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Variable Rate Irrigation for better potatoes

Frank D'Emden, Technology Development Manager, Precision Agronomics Australia
ACKNOWLEDGEMENTS: David Anderson, Supafresh; Craig Ryan, Pemberton Potatoes; Outpost Central; Bronwyn Fox, West Midlands Group

Purpose: To demonstrate the use of soil mapping and soil moisture sensors as data sources for variable rate irrigation and fertigation decisions, with the ultimate aim of reducing pumping and fertiliser costs, improving potato yields and quality and reducing the risk of nutrient enrichment of waterways and wetlands.
Location: Gingin (Wanerien Rd) and Dandaragan ('Lightning Ridge')
Soil Type: Sands (Gingin) and loams (Dandaragan)

BACKGROUND SUMMARY

Potato growers in the Gingin and Dandaragan areas face significant production challenges due to highly variable soil types under centre pivots. One problem during tuber establishment is where irrigation decisions for lighter soil types result in overwatering on heavier soil types, resulting in rotting of seed pieces on the heavier soils. On the other hand, optimizing irrigation for heavy soil types results in underwatering of seed pieces on lighter soils. Irrigating for the 'happy medium' can result in suboptimal germination and production on both soil types.

TRIAL DESIGN

The 2016 growing season was used to collect geophysical data and test soil moisture sensors, trials will be conducted in the 2017 growing season. Electromagnetic and gamma radiometric data was collected from the two centre pivots near Dandaragan (Lightning Ridge, Pemberton Potatoes, approx. 7.5km northwest of Dandaragan townsite) and Gingin (Wanerie Rd, Supafresh, approx. 35km northwest of Gingin) in March 2016.

Data from the Dandaragan survey was used to position Wildeye™ soil moisture sensors in brown sand and chocolate loamy soils. Soil moisture data was tracked over from June to October.
Yield and quality estimates from the dominant sand and loam soil types were conducted just prior to harvest in October.

OBSERVATIONS AND MEASUREMENTS

Soil sensing (gamma radiometrics)
The results presented will focus on the Pemberton Potatoes Lightning Ridge (Dandaragan) results. The radiometrics total count data was used to split the pivot into two broad soil types, sands and loams. This interpretation still needs to be confirmed with soil coring and analysis, however field textures conducted during soil moisture sensor installation and prior

experience in the region suggest that radiometrics total count is strongly correlated with clay content.

For example, the DAFWA E-Connected wheatbelt soil moisture probe site at Michael Brennan's property west of Moora is on a deep loamy sand, with a radiometric total count reading of approximately 250 counts per second (cps). The map in Figure 1 shows the variation in radiometric total count across the 20ha pivot, with soil moisture sensor locations indicated.

Soil moisture

Wildeye soil moisture sensors were installed on the 7 June and observations recorded every 15 minutes up until harvest on the 17 October. The soil was at field capacity when the sensors were installed at depths of 15cm and 25cm.

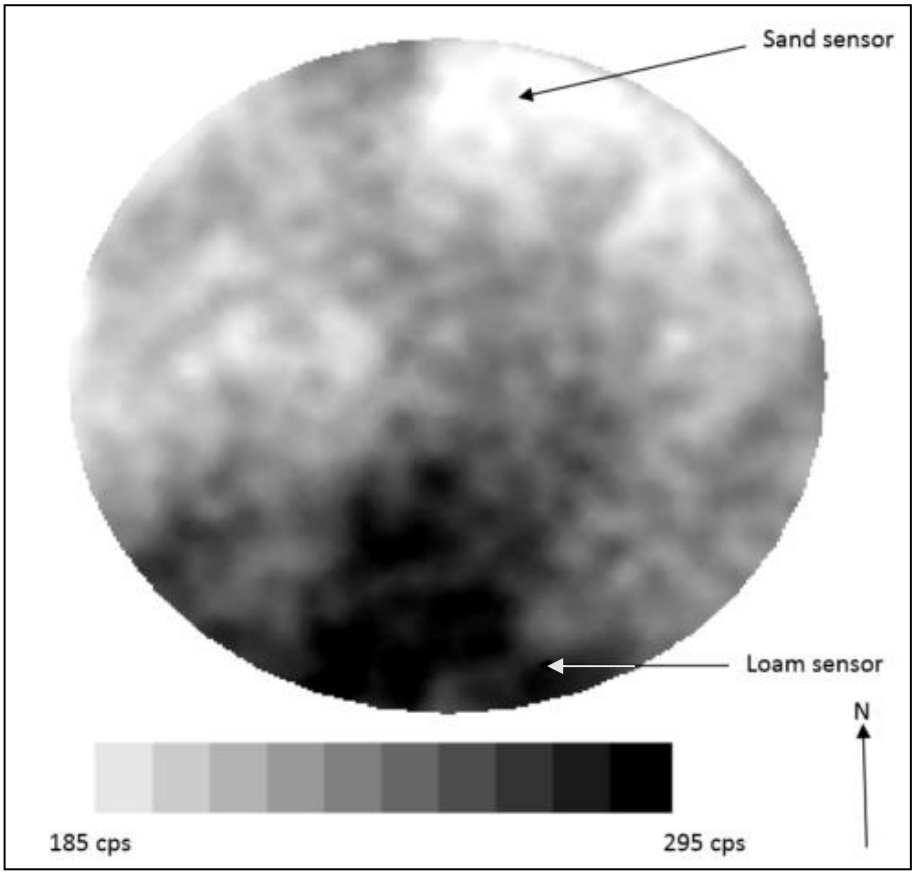

Figure 1. Radiometric total count (counts/sec) map of 'Lightning Ridge' centre pivot at Dandaragan

Figure 2 shows the differences in the soil moisture variation at 25cm between the brown sand (red line) that dominates the northern half of the pivot and the chocolate loam that dominates the southern half of the pivot. Rainfall and irrigation events are clearly shown as spikes in the moisture levels, with moisture drawdown rates increasing as the crop matures

and weather becomes warmer in August and September. The graphs show rapid drainage following a 20mm rainfall event on the 17th of August, with the graph clearly showing that the chocolate loam soil retains more water than the brown sand.

