

# Farmnote

## Pasture legumes and grasses for saltland

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Figure 1 Annual pasture between saltbush alleys at Pingaring, WA

### Saltland Principles

Approximately 1 million hectares in the south-west agricultural region are severely affected by salinity. A further 1.8 – 2.7 million hectares have been identified as being at risk from shallow watertables and/or soil salinity. Depending on

future climate and watertable trends, cropping could become risky in these areas.

Saltland soils are often associated with waterlogging in winter, due to the presence of a shallow water-table. Waterlogging causes soils to become oxygen deficient, resulting in increased salt uptake by plants. The combination of both stresses makes saltland soils particularly difficult for plant growth. Salinity and waterlogging can be highly variable over short distances.

Most legumes are sensitive to salinity, and as a result saline soils are often nitrogen deficient. Subterranean clover is particularly sensitive to salinity and is one of the first species to disappear from pastures when land becomes salt-affected.

The growth of salt and waterlogging tolerant legumes and grasses can complement saltbush-based pastures when used as an understorey (see Figure 1). Research has shown this can increase pasture profitability up to \$60 per hectare, depending on the severity of the site, input costs, livestock prices and pasture management.

Surface (0–10 cm) salinities vary throughout the season (see Figure 2). They are generally highest over the summer-early autumn period, prior to the

break of season, and lowest in mid-winter. Rainfall flushes salt from the surface down the soil profile, while evaporation in spring and summer causes salt to rise again to the surface. Below a depth of about 25 cm soil salinity tends to stay more constant.

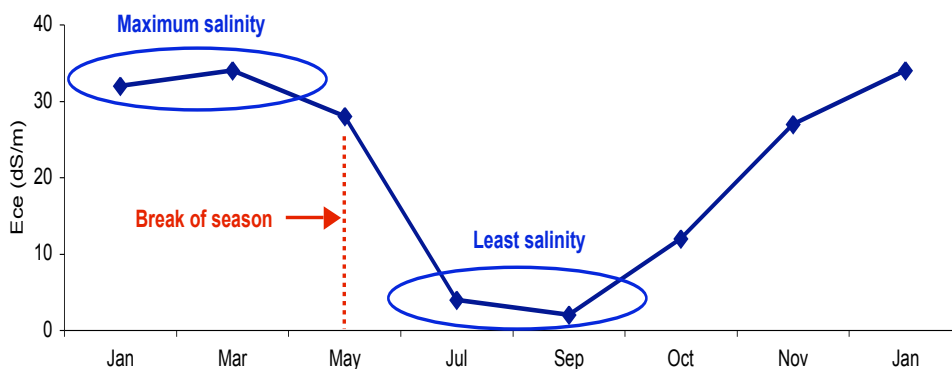


Figure 2 Seasonal salinity changes in the top 10 cm of a saline sandy loam at Darkan (the units of salinity are discussed below). Note this level of fluctuation may not apply to heavier textured soils, which have less leaching of salt down the profile.

### Important disclaimer

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## Consequences for annual plants

Annual plants on saline soils have a shorter growing season than those on adjacent non-saline soils. High salinities at the start of the growing season delay germination and can kill germinating seedlings of susceptible species. Plants adapted to saltland must, therefore, either have a high tolerance to salinity during germination or ways to defer germination until later, when surface soil salinities are lower. In spring, high salinities kill plants prematurely and reduce the time available for seed set.

## Consequences for perennial plants

To survive on saltland, perennial plants need to cope with the additional stress of summer drought. Even under non-saline conditions, few perennial pasture species can cope with the long summer drought in low and medium rainfall zones. However, on saltland perennial plants must also either have mechanisms to cope with high salinity or have some form of salinity avoidance mechanism, such as summer dormancy (e.g. puccinellia).

In general plants use the freshest water available to them. Perennials, with their deeper root systems, can extract water from more of the soil profile than annuals. Tall wheatgrass, for example, avoids high surface salinity in summer by accessing less saline water from depth and then uses relatively fresh water closer to the surface during winter.

