Native forage shrubs
for low-rainfall areas

A guide to successfully using shrub–pasture mixes for grazing livestock

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A step-by-step guide to using this publication to successfully implement a shrub–pasture mix

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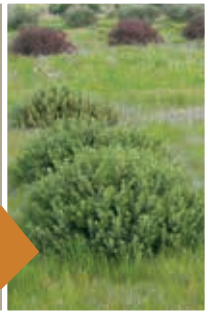

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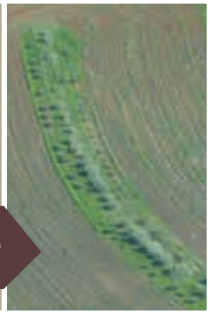

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Key points for successful shrub–pasture system utilisation

The building blocks of the system

- A mix of forage plants (shrubs, pasture and/or forage crops) will provide livestock with the complete suite of nutrients and minerals.
- A mix of shrub species decreases the chance of losses through specific pests and diseases and increases the range of nutrients on offer to livestock.
- Pasture options for shrub-based systems include annual legumes and grasses and forage cereals.
- The forage shrub mix will depend on soil type and constraints, such as salinity and waterlogging.

Preparation and planning

- Place orders with a forage shrub supplier before the end of November the year before planting.
- Prioritise weed control before planting.
- Deep rip shrub lines at least 2–3 months before planting.
- Adequate soil moisture at planting is critical.
- Plant seedlings with well-developed root systems, which have been hardened off in the nursery.
- When direct seeding always use fresh seed, less than one year old, and sow at a shallow depth (5mm).

Paddock layout

- Block planting consists of shrubs planted at a higher density in a relatively uniform configuration.
- Alley planting consists of belts of shrubs alternated with alleys of pasture or crops.
- If planting shrubs to reduce wind speed use a mix of shorter and taller species.
- Shelter is proportional to the height of vegetation.
- Curved rows of shrubs allow protection from differing wind directions.

Shrub–pasture system management

- Grazing management is critical for both livestock and the shrub–pasture mix.
- Past experience is a major factor influencing diet selection. Management strategies can modify diet selection.
- Grazing annually keeps forage shrubs leafy and at a height accessible to all livestock.
- Forage shrubs recover from grazing more slowly than herbaceous plants.
- Rest periods between grazing are critical — set stocking increases the risk of shrub regrowth being overgrazed.

Introduction and overview

This publication draws on a decade of work from the former Future Farm Industries Cooperative Research Centre (FFI CRC) *Enrich* project and local work instigated by the Mallee Catchment Management Authority (CMA).

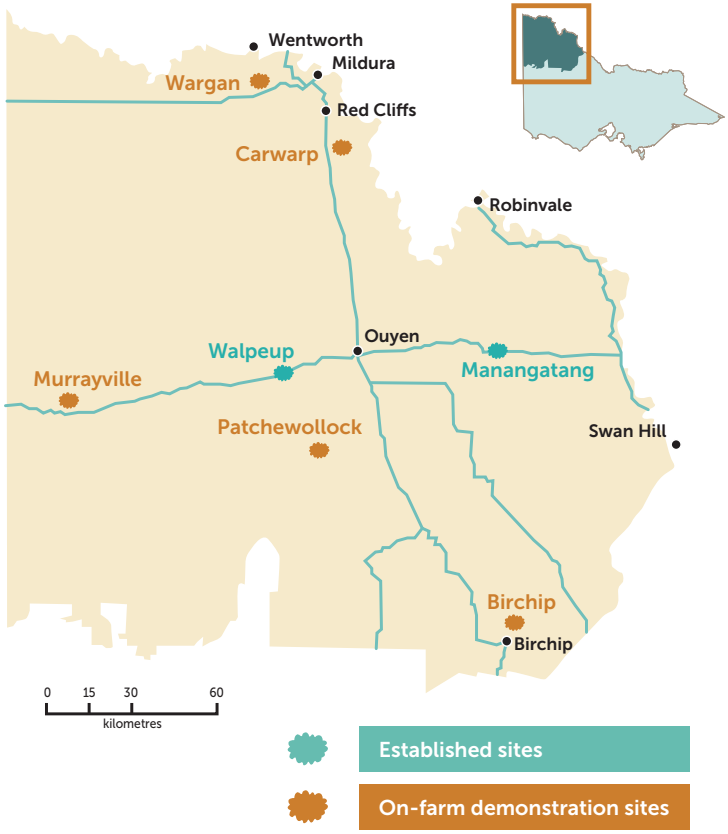
> *The national* Enrich *research project developed more productive shrub-based grazing systems, particularly in low-to-medium rainfall zones, through employing a mix of Australian native species along with grazing management approaches based on animal nutrition and behaviour.*

The results from *Enrich* are contained in two booklets: *Perennial forage shrubs providing profitable and sustainable grazing: Key practical findings from the* Enrich *project* and *Perennial forage shrubs — from principles to practice for Australian farms*. These booklets contain details of the species selection process, basic information on the forage traits of all 101 species tested during the project, detailed results of the most promising species, including their productivity and nutritive value along with management techniques to successfully utilise forage shrub systems. Both booklets can be downloaded from the Pasture Improvement Initiative website: http://pastureimprovementinitiative.com.au/research/enrich/

This publication forms a companion to these earlier works, providing practical instruction guidelines on all aspects of planning, establishing and using shrub-based grazing systems. It has an emphasis on the Victorian Mallee region, but will be equally useful for landholders wishing to implement shrub-based systems throughout southern Australia.

A decade of research has led to the development of more-productive shrub–pasture systems utilising a mix of elite native forage shrub species.

Location of forage shrub sites in the Mallee CMA region

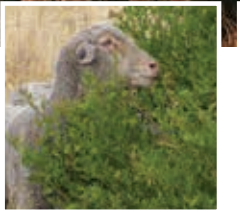


How it all began

The Mallee CMA started collaborating with the *Enrich* project team during 2008, establishing a local experimental site at Walpeup, in north-west Victoria to explore shrub species' performance. Continued work resulted in a larger site with a smaller set of species being planted at Manangatang during 2011.

Five on-farm demonstration sites were planted during 2015, covering a range of environments across the Mallee CMA region. These demonstration sites were planted with an elite mix of forage shrub species and designed to enable landholders to use and manage them as part of their whole farming system.

1. What shrub–pasture systems provide



At a glance

- **Shrub–pasture systems can reduce farm business risk, provide a level of predictability for annual feed budgets and offer a source of productivity in challenging areas.**
- **Shrubs can help fill seasonal feed gaps and allow deferred grazing of annual pastures and cereals.**
- **Shrubs can support both livestock and natural resource management (NRM) gains across the whole farm system.**
- **Forage shrubs protect and shelter soil, crops, pastures and livestock, and provide a habitat for birds, reptiles and insects.**

The reasons for using forage shrub-based systems are numerous and benefits can span both livestock production and natural resource management (NRM). The key reasons behind the decision to incorporate shrubs will shape the planting layout and the way forage shrubs are used within the whole farming system.

Reasons for planting forage shrubs

- Feed supply
  - predictable feed contribution
  - flexibility in time of use
  - source of protein and minerals
  - deferred grazing of annual pastures and grazing cereals
- Shade and shelter
- Reduced farm risk
- Soil erosion
- Recharge
- Biodiversity

The perennial shrubs covered in this guide can provide green feed during dry periods, can tolerate difficult conditions, will regrow after heavy grazing once or twice a year and respond rapidly to favourable seasonal conditions. They are not, however, miracle plants — they do not grow as fast as annual grasses and are less digestible than fresh legume pastures.

The successful use of forage shrubs depends on the combination of shrubs and inter-row pasture and the way in which they are grazed.

When the timing and amount of rain is unpredictable, forage shrubs can provide an element of predictability to feed budgeting. They can be grazed at various times of the year, adding flexibility to whole-farm grazing management. From a nutritional point of view, they provide moderate-to-high levels of crude protein and minerals, which complement senesced (dry) annual pasture or crop stubbles. Shrubs also can provide digestible energy at times of the year when it is needed most, allowing the deferred grazing of annual pastures and grazing cereals, which impacts significantly on whole-farm feed supply over many months.

It is important to view perennial shrubs in the context of how they can contribute to 'whole-farm management' in terms of the best use of difficult soil types and land capabilities, reliability and predictability in feed supply and how different parts of the farm can be used at different times of the year. When incorporated strategically in this way, forage shrubs offer a valuable risk management tool to the whole-farm system.

From an NRM perspective, the deep roots, longevity (10–20 years at least) and vertical structure of perennial forage shrubs deliver additional benefits in terms of shade and shelter for both livestock and adjacent pasture (or crop) plants, using or intercepting ground water, reducing risk of wind erosion by slowing wind speed at ground level, providing ground cover during dry months, and providing habitat for birds, reptiles and insects.

Forage shrubs deliver a wealth of benefits for livestock production and natural resource management.

Shrub–pasture systems — how they can work

The following four scenarios illustrate how forage shrubs can contribute to the farming system:

1. Fill an autumn feed gap

Residual pastures and crop stubbles often provide adequate feed during summer, but hand feeding is common during autumn. Feeding is time consuming and expensive. Converting paddocks or patches of land not suitable for cropping to a shrub-based system can provide a reliable source of green feed during autumn, when annual pasture species are at their lowest nutritional quality. The high protein in the shrub foliage complements the high fibre content of the dry pasture. Shrubs also provide a source of minerals, such as sulphur, which together with nitrogen are critical for rumen (gut) microbes to efficiently break down feed and convert it into digestible energy.

> *Recent research has shown that young sheep can grow up to 200g/head/day without grain supplementation during autumn in a diverse shrub–pasture paddock.*

For autumn grazing, shrubs will be the major component of the selected diet — probably about two-thirds shrubs, one-third pasture — although the proportions will depend on the amount of pasture available and its quality.

Handy hints

- **Ewe nutrition:** *A paddock primarily used to fill the autumn feed gap can also be used to meet the high nutritional demands of pregnant ewes. Research has shown the developing foetus is affected by the ewe's consumption of saltbush (and potentially other shrub species) in a way that helps the lamb when it grazes the shrubs after weaning.*
- **Wool production:** *In a rare case of a true bonus, the offspring of saltbush-fed ewes grow 10% more wool.*
- **Maintaining ewe condition:** *The high demands of late pregnancy and lactation (after lambing) mean it is important to closely monitor ewe body condition score. Provide supplementary feed if required (maintain single-bearing ewes at CS3.0 and twin-bearing ewes at CS3.0+).*

The combination of forage shrubs and pasture can be a valuable and nutritious source of feed during autumn.

