Meningie East Healthy Soils Group Wednesday 5th August 2020		**Farm Walk**		**10am – 2.30pm**		
Stop	**Item**	**Speaker**	**Organisation**	**Location**	**Time**	**Page n#**
1	**MEETING POINT** 'Menalpyn' / Cartledge's main driveway			'Menalpyn' main driveway 2396 McIntosh Way	**10am**	
2	**Soil pit on saline soil and second year saltland pasture**			'Menalpyn' - lucerne paddock fronting McIntosh Way	**10.10am** – *11.10am*	
	Soil pit, constraints, soil tests and interpretation	Brian Hughes	PIRSA Rural Solutions – Soils	Messina and salt tolerant Dryland Lucerne		3 – 4
	Tips & tools for Saline Soils	Felicity Turner	Independent Advisor			5 - 18
3	**'Green Plains' / Crossman's – 1450 McIntosh Way** – Soil acidity, soil tests and demonstration, site overview	Brian Hughes	PIRSA Rural Solutions – Soils	'Green Plains' / Crossman's – 1450 McIntosh Way	**11.30am** – *12 noon*	
4	**LUNCH** **'Green Plains' / Crossman's – 1450 McIntosh Way**			'Green Plains' / Crossman's – 1450 McIntosh Way	**12 noon** - *12.30pm*	
5	**'Green Plains' / Crossman's – 1450 McIntosh Way** – various paddocks Two soil pits – deep sand and limestone ridge Soil constraints, physical & chemical features, water holding capacity, soil tests & interpretation, optimum management	Brian Hughes	PIRSA Rural Solutions – Soils	'Green Plains' / Crossman's – 1450 McIntosh Way – various paddocks	**12.30pm** – *2.30pm*	19-22
	Soil Acidity Demonstration Site, Veris and EM Mapping	Brian Hughes & Felcity Turner				23-25
6	**FINISH**				**2.30pm**	

SOIL DESCRIPTION DATA SHEET – SOIL PIT Menalpyn salt patch

General Description:

Saline Sandy clay loam over mottled sandy light clay and gleyed clayey sand

Site Details

Site Name	Cartledge	1:50,000 Sheet:	
Hundred:		Easting:	54H 372893
Section:		Northing:	6047592
Sampling date:	6/7/2020	Annual Rainfall:	475mm

Soil Description:

Depth (cm)	Description
0 – 10	Brown sandy clay loam with high lime reaction
10 - 40	Brown light sandy clay loam with very high lime reaction
40-75	Grey sandy light clay with orange/brown mottles
75-90	Brown/orange clayey sand with light grey mottles

Laboratory data

Depth cm	pH H_2O	pH $CaCl_2$	EC1:5 dS/m	ECe dS/m	Chloride mg/kg	Nitrate N mg/Kg	Org C %	Avail P mg/kg (PBI)	PBI	Avail K mg/kg	KCL Sulphur mg/kg	Trace elements mg/kg (DTPA)				Boron mg/kg	CEC cmol (+)/kg	**Pre-washed** Exchangeable Cations cmol(+)/kg				ESP
												Cu	Fe	Mn	Zn			Ca	Mg	K	Na	
0 – 10	8.6	8.6	4.8	46	7200	25	2	41	225	170	200	.28	5.6	1.3	.35	2.8	23	11	11	0.3	1.0	4.3
10 – 20	8.4	8.4	6.1	58	9700	37	1.4	9	239	160	200	.16	1.8	<0.3	0.13	2.1	22	12	8	0.2	0.8	3.6
20 - 40	8.5	8.4	4.3	41	6800	22	1.1	<5	180	99	140	<0.08	<1	<0.3	<0.08	1.3	17	10	7	0.1	0.4	2.5
40 – 75	9.0	8.5	1.7	11	2400	1	0.3	<5	234	110	96	.08	1.2	<0.3	<0.08	2.5	17	8	8	0.2	1.1	6.2
75 - 90	9.3	8.7	0.9	13	1400	<1	.07	<5	55	93	40	<0.08	5	<0.3	.09	1.9	8	3	5	0.2	0.3	4
Adequate Levels	6-8.5	5.5 - 7.7	<.2	<2	<120 -300	>5	1	25-30	20-40	100-120	10	.3-1	5-10	1-5	.3-1.0	0.5-15	>5	60 - 80 %	10 - 20 %	3-8 %	<6 %	<6 %

Note: CEC (cation exchange capacity) is a measure of the soil's capacity to store and release nutrients.
ESP (exchangeable sodium percentage) is derived by dividing exchangeable sodium value by the CEC.
Used pre-wash cation test for this site. Adequate levels from Hughes.

Saltland Pasture Redemption

Tips and Tools for Identifying and Dealing with Saline Soils

REPORT PREPARED BY FELICITY TURNER FOR THE COORONG TATIARA LAP

Key Outcomes

- **Maintain groundcover at all costs; reduces evaporation, capillary rise of salt, and provides opportunities for micro-climates and plant colonisation.**
- **Know your soil salinity levels and choose an appropriate salt tolerant mix of species for remediation (some crops and pastures handle waterlogging, some don't).**
- **Seeding after a rainfall event that flushes the salt through the soil profile is important when remediating salinity affected sites.**
- **Diversity in the mix of pasture species being sown is important as it provides an opportunity for multiple species to find their fit on sites that can be highly variable in their levels of soil salinity and waterlogging.**
- **Neptune Messina was found to be a suitable species in the local environment (as part of a salt land pasture mix), providing the soil salinity threshold didn't exceed recommended levels (30 dS/m ECe).**
- **Prevention of dryland salinity is better (and often easier) than remediation.**

Background

The Coomandook Saltland Pasture Redemption Project was initiated by the Coomandook Ag Bureau in 2015 to investigate the application of new developments in the productive use of saline land across Coomandook / Cooke Plains area. The initial focus of the project was to assess the suitability of the salt tolerant pasture legume Messina as a potential species to remediate saline scalds and reduce the level of wind erosion and recharge to groundwater in these areas. The 'Saltland Pasture Redemption Project' broadened the scope to look at a range of species, methods and timing of establishment, the

PROJECT DETAILS

Project ID: 4-9GS7FPL

Funding Body

This project is supported by the National Landcare Program – Smart Farms Program, an Australian Government Initiative

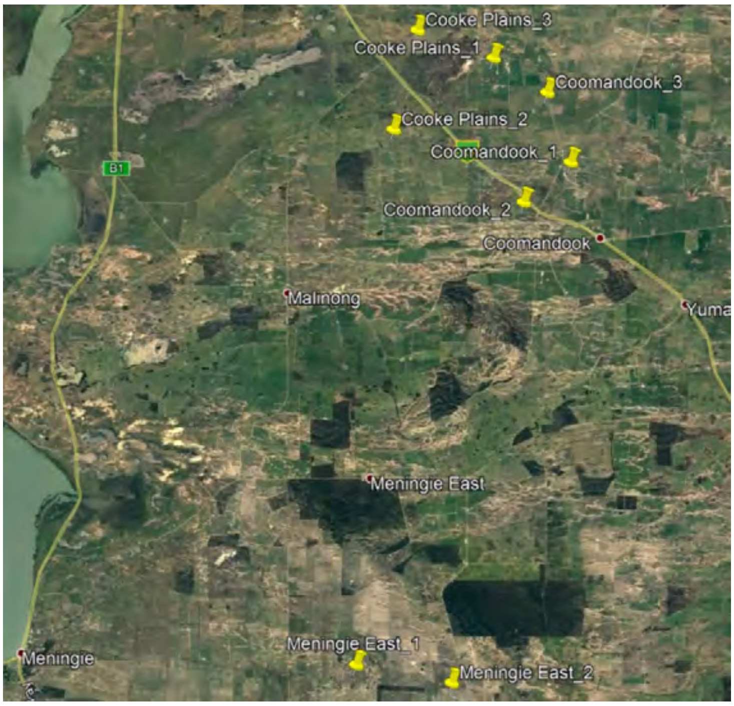
Project Duration

2018-2020

Site Locations

Coomandook, Cooke Plains and Meningie East, South Australia

(Various site locations)



use of groundcover and mechanical intervention methods to try and assist in the remediation of saline soils across the Coorong Tatiara Local Action Plan project area.

