Options for managing dryland salinity in the Coorong district

Management of dryland salinity is best focussed on understanding the causes of salinity in the first place, and then to try and address these issues. It is essential to make better use of water where it falls in order to prevent this water from entering the groundwater system (as recharge). As a result, there are a range of agronomic solutions that aim to reduce groundwater recharge, largely through the establishment of perennial pastures such as dryland Lucerne whilst utilising a ‘whole of catchment approach.

KEY POINTS

• The management of dryland salinity can be based on two key principles, these being (1) attacking the cause and (2) treating the effects.
• CSIRO research conducted more than 20 years ago confirmed that growing lucerne for a minimum of two years in rotation with other crops had a measurable effect in combating salinity.
• Prior to the impact of aphid attack of previously highly productive lucerne stands in the 1970’s, dryland lucerne proved to be an extremely valuable plant species for livestock, and at the same time helped reduce groundwater recharge. Fortunately, lucerne varieties nowadays have been bred for far better resistance to insect attack.
• Dryland lucerne is “one string in the bow” that is available to tackle recharge and salinity, an integrated approach to managing this problem is required, with other strategies that aim to increase crop and pasture water use highlighted in this edition of Farm Talk.
• A “whole of catchment” approach incorporating a full range of water use options to ensure a long term impact which can include;
  o A range of perennial vegetation options including; perennial pasture, revegetation, fodder shrubs, farm forestry, and protection of remnant native vegetation.
  o High water-se cropping options, for example summer cropping, phase cropping.
  o Soil modification to improve soil water holding capacity, plant vigour, and water use.
Attacking the cause of dryland salinity

The main management strategy to adopt when aiming to manage dryland salinity is to attack the causes of salinity. It is essential to make better use of water where it falls in the landscape to prevent this water from entering the groundwater system (as recharge). This was confirmed in research undertaken by CSIRO Land and Water almost 20 years ago. The relationship was modelled between different crops and pastures and the “water balance” on a farm, presenting a breakthrough in the management of dryland salinity. The research confirmed that growing dryland lucerne for a minimum of two years in rotation with other crops had a measurable effect in combating salinity.

The CSIRO researchers used huge underground “flower pots”, called lysimeters, to accurately measure plant water use. Lysimeters are steel containers 2 metres deep and 1.6 metres square, sitting on scales and were buried in the middle of the test farms. The researchers measured the weight of the container at various times to calculate the amount of water falling on and being used by the crops.

The researchers found that planting dryland lucerne in rotation with canola, wheat and triticale crops used more water, as did native vegetation. The study also found that other options for minimising salinity includes developing crop varieties that use more water during the growing season, and introducing companion crops into the farming system.

Strategies to help reduce the incidence of dryland salinity

The following provides examples of a range of management strategies that can be utilised to help reduce the likelihood of salinity impacting on agricultural productivity, it is a case of being pro-active before the on-set of salinity occurs. This is particularly useful if it is considered that land is at risk of salinity within your landscape. It is also worthwhile to assess the severity of the impact of salinity, and the relative opportunity for salt affected land to be able to support sown pastures, as illustrated in Figure 1.

![Figure 1: Salt affected land should be assessed according to its likely capability in supporting pasture plants, as illustrated (Credit: Saltland Pastures for South Australia).](Image)
Establish Perennial Pastures

Perennial pastures have the advantage of being able to respond quickly to rain whenever it falls. They are also often able to make use of spring and summer rains, where annuals cannot. The deep rooted systems of perennials are able to then use more water from deep in the profile for longer periods during the year. Deep rooted perennial pastures can use up to double the water used by annual plants.

Dryland lucerne is a deep rooted, summer active, high water using perennial species which has productive and economic value when grown on recharge areas. It can be used as grazing pasture, for hay, or for seed production.

