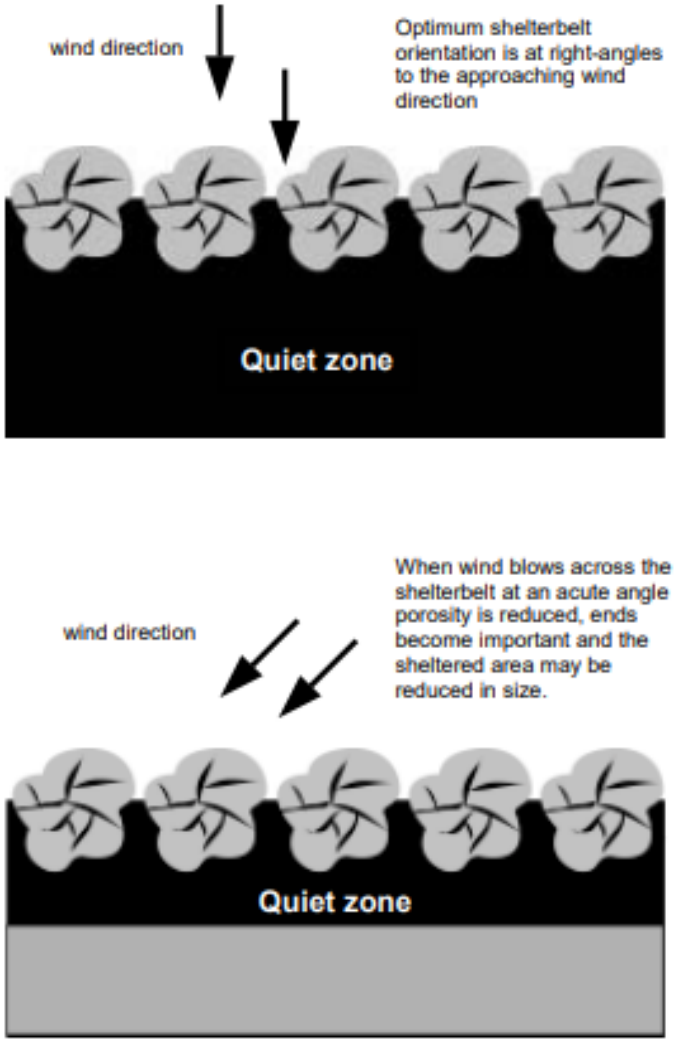
  'insectivorous bats can consume up to 600 small flying insects in an hour. Bats are known to eat army worms, moths and mosquitos. Many bats require the older trees, with hollows for roosting' (Farming for the Future 1998).

Many species of native parasitic wasps and other insects as well as spiders are extremely useful in controlling farm pests (Williams, J. in Stelling 1998). For these to be present in shelterbelts, a diverse mix of plant species, including local native trees and shrubs and grasses is required. This will ensure that nectar and nesting sites are provided throughout the year. Logs, leaf litter and rock material are also essential (Farming for the Future 1999).

- ## LANDSCAPE AND CONSERVATION VALUES

  Some species (mainly non local) have the potential to become environmental weeds. Environmental weeds are plants that rapidly spread and invade bushland or pasture areas (Brunskill, S in Stelling 1998). Many of these weeds are unpredictable and will rapidly colonise an area where they are not wanted. Some environmental weeds include cape broom (*Genista monspessulana*), Cootamundra wattle and sweet pittosporum (*Pittosporum undulatum*). These plants reduce the habitat value of bushland as well as destroying the food supply of many native animals that rely on local native plants (Brunskill, S. in Stelling 1998). They pose a long term threat to local regeneration of native vegetation (ANPWS 1991).

Achieving maximum shelter from your shelterbelt



(Abel et al. 1998)

a porous shelterbelt (porosity — 50%–60%)

a non-porous shelterbelt (porosity —20%)

(Abel et al. 1998)

- TOLERANCE OF FIRE AND DURABILITY

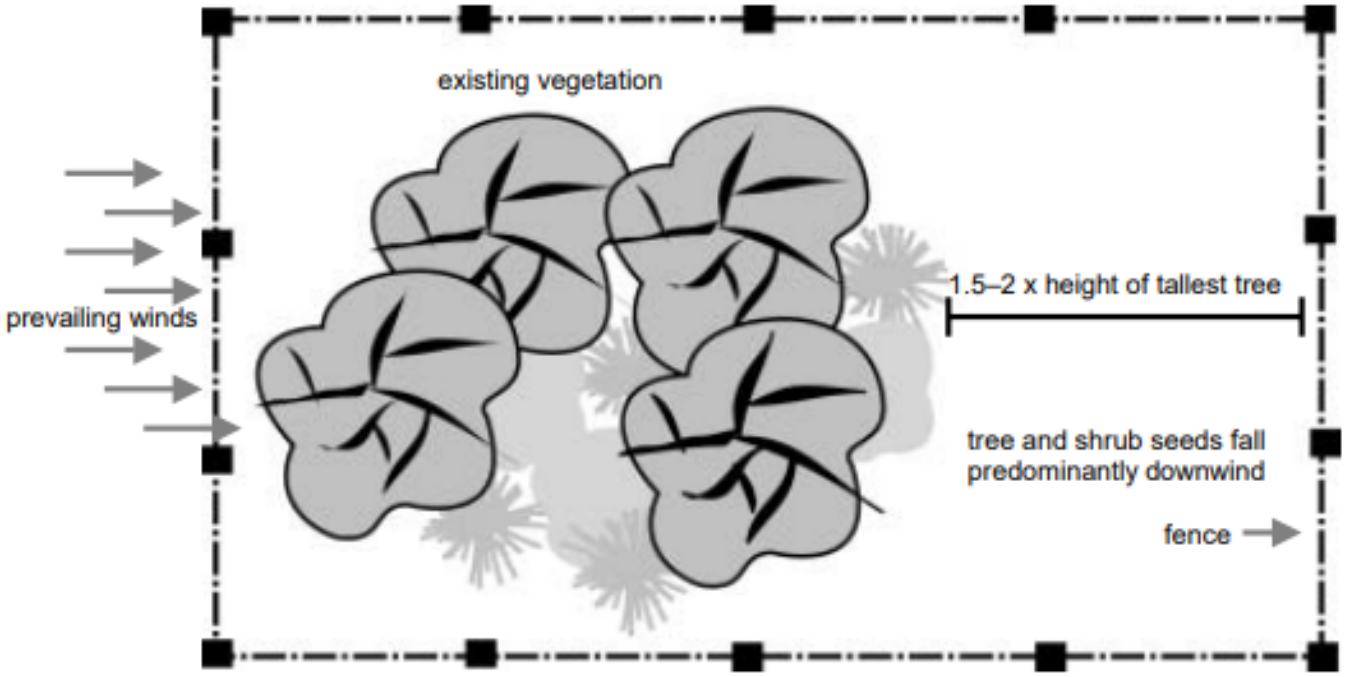
'*Traditionally, many shelterbelts have been planted using cypress trees. However, multiple rows of indigenous trees will often perform better as shelterbelt species. Many indigenous trees are often taller than cypresses, and subsequently provide more protection. Furthermore, most indigenous trees will also recover from fire, while cypresses are extremely susceptible to fire*' (Petris 1992). Local native species of plants are generally much better able to withstand the threats of frost and drought unlike introduced species such as conifers.

features of a good shelterbelt

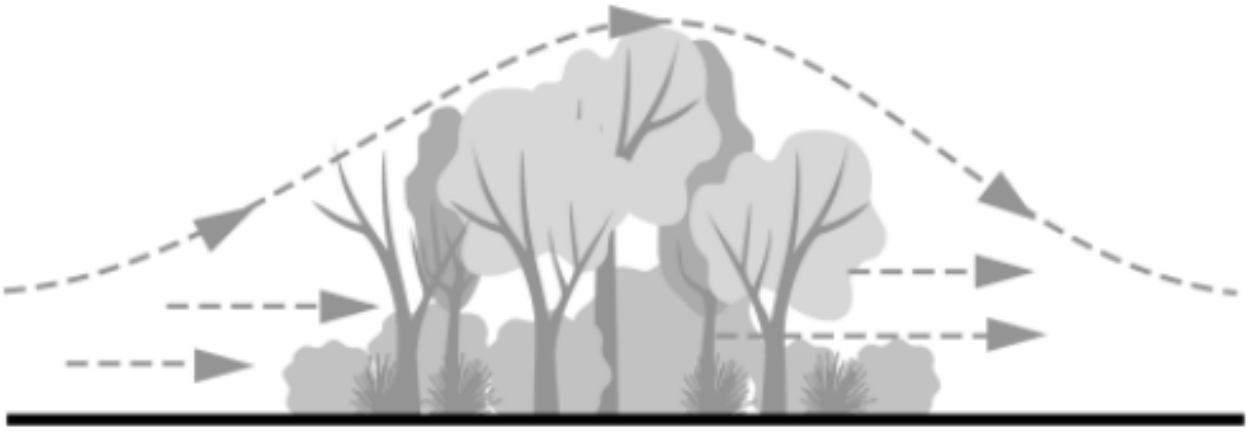
- Shelterbelts that are open but without large gaps provide semi-permeable protection and are usually recommended for crops and pastures. Allowing some airflow through the shelterbelt ensures that deflected air is not prone to descending too rapidly causing unwanted turbulence on the leeside of the shelterbelt, providing a greater area of protection (Breckwoldt 1983).
- Dense or impermeable shelterbelts can be used to protect small, confined areas such as farm buildings or yards (Breckwoldt 1983). L-shaped shelterbelts are ideal for areas requiring high protection.
- Shelterbelts do not need to be a strictly linear shape. Ones that follow the contour of the land or a creek or river line can still offer areas for stock shelter, regardless of changes in the direction of the wind.
- The height of shelterbelts determines what area of land is to be protected (Breckwoldt 1983). The area of land protected by the shelterbelt is approximately 20 times the height of the tallest trees in the shelterbelt (Brouwer and Dutton 1992; Breckwoldt 1983; Stelling 1998). Large properties may require numerous of shelterbelts for protection.

- Generally, longer shelterbelts are more desirable than shorter ones. Short shelterbelts tend to channel wind sideways around them — detracting from their effectiveness (Breckwoldt 1983). It is suggested that a shelterbelt's length be approximately 12 times the mature height of its trees, ie. 240 metres long for a shelterbelt 20 metres high (Stelling 1998 and Breckwoldt 1983). Linking shelterbelts to other corridors of natural vegetation greatly reduces windspeed when compared to single isolated shelterbelts (Simpfendorfer 1989).
- Environmental weeds can significantly threaten wildlife by decreasing the habitat value of bushland areas by competing with remnant vegetation. They can also cause problems for agricultural lands. Environmental weeds should be avoided in shelterbelts. For further information concerning environmental weeds in your area, contact either your NSW National Parks and Wildlife Service District office or your local council.
- The shape and width of shelterbelts determine their effectiveness. An ideal shelterbelt may be one, for instance, whose entire length and height is relatively uniform in providing semi-permeable protection. If, however, there are large gaps along the length of the shelterbelt this can lead to 'jets' of wind that can reduce the effectiveness of the shelterbelt (Abel et. al. 1997).
- The greatest potential for wildlife habitat is in wide shelterbelts (around 5-7 rows of trees or more) connected to large areas of native bushland (Stelling 1998). In narrow shelterbelts (around 2-3 rows of trees) gaps are difficult to manage and widely spaced individual or isolated trees are prone to dieback and are unlikely to be replaced by natural regeneration (Dorricott and Roberts 1993)
- Native wildlife will benefit and be attracted to shelterbelts if they are planted with a wide range of local native trees, shrubs and grasses. If a variety of species is not planted, the shelterbelt is prone to outbreaks of disease and pests — increasing the likelihood of dieback (Archer 1997).
- Consider species that provide good shade and are vigorous growers. These may be species that already grow on the property, or that are known survivors locally (*Farming for the Future* 1995). They will contribute to the effectiveness of the shelterbelt, as well as providing quality habitat and protection for native fauna.

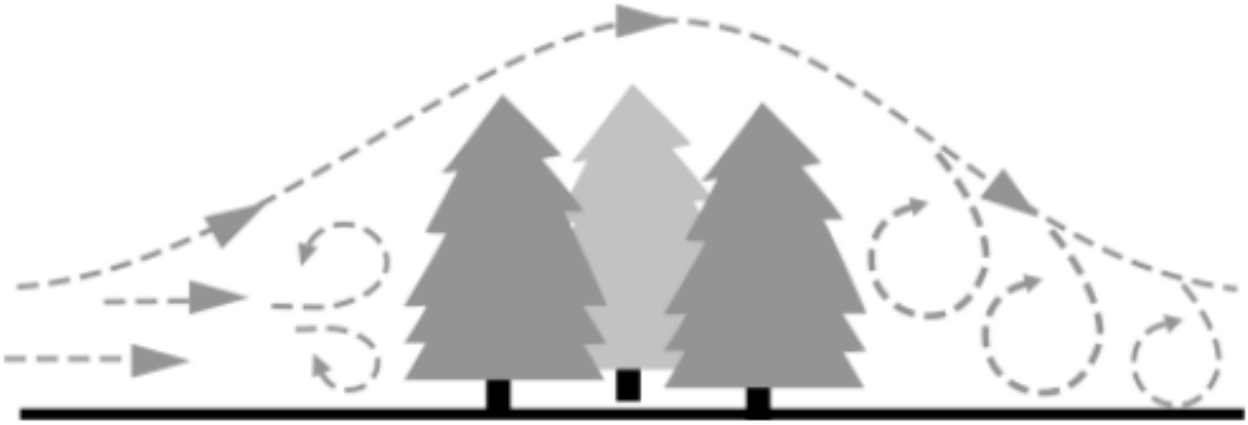
Plan view of one particular fence design for encouraging natural regeneration



Permeable shelterbelts planted with a variety of local native species provide habitat for native wildlife without creating turbulence.



Non-permeable windbreaks planted with conifers create turbulence and provide little habitat for native animals.



(Abel et al. 1998)

identifying shelterbelt locations

- Choosing suitable locations for shelterbelts is part of developing a Physical Property Plan (Whole Farm Plan) for the property, (*Farming for the Future 1995*).
- Shelterbelts that form natural corridors with other areas of native vegetation provide the opportunity for wildlife movement. Take into consideration naturally occurring shelterbelts such as along tree lined watercourses, ridges, farm boundaries, roadsides, and native vegetation occurring along travelling stock routes. These areas can provide high quality habitat for wildlife.
- Take advantage of existing habitat features. Consider establishing a shelterbelt that includes existing native plants such as old paddock trees and native grasses. These established areas will assist in any further regeneration process. Conversely, planting a shelterbelt in an area which is dominated by exotic grasses and has a history of fertiliser use, will reduce the chance of natural regeneration in the shelterbelt. This may lead to weed control problems, and the competition of exotics with the planted natives (Sheahan, M. 1998).
- Planning with neighbours can assist in determining the appropriate location for shelterbelts; maps and aerial photographs are also useful.
- Familiarity with the prevailing winds on your property will assist in determining the orientation of a shelterbelt. Generally, a shelterbelt that is at right angles to the prevailing winds will provide the best protection (Abel et al. 1997). When planting for shade, plan to avoid runoff from stock camps

damaging waterways. Planting a buffer zone of native vegetation near watercourses can help in intercepting runoff as well as providing habitat for native fauna.

