Development of a simulation framework for variable-rate irrigation of cotton

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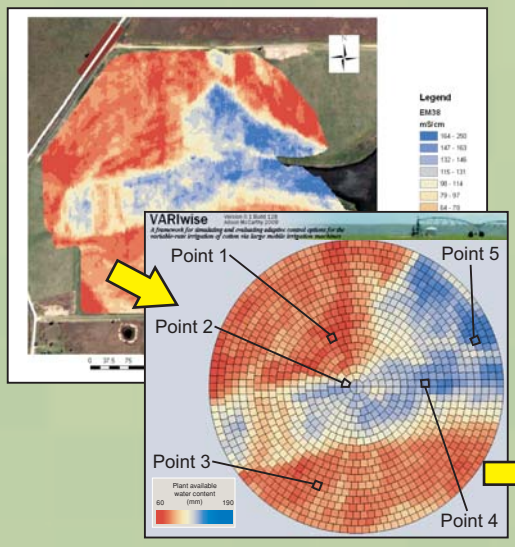
Background

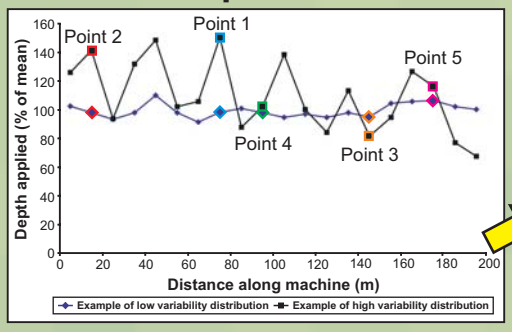
A simulation framework, VARIwise, is being developed to evaluate irrigation control strategies for lateral moves and centre pivots. VARIwise allows for field scale variations in input parameters and will simulate various levels of control strategies for site-specific irrigation at different spatial scales. The simulation model is presently OZCOT. The work reported on this poster provides a preliminary demonstration of the framework for conceptual purposes only.

1. EM38 map imported into VARIwise



2. Plant available water content map

3. Centre pivot uniformity can be imported



4. Control options

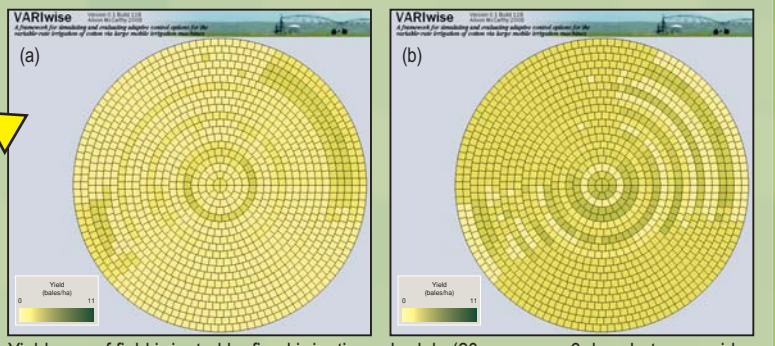
A. Fixed irrigation schedule
Irrigation is applied according to user-specified dates and amounts

B. Soil moisture deficit-triggered irrigation
User-specified irrigation amount (20 mm) is applied when soil moisture deficit reaches a set value (30 mm)

5. Examples of VARIwise simulations

A. Fixed irrigation output

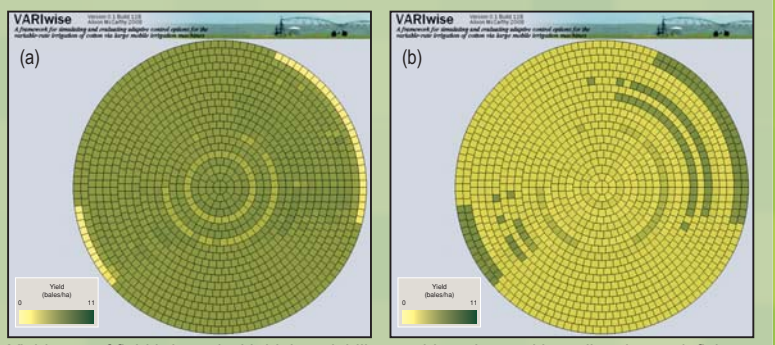
Days between irrigations	Application (mm)	Variability in machine uniformity	Yield (bales/ha)	Irrigation water use efficiency (bales/ML)
4	20	Low	7.1	0.9
		High	6.9	0.9
	40	Low	5.5	0.4
		High	5.6	0.4
	60	Not possible due to machine capacity		
6	20	Low	1.4	0.3
		High	3.3	0.6
	40	Low	5.6	0.5
		High	6.4	0.6
	60	Low	6.2	0.4
		High	6.2	0.4



Yield map of field irrigated by fixed irrigation schedule (20 mm every 6 days between mid-December and mid-March) with: (a) low variability machine; and (b) high variability machine

B. Soil moisture deficit-triggered irrigation output

Sensor location	Variability in machine uniformity	Yield (bales/ha)	Irrigation water use efficiency (bales/ML)
Point 1	Low	7.0	0.7
	High	7.0	0.7
Point 2	Low	7.1	0.7
	High	7.0	1.0
Point 3	Low	7.1	0.8
	High	4.6	0.4
Point 4	Low	6.8	0.7
	High	7.0	1.0
Point 5	Low	7.4	0.9
	High	7.0	0.9



Yield map of field irrigated with high variability machine triggered by soil moisture deficit (between mid-December and mid-March) at: (a) point 1; and (b) point 3

Future work

Adaptive control strategies will be integrated into VARIwise to locally modify the control, and, as required, account for infield temporal and spatial variability. By comparing adaptive control strategies, we may identify:

(i) optimal control strategies for irrigation;
(ii) temporal and spatial scale requirements for irrigation control; and
(iii) the usefulness of additional sensors.

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