Pasture is a critical component of the overall feedbase — shrubs alone cannot provide enough metabolisable energy (ME) for livestock production. A paddock used to fill an autumn feed gap may benefit from being locked up the previous spring to carry forward pasture to the following autumn. Far from wasting green feed, the dry pasture combined with the green shrubs will be a valuable source of feed during autumn — much better than dry pasture alone.

For shrubs to provide the bulk of an autumn diet, enough shrub forage needs to be available to make a difference to the overall feed budget. Insufficient shrub forage leads to poor-quality autumn pasture making up the greatest proportion of the diet and the complementary benefits of a shrub–pasture mix are not achieved. Either increasing the area planted to shrubs or increasing shrub density (planting more shrubs per hectare) can increase the supply of feed from shrubs, but there is a limit to increasing shrub density — too many shrubs will result in heavy competition. This limit depends on soil type, but as a guide will be about 1000 plants/ha.

2. Avoid a winter shortfall

In many parts of southern Australia, a reliable autumn break is a thing of the past. After opening rains, a dry spell — often accompanied by cold weather during early winter — creates extra pressure on the feed supply. In such a case there is a need to let the slow-to-start legume pastures establish and dual-purpose cereals may not yet be ready for grazing. Consequently, a lack of early winter feed can limit livestock production. Grazing forage shrubs can prevent the need to sacrifice a pasture paddock and reduce the time and expense of hand feeding during winter.

Similar to *Filling an autumn feed gap*, a shrub-based paddock can provide a reliable feed source at what can be a tricky time of year to ensure feed supply. Analysis of whole-farm profit suggests shrub-based paddocks are optimally grazed around the break of season — when other forage resources need time to establish and grow.

Grazing a shrub-based paddock during winter can also improve lamb survival due to shelter effects. Rather than hoping ewes and newborn lambs will seek shelter (which they sometimes do and sometimes don't), providing feed and shelter in the one area ensures shelter is obtained.

Handy hints

Forage shrubs can be grazed just after the break of season to bolster annual pastures on other areas of the farm. Deferring the grazing of annual-based pastures on other parts of the farm, for as little as just one or two weeks after germination, can increase pasture growth by 15–40% and paddock gross margins by 7–10%.

These deferred-grazing benefits are usually the major reason why incorporating forage shrubs boosts whole-farm profit.

3. Provide a spring top-up

During spring, some pasture paddocks may be locked up to: maximise pasture seed set for next year's grazing, support spray topping for weed control ahead of cropping the following year, or to save pasture for grazing during early summer before moving to crop stubbles. Shrub-based paddocks can help support any of these strategies.

A shrub paddock grazed during autumn could be grazed again during spring — shrub species recommended in this guide can be grazed twice a year.

Shrub-based paddocks that have been grazed during autumn also can provide a source of top-up feed during spring.

In fact, the annual production of edible dry matter (DM) from the recommended shrubs is virtually the same with grazing once or twice a year. If the leaves are not eaten, the growth of the shrubs slows down.

Avoid grazing new re-growth on shrubs, as this will stress the plants and can kill them.

Handy hints

A number of shrub species (e.g. rhagodia, ruby saltbush) have been found to have anthelmintic (internal parasite control) effects.

This is another potential advantage of using forage shrubs and highlights the multiple benefits on offer in addition to shrubs being 'just another feed source'.

4. Return unproductive areas to productivity

Most farms have areas that are not profitable for cropping. These areas may have become depleted in nutrients, show early signs of salinity (discharge area), be in critical recharge parts of the landscape, or at higher risk of wind erosion. Rather than writing off these areas (or entire paddocks) they can be regenerated with shrubs. Shrubs are resilient and tolerant plants suited to harsh conditions. Their growth allows other plants to colonise the inter-row.

In many cases, areas of lower productivity are irregular in shape and located in various pockets around the farm. There is no doubt this makes them trickier to manage, but the good news is, regenerating patches doesn't mean they are lost to farm production because they can be used strategically for grazing at any time of year.

> *Relieving pressure from grazing on other parts of the farm, for even short periods of a few weeks, can benefit whole-farm productivity.*

The downside of managing patches of otherwise unproductive land is the extra up-front cost of fencing and delivering drinking water to the areas so they can be grazed. Fencing costs can be reduced if the shrub patch and the rest of the paddock are treated as a whole management unit.

Handy hints

Research shows the potential for pockets of native plants to provide a habitat for desirable insects, which can support integrated pest management (IPM) systems. Many of the shrub species recommended also harbour desirable invertebrates. It's hard to put a precise dollar amount on such benefits, but there is a value nonetheless.

On the downside, shrubs can also create habitats for fox dens or rabbits. So monitor closely if this could be an issue (especially at lambing time with foxes).

The combination of crop stubbles and shrubs can be effective, especially while there is still some grain on the ground. However, in large cropping paddocks with small patches of shrubs, animals need to learn to combine the shrubs with the crop stubble into their daily diet, so grazing management that provides appropriate livestock experiences becomes important (this is covered in more detail on page 36).

Shrubs can bring otherwise unproductive areas of the farm back into production.

Temporary fencing is an effective method to achieve even grazing of shrubs and pasture.

Farmer: Ian McNabb

Location: Carwarp, Victoria

Property size: 2800ha

Average annual rainfall: 260mm

Soil types: West limestone soils and very light sands (blows all the time) closer to the river

Enterprises: Sheep, cattle and cropping — wheat and feed barley

Forage shrubs: 600ha old man saltbush and river saltbush

Case study

Forage shrubs find fit in mixed farming system

Ian McNabb has been planting forage shrubs across his property for more than 20 years to protect and improve the production from his more fragile country.

"We started planting shrubs mainly because we have a lot of salty country, which is unsuitable for anything else and we wanted to limit the spread of these areas," Ian explained.

"Forage shrubs have allowed us to turn about 600ha of useless ground into grazing country."

"Usually we fence off small isolated salt-affected areas (ranging from 4–6ha) where nothing else will grow and plant the shrubs in rows about 2m apart. In larger areas we are planting the shrubs further apart — up to 6m between each row."

Ian mainly utilises the forage shrubs over summer, when other feed may be limited and early in the year before pasture takes off. "We have lucerne on our better ground for feed and ground water control with grazing wheat and barley over the winter, but the saltbush fills the gaps in between," Ian said.

Complementary livestock system

Ian's grazing system lends itself to a split-calving / split-lambing operation. "During lambing the forage shrubs help keep our SAMM Merino ewes going," Ian said. "We have about 600 ewes and aim to turn off about 1000 lambs a year in 1.5 batches."

Ian uses his lucerne country to fatten the lambs and supports this with winter grazing on his wheat and barley crops. "This winter (2015) we ran out of feed," Ian said. "We put quite a few sheep back on the shrubs over winter.

"Whenever we have a feed gap we pop them in there. Sheep might be in a paddock that has two or three saltpans — we can just open the gate to the shrubs and let them in if feed runs out.

"The added advantage of saltbush is you can flog it out for four weeks and away it goes again. Because the watertable is shallow, the shrubs tap into the underground water — they really haven't got a season and will grow all year so short grazing times work best to get the most from the shrubs."

Management considerations

A clear fan of forage shrubs, Ian has only two important tips for others looking to incorporate saltbush into their system — manage the shrub height and ensure shrubs are given time to recuperate between grazings.

"I've always been a fan of saltbush because it will grow where nothing else will grow and the stock love it," Ian said "The only problem is you have to manage it with plenty of rest between grazings. If you leave stock in our saltbush paddocks they will pick every leaf off so you have to let the shrubs recover. We only use each paddock probably four weeks a year. Some years you may not use any of the paddocks at all, but you still need to manage the growth.

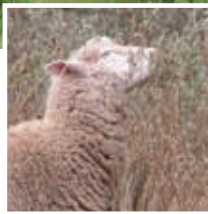
"Cows knock shrubs down to size when growth has been good — sheep can't reach high enough," Ian said. "Some people mechanically top their shrubs to keep them productive, but we just put our cows in."

Ian's existing forage shrub stands consist of old man saltbush (*Atriplex nummularia*), river saltbush (*Atriplex amnicola*), emu bush (*Eremophilia longifolia*) and he is looking to grow the new, Anameka old man saltbush cultivar.

"If we can find a new shrub that is palatable, prolific under our conditions and remains more of a bush than a tall shrub that will be great."

A 10ha demonstration site was established on Ian's property during autumn 2015 to explore a mix of elite forage shrub species for suitability to the area and local farming systems. Species on the site include: old man saltbush, ruby saltbush, tar bush, rhagodia and River Murray saltbush.

2. The building blocks of a shrub–pasture system



The shrub's resilience and year-round growth habit adds some predictability to the feed supply without losing the potential for large amounts of growth of both shrubs and pasture in favourable years.

At a glance

- **A mix of forage plants (shrubs, pasture and/or forage crops) will best provide livestock with the complete suite of nutrients and minerals they need.**
- **Growing a mix of shrub species decreases the chance of losses through specific pests and diseases and increases the range of nutrients on offer to livestock.**
- **Pasture options for shrub-based systems include annual legumes and grasses and forage cereals.**
- **The selection of the best forage shrub mix depends on soil type and constraints, such as salinity and waterlogging.**

Forage shrubs are one part of a shrub-based grazing system — they do not constitute the whole suite of forage plants needed. The combination of forage shrubs and inter-row herbaceous pasture and/or forage crops is what comprises a productive, stable and balanced shrub-based system.

Shrubs grow vertically and inter-row pasture can grow productively right up to the base of the shrub, so the total amount of feed being grown increases in a shrub-based system.

Shrubs have a significant effect on the surrounding microclimate by reducing evaporation with positive results on pasture growth. This is particularly pronounced late in the growing season or after small rainfall events. Shrubs also aid pasture growth and nutrition by recycling nutrients from deep in the soil profile and making them available for the shallower-rooted pastures.