- A shelterbelt on level ground will be most effective if orientated at right angles to the prevailing winds.
- It is recommended that buildings be sited more than 1.5 and less than 5 times the shelterbelt height from a dense shelterbelt for protection from fire (Simpfendorfer 1989). Fire resistant species should be considered for these locations.
- Pasture or crop yields may be reduced if located very close to shelterbelts, as plants compete for moisture and light. These areas can be used as firebreaks or laneways.
- On undulating lands, wind flows parallel with the ground rather than from one direction (Simpfendorfer 1989). Shelterbelts on ridgetops give the greatest deflection of wind but are the most vulnerable to damage. A wide shelterbelt provides greater protection in exposed, windy areas.

shelterbelt management

- Control weeds spreading by keeping disturbance of the shelterbelt to a minimum and avoiding the introduction of non-natives. Control weeds as soon as possible after they invade an area and prior to flowering and seed set so there will be fewer plants to control.
- Control pest animals such as rabbits, cats and foxes.
- Don't let your pets wander unsupervised at night — this will help safeguard your pets as well as native wildlife.
- Use pesticides and herbicides wisely — away from natural bushland, habitat areas and watercourses.
- Keep fences and gates in good condition to exclude grazing animals. Allow at least 2 metres from the shelterbelt to the fenceline to prevent stock browsing — allowing plants to grow to their full potential (Brouwer and Dutton 1992).
- In shelterbelt areas close to buildings and other areas requiring protection from fire, remove fallen twigs and leaves.
- Occasional wildfires may burn a shelterbelt. Many native species are likely to recover from a wildfire, but others, particularly rainforest species and conifers, are severely injured. An occasional wildfire can stimulate natural regeneration. Consult with local authorities and carefully plan where and when burning should take place. A controlled burn at a frequency and intensity similar to the natural regime may help in maintaining healthy bushland. Controlled burns also reduce the intensity of wild fires.
- In areas away from homesteads or other areas needing protection, allow the natural leaf litter to accumulate on the ground. This includes fallen logs and branches, tree stumps, rocks, leaf litter and debris. This will provide essential habitat for wildlife, control erosion and return nutrients to the soil.
- Leave mistletoes as wildlife shelter and food, unless they threaten the host tree. Mistletoe which is threatening or killing a tree may be controlled using light fire. Mechanical removal is often unsuccessful. Seek advice from a NSW National Parks and Wildlife Service district office, a Department of Land and Water Conservation district office or Greening Australia.

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Wind-proof your farm: Increasing farm productivity with shelterbelts

FACT SHEET 2018

The benefits of shelterbelts

Research has shown the beneficial effects of shelterbelts on farm productivity.

The main benefits for landholders in southern Australia are:

1. **Young lambs with shelter have a greater survival rate than those without.**
   - Shelterbelts can increase survival of young lambs in their first 48 hours from 84% to 93% for single lambs (Bird et al, 1984).
   - The increase in survival is even larger for twins, where shelterbelts have been shown to increase survival from 56% to 78% (Bird et al, 1984).
   - The bottom line $: For a flock of 2,000 ewes where half have a single lamb and half have twins, these percentages mean an extra 530 lambs surviving per year!
2. **Shelterbelts can reduce water loss in pasture plants particularly in spring and summer, which extends growing conditions.**
   - Although there can be a loss of productivity close to a shelterbelt, gains in productivity have been shown in plant production at a distance of 2-18 times the height of the shelterbelt into the paddock.
   - This positive effect is due to wind speed reduction and temperature modification resulting from the shelterbelt.

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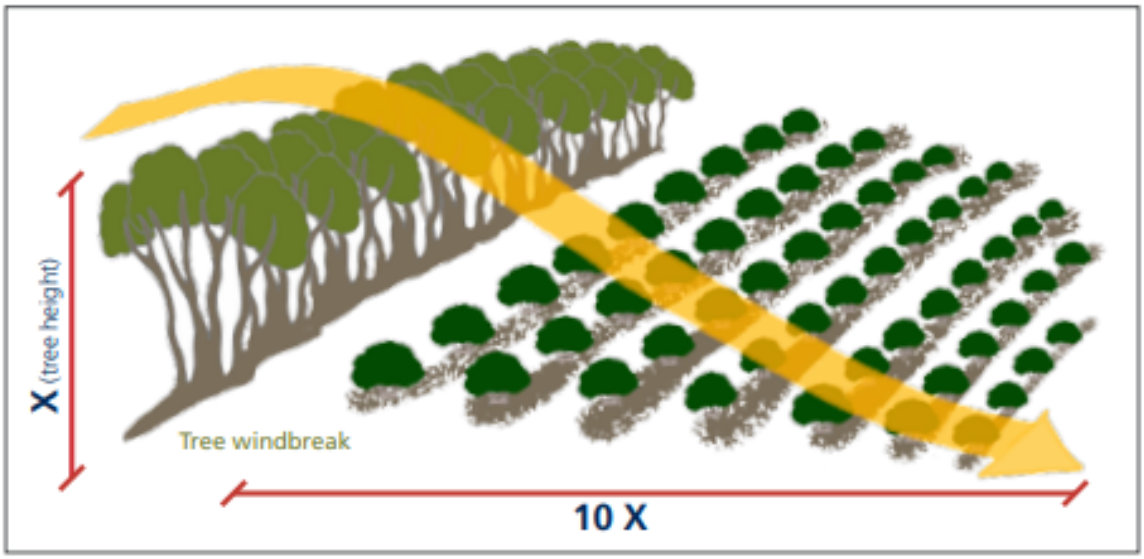

Figure 1. Protection offered by shelterbelts. *(adapted from the Goolwa to Wellington Local Action Planning Association Inc. Shelterbelt factsheet)*

3. **Shelterbelts provide biosecurity benefits, including the provision of habitat to beneficial insects (e.g. pollinators and predatory insects) and provide a natural barrier to fungal spores transported by wind.**
   - » Other biosecurity benefits include a reduction in the spread of weeds from one paddock to another, and preventing nose-to-nose contact between stock in different paddocks, which assists in disease control.

4. **Shelterbelts provide important landscape and biodiversity benefits.**
   - » Shelterbelts can be strategically placed to assist in the control of salinity.
   - » If planted along drainage lines and creeks there is potential to reduce erosion and increase water quality.
   - » Strategically placed shelterbelts can reduce topsoil loss from wind erosion.
   - » If they consist of remnant or planted native vegetation, they can support a diverse array of native birds and beneficial insects, and provide habitat for native wildlife (Johnson and Beck, 1988; Shibu, 2009). It also contributes to maintaining both on-farm and landscape scale biodiversity (Yahner, 1983).

Unsheltered paddocks are less productive

Wind can have a negative effect on both livestock and pasture, affecting farm productivity.

Livestock exposed to cold winds and rain can suffer from hypothermia, leading to decreased weight gain, wool and milk production, and can lead to stock death. High winds also damage pasture by reducing growth in winter and increasing moisture loss in spring.

Exposure can be fatal for lambs

Research on Kangaroo Island found that winds as light as 8 km per hour, in combination with 0.25-5 mm of rain per day, significantly increase mortality in Merino and Corriedale lambs. Higher winds (24-56 km per hour) combined with more than 5 mm of rain per day increased lamb mortality in Merinos by over 50% (Obst and Day, 1968).

Newborn lambs are most at risk. Further research on Kangaroo Island found that in the first six hours after birth (critical post-birth period), lamb losses were 5–10% if there was no rain and wind was less than 8 km per hour. However when wind was greater than 18 km per hour and more than 1.5 mm of rain was received in the critical post-birth period, lamb losses could exceed 70% (Obst and Ellis, 1977). In 2012, lamb deaths from exposure made the headlines, and it was estimated that up to 15 million lambs are dying within 48 hours of birth in Australia every year (The Australian, 2012). This results in large financial losses to sheep producers each and every year.

Post-shearing is a time of risk

For 14 days after shearing, adult sheep can be at risk of hypothermia if exposed to cold winds and rain. Sudden adverse weather events and unseasonal cold weather are the main cause of stock losses post-shearing. In South-West Victoria for example, unseasonal cold weather in March 1983 caused around 30,000 sheep to perish when a storm resulted in wind speeds of 32 km per hour, rainfall of 42 mm and a temperature drop to 16°C (Bird et al, 1984).

Wind affected pastures

Research indicates that high wind speeds increase water loss through transpiration in grasses and clovers leading to a reduction in growth (Radcliffe, 1983). In extreme cases, damaging winds can cause physical damage to plants through mechanical agitation (Sturrock, 1981).

Designing effective shelterbelts

Consider the following things when designing a shelterbelt:

Where do your prevailing strong cold winds come from?

Consider where your cold prevailing winds come from during risk periods such as lambing and shearing. Data from the Bureau of Meteorology shows that at many locations on Kangaroo Island strong winds in May-July are often from a westerly or north-westerly direction. Therefore lambing paddocks could benefit from both north-south and east-west running shelterbelts to protect young lambs from cold winter winds. Always base your alignment on your local conditions and landscape.

What other benefits would you like to obtain from a shelterbelt?

Do you have areas where salinity is becoming a problem? Or do you have a creekline that is badly eroded? Try positioning shelterbelts to provide shelter for stock as well as other landscape services to get maximum benefit from your shelterbelt.

How can shelterbelts assist with livestock management?

Can you position fenced shelterbelts in locations that help to minimise contact between mobs of sheep to assist with biosecurity? Shelterbelts along property boundaries can assist to keep your stock away from neighbouring stock where management practices may differ.

How wide should a shelterbelt be?

Shelterbelts should be at least two rows of plants wide (12–24 metres). Try to avoid using only trees (canopy layer) in a shelterbelt, as a lack of an understory layer (medium to large shrubs) can result in tunnelling of wind through the trunks of trees. Shelterbelts that incorporate both a canopy layer and an understory layer are far more effective at providing shelter.

Wider shelterbelts can also be more effective at providing habitat for local wildlife and addressing erosion along drainage lines.

How tall should a shelterbelt be?

The maximum height of the trees planted is important, as the higher the shelterbelt the greater distance it will protect. Therefore shelterbelts should incorporate tall trees. In general, a shelterbelt will reduce wind a distance of up to ten times the shelterbelt height (see figure 1).

Low maintenance shelterbelts

The easiest plants to use to establish a shelterbelt are often those that are locally native to your area. By planting Kangaroo Island species you will have a low maintenance shelterbelt that does not require additional watering during establishment and provides habitat for native wildlife such as pollinating insects and birds.

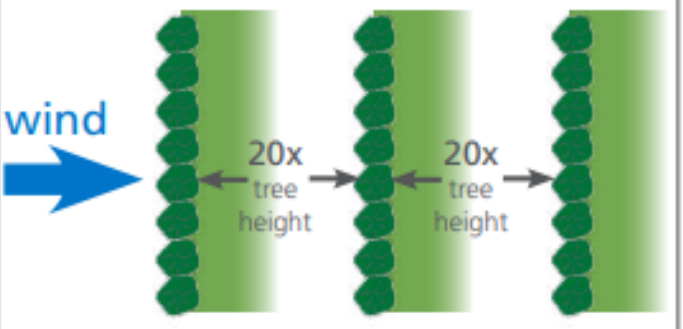

Figure 2.
Shelterbelt designed to give protection from a single predominant wind direction.

Figure 3.
Shelterbelt designed to give protection from three wind directions.

Figure 4.
Timberbelts can give shelter in all directions.

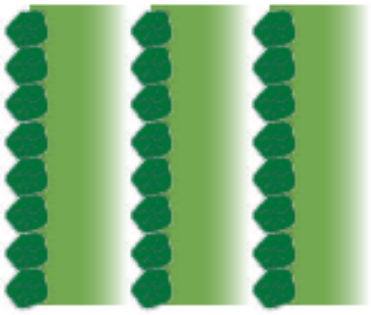

Figure 5.
Alley cropping.

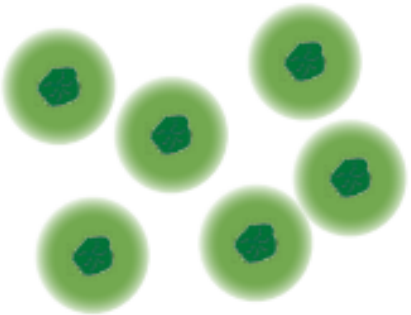

Figure 6.
Scattered trees.

How to source native seedlings for shelterbelts

An easy way to obtain Kangaroo Island native seedlings is to purchase them from the Kangaroo Island Native Plant Nursery. The nursery provides plants grown from seed collected on Kangaroo Island. Staff can provide tailored advice on which plants to choose based on your soil types and local climate. Contact details for the Kangaroo Island Native Plant Nursery are included at the end of this fact sheet.

If you would like to grow your own seedlings, organisations such as Trees for Life can assist you with getting started.

Further Resources

See the Bureau of Meteorology webpage on long-term climatic data and search for your nearest weather station:
http://www.bom.gov.au/climate/data/

For more information on shelterbelt design (i.e. widths, heights and orientation) the Agriculture Victoria website has some great information:
http://agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/erosion/shelterbelt-design

Evergraze Shelter for lambing investment tool:
http://www.evergraze.com.au/library-content/shelter-investment-tool/

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For further information please contact Natural Resources Kangaroo Island

Phone (08) 8553 4444 Visit 37 Dauncey Street, Kingscote Web www.naturalresources.sa.gov.au/kangarooisland

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Australian Government | National Landcare Program

Shelterbelts to protect wildlife

The establishment of shelterbelts is the most common form of revegetation on farms in Victoria. While the primary objective of shelterbelts is to protect farm enterprises from wind and improve productivity, they can also benefit wildlife by:

- providing habitats (nesting sites, shelter and food)
- acting as corridors for migration

offering shelter from predators.

Local wildlife can benefit your farm

Maximising the habitat value of a shelterbelt can provide a number of on-farm benefits, including pest control. Bats, ibis, parrots, robins, fairy wrens, magpies, lizards, bandicoots and sugar gliders are all known to consume a range of insect pests. While predatory birds, such as hawks, kookaburras and owls consume pests such as mice, rats and rabbits.