Sites were established in key areas where dryland salinity was occurring and have been monitored as either short term strategic sites, or longer-term demonstration sites. The location of these is shown in Figure 1.

Figure 1. Location of saltland redemption sites (2016-2020)

The local landscape

Parts of the Coorong Tatiara Local Action Plan project area have a high potential for dryland salinity formation due to being low lying in nature, and its proximity to the regional unconfined groundwater system drainage point into the River Murray Lower Lakes and Coorong. This is shown in the Digital Elevation Model (DEM) in Figure 2 where the red and orange areas are those that are less than 11.6m above sea level. Monitoring of piezometers within this localised area have found that groundwater levels respond strongly to changing rainfall patterns.

More information can be found in the 'Coorong Dryland Salinity Review: Improving Salinity Understanding – June 2019' which can be accessed here http://www.coorong.sa.gov.au/salinityreview

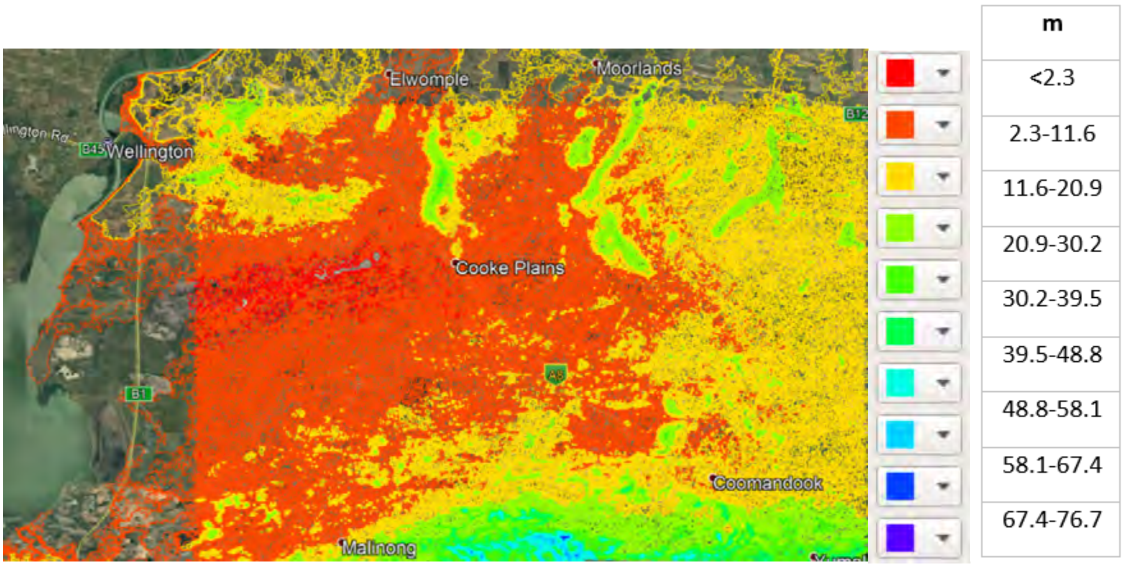


Figure 2. DEM of the Cooke Plains/Coomandook region (m above sea level)

Identifying areas that may be prone to salt scalds

As the water table below the surface rises, it brings with it dissolved salts to the root zone of crops, pastures, and native vegetation and potentially the soil surface. The first areas affected are often the low-lying areas within paddocks.

There appears to be two main processes occurring across the region leading to soil salinity;

- **Discharge -** where the water table intercepts with the ground surface creating an area that becomes waterlogged over a period of time
- **Capillary action** ('wicking') - where evaporation at the soil surface draws the water up through the soil. Capillary action is strongly influenced by soil type with water moving most easily through clay soils and less so through sandy soils making clay soils with a similar water table level more prone to salinity scalding.

Throughout the life of the project, various observations have been made by farmers around those areas that become saline over recent years. These include;

- **Annual Ryegrass (ARG) appearing in low lying areas**. This has largely been observed in cropping paddocks. ARG is much more tolerant of waterlogging than crop species and will often outcompete crops in wet conditions. The appearance of large patches in low lying areas (Fig.3) suggests that groundwater has risen within the plant root zone. If the ARG is controlled, it can leave the area largely bare and exposed increasing evaporation potential over the summer months. This is likely to result in an increase in the accumulation of salts at the plant root zone and soil surface.

Figure 3. ARG in a waterlogged area of a paddock

- **High biomass production in the year prior to dryland salinity appearing**. This has been observed in both crop and pasture situations (including Dryland Lucerne – Fig.4). The increase in biomass is thought to be due to the increase in available fresh water within the root zone (without the water actually reaching the surface) in that season. Fresh water is lower in density than saline water. Fresh water can sit in a lens on top of the saline groundwater. However once this fresh water source has been exhausted, the saline water is left behind. If the plants aren't tolerant to this saline water, they then die leaving bare exposed areas with the potential for increased wicking to occur.

Figure 4. Increased Lucerne growth in a low-lying area

Understanding Soil Salinity Levels

Knowing the soil salinity level of your soil is critical; particularly if you are looking to try and remediate the site by establishing pasture species.

Soil salinity is usually referred to as either EC 1:5 (where 1 part soil is mixed with 5 parts de-ionised water) or as ECe (dS/m) – an estimated amount of salt in the soil accounting for soil type.

Full methods for measuring soil salinity are available at:

https://www.publications.qld.gov.au/dataset/05c87bc5-6048-4767-85c8-36e660c38b1d/resource/6205ff5f-92b6-444b-95b7-f195fe4a64d6/fs_download/sn-l137-measuring-salinity.pdf

Soil sampling through a laboratory analysis is the most accurate way to determine soil salinity levels. Soil salinity levels across a paddock can vary greatly (Fig 5). In this instance it is probably worth conducting multiple tests.

The time of sampling can also impact results, with a sample taken at the end of summer most likely to show the maximum level of soil salinity. A winter sample is likely to show a lower result due to the flushing of salts through the profile from natural rainfall (see time of sowing below).

Figure 5. Variations in soil salinity across Coomandook site, 2018

Management options for Saltland Remediation

1. Varietal selection

There is a wide range of tolerance of different crop and pasture species to soil salinity as shown in Figure 6. The recently released salt tolerant legume Neptune Messina is adapted to winter-waterlogged areas where soil salinity in the top 10cms is 8-30 dS/m ECe in summer-early autumn. (https://www.agric.wa.gov.au/neptune)

Farmer demonstrations from 2017-2019 largely focused on the new salt tolerant (and waterlogging tolerant) pasture legume Neptune Messina (Figure 7a-c). It was assessed in different soil types and situations as both a stand-alone salt tolerant pasture, and as part of a saltland pasture mix where it's role was to add protein to the feed mix and to provide nitrogen to the system (all seed was inoculated with the salt tolerant Rhizobium strain for Messina).

