The national newsletter of salinity R&D

focus ON SALT

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Matching plants to soils — remotely

By Bruce Munday

Using remote sensing tools to reveal the best matches of perennial pastures to soils at catchment and farm scales is much closer following recent CRC Salinity research.

Work conducted across three states, and led by Dr Megan Lewis at The University of Adelaide, has developed diagnostic tools and rules for interpreting remotely sensed data to extend and improve the resolution of traditional soil mapping.

It also enables improved modelling of water balance in catchments, greatly assisting decisions about where best to locate perennial plantings for recharge and salinity management.

"Traditional soil maps are useful in indicating the best locations for different crops or salinity treatments, but they often indicate that say, 50 per cent of a unit has a good chance of being a certain soil type," Dr Lewis commented. "However they don't tell us which half, so that without a lot of ground-truthing and supporting information, much time, effort and expense could be wasted in unsuitable areas."

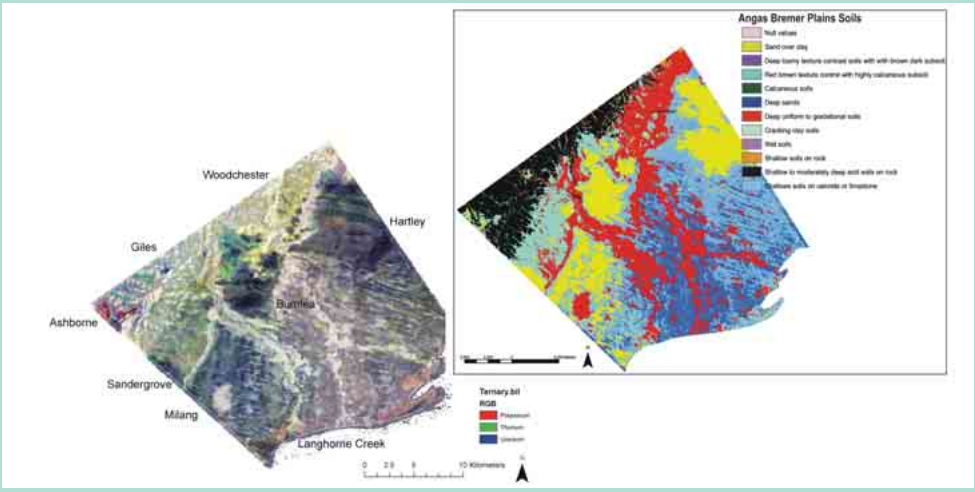
Traditional soil survey of large areas is also very labour intensive and may take years to complete – unlike new technologies which can survey large areas very quickly, building on methods originally developed for the mineral exploration industry.

The spatial analysis project has drawn on a variety of information sources including geophysical data, remote sensing from ground, air and satellite, plus climatic data to enhance catchment and property-level mapping.

Particular achievements to date include:

- Using gamma radiometric data to predict soil texture and soil hydraulic properties at property and land system scale. This has also led to development of functions to convert gamma radiometrics into soil hydraulic property maps, allowing prediction of water retention characteristics across catchments.
- Mapping of soil classes using radiometrics, topographic data and neural networks, thus enhancing the resolution of existing surface and subsurface maps (See figures below).
- Identifying soil horizons and subsoil constraints using ground penetrating radar.

• *Continued next page >*



Soils of the Angas Bremer Plains, SA (r), mapped from airborne gamma radiometric data and a digital elevation model (l) using a neural network. Soil mapping using geophysical data has the potential to provide more detail about soil variation than is currently available for many agricultural regions. (Gamma radiometric and elevation data: SASMMSP; soil mapping: D Mitchell)

CRC FOR PLANT–BASED MANAGEMENT OF DRYLAND SALINITY

CRCLEME
Cooperative Research Centre for Landscape Environments and Mineral Exploration

- *From previous page*
- Evaluating infra-red reflectance data to predict soil properties under varying plant cover conditions.
- Combining ground-based remote sensors (including EM, ground-penetrating radar and gamma radiometry) and ground observations (Geoprobe sampling) to better understand catchment characteristics and dynamics. This led to a 'regolith landscape' map attributed with soil and landscape properties for use in catchment modelling. This work is continuing in the Bet Bet Creek subcatchment in Victoria.

In Western Australia the project team is now applying geophysical techniques to find suitable locations for oil mallees, following research that has shown growth in some areas has been impeded by layers of silcrete below the ground surface. The methodology will then be further applied to potential oil mallee sites near Esperance.

A collaborative study is underway with Forest Products Commission in the central WA wheatbelt, evaluating gamma radiometrics and digital elevation data for soil property prediction and mapping.

Developing methodology for regional mapping of lucerne and perennial pastures is underway in South Australia and Victoria, and due for completion in a few months. This will enable monitoring of the extent of uptake of these plants in regions affected by or at risk of salinity.

The total effort over the three states will be synthesised later this year and will lead to web-based materials becoming available for land management and agricultural advisers.

Dr Lewis said that this work was fundamental to better targeting of areas for deployment of perennial pastures.

"The CRC has provided a focus and catalyst for us to evaluate a range of remote sensing technologies for their potential to improve these soil diagnostic tools.

"Prediction and mapping of soil properties with optical, radiometric and radar remote sensing are emerging areas of research internationally; our work makes us leaders in Australia in these fields."

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Lucerne as a mop

Lucerne's value to a farm enterprise in mopping up excess water can depend heavily on seasonal conditions and timing, according to a long-term simulation study.

Perry Dolling from the Department of Agriculture in Katanning, Western Australia, drew on historical weather data from 1957 to 2001 for high and low rainfall locations in high and low water-holding soils.

Modelling using the APSIM program showed that compared with continuous wheat, lucerne reduced the long-term leakage of water below the root zone by at least 23 per cent in rotations of 2–4 years followed by 1–4 years of crop. Under established lucerne, leakage was reduced to levels found under native vegetation especially at the low rainfall location.

The proportion of lucerne in the rotation had more impact on the leakage than soil types. However the impact of rainfall variation was greater than the impact of lucerne. "This makes decisions about when to grow lucerne to reduce water excess difficult, if livestock enterprises are less profitable than cropping," Mr Dolling noted.

In low rainfall locations, areas which are likely to be at risk to rising groundwater levels within the next 5–10 years should be targeted for lucerne production. The lucerne will prevent or reduce the groundwater rise and can be grown in rotation with crops.

More lucerne should be grown in high rainfall locations because of the greater rainfall and consequently greater leakage. Livestock systems are likely to be more profitable in these areas compared with the low rainfall region.

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Lucerne rules, OK

By Assoc. Prof. Mike Ewing, Deputy CEO, CRC Salinity

This edition of *Focus on Salt* has a distinct lucerne flavour, largely to announce the imminent publication of the CRC Salinity's *Lucerne Prospects Statement*.

Lucerne is a widely adapted perennial plant with good productive value, persistence, and such effective water use that in many situations it allows little or no leakage past its root zone.

When seeking perennials that might contribute to a profitable farm system whilst also reducing recharge, lucerne is often considered to be the benchmark.

Lucerne was cultivated in Australia in the 1830s and since then it has been very thoroughly investigated. And yet there remain challenges – challenges to extend the range of lucerne into more stressful settings associated with low rainfall and drought, acid and acidifying soil and frequent cropping in systems facing challenges such as herbicide-tolerant weeds. In tackling such challenges we are now finding lucerne performing effectively in situations most would have previously thought improbable.

Grazing industries have been resurgent in recent years and there are signs that this is well entrenched. Add to this a very large national fodder industry and it is clear that there will continue to be a great demand for lucerne in Australian farming systems.

The CRC's *Lucerne Prospects Statement* will provide an essential insight into just how far we have come with lucerne and what is its realistic future.

Drilling for liquid assets

By Georgina Wilson

Saline groundwater from beneath rural towns is being put to good use through the Rural Towns – Liquid Assets (RT-LA) project in Western Australia.

RT-LA is a partnership involving 16 rural shires, WA and Australian Government agencies, regional catchment councils and the National Action Plan for Salinity and Water Quality, aiming wherever possible to turn a problem into a resource or 'liquid asset' (see *Focus on Salt* # 32, 35).

At Merredin in the eastern wheatbelt, saline groundwater is becoming an important ingredient in reconstruction of a 60 kilometre section of the Great Eastern Highway that straddles the town.

Department of Agriculture project manager Mark Pridham said up to 500,000 litres of water per day was needed for the roadworks over summer, and using the saline water from beneath the town proved to be an ideal source.

"Even though the Goldfields Pipeline is right alongside the highway, using valuable scheme water on roadworks is unacceptable, so an alternative supply had to be found," he said.

"Groundwater beneath Merredin is about half as salty as seawater. Whilst too saline for most purposes, this is ideal for dust suppression."

Highlights

- Lowering water tables under towns can protect valuable assets
- Saline groundwater is a useful dust suppressant
- Saline irrigation water might suit salt-tolerant turfs

Photo: M Pridham

Mark Pridham inspecting outflow from production bore at Wagin, WA

Water for road construction, which needs to be better quality, is coming from local dams but next summer should come from desalination of the groundwater.

"If we can remove 70 per cent of salt through desalination, more of the rising groundwater threatening Merredin will be converted to a resource," Mr Pridham said. "The reject water from desalination will then be pumped to the evaporation ponds outside the town."