This reduces the landholder's pest control costs by saving time and reducing the need for chemicals.

Position your shelterbelt to benefit wildlife

The location of a shelterbelt requires careful consideration. The location of a belt to protect stock should be perpendicular to damaging winds. But shelterbelts for wildlife are best if they can link or incorporate existing native vegetation, or be placed along waterways or ridgelines.

The design and location of a shelterbelt depends on the purpose of the belt and your priorities. It is probably best determined through a whole farm planning (WFP) process.

When choosing a location, keep the following in mind:

- Many timid species may be deterred from using a belt in a busy or noisy location.
- Locating a belt away from disturbed sites can also reduce management issues such as weed invasion.
- Connecting native vegetation with a belt allows species to move along and between patches of vegetation.
- A shelterbelt located near a water body will attract more wildlife species. Locating vegetation near a water body can offer additional benefits such as bank stabilisation and improved water quality.

Incorporating large old trees into shelterbelts can increase the habitat value of belts significantly. Old trees provide hollows for shelter and nesting, a greater range of food and produce larger quantities of nectar over longer periods of time and more reliably than younger trees.

Large, wide shelterbelts are better for wildlife

The wider a shelterbelt is, the higher the value it provides as habitat for wildlife. This is because a wider shelterbelt:

- is less susceptible to detrimental 'edge effects'
- supports a larger diversity of species and populations of wildlife

will provide a greater 'core' area (area away from the edge), which is used by some species so they will be less disturbed and are less susceptible to predation.

Other ways to enhance a shelterbelt for wildlife

To enhance the habitat value of shelterbelts without compromising their effectiveness, you can:

- establish locally native species within the belt
- create vegetative layers within the belt (by using a mix of species, age classes of plant and ground layer components).

Plant locally native species
Here are some advantages of planting locally native species:

- It helps to maintain the genetics of plants in the area.
- They're easier to establish and more likely to survive, having already adapted to the conditions of the area.
- It helps to restore the processes of the natural ecosystem.
- They're more likely to regenerate naturally or after a fire.

Natural regeneration enhances the habitat value and provides self-perpetuating shelter.

Pair species with the right landform

Another thing to consider when selecting plant species is the matching of species to landform. Different plant species and communities occur on different landforms such as drainage lines, hills and gullies.

You can identify the appropriate species and landform by noting remnant vegetation in the surrounding area. Remnant vegetation can usually be observed along roadsides and in reserves.

Call our Customer Service Centre on 136 186 for advice on species selection.

Create vegetative layers to imitate the natural ecosystem
Creating natural layers within a belt replicates a natural plant community and is more likely to attract a variety of species.

Many small birds use dense or prickly shrubs for nesting and feeding because they provide protection from predators. Small animals such as lizards, small mammals and frogs utilise ground components like logs, leaf litter, mosses, grasses and rocks.

You can create vegetative layers by:

- establishing vegetation over a period of time or incorporating existing vegetation — Plants at different stages of development provide different resources and habitat for a greater variety of species.
- randomly or irregularly planting species — This needs to be balanced with considerations of the density of a belt. Uniform density from the top of a belt to the ground level usually maximises the effectiveness of a break in sheltering a productive area.
- planting a range of species — Different plant species provide different resources and at different times. This means a more reliable food supply.

placing nest boxes — Many birds such as parrots and owls as well as gliders, possums and bats have been known to use nest boxes. But it's important to monitor nest boxes to make sure they're not used by introduced species.

Management of shelterbelts

You must manage your shelterbelts so it stays an effective habitat to wildlife.

Management activities may include:

- pest animal and weed control
- fence maintenance
- fuel reduction burning as part for fire prevention

Sheep shelter guidelines

Prevention of Cruelty to Animals Act

Sheep are kept in a variety of situations, ranging from extensive grazing to close confinement and housing.

Section 9 of the Prevention of Cruelty to Animals Act 1986 defines cruelty offences and requires that proper and sufficient shelter is provided for animals.

Healthy sheep can tolerate a wide range of temperatures if they are acclimatised and have enough feed and water. Shelter can improve the welfare of the sheep and reduce production losses. Sheep without shelter need to put more energy into normal functioning and less into production.

Sheep should be provided with shelter in times of above or below average temperatures. This can minimise the impact of climatic extremes and prevent suffering or possibly death.

The amount of shelter provided should be sufficient for all animals to access it at the same time, and stocking rates may need to be adjusted to allow for this. This will prevent overcrowding around areas of shade or water.

Shelter in hot weather

While the Merino is considered to be better adapted to hot and shadeless conditions than British breeds, all sheep can experience heat stress to some degree on days of above average heat.

Sheep cool themselves primarily by increasing their respiration rate, and can also lose a small amount of heat through sweating. Heat stress and exhaustion should not occur if sheep are able to find shade and rest during the hottest part of the day.

Heat stress

Periods of extreme heat can cause heat stress, with lambs again more susceptible than adult sheep. Heat stress can:

- reduce productivity
- cause reproductive problems such as reduced semen quality
- lower birth weights
- compromise the immune system

Lambs and pregnant ewes are more at risk of heat stress due to their lower heat threshold and sheep with a history of respiratory disease due to a decreased ability to dissipate heat through panting.

Suitable shelter during hot weather

The best type of shelter during extreme heat protects animals from the sun and allows for the cooling effect of the wind. Some options for shelter in hot weather are:

- constructed shelters using materials such as shade cloth, corrugated iron or timber
- trees with large canopies — planted individually in fields
- naturally undulating paddocks and gullies
- shelterbelts — thick hedges of trees

Shelterbelts can provide good protection from sun, but should be thinned evenly to allow wind flow and planted in an east-west direction to provide shade during the hottest part of the day.

It is important that sufficient shelter is available for all animals at the same time to prevent sheep crowding and smothering. It is preferable that all animals are able to lie down as this helps them cool themselves.

Shelter and water
Water should be close to shelter and be of sufficient volume to cope during periods of peak demand.

Care should be taken when placing shelter near water so it does not result in animals camping around the water source, causing overcrowding and preventing animals from accessing water.

You might need to reduce the stocking rate into several small mobs, as even if sheep have access to several paddocks with shelter, mob instinct means that they tend to group together under one shelter or water source.

Shelter in cold weather

Cold weather, particularly when combined with wet and windy conditions, can have severe impacts on sheep especially lambs and recently shorn animals. It is important that lambing ewes and recently shorn sheep are put into areas or paddocks that contain the best shelter or protection from the elements.

Suitable shelter for extreme cold include:

- constructed wind breaks such as corrugated iron along fences or hay bales placed in the paddock
- natural undulating paddocks and gullies
- sheds (open on one side) erected in paddocks can provide protection from wind

forestry blocks can be used as emergency shelter for large numbers of stock, and can provide protection during sudden storms.

Sheltering recently shorn sheep
Freshly shorn sheep can be extremely difficult to move in cold weather so always put shorn sheep straight into a protected paddock with plenty of shelter from the cold if shearing in the colder months of the year.

Shorn sheep are at greatest risk of cold stress in the first three days (or nights) after shearing, and remain at some risk for up to two weeks as fleece growth is insignificant over this short period. Extra feed should be provided to sheep for up to four weeks following shearing to meet their increased energy requirements.

Check predicted weather conditions before putting shorn sheep into a paddock after shearing, so that if a cold snap is forecast, you can leave them in sheltered yards or sheds where they are better protected from the weather.

Shearing within a month before lambing encourages ewes to seek shelter — it does have its own risks, especially if a severe storm occurs shortly afterwards. Pre-lambing shearing must only be considered if ewes are in good condition and have free access to good feed and shelter. Heavily pregnant ewes should not be subject to the handling and feed deprivation that shearing involves. The use of hand shears, a cover comb or snow comb is recommended.

Lambing in bad weather
'Bad weather' in this context involves at least two of the three factors of low temperature, wind and rain. When combined these factors can impose a severe chill factor on newborn lambs. Under such circumstances, a lamb that fails to get a drink soon after birth will become progressively less able to do so.

Around 70% of lamb deaths that occur between birth and weaning take place within 48 hours of birth. The majority of these are believed to succumb to the 'mismothering-exposure-starvation' complex. Losses can be particularly high during short spells of bad weather, which may coincide with peak lambing periods in individual flocks during autumn, winter or spring. Wind and rain combined has an additive effect and it has been shown that a wet coat (rain or amniotic fluid) can increase heat loss by 13%, and by 18% with a wet coat and wind.

Studies have shown that in cold, wet and windy weather, lamb losses can be reduced by around 30% if flocks are provided good shelter. Reducing the wind speed at lambing sites is a critical factor contributing to the increased survival of lambs.

Stress and metabolic diseases in extreme weather

Sheep in poor condition (including those coming out of a drought), sick animals or those with previous history of respiratory disease, are especially vulnerable to the extremes of weather. These animals should be housed separately from the main mob to ensure preferential access to shelter and feed and expedited treatment. Moving animals already under stress requires care and planning so it needs to be done well before an extreme weather event, to prevent further aggravation of the animal's condition.

Animals that have been injured in a natural disaster such as fire or flood need protection from the elements as they will be especially sensitive to the extremes of heat or cold.

Stock showing signs of photosensitivity (sunburn) must have access to shade. Preventative measures are available for some types of photosensitivity, including facial eczema. Sunburnt stock will also benefit from veterinary treatment.

Holding yards

When sheep are in holding yards, use should be made of artificial and natural shade to protect them from extremes of wind, heat and cold.

Shelter is important for young animals if they are left in yards for longer than two hours before transport and loading.

Sheep in feedlots during extreme weather

If your sheep are in feedlots, you must be aware of the climatic conditions and the clinical signs in sheep that are associated with temperature stress.

Sheep in feedlots need to have access to shade and shelter during high temperatures, particularly in areas where the duration of high temperature and high humidity with decreased air movement is prolonged.

In these conditions sheep should be constantly monitored for:

- signs of restlessness
- decreased food intake
- congregating/huddling around water troughs
  The cessation of rumination will indicate thermal load stress requiring immediate preventative action.

Cattle shelter guidelines

Section 9 of the Prevention of Cruelty to Animals Act 1986 defines cruelty offences and requires that proper and sufficient shelter is provided for animals.

Healthy cattle can tolerate a wide range of temperatures if they are acclimatised and have adequate feed and water. Good shelter can improve the welfare of the animal and reduce production losses. Cattle without shelter need to put more energy into normal functioning and less into production.

Cattle should be provided with shelter in times of high and low temperatures. This can minimise the impact of climatic extremes and prevent suffering or possibly death. The amount of shelter provided should be sufficient for all cattle to access it at the same time.

Cattle at highest risk of heat stress
Animals at highest risk of heat stress include:

- overfat stock
- young cattle
- dark coloured cattle
- high producing dairy cows

sick cattle or cattle that have previous history of respiratory disease.

Reduced appetites of cattle in extreme heat
Appetite is reduced during extreme heat and can result in decreased daily weight gains and feed efficiency. Provision of good quality, highly palatable feed and plenty of shelter during periods of hot weather will reduce the heat load of the cattle and assist in maintaining normal feed intakes.

Any new feed should be gradually introduced to reduce the risk of acidosis or metabolic disease.

Dairy cattle under heat stress
A study on the economic effects of heat loads on dairy cattle production in Australia has shown that extreme heat has the following effects on dairy production:

- reduced milk yield
- reduced milk fat and protein percentages
- lower first service conception rates
- lower calf birth weights
- larger number of services per pregnancy.

The effect of extreme heat was more pronounced for high producing cows, and resulted in reductions of up to 461 litres of milk per cow per year on farms that did not provide shade for their herds.

A further study found that milk production was 3 per cent greater for **shaded** cows than for **unshaded** cows.

For more information about heat stress in Australian dairy herds can be found at the Cool Cows website.

Shelter close to water

Care should be taken when placing shelter near water so it does not result in cattle camping around the water source, causing overcrowding and preventing cattle from accessing water.
The number of watering points or water flow as well as the amount of available shade should be sufficient for the number of cattle and be increased if a large number of cattle are kept together.

Sick cattle in extreme weather

Cattle in poor conditions (including cattle coming out of a drought), sick cattle or those with a history of respiratory disease are especially vulnerable to the extremes of weather, and should be housed separately from the main mob to ensure preferential access to shelter and feed and expedited treatment. Without appropriate shelter these animals may die from the impact of adverse weather conditions.
Moving cattle already under stress requires care and planning so it needs to be done well before an extreme weather event, to prevent further aggravation of the animal's condition.

Cattle injured due to fire or flood

Cattle that have been injured in a natural disaster such as fire or flood need protection from the elements as they will be especially sensitive to the extremes of heat, sun or cold.

Cattle prone to sunburn

Stock showing signs of photosensitivity (sunburn) must have access to shade. Preventative measures are available for some types of photosensitivity, including facial eczema. Sunburnt stock will also benefit from veterinary treatment.

Feedlot cattle

Feedlot cattle should be protected from extreme adverse weather conditions causing cold stress, heat stress or excessive heat load. Feedlot staff and management must be aware of the climatic conditions and the clinical signs in cattle that are associated with heat stress.
Feedlots must have in place plans for minimising the impact of hot and cold weather and dealing with heat and cold stress.
In relation to heat stress, the provision of shade or alternative means of cooling such as sprinklers and fans may be required.
In these conditions, cattle should be constantly monitored for:

- signs of restlessness
- decreased food intake
- congregating or huddling around water troughs
- cessation of rumination — which would indicate thermal load stress requiring immediate preventative action.

Where cold stress predominates, shelter and allowance for additional nutrient requirements should be provided.

Shelter in holding yards

When cattle are in holding yards, use should be made of artificial and natural shade to protect them from extremes of wind, heat and cold.
Shelter is important for young cattle (especially calves under two weeks of age) if they are left in yards for longer than two hours before transport and loading.
Heat stress in dairy cows standing in the holding yard can be reduced with the use of sprinklers and the provision of shade during hot and humid weather.

Cows and their calves

Research also shows a higher mortality rate in calves subjected to heat stress in their first week of life. Cows may be observed trying to shade their calves and it has been shown that cows will actively seek sheltered areas in which to calve.

Artificially reared calves must have access to shelter in hot weather with natural air flow important for cooling of the environment.

Shelter suitable during hot weather
The best type of shelter during extreme heat protects cattle from the sun and allows for the cooling effect of the wind. Some options for shelter in hot weather are:

- constructed shelters using materials such as shade cloth, corrugated iron or timber
- shadebelts – these are usually a single line of deciduous trees, planted in an east-west direction to give shade on the south side
- trees with large canopies —- planted individually in fields

shelterbelts — thick hedges of trees usually fenced off from stock.

