



Australian Government Cotton Research and Development Corporation

Real-time irrigation decisionmaking and control for sitespecific irrigation of cotton using a centre pivot, 2012/13

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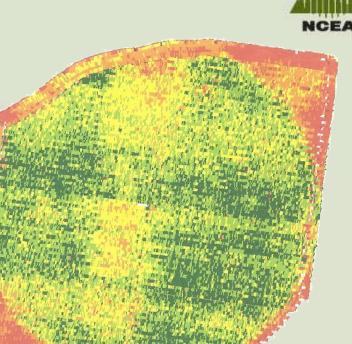
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Cotton irrigation in Australia

- Cotton industry uses 10% of Australian water consumption
- Site-specific irrigation automation presents opportunities for improved water use efficiencies





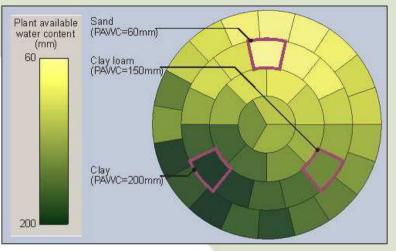
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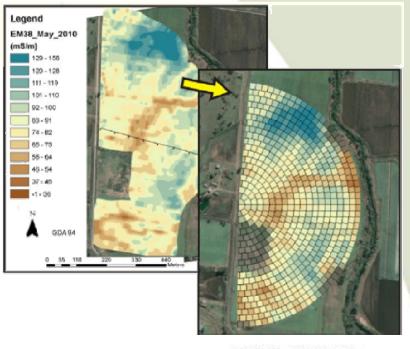


VARIwise control framework

- 'VARIwise' simulates and develops irrigation control strategies at spatial resolution to 1m² and any temporal resolution
- Iterative Learning Control (ILC) adjusts irrigation volume using error between measured and desired soil moisture
- Model predictive control (MPC) uses calibrated model to predict irrigation requirement
- Uses sensed data to determine irrigation application/timing

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Centre pivot irrigation experimental plan



Three replicates of MPC, ILC and FAO-56 with different targets and data inputs (weather, soil, plant)

One span with flow meters and valves





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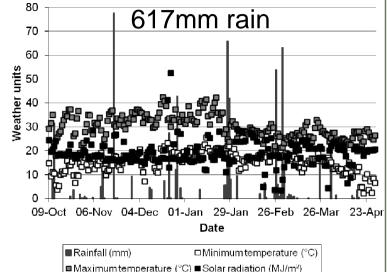
Infield variability sensing

NCEA

Soil-water estimation



Infield weather station



Overhead-mounted plant sensing platform



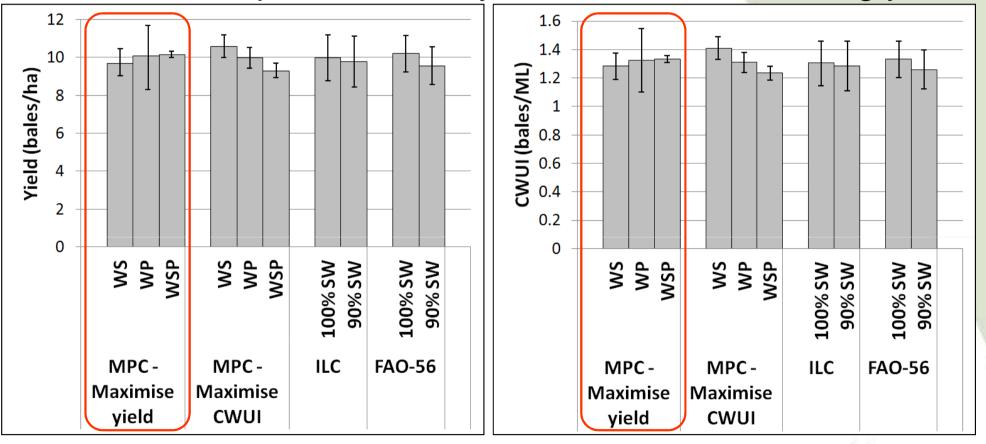
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MPC maximising yield



- Plant data input led to higher yield, no change in CWUI
- Plant data input increased yield for MPC maximising yield