Merredin Shire chief executive officer Frank Ludovico described using the saline water as a novel solution and 'win-win' for the town. However, the challenge is to find a long-term use for the water when roadworks finished.

Wagin in the Great Southern is another RT-LA Pilot Town and since November 2005 a production bore has lowered the water table by 6 metres next to the bore, extending its influence up to 500 m away, including into the CBD with its many historic buildings.

Mr Pridham said the pumping rate was initially 4.5 L/s but has since been reduced as the water table fell. Detailed monitoring of water tables will continue into winter to determine the extent to which they recover from rainfall or stormwater recharge. Pumped groundwater from Wagin is being discharged to a salt lake, but the project is looking at possible productive uses.

Irrigation potential

One option to be explored is to use groundwater to irrigate salt-tolerant turf grass on ovals, parks and other public open spaces. This would not only consume some of the saline water, but reduce input of other water sources.

Research to begin later this year will evaluate performance of four salt-tolerant turfs under low and high salinity irrigation.

The turfs will be the regional standard species of kikuyu (*Pennisetum clandestinum*) and saltwater couch (*Paspalum vaginatum*), plus newer contenders in saltgrass or NyPa turf (*Distichlis spicata*) and marine couch grass (*Sporobolus virginicus*).

Research shows that the paspalum tolerates irrigation with water of EC 600-2,200 millisiemens per metre and can survive to 4,000 mS/m NyPa turf is highly salt tolerant, attributed partly to salt-excreting glands on its leaves. It survives irrigation with water of 8,000 mS/m, but grows best at 2,000 mS/m. Marine couch is widely distributed in saline coastal and inland habitats, also excreting salt but with the ability to discriminate between Na^+ and K^+ during transport to shoots.

Wagin's groundwater of 1,300 mS/m is too saline for conventional turf, but well within the range expected for the new halophytic turf grasses. Based on the performance over the next two years, decisions can be made on the best options.

Operating and maintenance costs of pumping or other water treatments are concerning towns which have only small rate bases. In other cases surface water flow from surrounding catchment areas is contributing significantly to rising groundwater within the town. In these situations the solution may be new dams built to capture run-off for irrigation. Nyabing, Lake Grace and Dowerin will be some of the first towns to do this, commencing in autumn.

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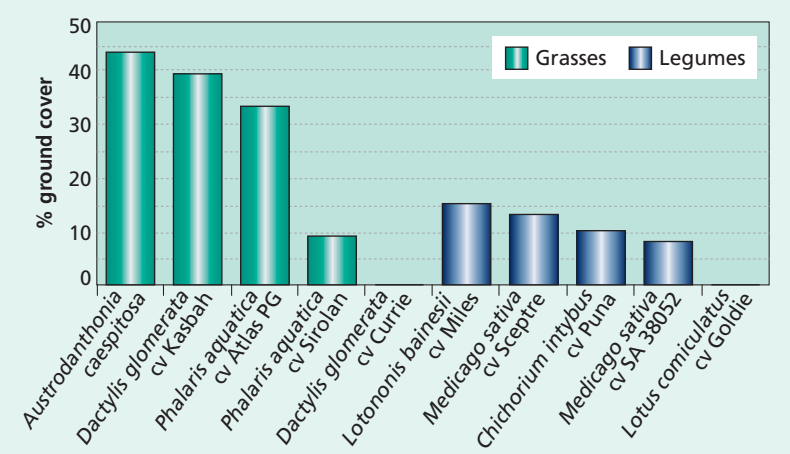
Unusual plants for odd weather

By Matt Crosbie

CRC Salinity research at Barmedman, in the low rainfall cropping belt in southern New South Wales, is finding answers to the problem of climate change and the level of persistence of current perennial pastures under what may be longer, hotter summers and unusual rainfall patterns in the future.



Persistence of grasses and legumes — leading species and cultivars

The Barmedman district, like the majority of NSW, has received extremely low rainfall over the past three years but a subtropical legume, a 'wild' lucerne, cocksfoot, phalaris and chicory are the surprising standouts in the unique trial aimed at introducing new perennial pastures into the low rainfall wheatbelt.

Trial leader, Dr Brian Dear, says the GRDC and CRC Salinity funded project is looking for perennials which will complement lucerne which is the only perennial currently being widely grown in the low rainfall cropping zone.

"We are looking to expand the range of perennials which can be grown either with lucerne or separately in the low rainfall cropping zones," Dr Dear said.

"So far we have had quite striking results with two perennial grasses standing out, despite the extremely low rainfall over the past three years."

Photo: B Dear

Richard Hayes with Kasbah cocksfoot and Grouse chicory plots at Barmedman

The grasses include Kasbah cocksfoot (*Dactylis glomerata*) and the CSIRO-developed Atlas PG phalaris (*Phalaris aquatica*) both of which exhibit a summer dormancy in their seasonal habits.

"What is interesting is that all these varieties have been available for some time, but haven't been thought of as being viable in the low rainfall cropping zones," Dr Dear said.

"These grasses complement lucerne as their peak growing season is winter. One of the problems of having a lucerne dominated pasture base is that it can induce a winter feed gap."

The grass species portion of the trial featured 19 varieties, including native species, with the percentage of crown cover used as an indicator of persistence.

Wallaby grass (*Austrodanthonia caespitosa*) was the most persistent in the trial with a crown cover of 43 per cent, however Kasbah cocksfoot was a close second with 39%.

The importance of summer dormancy was dramatically shown with Currie cocksfoot, which has less summer dormancy, failing to persist with a ground cover of only 0.1%.

Similarly, Atlas PG phalaris (*Phalaris aquatica*) with ground cover of 33% was far more successful on the Barmedman site than the more summer active Sirolan phalaris with 9%.

In the legume and herb section of the trial, Miles lotononis (*Lotononis bainesii*) persisted better than the lucernes, topping the list for ground cover and outproducing lucerne in drier periods.

The subtropical legume has been grown in Queensland, but has not been trialed extensively in NSW, let alone in the dry wheatbelt.

Despite this, the Lotononis had a ground cover of 15% compared with the next most persistent plot, Sceptre lucerne (*Medicago sativa*) with 13%.

The herb, Puna chicory (*Chichorium intybus*), was another plant being grown well outside its normal high rainfall area. Puna was the third most persistent perennial in the legume trial with ground cover of 10%.

Another interesting lucerne was the yellow flowering SA 38052 (*Medicago sativa caerula*) which exhibited ground cover of 8%.

This 'wild' lucerne should be more persistent than the currently available lucernes, Dr Dear believes, because of its prostrate habit which would not be as susceptible to crown damage from grazing.

The lotus varieties failed to persist with the best available lotus, Goldie (*Lotus comiculatus*) having only 0.1% ground cover.

Dr Dear said another trial is looking at the wild relatives of lucerne and their grazing and drought tolerance.

"Some are yellow flowered lucernes and creeping lucernes which are quite different to what people are used to."

Highlights

- Subtropical legume a surprise standout in drought conditions
- Perennial grasses show potential in low rainfall wheatbelt

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SIF3 — towards better investment decisions

The CRC Salnity's *Salinity Investment Framework (SIF3)* project team has visited the North Central region of Victoria to refine the framework and to better focus its analyses with practical information.

The SIF3 is a framework for analysing possible public investments in salinity management, and for helping investors improve the cost-effectiveness of that investment. It looks at the current land uses and investment targets, assessing the economic and practical feasibility of proposed land management or land use changes.

Photo: G Park

Trevor Campbell (r), Avon-Richardson Implementation Committee with SIF3 and North Central CMA personnel

For the past nine months the SIF3 project team has been working in partnership with catchment management authorities in Victoria and Western Australia, and with Australian and state governments to establish SIF3 as an essential tool in guiding salinity investments.

Team member Dr Anna Ridley from DPI Rutherglen says the SIF3 team aims to influence natural resource management in a way that improves the effectiveness of the next round of the National Action Plan for Salinity and Water Quality.

On the ground

The project team led by Dr Ridley and Prof. David Pannell recently visited several catchments in the North Central CMA region, all potential sites for CMA investment.

The CMA arranged for the team to meet up with local community members, experts and CMA staff, board or committee members at each site and helped them gather historical and local knowledge. In return, the team gave their hosts a better understanding of the SIF3 concept and how it might assist investment decisions.

Dr Ridley said the field tour had been very successful and quite revealing.

"We saw that there are some important institutional issues between and within agencies, and if these are resolved the CMA will be able to make better strategic choices of target regions for investment.

"There is also scope to improve the likely effectiveness of extension and incentives. The assumption that currently available farming systems options are sufficiently profitable, or otherwise attractive to be readily adopted appears not to have been sufficiently tested," said Dr Ridley.

"Our observations indicate that there could be an over-reliance on extension, and that (from a salinity perspective) incentives are not sufficiently well targeted given the adoptability of practices, groundwater responsiveness, and other criteria."

The SIF3 team found that in some instances no amount of extension or incentives would be likely to overcome the fundamental barriers to adoption. Practical considerations acting against the implementation of landscape scale change in land management practices include:

- poor persistence of exotic perennials
- uncertain cause and effect relationships between specific land-use changes and impacts on salinity and water yield
- long response times between cause and effect
- poorly understood biodiversity issues
- demographic changes towards lifestyle landholders.

