Tools to benchmark and maximise irrigated productivity - potatoes

Background
From 2014 to 2017, Natural Resources South Australian Murray-Darling Basin (SAMDB) established a demonstration in the southern Mallee to assess and benchmark the use of precision irrigation technologies on a property established for potato production.

A number of tools and technologies were used to determine if improvements could be made to a centre pivot potato production system. A site was selected at a seed potato growing property and two centre pivots were profiled for the duration of each cropping phase over a three year period.

Aims
Benchmarking horticultural production was an important aim of the project as well as demonstration and assessment of the practical use of specific tools being trialled. Ultimately the trials were designed to help producers optimise their irrigation decisions, improve efficiency of irrigation and in turn maximise profitability.

The aims of the demonstration were to:
- evaluate a range of tools and technologies that are simple to use and enhance strategic and day-to-day decision-making
- validate how practical it is to adopt and use the trialled technologies from a new start, and identify any barriers to adoption.

The demonstration
Centre pivots were monitored at two separate properties with varying soil types. Each site was surveyed and monitored over both the summer and winter cropping phases using the following techniques.

Electromagnetic (EM38) soil mapping
Prior to planting, each pivot site was EM38 soil mapped to identify the primary soil type zones. Over the course of the continued demonstrations two soil moisture probes were placed in each pivot footprint and EM38 soil mapping was used to identify the lightest and heaviest soil textures for probe placement.

EM38 mapping provided a significant advantage by accurately locating distinct soil zones. This enabled better location of soil moisture probes to inform irrigation decisions based soil textural information such as water holding capacity.

The GPS capability of the mapping also enabled the farmer to compare yield outcomes to distinct soil and irrigation zones, and to mark out the incidence of pest and diseases in each pivot.

Telemetric water metering and soil moisture probes
Fitting telemetry to existing water meters enabled water volumes to be monitored remotely. This enabled the farmer to readily identify water flow and usage patterns, and to regulate hourly applications and identify pivot malfunctions.

Drill and drop type soil moisture probes, with sensors at 10cm intervals, were chosen for their ease of installation and removal in short-term potato cropping situations. Telemetry units were fitted to the soil probes to monitor soil moisture balance information online. This enabled the user to compare irrigated depth by hours, effective rainfall and soil conductivity (salinity), and identify the depth of irrigation per pass by soil zone and by hour (mm).

Soil solutes
In the first two plantings, soil solution extractors were used to collect irrigated soil solutions from the crop’s root zones. Soil solutions can be extracted from the sampler at regular intervals and a portable Electrical Conductivity (EC) meter is used to monitor soil solute salinity and nitrate test strips. This data can be used to identify potential nitrate leaching after fertigation or broadcasting.
The extractors were placed next to moisture probes at 30 and 60cm depths. This equipment enabled the irrigator to better understand the status of the crop’s soils across irrigation seasons and in differing soil zones.

Irrigation system and diesel usage auditing

Auditing of the pumping and irrigation systems was undertaken to ensure that they performed to specification. This work was extended to consider efficiency of diesel usage on site and how well equipment was operating to specification.

The audit measured the performance of the hydraulic systems from the pump through to the centre pivot emitters and rated the basic performance of each system against its specification. To enable a more accurate evaluation of the diesel motor, performance fuel flow meters were temporarily installed in the main feed and return lines of the diesel motor and real consumptions under load evaluated.

The results of this audit found that the diesel motor driving the pump utilised considerably more diesel than the industry specification and that overall the business could reduce their diesel usage substantially through basic ‘tuning’ of motor revs and observation of pivot tower pressures. This could be achieved through observing pivot tower pressure using an app and selecting the minimum engine revs to achieve the optimal tower pressure.

Results

Over the life of the project, the use of various technologies produced observable advantages to the production system. Baseline EM38 soils mapping enabled specific agronomics to be applied to different soil zones leading to improved irrigation decisions and economic evaluations of productivity outcomes. This reduced reliance on more detailed soil testing.

Soil moisture information was definitely used more often in warmer growing conditions when crop water use was high and in low rainfall conditions to inform when irrigation was required. The observation of trends in free draining sands versus clays helped the land manager to avoid water logging issues by assessing the depth of water supplied.

Soil solution extraction was useful for identifying soil salinity and nitrate trends but was found to be hard to successfully re-install and utilize over time.

Auditing revealed that the irrigation system was operating to specification and this greatly improved the producer’s ability to schedule irrigations necessary to efficiently address crop water demand. Auditing the diesel used identified substantial gains could be made by the ‘tuning’ the diesel motor’s revs to meet system requirements. This approach is likely to achieve lasting savings if applied when pivot’s are established.

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For more information

Jeremy Nelson
Project Officer – Sustainable Agriculture
Natural Resources SA Murray-Darling Basin
2 Wade St, Berri, SA, 5343
Tel: 08 8580 1800
Mob: 0429 845 216
Email: Jeremy.Nelson@sa.gov.au