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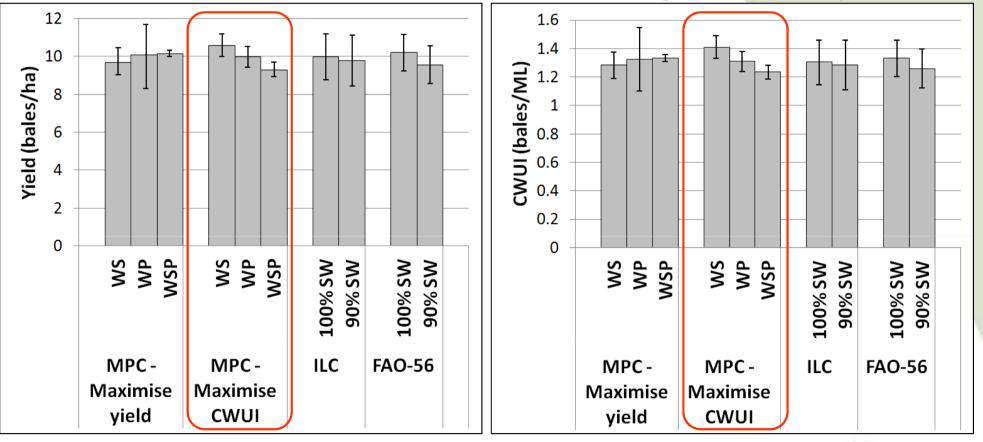
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MPC maximising CWUI

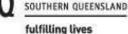


Plant data input reduced irrigation application, yield and CWUI

Plant input not as influential maximising CWUI as yield



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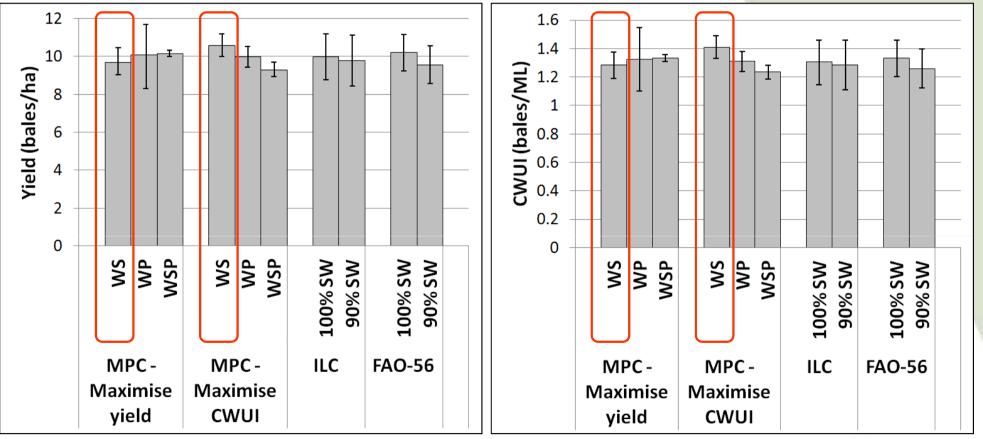
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MPC with weather, soil data



Lower yield and higher CWUI for MPC maximising yield than CWUI

> Sub-optimal model calibration with weather and soil data



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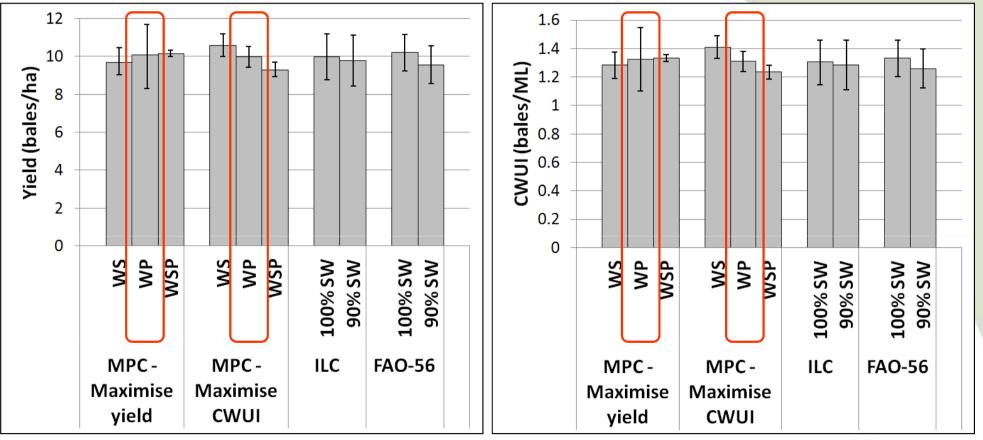
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MPC with weather, plant data