"We also noticed a need for improved understanding of the principles for public investments for public versus private benefit," said Dr Ridley.

"Across the region there is relatively little focus on development of new practices or technologies for salinity prevention or adaptation. An encouraging exception is the Donald Landcare group which is exploring commercial and other uses for saline groundwater.

"Elsewhere there often appears to be an unjustified assumption that existing land-use options for salinity containment are sufficiently attractive to farmers. But the absence of widespread adoption suggests otherwise and points to the need for new technology development, especially for commercially oriented farmers. A different strategy will be needed for non-commercially oriented landholders."

Valuable feedback

Dr Ridley commented that the North Central CMA very willingly tested its approach to investment planning against SIF3. At the same time they have given the project team invaluable information that will greatly assist the further refinement of the SIF3 framework.

SIF3 recommendations and strategies are based on about 60 distinct situations, depending on the type of asset affected, hydrological conditions, and the economics of available management options.

The recommendations are very sensitive to these conditions, and are based on a mixture of research results, theory, judgments and logic. A key feature is that all of the recommendations are open to discussion and debate.

The SIF3 team plans to carry out similar work in the south-west corner of WA.

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Lucerne — a passenger on the Silk Road

By Matt Crosbie

A couple of thousand years ago, on the famed Silk Road, which once tracked through the hard mountain passes and high plains of Asia from China to Rome and back again, the pack animals left in their passage something which may prove to be even more valuable than the precious silks, spices and exotica they once carried – lucerne.

More particularly, lucerne varieties which may hold the key to acid tolerance, better persistence and a whole range of agronomic possibilities.

Photo: G Auricht

Steve Hughes (SARDI) admiring the spoils

Lucerne originated in the Mediterranean areas, perhaps cultivated 3000 years ago and reached China at the time of Christ.

But it is the gap between the Mediterranean lucernes and the Far Eastern varieties which fascinates CRC Salinity researcher Geoff Auricht, based at the Waite Institute in Adelaide.

"We have representatives of the Asian lines and the Mediterranean lines of lucerne, which have been widely cultivated, but we haven't had the transitional lines, the ones where you will find the most genetic diversity – and we think we've found them on the Silk Road," Geoff says.

"Along the old route you will find lucernes growing and we imagine that the old traders and caravans took the seed with them, not necessarily cultivating lucerne in pastures but dropping seed from the hay that was carried to feed the pack animals."

In 2002 this brought Geoff Auricht, along with Australian, Chinese and Russian researchers and four locals, to Kazakhstan along the trail of what was once a part of the Silk Road.

"We were in the far east of Kazakhstan where it ranges from dry, desolate country almost like a saltbush plain with low rainfall salt pans through to mountainous high rainfall fertile areas. We were able to collect samples across the whole region.

"With the Russian withdrawal and the independence of Kazakhstan, the collective farm system collapsed and most of the livestock were sold off – livestock numbers are still only 40 per cent of what they were 10 years ago.

"So there has been fantastic regeneration of pastures – it is a Garden of Eden and an ideal place to collect plants.

"We found 'wild' yellow flowering lucernes that have different seed sizes and the ability to thrive in dense grass swards which the traditional cultivated lucernes can't do.

"If you are targeting genetic diversity you need habitat diversity so we were stopping every 30–60 kilometres depending on the changes in terrain.

Photo: G Auricht

Downloading data at an SGSL site

"We'd gather up seeds, test for soil acidity, dig for roots and take a sample with nodules, ideally to get the rhizobium bacteria essential for effective nodulation and nitrogen fixation. All up we collected 700 samples of a diverse array of pasture plants spanning some 60 different species and including 106 wild lucernes."

Through his career Geoff has collected pasture germplasm in eastern and south-western Turkey, Sicily, Romania, Bulgaria, Spain and Portugal as well as Kazakhstan. The lucerne samples collected on these and many other missions, and having passed through quarantine, are now held in the Adelaide Genebank at the Waite Institute where they provide an essential base for lucerne improvement in Australia and globally.

Selecting the best

From the Adelaide collections the CRC Salinity is now funding the characterisation and preliminary evaluation of 200 different samples of lucerne under the management of Genebank Curator, Steve Hughes. Around 40 different characteristics of each strain are recorded in a mix of taxonomy and preliminary agronomy.

The trials have now had two years of seed multiplication with further trials being carried out to determine their acid and aluminium tolerance through hydroponic testing in which an acid 'pulse' is put through the water.

This 'pulse' impacts the growth of the root and enables the researchers to determine which strains of lucerne are the most tolerant of acidity by their ability to continue growing despite the stress. There are now three generations of plants which have come through the screening process.

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Lucerne — what are the limits

By Bruce Munday

Lucerne stands out as the best plant prospect for reducing recharge in the low to medium rainfall (350–550 millimetre) regions of southern Australia. Not only does lucerne underpin the important and ever expanding fodder industry, it is also finding its niche within cropping systems.

Despite its benefits, the role of lucerne is still severely limited by its intolerance to acid soils containing aluminium. Indeed, improvements in the acid tolerance of lucerne and its rhizobia could make it an option for up to 10 million hectares in New South Wales, Victoria and Western Australia. However, more than 20 years of research, principally in the USA, has struggled to make much progress on this complex problem of acid tolerance.

A CRC Salinity project led by Geoff Auricht (SARDI) has brought together rhizobiologists, plant breeders and plant physiologists from four states to take up a challenge that also represents a great opportunity. (See *Focus on Salt* #32).

The CRC team has developed screening techniques in nutrient solution culture to select lucerne plants that continue to grow at pH 4.5 with aluminium. Plants selected from these experiments have been poly-crossed to form new lines that have then been retested against the original parents.

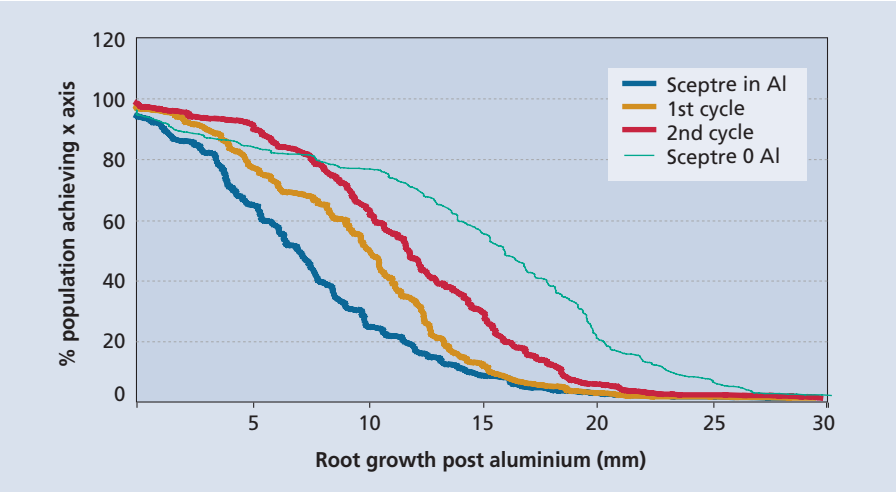

Figure 1 Root growth at pH 4.5, Al concentration 2 micromolar

As an illustration of the improvement, Figure 1 shows the root growth over two cycles of selection for the cultivar Sceptre. In the absence of aluminium 40 per cent of the base population achieved 17 mm root growth, but this reduced to 7.5 mm with 2 micromolar Al. After two cycles of selection, 40% of the population achieved 14 mm root length, about half way to overcoming the impediment to root growth at this concentration.

Alan Humphries, Senior Perennial Plant Breeder with the SARDI Pastures Group adds a cautionary note: "We are testing the Al in a very simple solution, so it is difficult to accurately quantify the level of our improvement. We are now attempting to validate these laboratory experiments with a range of soils from around Australia.

"In this project we have also selected acid-tolerant rhizobia in laboratory and field experiments, and developed a technique to improve nodulation at low pH. We have breeding for improved nodulation under way, completing a three-tiered approach to improving the acid tolerance of lucerne."

The CRC's evaluation project has also highlighted the potential of 'wild' lucernes in our farming systems (see page 4). Recent collection missions in Azerbaijan and Kazakhstan have discovered wild lucernes growing in incredibly dry (240 mm annual rainfall) and over-grazed environments.

Plants bred from these wild parents might have great potential for our low rainfall Mallee region, where traditional lucerne varieties have been difficult to establish and maintain. These, along with native herbaceous legumes being investigated in other CRC projects including SARDI, could be a valuable tool for reducing recharge in an environment currently delivers significant salt loads to the River Murray.

