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focus ON SALT

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CRC FOR PLANT–BASED MANAGEMENT OF DRYLAND SALINITY

CRCLEME
Cooperative Research Centre for Landscape Environments and Mineral Exploration

Lucerne – still the king of fodder plants

By Bruce Munday

The compelling case for plant-based approaches to salinity management is that growing plants is exactly what farmers do. This is their business, and if conducting a successful business contributes to solving a serious environmental problem, then that is a great outcome.

Photo: K Munday

The geographical area covered by the activities of the CRC for Plant-based Management of Dryland Salinity includes a diverse range of climates, soils and farming enterprises. Across that range lucerne stands out as the most widely sown perennial, but nonetheless restricted by factors such as soil acidity, waterlogging, risk of bloat and vulnerability to set stocking.

Aside from these agronomic issues, the potential role for lucerne on farms will always be strongly linked to its profitability compared with alternative crops. For catchment management organisations looking for widespread and long-term uptake of lucerne, it must be profitable in its own right and not dependent on external subsidies.

The CRC Salinity is in a unique position where it is harnessing vast lucerne-related research capability across institutions and disciplines.

This research covers a diverse but integrated suite of activities such as improving acid tolerance (see page 2), phase and companion cropping, mapping for favourable growing environments and groundwater flow systems (in collaboration with the CRC LEME), and the economics of including lucerne in farming systems.

The CRC is now reaching a point where it can provide comprehensive knowledge on how and where lucerne can be grown with confidence for salinity mitigation outcomes that are both profitable and practical.

All this feeds into an evolving extension program that 'springboards' off the CRC's strong working relationship with AWB Landmark.

There is already a considerable body of knowledge about establishment and management of lucerne, choice of appropriate varieties and the effectiveness of lucerne in recharge control. The CRC takes this as a given. Our research builds on this with important new findings, but just as importantly it is drawing it together with important knowledge from other disciplines

"This year the CRC will publish a round-up of current knowledge on the prospects of lucerne for dryland salinity management across Australia," says Kevin Goss, CEO of the CRC Salinity.

"It will be a business case for further investment in lucerne, including its impact on profitability and risks, and will be relevant to farmers, catchment organisations, agribusiness services and public policy advisers.

"This issue of *Focus on Salt* reports on several ambitious research projects that have already made exceptional progress — progress that has been possible only because the participating agencies were willing to share their past work, their diverse perspectives, their unique skills and their resources in this research collaboration."

Now at the mid-point of its first phase, the CRC is demonstrating the further value that comes from collaboration — the opportunity for projects to inform and add value to other projects, in many cases bridging the traditional gap between disciplines.

Lucerne team on acid trip

By Bruce Munday

Acid soils impose a serious limit to the expansion of lucerne into greater areas of southern Australia, where it might otherwise be a very practical tool for recharge control. However a team of CRC Salinity researchers from across the nation has made great progress towards overcoming this constraint and increasing the potential area available to lucerne by as much as one million hectares.

Photo: R Ballard

Rhizobiologist Nigel Charman (SARDI) checking the effectiveness of new acid tolerant strains of Rhizobium.

Lucerne's lack of tolerance to acid soils is a complex process which this research project is pursuing on three fronts (see *Focus on Salt* Issue 28, Oct 2003):

- Developing a screening method for selecting lucerne plants with a heritable tolerance of acidic soils containing aluminium;
- Selecting root nodule bacteria (rhizobia) strains that not only persist in an acid environment but which can also fix nitrogen; and
- Screening lucerne populations in acid conditions to select individuals for enhanced nodulation and nitrogen fixation.

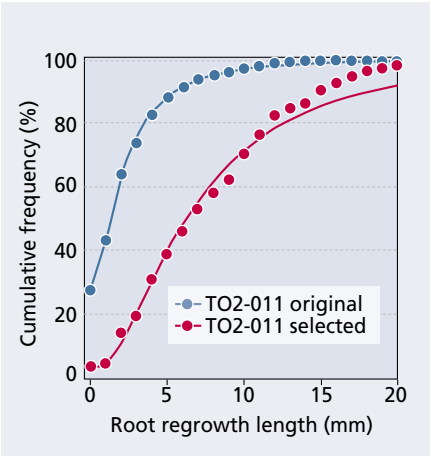

Figure 1 After one round of selection the proportion of the population of this lucerne genotype with damaged roots had fallen from 90 per cent to 40 pc.

The plant

The poor performance of lucerne in hostile acid and aluminium environments is strongly related to seriously impaired root growth.

Tackling this problem, Dr Brendan Scott (recently retired from NSW DPI) selected genetically diverse lucerne plants for their ability to grow in acid solutions containing normally toxic aluminium concentrations.

Grown on and intercrossed, the progeny of these plants were retested, four of the lines showing significant shifts towards greater tolerance (Figure 1).

"This result is very encouraging as it shows that the tolerance of aluminium in lucerne is a heritable trait that can be improved by selection," Dr Scott said.

"The selection process has been repeated and the best plants from among the cycle 1 progeny have been recovered and grown on to form a second selection cycle. We hope that this process will further improve tolerance of aluminium and position us to take our trials out of the glasshouse and into soils."

The bug

Ross Ballard (SARDI) leads a team searching the large collection of rhizobia held at Waite Institute in Adelaide for those that are at home in an acid environment. Initially the 10 most promising strains (from over 200) were field tested for persistence over two years in a soil of pH 4.2 at Mt Compass.

One strain (SRDI291) isolated from an acid soil near Naracoorte performed extremely well, the percentage of lucerne seedlings nodulated, the number of nodules per plant, and the dry matter produced all exceeding those for the current strain of lucerne rhizobia (RRI128). This has led to a much larger trial (160 strains) at Mount Compass along with further tests of SRDI291 at four different field locations.

Of course persistence is important, but the rhizobia must also be able to fix lots of nitrogen as this is essential for vigorous lucerne pasture. Glasshouse tests indicate that SRDI291 does indeed fix adequate amounts of nitrogen with the lucerne cultivars Super10, Aquarius and Jindera, a wider range of cultivars to be tested this year.

The marriage

The third component of this project addresses the vital symbiosis between the acid tolerant lucerne plant and the acid tolerant rhizobia — will they tolerate each other? If we are to expand the range of lucerne into acid soils we must have plants that are capable of initiating nodules in these conditions.

Dr Lesley Mutch (DPI Victoria) and Professor John Howieson (Murdoch University) have screened 32 well-adapted, genetically diverse lucerne cultivars and

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Mt Compass rhizobia trials.

Research and agribusiness successful partners

By Elizabeth Madden

An innovative partnership between the CRC Salinity and Landmark, the nation's largest employer of agronomists, is promoting the adoption of lucerne and other high water-use perennials in farming systems for salinity management across NSW, VIC, SA, QLD and WA.

"By linking an agricultural advisory business such as Landmark with a national research body, the CRC's *Promoting salinity solutions through agribusiness* project has created a unique opportunity for dialogue between farmers and researchers," said Dr Ian Nuberg, Leader of the CRC's *Education and Extension Program*.

Photo: L Beange

Deb Slinger (NSW DPI) coordinates Landmark workshops in NSW with Kevin Graham (Landmark).

Like all good partnerships, each has brought something important to the table. The CRC is abreast of the latest knowledge relevant to salinity management — not just results that have been published, but also important work in progress. Landmark has people on the ground, in daily contact with a huge client base.

The CRC's agency partners provide the training that covers salinity management and the role of lucerne and other perennials, all the way from establishment and management through to their role in the farming system.

This becomes useful knowledge in the Landmark team's tool box and greatly expands the CRC's reach to landholders.

But equally valuable to the CRC is the landholder feedback it receives via Landmark staff. This provides a vital reality check about the practicality and economic feasibility of salinity management tactics.

"By coming together like this, the CRC and Landmark are pooling their resources and working to make agriculture both profitable and sustainable," explained Kevin Graham, Manager of Landmark's Salinity Project.

"The project is now in its third year with 680 of our agronomists as well as livestock specialists having taken part in the first round of introductory salinity training. Some have now followed up with the second series of workshops focusing on lucerne management.

"The feedback from our staff has been overwhelmingly positive and they are especially impressed with the strong practical side of the training. Field trips to working farms that explain the 'dollars and cents' of different salinity management options really hit home for our agronomists. The printed resources and the contact made with local experts and researchers are useful for future reference, and we have an interactive page on the CRC's website.

"To implement new land management practices and to encourage the two-way information exchange between players in this project, six field demonstration sites have been set up on private land. We are currently submitting funding applications to the CRC to establish 24 more demonstration sites across NSW, VIC and SA.

"All the players benefit from this partnership as Landmark, the CRC and farmers want profitable and sustainable farming systems.

"Our business depends on a sustainable agricultural industry and our ability to offer the latest services and information to clients is a big plus. The CRC wants to see its latest research utilised and farmers want quick and ready access to reliable new information."

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breeding lines to identify elite individual plants with enhanced nodulation capability when exposed to acidity stress.

Plants with this attribute are now in seed production plots with plant breeders to develop populations for further selection.

Leader of the project, Geoff Auricht (SARDI), comments: "The great strength of this project is the intellectual and technical resource base that supports this multi-disciplinary approach.