The nutritional needs of grazing livestock vary significantly over time, both between years and within the year. Providing livestock with a forage mix comprised of different plants, each with their own unique combination of nutrients and minerals, increases the chance of fulfilling the requirements of animals during many differing scenarios and potentially reduces the need for supplements.

Shrubs help conserve soil moisture enabling pasture to stay green longer.

> *Total feed intake usually increases with additional plant species on offer — when an animal consumes its limit of one species, it may still consume another species with a different balance of nutrients.*

Just as every person is different, individual animals have different requirements and having a broad forage mix will cater to all individuals within the mob.

Growing more than one species of forage shrub and pasture also decreases the risk of total plant failure due to pests and diseases. During years of research, on several occasions short-term production losses due to various pathogens were observed on a particular species of forage shrub, but not on adjacent species. Where only one species is grown and attacked, the opportunity for any type of production would be lost and so the resilience of the feed supply is increased through growing a number of different species.

Inter-row or companion pasture

Selecting companion pasture species and cultivars for use in a shrub-based system varies little from when growing a stand-alone pasture. Suitability to soil type and rainfall are critical factors.

Total feed intake will increase with a combination of shrubs and pasture or forage crops.

Annual forage crops and pastures

Annual legumes

Annual legumes are particularly suited to growing alongside forage shrubs and include species such as strand medics on lighter alkaline soils and barrel medics on heavy alkaline soils. Other pasture legumes, such as subterranean clover or serradella, are suited to acidic soils. On saline sites, annual pastures such as burr medic and balansa clover are likely to be the best options. Using cultivars with lower levels of hard seed will help ensure good pasture regeneration every year.

Annual grasses, such as ryegrass and wild oats, may be cropping weeds but produce valuable feed in a shrub-based system, especially early in the season.

Research shows that while they are not as productive when grown in close combination with forage shrubs, annual grasses persist and grow well in wider alleyways. Even with a slight reduction in grass productivity, the combined supply of grass and shrubs exceeds what annual grasses alone can provide.

Grazing cereals

Grazing cereals can be sown in alley situations where machinery access is available. On more productive soils, it can be possible to crop the alley and graze the resulting stubble with the forage shrubs over summer and autumn. Growing a crop in the alleys is a particularly effective way to receive a return from the paddock in the first year when the shrubs are too small to graze.

Annual legumes are particularly suited to growing alongside forage shrubs.

Dry sowing cereals, or allowing seed set from the previous year, can provide early bulk to the inter-row pasture. Self-regeneration of oats after hay production in the inter-row during the previous year also can drive winter bulk in the shrub–pasture mix. Livestock are usually keen to consume shrubs when the inter-row pasture is fresh and green with high moisture content.

Perennial grass (right) grown in separated alleys from forage shrubs.

Perennial pastures

Perennial pastures, such as lucerne and cocksfoot, are strongly competitive and if grown alongside forage shrubs, will reduce shrub productivity, particularly during establishment. Over time this situation reverses, resulting in a reduced life of the perennial pasture stand.

Temperate perennial pastures

Temperate perennial pastures are most productive during spring and, particularly in dry conditions, often produce little feed during autumn. If the rationale for growing shrubs is primarily for autumn feed, companion temperate perennial pastures may only provide low quality and quantity feed at this time. In saline environments, tall wheat grass has been shown to be particularly competitive and can reduce old man saltbush production.

Perennial native grasses

Perennial native grasses are well suited to the short-duration intensive grazing used in forage shrub systems and will often naturally appear due to the cessation of cultivation. When considering native grass species as a companion option, keep in mind whether they are mainly winter active (e.g. wallaby grass) or summer active (e.g. windmill grass).

Sub-tropical perennial grasses

Recent research has explored the use of exotic sub-tropical perennial grasses, such as digit and panic grass in the Murray Mallee. These grasses have the advantage of being summer active and provide the potential for green feed at this time. Research has shown that in the Mallee the likelihood of providing green feed outside early summer with such species is low, and if used during autumn, feed quality is also likely to be low. However, in years of above-average summer rainfall, production can be exceptionally high.

If perennial pastures are grown in a shrub-based system, it is essential to spatially separate them from the shrubs, for example, growing them in wide alleys.

Species selection

Historically few forage shrub species have been grown on a commercial scale in Australia besides old man saltbush. However, recent research has revealed a number of species which, when used together, can be productive and persistent in the low-rainfall zones of southern Australia.

As part of the *Enrich* project, 101 species were evaluated for a range of forage traits including productivity, survival, resilience to grazing and feed quality.

The *Enrich* team selected nine species as the most promising across a range of growing conditions and soil types when used as a part of a forage shrub–pasture mix.

Planting a mix of species results in a more stable and productive feedbase than planting areas to a single species.

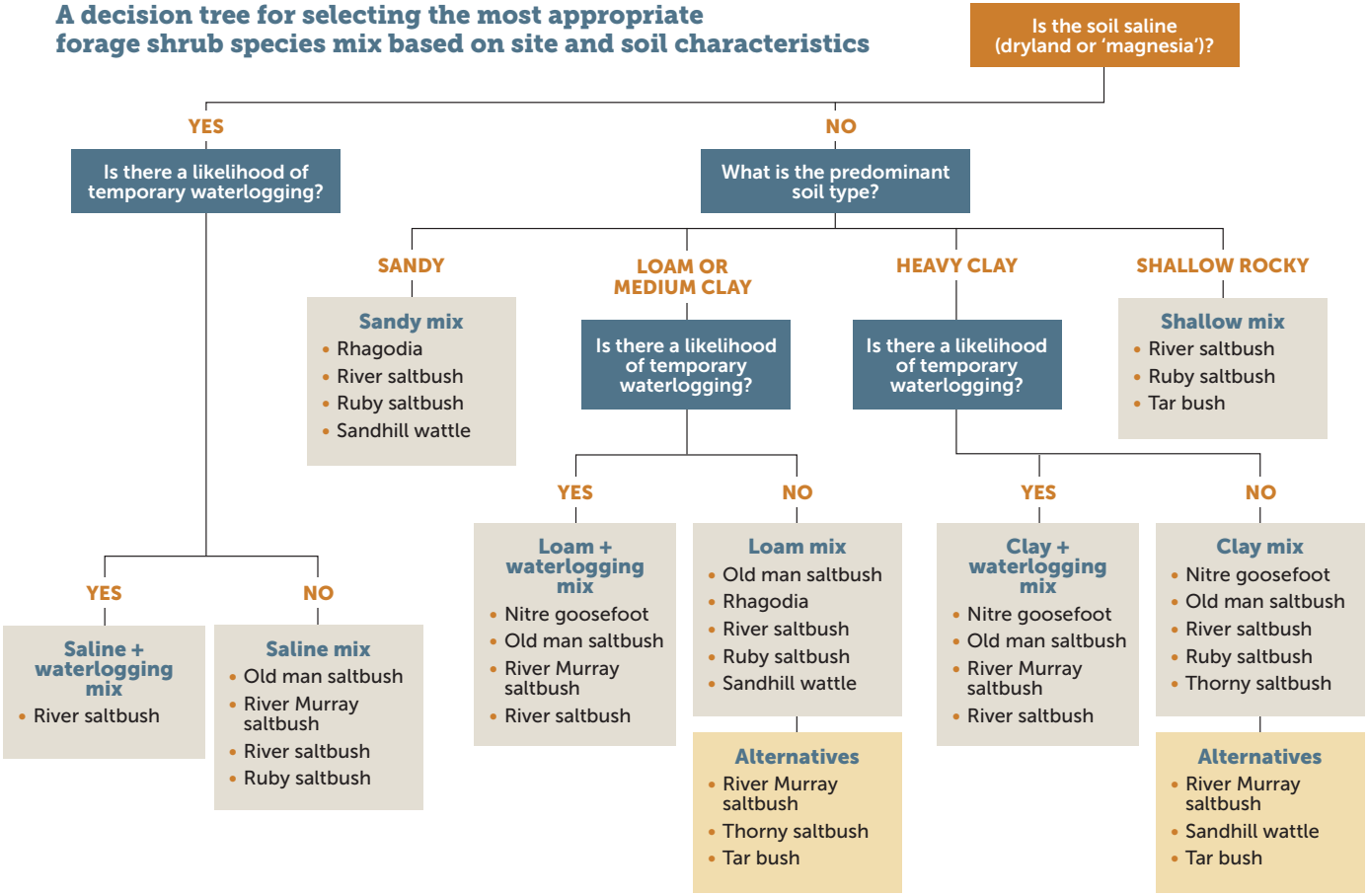
The *Enrich* project's most-promising species

- Nitre goosefoot (*Chenopodium nitrariaceum*)
- Old man saltbush (*Atriplex nummularia*)
- Rhagodia, Mallee saltbush (*Rhagodia preissii*)
- River Murray saltbush, silver saltbush (*Atriplex rhagodioides*)
- River saltbush (*Atriplex amnicola*)
- Ruby saltbush (*Enchylaena tomentosa*)
- Sandhill wattle (*Acacia ligulata*)
- Tar bush (*Eremophila glabra*)
- Thorny saltbush (*Rhagodia spinescens*).

All of these promising species suit environments receiving less than 500mm average annual rainfall. Where rainfall exceeds this amount, different shrub species are likely to be optimal choices.

Correct selection of shrub species depends primarily on soil factors such as salinity, waterlogging and texture. The species making up the mix do not necessarily need to be evenly proportioned.

A decision tree for selecting the most appropriate forage shrub species mix based on site and soil characteristics

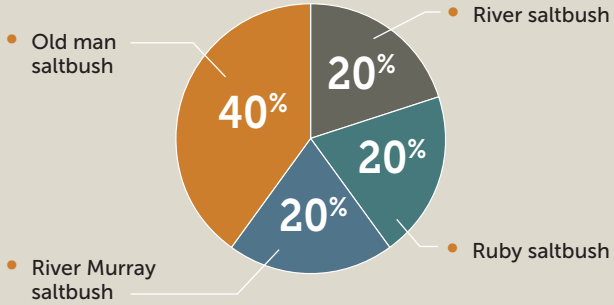


Shrub species mixes

The following pages provide a guide to appropriate forage shrub mixes for various soil and environmental situations. Other species can be added but all species chosen need to be represented in significant proportions (at least 10%) so as to provide enough biomass to influence the overall diet.