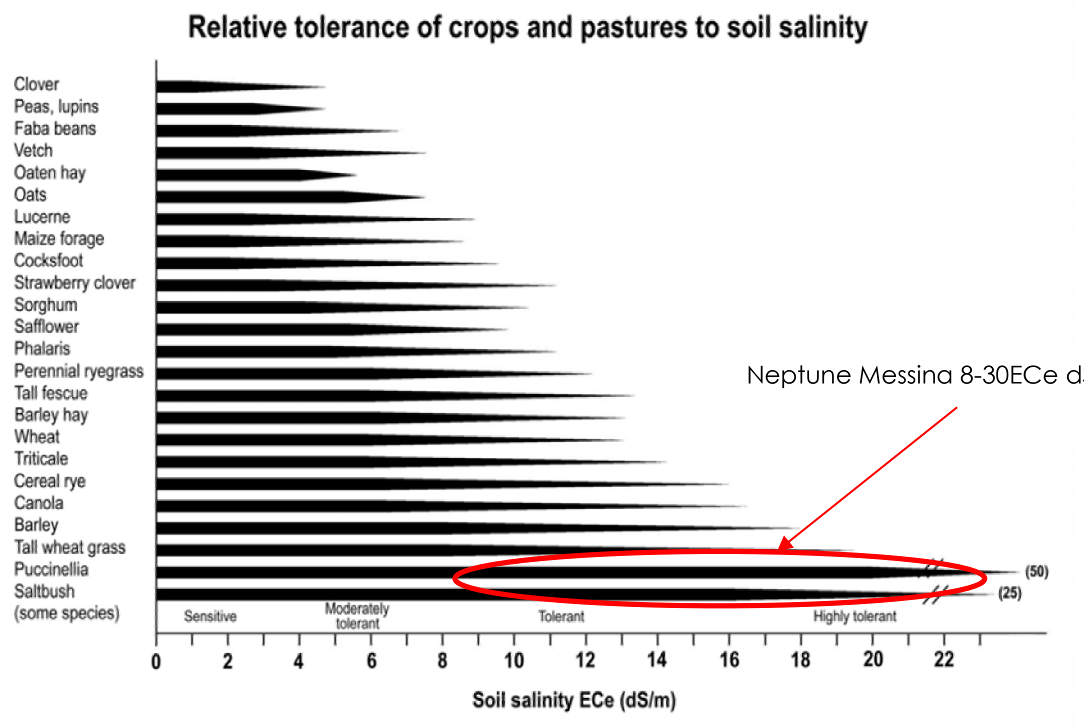


Figure 6. Relative tolerance of crops and pastures to soil salinity (Hermann, 1995)

Figure 7a – Messina establishment, Cooke Plains 2019

Fig 7b – Messina growing in waterlogged conditions, Meningie East 2017

Fig 7c – Seedling Messina, Coomandook 2018

Feed quality samples were taken from the Cooke Plains_2 site in 2017. This testing found that the Messina was comparable in feed quality to other legume species (Figure 8), however farmer experience has been that in larger paddocks with a mixture of soil types and pasture species the Messina can remain largely ungrazed but still provide valuable groundcover. In the absence of other feed sources, the stock will graze it.

Test	Messina	Nitro Persian	Balansa
Dry Matter (DM) (%)	12.3	10.9	7.8
Moisture (%)	87.7	89.1	92.2
Crude Protein (% DM)	32.7	26	25.3
Acid Detergent Fibre (% DM)	19.6	18.5	20
Neutral Detergent Fibre (%DM)	25	31	34.3
Digestibility (DMD % of DM)	82.9	80.5	78.1
Digestibility (DOMD) (Calculated % of DM)	77	75	73
Est. Metabolisable Energy (Calculated MJ/kg DM)	12.6	12.2	11.8
Fat (% of dry matter)	4.8	4.5	4.7
Ash (% of dry matter)	13.7	13.5	12.9

Figure 8. Feed test data (summarised), Cooke Plains_2, 2017.

Nodulation of the root system of Neptune Messina (Fig 9) was still evident in 2019 in a four-year old stand showing the ability of the rhizobia to survive in the hostile soils in the district.

The persistence of the Messina and Rhizobia over four years has shown the role that the Messina is likely to play in saltland pastures;

- As part of a diverse species mix (as opposed to a monoculture).
- As part of a mixed salt tolerant pasture sward providing maximum levels of groundcover and water extraction across the saline area.
- Providing the vital role of a salt tolerant legume (other than Balansa or Persian Clover) to provide nitrogen fixation in a salt tolerant pasture mix.

Figure 9. Nodulation of Messina, Coomandook, September 2019

2. Time of sowing

The time of sowing is critical in trying to remediate saline country. To improve the chances of plant germination, a ‘flush’ is thought to be required. In 2017-2018 this ‘flush’ wasn’t received and there was poor germination across all sites. In 2019, exceptional germinations were observed on hostile, saline soils and the late time of sowing after the salts had flushed through the soil was thought to be the key difference driving this success.

Figure 10 shows the effectiveness of the rainfall events received 12-June 2019 at a nearby Coomandook soil moisture probe in pushing water down through the profile (taking salts with it).

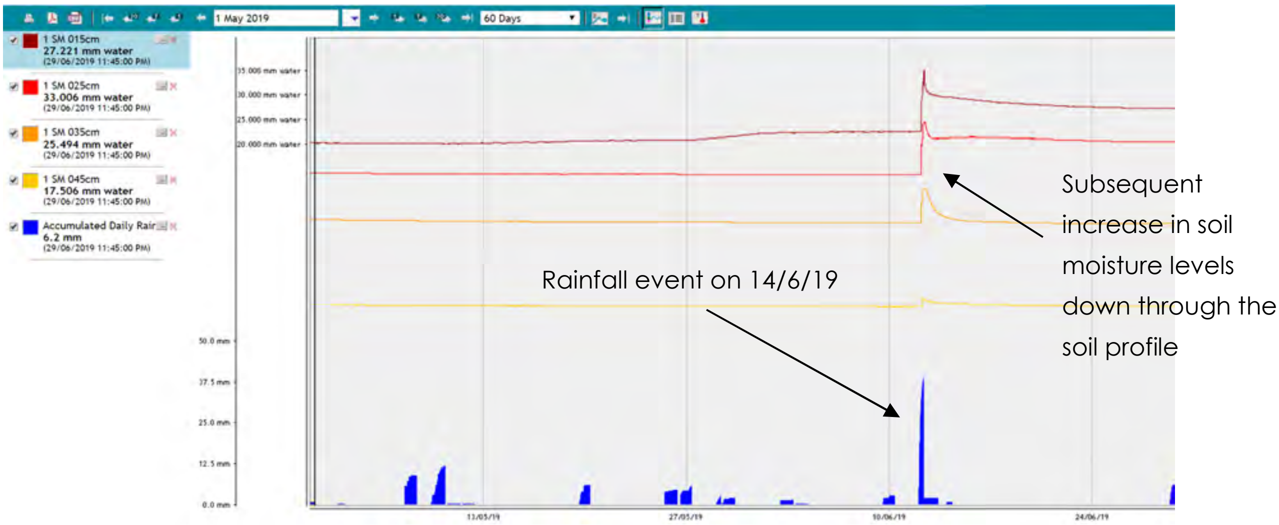


Figure 10. Coomandook soil moisture probe 1-May to 1-July 2019 (Data courtesy of SAMDB NRM Soil moisture probe network)

This is further supported by the Moorlands soil moisture probe data where the 2018 and 2019 data can be compared. In 2018 (Fig 11a) there was very little change in soil moisture levels from the 25-May to 25-June 2018, with the 50cm zone actually drying out further. This is in contrast to 2019 (Fig 11b) where there was an increase in the soil water through the profile down to 50cms.

Sensor depth	25-May	25-Jun	**CHANGE**
(cms)	mm water		
20	12.97	13.66	**0.69**
30	14.82	15.23	**0.41**
40	15.04	15.08	**0.03**
50	13.84	13.73	**-0.11**

Sensor depth	25-May	25-Jun	**CHANGE**
(cms)	mm water		
20	11.27	15.42	**4.15**
30	12.62	17.68	**5.07**
40	12.94	16.96	**4.03**
50	11.53	12.98	**1.46**

Fig 11. Moorlands soil moisture levels (a) 2018 (b) 2019

(Data courtesy of SAMDB NRM Soil moisture probe network)

3. Use of groundcovers and providing micro-climates

Throughout the life of the project, the areas where successful establishment of pastures occurred were those where there was evidence of groundcover (green or dead plant material) or areas where the surface was slightly elevated.