"Bringing together the capacity embedded within the various institutions has enabled extremely rapid and effective progress, possibly achieving in three years a level of acid and Al tolerance that many others have sought for decades.

"Down the track, farmers should get the whole package, lucerne and rhizobia, that can be reliably grown on some very acid soils. If successful this will be a significant contribution in the battle against dryland salinity."

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Fortune favours the bold

By Jo Curkpatrick

Farmers are going to change their farming systems only if they see a powerful reason to do so. The most compelling is usually a significant positive impact on farm profit. It also helps if the system can have a positive impact on water management and salinity without imposing economic and social burdens on the wider community.

Photo: A Avery

Profitable Animal Production from Perennials (PAPP) is an ambitious project that aims to achieve both these outcomes for farmers.

It will design, test and implement innovative animal production farming systems with perennial pastures that are more profitable than alternative land use systems, and at the same time markedly reduce recharge. This project will operate across both the farm and catchment scales.

Unlike many projects which begin with on-ground activities and assess their impact during or after the project, the *PAPP* project began with intensive bio-economic and hydrological modelling together with a series of farmer workshops to set the scene for on-ground experimentation and demonstration. In other words, this project has already worked out what success will look like and what is needed to get there.

Powerful partners

The CRC Salinity, Meat & Livestock Australia (MLA) and three catchment management authorities have now come together in a powerful partnership to test and demonstrate the meat production systems identified in the modelling phase.

"This project is important because it aims to improve the environment and increase production and profit at the same time," said Kevin Goss, CEO for the CRC Salinity.

"So often the environment and production seem to be in conflict, but this project tackles that issue head on by integrating production and environmental management.

"It is also a significant example of systematic thinking and makes real advances in linking disciplines within a project. The thinking and project planning process in *PAPP* might be applied as a model for other new farming systems research projects, involving pre-experimental modelling to assess potential farming systems that will deliver dual purpose goals of increased production and reduced deep drainage," suggests Kevin Goss.

"MLA has made a significant commitment to this project, reflecting the importance we place on having high performing livestock production and utilising perennial pastures. Industry will greatly benefit from successful implementation of *PAPP*," said Cameron Allan from MLA.

"The project presents a real challenge if we are to achieve the dual outcome. There are production systems available that can move well towards achieving just the profit, or just the recharge goal. But the dual goal would be an outstanding outcome leading to widespread adoption and industry benefit — both financially and in maintaining a productive resource base into the future.

"As well, the project is taking a multi disciplinary approach, bringing together a diverse scientific team — the very thing that the CRC does so effectively. This approach is to ensure the best outcomes from an animal feedbase, resource management and ultimately the farm business perspectives. The collaboration with the catchment management authorities brings a range of skills and resources to answer the key researchable questions in the project and move to change on farm," said Cameron.

Now for the action

According to the project's leader, Angela Avery from DPI in Victoria, the on-ground implementation will use the economic and hydrologic modelling undertaken in earlier phases of the project. These have been used to predict farm profit and water balance outcomes and represent a major step forward rather than incremental steps we are so used to.

"Testing on ground will help farmers and researchers identify the steps necessary to take the experimental studies and apply them successfully in the field," she says.

Four project sites are intended, two in south west Victoria, the south coast of Western Australia and the Murrumbidgee catchment in New South Wales.

In each of the selected sites, the project has had an excellent reception from participating catchment management authorities and producer groups, and researchers are looking forward to working closely with local communities.

"In each of the pilot catchments there will be a research site where a key research hypothesis will be tested as well as a satellite site for secondary research important to the project in that catchment.

"Demonstration sites will also be established to monitor, validate and share understanding of the research," added Angela Avery.

Nationally the project will use standard data on interactions between the biophysical characteristics of the farm, such as soil type, climate and topography; the perennial plants including measurements of growth, quality, persistence and rooting depth; and animal performance to validate and improve economic and hydrological models.

"Applying the models in and beyond the pilot catchments will provide a better insight into the impact of land use change

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Liquid assets sought from waste water

By Georgina Wilson, Department of Agriculture WA

Creating 'liquid assets' from saline groundwater and catchment run-off sounds like a dream, but *Rural Towns — Liquid Assets* is the name of a new project in WA.

The collaborative project, funded largely by the Department of Agriculture and 16 wheatbelt shires, is partnered by CSIRO's Water for a Healthy Country, UWA Agriculture Resource Economics, the Centre for Water Research and the CRC for Landscape Environments and Mineral Exploration (LEME) and others.

It is supported by four regional catchment councils and partially funded by the National Action Plan for Salinity and Water Quality (NAP).

Mark Pridham from the Department of Agriculture describes it as a logical extension of the Rural Towns Program which involved more than 40 WA rural towns over the last seven years.

"Although many communities recognise they have a problem, they may not find sufficient incentive to control townsite salinity," Mark commented.

"Because it is so insidious, they simply choose to live with the consequences of the damage. This new project will be a three-legged stool, rather than a shooting stick.

"We will focus on developing new water supplies that will provide a resource for water-based industries and employment. With the benefits of controlling a salinity problem, this trifecta is a big motivator."

Photo: M Pridham

Production bores in Wagin will create liquid assets in a new WA project.

The 16 participating towns have been selected on the basis of salinity risk and local priority, moving beyond salinity management to assessing new water resources and industry development.

The first four towns, for which in-fill drilling began in February, were Wagin, Lake Grace, Nyabing and Woodanilling, in the WA Great Southern.

The drilling has verified sites suitable for abstracting water and helped pinpoint areas most likely to respond to dewatering.

Similar work will commence next in Merredin, Moora, Pingelly and Wongan Hills, followed by two more groups of four towns as the project progresses over the next three years.

"Even though a town such as Wagin is very saline, the water beneath it is only about a third as salty as seawater," Mark said.

"Where water is only brackish and can be collected or extracted at reasonable cost, it may be possible to treat it through desalination or other means and convert it to a liquid asset.

"New water-based industries could include aquaculture and intensive agriculture such as feedlotting.

"All these towns are in catchments which shed a lot of run-off. We will pay close attention to harvesting, storing, reticulating and using that run-off.

"Town catchment water, when well managed, can alleviate salinity problems and provide good quality alternatives to expensive scheme water.

"Many communities are crying out for reliable local supplies such as this project will provide, to water parks, gardens and sports grounds."

Research has shown that many towns which thought they had a groundwater-driven salinity problem, might actually be suffering from inadequate stormwater control and poor surface water management.

Surface water harvesting could help solve a salinity problem while creating an asset from comparatively good quality water that is often wasted.

Water management plans for each town will take them to the threshold of implementation, and include salinity and waterlogging control measures; economic analysis of groundwater treatment and disposal options; and evaluation of water use options.

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on farm profit and recharge across south eastern Australia, and our ability to meet targets to manage dryland salinity as well as provide fresh water."

The animal system being investigated to achieve the profit outcome will be based on a highly productive meat-merino, to provide a target weaning rate of 140 per cent. This will require elite genetics for fertility, carcass value and growth. The production system will be investigating the interactions of management pre-joining through to post lamb feeding to achieve the profit goal.

"We have set some very ambitious targets, but we also have a very robust methodology and some outstanding research resources in the team. These new animal production systems will involve more than just tinkering at the edges but will require farmers to adapt their management to allow for a more intensive and complex but more rewarding enterprise," said Angela Avery.

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Agro-ecosystems that mimic native ecosystems

By Elizabeth Madden

Imitating the water-use strategies of native ecosystems may be the 'key' to combating dryland salinity and designing more sustainable agro-ecosystems. Exploring and understanding these strategies is the aim of the *Mechanisms of water use in native ecosystems* project, led by Professor Hans Lambers.

"Our research team, working within the CRC's *Function of Natural Ecosystems* program, is investigating native plant water-use at a site at Corrigin in the Western Australian wheat belt," said Prof. Lambers.

"We are looking into their different water-use strategies and trying to isolate hydraulic functional types of plants that might have a role in managing water in sustainable agro-ecosystems. We are screening plants along a catenary sequence from three typical wheat belt communities — heath, mallee and woodland — and we are investigating how they respond to water availability, evaporative demand and soil constraints in recharge zones."

Photo: S Burgess

PhD student Patrick Mitchell pressurising leaf samples of heathland plants to measure water stress.

"Our hypothesis is that low drainage under native vegetation is a result of 'niche filling' by a diverse assemblage of plant species, such that wherever and whenever soil water is available, one or another type of plant will always be able to use it," explained Research Fellow, Dr Stephen Burgess.

"We have been tracking the water-use behaviour of about 16 species that grow on various parts of Corrigin's gently sloping landscape. Although crop species tend to use water faster than native species during the growing season, we are hoping to identify plants that can keep using water during times of the year when the crops have long since gone to market.

"It has been surprising to see woodland species *Eucalyptus wandoo* and *E. salmonophloia* showing very little change in their levels of water-stress between spring and late summer. Stress in spring months is possibly due to salt, but it seems that if these plants can cope with salt stresses they can also handle the harshest of summer conditions. Our sap flow records suggest that these species behave like solar pumps all summer long, transpiring water in direct proportion to the amount of sun and atmospheric dryness. These species do not appear to shut down when conditions get tough.

Photo: S Burgess

Measuring sap flow.