## Measurement of salinity

Table 1 shows a new Australian soil salinity classification system and its relationship to soil texture. Soil salinity is generally estimated by its electrical conductivity (EC). Most commercial laboratories measure the  $EC_{1:5}$ , which is the electrical conductivity of a mixture of 1 part soil to 5 parts of water. However, to compare salinities of different soil textures, scientists generally measure the  $EC_e$ , which is the electrical conductivity of the water in saturated soil. The terms used to define the severity of salinity range from non-saline to extremely saline, and the  $EC_e$  and  $EC_{1:5}$  readings associated with these terms for different soils are given in the table.

## Measuring soil salinity for annual pastures

The greatest stress self-regenerating annuals encounter on saltland is high salinity on the soil surface during germination in the second and subsequent seasons after sowing. Therefore, the suitability of soils for annual pastures should be assessed by measuring the  $EC_{1:5}$  of the top 10 cm over the summer-autumn period, prior to the autumn break.

Table 1 Terms for describing the severity of soil salinity, in terms of electrical conductivity units of  $EC_{1:5}$  or  $EC_e$ , for different soil textures.

Salinity class	$EC_{1:5}$ range			$EC_e$ range
	Sands (dS/m)	Loams (dS/m)	Clays (dS/m)	(dS/m)
Non-saline	0–0.14	0–0.18	0–0.25	0–2
Low	0.15–0.28	0.19–0.36	0.26–0.50	2–4
Moderate	0.29–0.57	0.37–0.72	0.51–1.00	4–8
High	0.58–1.14	0.73–1.45	1.01–2.00	8–16
Severe	1.15–2.28	1.46–2.90	2.01–4.00	16–32
Extreme	>2.28	>2.90	>4.00	>32

## Measuring soil salinity for perennial pastures

The greatest salinity stress perennial plants encounter on saltland occurs in the subsoil during summer. Therefore soil samples should be taken 25–50 cm below the soil surface. Although this should ideally be done in summer, the timing is less critical, as salinities at this depth remain relatively constant throughout the year.

## Assessing waterlogging

Three terms are used here to define the risk of waterlogging. Soils of high risk will be sodden for much of the winter, often with prolonged periods of surface water. Soils of moderate risk will remain sodden for up to 2 weeks after heavy rain, often with surface water visible. Soils of low risk will be free draining.

## Pasture options for saline land

Tables 2 and 3 list current commercially available grass and legume options for different classes of saltland. To select the best species for a particular paddock, you will need to know your rainfall zone, the  $EC_{1:5}$  measured at the relevant time and soil depth (see above), the potential for winter waterlogging, the soil pH and the soil texture.

It can be seen there are few options for low rainfall regions. This reflects the limited range of pasture options for low rainfall regions in general. In contrast, higher rainfall regions have a wider range of options.

**There are no commercially available grasses or legumes for soils classed as severely or extremely saline. Saltland with these levels of salinity should be fenced off and allowed to revegetate naturally.**

## Use of mixtures

Because salinity and waterlogging vary over short distances within paddocks, mixtures of appropriate species are recommended. The best adapted species will colonise those parts of the landscape to which they are suited.

## Pasture establishment

Germinating seedlings are very sensitive to salinity. Therefore, all species, apart from the sub-tropical grasses, should be sown soon after early season

rains have flushed salt from the soil surface. Sub-tropical grasses should be sown in late-winter or early spring, while the soil surface is still moist and temperatures are beginning to rise.

Pasture legumes should be inoculated prior to sowing with the strain of rhizobium appropriate for the species. This is particularly important on saltland, as background rhizobia levels are likely to be very low (or nil).

As with any pasture sowing, good weed control is important to optimise pasture establishment.