It is thought that retaining some level of groundcover over the summer period may assist in shading the area and reducing the evapoconcentration of salts in the soil over the summer period. In 2019-20, three sites were monitored to see if groundcover/shade over the summer period assisted in reducing the evapoconcentration. Soil samples were taken on 30-Jan 2020 prior to a rain event. The results are shown in Figure 12 where it can be seen that the groundcover appeared to reduce the soil surface salinity levels across all sites both at the soil surface further emphasising the importance of trying to retain groundcover to reduce the level of salt scalding.

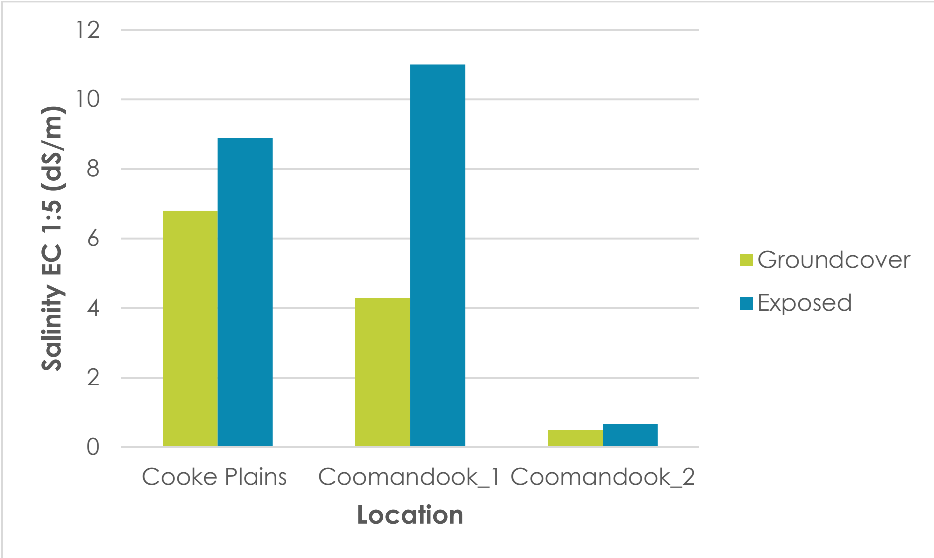


Figure 12. Impact of groundcover on soil surface salinity (0-10cms), 2020

This groundcover is also thought to provide a micro-climate for germinating plants. It not only provides an area that is lower in salinity levels, often the soil deposits lodge at the base of these areas providing a mounded area that appeared to be less hostile (thought to be due to reduced evapotranspiration, and more rapid leaching of salts when rainfall occurs). The natural colonisation of plants in areas where there was groundcover was evident across all sites throughout the life of the project (Figure 12). This prompted the thought of using mounds or organic matter to simulate what was being observed in nature.

4.Mechanical intervention

Throughout the project, different seeding techniques were used with varying success. The common method of seeding into the furrow and then providing a furrow with the press wheel was found to be detrimental to establishment of pastures in saline soil as the press wheel tended to create soil surface sealing impacting on germination. Those seeds that weren't placed in the base of the furrow rather on the sides of the furrow were those that germinated more effectively (and were more likely to survive).

The paddocks that were very roughly worked were those that appeared to have improved establishment. Mounding of a site at Coomandook in 2019 did not appear to improve establishment, however the time of sowing was very delayed at this site and the site may require rainfall to flush the salts out of the mounded area. This site will continue to be monitored as future opportunities allow.

In 2018 at the Cooke Plains_1 site the application of organic matter was demonstrated to see if this mulch effect provided a micro-climate to improve establishment of the Messina. Straw was chopped up through a Tomohawk bale shredder (Figure 13 a-b) and then incorporated with a chopper chain increasing the amount of organic matter in the soil. Germination in 2018 at this site was minimal, however the presence of the straw assisted in reducing wind erosion in 2018 and the summer/autumn of 2019. In 2019 good pasture establishment occurred across this (and all other sites). This has mainly been attributed to the rainfall 'flush' events, but areas where the straw had been incorporated appeared to visually have improved ground cover in 2019.

Figure 13 (a) Tomohawk Bale Shredder **(b) Straw on surface at site (August 2018)**

In 2019, a paddock at Cooke Plains that had been impacted by salt since 2013 was deep ripped to 400mm in a series of strips to see if cracking open the soil or reducing a hard pan layer had an impact on the soil salinity levels and establishment of pasture species. A mixture of crop and pasture species was then sown 11th June 2019 across the site.

The ripping was very successful in improving the pasture production and overall health of the plants (Fig 14). Establishment of the small seeds in the mix was reduced (thought to be due to seeding depth on the soft ripped area). Ripping was also effective in decreasing the salinity levels in the treated area, both at the surface, and at the 10-30cm layer (Fig 15).

Figure 14. Ripped (LHS) vs Unripped (RHS), Cooke Plains 2019

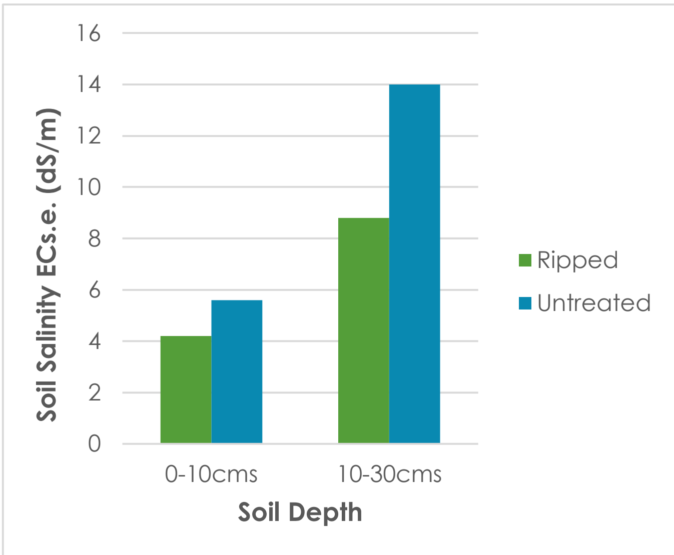


Figure 15. Soil Test Results, Cooke Plains 2019

Conclusion:

Throughout the life of the project, various saltland remediation techniques were demonstrated to improve farmer understanding of their effectiveness in remediating salt scalds. Varying success was achieved depending on the technique being demonstrated and the seasonal conditions being experienced.

Key Lessons learned;

- Maintain groundcover
- Wait until the soil has been 'flushed' before sowing
- Use a mixture of salt tolerant species

Gathering the following information will also assist in decision making in regard to the best way to manage a salinity impacted site;

- Knowing the soil salinity levels
- Is there a hardpan?
- The depth and seasonal variation of the saline water table

The use of mechanical interventions needs further exploration to improve understanding of the effect of different ripping techniques across a range of soils and the impact that it has on the movement of salts within the season.

There also needs to be a continued focus on prevention of saline areas (as opposed to cure). Further work needs to be done around suitable land use, the water use of different crops, pastures and other perennial vegetation to reduce the recharge of ground water across the landscape.

This project is supported by the National Landcare Program – Smart Farms Program, an Australian Government Initiative

Neptune messina

An annual pasture legume for saline and waterlogging prone soils

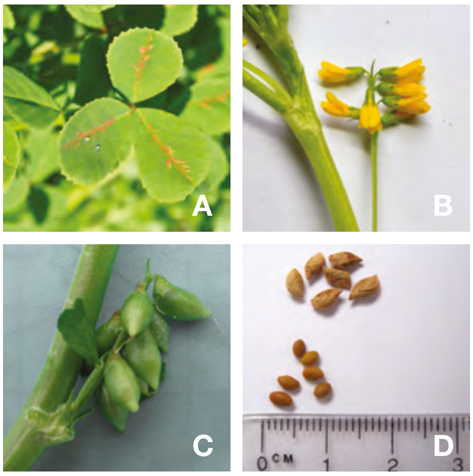
Key features

- Higher combined tolerance to salinity and waterlogging than all other current pasture legumes.
- Best suited to winter-wet saltland areas of southern Australia with ≥ 375 mm annual rainfall and soil pH($CaCl_2$) ≥ 5.5.
- Recommended for grazing in combination with other pasture species.
- Supplies nitrogen to N-deficient soils, provided it is inoculated with a specially developed salt-tolerant messina rhizobia.