"Heathland species on lateritic uplands show a variety of responses to summer drought. Some seem to spend water wildly and then suffer at the end of summer, whereas one or two more conservative species seem to maintain a healthy water status throughout the day and throughout the season.

"Preliminary results from pressure-volume analysis of leaves yielded strong correlations between turgor-loss point, elasticity and osmotic potentials, presumably as a result of trade-offs between strategies that rely on leaf elasticity and strategies that rely on osmotic adjustment to cope during drought. Cell wall elasticity was also correlated with daily variation in plant water status in late summer. These results indicate that different strategies to avoid and/or tolerate drought have a large impact on plant performance and water-use."

An intriguing finding from this research is the way in which native trees equalise patchy soil water by moving water between roots using the trunk as a highway interchange route.

The focus of this research is to understand how native vegetation is assembled, so agro-ecosystems can be re-assembled in a way that mimics these native systems. Ultimately this would lead to practical outcomes such as understanding where particular species and combinations of species should be located in our landscapes.

Although too early to draw conclusions, it does seem that new agro-ecosystems will lie somewhere between the simplicity of the early models of alley farming and the unworkable complexity of native systems.

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Melilotus – big steps down a long road

By Bruce Munday

"Saltland agronomy will really come of age when we find a waterlogging- and salt-tolerant legume."

These were the words of Neville Stopp, a farmer near Keith in South Australia, who with his two brothers has about 400 hectares of puccinellia pasture, forming an important component of their 3,700 ha farming system.

Neville Stopp's comment has been reinforced on his own doorstep by the Sustainable Grazing on Saline Land (SGSL)* grazing trial at nearby Mount Charles. This trial, reported by Dr Nick Edwards at last year's Salinity Solutions conference, showed significant increases in both pasture and animal productivity in response to added nitrogen. And it is to legumes that graziers generally turn as a sustainable source of low cost nitrogen.

Photo: A Craig

Sean Miller sampling Melilotus for coumarins.

In the Upper South East of SA the legume of choice and the benchmark for saline and waterlogged sites is balansa clover (*Trifolium michelianum*), in particular the early maturing cultivar Frontier.

Frontier's ability to set seed before increasing soil salinity levels in spring impede seed set has improved the persistence of balansa. But the fact remains that balansa is only moderately salt tolerant and only moderately persistent under these conditions.

For some time now there has been interest in the potential of the *Melilotus* genus, to fill the role of a companion legume with salt tolerant grasses.

Bring on the scientists

Andy Craig and Dr Sean Miller, SARDI scientists at Struan in SA, are conducting trials with various salt tolerant pasture plants as part of the CRC's *National Field Evaluation and Selection of New Pasture Plants***.

At their field site at Mount Charles they have observed that a number of Melilotus species have persisted further into the salt gradient than balansa clover.

"This is of course the promising first sign we are always looking for," said Andy Craig. "But on its own it is a long way short of proving that this plant will be a useful component of salt tolerant pasture."

Andy and Sean are studying the performance of 20 different species of *Melilotus*, including both annuals and perennials. Those showing the most promise to date include *Melilotus indicus*, *M. messanensis*, *M. sulcatus* and *M. infestus*.

In a collaborative CRC project, *Developing new forage options to stabilise and regenerate saline environments*, Dr Mary-Jane Rogers (DPI Victoria) has commenced salinity screening of legumes starting with an evaluation of the *Melilotus* genus. Dr Rogers' initial work has confirmed the superior salt tolerance of a number of *Melilotus* species and shown that there is significant variation within the species to encourage further selection. This work will soon be followed up with screening for waterlogging tolerance in Perth, leading to 'elite' material for field testing.

"Dr Rogers' screening work has been very encouraging," said Andy Craig. "It is further supported by laboratory studies we have undertaken here at Struan, showing that *Melilotus* has a superior ability to germinate under saline conditions. This has always been the 'Achilles heel' of balansa."

Of course the economic value of a pasture plant will be its contribution to the productivity of the grazing animal. From this perspective *Melilotus indicus*, the species widely spread throughout saline environments, has the disadvantage that it produces coumarins — plant compounds that are believed to cause tainting of animal products and that may also be unpalatable to sheep. Furthermore, under some circumstances when Melilotus pastures are cut for hay or silage the coumarins can be converted to dicoumerol, a harmful compound which can lead to internal haemorrhage and eventual death of livestock.

Further linking work through the *National Annual Pasture Legume Improvement Program (NAPLIP)* reveals that some of the most promising *Melilotus* species appear to have low coumarin levels. A collaborative research program being conducted between SARDI and the University of Adelaide has revealed that a number of the best agronomic performers contain little or no coumarin.

"The wide variation in many of the significant plant attributes, particularly coumarin levels and salt tolerance offers great potential for selecting elite lines of *Melilotus*," said Andy Craig.

"We still have a long way to go, including an evaluation of the weed potential of Melilotus, but collaboration between several research projects has delivered far more progress that any one of us could have achieved alone."

Neville Stopp's wish for a saltland legume just might be somewhere down this road.

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* *An initiative of Australian Wool Innovation Ltd with Land & Water Australia.*

** *A project financially supported by GRDC.*

Managing the risk — ensuring solutions don't become the new problem

By Chris Twomey

One of the challenges we face in developing new farming systems and landscape-scale industries is to ensure that the plant we use to solve one problem does not create another — by becoming a weed.

This is where Dr Margaret Byrne and CRC Weed Scientist Dr Lynley Stone enter the picture. Dr Byrne leads the CRC Salinity project *Managing weed risk in perennial land use systems* and is on a mission to help researchers to develop new land use systems that are environmentally responsible and without negative impacts on natural ecosystems. This project is a collaborative venture supported by investment from both the CRC Salinity and the CRC for Australian Weed Management (Weeds CRC).

Tall wheat grass out of its cage.

The CRC Salinity has two main areas of focus that present different weed risks. New grazing systems using herbaceous perennial pasture plants will have greater impact in the shorter term — as existing production systems can be readily adapted, pasture plants reproduce within 12 months, and the grazing industry has considerable capacity for rapid change.

New industries based on woody crops at the landscape scale represent a longer term prospect. Identification of woody natives with large-scale product potential, breeding of productive cultivars and establishment of industry infrastructure require that these enterprises will take longer to become reality. These industries have the potential for greater impact on recharge over larger areas, and present a different sort of weed.

What are the risks?

Invasive species are considered the greatest threat to biodiversity after habitat destruction, and agricultural weeds already cost farmers millions of dollars in lost production and control measures.

However, weeds are not the only threat to the environment from new plant systems. Gene flow to indigenous plants from plantations of the same species, selected for particular attributes, can threaten their diversity. Similarly native cultivars, or exotics with native relatives, could cross-breed with natural populations to produce unwanted hybrids.

The challenge for researchers and policy makers is to introduce plants that on the one hand thrive and perform strongly in farming systems, reduce recharge or contribute to production on saltland, but at the same time do not pose a threat to other crops or to the natural biodiversity of nearby ecosystems.

Experience has taught us a lot about the problems that come with the wrong plant in the wrong place, and it also enables us to develop preventative strategies. However, some of the systems being proposed to manage salinity are unlike any that have been tried before and therefore might pose risks we cannot easily anticipate.

Researchers, agronomists and policy makers proposing, designing and advocating new land use systems recognise that they have a duty of care to the environment. This is why the CRC Salinity has in place a clear and rigorous process to assess the weed and environmental risk associated with native and exotic species undergoing research, and is developing firm guidelines for species with high benefit and manageable risk.

Native plants as an environmental threat

When we think of weeds we usually think of exotics — plants deliberately or inadvertently brought from overseas that spread out of control. What we may not always appreciate is the possible threat posed by large-scale production systems based on Australian native plants.

There are already several translocated Australian native plants that have become naturalised and are considered environmental weeds elsewhere within Australia, out-competing indigenous plants in bushland. *Acacia saligna* (a WA native) has been used as a forage shrub to assist with recharge control, but is now a weed problem in some parts of south-eastern Australia.

Where a plantation is sited next to a native remnant that contains trees of the same or a similar species, we also need to think about the possible consequences of gene flow. If these plants are all flowering at

Salinity mitigation versus weed risk

A paper produced in collaboration by the CRC Salinity and the Weeds CRC as a Scoping Study to inform the strategic direction of this project appears as the feature article in Australian Journal of Experimental Agriculture 44(12):1141-1156.

Bennett S J and Virtue J G (2005), *Salinity mitigation versus weed risks — can conflicts of interest in introducing new plants be resolved?* http://www.publish.csiro.au/nid/72.htm

"This paper follows on from a workshop held between the CRC for Plant-based Management of Dryland Salinity and the CRC for Australian Weed Management. It discusses 4 key areas where potential conflict exists between the maintenance of biodiversity in natural ecosystems and the development and introduction of new herbaceous perennials. Each of the issues within pre-entry weed risk assessment, post-entry weed risk assessment, weed risk of translocating native species and field assessments of new species is discussed in detail and suggestions are given on the means to resolve the conflicts."

the same time, pollen from our cultivated plants could flow across into the nearby natural population (which is usually more diverse and locally adapted), potentially 'swamping' it and thereby reducing its long term diversity.