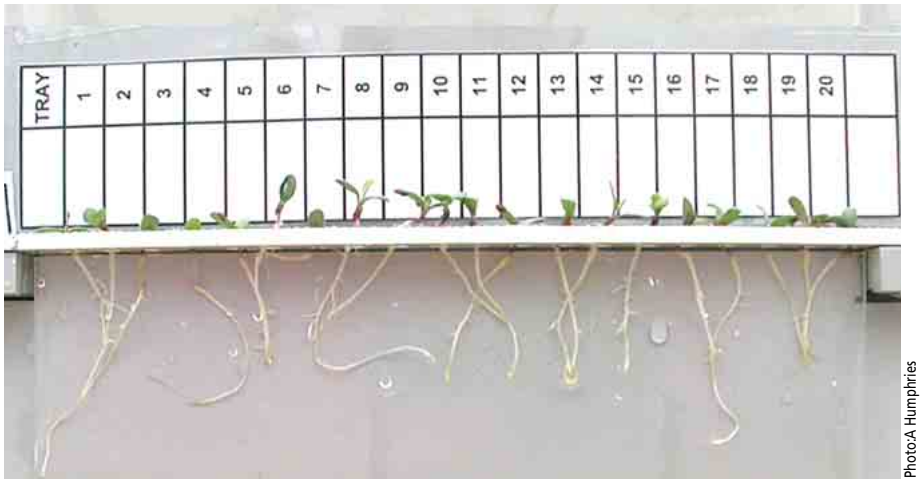

Photo:A Humphries

Five day-old lucerne seedlings after Al at day two

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Aluminium getting in the way of salt interception

Salt interception forms the last line of the River Murray's defence against salinity.

Mostly located in the Mallee zones of New South Wales, Victoria and South Australia, from Kerang to Morgan, these salt interception works pump saline groundwater to disposal basins a 'safe distance' away from the River.

Together these works pump about 25 gigalitres of saline groundwater each year, preventing about 425, 000 tonnes of salt from reaching the River.

Clogging and fouling of pumps and screens is one of the hazards of pumping from bores, iron salts being one of the most common fouling agents. Recently an unusual fouling has occurred at a number of wells completed in the Loxton Sands aquifer on the highland at Bookpurnong, the culprit being precipitated aluminium hydroxide.

Pump tests have shown that this can reduce flow rates from pumps by as much as 80 per cent, necessitating costly and time consuming cleaning.

Dr Paul Shand from the British Geological Survey, working with staff from the SA Department of Water, Land and Biodiversity Conservation (DWLBC), has developed a conceptual acidification model to explain the process leading to aquifer acidification and ultimately aluminium clogging.

Photo:SAWater

Discharge line clogged with $Al(OH)_3$

Using scanning electron microscopy, iron sulphide (pyrite) was identified in core material from boreholes affected by clogging. During pumping, oxygen arising from cascading and cavitation within the pump and/or drawdown of oxygenated groundwater water results in the oxidation of the pyrite, producing sulphuric acid.

Under acidic conditions, aluminium is released into solution and transported in groundwater until the pH increases. The mixing of acidic aluminium-bearing water, with higher pH water in the borehole column causes precipitation of solid $Al(OH)_3$, coating screens and pumps, retarding the intake of water and rapidly reducing the efficiency of the production bore.

Clogging as the result of the actions of iron bacteria can be treated by chlorine dosing, but to date a chemical solution to aluminium clogging remains elusive.

SAWater are currently trialing the use of positive displacement pumps in affected bores, indications being that this type of pump is effective in pumping waters containing $AL(OH)_3$ in suspension. Whilst this trial continues, the SA DWLBC continues to investigates management and treatment options.

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Innocents in the garden

The price of plant collection, Geoff Auricht jokes, "is you meet interesting people – and then you get locked up by the secret police."

"Searching for different lucerne varieties in remote Kazakhstan, we'd driven without realising into a prohibited area when we were stopped at a checkpoint by a junior policeman, who thought we looked a bit peculiar, these so-called scientists from six different countries.

"He escorted our two Russian-built four wheel drives back to a pretty grim looking military building.

"The regional head of the army and a former KGB officer charged us with entering a restricted military area without permission and ordered us to be held until a court could be brought together.

"Since he spoke Kazakh and some Russian and our Russian scientist spoke Russian and some Kazakh, our arguments didn't go so well and we were marched off to write our confessions.

"It was quite Shakespearean really," Geoff laughed, "while in the court room a huge windstorm came up and several of the glass windows blew in.

"A judge finally turned up, tried us and found us guilty and had to pay a fine of $AU63. We couldn't pay there and then, but he agreed we could have our passports back and pay within 10 days.

"It was an eight hour episode and as we drove off we drank some vodka and sang songs of freedom – relieved to be through a pretty dicey situation.

"Dicey or not, the collection of lucernes we found, including wild varieties and relatives of cultivated lucernes, are showing considerable potential for acid soil tolerance and grazing tolerance. Needless to say we are extremely grateful to the Kazakhs who alltow us to collect from their unique botanical storehouse."

SGSL pulling it all together

Sustainable Grazing on Saline Lands (SGSL) has begun the process of synthesising current best knowledge into a National Saltland Management Resource Document.

In the coming months, SGSL will be seeking input from researchers, extension specialists and farmers to assist with drawing together the best current knowledge to address five key questions:

1. How do I decide if saltland pastures are for me?
2. What do I need to know about my site to make the right decisions?
3. How do I select the right plants for my site?
4. How do I get my saltland pasture established?
5. How do I get the best out of my saltland pasture?

The results will be synthesised into a National Saltland Management Resource Document which will then provide the core information for the development of a suite of Regional Products.

"The five questions will form discrete modules in both the National and the Regional Products," said SGSL Coordinator for Land, Water and Wool, Dr Warren Mason.

"The Resource Document will be a comprehensive compilation of relevant saltland pastures knowledge and not just present the findings from SGSL.

"Importantly, the products will reflect the SGSL objectives of Profit, Pride and Reducing environmental impact," said Dr Mason.

The information for the Regional Products will come from SGSL's state producer networks, CRC research sites, the SGSL Themes and from non-SGSL sources.

According to Dr Mason the SGSL themes will help to draw together SGSL information relating to saltland economics, biodiversity, salt and water movement, siting and establishment, and saltland pasture production and utilisation.

Photo:E Barret-Lennard

Downloading data at an SGSL site

In compiling the Resource Document, equal weight will be given to research knowledge and to producer knowledge/ experience. It will be information rich with a strong focus on, and reference to, supporting documentation.

"A typical Regional Product might have a title like 'Successful Saltland Management in South West Victoria' and will have a range of local partners (such as CMAs) who not only have an interest in better managing saltland, but who have the mechanisms and local networks to distribute the products," added Dr Mason

The Regional Products will not be 'clones', but will be tailored and branded according to the needs of the target region - they will focus less on information and more on providing the tools and products that directly assist the decisions that need to be made on farm.

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The propects for grazing saline land

The next of the CRC's *Prospects Statement* series (following lucerne) will deal with the issue of managing saltland for profitable, environmental and social outcomes. The preparation of this Statement fortuitously coincides with the planning for an extension to the SGSL initiative, which presently concludes in December 2006, and the design of a saltland management program as part of the CRC Salinity's rebid for funding beyond 2008.

Apart from documenting the current state of knowledge about managing saltland, the Prospects Statement will highlight significant gaps in our present capacity to manage saline land to inform future research and extension strategies. Likewise, consultation to ensure that the business case for the CRC and a second stage of SGSL reflects stakeholder demand should inform how the Prospects Statement can be presented to hit the right chord.

Dr Richard Price of Kiri-ganai Research has been engaged to prepare both the Prospects Statement and the business case for further investment in Saltland management. Richard was one of the architects of the SGSL program and has an intimate knowledge of the CRC as a former Board member. Between February and April, Richard will convene 10 producer workshops across Australia and consult widely with researchers and extension specialists involved in saltland management. As part of his approach, he will assess the impact of saltland management from the perspective of farm-profitability, industry competitiveness, business resilience, environmental sustainability and producer pride and farm-family well-being.

The Prospects Statement is due for completion in June 2006.

Online database paves the way for better land-use management

By Greg Lawrence

CRC LEME has designed and pioneered an easy to follow pictorial online database for identifying critical soil indicators and options for land-use managers. The user-friendly online program was specifically created to allow natural resource managers to make informed land-use decisions and share data quickly.

Australia has a complex soil-landscape system resulting from its unique integrative history of ancient and modern soil-landscape formation processes. This has made it difficult for research scientists and natural resource managers to accurately assess environmental conditions, as making good land-use decisions requires looking at a lot of soil and regolith data generated at different scales and timeframes.

To make this data gathering task and assessment a lot easier, hard copy manuals, containing detailed information on morphology, chemistry and mineralogy at regional and site levels, have traditionally been used. These manuals typically contain a series of easy-to-follow pictorials used to identify critical soil indicators, land use options and best management practices. They have information about soil colour and contain regolith photographs, idealised landscape cross-section sketches and toposequence models, which show the direction of water flow within the various soil and regolith layers.

The manuals are used by farmers and other land-use managers to compare features highlighted in the manual within their own soil-landscapes. Criteria from these observations are the basis from which land-use decisions are then made.

CRC LEME Researcher, Dr Rob Fitzpatrick, said the Centre had successfully used such manuals in the eastern Mt Lofty Ranges of South Australia, parts of Victoria and the Iraqi marshlands.

"The model is yet to be adapted to other parts of the world as there is no easy-to-follow systematic framework to construct simplified toposequence models, and there are high costs associated with colour manual printing," Dr Fitzpatrick said.

Highlights

- Online database provides a framework for managing vast quantities of data
- Maintains all the attributes of hard copy manuals
- Interpretation sits alongside data

Going web-based

To make the techniques used in these manuals globally accessible and applicable, a systematic and flexible web-based approach for the improved acquisition, collation and communication of diverse soil-regolith data was created by CRC LEME. The online database was constructed using Microsoft FrontPage 2003 to ensure that large data sets were structured and could be managed in a methodical way to allow the rapid and effective communication of results. The methodology underpinning the database's construction was outlined in a recently published CRC LEME paper by Baker and Fitzpatrick (2005)[1].