Saline soils (saline mix)

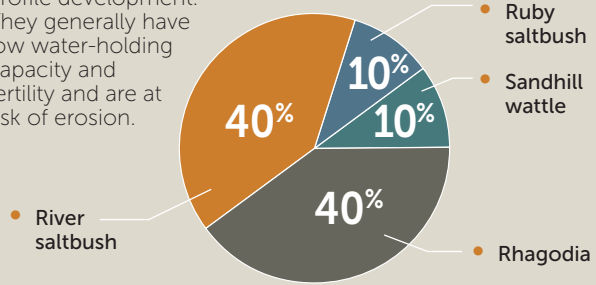
These are considered to be slightly or moderately saline. Soils that are more saline, such as those which support samphires, are not suitable for forage shrub growth.



Where temporary waterlogging also occurs in combination with salinity, river saltbush is the best option.

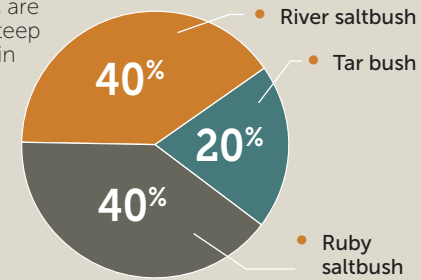
Sandy soils (sandy mix)

Sandy soils often show little profile development. They generally have low water-holding capacity and fertility and are at risk of erosion.



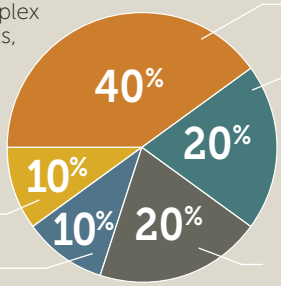
Shallow rocky soils or soils above a shallow calcrete layer (shallow mix)

Shallow rocky soils are usually found on steep hillsides and contain many stones. Alternatively, they can be stoney calcareous soils, which have a solid limestone layer a metre or more thick within 30cm of the soil surface.



Loams, sand over loams and clay loams (loam mix)

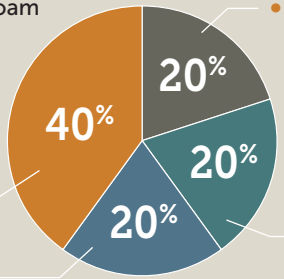
These soils include duplex or texture contrast soils, which have a different A and B horizon, with the deeper horizon being heavier in texture.



- Old man saltbush
- River saltbush
- Ruby saltbush**
- Sandhill wattle
- Rhagodia*

** Substitute with thorny saltbush in areas with mainly loamy-clays or clay loams*
***Consider tar bush for potential livestock methane reduction*

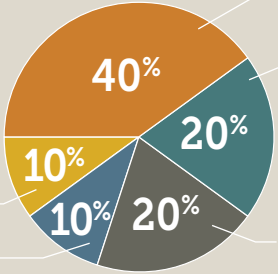
Where temporary waterlogging (**loam + waterlogging mix**) occurs:



- River Murray saltbush
- Old man saltbush
- Nitre goosefoot
- River saltbush

Clays and heavy clays (clay mix)

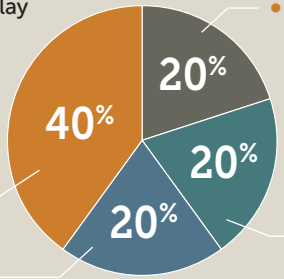
These clay soils shrink and swell causing seasonal cracking as the soil dries out, they are also known as vertisols.



- Old man saltbush
- River saltbush
- Ruby saltbush*
- Nitre goosefoot**
- Thorny saltbush

** Consider sandhill wattle for extra shade and shelter*
*** Consider tar bush for potential livestock methane reduction*

Where temporary waterlogging (**clay + waterlogging mix**) occurs:



- River Murray saltbush
- Old man saltbush
- Nitre goosefoot
- River saltbush

Farmers: Kevin and Peter Willersdorf

Location: Murrayville, Victoria

Property size: 4000ha

Average annual rainfall: 300mm

Soil types: Mostly mallee sandy loam and a bit of marginal limestone ground

Enterprises: Sheep (1500 Merino ewes) cropping (2800ha) — wheat barley, triticale, lupins and vetch

Forage shrubs: All saltbush (mainly old man saltbush)

Case study

Shrub–crop combination yields greater options

A trial investigating a range of elite forage shrub species is set to allow Kevin and Peter Willersdorf, Murrayville, Victoria to increase the productivity of their less reliable cropping country.

Kevin and Peter have been incorporating forage shrubs into their mixed farming system since 1994, when they established about 20ha of old man saltbush.

"We started planting saltbush on some of our poorer ground, with financial support from the local Mallee CMA." Kevin said. "This country really didn't support any sort of production — neither cropping or livestock — before we incorporated the forage shrubs."

"Since then we have increased the saltbush area by another 25ha or so and this new planting will see the total area expand by another 10ha again."

A new site in conjunction with the Mallee CMA has been planted using elite forage shrub species. Kevin is hoping they will be every bit as productive as the saltbush and offer increased options for future shrub plantings. Kevin and Peter also have adjusted the planting layout of the new shrubs to allow inter-row cropping this time around.

"Our original shrub stands were planted in rows about 10m apart," Kevin explained. "Now the shrubs have matured it can be difficult to drive a ute between the rows and we can really only muster these paddocks effectively on a four-wheel motorbike."

"The new stands have been planted in rows about 20m apart — wide enough to sow the middle to a cereal crop, which will provide extra winter grazing options and a grain harvest if the season allows."

"We currently grow triticale on this ground each year — it is better country than the existing saltbush areas, but is still a bit stony. Our ewes and lambs graze the triticale during winter and depending on the season we may, or may not get a harvest. In a quite a good year you will still be able to harvest 50% of the paddock, but in a year with a dry finish there will be no harvest."

Kevin also rotates his sheep through the existing saltbush country during winter to keep the height of the forage shrubs under control.

Factoring in logistics

Although forage shrubs have brought non-productive land into production, Kevin warns that this does not come without cost.

"As with any grazing situation, stock need access to plenty of fresh water," Kevin said. "You need to make sure you can get water to the stock relatively easy. We put poly pipe in for about 1–2km to the area we fenced off for shrubs. For a while we had trouble getting water to the paddocks — we have tanks and bores across the property."

"The other thing to consider is to ensure you evaluate the country where you want to plant the forage shrubs — make sure they will grow. I wouldn't plant forage shrubs on otherwise productive land where you are making cropping income. We have selected land where we would only make money from cropping one year in 10. And with the shrubs we can run sheep there for 4–6 months a year."

A 10ha demonstration site was established on the Willersdorf's property during autumn 2015 to explore a mix of elite forage shrub species for suitability to the area and local farming systems. Species on the site include:old man saltbush, ruby saltbush, tar bush, rhagodia and River Murray saltbush.

3. Putting it together — paddock layout

At a glance

- Block planting consists of forage shrubs planted at a higher density in a relatively uniform configuration.
- Alley planting consists of belts of forage shrubs alternated with alleys of pasture or crops.
- If planting shrubs to reduce wind speed use a mix of shorter and taller species to let some wind move slowly through the vegetation and minimise the wind tunnelling effects that can occur with tall species.
- Shelter is proportional to the height of vegetation and extends on the leeward side to about 10 times the height of the shrub row.
- Using curved rows allows protection from differing wind directions.

Forage shrubs are most commonly planted either as a block or in an alley configuration. In a block planting shrubs are planted at moderate to high density with small and usually equal distances between shrub rows. Alley planting comprises rows or belts of shrubs alternated with wider spacings where pasture or crops can be grown.

Block planting

Block planting is best suited to situations where companion pasture productivity would be low, in small paddocks or near yards. Planting too densely is likely to result in reduced productivity per shrub, due to competition between shrubs after only a few years. Mustering stock in dense shrub stands can also be problematic.

Ideal shrub density for block planting is between 400–1200 plants/ha with higher densities suitable for wetter environments or more productive soils. Shrub spacing can be altered both between and along the rows, but gaps should be 3m or more.

Examples of shrub spacing in a block configuration

Spacing between rows (m)	Spacing between shrubs within each row (m)	Shrub density (plants/ha)
5	4	500
4	4	625
4	3	833
3	3	1111

Alley planting

The shrub belts in an alley planting are usually made up of double rows, but three to four rows can be used.

Using multiple rows in alley plantings increases the chance of shrub cover along the entire belt in case some shrubs fail to establish.

> *Even in an alley belt a significant gap, such as 3–5m, between shrub rows is needed. Pasture will still grow in this area and annual legumes, in particular, will be productive.*

When considering the width of the alley it is important to consider machinery access, total paddock size, the shrubs' affect on wind speed, the proportion of shrub forage in the total paddock feed and in particular the grazing management strategies to be used.

Handy hints

- *It can be difficult to achieve full utilisation of forage shrubs planted in a large paddock with wide alleys.*

  Consider this example; if double rows of shrubs are separated by alleys 25m wide to accommodate machinery, it can result in a feedbase comprising 85% pasture and only 15% shrubs. Without using some readily-applied grazing management techniques, livestock may eat negligible levels of shrub foliage and the full benefits of a shrub–pasture mix will not be realised. Grazing management techniques to encourage optimal shrub utilisation are detailed on page 36.
- *Where shrubs are planted in long rows it is useful to leave a gap, or several gaps, in the row for access when mustering stock or to run temporary fencing to subdivide paddocks.*

Species mix

Shrub rows or belts can comprise single species. This is often easier when planting. The different shrub species do not need to be completely mixed within rows for livestock to include many species in their diet. However, it is important livestock can move freely between species — keep this in mind if paddocks are subdivided.

Shrubs and shelter

> *When using forage shrubs as a shelterbelt or windbreak, species choice and planting design will significantly determine its effectiveness.*

It is advantageous to create a porous windbreak that allows some wind to move slowly through the vegetation as well as over it. This is best achieved by growing a mix of short and tall species. The use of only tall species, with a canopy off the ground, can tunnel the wind under the canopy and along the soil surface.

The effect of vegetation on wind speed extends to about 10 times the height of the vegetation. So for shrubs that grow to about 1.5m, expect beneficial effects of reduced wind speed for about 15m. Plant shrubs perpendicular to the most prevailing winds to provide protection. Planting the shrub belt in a curve, can create some shelter regardless of wind direction. Planting shrubs along the contour will almost always give this effect.

