Using PA technologies to manage salinity and sodicity

R&D FARM-READY ADOPTION READINESS

Department of Agriculture and Fisheries

Fresh Select Farms, Victoria

Jan 2020

Key outcomes

- EM38 soil mapping proved effective at detecting soil characteristics and constraints such as salinity and sodicity.
- Grid sampling enabled development of accurate prescription maps and analysis for variable rate (VR) application of gypsum.
- Fresh Select will re-map in 2020 and use drone crop sensing imagery to assess impact of VR applications.

Background

Fresh Select Farms is a major lettuce and brassica enterprise based in Werribee South, Victoria with other sites across Australia. The company produces and sources a range of crops including broccoli, baby broccoli, cauliflower, cabbage, Brussels sprouts and iceberg, cos and hydroponic lettuce.

Soil salinity and sodicity have become major constraints to yield and quality of produce at the Werribee South site due to the proximity to the coast and the inherent soil characteristics.

Variability in production is a problem across the farm, so the company, guided by their agronomist Stuart Grigg, decided to use soil sensing technologies to investigate possible reasons for the soil variability.

Activities

An EM38 survey was carried out in an 8 ha block, across the main Fresh Select farm in Werribee South. This was carried out in two parts as land became available after harvest. As Fresh Select was interested in using VR technology to manage this variability, grid sampling was carried out to ground-truth the EM38 mapping and provide sufficient detail for any VR prescription maps.

"Using precision paddock grid mapping allowed us to further understand EM surveys and determine the accuracy and causes of soil variations."
– Shane Sutherland and Stuart Grigg

Grower: Fresh Select Farms *(pictured is Farm Manager, Shane Sutherland and Agronomist, Stuart Grigg)*

Location: Werribee South, Victoria

Area: 81 ha

What they grow: brassicas and leafy vegetables, cover crops

Soils: topsoil generally friable red/brown fine sandy clay loam over a medium clay/sandy clay; soils are mostly moderately sodic, somewhat saline and alkaline

Topography: flat to slightly undulating

Average annual rainfall: 450 mm, fully irrigated

Precision technologies implemented: The EM38 and grid soil mapping undertaken as part of this case study were the first PA technologies implemented on farm

The grid mapping for soil analysis was done at a resolution of one sample per 0.1 ha, which is a higher sampling density than the 0.25 ha resolution that is more common used for vegetable systems. Analyses included pH, Colwell Phosphorus, Potassium, Exchangeable K (%), Calcium, Exchangeable Ca, Magnesium, Exchangeable Mg, Sodium, Exchangeable Na, Cation Exchange Capacity and EC (dS/m).

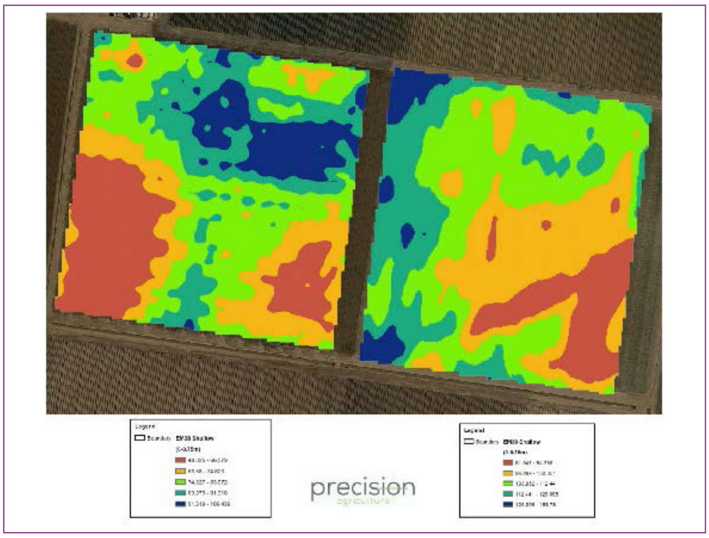

Figure 1. EM survey (EC apparent).