To date, the online data set has already assisted Dr Fitzpatrick's research team in planning several large multidisciplinary environmental projects.

"It has already provided a framework for us to cope with vast quantities of data, especially in the acid drainage project in the wheatbelt of Western Australia and in the recent evaluation of floodplain soils along the Loxton Salt Interception Scheme Pipeline Corridor near Loxton, South Australia," Dr Fitzpatrick said.

"More specifically, the web-based data site approach has assisted us tremendously in maintaining uniformity of field protocols and the quality of data acquisition. It enables rapid and effective communication between multidisciplinary project team members, creating a dynamic way to deliver progress reports to clients and other interested parties, assisting in the production of final reports, providing a cheaper alternative to colour filled booklets and manuals, and allowing reported findings to be delivered to the general public via the internet."

How it works

The web-based data set provides a dynamic framework to manage large, complex projects as outlined in Figure 1. The locality map, when linked to the site summary pages allows rapid and simple navigation between sites and provides links to more detailed information. The location of each sample, or group of samples, taken at each site is displayed on photos in the site summary pages (Figure 1(ii)). This provides an accurate record of sample localities relative to each other and their spatial distribution in the regolith environment. Each sample, group of

Glossary

Eh	—	redox potential (anaerobic condition)
EC	—	Electrical conductivity (salinity)
XRF	—	X-ray fluorescence spectroscopy (geochemistry)
XRD	—	X-ray diffraction analysis (mineralogy)
ICP-MS	—	Inductively coupled plasma – mass spectroscopy (solution chemistry)
SEM	—	Scanning electron microscopy

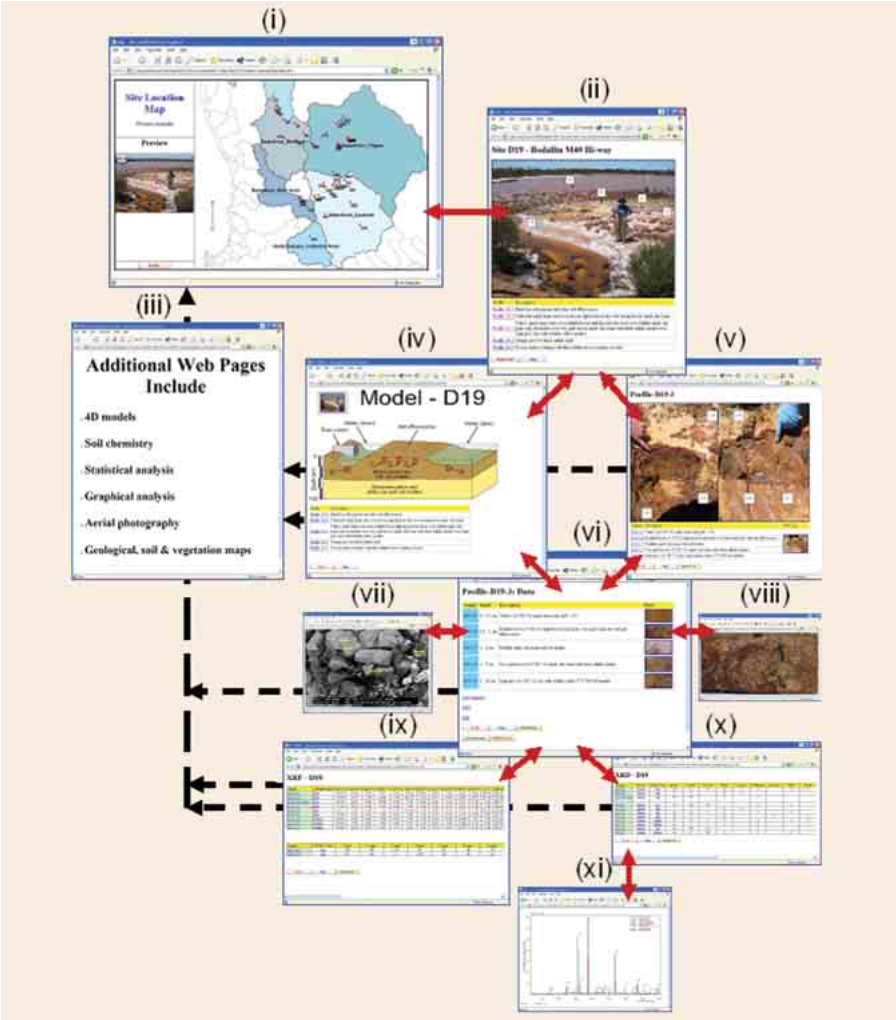

Figure 1. Flow diagram constructed of web views from a Western Australian acid sulfate soil, web-based data set. Views represent: (i) Site locality map, (ii) site summary web page, (iii) additional web pages that were included in the data set, (iv) 3-dimensional, interpretive model, (v) profile/sample summary page, (vi) data summary page, (vii) SEM photograph, (viii) chip tray photograph, (ix) XRF data, (x) XRD data, (xi) XRD spectra.

samples or profile can then be investigated in more detail via a HTML link to a sample summary page (Figure 1 (v)). These pages provide more detailed information on each sample and their location within a profile or group of samples.

Quality photographs, with a scale, of each sample can be invaluable in later data interpretation. Data summary pages (Figure 1(vi)) contain or have direct HTML links to all the observations and data recorded in the field (such as pH, Eh and EC), subsequent laboratory observations (colour, texture etc.) and results from laboratory techniques (XRD, XRF, ICP-MS etc). Once the basic structure of the data site has been constructed, any additional data can be added quickly and easily. Data, such as SEM photos, can also be made available as soon as they have been acquired (Figure 1(vii)). Chip tray photos can be added to avoid the need of retrieving samples from storage (Figure 1(viii)).

Often multi-organisational and multi-disciplinary research efforts involve team members spread over vast distances making it impractical for all to have accesses to samples. Spreadsheets containing geochemical data (e.g. XRD (Figure 1(ix)) and XRF (Figure 1(x)) can be made available for download, via the data site, without putting the original data at risk. There is no practical limit to the amount and type of data that can be stored and displayed in this fashion (Figure 1(iii)).

Data can also be grouped via HTML links according to shared physical and chemical characteristics. Interpretive toposequence models (Figure 1(iv)), graphs, statistical analysis and other forms of interpretation can be included in the site. The advantage of this grouping is that interpretation does not exist independent of the data that created it but is instead instantly accessible via HTML link.

The application

Two major national projects have already adopted this web-based approach to data presentation and management.

The projects are:

- National Atlas for Coastal Acid Sulfate Soils (managed by CSIRO Land and Water; coordinated by The National Committee for Acid Sulfate Soils)
- National Atlas for Inland Acid Sulfate Soils (managed by CRC for Landscapes Environments and Mineral Exploration; coordinated by The National Committee for Acid Sulfate Soils).

Once complete, these data sets will be integrated with web-based acid sulfate soil maps located on The Australian Soil Resource Information System (ASRIS).

[1]Baker A.K.M. and Fitzpatrick R.W. 2005. A systematic web-based approach for the acquisition, collation and communication of soil-regolith data. In: Roach I.C. ed. 2005. Regolith 2005 — Ten Years of CRC LEME, pp. 3–7.

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EverGraze site in Victoria on track

By Jo Curkpatrick

EverGraze — More livestock from perennials **has moved to its third and most intensive phase with the establishment of large-scale farming system trials in Western Australia, Victoria and New South Wales. The research is a CRC Salinity project with significant support from Meat & Livestock Australia.**

In Victoria, 70 hectares at DPI Hamilton has been transformed, with more than 60 plots now established to study the interactions between pasture type, animal production and water use.

Photo: J Curkpatrick

Tall wheatgrass trialled in nursery paddocks for lamb protection

Triple pasture system

The main site will challenge existing thinking by comparing widely different pasture types (subtropical species like kikuyu, temperate species such as ryegrass and fescue, summer versus winter active, all legume versus grass dominant, systems of differing pastures versus perennial ryegrass/sub clover) grazed by Merinos with high meat traits and double the normal lambing rate. A cattle treatment expands the range of pasture/animal combinations (Table 1).

"In one of the treatments we are looking at a novel farming system with pasture species like chicory and kikuyu, which are new to the high rainfall zone in Western Victoria and we don't know a lot about their performance," said site leader Geoff Saul.

"The kikuyu established very well and shows some potential," he said. "We will be interested to see how it goes through the summer."

Other work on the site will increase the understanding of the ecology of summer active tall fescue under appropriate grazing management.

"There is no information available about how summer active tall fescue grows and survives in winter rainfall areas and we need to understand the basic ecology of the plant."

"Summer active tall fescue sown in spring 2004 established very well and provided good production over summer-autumn 2005. Tall fescue has a reputation as being a difficult species to get established but we found excellent results with spring sowings," Geoff added.

The research is complemented by demonstration sites working with farmers and the Corangamite and Glenelg Hopkins Catchment Management Authorities. At these sites, the Hamilton research team is monitoring the performance of a range of summer actives species on farms and comparing their water use and production with that of traditional species.

