IRRIGATION UPDATE

VOLUME 9

IRRIGATION AND THE ROOTZONE

Investigating the salt of the earth

Excessive salinity in the root zone reduces the yield of many crops and this can range from a slight loss to complete failure, depending on the type of crop and the severity of the salinity problem.

Tapas Biswas, of the South Australian Research and Development Institute (SARDI), has been investigating the problem using technology developed in-house – the SoluSAMPLER – to measure salinity in the field.

The SoluSAMPLER is marketed by Sentek Sensor Technologies (www.sentek.com.au) throughout the world. At the heart of the technology is the "suction cup" – a custom-designed ceramic cup glued to a short length of casing, housing an extraction tube with a two-way stopcock. Typically suction cups are placed at 30, 60 and 90cm in a root-zone of 1m, and located about 15cm from a dripper along the line of a drip irrigation system.

"All irrigation water contains dissolved mineral salts," Dr Biswas said. "Salt in irrigation water can have a profound impact on crop production, depending on the sources, concentration and composition.

"Saline soils cannot be reclaimed by chemical amendments, conditioners or fertilizers, but in some cases selecting salt-tolerant crops may be a choice."

Dr Biswas said there were three ways to manage saline soils.

- In the first method salts can be moved below the root zone by applying more water than the plant needs. This method is called the leaching requirement.
- The second method, where soil moisture conditions dictate, combines the leaching requirement method with artificial drainage.
- Thirdly, salts can be moved away from the root zone to locations in the soil, other than below the root zone, where they are not harmful. This method is called managed accumulation.

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Tapas Biswas, kneeling at centre, and SARDI researchers working with the growers to achieve highly efficient water use and minimise root zone salinity *Photo: SARDI*

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NATIONAL PROGRAM FOR Sustainable Irrigation

Digging deep and the quest for super soils

Almost every discussion of Australian soils starts off noting that in general they are ancient, heavily weathered and relatively infertile compared with those found in other regions of the world.

Given the root zone's vital role in plant health and productivity, NPSI has funded several research projects to investigate how best to conserve and improve those soils used under irrigated agriculture.

Rob Murray, of the University of Adelaide, is running one of these projects to investigate the long-term sustainability of precision irrigation.

Dr Murray's team compared irrigated and non-irrigated soil in the Barossa Valley and found no evidence that drip irrigation had caused any problems. As vineyard water use in the Barossa Valley is relatively low, the project is currently working to confirm its findings at vineyards in Victoria and NSW where water use is higher.

While the absence of structural decline under drip irrigation would seem to be good news, Dr Murray said virtually every soil his team worked with already had very poor structure.

"These soils have low aeration and high resistance to penetration by roots so that they are hostile to root growth at depths of only about 30cm," Dr Murray said. "What we've seen so far makes a strong case for much more intensive soil preparation in advance of permanent plantings of irrigated crops and for ongoing measures to conserve and improve the soil structure that is created during preparation."

These measures would certainly involve increased uses of cover crops and the reduction of machinery traffic. "These investments will be returned by efficient plants with extensive root systems that are not addicted to frequent irrigation. While some crops benefit from stress, this should be a condition growers can choose to impose, rather than a necessity they must live with," Dr Murray said.

"With severe water restrictions and the looming threat of adverse climate change, these strategies will become essential. The future suggests that roots are going to have to 'dig deeper'."

Bruce Cockroft of Soils Research Pty Ltd is another researcher who believes soil management changes could unlock far more dollars per hectare and megalitre of water for Australian farmers.

"The productivity of irrigated agriculture in Tulare County, California, is four times what we find in Australia; in Israel it's nine times," Dr Cockroft said. "Our low productivity comes from our poor soils – they coalesce to a hard mass."

Dr Cockroft has studied the most productive soils in North America, Europe, the Middle East, Asia and New Zealand. He found that the best soils around the world – dubbed "super soils" – had the same 24 key properties.

Rhizosheaths adhering to roots help build up organic matter

"Australian soils lack several key properties that cannot be changed, mainly due to the great age of our soils – super soils are very young. Our research must find alternatives to the key properties of the super soils," Dr Cockroft said.

"Out of 3000 small plots that we have set up in orchards over 20 years, six have achieved super soil status. So alternatives to the key properties do exist. Our problem now is to find how the six came about."

He said super soil status in our soils appeared to come from two vital key properties – high organic matter and very high biological activity, but in such a way that soil fauna and flora did not consume the organic matter that was incorporated. His project team believes it has found one way to build these properties using rye grass.

"The understanding of changes towards super soil must be at a microscopic level of the soil biology," Dr Cockroft said. "The rhizosheath is the layer of soil particles that adheres to the roots of some plants, mainly grasses and especially rye grass.

"The rhizosheath is very special because it is the site of intense biological activity. Its soil becomes very stable and builds up high levels of organic matter from the very fine roots and organisms within it – their exudates and remains.