**Table 2 Annual legume and grass options (registered cultivars) for different categories of salinity, waterlogging, soil texture, soil pH and rainfall**

Annual rainfall (mm)	Soil characters			pH (CaCl <sub>2</sub> )	Suitable species			Comments
	Salinity (see Table 1)	Waterlogging risk	Texture		Common name	Scientific name	Cultivars <sup>1</sup>	
<b>ANNUAL LEGUMES</b>								
275–325	Moderate–high	Low	Sandy loams–clay loams	5.2–8.5	Burr medic	<i>Medicago polymorpha</i>	Serena	Less salt tolerant than Scimitar
275–350	Moderate	Low	Loams–clays	5.8–9.0	Barrel medic	<i>Medicago truncatula</i>	Caliph Ⓢ	
300–425	Moderate–high	Low	Sandy loams–clay loams	5.2–8.5	Burr medic	<i>Medicago polymorpha</i>	Scimitar Ⓢ, Santiago	Scimitar is the best performing burr medic on saltland
325–500	Moderate	Low	Loams–clays	5.8–9.0	Snail medic	<i>Medicago scutellata</i>	Sava, Silver, Essex Ⓢ	
350–550	Moderate–high	Low	Sandy loams–clay loams	5.2–8.5	Burr medic	<i>Medicago polymorpha</i>	Cavalier Ⓢ	
350–550	Moderate	Low	Sandy loams–clays	4.8–8.0	Sphere medic	<i>Medicago sphaerocarpos</i>	Orion	
350–550*	Low–moderate	High	Sandy loams–loams	4.5–8.0	Balansa clover	<i>Trifolium michelianum</i>	Frontier Ⓢ	
350–550*	Low–moderate	High	Loams–clays	5.0–8.0	Persian clover	<i>Trifolium resupinatum</i>	SARDI Persian Ⓢ	
375–600	Moderate	Low	Loams–clays	5.8–9.0	Barrel medic	<i>Medicago truncatula</i>	Jester Ⓢ	Untested on WA saline land
425–650*	Low–moderate	High	Loams–clays	5.0–8.0	Persian clover	<i>Trifolium resupinatum</i>	Prolific, Nitro Plus Ⓢ	
450–700*	Low–moderate	High	Sandy loams–loams	4.5–8.0	Balansa clover	<i>Trifolium michelianum</i>	Paradana	
>550	Moderate–high	Low	Loams–clays	5.6–9.0	Bokhara clover/White sweetclover	<i>Melilotus albus</i>	Jota Ⓢ	High coumarin levels can cause haemorrhaging of stock if fed mouldy hay
>600	Low–moderate	High	Sandy loams–loams	4.5–8.0	Balansa clover	<i>Trifolium michelianum</i>	Bolta Ⓢ	
>650	Low–moderate	High	Loams–clays	5.0–8.0	Persian clover	<i>Trifolium resupinatum</i>	Kyambro Ⓢ	
>700	Low–moderate	High	Loams–clays	5.0–8.0	Persian clover/Shaftal clover	<i>Trifolium resupinatum</i>	Laser Ⓢ, Leeton, Lightning Ⓢ, Maral, Morbulk	One year fodder types, untested on WA saline land
<b>TEMPERATE ANNUAL GRASSES</b>								
275–650	Moderate	Low	Sands–clays	5.0–8.0	Annual ryegrass	<i>Lolium rigidum</i>	Wimmera, Safeguard Ⓢ	Safeguard has resistance to annual ryegrass toxicity
>650	Low–moderate	Low	Loams–clays	5.0–8.0	Italian ryegrass	<i>Lolium multiflorum</i>	Many cultivars	Early flowering cultivars best in WA

<sup>1</sup>Other proprietary cultivars may be available that have not been tested on saline soils in WA

Ⓢ Cultivars protected by Plant Breeders Rights

\*Less reliable north of Perth

Ideally, weeds should be controlled in the year prior to sowing to prevent seed set. Two knockdown herbicide applications are recommended, the first following an initial weed germination and the second just prior to sowing. It is important to note that many weeds (e.g. sea barley grass and ice plant) will have a delayed germination on saline sites (the delay will be longer on more highly affected sites).