Where the local plants are a related species, hybridisation may occur, with the hybrids potentially out-competing the locals in future generations. Even where cross-pollination between species cannot occur but the plants flower at the same time, the cultivated plants can reduce the availability of pollinators (birds or bees) and indirectly impact on the local population.

How we manage the risks

The management of a complex issue like salinity requires a balance between the benefits and risks of new land use systems.

The CRC Salinity is developing and promoting a culture of weed risk management, based on clear protocols and guidelines for all CRC plant-based research.

Australia has strict quarantine laws controlling the introduction of exotic plants. However, aside from declared noxious weeds, there are generally minimal controls on plants already introduced to the country but not yet in widespread use. Some of these plants might already have demonstrated their weed potential; others might be candidates for new landscapes or for use at a much greater scale without an appreciation of the risks that could be involved.

To complicate matters, while pre-entry weed risk assessment is controlled federally by Biosecurity Australia, post-entry weed risk management is the domain of the states which have different legislation and regulations, and apply different weed risk assessment protocols.

To address these issues, the two CRCs are contributing to the development of national guidelines for post-border weed risk assessment and management for both exotic and native species, and ensure these protocols are rigorously applied by all of their researchers.

The need for controlled testing

Our current pre-entry (border) weed risk assessment system can have three outcomes — a plant can be either accepted for import or rejected, or it can be deemed to require further study. Often there is inadequate scientific information on the characteristics of a plant to make a definitive judgment. While published information for species from the Mediterranean Basin is usually quite comprehensive, much less is known about plants native to other areas with a Mediterranean climate (e.g. South Africa and South America).

This situation imposes huge demands on the resources within Biosecurity Australia, resulting in major delays in plant-based research. Appropriately regulated, the expertise and data within our Genetic Resource Centres could possibly be used to help free up this bottleneck.

Benefits versus Risks

Sarita Bennett and John Virtue aptly summarise the state of play:

"Dryland salinity is a rapidly expanding environmental problem that is reducing the amount of land available for agriculture, and causing a significant ecological cost to remnant and riparian vegetation. There is an urgent need to increase the area of the landscape that is sown to deep-rooted herbaceous perennials to reduce the increase in dryland salinity, and for their successful adoption by landowners it is recognised that these perennials must be economically viable. Australian perennials are unlikely to provide such options in the short term and therefore there is a need to search for species overseas. Many agricultural weeds have arisen as a direct result of deliberately introduced species escaping cultivation and naturalising in the Australian environment. They cause a huge cost to agriculture in terms of both lost production and control. There is also a cost to natural ecosystems as a result of lost biodiversity and weed management. A conflict of interest thus arises.

"Actions to address the recommendations are urgently required if we are going to resolve the current conflicts of interest between the need for managing present and future environmental weeds and for mitigating dryland salinity."

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ESCASI arrives

The newly formed Executive Steering Committee on Australian Salinity Information (ESCASI) held its first meeting in December when it:

- refined the draft Terms of Reference (ToRs);
- developed the draft Workplan with cross-referencing to the ToRs; and
- agreed to change the name of the Committee by dropping the word 'dryland' from the title.

The Workplan will map out the rationale for undertaking tasks, and identify gaps and priorities and linkages between tasks. The ToR and the Workplan are being revised out-of-session prior to the next meeting on 28th April.

ESCASI members affirmed their commitment to improving data collection through coordinated approaches, and support for an integrated approach with other relevant steering committees to ensure complementary operations.

Members list

Simon Veitch (Chair), Australian Government DAFF
Peter Baker, BRS
Blair Wood, NLWRA
Alana Innes (supporting officer), NLWRA
Matt Kendall, M-DBC
Mirko Stauffacher, CSIRO Land and Water
Chris Pigram, Geoscience Australia

STATE Members

John Verhoeven, DIPNR (NSW)
Adam Hood, DSE (VIC)
Brian Vandersee, QDNRM (QLD)
Glenn Gale, DWLBC (SA)
Colin Bastick, DPIWE (TAS)
Bob Nulsen, DA (WA)

Salinity brain drain ... but they will return

Although we sometimes take it for granted, and have our little tiffs from time to time, cooperation is the defining characteristic of Australian salinity science: research organisations working across the national-state divide; researchers working with producers on their farms; researchers combining their many disciplines.

Challenging ourselves and learning from others' experiences is how salinity science moves forward. Now Australian salinity researchers will extend their learning network internationally, with a contingent of 40 researchers from a dozen Australian research agencies attending the International Salinity Forum in Riverside, California in April.

The Forum will draw around 400–500 delegates from across the world. Already (in February) researchers from over 35 countries have registered, while around 180 speakers have had their papers accepted for presentation.

With a significant delegation of Australian scientists attending, and with the first night of the conference coinciding with ANZAC Day, it was natural for the CRC Salinity to want to host an 'Australian Night' on 25 April.

The Master-of-Ceremonies for the evening will be the Australian Consul General in Los Angeles, the Hon John Olsen (former Premier of South Australia), and Australia's advances in salinity science will be showcased (together with examples of Australian fine wine and cuisine).

With Australian science under pressure to internationalise, commercialise and capitalise, the International Salinity Forum is a great opportunity for Australian salinity researchers to report on our achievements, learn from others and move into new scientifically rewarding relationships.

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Meeting online

Many readers will know that the CRC has now established an online forum that can be accessed from its website.

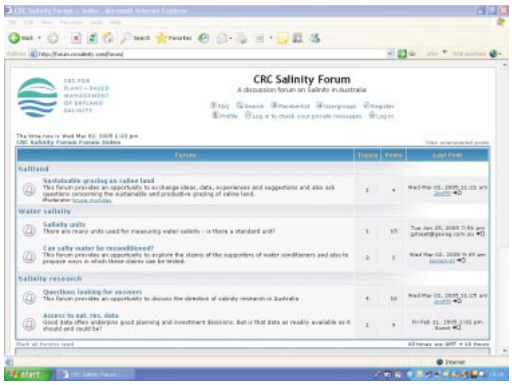
The online forum does not exist to promote the CRC or the CRC's views. Rather, it is a service provided by the CRC to further our understanding of issues surrounding salinity, to make this understanding more accessible, and to give voice to diverse opinion.

Anyone can use the forum — the CRC is simply the host, although a number of CRC staff use it for in-house discussion.

An online forum is just like a meeting. But like a well run meeting it provides an opportunity to focus on a single issue at a time, it keeps reliable minutes, and it involves only those people who are interested.

At http://forum.crcsalinity.com/forum/ we have set up three Categories for discussion: *Water salinity*, *Salinity research* and *Managing saltland*.

Within each of these Categories there are Forums (ie meetings that people can join) and within each Forum there are Topics.



People attending the Forum can respond to posts or simply browse, and can initiate new Topics at any time.

Rather than me give instructions, I suggest that you visit http://forum.crcsalinity.com/forum/ and spend a few minutes at FAQ.

If you approach this with the attitude that this'll be easy — it will. Rest assured, you cannot break anything or hurt yourself. (You can always return to the home page by clicking on the CRC logo.)

The Online Forum does not replace Saltlist, it complements it. Saltlist is best used as a bulletin — a tool for asking a quick question (eg 'anyone know how to grow saltbush on concrete?'), announce an upcoming event (conference, field day, etc), alert people to a recent publication, etc.

Extended debates are very valuable, but generally enthrall only a small fraction of our 700 Saltlist subscribers. You will find the Forum a much better venue for this activity.

If you are under 30, forums will be nothing new to you. Between 30 and 40 you are probably prepared to give it a go but not explore too many of the non-essential functions — wait for the kids to show you. If you are over 60 like me you might find that it is not nearly as scary as you thought and actually pretty cool.

As with Saltlist, the online forum is administered to ensure that a reasonable level of decorum is maintained, no laws are broken and that it is not used as an advertising medium.

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SGSL finding local answers to national problems

By Jo Curkpatrick and Bruce Munday

Sustainable Grazing on Saline Lands (SGSL) is an ambitious national project with key research sites in WA, SA, Victoria and NSW.

The CRC Salinity manages the R&D strand of SGSL on behalf of the Land, Water & Wool initiative. This is closely linked to the SGSL Producer Network which has 120 projects initiated and run by farmers to test locally relevant options for managing their saline land.

Photo: A Craig

Photo: N Edwards

Weighing the benefits. Inset: A typical circle where a local salinity 'high' has eliminated balansa clover from the pasture.

The farmer groups in the Producer Network are harnessing the practical ideas and know-how of producers and combining this with the technical knowledge and experience of salinity researchers.

According to Dr Nick Edwards, the SGSL national research leader, research outcomes will boost the confidence of landholders to incorporate more saline land into their farm management plans to achieve social, environmental and financial benefits.

"There are different research priorities at each site, but data collection is governed by common measurement methods," said Dr Edwards. "Salt and water movement, biodiversity impacts, pasture performance and sheep productivity, and the economics of saltland pastures are all measured in the same way at each site in order to make comparisons and share data across sites.