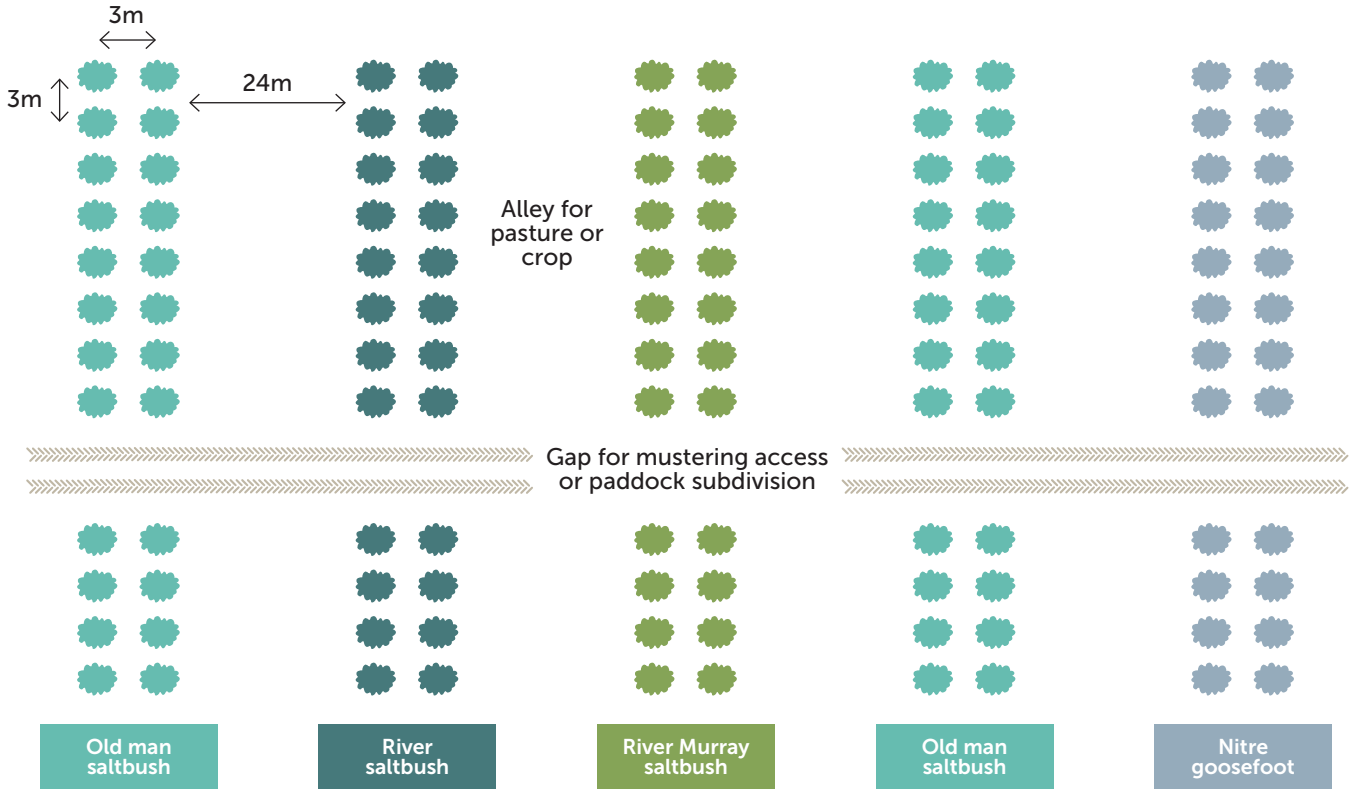
Livestock shelter is a key benefit of shrub-based systems, particularly during lambing.

While slowing wind speed reduces soil erosion, another major benefit is reduced soil moisture loss through evaporation.

During dry periods, pasture (or crop production) can increase because of moisture conservation in the topsoil. It may be counterintuitive to think shrubs could actually increase pasture or crop production, but research data and practical experiences shows this can happen.

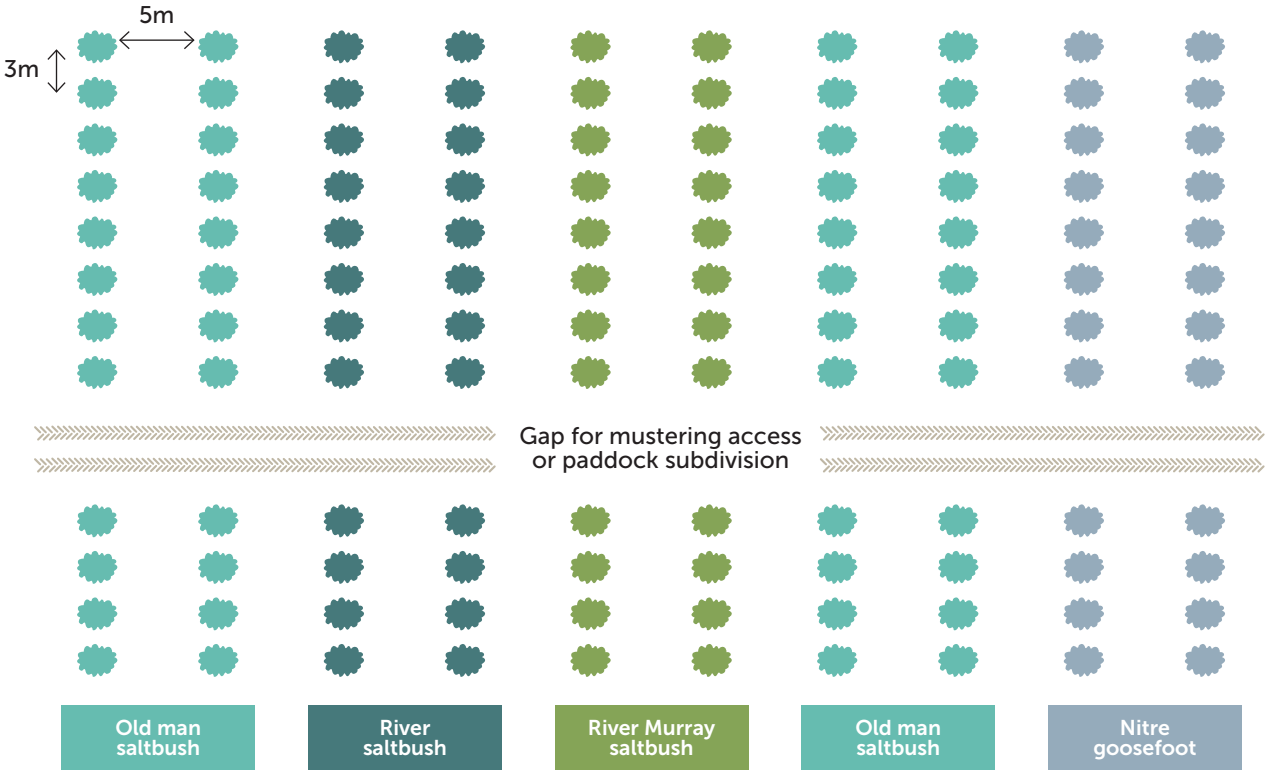
Example of an alley planting for sand over loam where temporary waterlogging is likely

Shrubs are grown in double rows with a gap for access when mustering or for subdivision fencing.



Example of a block planting for sand over loam where temporary waterlogging is likely

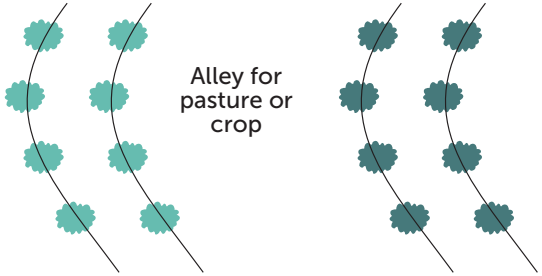
Shrubs are planted at 667 plants/ha with a gap for access when mustering or for subdivision fencing.



Alternative alley planting designs

Alley planting with species mixed randomly within each row.

Alley planting with shrub rows following the contour.



Planting along the contour provides shelter from winds coming from different directions.

4. Getting underway — preparation and planting

At a glance

- Place orders with a forage shrub supplier before the end of November the year before planting.
- Thorough paddock preparation will pay long-term dividends: prioritise weed control before planting and deep rip at least 2–3 months before planting.
- Adequate soil moisture is critical at planting.
- Plant seedlings with well-developed root systems, which have been hardened off in the nursery.
- When direct seeding always use fresh seed, less than one year old, and sow at a shallow depth (5mm).

Most local nurseries or tree growers can supply forage shrub species. Nurseries* in or near the Mallee CMA region that have been involved with forage shrub research projects include:

- Mildura Native Nursery, Mildura, Victoria
- Waikerie Saltbush, Waikerie, South Australia
- Jayfields Nursery, Holbrook, New South Wales

When using established seedlings for planting, pre-order shrubs from a supplier around November (or earlier) the year before planting to allow the plants to develop strong root systems and a branch structure that support seedling survival.

In areas where frost is an issue, seedlings should be hardened off (exposed to conditions outside the greenhouse — sunlight and temperature fluctuations) as much as possible before planting.

**This is not an endorsement of providers by the Mallee CMA*

Seedlings sold in the nursery sell for about 30–40 cents per plant. Establishment costs using established seedlings range from $300–$400/ha but depends heavily on the density of shrubs being planted.

If looking to establish shrubs by direct seeding, collect seed or source it from external suppliers. Ensure seed to be used is less than one year old. Establishment costs using seed are in the order of $150/ha.

Paddock preparation

Careful paddock preparation is the most important aspect when establishing forage shrubs and the benefits from thorough planning and preparation will be significant and long lasting.

Select the paddock the year before planting so weed control can start well before planting. Weed control options following planting are limited, so pre-planting weed management is critical. Weed control in the previous crop or pasture and non-selective herbicides after the break of season, possibly in combination with a prior light cultivation to stimulate annual weed germination, are key strategies for establishment success. Scalping, where the surface soil along the shrub row is removed along with weed seeds, also can be worthwhile.