Water
The importance of clean fresh water during periods of extreme heat should not be underestimated. As a general rule dairy cattle drink somewhere in the range of 120 to 150 litres of water per day when producing about 20 litres of milk. This requirement can increase by as much as 80 per cent on days over 35ºC.

Water sources should be:

- familiar to cattle before an extreme weather event
- be close to shelter
- be of sufficient volume to cope during periods of peak demand.

The number of watering points and water flow should be increased if a large number of cattle are kept together.

Managing cattle in cold weather

Wind chill and rain may reduce the animal's effective temperature to below its critical level, resulting in a decrease in weight gain and milk yield and increases in milk fat. For high risk animals the outcome may even be death.

Cattle at highest risk of cold stress include:

- newly born calves and calving cows
- cattle in low body condition
- sick cattle.

Appetite is stimulated by cold temperatures, and cold stress increases an animal's requirement for energy to maintain body temperature and functions.

Studies suggest that a yearling's energy requirement may increase during an extreme winter event.

Where cold stress is likely, providing shelter and increasing the availability of highly digestible and palatable feed will assist cattle to maintain normal body temperature and production — minimising the effects of cold stress.

Shelter for calving cows
Special shelter management may be necessary for calving cows and their calves. If required, small paddocks within a sheltered area along the edge of shelterbelts are useful.

Close regular observation should be carried out and any cow found down and unable to stand should receive appropriate treatment and be provided with shelter or be moved carefully to a sheltered area. Extra feed may be required to help the cow meet her own metabolic needs as well as the nutritional needs of the calf.

Calves in cold weather
Calves are most at risk during cold weather due to their small size. They need to have good shelter provided, as even strong and healthy calves can die if exposed to adverse weather.

Decreasing temperature and increasing precipitation on the day of calving increases mortality, and calves born to heifers are particularly susceptible to adverse weather conditions.

Additionally, cold stress has been shown to decrease the rate of absorption of colostrum in newborn calves — compromising their immune system and contributing potentially to morbidity and mortality.

Pens used for rearing calves should have a draught-free covered area to protect calves from the elements, and paddocks should have shelter accessible to all calves

Shelter suitable for extreme cold
The following forms of shelter are suitable for cattle:

- constructed wind breaks
- natural undulating paddocks and gullies
- shelterbelts
- trees — planted in a north-south direction to protect from north and south westerly winds.

Sheds (open on one side) erected in paddocks can afford protection from wind.

Temporary shelter can be provided in the form of shade cloths or plastic tarpaulins if other shelter is not available.

Shelterbelts

Shelterbelts are the best form of shelter against wind, with the 'shelter zone' spanning a distance about 14 times the height of the trees. If wind speed is reduced, cold stress is markedly reduced.

The trees forming the shelterbelt should be spaced evenly and be semi-permeable in order to slow the wind without creating turbulence. Under-planting should be incorporated to prevent the wind being funneled through gaps at livestock level.

Shelterbelts should be thinned evenly to allow wind flow. Planting them in an east-west direction provides shade during the hottest part of the day.

Shelter close to water

Care should be taken when placing shelter near water so it does not result in cattle camping around the water source, causing overcrowding and preventing cattle from accessing water.

The number of watering points or water flow as well as the amount of available shade should be sufficient for the number of cattle and be increased if a large number of cattle are kept together.

Sick cattle in extreme weather

Cattle in poor conditions (including cattle coming out of a drought), sick cattle or those with a history of respiratory disease are especially vulnerable to the extremes of weather, and should be housed separately from the main mob to ensure preferential access to shelter and feed and expedited treatment. Without appropriate shelter these animals may die from the impact of adverse weather conditions.

Moving cattle already under stress requires care and planning so it needs to be done well before an extreme weather event, to prevent further aggravation of the animal's condition.

Cattle injured due to fire or flood

Cattle that have been injured in a natural disaster such as fire or flood need protection from the elements as they will be especially sensitive to the extremes of heat, sun or cold.

Cattle prone to sunburn

Stock showing signs of photosensitivity (sunburn) must have access to shade. Preventative measures are available for some types of photosensitivity, including facial eczema. Sunburnt stock will also benefit from veterinary treatment.

Feedlot cattle

Feedlot cattle should be protected from extreme adverse weather conditions causing cold stress, heat stress or excessive heat load. Feedlot staff and management must be aware of the climatic conditions and the clinical signs in cattle that are associated with heat stress.

Feedlots must have in place plans for minimising the impact of hot and cold weather and dealing with heat and cold stress.

In relation to heat stress, the provision of shade or alternative means of cooling such as sprinklers and fans may be required.

In these conditions, cattle should be constantly monitored for:

signs of restlessness

decreased food intake

congregating or huddling around water troughs

cessation of rumination — which would indicate thermal load stress requiring immediate preventative action.

Where cold stress predominates, shelter and allowance for additional nutrient requirements should be provided.

Dairy Australia
Your Levy at Work

Designing and locating shelterbelts on your dairy farm

Shelterbelts Fact Sheet 1

This Fact Sheet has been developed as part of the *Profitable Dairying in a Carbon Constrained Future* project.

It is one in a series of resources developed to profile practices that profitably reduce greenhouse gas emissions from dairy farm systems, embedded in the context of every-day farm management decisions.

The Australian dairy industry has committed to reducing greenhouse gas emissions intensity.

Shelterbelts can enhance productivity on farm by keeping cows comfortable and allowing them to put their energy into milk production. They also provide opportunity for sequestration of carbon on farm and consequently contribute to the efforts of reducing emissions on dairy farms.

This project is supported by funding from Dairy Australia and the Australian Government.

Tips for designing and locating shelterbelts

- Understand the purpose of the shelterbelt – shade, shelter, habitat etc.
- Use your whole farm plan to help locate the best positions for shelterbelts.
- Consider length and width of your shelterbelt.
- Choose species to provide adequate density for protection requirements.
- Visit a nearby farm and learn from another landholders trials and errors.

What are shelterbelts?

A shelterbelt is a plantation made up of one or more rows of trees or shrubs with the aim of providing shelter from the wind and/or shade from the sun. Shelterbelts can enhance productivity on farm by keeping cows comfortable and allowing them to put their energy into milk production. They also provide valuable habitat for wildlife and contribute to the overall landscape value of the dairy farm.

Why have shelterbelts on dairy farms?

> Increase milk production, feed availability and herd fertility by keeping cows comfortable
> Protect stock in extreme events such as heat waves, wind storms and cold weather
> Provide habitat for wildlife and biological control agents for pasture and crop pests
> Protect the soil from erosion and salinity
> Extend the pasture growing season by reducing water loss by shading or reducing wind speed
> Boundary plantings can offer biosecurity, minimising stock contact and blocking weed movement
> Improve the farm work place and increase medium to long term land values.

For more information contact Cathy Phelps on 03 9694 3730 | cphelps@dairyaustralia.com.au | www.dairyclimatetoolkit.com.au

Australian research has found...

- Sheltered areas have up to 17% estimated increase in dairy milk production
- On a 27°C day, unsheltered cows have 26% less milk production than shaded stock
- Milk yields are depressed by cold at a rate of up to 1.34kg per day (4% fat-corrected milk)
- Over (approx.40-60 years) the lifetime of fencing and shelterbelt; total dairy production will increase by 30% (20% improved pasture growth, 10% improved milk production), and $150/ha of sheltered pasture
- Heat stress can markedly reduce stock fertility, milk production and increase mortality of calves
- The use of trees can reduce heat load (summer) in cows by 50% and heat loss in winter, and is more cost-effective than using electricity-driven sprinklers and fans while absorbing carbon dioxide.

How do shelterbelts work?

Well-designed shelterbelts break the force of the wind, offering shelter to stock in cold conditions and shade on sunny days.

The first step in designing a shelterbelt is to consider what you want it to achieve. The purpose will determine the type of shelterbelt to plant.

Shelterbelts can have a negative impact on farm productivity if they are not appropriately designed and are not easy to move if they are placed in the wrong spot.

What to consider when locating shelterbelts on dairy farms

1. Location of shelterbelts

Use a whole farm plan to map out the best location for shelterbelts.

The location of a shelterbelt should consider placement of infrastructure, prevailing seasonal winds, problem areas of erosion and salinity, remnant vegetation, non-productive areas and fencing and revegetation of waterways.

Tree belts located on tops of ridges or other high points in the landscape provide shelter over larger areas than those planted along gullies and other low points. The ideal tree belt will be oriented at right angles to the prevailing problem wind.

2. Height and length of the shelterbelt

The height of the shelterbelt determines the size of the sheltered area. Taller trees protect a greater area. Using the tallest suitable shelter species in at least one row of the belt will increase the eventual area over which a windbreak is effective.

Longer windbreaks are more effective than short ones. Wind will flow around the ends of a shelterbelt and increase turbulence. The length of a windbreak combined with its height determines the extent of the protected area. For maximum efficiency the uninterrupted length of the windbreak should be at least 10 times its height.

Photo: A dense belt of trees with taller species in the inner rows an understorey towards the edges ensures wind protection for stock*

3. Width and density of the shelterbelts

Gaps within a windbreak reduce its effectiveness resulting in an increase in wind speed due to the wind accelerating as it funnels through the gap within the shelterbelt. Aim for an even density from the ground level to the top of the shelterbelt using shrubs and ground cover species as well as taller species. Species with dense foliage, having more rows or spacing plants closer together can increase windbreak density.

Shelterbelts of 2-4 rows can provide significant benefits while not requiring large areas of land to be removed from productivity. Use taller species together with shrub species that provide shelter lower down.

Rows should be spaced 2 to 4 metres apart and allow space between the first row of plants and the fence to prevent stock from grazing on the plants.

4. Species Selection

The species selected for your shelterbelt should provide the height, growth rate and density characteristics suitable for your needs.

Talk to farmers in your area who have successfully established shelterbelts they can be a wealth of knowledge. Landcare networks and local nurseries will also provide species lists for you to consider.

5. Other considerations

- An "L" shaped shelterbelt with trees and shrubs provides shade for stock at different times of day and protection from winds from all directions and prevents permanent shading of pasture, exposing all areas to sun at different times of the day
- Remember to place gate access into your shelterbelts to allow access for maintenance including weed control
- Tree planting and shelterbelt design can fall to the bottom of the list on a busy dairy farm. The job can be contracted out to a local nursery.

Photo: Careful planning can create a number of sheltered paddocks ensuring cattle are comfortable throughout the grazing rotation*

For more information

Basalt to Bay (2014) Economic Benefits of Native Shelter Belts

Agriculture Victoria – Shelterbelt design

Murrumbidgee Landcare Incorporated guide – Establishing shelterbelts on your farm

Dairy Climate Toolkit

Acknowledgments

*Photos – supplied by Gillian Hayman

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Dairy Australia
Your Levy at Work

Crop shelter guidelines

pel.services.com.au

The benefits of shelter to the land whether it be broadacre or the small landholder have long been recognised and include protection of crops, livestock, and the home, reduction of soil erosion, salinity control and biodiversity improvements.

Shelterbelts are vegetative barriers that are designed to reduce wind speed and provide sheltered areas on the leeward (the side away from the wind) and windward (the side toward the wind) sides of the shelterbelt.

PALS will design a belt to suit soil types rainfall and above all what the belt aims to protect (eroded zones, capital assets or paddock shelter) Parameters of the design include:

- height
- density
- number of rows
- species composition
- spacing between the trees or shrubs.

Paying attention to the length, orientation and continuity of your shelterbelt will also improve its efficiency.

Case study : Mullewa, West Australia

Problem

The Midwest of West Australia grows some of the best cereal and lupin crops in Australia. However the soils are very fragile with the dominant soil type being non-wetting sand. Soil erosion is a major problem, especially when the paddocks have just been sown to crop and at the end of summer when the stubbles have deteriorated.

The top few centimetres of soil is usually the most fertile and most valuable for crop and pasture production. While the loss of a few millimetres of soil during a heavy downpour or windstorm may not seem critical, the impact over time on farm productivity and fertiliser requirements over a generation can be devastating.

Solution

A series of strategic belts were planted across the prevailing winds and to follow the working pattern of the paddocks to help with the overall paddock management efficiency ie control traffic and GPS guidance

PALS recommended each belt was to be four lines wide with the outside lines containing mallee trees in conjunction with low shrubs so to add low shelter and prevent further land loss to root penetration out into the crop. Taller Eucalyptus specie to add height through the central rows.

Alternative design options: Where possible fodder shrubs are integrated. This adds shade and low shelter and increases the grazing capacity of the belts. Mixed with mix of tall, deep-rooted native Eucalyptus and mallees is the ultimate in shelterbelt design. Fodder shrubs are also less sensitive to chemical drift, a major consideration on broadacre cereal properties

3 years growth into the project

Management actions for existing shelterbelts

Maintain fences to control grazing pressure. Lower levels of grazing lead to increased vegetation cover, more leaf litter, less bare ground, and more species of birds and reptiles.

Add new plants to replace those that die in the early years of establishment. New plants might be needed to maintain the structural diversity of the shelterbelt – that is, so there's a mix of trees, shrubs and ground-covers.

Add fallen timber. If a log or fallen branch is in the way elsewhere on the farm, don't burn it – move it into a shelterbelt where it can provide great habitat for animals like yellow-footed antechinus.

Control pests and weeds. Shelterbelts can be a useful focal point to concentrate pest control efforts.

Repair and rejuvenate older shelterbelts. Sometimes, old shelterbelts become less effective. Perhaps fences have fallen down, enabling stock access and meaning understory and groundcover plants may struggle to persist. Perhaps the original shelterbelt was narrow, or planted with trees only, and isn't a very effective windbreak. But old shelterbelts have great potential for wildlife and, with some rejuvenation, will quickly offer benefits for the farm as well.

SUSTAINABLE FARMS

Shelterbelt maintenance and management

Shelterbelts can provide a range of benefits over a long period of time if they are managed appropriately.

Management aims to maintain the:

- health and vigour of individual trees and shrubs
- overall structure of the shelterbelt as an effective barrier to the wind.

Your management practices will usually involve the following:

- weed control
- pest animal control
- pruning
- insect and disease control.

The level of management required to maintain a belt will often decrease as the belt becomes established.

Newly established belts

Newly established belts are usually the most vulnerable, as they are highly susceptible to:

- grazing by animals
- dry conditions

weed competition.

Soil moisture helps young plants to establish
Thorough site preparation and weed control can maximise the amount of moisture available to young plants. Good soil moisture during the first growing season ensures good root and above ground growth.

Faster growth reduces the plant's susceptibility to grazing, fire, insect attack and weed competition. This in turn leads to higher rates of survival.

Replace dead plants early
Losses of plants are likely to be highest during the first few years. Dead plants should be replaced as soon as possible to maintain even heights and densities within a belt.