• *Continued next page >*

Table 1. Treatment matrix for the Victorian experimental site

No	Pasture treatment	Animal type	Wean %	Green pasture on offer – Sept (kg/ha)	Soil type and pasture species Gravel (Crest)	Loam (Slope)	Clay (Valley)
1	*High fertility* Perennial ryegrass	Ewes	90	1200	PRG *Fitzroy*	PRG *Avalon*	PRG *Banquet*
2	*High fertility* Perennial ryegrass	Ewes	>150	1500	PRG *Fitzroy*	PRG *Avalon*	PRG *Banquet*
3	Triple pasture system	Ewes	90	1200	Lucerne *SARDI 7*	PRG + N *Avalon*	Tall fescue *Quantum Max P*
4	Triple pasture system	Ewes	>150	1500	Lucerne *SARDI 7*	PRG + N *Avalon*	Tall fescue *Quantum Max P*
5	*High fertility* Perennial ryegrass	Steers	NA	1500	PRG *Fitzroy*	PRG *Avalon*	PRG *Banquet*
6	Triple pasture system	Steers	NA	1500	Lucerne *SARDI 7*	PRG + N *Avalon*	Tall fescue *Quantum Max P*
7	Novel pasture system	Ewes	90	1200	Chicory *Puna II*	Italian RG+ N *Crusader*	Kikuyu *Whittet*

From saline to sodic soils

Drainage works designed to ameliorate salinity and improve the agricultural productivity of waterlogged land are throwing up another land degradation problem – soil sodicity.

CRC Salinity postgraduate student Melissa Fraser (photo) from The University of Adelaide is studying the effects of drainage and sodicity in the Upper South East of South Australia. There the saline heavy grey clay soils (vertosols) of the inter-dunal flat in the Keilira district are beginning to exhibit signs of degradation.

"Landholders have noticed reduced plant growth and areas of poor soil structure, coinciding with the extension of the drainage network," said Melissa.

The drainage network has lowered the water table near the drain to below the capillary range. Under such conditions, rainfall can leach salt from the profile, reducing the electrical conductivity and leaving sodium attached to the clay. This then leads to swelling and possibly dispersion of clay particles.

Unless precautions are taken structural degradation due to sodicity may develop with the leaching of salts and decrease in EC.

Photo: M Fraser

"Where there is high clay content throughout the profile, sodicity can strongly affect both the subsoil and the topsoil, impacting on seedling establishment and water infiltration.

"Members of the Keilira Farm Management Group (KFMG) have identified areas of degradation and are monitoring its extent," Melissa says.

The KFMG are currently conducting research throughout the region in collaboration with The University of Adelaide, to:

- Determine the extent and severity of sodicity throughout the Keilira district
- Identify landscape features (both macro and micro) that may affect the development or amelioration of sodicity
- Characterise the changes in chemistry, especially for the clays, that has occurred as a result of the drainage process
- Determine best management practice
- Monitor the change in awareness, understanding and management of sodicity by participants of the KFMG.

Melissa is using geophysics techniques and remote sensing software to detect changes in soil structure, impeding barriers to plant growth and infiltration, and the accumulation of salts.

The team has excavated soil pits, conducted grower surveys and held a farm walk, identifying the differences at the three core trial sites. Melissa will conduct mineralogical studies, detailed ground surveys and annual sampling to determine the effects of drainage in this region.

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• *From previous page*

Not just ordinary sheep

To further add to our understanding of genetics and the environment, two different sheep genotypes will be used on the Hamilton site. Ewes from Centreplus flocks in central NSW (large frame – 60 kilograms), high weaning rate (120 per cent +) and 19 micron wool will be compared with a local bloodline that has similar wool but is smaller (55 kg) and has typical weaning rates of around 80–90%. The Centreplus sheep are also being used at the NSW site.

Ewes selected for their reproductive performance will be fed to encourage twins and a favourable environment will be established within the triple pasture system to increase lamb survival. The Hamilton group will look at the potential to use hedge rows of tall wheat grass as a nursery paddock for twin lambing ewes.

Photo: J Curkpatrick

Centreplus sheep at the Hamilton site

"Provided good nutrition of ewes is maintained, it is relatively easy to have lambing rates of 150% or more, but we need management options to improve lamb survival.

"Tall wheatgrass hedges set to intercept the prevailing westerly winds should offer good protection for twin lambs whilst using water as well," said Geoff Saul.

The Hamilton team will also complete a desk-top study on the potential for ewes to lamb every eight months rather than the commonly used annual lambing systems.

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Surface water — get rid of it

By Georgina Wilson

Poor surface drainage, particularly on the broad valley floors of the Western Australian wheatbelt, but also in similar landscapes elsewhere in Australia, can have a significant impact on salinity.

Principal Research Officer Greg Hamilton points out that this significance is often overlooked and relatively straight forward opportunities for managing salinity are missed.

"The fundamental problem is that soil under annual crops always contains more moisture than that under trees or native vegetation," he says.

"For example, recent research at Esperance by Department of Agriculture researchers has shown soil beneath trees is always dry to 3 metres or more, whereas soil beneath good adjacent cereal crops is always moist below 0.5 m.

"Other research on valley floors at Cunderdin, Woodanilling and North Stirlings in WA shows that shallow water tables rise every winter from 2 m depth to within 30 cm of the surface in response to just 100 to 140 mm of autumn and early winter rain. With water tables so close to the surface, even small rainfall events in winter cause waterlogging or inundation."

These valley floors are subject to run-on water from adjacent slopes and are more prone to waterlogging and inundation than any other section of the landscape. This subjects the soil to prolonged periods of saturation, with evaporation of this water in spring and early summer accumulating salt in the soil profile.

To highlight the importance of run-off water, Mr Hamilton points out that surface water flows at rates at least a million times faster than groundwater in typical wheatbelt soils.

Valley floors thus have a high probability of suffering many waterlogging and flooding events every year, and the only way productive agriculture can be protected from this inundation is to ensure that efficient surface and root zone drainage quickly sheds most if not all excess water.

Photo: D Farmer

Localised flooding in North Stirlings (May 2005) caused by lack of roadside drains and culverts

Photo: G Hamilton

Flooding caused by inadequate roadside culverts at Woodanilling in May 2005

Getting rid of it

The Department of Agriculture has assembled a pictorial record of frequent and prolonged flooding that shows salinity has been worsened by the absence of roadside drains.

"Even where roadside drains and culverts exist, their capacity is often inadequate," says Mr Hamilton. "This is partly because many shires are unaware of the salinity control benefits that result from efficient valley floor drainage and most lack the expertise to design adequate structures for these situations.

"Of course drainage problems are not solved by simply taking water to the other side of the road. In many area the access of surface water to streams and rivers is poor and this is compounded by their channels lacking the capacity to cope with the larger and more frequent run-off from agricultural land. These stream and river channels were formed when the agricultural area was completely covered by trees, and run-off events were very much smaller and less frequent than today."

Mr Hamilton lists the essential steps for reducing the incidence of waterlogging and salinity on valley floors:

- Good soil management and agronomy to increase soil infiltration capacity, reduce waterlogging and increase the chances of profitable production (e.g. deepened seedbeds, controlled traffic and appropriate plant types).
- Properly designed and constructed surface drains to direct run-off around or through valley floors and collect and dispose of excess water (e.g. permanent raised beds and their associated drains).
- Properly designed and constructed roadside drains and culverts.
- Cleared and possibly widened stream and river channels.

These conditions call for on-going and active partnerships involving farmers, soil, water and agronomy experts, shire councils, main roads and possibly river authorities.

Photo: CALM

A typically ill-defined and inaccessible drainage line/stream channel in the Lake Grace district, WA. Note the flooding of adjacent paddocks in the foreground and along both sides of the vegetation

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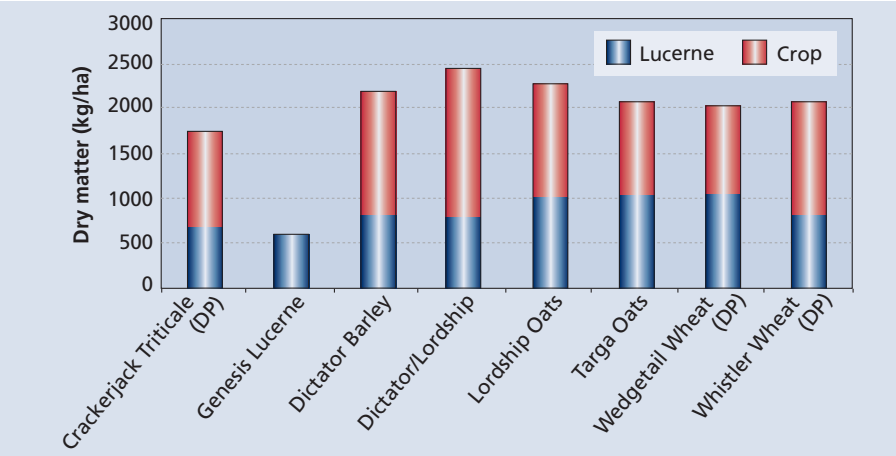
Companion cropping boosts winter forage

Research at Rutherglen in north-east Victoria has shown that sowing dual purpose and forage cereals into a three-year-old lucerne stand (a practice called companion cropping) can increase winter dry matter production by as much as 300 per cent.