- Yield and CWUI slightly higher for maximising yield than CWUI
- Plant data input more beneficial for yield than CWUI



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fulfilling lives

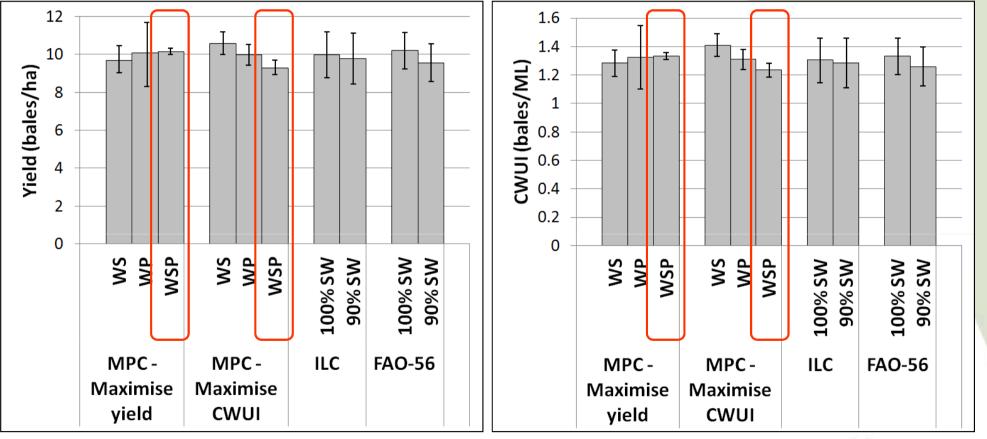
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MPC with weather, soil, plant data



Higher yield and IWUI for MPC maximising yield than CWUI

> All data input led to better performance maximising yield



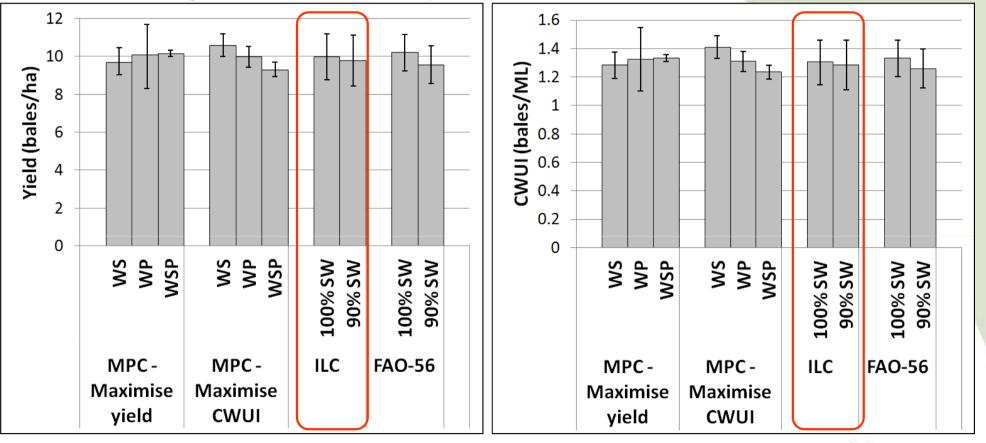
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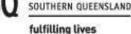
Iterative Learning Control (ILC)



- Higher yield and lower CWUI for full than deficit irrigation
- Less irrigation reduced yield and increased CWUI



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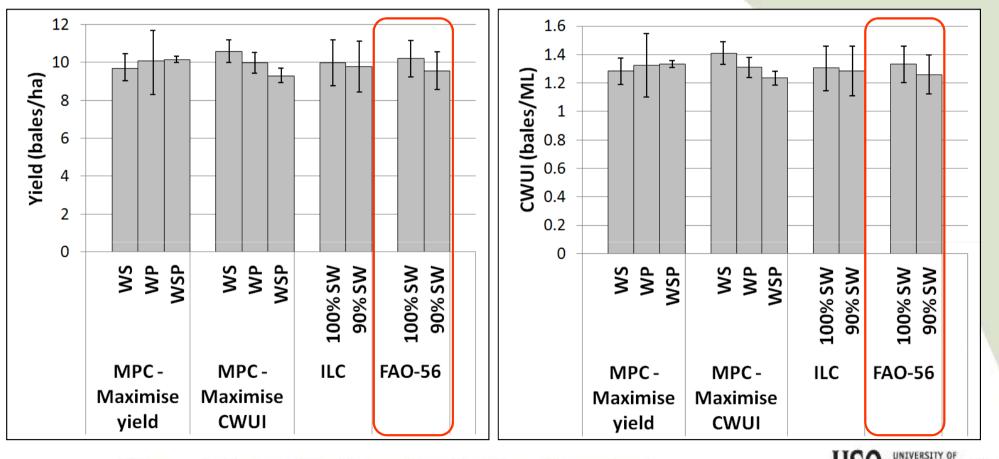