"In the bulk soil outside the rhizosheath organic matter does not build up because it is consumed by soil organisms. In the rhizosheath the organic matter is protected."

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Measuring infiltration in one of the Barossa Valley vineyards being studied by Rob Murray

Rob Murray found no evidence that drip irrigation caused problems in Barossa Valley vineyards

Adaptive learning through combined information

Running a profitable farm is a complex business with many interacting factors influencing management decisions.

Individual research projects often focus on just one factor and may tend to view a particular management issue in engineering terms with a focus on the associated command and control strategies for that single factor in isolation from all the others.

Richard Stirzaker, of the Cooperative Research Centre for Irrigation Futures, believes it is necessary to incorporate a more holistic "adaptive learning" approach that brings together various strands of information, including "local knowledge", about what is happening in the root zone.

"If we think of irrigation management as an engineering problem, then we will think in terms of command and control strategies. If we think of irrigation management as but one part of the complex business of running a profitable farm, then we should think in terms of adaptive learning," Dr Stirzaker said.

His research project aims to demonstrate how the collection of five independent strands of irrigation data via a novel sensor and logging platform will link irrigator experience with measured data, link atmospheric scheduling with soil-based monitoring, and link water management with solute management. The project will be carried out in seven locations around the country together with expert practitioners from different sectors of the irrigation industry.

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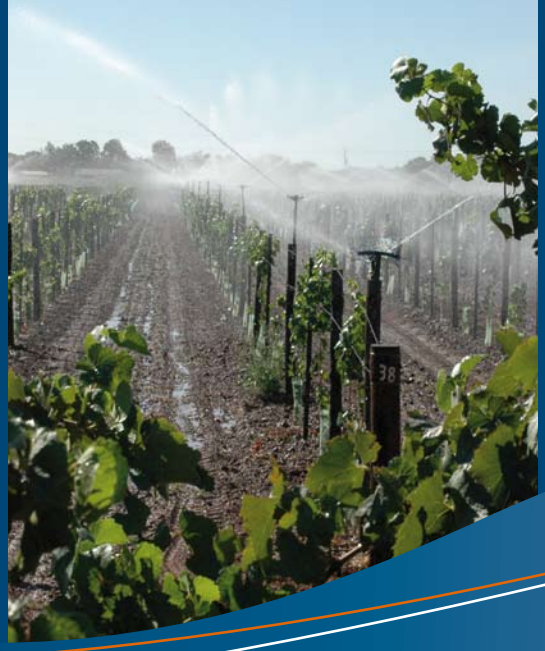
Collecting irrigation data via a sensor and logging platform


NPSI NEWS

Welcome back to the National Program for Sustainable Irrigation (NPSI) newsletter Irrigation Update. The program has been busy for the past 18 months putting together a new NPSI team and selecting new research projects.

The program welcomes Guy Roth as the Program Coordinator and Sarah Leonardi as the Program and Communication Officer. Feel free to contact Guy or Sarah with any irrigation or program enquiries, contact details are at the bottom of the page.

Scholarships initiative and Travel Fellow

A NPSI initiative is the Undergraduate Student Scholarship Projects. The first undergraduate scholarship winner was Ross Stottelaar at RMIT University, who looked at salt management issues in Lake Tutchewop in Victoria. Ross received considerable support from Goulburn Murray Water to help him with his project. Another four scholarships have been awarded recently. The recipients are:

- Kimberley Althaus – Effect of irrigation management on nitrate movement under a lettuce crop.
- Samantha Connor – Partitioning almond evapotranspiration into soil water evaporation and crop transpiration.
- Felicity Roos – Monitoring aqueous root zone conditions under irrigated cotton and grains.
- Amber Webster –Design criteria for tailwater input into wetland systems in the Burdekin River Irrigation Area.

The NPSI and Irrigation Australia Limited (IAL) $10,000 fellowship provides for overseas travel to study issues related to sustainable irrigation, giving the winner an opportunity to develop knowledge and industry networks and bring the findings back to Australia. Matthew Shanahan won the 2008 NPSI/IAL travel fellowship and will travel to the United Arab Emirates, Israel and Spain to see at first-hand alternative water use options in use by other countries.

Looking to the future

Recently, the program has been leading the development of a big-vision, strategic plan for irrigation research and development from 2010-2020. NPSI, in association with the Cooperative Research Centre for Irrigation Futures and IAL, has brought together Government, irrigators, water providers, suppliers and research organisations to get their thoughts on what the industry wants to achieve over the next 20 years and what research is needed to achieve this. The workshop report can be found on the NPSI website. If you would like to discuss this important initiative further, please contact Guy Roth.

Upcoming activities include scenario planning for irrigation communities in relation to water scarcity, an irrigation modernisation workshop for water suppliers, and a national workshop on reducing and managing evaporation.

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The National Program for Sustainable Irrigation is managed by Land and Water and Water Australia on behalf of the partners. The partners include irrigators, water authorities, research agencies, state and Commonwealth departments. For information about becoming involved in the Program, please contact:

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