It's harder to establish new plants in an advanced belt due to competition for water and shading by the older plants.

Weed control

Grasses and weeds compete with shelterbelt plants for water, light, space and nutrients.

Weeds can significantly reduce the effectiveness of a belt and degrade the quality of the habitat for local wildlife. Strategic grazing, herbicide application or possibly burning can be used to control weeds.

Young belts
Effective weed control is especially important during the first 5 years. A shelterbelt that has effective weed control from establishment on will become effective earlier and last longer.

Weed control should be undertaken within and between the rows of a shelterbelt to give plants the opportunity to establish. Weed control is undertaken between rows to remove the source of weed seeds. This can be achieved by mowing weed species prior to them setting seed.

Complete removal of the weeds is more appropriate in dry areas.

Older plantings
It's recommended that weed control be undertaken for up to 10 years following the establishment of a belt. After this time you can do it as required to ensure that no serious weed infestations occur.

Weeds that aren't controlled can spread weed seeds to other areas of the property.

As a belt matures weed control should become less time consuming. Litter from the trees and shrubs will fall and create a mulched area. Weeds will find it more difficult to get sufficient sunlight and moisture to become established.

Protection from animals

A range of animals, both domestic and wild, can damage both new and old shelterbelts.

Closely monitor your shelterbelt so you can quickly address any issues.

Stock accessing the shelterbelt
Stock within a well-established belt can damage or reduce the health of belt species by:

- grazing on shelter plantings
- leaning on fences to graze
- trampling and compacting the soil
- increasing nutrient levels within the site
- rubbing and chewing on the trunks of plants
- preventing the regeneration of new plants within the belt.

All shelterbelts located in areas where they may be grazed should be fenced to ensure grazing can be controlled. Grazing may be used for short periods to reduce the fire risk. Some belts benefit from crash grazing to promote bushiness.

Pest animals accessing the shelterbelt
Rabbits, hares and other grazing animals can also enter a belt and cause significant damage to both plants and local wildlife within the belt.

Rabbits can degrade the habitat value of a shelterbelt by grazing and eliminating understorey species.

Foxes and feral cats must be controlled or they will predate on wildlife within a shelterbelt. Nest predation in linear strips of vegetation is almost double that of large areas of remnant vegetation.

Pruning

Pruning a shelterbelt may reduce its potential to deflect wind by reducing its density or creating gaps. Carefully consider the purpose before undertaking pruning.

Damaged or dead branches may be removed if their removal is not likely to alter the density or profile of the belt. You can do this annually to enhance the shape, density and longevity of a belt.

Always use appropriate equipment. A clean cut out from the main stem is ideal, as it will reduce the chance of infection of the tree. If there's the possibility of trees having a disease, the pruning equipment should be sterilised between each use to prevent infection of subsequently pruned trees.

Pruning may be an integral part of the management of shelterbelts for the production of timber products such as saw logs.

Structural management

The overall structure of a shelterbelt determines its effectiveness. Therefore structural management should take into consideration the ideal cross sectional profile, height and density of a belt.

As trees grow, the relationships among them change. The density and position of tree crowns alter in relation to height above ground and neighbouring trees. These changes are usually small but they may sometimes alter the belt to such a degree that it doesn't provide as much protection from wind as it should.

An example of this is where a belt may be a higher density than desired. High-density belts don't protect as large an area as medium density belts.

Current Local Land Services Projects 2022

Seedlings for Superb Parrot

This August and September, 2022, Murray Local Land Services is offering 'Seedlings for Superbs' - a native plant giveaway of trees, shrubs, and grasses that superb parrots love to feed on and live within.

About the Superb Parrot

The superb parrot (*Polytelis swainsonii*) is a large, attractive green parrot with swift and graceful flight. It is found in the Murray region - from Barham and Wanganella in the west through to Albury and Holbrook in the east.

It is listed as vulnerable in New South Wales and Australia. There are fewer than 5,000 – 10,000 birds remaining in the wild.

In the Murray region, it nests between September and January in River Red Gum tree hollows along the Murray and Edward/Kolety Rivers. Over the nesting period, flocks of males feed together and travel to and from foraging sites where they collect food for the brooding females. Foraging sites are usually within 10 km of the nest site. Males may make 2-3 flights each day from nests to foraging areas and back, during which time the females do not leave the nest other than to be fed by the male.

Throughout the rest of the year, superb parrots forage in the surrounding grassy box woodland, white cypress pine woodland, boree woodlands, and grasslands of the Riverine Plains, away from the major rivers. Most of the foraging habitat is on private land. Superb parrots feed mainly on the ground and sometimes in trees and shrubs. They eat the seeds of grasses and plants, fruits and berries, nectar, flowers, and some insects.

The superb parrot has declined in range and abundance over the last 100 years. Major threats include clearing and degrading nesting and foraging habitats, disturbance around nesting sites, competition for nest hollows, trapping for the pet trade, and road kills.

More information about Superb Parrots can be found here.

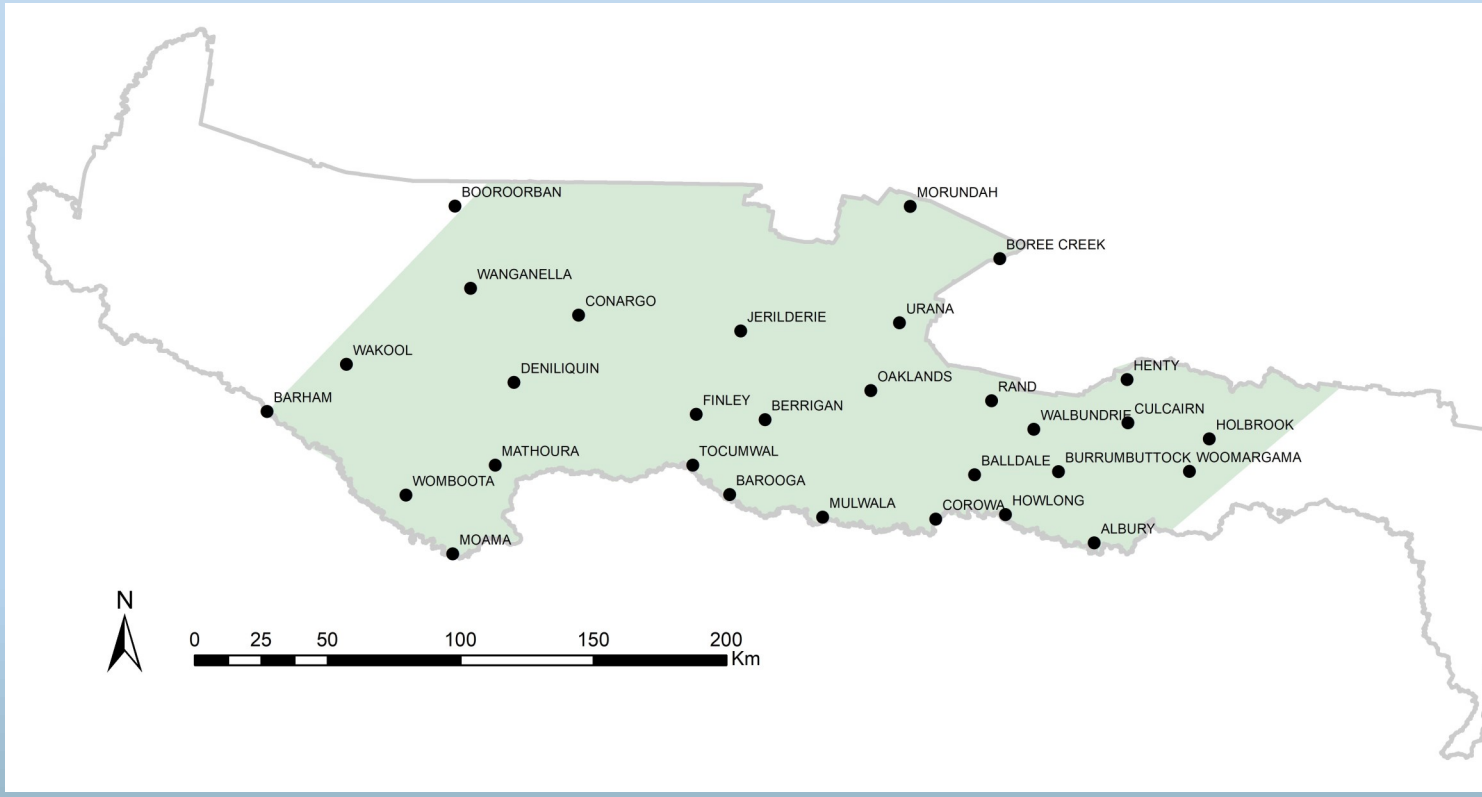
NSW GOVERNMENT Local Land Services Murray

About ‘Seedlings for Superbs’

You can help to create superb parrot foraging habitat by planting known food plants.

We are offering free ‘Seedlings for Superbs’ - a native plant giveaway of trees, shrubs, and grasses that Superb Parrots love to feed on and live within.

To be eligible to order plants is simple! – Just live in the central zone of the Murray LLS region (i.e. where Superb Parrots can be found). See the map below (the eligible area is shown in green):



Initially, up to 80 plants per household/property are available (depending on interest, we may be able to offer more, so please let us know in your order form if you are interested in more than 80 seedlings). The plants available will be most suitable for larger blocks or farm revegetation projects. If you are after plants for your backyard, you may only want a small selection.

Landholders will be required to plant the seedlings in an appropriate area, protect them from stock for at least five years and control pest plants and animals until seedlings are established.

‘Seedlings for Superbs’ will be run on a first-come, first-served basis, so get in quick to take advantage of the giveaway.

Place your ‘Seedlings for Superbs’ order here.

NSW GOVERNMENT | Local Land Services Murray

Restoring Superb Parrot Flyways

The Restoring Superb Parrot Flyways project aims to restore superb parrot foraging habitat in the Mulwala-Savernake district of the NSW Murray region.

About the Superb Parrot

The superb parrot is a large, attractive parrot with a distinctive yellow neck and forehead and an orange blaze under the chin.

In the Murray region, it nests between September and January in River Red Gum tree hollows along the Murray and Edward/Kolety Rivers. Over the nesting period, flocks of males feed together and travel to and from foraging sites where they collect food for the brooding females. Foraging sites are usually within 10km from the nest site. Males may make 2-3 flights each day from nests to foraging areas and back, during which time the females do not leave the nest other than to be fed by the male.

Throughout the rest of the year, Superb Parrots forage in the surrounding grassy box woodland, White Cypress Pine woodland, Boree woodlands and grasslands of the Riverine Plains, away from the major rivers. Most of the foraging habitat is on private land. Superb Parrots feed mainly on the ground and sometimes in trees and shrubs. They eat the seeds of grasses and plants, fruits and berries, nectar, flowers and some insects.

The Superb Parrot has suffered a decline in range and abundance over the last 100 years. The Superb Parrot (*Polytelis swainsonii)* is listed as vulnerable in NSW and Australia. There are fewer than 5,000 – 10,000 birds remaining in the wild.

Major threats include clearing and degradation of nesting and foraging habitat, disturbance around nesting sites, competition for nest hollows, trapping for the pet trade and road kills.

What is the project doing for Superb Parrots?

This project will work with landholders to restore foraging habitat and flyways for Superb Parrots by:

- protecting remnants containing hollow-bearing trees by fencing and excluding grazing stock;
- planting and direct seeding of known food plants for superb parrots, such as Gold-dust Wattle, Silver Wattle, Deane's Wattle, Wallaby Grass, Wedge-leaf Hopbush, Creeping Saltbush; and

creating revegetation flyways to improve connectivity between foraging and breeding habitat, including paddock trees with hollows where possible.

What can you do to help Superb Parrots?

- Retain and protect woodland remnants.

Plant native trees, shrubs and grasses for habitat and feeding. You can do this by participating in '**Seedlings for Superbs**' - a native plant giveaway of trees, shrubs, and grasses that superb parrots love to feed on and live within.

- Prevent grain spills and watch out for superb parrots feeding along roads.

- Report suspected illegal bird trapping, egg collection or sales to NPWS.

- Ensure that hazard reduction burns and stubble burns avoid damaging large hollow-bearing trees that provide Superb Parrot breeding habitat.

Bringing Plains - Wanderers back from the brink

The **Bringing Plains-wanderers back from the brink** project aims to recover the population of the critically endangered plains-wanderer (*Pedionomus torquatus*) in the region.

About the Plains-Wanderer

Plains-wanderers are small, ground-dwelling birds found in sparse native grasslands of the Murray & Riverina. They have a yellow bill and legs, and feathers that are fawn in colour with black rosettes. The sexes differ in appearance, with the female being slightly larger, and she has a black and white collar above a red breast patch.

Plains-wanderers prefer sparse native grasslands, which typically occur on hard red soils. An open grassland structure with around 60% bare ground allows birds to easily move about, find seeds and insects to eat, and to detect and slip away from predators like foxes. Plains-wanderers will disappear from the habitat that becomes too sparse or too dense.

The last couple of decades in the NSW Riverina have been tough for plains-wanderers. There have been long dry periods and some very wet years. This has meant that large areas of habitat have often been too sparse or too thick to support birds, which has caused a steep decline in plains-wanderer numbers. There is estimated to be only 300 birds remaining in NSW and less than 1,000 in Australia.

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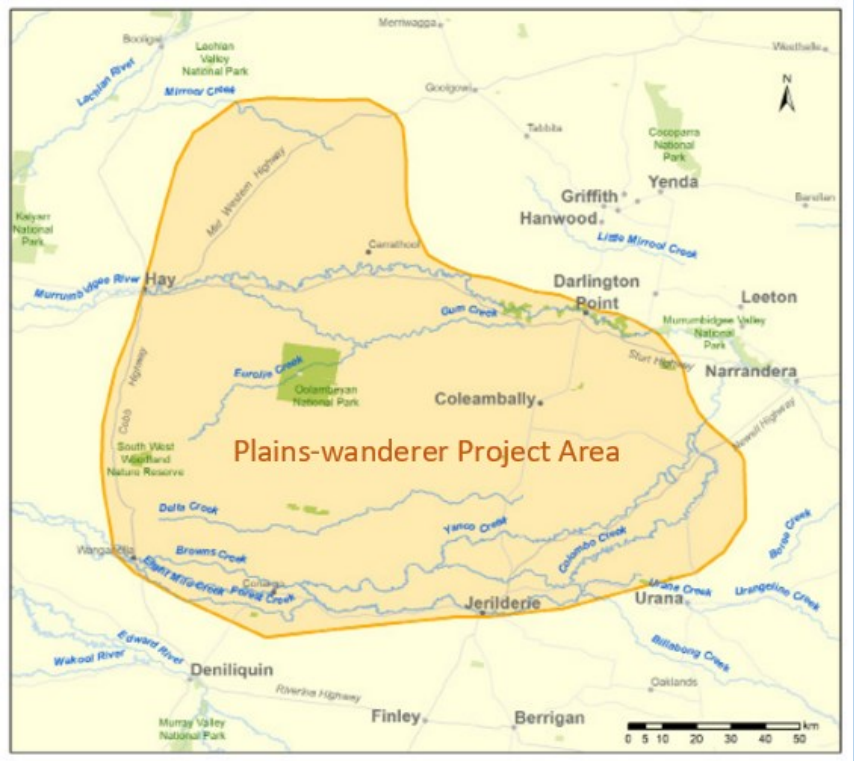
NSW GOVERNMENT | Local Land Services Murray



What is the project doing for Plains-Wanderers?