Sowing and fertiliser rates, seeding depth, post-emergent weed and insect control and grazing management will be the same for these species as for establishment on non-saline land (see Further Information). The aim should be to maximise the seed set of annuals and the ground cover of perennials to set up a long-term pasture.

## Further information

Frontier—an early maturing balansa clover for the wheatbelt, Farmnote no 3/2001

Scimitar and Cavalier annual burr medics, Farmnote no 83/2004

Perennial pastures for Western Australia, Bulletin 4690

Saltland prospects—prospects for profit and pride, Future Farm Industries CRC

Pasture Picker website: [www.pasturepicker.com.au](http://www.pasturepicker.com.au)

Saltland genie website: [www.saltlandgenie.org.au](http://www.saltlandgenie.org.au)



## Acknowledgements

This Farmnote was developed using information obtained from research funded by the Future Farm Industries CRC

**Table 3 Perennial legume and grass options (registered cultivars) for different categories of salinity, waterlogging, soil texture, soil pH and rainfall**

Annual rainfall (mm)	Soil characters			Suitable species			Comments	
	Salinity (see Table 1)	Waterlogging risk	Texture	pH (CaCl <sub>2</sub> )	Common name	Scientific name		Cultivars <sup>1</sup>
<b>PERENNIAL LEGUMES</b>								
>400*	Moderate	Low	Sands–clay loams	5.6–9.0	Lucerne	<i>Medicago sativa</i>	Many cultivars	Winter active and highly winter-active cultivars perform best in WA
>550	Low–moderate	High	Sandy loams–clays	5.5–9.0	Strawberry clover	<i>Trifolium fragiferum</i>	Grasslands Onward $\Phi$ , Grasslands Upward $\Phi$ , O'Connors, Palestine	
<b>TEMPERATE PERENNIAL GRASSES</b>								
>400*	High–severe	High	Sands–clays	5.5–9.0	Puccinellia	<i>Puccinellia ciliata</i>	Menemen	Best species for waterlogged saline soils.
>400*	High	Moderate	Sandy loams–clays	4.5–9.0	Tall wheat grass	<i>Thinopyrum ponticum</i>	Dundas $\Phi$ , Tyrell	Has weed potential in Victoria
>500	Low–moderate	Moderate	Sands–clays	4.3–8.5	Tall fescue	<i>Festuca arundinaceae</i>	Fraydo $\Phi$ , Grasslands Flecha $\Phi$ , Prosper $\Phi$ , Resolute $\Phi$	Summer dormant cultivars perform best in WA
>550	Low–moderate	Moderate	Loams–clays	4.5–8.0	Phalaris	<i>Phalaris tuberosa</i>	Atlas PG $\Phi$ , Holdfast $\Phi$ , Landmaster $\Phi$ , Sirolan	Winter active cultivars perform best in WA
<b>SUB-TROPICAL PERENNIAL GRASSES</b>								
>350*	High	High	Sands–clays	5.5–8.0	Distichilis	<i>Distichilis spicata</i>	NyPa forage™	Only propagated by cuttings
>400	Low–moderate	Low	Sands–loams	4.5–7.5	Rhodes grass	<i>Chloris gayana</i>	Callide, Finecut $\Phi$ , Katambora, Nemkat $\Phi$ , Pioneer, Topcut	Low frost tolerance, suited to northern and south coastal districts
>400*	Moderate	Moderate–high	Sands–clays	3.7–7.0	Kikuyu	<i>Pennisetum clandestinum</i>	Whittet	Performs poorly north of Perth

<sup>1</sup>Other proprietary cultivars may be available that have not been tested on saline soils in WA

$\Phi$  Cultivars protected by Plant Breeders Rights

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