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FAO-56 irrigation management



- Yield and CWUI higher with full irrigation
- Reduced irrigation application led to reduced performance



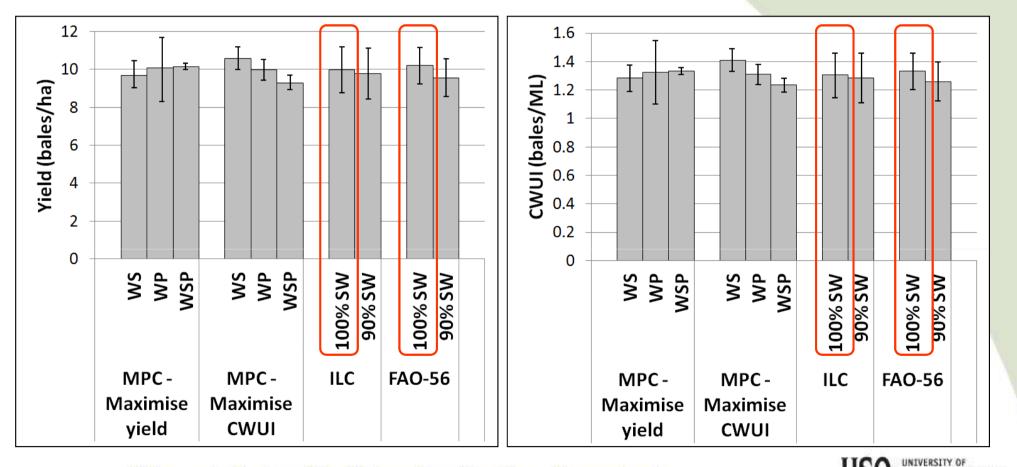
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ILC and FAO-56 filling soil water profile



Higher yield and CWUI for FAO-56 than ILC
FAO-56 would be suitable for full irrigation



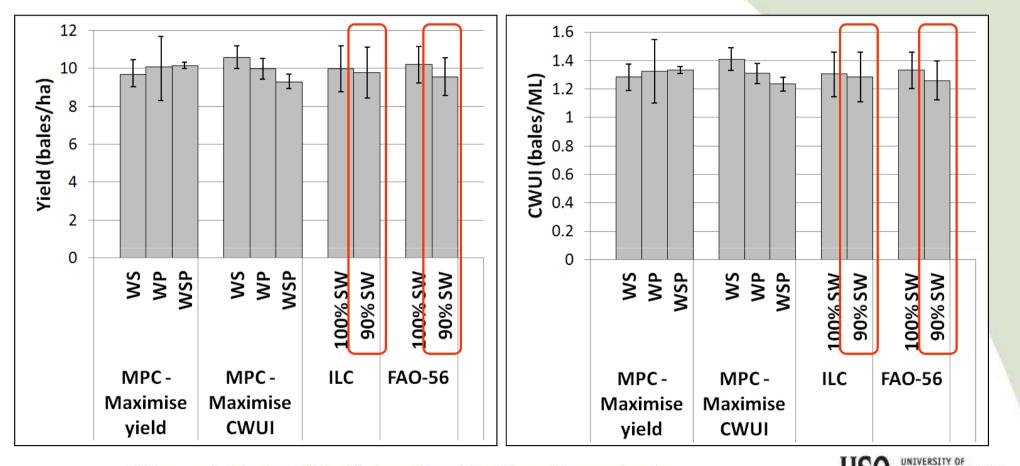
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ILC and FAO-56 for deficit irrigation



Higher yield and CWUI for ILC then FAO-56
ILC better for targeting deficit irrigation than FAO-56



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Conclusion



- 1. High rainfall, trial compared control options
- 2. Plant data input increased yield for MPC maximising yield
- 3. Plant input more influential for MPC maximising yield than CWUI
- 4. ILC better at targetting and refining soil moisture than FAO-56
- 5. FAO-56 sufficient for full irrigation



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