We are working with landholders to improve grazing management practices on areas of plains-wanderer grassland habitat. We support landholders to manage paddocks for livestock production and plains-wanderer conservation, by offering incentives for pest and weed control, fencing, water points, saltbush plantations, stock management areas, and feeding infrastructure.

Landscape-scale fox control is also being undertaken over 95,000 ha in the Murray & Riverina.

By improving grazing management of grasslands & controlling predators like foxes, this project will safe-guard suitable grassland habitat areas to recover plains-wanderers in the Murray & Riverina.

What can landholders do to help the Plains-Wanderer?

The most important thing landholders can do is to manage their habitat in 'Ideal' conditions. Ideal habitat has roughly equal parts bare ground and plants, with most of the plants being herbs and grasses around five centimetres tall plus a scattering of taller plants.

Grazing is an important tool for achieving this outcome. In some cases, no change to the current grazing regime will be required. In others, landholders will need to reduce grazing pressure in dry years or in-crease grazing pressure in wet years. The most critical times are during drought, when paddocks may need to be de-stocked completely for extended periods.

NSW GOVERNMENT | Local Land Services Murray

Local Land Services - Seed Services

Murray Seed Services undertakes seed collection, seed storage, direct seeding, and technical support for planning and implementation of revegetation activities in the region.

Our Native Seedbank

Our facilities enable us to collect from a large range of species and from different provenances across the region. We process then store the seed in a temperature and humidity-controlled seed vault to ensure the best quality seed. When a seed order is submitted to us we are able to match the appropriate species, and provenance to your sites soil and vegetation type, to provide the best opportunity for successful establishment.

Direct Seeding

Establishing native vegetation in a changing climate presents many challenges. We have four direct seeding machines that enable large scale revegetation works to be completed in a short period of time in an efficient and economical manner.

We are able to assist with; enhancing existing native vegetation areas, linking fragmented remnant vegetation, sowing Old Man Saltbush pasture, creating shelter belts, establishing offset areas and establishing native vegetation for erosion control.

Our species mix for direct seeding sites includes a range of species suited to your location, soil type and vegetation community. We include a range of provenances into the mix including seed sourced from dryer areas to help ensure a successful establishment in a variable climate.

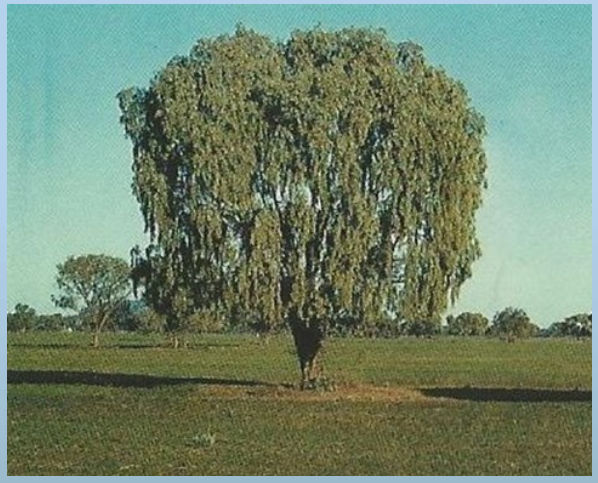
By providing sound, proven advice on how to best prepare your site prior to seeding and also follow up advice after sowing to help inform positive management decisions, we aim to give your direct seeding every opportunity to successfully establish with the right seasonal conditions.

MORE INFORMATION

For more information or an obligation-free direct seeding quote, contact Tash Lappin 02 6051 2231, 0429 827 471, natasha.lappin@lls.nsw.gov.au

NSW GOVERNMENT Local Land Services Murray

Recommended Species for the Wanganella Plains Preservation Project



Upper Story - High

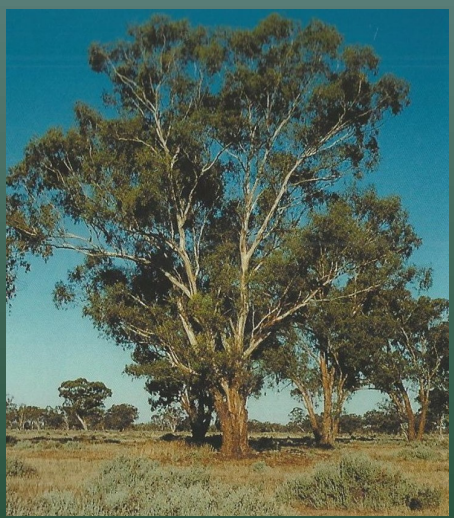
- Silverton Gum
- Red Gum
- Yellow, Grey and Black Box varieties
- Ironbark
- Black Box

Medium Story - Medium

- Weeping Myall
- Boree
- Western Golden, Western Black, Flinders Ranges and Mallee Wattles.
- Moonah
- Miljee

Lower Story - Low

- Butterbush
- Hedge Saltbush
- Old Man Saltbush

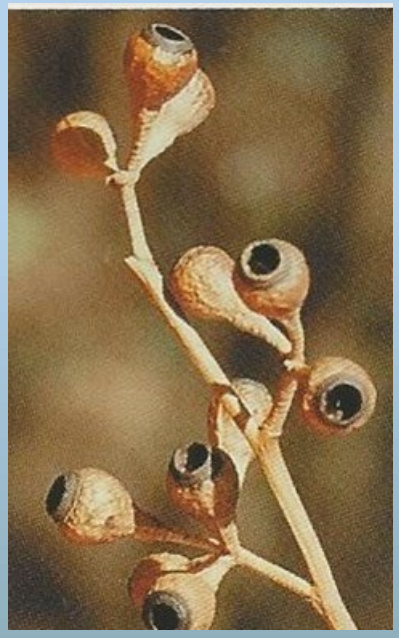


Yellow Box

Eucalyptus melliodora

Form

Tree, growing to 15-25m tall, forming a lignotuber.
Flowering winter through to summer

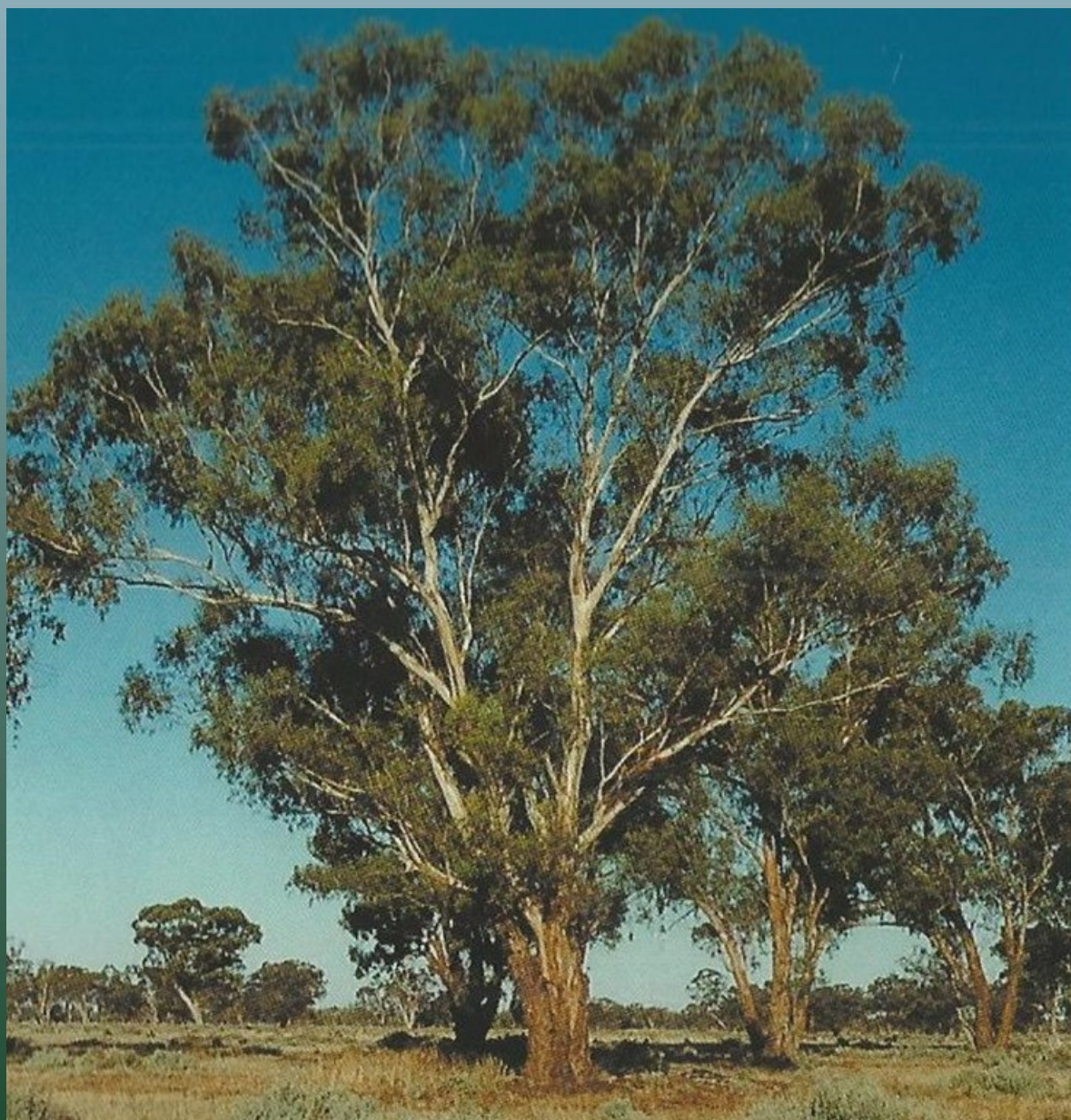


Habitat

Widespread in Vic, western slopes and southern region of NSW, also extending into Qld. Occurs on well drained soils.

Uses

An excellent provider of honey. Also useful as firewood, heavy engineering, construction, poles, railway sleepers and fencing.



Mugga Ironbark

Eucalyptus sideroxylon

Form

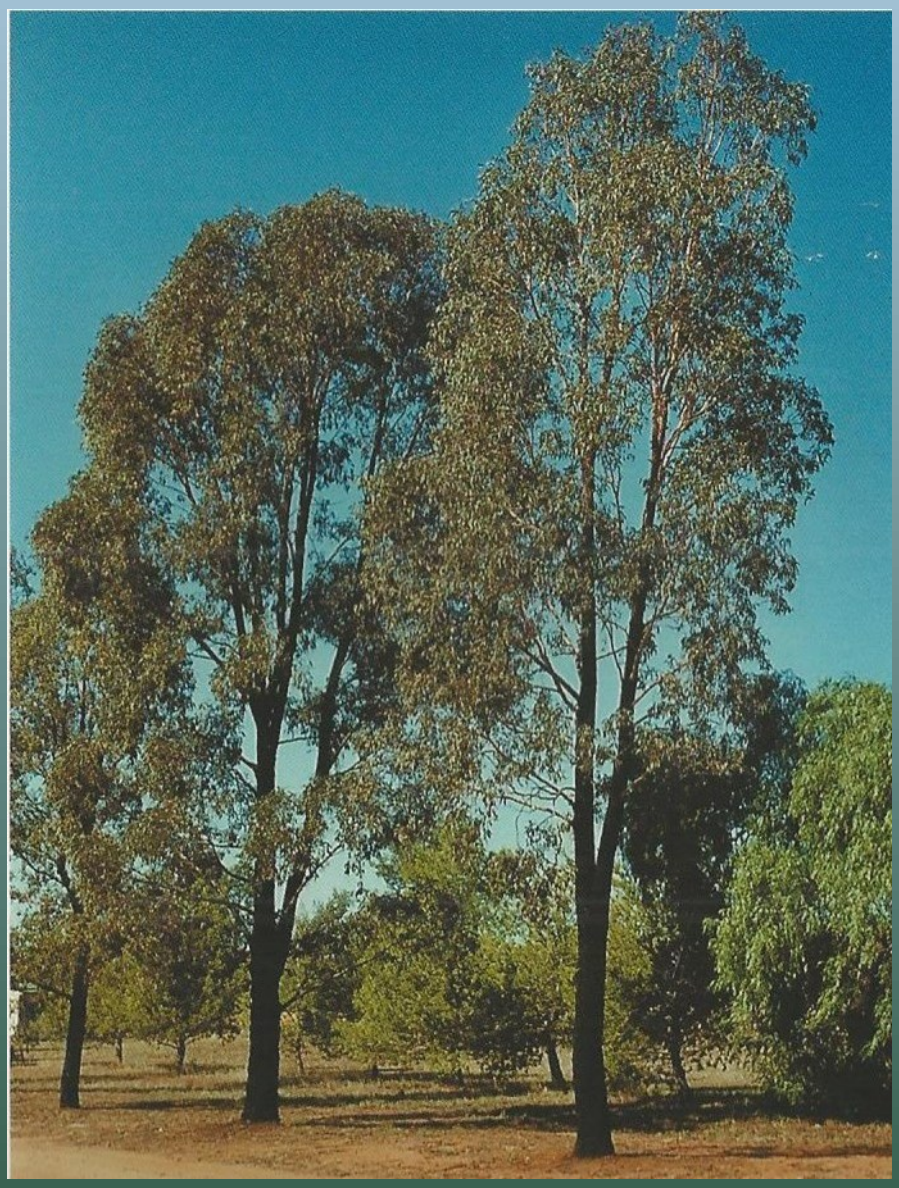
Tree which grows 10-20m tall and forms a lignotuber.
Flowering mainly between Autumn and Spring

Habitat

widespread on the western slopes and plains of NSW, on ridgy country in the east and on sands in the west; extending into northern Vic, also in south-eastern Qld.

Uses

heavy engineering construction, railway sleepers, timber, gums and oils. Excellent for honey production. Widely grown as an ornamental, especially for its colourful flowers and the contrast between crown and bark colour.