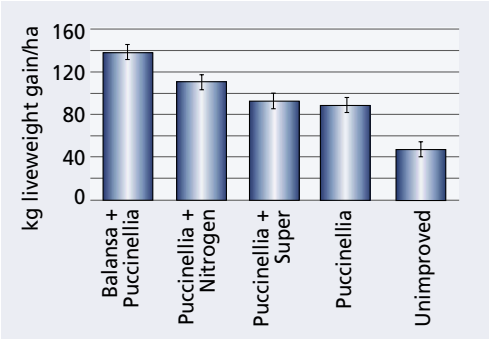
"The results from individual sites are collated into a database and analysed nationally to make the results more robust than a simple collection of individual research projects," he said.

South Australia — puccinellia and balansa the perfect pair?

Dr Michelle Hebart (SARDI) leads the SA component of the SGSL research program near Keith in the State's Upper South East. This work focuses on puccinellia (*Puccinellia ciliata*) based pastures, looking particularly at the effects of nitrogen and phosphorus fertiliser along with grazing strategies to optimise livestock productivity.

As expected, the SGSL team has found that saltland pastures based on puccinellia are more productive from both an animal and pasture perspective than if the pastures were left in an unimproved state dominated by sea barley grass (*Hordeum marinum*), samphire (*Halosarcia* spp.) and salt scalds. The results also indicate a strong response to fertiliser, particularly nitrogen.

Legumes in pasture mixes are the standard economical approach to increasing and then maintaining soil nitrogen levels, and in temperate grazing systems this is often the role of annual clovers. Results from this work show significant benefits from including balansa clover (*Trifolium michelianum*). Liveweight gains from sheep were significantly higher on the balansa clover/puccinellia pastures than on any of the other pasture types, partly due to the intrinsic feed value of the balansa but possibly also due to the nitrogen benefit gained by the puccinelia.



Liveweight gains for set stocking (2004).

"The appeal of balansa clover in the Upper South East is its excellent tolerance to waterlogging," commented Dr Hebart.

"However local farmers have found that its poor tolerance to salinity means that it often persists poorly into the second and subsequent years. One of the key objectives of our research is to understand the reasons balansa clover fails to persist. In doing so we will be better placed to develop new, better adapted varieties."

The sensitivity of balansa clover to what appears at first sight to be minor differences in salinity is shown in the photograph. The 'circles', typically about one metre in diameter, are where the balansa has either died or failed to regenerate in the year after establishment.

Early indications suggest that salt is the major culprit — being on average five times higher within the circles than on the immediate area outside. Soil pH is also higher on the inside, presumably as a result of the higher salt levels.

These micro-environments are quite dramatic across what appears to be flat uniform paddocks. While each might be quite small, collectively they can represent very significant parts of a paddock, emphasising the need for a suite of salt-tolerant pasture types that can adapt to the variations that typify saline landscapes.

SGSL is an initiative of Australian Wool Innovation Ltd with Land & Water Australia and support from the CRC Salinity, MLA, CSIRO and state agencies in WA, SA, Victoria and NSW.

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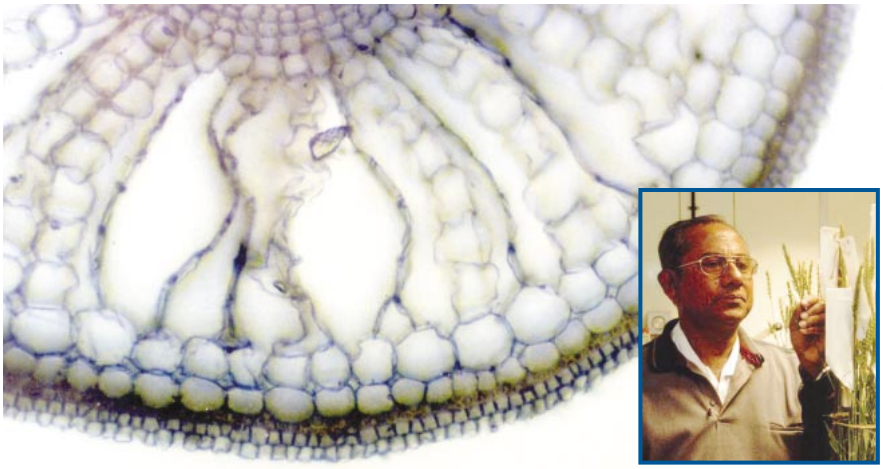
Getting cereals onto salt

By Bruce Munday

Sea barley grass (*Hordeum marinum*) is one of the most recognisable indicators of saltland in southern Australia. With very little grazing worth but lots of nuisance value, it announces the end of Spring with seed awns often covering lambs' faces and farmers' socks.

But sea barley grass has an interesting 'pedigree' that brings with it a couple of very useful traits. Firstly it belongs to the same tribe as wheat and barley; secondly it is both salt-tolerant and waterlogging-tolerant. If these traits could be captured and donated to its domesticated distant relatives, sea barley grass just might help to dramatically extend the range of soils on which we can grow profitable crops.

Currently the productive use of saltland is largely limited to fodder for livestock, with little opportunity for cropping. A CRC project led by Dr Tim Colmer at the University of Western Australia and funded by the GRDC is working towards a cereal with significantly more salt- and waterlogging-tolerance than existing cultivars of wheat and barley.



Cytogeneticist Dr Rafiq Islam

Photos: T Colmer

Sea barley grass root tip showing aerenchyma — 'snorkles' that allow oxygen to reach the tips of waterlogged roots.

Sourcing salt- and waterlogging-tolerance

There are essentially three alternative routes that might be followed for improving salt- and waterlogging-tolerance:

- exploit the variation that might already be present within existing crops (and their relatives); or
- use the variation between different species or between different genera by wide-crossing of crops with salt tolerant 'wild' relatives; or
- attempt to generate additional variation by transgenic approaches (i.e. genetic engineering).

Dr Colmer comments: "Our research follows the second option. We are looking to take the best of sea barley grass (its tolerance of salt and waterlogging) and introduce these 'virtues' to its agronomically valuable distant relative, wheat. But there is no 'silver bullet' — if there is a solution it will come from medium- to long-term investment in multidisciplinary research."

Perhaps surprisingly, the search for the key to salt- and waterlogging-tolerance began in Sweden, where Prof. Roland von Bothmer (Swedish University of Agricultural Science) provided access to the world's most comprehensive germplasm collection of 'wild' *Hordeum* species. Thirty-six *Hordeum* species were screened for tolerance and then priority species were imported from Sweden to be grown in quarantine at the University of Adelaide. To these were added accessions of *H. marinum* collected from the WA wheatbelt.

Several *Hordeum* species, screened for high tolerances of salt and waterlogging, were found by root tip chromosome counts to be diploid and hence capable of reproduction. These were then potentially useful for the wide-hybridisations, and include two that have displayed the best tolerance to both stresses.

Crossing with wheat

The next challenge was to create a successful hybrid of *Hordeum marinum* with wheat that maintains these key traits for salt and waterlogging tolerance.

"Several wheat x *Hordeum marinum* hybrids have now produced amphiploids (i.e. progeny containing the full genome of both parents), demonstrating the feasibility of the cytogenetic approach (i.e. manipulation of chromosomes)," said Dr Colmer.

"We are particularly excited by the successful wide-hybridisations between *H. marinum* and a couple of Australian wheat cultivars. This is a considerable advance on the model wheat typically used for this type of work, Chinese Spring, and would have been impossible without the great skills of cytogeneticist Dr Rafiq Islam at the University of Adelaide."

Amphiploid: Contains the full genome, or set of chromosomes, of both parents.

Cytogenetics: the study of the 'behaviour' of chromosomes.

Next — wheat with a bit of mongrel

This project was considered 'high risk, blue-sky research' by the CRC and GRDC when it commenced, however it has already broken important new ground towards the ambitious goal of producing a salt-tolerant cereal.

"We now have a solid understanding of salt- and waterlogging-tolerance in the genus *Hordeum*, and we have demonstrated the feasibility of utilising this tolerance by producing *Hordeum*–wheat amphiploids," said Dr Colmer. "However, there is still much to do, confirming the salt- and waterlogging tolerance of the amphiploids and then producing cytogenetic stocks with progressively less chromatin from the wild species, but with the key chromosome segments conferring tolerance. These materials

• *Continued next page >*

Dryland salinity: Economic issues at farm, catchment and policy levels

Economists have increasingly been studying the impacts of dryland salinity on agricultural industries, biodiversity, water resources and infrastructure, and responses to them by land managers, scientists and policy makers.

A book edited by Tennille Graham, David Pannell and Ben White reflects the breadth of issues that economists are addressing today. *Dryland salinity: Economic issues at farm, catchment and policy levels* also reflects the multifaceted nature of salinity and its impacts, and the need to combine perspectives if it is to be effectively managed.

"The book is based on a pre-conference workshop held before the Australian Agricultural and Resource Economics Society (AARES) Annual Conference in 2003 in Fremantle WA," said co-editor Tennille Graham.

"We have sourced authors from government, academia and the private sector, and also from a range of disciplines: economics, hydrology, plant science and social science, so the book covers a very broad range of topics from a range of disciplines."

The book includes five sections, the first providing an overview of dryland salinity in Australia and prospects for its management. This includes a snapshot of land use options that can be used for prevention of or adaptation to salinity.

The second section addresses the linkages between hydrology and economics in the analysis of salinity management and policy. A review of hydrological models relevant to dryland salinity is followed by principles and methods for incorporating a hydrological component into economic analyses.