Yield and quality estimates

Yield and quality estimates were conducted at the site on the 17 October 2016. Potatoes were dug by hand from 3m of row in alternating rows on the sand and loam soil types. Tubers were sorted into weight categories of <40g, 40-80g, 80-120g, 120-300g and >300g. They were then further sorted into first and second grades according to skin condition and shape.

Yields on the sand were significantly higher than the loam (up to 9t/ha more grade 1 potatoes), and were generally more consistent in quality and size than the loam (see Figure 3).

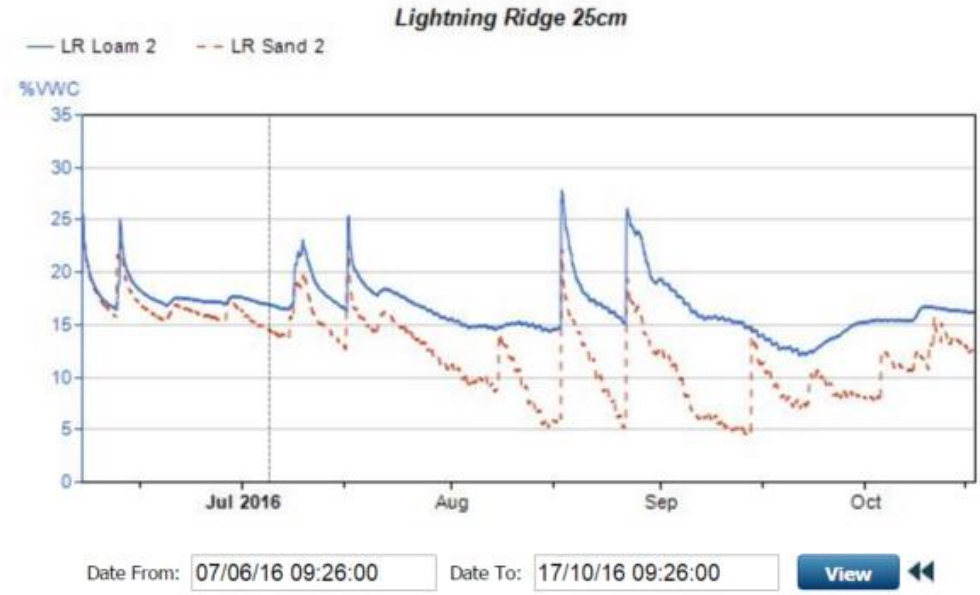

Figure 2. Differences in soil moisture variation at 25cm between the brown sand (dotted line) and chocolate loam (solid line) from June to October

A number (not recorded) of rotted seed pieces were observed on the chocolate loam soil, which is the most likely contributor to the differences in observed yield and quality. The problem of rotted seed pieces on this soil type is consistent with the wet conditions experienced last winter (approx 450mm of rain from June to October).

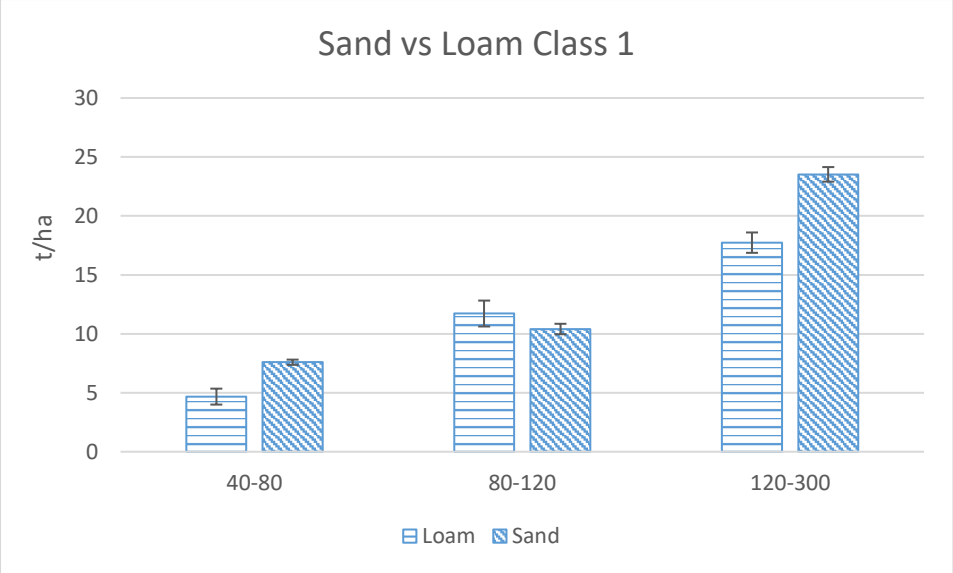

Figure 3. Differences in potato yields for 40-80g, 80-120g and 120-300g weight categories between brown sand (diagonal lines) and chocolate loam (horizontal lines) soils

DISCUSSION

- Centre pivot irrigation plots were surveyed using gamma radiometric and electromagnetic sensors.
- Soil moisture sensors with 3G logging devices were installed in contrasting soil types according to interpretation of the gamma radiometric data.
- Replicated yield and quality estimates were conducted on each soil type
- Yields and tuber classes varied significantly between soil types
- Experiments to determine optimal irrigation and fertiliser regimes for contrasting soil types will be conducted in 2017.

CONTACT DETAILS:

Frank D'Emden
0488 917 871
frank.demden@precisionag.com.au