Black Box

Eucalyptus largiflorens

Form

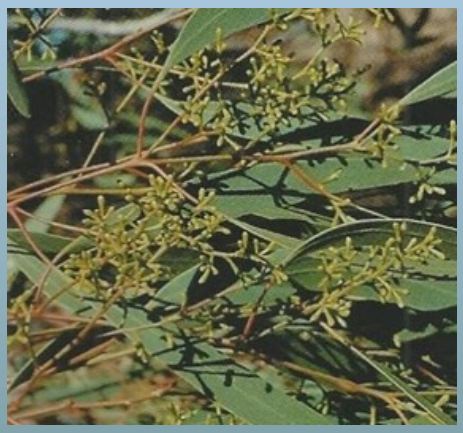
Tree, growing to 10-15m tall, forming a lignotuber.
Flowering winter through to summer

Habitat

Widespread on the higher levee and flood plains of the major eastern, inland river systems.

Uses

Used for posts, small poles, sleepers, gums, honey and amenity planting on clay soils. A hardy tree
useful for windbreaks.

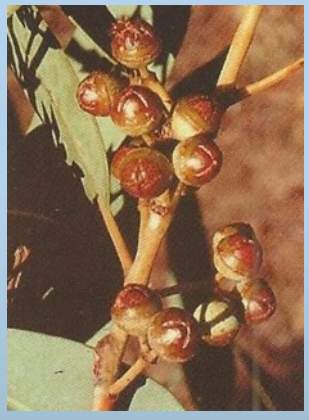


River Red Gum – Silverton

Eucalyptus camaldulensis var. obtuse

Form

Umbraceous tree, growing 15-25m tall.
Flowering through spring and autumn



Habitat

Naturally occurring along sandy creek beds of the main inland water courses, but adaptable to loamy soils in other areas as a planted tree.

Uses

Mainly used for windbreaks, shade, timber and apiary. This is a fast growing, highly drought and salt tolerant species. Capable of withstanding winter flooding, but not summer floods. More salt tolerant than the eastern form.

Old Man Saltbush

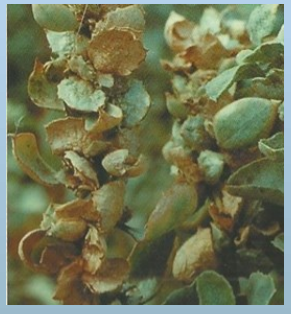
Atriplex nummularia

Form

A large bluey-grey shrub about 2m tall and 4-5m diameter, with many brittle, woody branches. Flowering in Spring.

Habitat

Mostly associated with old watercourses and alluvial plains where it occurs on the higher levees. Common on both scaled and saline soils.



Uses

Widely used as a reclamation plant on salinised areas. Also used extensively as a fodder plant, either as natural stands or as plantation stands as part of a whole farm management program. Ideal as a shrub in windbreak designs.

Miljee

Acacia oswaldii

Form

Shrub or tree to 4-6m tall with a dense bushy canopy. Linear to narrow oblong shaped leaves with a pointed tip.
Flowering late Spring to Summer.

Habitat

Occurs in most communities across western NSW usually as single trees. The trees are often conspicuous because of their dense, shady canopy and by their persistent, long, coiled, woody pods.

Uses

A useful small tree for hedges or windbreaks due to its ability to supply shade and shelter. Relatively unpalatable to stock, though browsed in dry times.

Myall

Acacia pendula

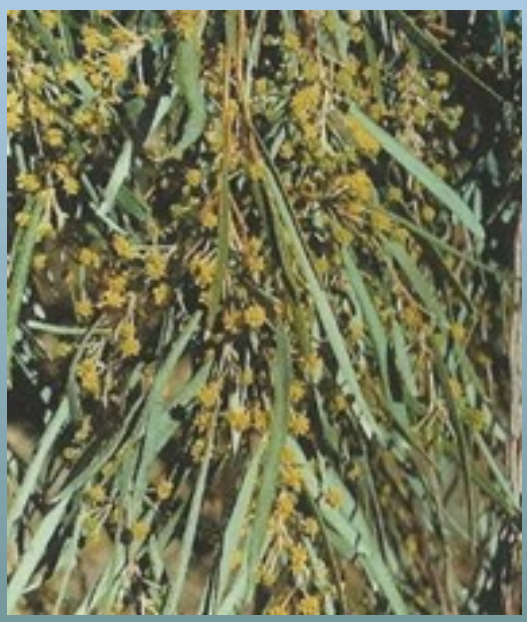
Sometimes referred as the Boree Tree

Form

Tree, which grows to 5-7m high with drooping branches.
Flowering is mainly between summer & autumn, but irregular.

Habitat

Mostly on alluvial country subjected to periodic waterlogging, usually in areas with clay soils. Occurs as individual trees or in dense clumps, sometimes in association with black box or with old man saltbush. Found in the Riverina and along the western edge of the slopes and plains.



Uses

The forage is palatable and trees usually display a 'browse line', during dry times. Its attractive shape and good shade make it useful in windbreaks. This species is prone to periodic defoliation by 'bag-shelter' moths, taking several months to recover once stripped of leaves. Useful as a pollen source.

Moonah

Melaleuca lanceolate

Form

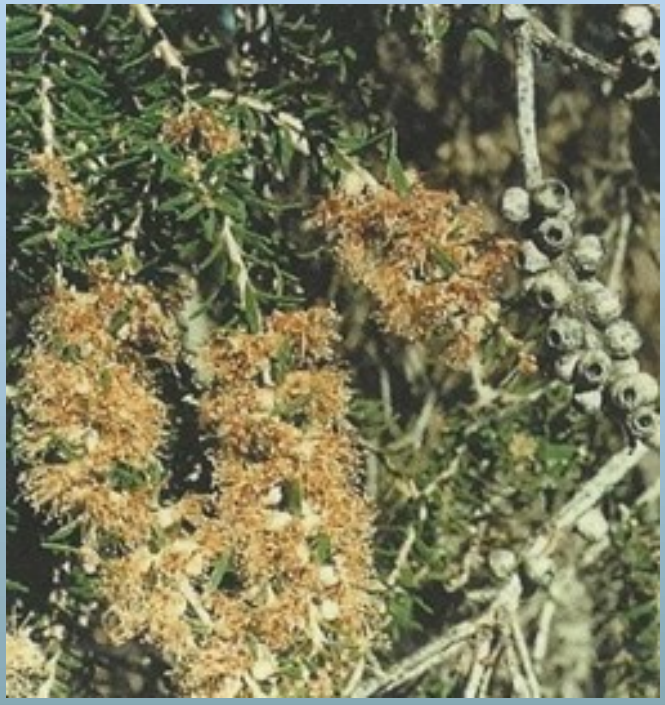
Medium sized shrub or small tree, growing 4-7m tall, with a dense domed canopy.
Flowering in Summer.

Habitat

Often grows on saline soils, of various texture and colour, including heavy clays subject to periodic waterlogging and around margins of lakes.

Uses

Rarely grazed but often used for shelter belts. Produces good yields of light amber honey. Timber mostly of poor size, but is durable and suitable for fence posts, very salt tolerant.



Belah

Casuarina cristata

Form

Tree, growing to 15-20m tall, with dark scaly bark.
Mostly flowering in summer and autumn

Habitat

Most common on clay or clay-loam soils in the central part of NSW, extending to Qld, often on soils that are subject to flooding or short term waterlogging. Often occurring as clumps of timber.

Uses

The foliage is readily browsed by stock, mainly cattle. The wood has limited use in fencing, but makes reasonable firewood. Used extensively in shelter belts and windbreaks.

Butterbush

Pittosporum angustifolium

Sometimes known as Weeping Pittosporum, Berrigan, Native Willow, Native Apricot, Western Pittosporum, Apricot Tree, Bitter Bush, Cattle Bush, Poison Berry Tree.

Form

Weeping tree growing occasionally to 10 metres. Leaves are long and narrow, ending in a slight hooked point. Flowers are cream or yellow in colour and occur singly or in clusters. They are followed by woody, orange, round or apricot-shaped fruits, which split open at maturity to reveal bright red seeds. These fruits mature over several months and often remain on the plant for long periods. Seeds are irregular in size and shape.
Typically flowers during winter spring.

Habitat

Woodland and mallee, and widespread on sandy soils in the arid zone
Shrub or small tree to 10m high. Virtually hairless with drooping branches, whitish or mottled trunk, narrow leaves 4-12cm long and characteristic orange fruit.
Tolerates drought and frost. Prefers full sun. Resents waterlogging.

Uses

Useful low-level cover in windbreaks
Cut for emergency fodder in drought.
Very palatable to livestock.

Pink Flowering Yellow Gum

Eucalyptus petiolaris syn. leucoxylon rosea

this small tree is an ideal ornamental for any garden. Growing to just 6 metres it also makes a useful shade or windbreak tree and produces a very nice honey.

Form

The Pink-Flowered Yellow Gum or White Ironbark (Eucalyptus petiolaris syn, leucoxylon rosea) is the only ironbark with a smooth gum-like bark. A native of the South Australian mallee country, this small tree is both drought, frost and wind tolerant. With an attractive trunk, grey-green leaves, showy deep pink flowers in threes and an Autumn/Winter flowering period, Growing to just 6 metres it also makes a useful shade or windbreak tree and produces a very nice honey.

Habitat

Uses

Useful low level cover in windbreaks

McKindlays Nursery Plant List 2020

McKindlay's Riverine Nursery, 1323 Perricoota Road, PO Box 32, Moama NSW 2731

Email: mckindlays@bigpond.com

Call us: Felicity: 0408 641 222 John: 0448 836 248

BOTANICAL NAME	COMMON NAME	HEIGHT	SOILS
Acacia acinacea	Gold dust wattle	50cm-2m	Loam
Acacia brachbotrya	Grey leaf mulga	1-4m	Sandy
Acacia brachbotrya	Grey leaf mulga	1-4m	Sandy
Acacia dealbata	Silver wattle	2-30m	Loam
Acacia decora	Western Golden wattle	2-3m	Loam
Acacia hakeoides	Western black wattle	2-8m	Loam
Acacia dealbata	Silver wattle	2-30m	Loam
Acacia decora	Western Golden wattle	2-3m	Loam
Acacia hakeoides	Western black wattle	2-8m	Loam
Acacia implexa	Hickory wattle	2-8m	Loam
Acacia iteaphylla	Flinders ranges wattle	2-4m	All
Acacia melanoxylon	Blackwood	10-20m	All
Acacia montana	Mallee wattle	1-3m	Loam
Acacia oswaldii	Miljee	2-6m	All
Acacia paradoxa	Hedge wattle	2-4m	All
Acacia pendula	Boree	5-10m	All
Acacia pycnantha	Golden wattle	3-8m	Loam
Acacia rigens	Nealie	1-4m	Sand
Acacia salicina	Native willow	3-12m	All
Acacia stenophylla	River cooba	4 -10m	All
Allocasuarina leuhmannii	Bull oak	5 -15m	Loam
Atriplex nummularia	Oldman saltbush	1-3m	All
Bursaria spinosa	Native blackthorn	1-8m	Loam
Callistemon brachyandrus	Prickly bottlebrush	1-5m	All
Callistemon citrinus	Crimson bottlebrush	1-3m	All
Callistemon sibieri	River bottlebrush	2-7m	Loam
Callistemon salignus	White weeping bottlebrush	2-8m	All
Callistemon viminalis	Crimson weeping bottlebrush	2-6m	All

Callitris gracilis subsp. murrayensis	Murray cypress pine	5-16m	Sand
Casuarina cristata	Belah	10-15m	Clay
Casuarina cunninghamiana	River sheoak	10-20m	All
Casuarina glauca	Swamp oak	6-20m	All
Chenopodium nitrariaceum	Nitre goosefoot	1-2m	All
Clematis microphylla	Narrow leaf clematis	Climber	Sand/Loam
Dianella revoluta	Flax lily	50cm	All
Dillywynia cinerescens	Showy parrot pea	1m	All
Dodonea angustissima	Narrow leaf hop bush	1-4m	Loam
Dodonea cuneata	Wedge leaf hop bush	1-2m	Loam
Enchyleana tomentosa	Ruby saltbush	20-80cm	All
Eucalyptus camaldulensis	River red gum	12-45m	All
Euc. camaldulensis var. silverton	Silverton gum	12-45m	All
Corymbia. citriodora	Lemon Scented gum	12-40m	All
Euc. largiflorens	Black box	10-20m	Clay
Euc. leucoxylon-rosea	Pink flowering gum	4-10m	All
Euc.maculata	Spotted gum	15-30m	All
Euc. melliodora	Yellow box	12-30m	Loam
Euc. microcarpa	Grey box	10-20m	Loam
Euc. occidentalis	Swamp yate	10-25m	Clay
Euc. sideroxylon-rosea	Red flowered ironbark	10-20m	All
Euc sideroxylon	red iron bark	10-20m	All
Eutaxia microphylla	Mallee pea bush	1-2m	Loam
Hakea tephrosperma	Hooked needlewood	2-4m	Loam
Indigo australis	Indigo plant	1-2m	Clay
Melaleuca decussata	Cross-leaf honey myrtle	2-4m	All
Melaleuca lanceolata	Moonah	1-8m	All
Melaleuca linariifolia	Snow-in-summer	1-8m	All
Melaleuca styphelioides	Prickely paperbark	1-8m	All
Myoporum platycarpum	Sugar wood	10m	Clay/loam
Pittosporum phylliraeoides	Butterbush	3-7m	All
Rhagodia spinescens	Hedge saltbush	1m	All
Senna artemseioides	Punty bush	2-3m	Sand/Loam

ROCHESTER NURSERY

TUBESTOCK

BOTANICAL NAME	COMMON NAME	Order QTY
Acacia acinacea	Gold Dust Wattle	
Acacia baileyana Purpurea	Purple Tip Cootamundra Wattle	
Acacia brachybotrya	Grey Mulga	
Acacia cardiophylla	Western Wyalong Wattle	
Acacia covenyi	Blue Bush	
Acacia dealbata	Silver Wattle	
Acacia drummondii ssp elegans	Drummond's Wattle	
Acacia floribunda	Catkin Wattle	
Acacia genistifolia	Spreading Wattle	
Acacia glaucoptera	Flat Wattle, Clay Wattle	
Acacia hakeoides	Hakea Wattle	
Acacia implexa	Lightwood	
Acacia iteaphylla	Flinders Range Wattle	
Acacia mearnsii	Black Wattle	
Acacia montana	Mallee Wattle	
Acacia oswaldii	Umbrella Wattle	
Acacia pendula	Weeping Myall	
Acacia podalyriifolia	Mount Morgan Wattle	
Acacia pravissima	Ovens Wattle	
Acacia pycnantha	Golden Wattle	
Acacia salicina	Native Wattle	
Acacia stenophylla	River Cooba	
Acacia williamsonii	Whirrakee Wattle	
Allocasuarina littoralis	Black Sheoak	
Allocasuarina luehmannii	Buloke	
Angophora costata	Smooth Barked Apple	
Atriplex nummularia	Old Man Saltbush	
Atriplex semibaccata	Creeping Saltbush	
Banksia integrifolia	Coastal Banksia	
Banksia marginata	Old Man Banksia	
Banksia serrata	Saw Banksia	
Brachychiton populneus	Kurrajong	
Bursaria spinosa	Sweet Bursaria	
Callistemon citrinus	Crimson Bottlebrush	
Callistemon pallidus	Lemon Bottlebrush	
Callistemon salignus	Willow leaf Bottlebrush -Yellow	
Callistemon salignus Rubra	Willow leaf Bottlebrush - Pink	
Callistemon sieberi	River Bottlebrush	
Callistemon viminalis	Weeping Bottlebrush	
Callitris glaucophylla	White Cypress Pine	
Carex appressa	Tall Sedge	
Casuarina cunninghamiana	River Sheoak	
Chamaecytisus palmensis	Tree Lucerne	
Dianella revoluta	Black Anther Flax Lily	