In the next section there are four contributions on the development and evaluation of salinity management options. The development of profitable new management options and supporting industries has been highlighted as an important step in dealing with dryland salinity, and the CRC Salinity is leading national research efforts in this area.

Section 4 examines a range of issues in the prioritisation of salinity-related investments, particularly by policy makers and regional planners involved in natural resource management. This is particularly important, given the large sums of public money being invested in national and state programs, and emerging evidence that the return on public investments in salinity varies widely from situation to situation.

The final section covers the design of policy instruments for efficient and effective outcomes of salinity management.

"We believe the book will be of interest to policy makers, bio-physical researchers and educators in natural resource management, as well as to economists," said Ms Graham.

Financial and in-kind support for the book's publishing came from the CRC Salinity, the School of Agricultural and Resource Economics at the University of WA, and the AARES.

The book is available at no charge from Natalie Lennon at the CRC office: nlennon@fnas.uwa.edu.au

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• *From previous page*

should be valuable sources of tolerance for future wheat breeding programs. In addition, we will also investigate the possibility of utilising the amphiploids themselves as a feed cereal for saltland, taking advantage of a much faster breeding cycle."

Dr Colmer cautions that salt- and waterlogging-tolerant cereals will not be used on highly saline areas such as bare scalds or samphire flats.

"Cropping is unlikely to be viable on severely salt-affected land, where forage plants would remain the most appropriate option. Our target is those vast areas that are mildly or moderately saline such that they significantly reduce crop yields, particularly when transient waterlogging also occurs, or where salinity limits the choice of crops that can be grown profitably."

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PUR$L 2005

NSW hosts this year's PUR$L Conference and (as with all PUR$L conferences) this one will be different. The theme is Networks, Partnerships and On-ground Actions.

Allan Nicholson, Chair of the 2005 PUR$L Conference Committee, says "this year's event will be more like a big workshop-field day rather than the familiar conference format. We are in the relatively early planning stages, but we can say that Day 1 will be at Dubbo, followed on Day 2 with a field trip that finishes at Cowra, where we will then spend Day 3. From Cowra there is the option of returning to Dubbo or to Canberra.

"There will be a number of facilitated seminars tackling key issues, the lead speakers being landholders and followed by researchers. Underlying all of this will be a consistent theme highlighting the importance of community networks and information sharing. Throughout the program we will employ a buddy system, pairing off landholders and researchers."

Whilst the date has not yet been finalised, 25–27 October 2005 should be pencilled into your diaries.

In previous years information about PUR$L has been available from the NDSP website. That site is no longer updated, but PUR$L now has its own site hosted on the CRC Salinity site www.salinity.com

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Ground geophysics — mapping buried streams

By Paul Wilkes,
Deputy CEO, CRC LEME

An exciting new project, undertaken by CRC LEME and funded by the WA Department of Environment through the Engineering Evaluation Initiative, is demonstrating the power of geophysical methods to define the location and geometry of buried valleys — often referred to as paleochannels.

Paleochannels are important for siting production bores designed to lower the saline watertable below valuable agricultural land, thereby providing an opportunity to improve soil health and productivity.

Two sites are being investigated in this project — Tammin about 200 kilometres east of Perth and Dumbleyung about 250 km south east of Perth. The project has also benefited from earlier work done at Lake Bryde — a recovery catchment east of Dumbleyung. Field work and interpretation of all three areas was undertaken by staff and students of Curtin University (a core partner in CRC LEME) in close collaboration with the WA Departments of Agriculture and Environment.

This article focuses on the Tammin site, a study area of approximately 1800 hectares, about 10 km north-west of Tammin — a small town on the Great Eastern Highway linking Perth and Kalgoorlie.

The site is of low relief (less than 50 metres variation) and includes drainage in naturally occurring water courses. Annual rainfall in this area averages 370 millimetres, mainly in the winter months, but the land available for annual crops and grazing is decreasing due to salinisation.

The area is close to the western margin of the very extensive Kellerberrin granite batholith. Granite has been intersected at 14 m depth in a CSIRO borehole on the eastern side of the study area, but other CSIRO boreholes drilled in 2002 have shown 50 m of sediments without reaching bedrock, indicating the likely presence of a paleochannel.

Brett Harris collecting EM data.

The principles

The position and geometry of a paleochannel can be determined through careful interpretation of data obtained using gravity and time domain electromagnetic methods.

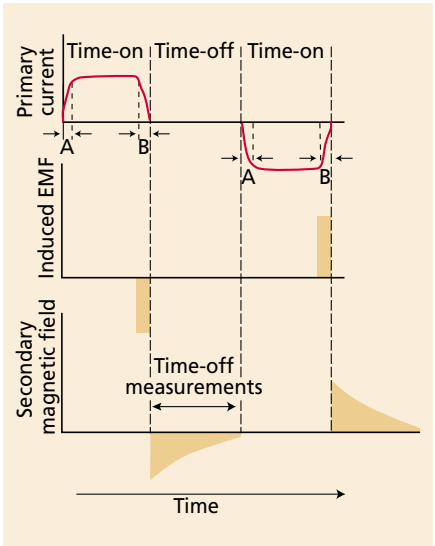

Figure 1. Typical input and output electromagnetic signals.

High accuracy gravity measurements show subtle variations in gravity due to the differences in density of the underlying rocks and sediments.

This method is well suited to detecting paleochannels which are often filled with sediments of lower density than the underlying bedrock (probably granite), and hence show local gravity lows.

The advent of digital gravity meters, developed for mineral exploration and geodesy, means that it is now straightforward to measure gravity to an accuracy of about 1 part in 100 million. This sensitivity is sufficient to detect the gravitational variation associated with paleochannels.

A single gravity observation is typically completed in less than five minutes, levelling the instrument usually being the most time consuming part.

Gravity measurements also require accurate surveying with horizontal positions known to a few metres and heights to better than 5 cm. These accuracies are readily achieved with kinematic GPS or conventional optical surveying. In this project we used optical surveying at Tammin and GPS at Dumbleyung.

The electromagnetic methods rely on differences in electrical conductivity in the rocks and sediments being investigated.

A pulsed current in a transmitter loop laid out on the ground creates a magnetic field, which in turn induces secondary currents in the ground. These secondary currents decay at a rate that depends on the conductivity of the ground.

A receiving antenna, which is typically located in the centre of the transmitter loop, detects the secondary currents through the magnetic fields they produce.

Measurements are made in the time intervals between primary current pulses as illustrated in Figure 1.

The signal received is effectively a report on the conductivity which is affected by porosity, water content, salt content and the presence of clays and sands.

In this case we expected higher conductivity in the paleochannel leading to

increased electromagnetic response. We selected an electromagnetic method which uses a 50 m x 50 m transmitter loop through which we passed pulses of current, each lasting less than 0.1 seconds.

Four complete measurements were made every second. The measurement at each station takes approximately 5 minutes, allowing for data to be accumulated and averaged.

The combination of gravity with electromagnetic methods is useful to improve the accuracy of the interpretation. Gravity is good for showing us the geometry of the paleochannels and locating their axes, whilst the electromagnetic method gives a better indication of depth and width extents.

The results

Four lines were surveyed across the area, each approximately 2 km long, with line spacing varying between 800 m and 2 km. Gravity and survey measurements were taken at 25 m intervals while electromagnetic data were collected at 50 m intervals, the whole site survey taking abut seven days.

Figure 2 shows typical gravity and conductivity results for one of the survey lines (Line B), the colour range describing the variation in conductivity. The interpreted depth and geometry are shown superimposed on the conductivity data.

Figure 3 shows a two dimensional image of the processed gravity data and reveals a clear low trending approximately NNW across the area. (In this figure the colour range indicates variation in gravity.) This is interpreted as the axis of the paleochannel.

Interpreted depths from both gravity and electromagnetic data indicate depths down to about 60 m in the centre of the paleochannel, the axis of which is up to 1 km east of the present day drainage.

Line B, the second line up from the bottom of the image, was recently drilled, confirming the presence of about 60 m of sediments — mainly sands. This line was selected for drilling as the optimum line on which to locate a production bore — because it is central in the area, the paleochannel is narrower than on the adjacent survey lines and the water may flow faster here.

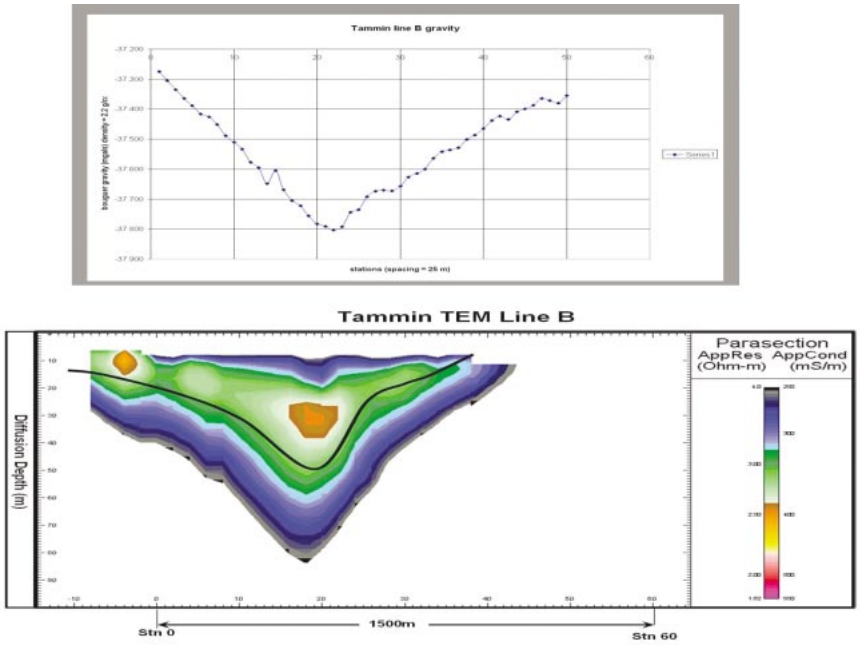

Figure 2. Typical gravity and conductivity results.