Neptune three years after sowing on a saline valley floor at Woodanilling, WA.

Plant description and soil requirements

- Messina *(Melilotus siculus)* is native to the Mediterranean basin. It was identified in trials by DAFWA and SARDI as the only pasture legume tested able to persist on highly saline, waterlogged soils and Neptune was subsequently selected as the most productive and persistent messina variety.
- Neptune is an aerial-seeding annual legume that grows up to 0.8 m tall.
- Neptune is adapted to winter waterlogged areas where summer-early autumn topsoil (0–10 cm) salinity levels are 8–30 dS/m ECe (moderate-high salinity).
- Neptune requires soil pH($CaCl_2$) ≥ 5.5 or pH(water) ≥ 6.0, which is important as messina nodulation is sensitive to soil acidity (liming may be required).
- Neptune is suited to a range of soil textures from sands to heavy clays.



(a) Leaf, showing typical early season red-orange flecking (b) Flowers (c) Developing pods (d) Mature pods and seed

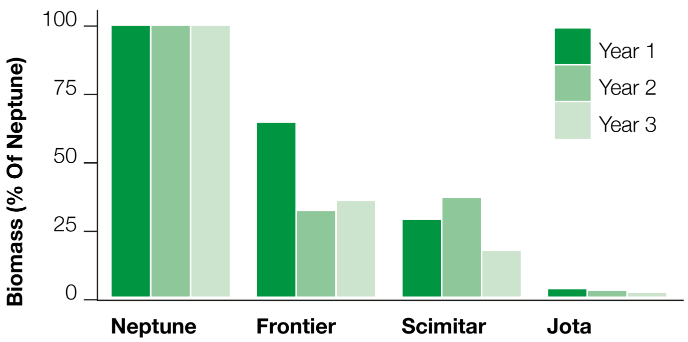
Neptune messina

Dormancy and maturity

- Neptune is moderately hard-seeded. A study in South Perth WA in 2010-11 found 26% of Neptune seeds remained hard in June, compared to only 6% for Frontier balansa clover. This provides a reserve seed source for germination in future years and results in staggered germination to cope with fluctuating salt levels and avoiding false breaks
- Neptune starts flowering around 98 days in Perth (WA) and 121 days in Keith (SA) from an early June sowing, 3-5 days later than Frontier balansa clover.

Biomass production

Neptune messina produced considerably more biomass than Frontier balansa clover, Scimitar burr medic and Jota white melilot at five saline, waterlogged trial sites in WA and SA in 2010 and 2011.

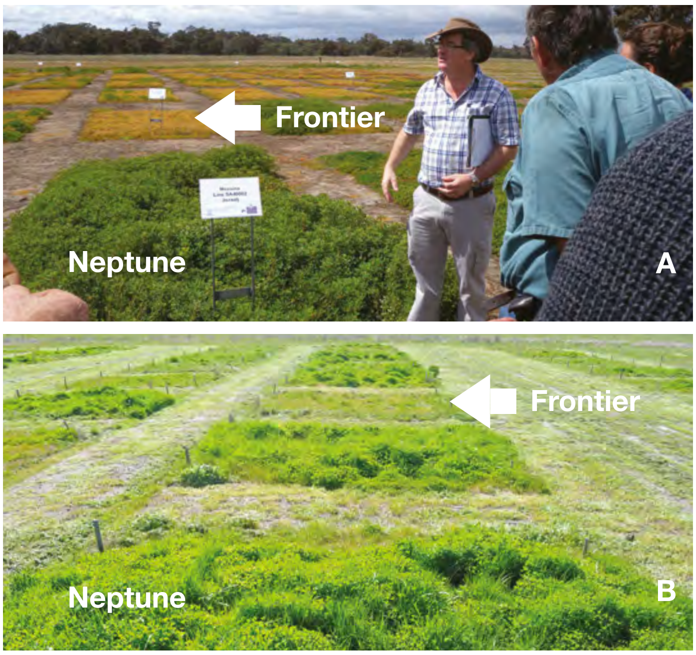


Mean biomass production of Neptune messina, Frontier balansa clover, Scimitar burr medic and Jota white melilot (as a percent of Neptune) over three years at the three most saline sites (Darkan and Tambellup, WA and Keith, SA).

Grazing value

Neptune messina has similar digestibility and protein levels to balansa and subterranean clovers, has no known chemicals that pose a threat to livestock health and produces meat acceptable to consumers.

Grazing trials with crossbred ewe lambs and crossbred ewe hoggets in Kybybolite SA in 2015 and 2016 showed Neptune tended to be less palatable than subterranean clover. This suggests liveweight gains may be limited if Neptune messina is the sole feed source, but weight should be maintained. Neptune appears to be grazed more readily when other species are also present in the paddock and it is, therefore, recommended for use in mixed pastures for livestock production.



Plots of Neptune messina and Frontier balansa clover three years after sowing: (a) Darkan (WA) showing Frontier plot dominated by button weed (Cotula sp.); (b) Keith (SA) with very low Frontier density.

Neptune messina

Sowing recommendations

Seed inoculation and dressing

- Neptune messina will be grown on soils unlikely to contain any suitable rhizobia and must be inoculated with the special salt-tolerant messina Rhizobium (strain SRDI554). Other strains of rhizobia will not survive over the summer in the saline soil.
- Seed should be inoculated with a peat slurry, lime pelleted and sown promptly (ideally within 24 hrs) after inoculation.
- Apron fungicide (metalaxyl) has been used in research trials to prevent damage from Pythium and Phytophthora root rots in wet soils. It should be applied to seed before inoculation with rhizobia.

Sowing

- Sow into moist soil in autumn or early winter.
- Ideal timing is to delay sowing until early rains have flushed salts from the surface, but before waterlogging occurs.
- Recommended sowing rate is 10 kg/ha.
- Sowing depth should be 10-15 mm deep, similar to subterranean clover (which has a similar seed size).
- Sow into a well prepared seed bed following good weed control.
- Apply adequate rates of fertiliser to ensure phosphorous, potassium and other trace elements do not limit production.

(a) Sheep grazing Neptune at Kybybolite, SA; (b) Saltland pasture mix of messina, balansa clover, burr medic, puccinellia and old man saltbush.

Other species

Saltland environments are highly heterogeneous for salinity and waterlogging potential. Species mixtures are recommended to enable different plants to colonise parts of the landscape where messina is less suited and to provide a more balanced feed intake. Neptune can be mixed with other pasture legumes, including balansa clover and burr medic and with the perennial grass, puccinellia. It can also be sown as an understorey species with saltbushes.

Neptune messina

Weed control

The paddock should be weed free prior to sowing. No chemicals are currently registered for use on messina and herbicide testing has been limited.

The grass selective herbicides Verdict, Select and Factor (Group A) used on other pasture legumes appear to be safe. Treflan applied pre-sowing at 1.4 L/ha and incorporated appears to be safe, although some damage has been measured at higher label rates. Post-emergent broadleaf weed control options used successfully in field trials include 25 g/ha of Broadstrike (plus label rate of uptake oil) and 50g/ha of Spinnaker at the 3-8 trifoliate leaf stages. Dual gold and Igran (at low label rate) have also been used safely on messina.

MCPA, Raptor and Simazine have caused significant damage to messina. Messina is very sensitive to the SU herbicide chlorsulfuron (Glean). Growers should avoid paddocks where SU herbicides have recently been used and strictly observe plant back periods on soils where residues persist.

Growers should observe cautions regarding the application of herbicides to waterlogged soils.

Pests and diseases

Messina should be monitored for redlegged earth mites and aphids during emergence and later in the season and controlled as required. Neptune has some susceptibility to powdery mildew.

Breeding and selection

Neptune messina was developed by DAFWA and SARDI as part of the Future Farm Industries Cooperative Research Centre. It is derived from accession SA40002, collected from the wild in Israel.