6708 Northern Hwy Rochester Vic 3561
email: info@rochesternursery.com.au
phone: 03 5484 3777
www.rochesternursery.com.au
Instagram: @rochesternursery

PLEASE NOTE... ALL SPECIES ARE SUBJECT TO AVAILABILITY AT TIME OF ORDERING

ROCHESTER NURSERY

TUBESTOCK

BOTANICAL NAME	COMMON NAME	Order QTY
Dianella tarda	Late Flowering Flax	
Dodonaea viscosa cuneata	Wedge Leaf Hop Bush	
Einada nutans	Knodding Saltbush	
Enchylaena tomentosa	Ruby Saltbush	
Eucalyptus albens	White Box	
Eucalyptus albida	White Leaved Mallee	
Eucalyptus caesia ssp magna	Silver Princess	
Eucalyptus camaldulensis	Red River Gum	
Eucalyptus cinerea	Argyle Apple	
Eucalyptus (Corymbia) citriodora	Lemon Scented Gum	
Eucalyptus erythrocorys	Red-Capped Gum, Illyarrie	
Eucalyptus (Corymbia) eximia nana	Dwarf Bloodwood	
Eucalyptus (Corymbia) ficifolia	W.A Flowering Gum	
Eucalyptus forrestiana	Fuchsia Gum	
Eucalyptus grossa	Coarse Leaved Mallee	
Eucalyptus kingsmillii	Kingsmill's Mallee	
Eucalyptus kruseana	Kruse's Mallee	
Eucalyptus largiflorens	Black Box, River Box	
Eucalyptus latens X kruseana	Moon Lagoon	
Eucalyptus leucoxylon	Yellow Gum	
Eucalyptus leucoxylon Rosea	Pink Flowering Yellow Gum	
Eucalyptus leucoxylon ssp megalocarpa	Large flowering Yellow Gum	
Eucalyptus (Corymbia) maculata	Spotted Gum	
Eucalyptus melliodora	Yellow Box	
Eucalyptus microcarpa	Grey Box	
Eucalyptus latens Moon Lagoon	Moon Lagoon	
Eucalyptus nicholii	Narrow-Leaf Peppermint	
Eucalyptus nutans Syn: E. cernua	Red Flowered Moort	
Eucalyptus orbifolia	Round Leaved Mallee	
Eucalyptus platypus ssp platypus	Round-Leafed Moort	
Eucalyptus platypus Red flowers	Red Flowering Moort	
Eucalyptus pleurocarpa	Silver Marlock	
Eucalyptus polyanthemos	Red Box	
Eucalyptus preissiana	Bell Fruited Mallee	
Eucalyptus pulverulenta	Silver Leaf Gum	
Eucalyptus salmonophloia	Salmon Gum	
Eucalyptus sargentii	Sargent's Mallet	
Eucalyptus sideroxylon	Ironbark	
Eucalyptus sideroxylon rosea	Pink Flowering Ironbark	
Eucalyptus stoatei	Pear Gum	
Eucalyptus torquata	Coral Gum	
Eucalyptus tricarpa	Red Ironbark	

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TUBESTOCK

BOTANICAL NAME	COMMON NAME	Order QTY
Eucalyptus viridis	Green Mallee	
Eucalyptus websteriana	Heart Leaved Mallee	
Eucalyptus woodwardii	Lemon Flowered Gum	
Eucalyptus youngiana	Large Fruited Mallee	
Eutaxia microphylla	Mallee Bush Pea	
Eutaxia diffusa	Common Eutaxia	
Grevillea robusta	Silky Oak	
Hakea francisiana	Emu Tree	
Hakea laurina	Pin Cushion Hakea	
Hakea salicifolia	Willow leaf Hakea	
Hakea tephrosperma	Hooked Needlewood	
Hardenbergia violacea	Purple Coral Pea	
Kennedia prostrata	Running Postman	
Leptospermum petersonii	Lemon Scented Tea Tree	
Lomandra longifolia	Mat Rush	
Maireana brevifolia	Cotton Bush	
Maireana decalvans	Black Cotton Bush	
Melaleuca decussata	Cross Leaf Honey Myrtle	
Melaleuca halmaturorum	Salt Paperbark	
Melaleuca incana	Grey Honey Myrtle	
Melaleuca lanceolata	Moonah	
Melaleuca laterita	Robin Red Breast Bush	
Melaleuca linariifolia	Snow In Summer	
Melaleuca nesophila	Lavender Paperbark	
Melaleuca styphelioides	Prickly Paperbark	
Melaleuca wilsonii	Violet Honey Myrtle	
Pinus halepensis	Aleppo Pine	
Pittosporum angustifolium	Weeping Pittosporum	
Poa labillardieri	Common Tussock Grass	
Poa labillardieri	Blue Form	
Pycnosorus globosus	Drumsticks	
Rhagodia spinescens	Hedge Saltbush	
Senna artemisioides	Silver Cassia	

Tree Guards	
2 litre Milk Carton tree guards	With 2 Stakes 600mm tall
Plastic Sleeves tree guards	With 3 Stakes 750mm tall

Customer Name:	
Contact Number:	

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Common Name:	General Size:	Pot Size
Drooping Sheoak	3-5m	2"
Large Drooping Sheoak	6-10m	2"
Crimson Bottlebrush	1-4m	2"
Albany Bottlebrush	1-3m	2"
Scarlett Bottlebrush/Firey Bottlebru	0.5-3m	2"
Murray Pine	4-8m	2"
Mallee Cypress Pine	4-8m	2"
Swamp Sheoak	12-15m	2"
Nitre Goosefoot	1-2m	2"
Red Flowering Gum	8-10m	2"
Spotted Gum	40-60m	2"
White Leaf Mallee	3-5m	2"
Purple Flowering Mallee	3-5m	2"
Burracoppin Mallee	1-5m	2"
Silver Princess	6-8m	2"
Argyle Apple/Silver Dollar Tree	15-30m	2"
Lemon Scented Gum	20-40m	2"
Dwarf Sugar Gum	6-12m	2"
Crowned Mallee/Mitre Gum	4-6m	2"
Rough Fruited Mallee	4-15m	2"
Silver Mallee	3-8m	2"
Slender Mallee	1-5m	2"
Red Capped Mallee	1-6m	2"
Crebra/Narrow Leaf Ironbark	20-30m	2"
Illyarrie	3-8m	2"
Fuschia Gum	4-6m	2"
Kingsmill's Mallee	1.5-8m	2"
Book Leaf Mallee	1.5-2.5m	2"
Tammin Mallee	1-8m	2"
Red Flowering Yellowgum	12-15m	2"
Warted Yate	4-8m	2"
Fine Leaf Mallee	2-3m	2"
Red Mallee	10-12m	2"
Round Leaf Mallee	3-8m	2"
Silver Mallee	6-10m	2"
Platypus Gum	5-7m	2"
Purple Leaf Mallee	3-7m	2"
Bell Fruited Mallee	2-3m	2"
Silver Leaf Mountain Gum	5-9m	2"
Pear Fruited Mallee	2-3m	2"
	4m	2"
Salmon Gum	10-25m	2"
Gimlet	4-15m	2"
Red Flowered Ironbark	10-20m	2"
Scarlett Pear Gum	2-7m	2"
Jimyngia Mallee	3-4m	2"
Square Fruited Mallee	1-3m	2"
Torwood	8m	2"
Hook Leaf Mallee	2-8m	2"
Heart Leaf Mallee	3m	2"
Lemon Flowered Gum	6-15m	2"
Large Fruited Mallee	3-10m	2"
Hooked Needlewood	3-12m	2"
Prickly Paperbark	10-15m	2"
Bush Apricot/Butterbush	6-10m	2"
Desert Cassia	2-3m	2"

Tulla Natives

Phone:
Stacey: 0419 296 410
Marc: 0448 627 288

Address: 7120 Wakool Road, Wakool NSW, 2710 Australia

We began Tulla Natives in 2015.

Initially, we began with a passion for gardening and native plants. We loved it so much we began germinating our own seed and that soon flourished into our native nursery and cut flower & foliage plantation.
The process of planting the cut flower plantation involved germinating our own seed to ensure reliable plant stock. Eventually, after the plantation was complete (or so we thought)- we continued to germinate our own seed, and this led to creating the nursery we have today. We are still continuing to expand the cut flower & foliage plantation due to increasing demand and have thus far 35 acres under intense plantation.
We are extremely proud of our growing business. We thoroughly enjoy what we do and absolutely love working with customers to achieve great gardens and plantations!

We are now able to offer contract planting for wholesale stock, and are closely following the incredible demand in revegetation and carbon reduction plantations. We are incredibly excited for the future of our growing business.

To date in the nursery, we grow a huge range of tree-line and revegetation varieties as well as garden varieties and everything in between. We proudly supply stock to local schools, farms, garden enthusiasts, other local business and also supply various government and private organizations.

As well as the nursery, we are also very excited in the continuing expansion of our cut flower and foliage plantation. We supply local event styling businesses, as well as corporate events and individuals for events such as weddings, birthdays, meetings ect. See more under the 'Cut Flowers & Foliage' tab.

We are also extremely excited to continue growing **Anameka Fodder Shrub** for the Eastern states of Australia under Chatfields National Growers Licence in partnership with CSIRO. We are extremely fortunate to have the support from Dustin & Lisa McCreery from Chatfields nursery, who have helped us begin and continue our journey in growing the amazing Anameka fodder shrub. We are planning to expand significantly in the next few years in this space. Please go to the *Anameka (TM)* tab for further information.

Tasmanian Blue Gum	20-40m	2"
Jam Wattle	3 - 7m	2" & 3"
Hakea Wattle	2-4m	TRAY
Flinders Rangers Wattle	2-4m	TRAY
Small Cooba	1-5m	2" & TRAY
Buloke	10-20m	2" & TRAY
Lerp Mallee	5-8m	2" & TRAY
Swamp Mallet	8-12m	2" & TRAY
Knife Leaf Wattle	2-3m	3"
Pallinup Gold	50cm	3"
Sandpaper Wattle	2-4m	3"
Fern Leaf Wattle	3-14m	3"
Panjang/Lime Sand Wattle/Glow W	0.5-2m	3"
Zig-Zag Wattle	3-5m	3"
Mt Morgan Wattle	5-7m	3"
Ovens Wattle	2-8m	3"
Desert Carpet	0.5m - 1.5m	3"
Mudgee Wattle	2-6m	3"
Willow Myrtle	8-10m	3"
Common Astartea	1-1.5m	3"
Swamp Bottlebrush	2-3m	3"
Kurrajong Tree	10-20m	3"
Wallum Bottlebrush	1-2m	3"
Lemon Bottlebrush	2-3m	3"
Alpine Bottlebrush	1-2.5m	3"
Weeping Bottlebrush	1-10m	3"
	2-6m	3"
	1m	3"
Dwarf Clawflower	50cm	3"
Dense Clawflower	0.5-2m	3"
One sided Bottlebrush/Crimson Ne	1-3m	3"
One sided Bottlebrush/Yellow Netb	1-3m	3"
One sided Bottlebrush/Crimson Ne	1-3m	3"
Silky Leaf Blood Flower	1-2m	3"
Wooley Netbush/Silky Netbush	0.5-1.5m	3"
	1m	3"
Spotted Emu Bush	1.5-2m	3"
Silky Oak	10-30m	3"
Bird Beak Hakea	1.5-3m	3"
Dagger Hakea	2-3m	3"
White Kunzea/Tick Bush	3-5m	3"
Scarlet Kunzea	2m	3"
	2-5m	3"
Spearwood	3-4m	3"
Violet Kunzea	0.5-1.5m	3"

Granite Kunzea	1-3m	3"
	1-2m	3"
Pink Tea Tree	1-3m	3"
Lemon Scented Tea Tree	1-2.5m	3"
Tantoon/Yellow Tea Tree	1-3m	3"
Round Leaf Tea Tree	3m	3"
Silver Tea Tree	2-3m	3"
Bracelet Honey Myrtle	3-5m	3"
Goldfields Bottlebrush	2m	3"
Heart Leaf Honey Myrtle	0.5-2.5m	3"
	0.5-3m	3"
Green Honey Myrtle	2-3m	3"
Scarlet Honey Myrtle	1-3m	3"
Scarlet Honey Myrtle	1-3m	3"
Slender Honey Myrtle	2m	3"
Mauve Honey Myrtle	1-1.5m	3"
Grey Honey Myrtle	1-2m	3"
Robyn Redbreast	1-1.5m	3"
Hillcock Bush	1.5m	3"
Claw Honey Myrtle	0.5-2m	3"
Broad Leaf Paperbark	15-20m	3"
Graceful Honey Myrtle	0.5-2.5m	3"
	1.5-2.5m	3"
Pom Pom Honey Myrtle	0.5-2m	3"
	1-5m	3"
Sand Wattle Myrtle	1-4m	3"
	1-2.5m	3"
	2m	3"
Broad Leaf Paperbark	3-10m	3"
Gondwana Christmas Tree	3m	3"
Silver Cassea	1-3m	3"
Purple Cootamundra Wattle	5-8m	3" & 6"
Various		3" & 6"
Violet Honey Myrtle	1.5m	3" & TRAY
Pinbush/Burkitt's Wattle	1-4m	6"
Spreading Wattle	3m	6"
Flat Wattle/Clay Wattle	1-1.5m	6"
Rock Wattle	1-2m	6"
Wooleybush	1-4m	6"
Persian Silk Tree	5m	6"
Sydney Red Gum	20-30m	6"
Tall Green Kangaroo Paw	1m	6"
Tall Red Kangaroo Paw	1m	6"