



Improving surface irrigation application performance

Steven Raine & Kelvin Montagu
CRC for Irrigation Futures

IN A NUTSHELL

- ▶ The Irrigation Futures CRC is developing a wide range of products, management systems and decision support systems to improve the efficiency of surface irrigation
- ▶ Irrimate™ is an in-field surface irrigation evaluation service now available throughout Australia, which measures and logs an irrigation event, and with integration with software, management decisions can be made to optimise irrigation application efficiency
- ▶ A suite of other tools is under development, including adaptive control systems which help match plant water requirements to variations in field conditions, and solute monitoring and management tools to manage salts and nutrients in the root zone

The Cooperative Research Centre for Irrigation Futures (CRC IF) is leading the development of Irrigation Toolkits™ to help growers improve irrigation application performance.

The CRC IF brings together researchers developing field measurement tools to assist in improving irrigation management. Already a range of tools has been produced by the CRC's research partners for improving surface irrigation application performance. The CRC will build on and add to currently available tools to help improve the efficiency of surface irrigation systems.

Improving application performance

The commercial Irrimate™ in-field surface irrigation evaluation service was introduced into the cotton industry in 2001. Most clients were able to save an average of 0.15 ML/ha/irrigation after their in-field performance was assessed using Irrimate and necessary management changes were made.

Surface irrigation performance is determined by furrow inflow rate, the soil infiltration characteristic, field slope and length, surface roughness and furrow geometry. The Irrimate monitoring system measures and logs furrow inflow rates and the movement of the water front down the field during an irrigation event. Careful integration with software allows the Irrimate data to calculate the infiltration characteristics of the soil and calculate the depth of irrigation application down the length of field.

Decisions can then be made to optimise the application efficiency within practical constraints set by the grower. The software considers the impact of furrow flow, irrigation period or set time, run length, slope and soil moisture deficit

at irrigation to predict the effects of these factors on the efficiency of the irrigation event. Based on these predictions the grower is then able to adapt the management of the irrigation system, by adjusting siphon flow rates, irrigation set times and soil moisture deficit, to get the best application efficiencies.

Over the last five years, the range of evaluation equipment has been improved and is now more user-friendly. The Irrimate monitoring package (Figure 1) now includes:

- a siphon flow meter
- six water advance sensors
- an in-furrow downstream flume
- computer software

In general, measurements conducted on a couple of irrigations in a field are enough for an experienced user to optimise the irrigation operation for that field.

There are now 15 consulting agents providing Irrimate tools and support in areas ranging from Emerald to Hillston in the cotton industry, and extending into South Australia and northern Victoria. There have been over 300 field optimisations conducted over the last five years. The standard full season evaluation service includes optimisation on three irrigations in a field by the local agent and currently costs approximately \$5000, where as optimisation of single irrigation events costs around \$2000. Full sets of in-field measurement equipment cost around \$6000.

In the CRC's pipeline

A number of Irrigation Toolkits are currently under development by the CRC IF. The toolkits are in integration of hardware, software, information, training and/or service



components. Importantly, to deliver these toolkits the CRC IF supports industry consultants and adviser networks who can provide ongoing support at the local level. In essence, the CRC IF is a developer and "wholesaler" of toolkits for improving irrigation management.

Some of the toolkits being developed will assess the most appropriate product and management practices for reducing evaporation losses from on-farm storages, and ultimately help irrigators make decisions about managing such losses.

For pressurised systems, the CRC IF is developing a "smart" water meter. This single meter will give information on water volumes applied to a specific field or identify breakages or blockages in the distribution system.

Also, the CRC IF is well down the track of being able to deliver daily estimates of potential evapotranspiration for anywhere in Australia. These will be available for historic, current and in the near future, forecast daily weather information.

What's next?

Future on-farm research investment of the CRC IF focuses on four areas of research.

1. Matching irrigation and crop water requirements in real-time

The water needs of crops vary over time and across the paddock. Adaptive control systems try to "read" these variations and match irrigation to what the plants actually require. While the actual adaptive control systems vary with irrigation delivery systems, the approach is as much applicable to surface irrigation as that used in micro-irrigation or centre pivots and lateral moves.