Consider higher water use or longer season cropping alternatives

An improved local understanding of cropping alternatives to improve plant water use under cropping rotations is required. Options that could be more carefully analysed include a range of strategies such as pasture cropping (for example the use of cover crops over lucerne, use of lucerne in cropping rotations), consideration towards an increased use of summer crops such as sorghum and millet, and crop cultivars that use more water and/or longer growing season varieties (depending upon time of crop sowing and frost risks).

Increase crop and pasture water use

Increasing the health and productivity of crops and pastures so they are growing at their optimum production levels ensures that they are using the maximum amount of available soil water. Good agronomic, soil health and fertility practices need to underpin the overall management strategy adopted.

Improve soil health by identifying soil constraints and ameliorating them.

By identifying soil constraints and addressing these, improvements in the capacity of healthy plants to use rainfall where it falls is the net result. It is also important to adopt a systems approach to managing all of the soil constraints that impact on soil plant growth and vigour. These include the treating non wetting sands with appropriate soil amendments, for example clay spreading, as well as treating soil acidity through spreading lime. It is also important to improve soil fertility through targeted application of nutrients, trace elements, or biological treatments. Other physical constraints, such as the treatment of hard pans, or nutrient poor layers in the soil through ripping, Yeomans Plough or other mechanical techniques.

Establish trees and shrubs

Trees (particularly eucalypts) and shrubs have an annual evaporation rate of up to seven times that of surrounding annual pastures. This is due to the evergreen canopy, large leaf area and the fact that they may have their roots directly into the groundwater. Annual crops and pastures lack these features. The density of trees and/or shrubs required to minimise groundwater recharge will depend on species, age and health of trees, climate, soil and position in the landscape. There are a number of ways that trees and shrubs can be incorporated viably into farming systems. Farm Forestry is a productive option to reduce recharge, provide stock shelter, valuable windbreak and have the potential for an economic return when harvested.

Fodder shrubs such as saltbush or tagasaste are also productive options that reduce recharge, provide shelter as well as being valuable stock feed, particularly in times of drought. Perennial forage plantings that include native shrubs can extend groundcover to consolidate fragile, easily eroded soils. Skilled management of these plants and grazing livestock can buffer feed shortages and protect the environment. Experimental work carried out by the CSIRO in the Cooke Plains region demonstrated that these strategies need to be carried out over a large scale to be effective.

Figure 2: Mulch being spread across salt affected land to help with pasture establishment using a “Tomahawk” bale shredder.
Treating the effects of dryland salinity

The second approach to the dryland salinity problem is to tackle directly the salinity affected soils that result from rising water tables. Following are some strategies for rehabilitating, or at least preventing the spread of these salt affected areas.

Understand your soil

How saline is your soil? Ensure that your soil is tested for its level of soil salinity (ECe). This is the first step to understanding what your options agronomic and tree planting options are.

Management of cropping land (land with low to moderate salinity)

There are a range of management practices that are recommended. These include the use moderately salt tolerant crops such as barley or canola, sowing salt tolerant pasture cultivars, (such as Balansa Clover or Puccinellia). Good agronomic practices are recommended through growing high yielding crops and pastures to maximise plant water use. It is also important to address other limiting factors such as low fertility, disease control, weed control and seed bed preparation. It is also important to maintain crop and pasture residues to ensure the soil surface is covered at all times to minimise evapo-concentration of salts.

Management strategies for saline land (land which is too saline for broad acre crops)

There are less options where land has become too saline for crops to successfully grow on the salt affected land. In these instances, the main option is to grow salt tolerant pastures. Good management is a critical success factor. It is important to fence off to enable the control of grazing pressure. Where possible keep this separate from annual crop and pasture land. Within the fenced off areas aim to establish salt tolerant perennial pastures (including Puccinellia, Tall Wheat Grass, salt tolerant legumes such as Messina and Balansa Clover). It is important to also encourage and maintain surface cover at all times to reduce evaporation and prevent salt from concentrating at the soil surface. Grazing perennial pastures in spring and autumn and allowing them to set seed on a regular basis will help to maintain stand density. Saltbush can be an option where the site is not prone to waterlogging.
There are a variety of strategies that have been identified though a number of seep projects in the SA Murray Mallee in recent years that provide practical options for farmers to apply into the 3 critical areas of Recharge, Discharge and Intercept Zones. More work is currently refining these strategies through the Mallee Seeps project that aims to ensure improved water use efficiencies and remediation of these issues.

