SAGIT Research Snapshot

PCT0111: Increasing the economic returns of agronomic management using precision agriculture

FAST FACTS

The details
Start: April 1, 2011 **Finish:** March 31, 2014
Project participants: Precision Cropping Technologies - Michael Wells, Peter Treloar and Felicity Turner.

The problem
Relying on yield data alone and the lack of good quality yield data has restricted the understanding as to the causes of production variability and limiting the full potential and uptake of Precision Agriculture.

The research
Research in applying PA decision support tools and the evaluation of various sensors to understand cause and effect which will focus on reducing risk and increasing returns to growers.

BACKGROUND

Different sensors have been found to have varying levels of effectiveness in measuring soil variability. By addressing these issues, precision agriculture that reduces risks and increases returns for South Australian growers can be developed.

RESEARCH AIMS

- Isolate critical management and agronomic challenges facing farmers in specific regions.
- Optimise the use of precision agriculture technologies to address these challenges.
- Integrate local decision support into practical solutions.
- Evaluate the benefits of precision agriculture as a management tool.
- Quantify the economic benefits achieved from targeted management through trial analysis.

In a nutshell
Precision agriculture decision-support tools are useful in providing growers and agronomists a simple step-by-step guide to implement precision agriculture on-farm.

IN THE FIELD

The project started in 2011 and focused on five farm sites at Edillilie, Kimba, Hart, Yumali and Padthaway. A consistent and strategic approach was adopted in order to quantify the growing environment, ground truth the results and analyse the impact on production. Trial results were extrapolated over the entire field in zones to establish a total cost-benefit.

RESULTS

The strongest understanding of soil variability across all sites was achieved with using electromagnetic technology (EM or EM38).

Not all environments responded to increases in inputs using variable rate technology. Soil modification and/or amelioration were found to have greater potential as a profit-making management decision. Using soil sensors was effective at identifying depth to clay using EM technology and deep ripping of bleached layers using EM and gamma radiometrics, which measures gamma ray emissions from the natural radioactive decay of elements within rocks and soil.

Relationships with EM and soil water were identified in some environments. This is a key component of risk management with inputs, particularly nitrogen. Reducing inputs on heavy soils in low rainfall environments had economic benefits, while in medium rainfall environments, there were economic

gains from increased inputs on better soils and reduced inputs on poorer soils. These benefits were influenced by rotation.
Nitrogen sensors and the response across soil zones showed potential as a management tool to maximise yield within certain soil zones in some cropping environments. Specific site results include:

Edillilie
Combining gamma radiometrics and EM was most useful in identifying soil types and profiles. PA Technologies were used for identification of different land use capability areas isolating land that would be better suited to grazing.
Dual EM readings correlated with chemical soil properties of pH, exchangeable sodium and, aluminium and cation exchange capacity (CEC), which influences a soil's ability to hold onto essential nutrients. This allowed for targeted gypsum and lime applications via variable rate technology, reducing total gypsum requirements by 25 percent.
Identification of "yield zones" and targeted application of variable rate fertiliser according to these zones resulted in responses of up to $50/ha.

Hart
The EM38 survey strongly correlated with soil properties such as salinity, sodicity, boron, and soil texture. End-of-season moisture cores confirmed a strong correlation with crop lower limits (CLL). In-season coring showed a strong correlation with drained upper limit (DUL). Targeting increased fertiliser application to low constrained soils using variable rate saw gains of up to $70/ha.

Kimba
EM38 was the dominant soil sensor correlating to yield, especially in below-average years. EM showed good correlation to depth of clay. This assisted in the identification of areas best suited to clay spreading, clay delving and no treatment and improved efficiency of these operations. In contrast to experiences in similar soil types and rainfall regions, increased inputs on sandy soils did not increase production.
Reducing inputs on soils identified by EM38 as highly constrained did not reduce yield, but improved the gross margin while reducing risks.

Yumali
Limestone layers varying in depth below the soil surface impeded correlations between DualEM and Gamma Radiometrics with soil texture. Additional analysis of soil survey maps supported with intensive soil coring and field observations showed the potential for identifying the presence and depth of limestone. This will allow for targeted soil modification.
Crop sensor data correlated well with final yield suggesting potential for production increases through targeted nitrogen applications matched to yield potential and nitrogen supply.

Padthaway
Dual EM was the more effective sensor for detecting soil variability at this site. However, the high variability of soils over short distances may limit the ability for large scale spatial management.
Combining Normalized Difference Vegetation Index (NDVI) data with soil data resulted in improved post-emergent nitrogen management outcomes, compared with using soil zones alone.

VALUE FOR GROWERS

- Positive economic returns can be achieved by targeting inputs to soil type and differing yield potential.
- A combination of sensors may be necessary to understand agronomically-important soil variability.
- Multi-depth EM was the dominant sensor for detecting spatial soil variability providing important soil definitions.
- Accumulating spatial information data can be used for agronomic decision-making and provides opportunity for continued precision agriculture research.

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