Real-time irrigation decision-making and control for site-specific irrigation of cotton using a centre pivot, 2012/13

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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
‘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
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
Infield variability sensing

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
MPC maximising CWUI

- Plant data input reduced irrigation application, yield and CWUI

- Plant input not as influential maximising CWUI as yield
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
MPC with weather, plant data

- Yield and CWUI slightly higher for maximising yield than CWUI
- Plant data input more beneficial for yield than CWUI
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
Iterative Learning Control (ILC)

- Higher yield and lower CWUI for full than deficit irrigation

- Less irrigation reduced yield and increased CWUI
**FAO-56 irrigation management**

- Yield and CWUI higher with full irrigation
- Reduced irrigation application led to reduced performance
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
ILC and FAO-56 for deficit irrigation

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