Current Mallee Seeps management research challenges

The successful establishment of pastures on seeps sites are dependent on both seasonal factors and a range of soil specific soil parameters that have not been fully explored in previous salinity research. Recent research has shown that slight increases in soil surface organic matter can make a positive influence. Some sites have been found to have toxic soil pH levels at 11.

The Mallee Seeps project is currently looking to gain a better understanding of these parameters through measuring soil qualities through the growing season, so that better informed management recommendations for seep induced scalded areas can be provided

New innovative strategies being tested

The Mallee Seeps Project is currently exploring a range of innovative management tools through on-farm demonstrations.

1. Sand, straw and animal manure scald treatment

Initial success has been shown with using a front end loader to add 10cm layers of sand, straw and manures to bare scalds to get salt tolerant grasses established and even a cereal crop at one site. These sites will be monitored over coming seasons to see if they will deteriorate over time, or continue towards greater soil improvements. In areas that already have salt scalded centred too toxic for re-establishing crop growth, it is still important to employ these strategies on the edge areas to help stop the growth of these bare seep scalds.

2. Sub-soil manure slurry extruder

The use of a subsoil extruder on the deep sands above a seep at Alawoona. This machine profiles a manure slurry behind its multiple deep ripping tines. This is much safer for wind erosion control than spading in manure, and initial results have been promising for improving crop production and water use. Other trials are assessing the use of other subsoil amelioration techniques, alternative pasture species and longer season varieties.

3. Use of an in-ground sump

Another site will assess the practicality of establishing an in-ground sump just above a seep scald area to pump water out to be stored and used for either spraying, livestock or liquid fertiliser application. Early water quality measurements at the particular site has presented some challenges, but work is ongoing.

4. Assessment of suitable pasture species

The Seeps project is also undertaking field trials that are examining the suitability of a range of pasture species that can be used to assist in the management of seeps.

Native Vegetation, Revegetation and Farm Forestry

Revegetation, Farm Forestry, and protection and encouraging natural regeneration of remnant native vegetation is a high priority right across the landscape. This approach also benefits the ‘using rain when and wherever it falls’ concept.

Establishment of salt tolerant native trees and shrubs around the edge of salt affected sites to increase water use and halt or slow down the rate of spread can work well in some circumstances. In the case of bare patches, it is best to rip the area with a single tine ripper to help roughen up the soil to promote the leaching of salt. Where possible, cover any bare patches with hay, straw, or similar material. This will help to reduce salt concentration at the surface due to evaporation, encourage natural regeneration and importantly reduce risk of topsoil loss.

Factoring in rainfall and climatic variability

Consideration must be given to variability in rainfall and climate. Success of the plant based options discussed above is based on the assumption that there will be sufficient growing season rainfall, and in the case of summer based perennial pastures, at least some rainfall over the spring and summer.

Long dry periods such as the millennium drought, 2015-16 drought, and 2018-19 drought would have significantly impaired the health, vigour, density and water use potential of perennial pastures on both saline and non-saline land. In particular the summer active perennial pasture base that prevails in this region of dryland lucerne, perennial veldt grass and primrose are challenged during extended periods of low rainfall. When rainfall did return after these dry periods, these pastures would have not been in optimum condition to ‘use the rain where and when it fell’, and hence reduce recharge to groundwater.
MORE INFORMATION

A full list of research cited in this Farm Talk is available at www.msfp.org.au

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