Six observation bores were also drilled along the axis of the paleochannel where groundwater salinities are about 40,000 mg/l (cf seawater ~35,000 mg/l) at a depth of about 2 m from the surface.

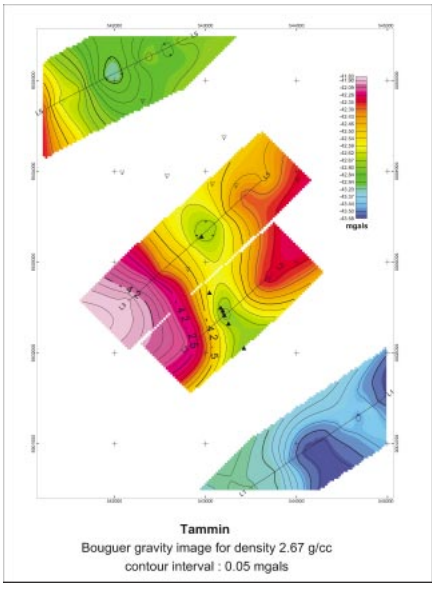

Figure 3. Processed gravity data.

The boreholes were geophysically logged to measure their conductivity. These logs show that the conductivity increased markedly below 40 m depth, which we interpret as due to higher salinity in coarser sands just above bedrock. The next stage is to pump test and evaluate the prospects for groundwater pumping, whereupon the saline groundwater would be pumped to a suitable local disposal area.

This project has demonstrated the cost effectiveness and the practicality of gravity and electromagnetic methods for defining the location and describing the geometry of paleochannels. This information, not always readily determined from landscape features, can greatly assist planning for groundwater management. Geophysics is a powerful tool to complement drilling programs and reduce the time and cost often associated with drilling.

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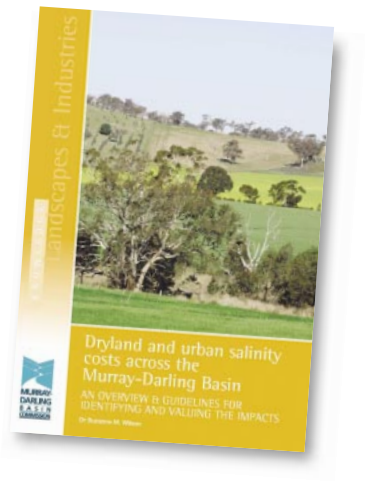
Dryland and urban salinity costs across the M-D B

In 1998, the Murray-Darling Basin Commission, in partnership with the National Dryland Salinity Program, initiated the project *Determining the full cost of dryland and urban salinity across the Murray-Darling Basin*.

Otherwise known as the 'Costs project', this was to develop and apply a method to estimate the full range of dryland salinity impact costs across the Basin. As part of this project, which concluded in 2003, guidelines to identify and value salinity impact costs were developed, and then applied to collect information on salinity impact costs from across the Basin.

The outcomes of this project have been recorded on a CD compiling all of the data gathered during this project and is supported by the publication *Dryland and urban salinity costs across the Murray-Darling Basin: an overview & guidelines for identifying and valuing the impacts*.

This outlines the methods used and assumptions made when applying this particular approach to estimating salinity impact costs. Copies of this publication are available from the MDBC (e-mail info@mdbc.gov.au, tel: (02) 6279 0141).



The Costs project has built on the work of earlier salinity impact cost research undertaken in the early 1990s, and the Commission, through its Salinity Program, has continued to develop and refine ways that the costs of salinity impacts can be more accurately estimated in the Basin.

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Water CRCs merge

The two key Cooperative Research Centres that are focused on water issues, the CRC for Catchment Hydrology and the CRC for Freshwater Ecology, are to be merged into a single centre, following a successful bid for continued funding under the 2004 round of the CRC program.

The eWater CRC, to be based in Canberra, will receive $40.25 million over seven years from the Commonwealth.

It will combine the skill bases and end-user networks of its two parent centres to develop tools supporting the implementation of the National Water Initiative, the environmental sustainability of cities and water-dependent industries, and the development and commercial success of Australian water businesses.

The new director of the eWater CRC, Professor Gary Jones, will be outlining the work off the new CRC at the Victorian Sustainable Development Conference on March 15–16.

■ **CONTACT**
http://www.halledit.com.au/conferences/vicsustainable/

Salt in the city

It was symbolic that the *Urban Salt 2005 Conference* should be at Parramatta, the site of Australia's earliest agricultural endeavours and *Elizabeth Farm* which bears the scars of salt and water damage.

Engineers, industry group representatives and research scientists, presented the latest in urban salinity management from establishing new suburbs to minimise salinity occurrence, to managing salt affected urban areas.

Sian McGhie, Urban Salinity Team Leader for the NSW Department of Infrastructure, Planning and Natural Resources (DIPNR), outlined how urban salinity management has evolved over the past five years and hurdles that needed to be overcome.

"Urban Salinity cannot be managed in the same way as dryland and irrigation salinity. There are different processes and different impacts. We have to think about the various types of salts and how they chemically and physically impact on bricks, mortar and cement," explained Sian McGhie.

One of the major hurdles in urban salinity management is establishing better links between natural resource management advisors, academics and researchers, and those involved in design, construction and management of urban infrastructure and land use.

The range of professions represented at the conference and the list of speakers, suggest these links are beginning to evolve.

More than 120 people working on urban salinity projects throughout NSW and elsewhere in Australia participated in the conference, establishing valuable networks and sharing knowledge and experiences in this relatively new area of salinity management.

The conference also hosted the launch of the NSW Local Government Salinity Initiative's excellent urban salinity booklets number 8 to 11 — *Costs of Urban Salinity, Land Use Planning and Urban Salinity, Groundwater Basics for Understanding Urban Salinity, Salinity Indicator Plants*.

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State roundup

New South Wales

Elizabeth Madden, Communication Coordinator (NSW)

Salinity management training for Lachlan & Macquarie CMA staff

The second round of salinity management training for Lachlan and Macquarie CMA staff will run in March 2005. Coordinated by Luke Beange (NSW DPI Salinity Advisory Officer) this training session builds on the salinity principles covered previously and investigates the practicalities and impacts of vegetation management in agricultural ecosystems on water-use and groundwater recharge.

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Pass the Salt...

The Pass the Salt.... Stories of salinity from Wagga Wagga and surrounds project is an initiative of the National Museum of Australia and the Murray-Darling Basin Commission in association with the Museum of the Riverina. The project has documented the cultural dimensions of salinity as seen by the people affected by it. Using taped interviews, still and video images of landscapes, places and objects a website has been created and salinity related objects have also been collected for the museum. The website will be launched in Wagga Wagga on 22 March 2005.

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Three Murrumbidgee CMA projects in place

The Murrumbidgee CMA's Jugiong Creek, Muttama Creek and Yass River Salinity and Water Quality Projects are under way with three community groups managing the works program. The CMA has allocated $940,000 over the next year together with technical and support staff.

The three community groups managing each project area are the Yass Area Network, Harden-Murrumburrah Landcare Network and Cootamundra Landcare Network Inc. The projects focus on sub-catchments to reduce high concentrations of salt and sediment in the Murrumbidgee River.

The on-ground works include revegetation and fencing of groundwater recharge sites, gully and stream bank erosion control, sowing of salt tolerant pastures in saline discharge sites and fencing.

Fencing to manage stock access along streams and the provision of alternative watering points, replanting and protection of high conservation value remnant and riparian vegetation are additional works.

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Victoria

Jo Curkpatrick, Communications Coordinator (Vic)

NDSP finalised in Victoria

It has been a long time in the making but worth the wait. At the end of February over 40 Victorians attended a briefing on the three information resources produced by the National Dryland Salinity Program (NDSP).

The Department of Sustainability and Environment (Land Management Branch) sponsored the briefings which demonstrated not only the extent of these resources but also how to get maximum value from them.

This was an excellent opportunity for those involved in natural resource management projects to see how these tools can provide ready access to such a large amount of important information. It was particularly relevant for those managing and developing projects under the Regional Catchment Investment Plans.

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CRC Node Meets in Beechworth

Scientists from across Victoria gathered in Beechworth in February for the CRC Salinity's node meeting.

Over 60 members of the Victorian Node and the CRC Board took the opportunity to update on research in progress and visit a number of sites across the North East in a tour themed *Soaking up leaky systems*.