Seed enquiries

Neptune messina is marketed under the Dyna-Gro Seed brand. For seed enquiries contact Seednet personnel.

Seednet

WA
David Clegg
0408 630 641
david.clegg@seednet.com.au

SA, VIC & NSW
Rob Christie
0427 340 608
robert.christie@seednet.com.au

Technical information
Chris Walsh
0417 891 546
chris.walsh@seednet.com.au

Dyna-Gro Seed logistics
enquiries@dyna-groseed.com.au

Technical information

Department of Agriculture and Food

Dr Phillip Nichols
DAFWA, 3 Baron-Hay Court. South Perth WA 6151
(08) 9368 3547, 0418 955 943
phil.nichols@agric.wa.gov.au

SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Amanda Pearce
SARDI, Struan Research Centre,
PO Box 618, Naracoorte, SA 5271
(08) 8762 9105
Amanda.Pearce@sa.gov.au

SOIL DESCRIPTION DATA SHEET - SOIL PIT Green Plains Flat

General Description:

Thick sand over sandy light clay

Site Details

Site Name	Crossman 1	1:50,000 Sheet:	
Hundred:		Easting:	54H 0363560
Section:		Northing:	6047908
Sampling Date:	6/7/2020	Annual Rainfall	375mm

Soil Description:

Depth (cm)	Description
0 – 15	Dark brown loamy sand, single grain structure
15 – 35	Light brown loamy sandy, single grain structur
35 – 60	Bleached light brown sand, single grain structu
60– 80	Brown sandy light clay, ?? structure, slight dispersion
80 - 95	Brown clayey sand, ?? structure, very high lime reaction

Laboratory data

Depth cm	pHCa trial site hole	Al (CaCl2) mg/kg	pH $CaCl_2$	EC1:5 dS/m	ECe est	Chloride mg/kg	Nitrate N mg/Kg	Org C %	Avail P mg/kg (PBI)	PBI	Avail K mg/kg	KCL Sulphur mg/kg	Trace elements mg/kg (DTPA)				Boron mg/kg	CEC cmol (+)/kg	Exchangeable Cations cmol(+)/kg				ESP
													Cu	Fe	Mn	Zn			Ca	Mg	K	Na	
PADDOCK			5.3	.06	0.9	27	5	1.2	14	7	47	10	1.4	23	11	3.9	.3	3.2	2.7	0.4	0.1	.05	1
0 – 10	5.1	0.3	5.6	.06	0.9	6	8	1.4	10	5	45	7	.7	25	5	2.8	.3	4.1	3.6	.45	.1	.05	1
10 – 20	4.7	0.4	5.6	.02	0.3	<5	2.2	.5	8	7	35	4	.2	16	1.6	1.2	.2	2.1	1.8	.24	.07	<.04	1
20 - 35	5.3	<0.1	6.4	.02		<5	1.5	.2	5	5	29	<2	.1	9	.3	.3	<0.1	1.1	.9	.14	.05	<.04	1.3
35 – 60			6.4	.02		<5	1.3	.1	<5	6	42	3	.1	7	.9	.1	.2	.7	.5	.12	.05	<.04	3.1
60-80			7.3	.2		48	1.7	.3	<5	41	310	8	.1	18	.4	.1	.9	20	16	2.1	.7	.9	4.3
80-95			7.3	.2		110	2	.3	<5	68	210	14	.1	14	1.1	.2	1.1	22	18	1.7	.5	1	4.7
Adequate Levels	6-8.5	2	5.5-7.7	<.2	<2	<120-300	>5	1	25-30	20-40	100-120	10	.3	5-10	1	.3	0.5-15	>5	60-80%	10-20%	3-8%	<6%	<6%

Note: CEC (cation exchange capacity) is a measure of the soil's capacity to store and release nutrients. ESP (exchangeable sodium percentage) is derived by dividing exchangeable sodium value by the CEC.

SOIL DESCRIPTION DATA SHEET - SOIL PIT Green Plains Ridge

General Description:

Loamy sand over carbonate and limestone

Site Details

Site Name	Crossman 2	1:50,000 Sheet:	
Hundred:		Easting:	54H 0363593
Section:		Northing:	6047942
Sampling Date:	6/7/2020	Annual Rainfall	375mm

Soil Description:

Depth (cm)	Description
0 – 12	Dark greyish brown loamy sand, single grain structure
12 – 30	Brown loamy sand, single grain structure
30 – 60	Calcareous brown rubbly calcareous layer with significant calcrete nodules
60 – 90	Calcareous light brown rubble with areas of non- calcareous clayey sand