The CRC IF's adaptive control research is focused on both the plant and delivery system. Plants are the best sensors of growth conditions. The CRC is looking at plant sensing techniques which will measure how well irrigation, and

possibly fertiliser management is performing in terms of achieving the target crop growth or quality. A key component of these techniques will be the integration of such information into management systems and importantly, providing the training and support for these systems to deliver improved irrigation performance.

All outlooks point to increasing costs of energy required to run irrigation systems. Adaptive control systems can assist in reducing the impact of these cost increases by lifting pump efficiencies and reducing energy consumption, contributing to an overall improvement in the performance of delivery systems.

2. Sustainable root zones under precision irrigation systems

The main focus of the CRC IF sustainable root zone activities will be to develop tools for growers to manage salts and nutrients in the root zone. Without this the yields and long-term survival of high value irrigation systems will be under threat.

Three trends have brought solute monitoring and management to the forefront of sustainable irrigation management. First, the move towards micro-irrigation, precision irrigation and deficit irrigation requires leaching fractions to be taken seriously for the first time in Australia - until now generally excessive irrigation and the associated flushing of salts from the profile meant leaching fractions were not an issue. Second, the technology to deliver nutrients to the field is not matched by an understanding of the fate of the nutrients in the root zone. Finally, the increased use of recycled water demands tools for monitoring and managing the accumulation and movement of solutes (predominantly salts) in the root zone.

3. Gathering and using different information to manage irrigation

Deciding how much water crops will need and how much water will need to be ordered or diverted to meet regional



Figure 1 The Irrimate™ in-field surface irrigation evaluation service provides irrigators with a means of assessing surface irrigation performance and in conjunction with integrated software, identifies possible management changes to improve efficiency. The Irrimate monitoring package contains a siphon flow meter (left), water advance sensors, an in-furrow downstream flume (right) and computer software.



requirements are fundamental decisions for individual irrigators and water managers. The information available to assist in making these decisions is increasing but the mechanisms to assemble and analyse the information are quite limited.


The CRCIF through its Irrigation Informatics™ will be identifying the existing and developing sources of information, and bringing these together with models that relate water, crop growth, yield and financial implications. The starting point is estimates of evapotranspiration where both regional and local sources are becoming more readily available. These can be combined with climate forecasts, soil water status, salinity levels, crop canopy condition and water availability estimates to provide estimates of water needs and likely yield responses to irrigation practice.

The rapid advances in electronics, communications and remote sensing provide exciting opportunities for tools bringing together an increasing number of information sources to provide actual readings and forecasts of evapotranspiration, crop responses and financial implications. The CRC is focusing on developing the capability to provide decision makers with tools to fully and easily use the information to improve water productivity and profitability.

4. Reducing losses from on-farm storage and distribution systems

In the research area of storage and distribution system loss, the primary focus will be on the development of evaporation mitigation systems that can be successfully applied to large water bodies (>10 ha). These systems will complement the already commercially available floating cover and shade structure systems used for smaller storages.

The research will lead to development of products and systems to improve the performance of monolayers and technologies for monitoring and optimising the application of these products. Consideration will also be given to other chemical options (eg monolayer/polymer combinations and polyacrylamides), as well as possible structural solutions such as floating modular systems.

There will also be a need to develop instrumentation and procedures for accurate measurement and quantification of both evaporation and seepage losses from storages in order to prioritise intervention and determine economic viability. 

Further information

Associate Professor Steven Raine
CRC for Irrigation Futures, University of Southern Queensland
T: 07 4631 1691
E: Steven.Raine@irrigationfutures.org.au



Riverina Helicopters

- ▶ For excellent crop coverage and a precision application
- ▶ Rotor downwash and low spray height place the spray where it needs to be...into the crop
- ▶ No wastage from missing the target, evaporation or drift
- ▶ Rice Growers - use our helicopter for SCWIIRT and MCPA

Maximise your weed kill...
Give our helicopter a go and see the difference

Contact Gerry Wilcox
Griffith Airport
02 6964 9433