Concentrate weed control along the rows where shrubs will be planted to allow for pasture growth between shrub rows. This is particularly important when planting into a paddock with a plentiful pasture seedbank and allows pasture to be sown across the paddock in the same year before planting shrubs.

Deep ripping before planting helps break through soil pans and encourages root development.

Before planting established seedlings, deep rip the soil to 30–50cm along the shrub row to allow the seedlings easy entry into the soil. Deep ripping also will help break soil compaction aiding quick root penetration. Ripping also creates a furrow that harvests water. Carry out ripping at least 2–3 months in advance of planting, giving the soil the time to settle and remove air pockets. Even on light soils ripping can help capture moisture.

Mounding along the shrub row is useful if waterlogging around the time of planting is likely to be an issue or on shallow soils where it increases the soil area young roots can expand into. Mounding has also been found to aid water infiltration on water-repellent sands.

Timely planting

Plant shrubs early after the break of season if weeds have been effectively controlled. Annual weeds grow faster than shrub seedlings and can easily smother them during winter. Planting later in the season can allow for extra weed control, but moisture can quickly become limiting as temperatures rise.

Frost can kill young shrub seedlings. In frost-prone areas, consider planting in less susceptible parts of a paddock or later in the season when the risk is less. Always use seedlings that have been hardened off and have already experienced some frost in the nursery.

Planting seedlings

Only use seedlings with well-developed root systems and strong stems. Soak seedling trays in water immediately before planting. Use commercial contract planters or a tractor-mounted tree planter for planting.

Ensure the root ball and a few centimetres of stem are covered with soil as each seedling is planted. Press wheels will help provide sufficient root–soil contact and will reduce any remaining air pockets in the rip line. Do not plant if the soil is dry.

Providing water after planting can be valuable but is time consuming. Some commercial planting machines have a water injection system.

Selective herbicides can be used 'over the top' after shrub planting to control grass weeds, however there is insufficient evidence to support the safe use of selective herbicides for broadleaf weed control on forage shrubs.

Seedling planting checklist

1. Select paddock the year before planting.
2. If possible control undesirable species while promoting the pasture seedbank.
3. Choose the desired planting layout and calculate the number of shrubs needed.
4. Order shrubs with the supplier by at least the November the year before planting.
5. By at least March the year of planting, deep rip the rows to be planted.
6. Before the break of season organise a contract planter or the use of a planting machine.
7. Carry out scalping or mounding along the shrub rows after the break to minimise the erosion risk.
8. Use a non-selective herbicide along the rows after weed germination.
9. Ensure seedlings to plant are strong with a well-developed root system.
10. Soak seedlings immediately before planting.
11. Plant seedlings into moist soil achieving good root–soil contact.

Mature saltbush species show some tolerance to glyphosate, however juvenile plants have been killed when in contact with this chemical.

Direct seeding

Although direct seeding is more cost effective than planting established seedlings, it is less reliable and not suitable for all shrub species. Direct seeding of forage shrub species including old man saltbush, rhagodia, ruby saltbush and thorny saltbush has been successful in some situations, but results can be inconsistent.

Assessing the viability of seed with a germination test before seeding is essential.

If using the actual fruit for seeding, which is usually done with old man saltbush, check the fruit contains seeds by threshing a sample of the fruit to be used.

Weed control is even more critical when direct seeding, as young shrub seedlings are poor competitors. Before seeding use a knockdown herbicide after the initial weed germination and repeat if necessary with subsequent germinations. The use of an insecticide before or immediately after seeding is also recommended.

Seed can be planted using various models of tree seeders. To obtain an adequate density of established shrubs, use a seeding rate of 10 seeds or fruit per metre.

Depth control is essential when direct seeding shrubs. Place all species of shrub seed 5mm deep into the soil. Placing seed too shallow (on the surface) or too deep (even at a depth of only 15mm) will drastically reduce emergence. Press wheels help obtain sufficient seed–soil contact. Only embark upon direct seeding when there is adequate soil moisture.

Direct seeding checklist

1. Select paddock the year before planting.
2. If possible carry out weed control to minimise undesirable species and promote the pasture seedbank.
3. Choose the desired planting layout and calculate the amount of seed needed.
4. Organise a source of fresh seed, which can be procured by March the year of planting.
5. Before the break of season test a small sample of seed for germination.
6. Organise suitable seeding machinery.
7. Use a non-selective herbicide along the shrub rows after weed germination and repeat with subsequent germinations.
8. Sow into moist soil at a depth of 5mm — ensure good seed–soil contact.
9. Apply insecticide to control lucerne flea and red-legged earth mite.

5. Making the system work — effective management

At a glance

- Grazing management is critical to ensure the benefits of a diverse shrub–pasture mix for both livestock and shrubs.
- Management strategies can be used to modify the diet selection of livestock.
- The diet on offer does not always represent the diet eaten — past experience is a major factor influencing diet selection.
- Grazing at least once a year keeps forage shrubs leafy and at a height accessible to all livestock.
- Forage shrubs recover from grazing at a slower rate than herbaceous plants.
- The threat of overgrazing comes from continually grazing shrub regrowth and not the level of initial defoliation.
- Set stocking at low stocking densities will increase the risk of shrub regrowth being grazed.

Managing for livestock benefits

It is critical to build grazing management into the successful use of a diverse shrub–pasture mix otherwise livestock will eat only some of the species on offer, leaving others. Just because feed (of any sort) is provided there is no guarantee animals will include all components in their diet, especially if the plant species is new to the animals.

If livestock heavily graze the inter-row pasture before eating shrubs, the complementarity of shrubs and pasture will be missed, which will compromise animal performance and increase the risk of erosion in the inter-row alleys.

One of the largest factors affecting how grazing animals select their diet is prior grazing experience and whether those experiences were positive or negative.

Livestock not previously exposed to shrubs will have a more positive experience if they can consume small amounts of shrubs with other forage first time round.

If a new plant or feed is consumed as part of a balanced diet, positive feedback will reinforce the consumption of the new plant. But if it is eaten in isolation, higher levels of certain plant substances (e.g. salt, or oxalates) can have negative impacts on the animals, which will deter further consumption.

Palatability is not fixed: it depends on plant traits and the experiences animals have with any chosen plant. Effective livestock management with diverse shrub–pasture mixtures is designed to make the full suite of plants familiar and nutritionally rewarding to livestock. A little bit of intensive management at the start will change the way livestock graze and the feed sources they select, resulting in less intensive management thereafter.

Following are four key management strategies that can maximise the consumption and value of shrubs in the diet of livestock unfamiliar with shrub–pasture mixes:

1. Make sure animals are well fed when they first enter a new shrub-based paddock and alternative feed is not limiting.

Contrary to common belief, animals will not normally consume more shrub vegetation if they are hungry. There are two main reasons for this. Well-fed animals are more willing to try a wide variety of feed sources to ensure they ingest a balance of nutrients and maximise their total daily intake. Secondly, shrubs can have high levels of 'secondary plant compounds' (sometimes called toxins) such as tannins, oxalates or saponins, which can deter consumption in hungry animals. At a low level in the diet these compounds can be benign, or even positive, but at higher levels they can limit feed intake and reduce performance. The gut or liver of a well-fed animal can better tolerate the compounds and avoid negative metabolic outcomes.

As such, it can be helpful to expose livestock to shrubs for the first time during periods of abundant feed (e.g. spring) so they can learn about the new shrubs when they are well nourished and have other available forage options. When livestock are subsequently placed on a shrub–pasture mixture during autumn, when the quantity and quality of inter-row pasture is lower, the animals will already be familiar with the shrubs and are more likely to consume the shrubs more readily.

2. Manage livestock so they are not stressed.

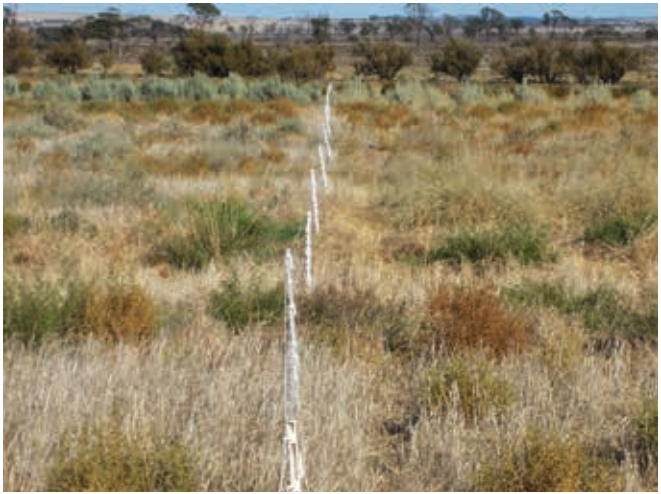
If animals are forced onto a shrub-based paddock in poor condition, pushed in with poor stockmanship, or are stressed for any other reason, they will be less willing to try new forage sources.

3. Increase grazing pressure.

Generally, a higher grazing pressure broadens the suite of plants included in the diet because there is more competition between individual animals. Stocking rates of 30–50DSE/ha have been used successfully in shrub–pasture mixtures. Temporary and moveable subdivision with electric fencing is an option to increase grazing pressure when animals are first put into a shrub-based paddock. When they are readily consuming the shrubs, grazing pressure can be reduced (e.g. by removing electric fencing).

4. Regular rotation.

If small patches of shrubs are established in close proximity to each other, or a larger shrub paddock is subdivided, then livestock can be moved from one area to the next in order to provide a positive experience of the new plant species. It can be tempting to leave the animals in their allocated portion or subdivision until they consume all of the species on offer, but when they are still learning about the full suite of plants on offer it can help to take the first few moves to the next subdivision before the preferred plant species are completely gone. When the animals become more experienced, they will graze the full suite more evenly with less management.



Forage shrub systems are well suited to rotational grazing. The strip on the right had been grazed for one week.

Only a small number of positive experiences (normally 3–4 occasions) are required to change grazing behaviour quite dramatically. What may start as a low-preference plant species can relatively quickly become an important part of the diet. The plant won't necessarily have changed its composition, but the experience of the animals has been broadened, which alters feed preferences. New behaviours of diet selection can persist for a long time (for years, even with limited opportunities to graze the plant species in between times), so any short-term efforts will be rewarded over the longer term.

