Smart Automated Precision
Broad-acre Irrigation Systems

Delivering savings in labour, water & energy

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Improving Surface Irrigation performance

<table>
<thead>
<tr>
<th></th>
<th>Application efficiency (%)</th>
<th>Root zone replenishment (%)</th>
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<tbody>
<tr>
<td>Farmer management in cotton</td>
<td>48.2</td>
<td>93.6</td>
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<tr>
<td>Higher flow rates and shorter irrigation times</td>
<td>73.6</td>
<td>82.3</td>
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Farmer management measured

Simple Improved Management

Similar outcomes obtained for bay irrigated pastures in Victoria and for furrow irrigated sugarcane in north Qld.

Smith et al., 2005
VARIwise Real-time irrigation control

Control methodology developed that can adapt to different irrigation systems and crops

- Adjust variable-rate hardware
- Adjust flow/cut-off time

Infield measurements
- Weather
- Soil moisture
- EM38
- Crop growth
- Fruit load
- Yield
- Irrigation application measurements

Other data
- Forecast weather
- Historical field data

VARIwise
- Measurements are spatially interpolated
- Measurements calibrate crop production model
- Control strategies executed to determine irrigation

Irrigation application/timing
- Irrigation hydraulics analysed to determine irrigation control hardware actuation
- Measured and modelled application compared and irrigation application updated accordingly
IrriMATE™ for Surface Irrigation

(1) Measure the irrigation

(2) Estimate the soil infiltration rates
   SISCO Calibration

(3) Simulate & Evaluate irrigation performance
   SISCO Model

(4) Optimise by changing management
    - e.g. inflow rate and time

Re-Evaluate
IrriMATE™ for Surface Irrigation

1. Measure the irrigation
2. Estimate the soil infiltration rates
3. Simulate & Evaluate irrigation performance
4. Optimise by changing management - e.g. inflow rate and time

Automate this Process
VISION for Automated Precision Broad-acre Irrigation Systems

USQ’s on-going research activity for automated precision broad-acre irrigation performance:

• USQ testing of hundreds of irrigation systems through IrriMATE
• Irrigation performance is widely varied on-farm & across valleys
• Growers could improve irrigation performance and make more $$/ ML – too busy, too tired, it is too hard to implement
• Automation can adaptively control irrigation from field to water supply with sensors & an irrigation logic engine
• This can deliver large industry wide step improvement in irrigation performance which benefits the whole industry
Site-specific cotton irrigation

- 1st yr trial near Dalby to demonstrate variable-rate irrigation and sensors in control system on Lateral Move
- Three irrigation treatments in each zone down the field
Site-specific cotton irrigation

- 2\textsuperscript{nd}, 3\textsuperscript{rd} yr trials of commercial variable rate irrigation (VRI) of cotton under 37ha & 50ha centre pivots at Yargullen with sensors for VARIwise control using VARIwise generated prescription maps & remote uploads.
Soil Water Content Variation

Calibrated EM38 to Waverley heavy grey cracking clay (APSoil entry) with gravimetric sampling \((n = 128)\)

- Operated over five times down furrow & beds in separate vertical & horizontal modes each time

VMC calibration: \(\text{VMC} = 0.001 \times \text{Conductivity} + 0.1923\) [R-squared = 0.8995, \(n = 128\)]
Rainfall uniformity?

- Taggle rain-gauge system reception tested over 12.5 km
- GE Smartphone app developed; rain-gauge cost $350
Automation of furrows in cotton with small Pipe Through Bank (sPTB)

sPTB, blind head-ditches, Padman gates, Rubicon near Wee Waa over six sets of 18 ha each for total of 108 ha – automated.
small Pipe Through Bank – sPTB

- Waverley Ag., Wee Waa – Steve Carolan & Andrew Greste
- 108 Ha trial developed in Sept ’15, chose to develop additional 2100 Ha by June 2018
small Pipe Through Bank – sPTB
sPTB Field Costs - Waverley

Components required include:

- HDPE PN8 75mm pipe @ 2m spacing (~$15 ea.)
- For 600m long field, about $140/ha (900m long field = $100/ha)
- Lasered pad - to lay-down straight pipes before covering
- Blind head-ditch bank (estimated at $450 /ha for 600 m long field with 18 hectares for each irrigation set)
- Communications base station & software = $20/ha
- BayDrive sealed rubber door actuator = $180/ ha
- PadmanStops PBC 1000 sealed rubber gate = $130 / ha
- Standalone water level sensor for monitoring = $60 / ha
UAV Detection of Surface Irrigation Advance
Taggle IrriMATE Irrigation Advance Sensor & SMS notifier
Cheap smartphone water level sensor & Android app

Smartphone water level sensor test results

- Input Data
- $R^2 = 0.9797$
Automated Precision Broad-acre irrigation systems

- We now have remote control broad-acre irrigation
- Good managers who already irrigate well “95%” of the time, can now do this more often, more easily
- Adaptive autonomous irrigation developments continue from water supply through to in-field irrigation control
- These offer ability to irrigate the right amount at the right time at the right place, everytime, to optimise for:
  - Maximum crop yield, or
  - Maximum water savings
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