The group saw a range of sites including those established for sub-catchment modelling work in the CRC project *Water use by plants in a catchment context*. Also at the Hodgkins Horseshoe Creek Landcare site visitors listened to presentations on adaption in native vegetation to soil and water constraints, and inspected the hill slope native grass site where Meredith Mitchell updated progress in the project *Managing perenniality in permanent pastures*.

The afternoon was spent at LaTrobe University in Beechworth with updates on the many CRC projects with links to Victoria.

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Western Australia

Chris Twomey, Communications Coordinator (WA)

Royal visit

On Tuesday 1 March, His Royal Highness Prince Charles spent a large part of his only day in Perth visiting CRC headquarters to see first-hand how researchers are adapting farming systems to the Australian environment to help develop the sustainable agriculture of the future.

His Royal Highness saw and heard from:

- Kevin Goss — the prospect of developing a uniquely Australian agriculture
- Dr Tim Colmer and PhD student Natasha Teakle — developing salt and waterlogging tolerance in wheat
- Johhn Bartle and PhD student Nic George — the brave new world of FloraSearch
- Dr Hayley Norman and landholder Tony York — drought proofing the farm with saltbush.

That Prince Charles asked to visit the CRC apparently reflects his genuine interest in

• *Continued next page >*

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the issue of salinity but also in the unique way the CRC is tackling the problem, developing an agricultural system that is informed by indigenous ecosystems and by forming partnerships that cross institutional and academic discipline boundaries.

Prince Charles discussed comparable problems overseas and suggested that by exporting this approach and these technologies to developing countries, Australia could make an important contribution to global harmony.

The presentations will provide the sort of snapshot of the real world that future kings probably get wherever they go.

South Australia

Bruce Munday,
Communications Coordinator (SA)

Information flows from drains

The Upper South East Dryland Salinity and Flood Management Program is one of the largest regional projects of its kind in Australia. The Program recently ran a Forum for Government agency staff not directly involved but having a general 'need to know'.

A major part of the event was a series of workshops updating participants and fielding questions and comments on five subprograms: Drainage construction; Biodiversity offset scheme; Adaptive management and integrated monitoring; Saltland agronomy; and Communications.

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Another big event looming

Planning is underway for the SA Dryland Salinity Committee's annual forum. This will be something of a retrospective, looking at the lessons learned from salinity planning, on-ground action and monitoring in the various regions across the State.

This is by no means a backward looking exercise, but rather making sure we learn from the experience, particularly as much of the good work that is going on does not always finish up in a written report and is also still evolving.

Trevor Dooley's recent review of the Coorong Districts Local Action Plan was extremely enlightening, providing good feedback to the LAP Group and also to others who have always watched the progress of this group with admiration and at times envy.

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Mapping salt and other things

A series of fact sheets summarising the site and overall project outcomes from the SA Salinity Mapping & Management Support Project is expected back from the printers by late March. They present a range of applications, likely costs and guidelines for successful application of airborne geophysical techniques.

For general consumption, the fact sheets will also help NRM/catchment managers decide whether airborne geophysics could be used in their region.

They will also be available on-line at www.dwlbc.sa.gov.au

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How to eat saltbush

Three hundred and forty hectares of the Condobolin Research Station is being set up for alley farming. A five year trial will develop the management practices needed to incorporate Old Man Saltbush into the business of mixed farming.

Part of the broadly based Grain and Graze project, the trial will see 15 metre strips of saltbush interspersed with 60 m strips of crop or pasture in a five year rotation.

While a lot is known about the production and water-use benefits of saltbush, Peter Milthorpe (NSW Department of Primary Industries) warns that there is still much to be learned about the technique for managing it.

He says stock have to be 'taught' to eat it. "They need to learn to browse rather than to graze and it is important that the shrub not be allowed to get away," said Peter Milthorpe.

"We need to develop the techniques to manage it in good and bad seasons, the good season often being the greatest challenge."

A series of 10ha paired paddocks is being established for the trials. The standard rotation will be two cereal crops followed by three years of a sub-clover, medic and lucerne based pasture with the saltbush remaining undisturbed. The experiences of some 20 producers who have included saltbush in their farming systems will be incorporated in the trials, which are backed by the Central West/Lachlan Grain and Graze group. The trials will continue for a minimum of five years.


Peter Milthorpe

The Grain and Graze program is a joint initiative of the Grains Research and Development Corporation, Meat & Livestock Australia, Land & Water Australia and Australian Wool Innovation Ltd which aims to increase the profitability of producing crops and livestock while helping to better manage water, soil and biodiversity.

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New plants and old – how are they stacking up?

By Bruce Munday

The *National field evaluation and selection of new pasture plants* project forms part of the CRC's research into scientifically sound and practical plant-based approaches to managing salinity across Australia.

This research, supported by funding from the CRC Salinity and the Grains Research and Development Corporation, takes advantage of the array of plant germplasm that might contribute to management of groundwater recharge and discharge in productive farming systems.

The over-riding challenge for this project is to identify and evaluate new herbaceous plant species that:

- Can contribute to recharge control or discharge management and are adaptable to environments that are inhospitable to the range of plants currently available
- Will form a component of productive and profitable farming systems.

Dr Brian Dear (NSW DPI) leads this large project and has recently provided a progress report that signals where success might be most likely to emerge.

The field trials at 30 sites around the country are now beginning to reveal those new species and cultivars with the most potential for recharge and discharge areas. In some cases the researchers are finding that there are species and cultivars already commercialised which have potential, but are not being widely used, often because of perceived or real difficulties in incorporating them into farming systems. In other cases we are finding new species for which there are currently no cultivars available.

The findings to date represent a 'work-in-progress'. However they give an early indication of prospects, particularly to readers with an interest in developing agronomy and management packages for these new species:

- **Chicory** has shown a lot of potential as a valuable new plant for preventing recharge in all major cropping regions of southern Australia. It should be a priority to introduce chicory into farming systems as an alternative to or component of lucerne swards. A further priority should be to select cultivars better adapted to the drier Australian environment.

Photo: B Munday

- **Subtropical grasses** have adapted well to northern NSW and WA grain belts, however we require more knowledge on their agronomy and use in mixtures before existing cultivars can be introduced into farming systems.
- The potential roles of existing drought tolerant summer dormant cultivars of **phalaris and cocksfoot** (and possibly fescue) have been unappreciated in the eastern and western grain belt. Farming systems and agronomy packages for these *spp* will need development for this potential to be realised.
- The native plant **Cullen** has shown potential for use in low to medium rainfall (350 – 600 mm) on infrequently cropped land where lucerne fails to persist under uncontrolled grazing.
- **Bromus species** and **mission grass** have shown excellent establishment and the Bromus spp excellent regeneration. The high winter feed potential of these is an advantage, however the impact on farming systems and weed potential still needs to be evaluated.
- Of the **native grasses** *Danthonia caespitosa* had shown good establishment, seed production and regeneration in low rainfall environments, however sowing may prove difficult.
- **Perennial legumes** have been disappointing generally, those with the most potential being *Trifolium uniflorum* as a ground cover between other perennials, and *Onobrychis viciifolia* (sainfoin) for low rainfall alkaline soils. Other promising legumes were *H. coronarium, H. boutigynanum, L. corniculatus, L. glaber, T. fragiferum, T. hybridum, T. uniflorum, Lotononis bainesii, Dorycnium hirsutum.*
- For **saline, non-waterlogged areas the annual legumes** burr medic and woolly clover show greatest potential, while balansa, Persian, and Moroccan clovers and *T. ornithopodiodes* show the most promise where waterlogging is also an issue. However poor regeneration continues to be a feature of a number of these species and we need to understand the reasons for their failure.
- Puccinellia and tall wheat grass continue to show the most potential among the **salt tolerant perennial grasses**. However, no **perennial legumes** have been identified with adaptation to saline, waterlogged soils.
- Of the new germplasm evaluated in 2004, *Melilotus messanensis, infestus, sulcatus, segetalis* and *indicus* offer huge potential to extend the range of adaptation of **annual legumes** into waterlogged, saline environments. The research team is investigating the possibilities of selecting *M. polymorpha* for increased waterlogging tolerance.

Farmers in Australia currently have only a limited range of productive grasses and legumes suitable for reducing groundwater recharge and for stabilising or revegetating salt affected lands. This project, which also draws on the findings of several other CRC projects, will expand that range and add to its diversity with practical options. It also adds value to the extensive collection of germplasm held by Genetic Resource Centres across Australia.

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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 & Industrial Research Organisation (CSIRO); Department of Agriculture WA (DAWA); Department of Conservation and Land Management WA (CALM); Departments of Primary Industries (DPI) and Sustainable Ecosystems (DSE), Victoria; Department of Primary Industries (DPI), NSW; 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

CRC LEME is an unincorporated joint venture that brings together groups from:

- Australian National University
- CSIRO Exploration and Mining and CSIRO Land and Water
- Curtin University of Technology
- Geoscience Australia
- Minerals Council of Australia
- NSW Department of Primary Industries
- Primary Industries and Resources SA
- The University of Adelaide

For information about CRC LEME visit http://crcleme.org.au

CRC FOR PLANT–BASED MANAGEMENT OF DRYLAND SALINITY

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