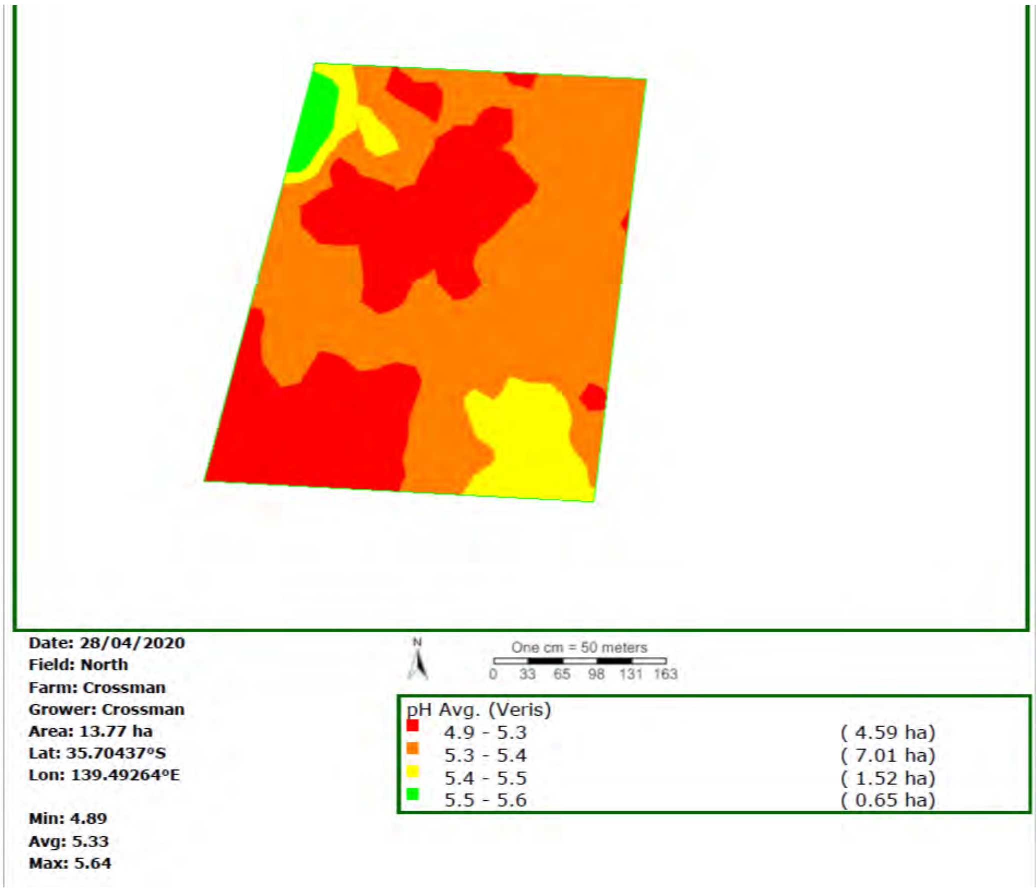
Laboratory data

Depth cm			pH H_2O	pH $CaCl_2$	EC1:5 dS/m	ECe dS/m	Chloride mg/kg	Nitrate N mg/Kg	Org C %	Avail P mg/kg (PBI)	PBI	Avail K mg/kg	KCL Sulphur mg/kg	Trace elements mg/kg (DTPA)				Boron mg/kg	CEC cmol (+)/kg	Exchangeable Cations cmol(+)/kg			
														Cu	Fe	Mn	Zn			Ca	Mg	K	Na
0 – 10			7.3	6.8	.2	2.9	88	6.9	2.1	32	13	200	12	1	24	3.7	4.4	0.7	7.4	5.6	1.0	0.5	0.3
10 – 20			7.2	6.5	.08	1.2	36	2.3	0.7	19	12	110	6.8	0.3	23	1.2	0.8	0.3	3.1	2.4	0.4	0.2	0.1
20 - 30			7.3	6.5	.05	0.7	22	1.7	0.4	17	9	90	4.6	0.2	16	0.6	0.6	0.2	2.9	2.4	0.3	0.2	0.1
30-60			8.6	7.8	.2	1.9	41	3.4	0.7	17	81	230	13	0.1	8.9	0.5	0.2	1	21.5	19	1.0	0.5	0.4
60 – 90 carb			8.7	7.9	.2	1.9	77	2.1	0.6	5	112	230	17	0.1	12	0.8	0.2	1.1	23.6	21	1.3	0.5	0.7
60-90 CS			8.1	7.5	.3	4.3	230	<1	0.2	9	23	150	20	0.1	15	<.3	0.1	0.6	9.4	7.0	0.9	0.3	1.2
Adequate Levels			6-8.5	5.5 - 7.7	<.2 -.3	<2	<120 -300	>5	1	25-30	20-40	100-120	10	.3-1	5-10	1-5	.3-1.0	0.5-15	>5	60 - 80 %	10 - 20 %	3-8 %	<6 %

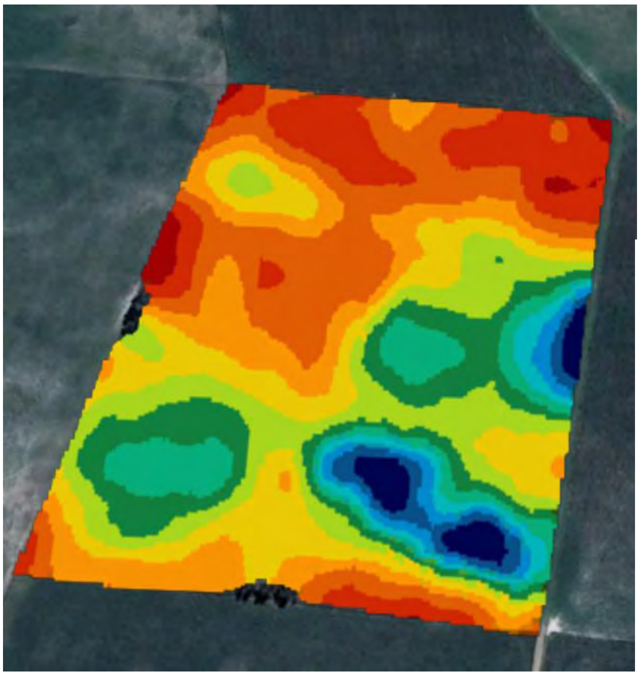
Note: CEC (cation exchange capacity) is a measure of the soil's capacity to store and release nutrients.

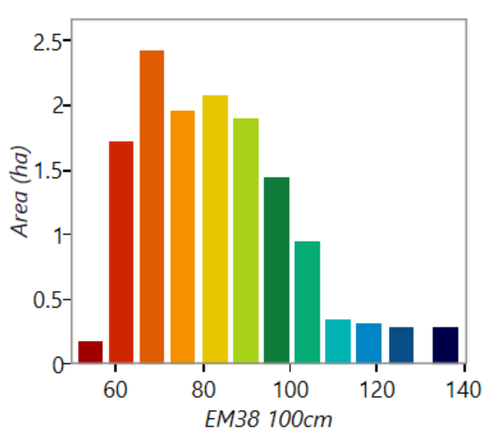
__Veris and EM maps__

Veris pH

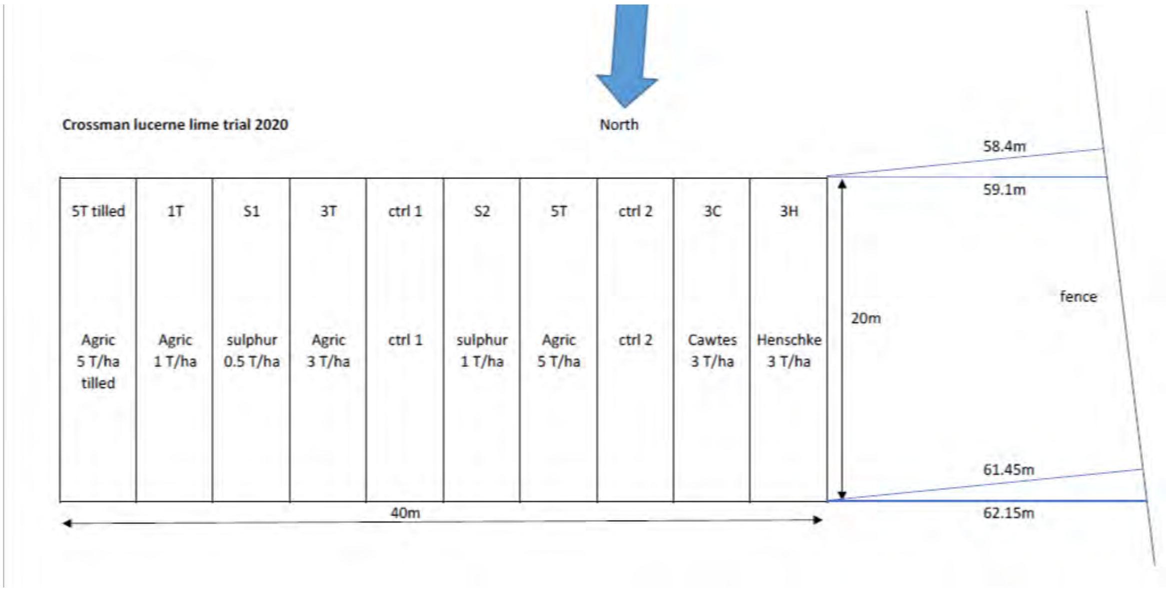


EM 38 100cm





Liming Demo site map



Soil Acidity basic rules

Why are soils acidifying

Acidifying fertilisers- most forms of N, elemental S

Product removal- hay, grain, livestock products

N leaching – shallow rooted plants worse

Legumes can increase in some situations

Impacts

Rhizobium cannot persist- linked to Mo/ N deficiency in plant

Toxic Al reduces root growth

Some nutrients lost or reduced availability/ tie-up- P, Ca, Mg. K, Cu, Zn, B, Mo

Critical pHCa (reads about 0.8 less than pHw)

<pHCa 5.5- need to start thinking about acidity as an issue, if surface pH drops below will see acidity creeping deeper into soils, particularly sandy soils

<pHCa 5.0- highly sensitive plants including lucerne, beans, lentils affected

< pHCa 4.8- toxic Al starts to accumulate- sensitive plants affected –phalaris, barley