Tips to influence grazing behaviour:

- Use experienced livestock with lower nutritional requirements, such as steers or dry ewes, to 'clean up' shrub paddocks that have not been fully utilised and are at risk of growing too tall or woody.
- Allow lambs to learn from their mothers. The diet selection of grazing offspring is strongly influenced by experiences gained from their mothers. If a young animal becomes familiar with a new food — such as forage shrubs — when it is still with its mother, it will eat more of that feed (or will start eating it more quickly) later in its life than if it first encounters the plant after weaning.
- The feeds that pregnant animals consume during mid-to-late pregnancy can influence the willingness of her offspring to consume those feeds later in life, or to use those forages more efficiently.
- Use experienced animals to 'teach' others. When there is a group of animals that are naïve to the shrub mixture, consider including some experienced 'old timers' in the mob, such as older wethers or ewes, that have previously grazed the shrubs and done well on them. Animals learn from what others are doing, especially if the experienced animals show a keen eating behaviour.

Experienced animals can be used to introduce inexperienced animals to shrubs with a positive impact on future grazing habits.

Managing for shrub productivity and persistence

The age at which shrubs can first be grazed depends on seasonal conditions and shrub growth rate, but is likely to be between 9–24 months after planting. As a guide, consider grazing when:

1. shrubs cannot be pulled out when tugged by hand, and
2. they reach knee to thigh height (lower-growing species, such as ruby saltbush, tar bush and thorny saltbush, can be first grazed from high shin to knee height).

The forage shrubs listed in this publication tolerate short-duration heavy grazing and will survive when grazed to a level where only 10% of original leaf matter remains. Regrowth will not occur immediately and so there is no need to remove livestock just because a few plants in the stand have been heavily grazed.

Grazing at high stocking density and using experienced livestock will allow as many shrubs as possible to be utilised without compromising plant survival.

Regrowth of River Murray saltbush after being grazed when knee height.

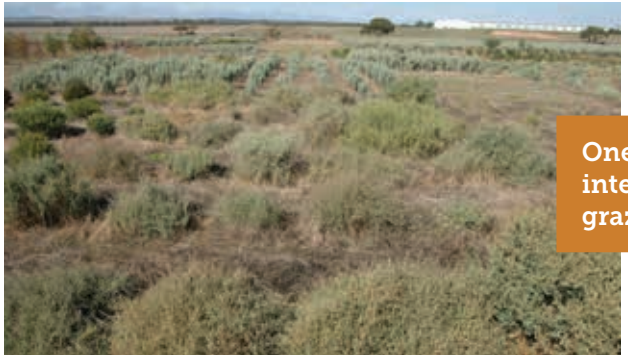
Forage shrubs can withstand heavy defoliation with a subsequent rest period of 6–12 months.

Shrub defoliation after one month of intensive grazing

One month intensive grazing

Old man saltbush (Atriplex nummularia)

Old man saltbush (Atriplex nummularia)



One month intensive grazing

River saltbush (Atriplex amnicola)

River saltbush (Atriplex amnicola)

With strategic management shrubs can be well grazed and still leave sufficient ground cover.

Set stocking at a low density for long periods will promote selective grazing and increase the risk of retarding regrowth of the most preferred shrubs, which are more likely to be continually grazed. This will deplete the shrub resources and eventually kill these plants.

Frost is also a danger to new regrowth. While older growth will not be affected by mild frost, new regrowth following grazing can be killed by frost. Consider the risk of frost damage on new regrowth when grazing during winter. Where the risk is high, leave more original leaf matter on the shrubs after grazing to help prevent detrimental effects on shrub vigour.

Leaving forage shrubs for use only in the driest times is likely to result in plants becoming overly woody, with reduced edible feed and, for species such as old man saltbush, River Murray saltbush and sandhill wattle, plants will grow to the point where they are out of reach for sheep. When forage shrub species are left ungrazed, they will cope with dry conditions by dropping leaves, reducing the amount of available feed. Grazing at least annually, and in years of plentiful growth twice a year, will keep shrubs short and productive.

Forage shrubs require long rest periods, up to six months, between grazing events. In dry conditions, when production is lower, the rest period needs to be longer.

How much grazing can shrub-based systems support?

The number of grazing days (days of grazing, per animal, per hectare) a shrub-based grazing system can provide depends on:

- seasonal growing conditions
- edible biomass from shrubs
- amount of pasture or crop in the inter-row
- proportion of shrub:pasture (or stubble) in the diet of the livestock grazing the mixture
- the class of livestock (dry, growing, pregnant or lactating) as this affects animal requirements.

Four examples are presented below to provide a guide to feed supply and the number of grazing days per hectare a shrub-based system can provide during autumn under 'poor' and 'good' seasonal conditions, with shrubs grown in either a block or alley layout for a range of livestock classes.

Grazing days available during autumn for block and alley shrub-based systems under poor and good seasonal conditions*

Layout	Block (10m inter-row)		Alley (25m inter-row)	
Seasonal conditions	**Poor**	**Good**	**Poor**	**Good**
Shrub edible biomass (kg DM/ha)	700	1000	700	1000
Pasture biomass (kg DM/ha)	500	1500	500	1500
Proportion of diet from shrubs (%)	60	60	15	15
Proportion of diet from in pasture (%)	40	40	85	85
Total paddock feed on offer (FOO) (kg DM/ha)	**620**	**1200**	**530**	**1425**
Proportion of pasture to remain after grazing as ground cover (%)	30	30	30	30
Feed available for consumption (kg DM/ha)	**560**	**1020**	**403**	**1043**
Grazing days per hectare:				
Growing weaner sheep (@ 1kg DM/head/day)	560	1020	403	1043
Maintenance of dry sheep (@ 0.7kg DM/head/day)	800	1457	575	1489
Late pregnancy ewes (@ 1.5kg DM/head/day)	373	680	268	695
Lactating ewes (@ 2.1kg DM/head/day)	267	486	192	496

**A 'grazing day' is calculated as the number of animals multiplied by the number of days of available feed: e.g. 100 'grazing days' is enough feed for one animal for 100 days, 10 animals for 10 days, or 100 animals for one day.*

Using the table above:

During **autumn** of a good season, a paddock with an alley planting of shrubs and pasture could reasonably be expected to have a total feed on offer (FOO) of 1425kg DM/ha (15% shrubs: 85% pasture). With the aim of removing livestock while there is still 30% pasture ground cover, a mob of 150 weaners (consuming an estimated 1kg DM/hd/day) could graze the paddock for a week (1043 grazing days divided by 150 weaners eating 1kg DM/day).

Farmers: Matt Curtis

Location: Wargan, Victoria

Property size: 4000ha

Average annual rainfall: 250mm

Soil types: Sandy loam to calcareous soils and river flood plain

Enterprises: Merino and crossbred lambs, cropping — wheat, peas, vetch.

Forage shrubs: About 80ha planted saltbush and 1000ha of native saltbush/bluebush country

Case study

Forage shrubs offer seasonal feed on marginal country

Saltbush is providing a valuable forage option on otherwise unproductive country for Victorian Mallee mixed farmer Matt Curtis.

"We had an extensive area of native saltbush and bluebush across the poorer areas of our country — about 1000ha," Matt explained. "Over time we have fenced off small areas of unproductive land and planted additional 80ha with saltbush."

"We currently use these paddocks to hold ewes during April to fill the autumn feed gap. In drier years where there is a feed shortage before harvest we might use them during September–October, before stubble becomes available.

Matt runs Merinos and also produces crossbred lambs each year. He plants a mix of vetch, peas and barley to graze across 600ha, which supplies winter grazing and stubble during summer.

"We fatten our crossbred lambs on the crop stubbles, vetch hay and some grain," Matt said.

Although the saltbush alone is unsuitable for fattening lambs it provides valuable feed to maintain ewe condition when little else is on offer and is supported by vegetation between the rows and supplementary grain or hay as required.

Grazing management

Matt grazes his ewes on both the native saltbush and bluebush country and his more densely-planted saltbush paddocks.

"The saltbush needs grazing every year to keep them regenerating — to freshen them up," Matt said. "They also need to be kept small, otherwise they get too high for the sheep to graze.

"It is quite manageable as long as you ensure they are grazed as soon as they can — the first summer after establishment.

"You can probably put 200 sheep in a well-established 10ha paddock for a month — on new stuff you would only graze for a fortnight.

"We manage our native country a bit differently — we put a mob in there and leave them for longer as these paddocks are up to 200ha, whereas our planted areas are in 10ha paddocks."

In addition to filling the seasonal feed gap, Matt appreciates having smaller paddocks in which to hold his sheep during dry seasons.

"Our planted paddocks give us somewhere to hold our sheep, saving erosion in other paddocks. They are also easier to hand feed in a small area," Matt explained.

Exploring options

Matt is working closely with the local Mallee CMA to explore new options for his forage shrub system.

"Because our stands are mainly old man saltbush, we are trying some different varieties to see how they go in this area," Matt explained.

"The demonstration site was planted during May 2015 and although it is still a bit too early to make any resounding evaluation, the survival rate looks good and the shrubs are about 30cm high (October 2015)," Matt said.

A 10ha demonstration site was established on Matt's property during autumn 2015 to explore a mix of elite forage shrub species for suitability to the area and local farming systems. Species on the site include:old man saltbush, ruby saltbush, tar bush, rhagodia and River Murray saltbush.