Lucerne is largely dormant over the winter period, and even highly winter active lucerne varieties produce very little dry matter over this period. However companion cropping can increase productivity because cereal crops grow and produce more dry matter over winter compared with lucerne.

The additional production promoted through companion cropping may be attractive to livestock enterprises on mixed farms.

While this work demonstrates that companion cropping produces substantially more winter dry matter, more research would be useful to identify ways of profitably utilising additional production.



Dry matter production from stand-alone lucerne with companion cropped lucerne (DP: dual-purpose)

Findings like these, as well as other current and past lucerne research will form the basis of six regional guideline packages currently under development for southern Australia through the CRC Salinity.

The guidelines will provide information to specialists and landowners on why and how lucerne should and can be integrated into dryland cropping systems across Western Australia, South Australia, Victoria and New South Wales.

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Understanding sheep and smorgasbords

Under the CRC Salinity's *Sustainable Grazing on Saline Lands (SGSL)* project, researchers at CSIRO in Perth are trying to establish a cheap and reliable way to measure diet selection by sheep. Where a range of plants is on offer, how much of each is a typical sheep eating, rather than the group average, and how much variation is there within a flock?

Saltbush and many subtropical grasses have C_4 photosynthetic pathways, while annual clover and medics have C_3 pathways. Photosynthetic discrimination in plants results in different ratios of ^{13}C to ^{12}C in the plant tissue. As a result, it is possible to use ^{13}C in animal material as a 'marker' of relative intake of C_3 and C_4 plant species. The technique has been used on various animals using faeces, hair and muscle samples, but it has not been used to predict saltbush intake in sheep and wool has not previously been tested as a source material

For three weeks during January and early February small groups from 37 hogget wethers were fed 11 different diets combining annual pastures with saltbush and perennial pastures at maintenance level. Samples were taken from the sheep including wool, faeces, urine, blood and rumen fluid. These are being analysed in an attempt to find a link to diet based on a single sample. If successful it will help researchers to correlate liveweight change with diet selection, and information will feed back into design of saltland pastures to maximise animal productivity.

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WALG bridges lucerne gaps

By Georgina Wilson

Growing a perennial such as lucerne can be very different to annual pasture, so a self-help group to share experiences can be invaluable.

The Western Australian Lucerne Growers fills this niche in WA providing about 140 members with a quarterly newsletter, field days and an informal advice network for only $33 per year. Interstate trips to learn from others' experience have also been organised.

Around two-thirds of current members are from central and northern agricultural regions of WA, plus a few subscriptions from interstate seed suppliers. More than 50 additional members are expected very soon in a special funding arrangement with the Fitzgerald Biosphere Group on the South Coast.

The group was formed around 1992–93, run from the Department of Agriculture office in Katanning. It has managed to secure extra funding from various sources and is currently supported by the National Landcare Program.

Close relationships with the Department of Agriculture have encouraged WALG members to offer land for research trials, and this has been beneficial for both parties.

Besides the membership cost, an assistance package is available for an extra $100 plus GST under which field technician Tom Bailey visits a farmer's property before and after sowing to provide practical advice.

Tom estimates that about three-quarters of new members take the package and some are quite surprised at the differences in sowing depth and weed control needed compared with other pastures. Lucerne is a poor competitor in the first year, so insect control, lime coating and inoculation with the correct 'sticker' are all essential to give the young plant the best chance.

Taking the assistance package for a second year is not unusual, and extra visits and phone consultations to answer questions are common.

Some new growers start small, Tom says, with only 20 hectares, but others begin larger. One WALG founder member, Geoff Bee of Jerramungup, is currently growing 2000 ha of lucerne.

Photo: J. Patterson

Harvesting canola oversown into lucerne

Geoff began growing lucerne in small patches to control salinity in the late 1980s. Checks on water table levels showed that recharge of groundwater was higher than expected and the areas were extended. More than 25 years on, Geoff Bee is still a strong advocate and is sowing down the whole of a new property to lucerne at Jacup.

WALG Chairman, Jeff Patterson of Dumbleyung, is passionate about its value in managing salinity in his 300 millimetre rainfall area. He reckons if farmers can grow wheat on their land they can grow lucerne.

Each year he sows 300–350 ha, so that about half of his property or a total of about 1200 ha at any time is sown to lucerne to control water tables and provide extra nitrogen while the rest is sown to crop. Without a high proportion of lucerne it is too difficult to organise rotations properly, he argues. All of his lucerne is undersown with crop, providing low cost establishment and at least 70 per cent of normal crop yields in the first year. The main variety is Sceptre, although the new SARDI 10 impressed with its seedling vigour in the last year.

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Ensis sends CABALA to help

Ensis, the joint venture between CSIRO and Scion (New Zealand's leading forestry R&D organisation), has developed a software model called CABALA that will help managers make better plantation management decisions.

This comprehensive model has been developed over six years in partnership with the CRC Sustainable Production Forestry and is now being used by over three-quarters of the blue gum growers in temperate Australia.

Chairman of Commercial Plantations WA, Gavin Ellis, says: "CABALA has proved a valuable part of the decision-making process. It allows an insight into plantation performance in new regions where actual plantation performance data may be minimal or non-existent."

Using daily climate information along with tree growth modelling and forest health information, CABALA can make predictions to help with decision-making on issues such as plantation site establishment, rotation length, optimum wood and fibre production and the production of non-traditional forest products such as carbon and salinity credits.

According to Ensis Forests general manager Dr Clive Carlyle: "Being able to situate a plantation for maximum benefit with minimum disruption to the environment is essential for a sustainable forest and plantation industry.

"Generalisations are impossible due to different regions, soil types, water availability and tree species, so it is very exciting that we now have a system that can, and is, being used by our industry and environmental managers to help with their important decisions."

No cold comfort for tropical grasses

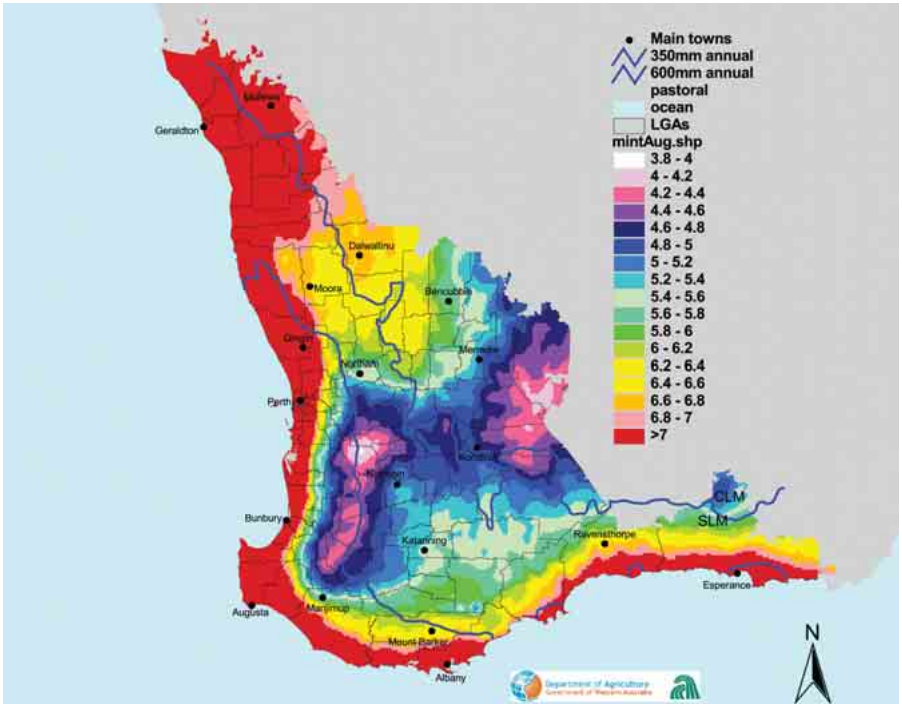
Widespread January rain in Western Australia has produced spectacular growth from subtropical grass trials. But CRC Salinity researcher, Geoff Moore from the Department of Agriculture Western Australia (DAWA), says new research points to limits to their adaptation in regions with cool and wet winters.

Results from an on-going trial at south-west Kojonup conducted by the DAWA team, Australian Wool Innovation and farming group, Evergreen, reinforce other results and farmer experience that there is a 'cold zone' in WA where subtropical (C_4) grasses fail to persist over winter.

"The poor persistence is due to a combination of cold, wet soils and frosts," Geoff says.

"As expected the sub-tropical grasses are burnt off by the first frosts in June, but instead of regrowing in spring with warming temperatures, a high proportion – commonly 70 to 100 per cent – of the plants die over winter. An obvious exception is kikuyu which seems to be unaffected."

The trial was established south-west of Kojonup in spring 2004 and most lines grew strongly in autumn 2005 producing 1.6–3.1 tonnes of dry matter per hectare.