< pHCa 4.5- slightly tolerant plants can be affected- sub-clover, wheat-var

<pHCa 4.0- Fe becomes released, tolerant plants affected – lupins, oats

Targets

Keep surface pH at 5.5 or better

Sub-surface at 4.8-5.0 or better

Avoid sub-surface acidification developing

Crossman Farm – estimate of acidification and alkaline inputs

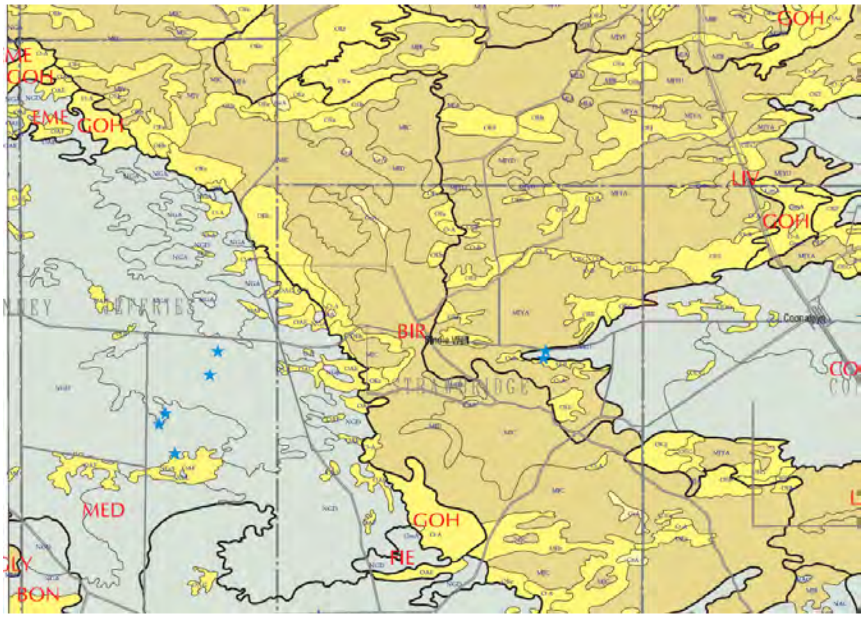
Item	Possible acid/ alkalinity	Net/ farm 2000ha/yr
Applies 90kg/ha Sulphate of Ammonia last 10 years	102 kgs lime equiv acidification per year/ 10 years = 1 tonne lime- drop pH by 0.5 unit	204 tonnes acidification/yr from SofA -204t
Single super and KCl also applied	no direct impact, indirect due to increased pasture growth and release of N	nil
Deep N leaching	possibly lower under deep rooted lucerne and veldt- use 20 kg/ha lime equivalent	40,000 kgs lime (40t) per year -40t
Product Removal	milk lose 4 kgs lime eq/ tonne 6t/yr Meat – depend on stock removal- no data 17kgs per tonne meat	4kgsx6t milkx600 cows= 14 tonnes lime equiv -14t for milk only
Large hay and grain input 2500t hay, 1600t grain	can have alkaline impact- some possibly lost as effluent oats, some clover hay 30kgs lime eq/ton= 75 t lime eq grain 10kgs lime eq/ton= 16 t lime eq	+ 91t lime if all ends in the paddocks (lot possibly ends in effluent) +90t?
Calcareous subsoils	will roots pick up calcareous materials from subsoil and add to surface of acidic sandy soils	+???

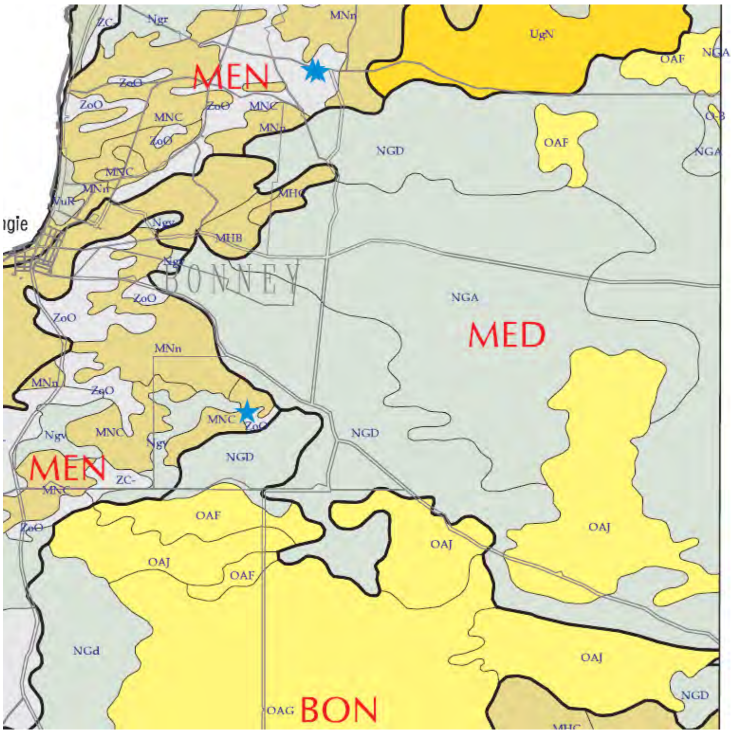
Summary

Test and test for pHca– surface, sub-surface and precision mapping all useful

www.acidsoilssa.com.au soil acidity web site about to be launched!!

__Regional Soil Info__





MED Meningie Downs Land System
(based on the description by A.K.McCord in "A Description of Land in the Southern Mallee of South Australia")

Gently undulating sandplain east of Meningie.

Area: 436.9 km^2

Annual rainfall: 450 - 500 mm.

Geology: The land is underlain by sandy limestones of the Coomandook Formation. These are covered by sandy lagoon sediments (Padthaway Formation) deposited in corridors between ancient coastal dunes. A discontinuous limestone layer caps the Padthaway Formation materials. Most of the land is covered by a veneer of aeolian Molineaux Sand. Minor Tertiary remnants with ironstone cappings protrude through the sedimentary cover.

Topography: The Meningie Downs Land System is a gently undulating sand plain with low to moderate irregular sand dunes and isolated low stony rises. Saline water tables underlie the System and are near the surface in some low lying depressions.

Elevation: 4-30 m.

Relief: Up to 10 m.

Soils: Sandy soils predominate. They range from deep sands to sand over sandy clays. Shallow stony soils are minor.

Main soils

G3a Sand over sandy clay - Extensive (on flats and rises).
H3 Deep siliceous sand - Extensive (on sand dunes).
G3b Thick sand over sandy clay - Common (on flats).

Minor soils

B3 Shallow stony loamy sand - stony rises
B7/N2 Sand over yellow and grey mottled clay - saline depressions

Main features: The Meningie Downs Land System comprises mainly sandy soils, with clayey subsoils on flats, but usually extending below a metre on sand dunes. Natural fertility is low, and water repellence and wind erosion are moderate to high limitations. Although some cropping is carried out, grazing of perennial pastures is the most extensive land use.

BIR Binnie Range Land System

(based on the description of the Binnie Range System by A.K.McCord in "A Description of Land in the Southern Mallee of South Australia")

Undulating range, parallel to and 10-20 km west of the Duke's Highway, between Tintinara and Coomandook.

Area: 422.7 km^2

Annual rainfall: 400 - 475 mm

Geology: The System is formed on calcreted calcarenites (Bridgewater Formation) of an ancient coastal dune. About 30% of the land surface is overlain by more recent windblown sands (Molineaux Sand) in the form of dunes or sand spreads. Locally derived alluvium has accumulated in larger depressions and corridors between the rises. Granitic intrusions underlie the System and outcrop sporadically.

Topography: Undulating to rolling rises with occasional low to moderate irregular sandhills superimposed over the main landscape. Depressions between the rising ground are usually closed.

Elevation: 20-170 m.

Relief: Up to 30 m.

Soils: All soils are underlain by calcreted calcarenite. Some are shallow, with sand to sandy loam surfaces and thin clayey subsoils. Others have a substantial thickness of sand, with or without a more clayey subsoil.

Main soils

- **B6** Sandy loam over red sandy clay on calcrete. Extensive on slopes and flats.
- **B7** Loamy sand over brown sandy clay on calcrete. Common on sandy flats and slopes.
- **H3** Deep bleached sand. Common on sand dunes and spreads.

Minor soils

- **G2** Sand over sandy clay. Limited on sand dunes and spreads.
- **A6/D2** (Calcareous) sandy clay loam over red clay. Minor on lower slopes and swales.

Main features: The Binnie Range Land System comprises mainly shallow stony soils on rising ground, associated with either deep sands or shallow sand over clay soils. Most of the land is arable, although water holding capacity is restricted, and some areas are sufficiently stony or characterized by sheet rock as to be non arable. The sandy soils have lower inherent fertility and are susceptible to wind erosion, making them less attractive for agriculture. There are minor heavy flats which have high productive potential.