7. Forage shrub species information

Attributes of individual forage shrub species

Common name	Scientific name	Maximum height (m)	Maximum diameter (m)	Seedling frost tolerance	Crude protein % (actual range in brackets)	Organic matter digestibility* (% of dry matter) (actual range in brackets)
Nitre goosefoot	*Chenopodium nitrariaceum*	2	1.5	High	21 (16–28)	64 (57–69)
Old man saltbush	*Atriplex nummularia*	2.5	2.5	High	14 (7–23)	35 (27–45)
Rhagodia	*Rhagodia preissii*	1.5	1.5	Moderate	14 (10–23)	60 (54–70)
River Murray saltbush	*Atriplex rhagodioides*	2	2.5	High	22 (19–27)	46 (45–47)
River saltbush	*Atriplex amnicola*	1.5	2	Moderate	21 (18–27)	50 (49–51)
Ruby saltbush	*Enchylaena tomentosa*	1	1	High	18 (19–29)	46 (41–55)
Sandhill wattle	*Acacia ligulata*	4	2.5	Moderate	11 (9–14)	23 (15–26)
Tar bush	*Eremophila glabra*	2	1	Low	11 (8–16)	67 (64–69)
Thorny saltbush	*Rhagodia spinescens*	1	1.5	High	21 (16–27)	56 (50–64)

**The components of feeds that can provide energy to animals are all in the organic matter fraction, so considering the digestibility of the organic matter is* indicative *of the digestible energy content of a feedstuff.*

Suitability of forage shrub species to various environmental and soil conditions

Common name	Scientific name	Moderate salinity	Temporary waterlogging	Sands	Sandy loams	Loams	Clays	Heavy clays	Shallow rocky hills/ slopes	Calcareous
Nitre goosefoot	*Chenopodium nitrariaceum*	Not suited	Highly suited	Not suited	Suited	Highly suited	Highly suited	Highly suited	Not suited	Highly suited
Old man saltbush	*Atriplex nummularia*	Highly suited	Suited	Moderately suited	Highly suited	Highly suited	Highly suited	Highly suited	Not suited	Highly suited
Rhagodia	*Rhagodia preissii*	Moderately suited	Not suited	Highly suited	Highly suited	Highly suited	Suited	Moderately suited	Not suited	Highly suited
River Murray saltbush	*Atriplex rhagodioides*	Highly suited	Suited	Not suited	Suited	Highly suited	Highly suited	Highly suited	Not suited	Highly suited
River saltbush	*Atriplex amnicola*	Highly suited	Highly suited	Suited	Highly suited	Highly suited	Highly suited	Highly suited	Suited	Highly suited
Ruby saltbush	*Enchylaena tomentosa*	Suited	Not suited	Suited	Highly suited	Highly suited	Highly suited	Highly suited	Highly suited	Highly suited
Sandhill wattle	*Acacia ligulata*	Not suited	Not suited	Highly suited	Highly suited	Highly suited	Highly suited	Suited	Moderately suited	Highly suited
Tar bush	*Eremophila glabra*	Moderately suited	Not suited	Suited	Highly suited	Highly suited	Highly suited	Highly suited	Highly suited	Highly suited
Thorny saltbush	*Rhagodia spinescens*	Not suited	Not suited	Suited	Highly suited	Highly suited	Highly suited	Highly suited	Not suited	Highly suited

Key

- Highly suited
- Suited
- Moderately suited
- Not suited

Nitre goosefoot (*Chenopodium nitrariaceum*)

- Tall straggly shrub growing to 2m high
- Leafier and less 'spiny' forms exist
- Grows well on heavy clays and in waterlogged conditions

Flower

Leaf and stem

Shrub form

About

- High digestibility (among the highest for Australian shrubs)
- High crude protein and low fibre
- Can grow out of reach of sheep
- Requires annual or bi-annual (twice yearly) grazing to keep 'leafy' and accessible

Grazing

Edible biomass 141g DM/plant

After-grazing edible biomass 15g DM/plant

Regrowth edible biomass 278g DM/plant after 12 months

Old man saltbush (*Atriplex nummularia*)

- Large grey woody shrub
- Will grow to 2m tall
- Male and female plants exist

Shrub form

***Flower** (male)*

Fruit

***Leaves** (Eyres green)*

Leaves

About

- High drought tolerance
- High productivity
- High sulphur and vitamin E content
- High salt content of foliage (limits intake and requires higher supply of fresh drinking water)
- Eyres green and Anameka cultivars are available, which have been selected for desirable traits (Eyres green for biomass, Anameka for nutritive value)

Grazing

Edible biomass 786g DM/plant

After-grazing edible biomass 77g DM/plant

Regrowth edible biomass 1008g DM/plant after 10 months

Rhagodia (*Rhagodia preissii*)

- Compact bright green to deep green shrub
- Reaches 1.5m high
- Red to pink berries
- Tolerates infertile soils

Shrub form

Flower and fruit

Leaves

About

- Relatively high digestibility
- Variation in palatability between plants and growing location
- Potential anthelmintic (internal parasite control) activity

Grazing

Edible biomass 1600g DM/plant

After-grazing edible biomass 150g DM/plant

Regrowth edible biomass 1100g DM/plant 10 months after grazing

River Murray saltbush (*Atriplex rhagodioides*)

- Large grey shrub
- Grows 2m high and 2.5m across
- Good salinity tolerance especially on 'magnesia' soils

Shrub form

Fruit

***Flower** (male)*

Leaves

About

- Has good winter regrowth from autumn grazing
- Will grow out of reach of sheep if not kept short
- High in crude protein

Grazing

Edible biomass 340g DM/plant

After-grazing edible biomass 35g DM/plant

Regrowth edible biomass 721g DM/plant after 12 months

River saltbush (*Atriplex amnicola*)

- Many-branched small shrub
- Reaching 1.5m high and 2m across
- High salinity and waterlogging tolerance

Shrub form

***Flower** (male)*

Fruit

Leaves

About

- High in crude protein
- Palatable saltbush, which helps in adapting animals to consume forage shrubs
- Responds well to grazing
- Do not set stock

Grazing

Edible biomass 310g DM/plant

After-grazing edible biomass 31g DM/plant

Regrowth edible biomass 498g DM/plant after 11 months

Ruby saltbush (*Enchylaena tomentosa*)

- Small shrub to 1m high
- Has red, orange or pinkish berries
- Volunteers freely
- Very wide soil tolerance

Shrub form

Fruit

Leaf and stem

About

- Easy to establish
- Highly suitable for direct seeding
- Potential anthelmintic (internal parasite control) properties

Grazing

Edible biomass 478g DM/plant

After-grazing edible biomass 47g DM/plant

Regrowth edible biomass 571g DM/plant after 10 months

Sandhill wattle (*Acacia ligulata*)

- Dense rounded large shrub
- Can reach 4m tall
- Member of the legume family

Shrub form

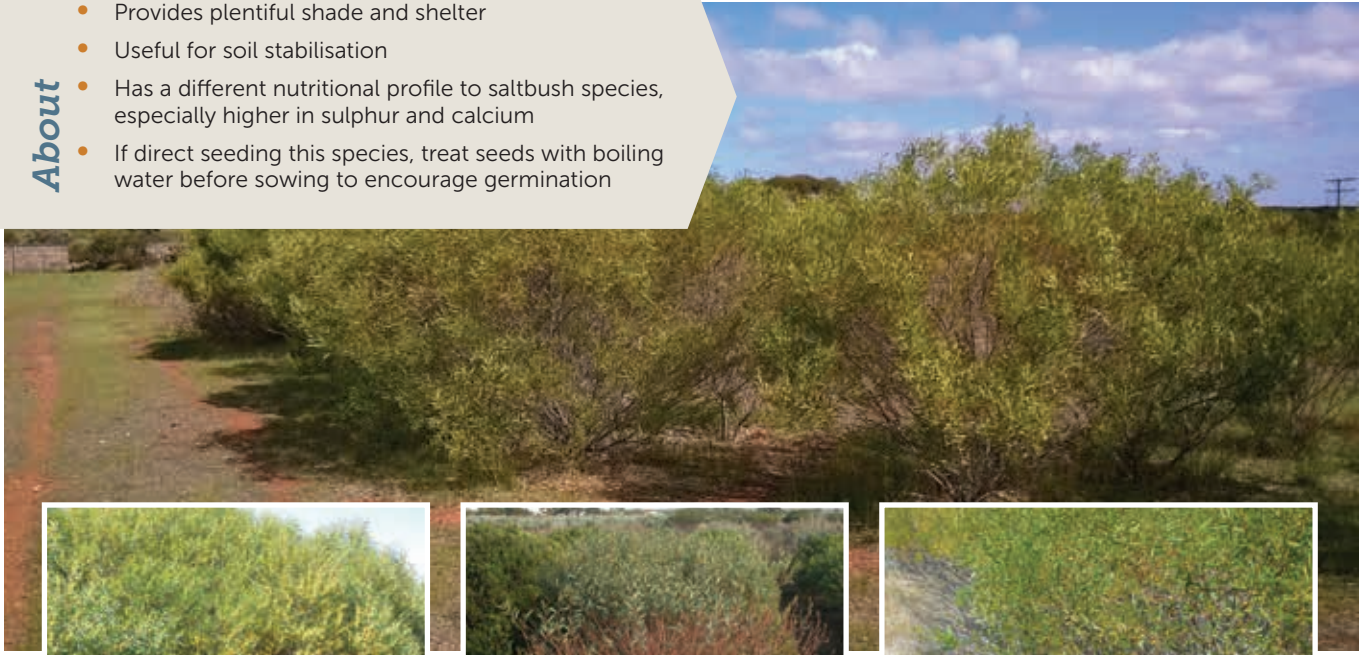
Fruit

Flowers

Leaf and stem

About

- Provides plentiful shade and shelter
- Useful for soil stabilisation
- Has a different nutritional profile to saltbush species, especially higher in sulphur and calcium
- If direct seeding this species, treat seeds with boiling water before sowing to encourage germination



Grazing

Distinct grazing line on large shrubs

Heavy defoliation of smaller shrub

Regrowth on lower stems

Tar bush (*Eremophila glabra*)

- Small shrub to a maximum of 1m
- Wide variation in growth form and flower colour
- Flowers range from yellow to red
- Difficult to grow from seed and thus seedling cost is considerably higher than other species

Shrub form

***Flower** (variations)*

Fruit

Leaf and stem

About

- Relatively high digestibility
- Types with leaves that are less 'sticky' are likely to be more palatable
- Possible role in reducing methane emissions and mitigating acidosis in livestock

Grazing

Edible biomass 963g DM/plant

After-grazing edible biomass 95g DM/plant

Regrowth edible biomass 2990g DM/plant after 28 months

Thorny saltbush (*Rhagodia spinescens*)

- Low-growing shrub to 1m tall
- Does not contain true thorns or spines
- Produces red–orange berries
- More suited to heavier loams and clays

Shrub form

Leaf and stem

Flowers

Fruit

About

- High in crude protein
- Relatively high digestibility
- More leafy forms exist, which have more accessible biomass for livestock
- Suited to bi-annual (twice-yearly) grazing

Grazing

Edible biomass 571g DM/plant

After-grazing edible biomass 56g DM/plant

Regrowth edible biomass 976g DM/plant after 12 months

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