Mean minimum temperature in August showing the so-called 'cold zone' where there is poor persistence of most sub-tropical grasses. (D. van Gool, DAWA; source: Bureau of Meteorology Base Climatological Data 1961–1990)

Persistence over the first winter for spring sown perennial species at Kojonup

Treatment	Variety	Plant persistence (plants/m^2)	
		May-05	Dec-05
Digit grass	Premier	54	0
Finger grass	Strickland	20	0
Kikuyu6752	Evergreen mix	34	5
Panic	Bambatsi	27	1
Panic	Gatton	41	0
Panic	Green	45	0
Rhodes grass	Callide	48	1
Rhodes grass	Finecut	46	6
Rhodes grass	Katambora	52	19
Setaria	Narok	30	7
Setaria	Splenda	32	1
Signal grass		33	0
Tall wheatgrass	(spring sown)	24	21
Lucerne	(spring sown)	40	37
Siratro		17	0

"However, the subtropical grasses failed to persist over winter, except for kikuyu which has almost 100% groundcover and some of the Rhodes grass lines which have more than 25% groundcover," Geoff said.

"On the other hand, the temperate perennial grasses and legumes are showing good potential in this area.

"This 'cold zone' has been spatially defined from maps of July-August mean minimum temperature, where the minimum temperature is more than 5.3 °C, as well as frost frequency

"This research also provides evidence as to the type of plant which will be successful in this environment.

"In other words, it will probably require a subtropical grass with a rhizomatous growth habit to persist."

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Love potion found for saltbush

A love potion has been found for an Australian saltbush that could revolutionise its use in saline areas across the country.

Research at Kings Park and Botanic Garden in Perth, in under a joint project with the CRC Salinity and the SGSL program, should lead to major cost savings in establishing river saltbush (*Atriplex amnicola*).

Dr Jason Stevens (pictured) from Kings Park has found that priming saltbush seed with gibberellic acid, a plant hormone, can cut germination time from 30 days to five, with a 99 per cent success rate. This compares with the normal direct seeding where germination rates can be as low as 5%.

"Large scale direct seeding of saltbush is very attractive to environmental managers because it costs about a third of the price of seedlings," Dr Stevens said. "But until now it has been a very hit-and-miss process – in both success rates and timing."

The research is showing that a basic understanding of seed dormancy and germination requirements has the potential to significantly improve field emergence of saltbush species.

Photo: G Wilson

Dr Ed Barrett-Lennard from the CRC Salinity and Department of Agriculture in WA, said unreliable germination had been a major obstacle to the wide-scale adoption of saltbush, which could play an important role in rehabilitating saline areas while providing valuable grazing.

"This is just the first step in a larger investigation to look at improving the establishment of a wider range of saltbush species on saltland and arid soils," he noted. "With further work, we expect to find better ways to engineer niches in which seeds can germinate that will be just as important as seed treatments."

Dr Barrett-Lennard said that while man had been working with plants such as wheat for thousands of years to improve their yields and performance, saltbush had been largely ignored. But since attracting scientific attention in the last few years, prospects are very exciting.

Dr Stevens has been working with three common varieties of saltbush, but the others, old man saltbush from Australia and wavyleaf saltbush from Argentina, had not had the same results from the gibberellic acid.

But other treatments, such as removing bracteoles or the wings around the saltbush seed before planting, were increasing rates of emergence significantly, as did salicylic acid (the active ingredient in aspirin). These will be investigated further in coming months if funding is available.

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Revegetation by design

Dr Peter Taverner, an entomologist with the South Australian Research and Development Institute (SARDI) leads a research project investigating the potential of native vegetation to reduce horticultural pests and diseases of the Northern Adelaide Plain.

The main villain is the exotic western flower thrip, an important carrier of a plant virus that causes around $25 million of annual crop losses and management overheads. Preliminary investigations showed these thrips are present on most of the common weeds of the region, and the trial aims to displace these weeds with native vegetation that will host predators of the thrip.

While not strictly a salinity research project, seven of the 15 most promising varieties of native plants being studied are saltbush species.

"We know that the beneficial insects (many of which are native) that prey on the horticultural pests are visiting native plants which provide them with habitat and food," said Dr Tavener.

"To maximise the horticultural benefit from native species we need to determine which will offer greatest refuge and food for the beneficial insects, but which do not support pests and diseases.

Photo: SARDI

'Revegetation by design' trial plot open day

"If this 'revegetation by design' does help reduce the population of harmful insects it should also reduce the need for pesticides.

"So far the populations of pest thrips found on the native plants have been very low. In contrast, the brassica weeds, salvation jane, mallow and caltrop have very large thrip populations."

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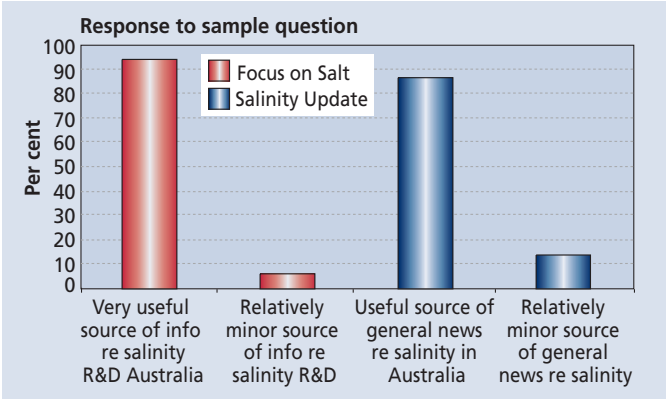
What do readers think?

Does *Focus on Salt* keep its readers happy and satisfied?

The first edition of *Focus on Salt (FoS)* appeared in February 1994 under the banner of the National Dryland Salinity Program. The editorial column in that edition claimed that "FOCUS will convey information of technical, production, economic and social interest. While much of the information will centre on (the NDSP), FOCUS will highlight items of national interest wherever possible."



Since the wind-up of the NDSP in 2004, the CRC Salinity and CRC LEME have taken responsibility for much of the nationally coordinated salinity research and development. However, twelve years on, the original objectives of *FoS* are still relevant and appropriate.

In 2005 approximately 200 readers responded to a fax-back survey aimed at assessing reader satisfaction and exploring ways of improving the publication. This was backed up with a targeted and more detailed online survey of 36 CMA personnel, government agency staff and CRC program leaders.

At the same time, we surveyed readers' opinions of our *Salinity Update* that is now available only on the CRC Salinity's website.

Whilst hardly a statistically significant sample of our 5600 subscribers, this did give the CRC Salinity's communications team some insights into how the publication is traveling.

Generally the readers who responded to the survey are very satisfied with the publication. A couple of suggestions from readers have been taken on board, such using the front page to highlight research outcomes rather than the CRC's policy position, and using 'highlights' to assist readers with longer articles.

SALT magazine

The CRC Salinity's companion publication, *SALT* magazine, is jointly published with Meat & Livestock Australia and Australian Wool Innovation Ltd (through their *SGSL* program). This too was surveyed as above, but backed up with much more thorough market research based on a phone survey of 352 readers. We are receiving the results of that research as this edition of *FoS* goes to press. A summary will appear in the June edition of *SALT*.

Notwithstanding all these surveys, the communications team of the CRC Salinity always welcomes comments on its publications and particularly suggestions for improvement. We also welcome contributions to *FoS* from R&D organisations (such as state and Australian government agencies) outside the CRCs.

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Polymer application looking good

Applying a small amount of a polymaleic acid powder form of polymer to raised beds, has reduced salinity by more than a third in the first year of CRC Salinity trials conducted by Greg Hamilton's team in Western Australia.

The polymer was applied to raised beds at Woodanilling in the Great Southern with fertiliser at 10 kilograms per hectare. Compared to untreated soil in the beds it cut EC from 25 to 15 millisiemens per centimetre in the top 5 cm of sown rows and from 27 to 16 mS/cm in the inter-row area on the beds. At a slightly deeper level of 5–10 cm below the surface EC levels in sown rows declined from 17.5 to 9.5 mS/cm and 17.5 to 10.5 mS/cm between the rows.

Greg describes the results as "a very significant effect on salinity and sodicity" while cautioning it is only one year of results in a year too waterlogged and saline for germination of most of Dr Tim Colmer's salt-tolerant wheat on the same site.

Also amounts of exchangeable calcium were increased by the presence of the polymer, magnesium was reduced and sodium reduced significantly. Soil pH rose slightly from 6.5 to 6.8. The polymer is biodegradable and will need to be provided annually with fertiliser. The cost is about $10 per hectare. Further monitoring and evaluation is planned.

In other number-crunching recently related to the cropped area on the Woodanilling site in 2004, Greg has shown that loosened raised beds are leaching more salt from the surface layer (0-20 cm) and constraining more of the capillary rise in spring and early summer than occurs in the other treatments – a no-till control and a no-till raised beds. Further analyses from other sites and years are underway.

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About Focus on Salt

Focus on Salt is published by the CRC for Plant-based Management of Dryland Salinity (CRC Salinity) in collaboration with the CRC for Landscape Environments and Mineral Exploration (CRC LEME).

CRC Salinity core partners are Charles Sturt University (CSU); Commonwealth Scientific and Industrial Research Organisation (CSIRO); Department of Agriculture WA (DAWA); Department of Conservation and Land Management WA (CALM); Departments of Primary Industries (DPI) and Sustainability & Environment (DSE), Victoria; NSW Department of Primary Industries (NSW DPI); Departments of Primary Industry and Resources (PIRSA) and Water, Land and Biodiversity Conservation (DWLBC), SA; The University of Western Australia (UWA); The University of Adelaide (UA).

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For information about CRC Salinity visit www.crcsalinity.com.au

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