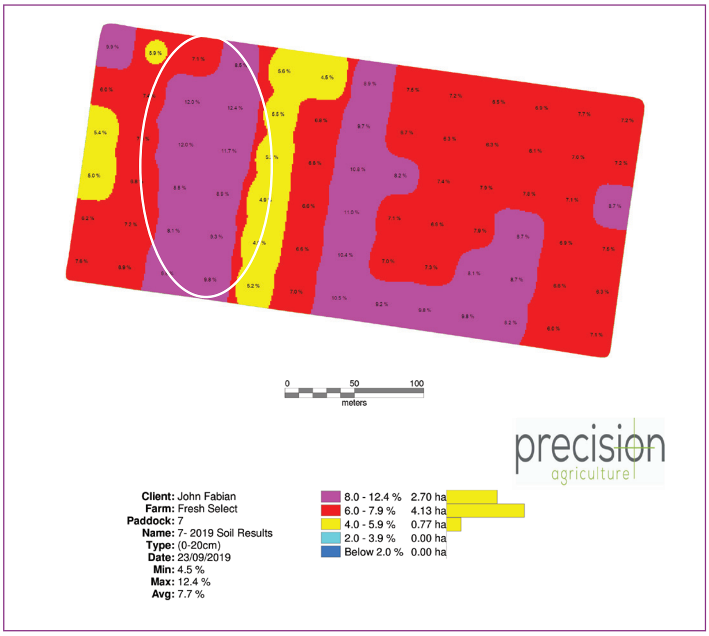

Figure 2A. Grid survey (Exch. Na).

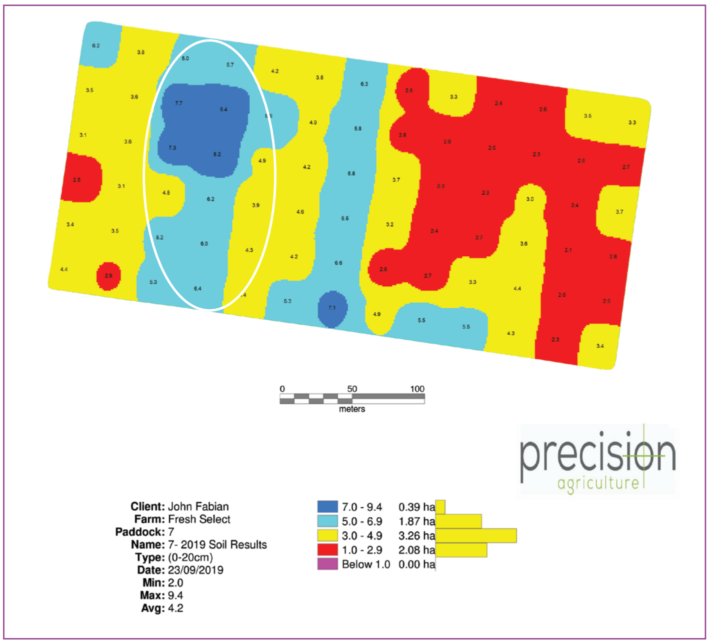

Figure 2B. Grid survey (EC soil extract).

Em38 surveys of each half of the field, showing the variation in apparent EC (ECa) (red-orange = low EC; teal to blue = high EC) (see Figure 1).

The EM38 map shows significant areas of high ECa across the field, particularly in the northern and middle sections of the field, indicating possible salinity issues. Anecdotally it has been noted that there is an inherent drainage issue in this field.

The subsequent grid mapping highlighted exchangeable sodium (Na) as an issue in some parts of the field (Figure 2A). Though variable, the exchangeable Na percentage (ESP) was high across most of the field, ranging from 6 to over 12 per cent (red and pink areas) The critical limit for sodicity is 6 per cent ESP and ideally, ESP would be below 2 per cent.

A second map from the grid survey (Figure 2B) shows the variability of EC soil extract (ECse) at 0–20 cm depth from laboratory analysis. The ECse map shows the western side of the field has a higher EC (3 dS/m or higher) than the eastern half (mostly 1–3 dS/m), which may be a legacy of land use before the two fields were merged. The indication is that the western half of the field is more saline.

The higher EC areas also roughly aligned with higher cation exchange capacity areas (data not shown), which could indicate slightly heavier textures in these areas. As the same areas of the field (circled area) had high EC and the higher exchangeable Na, the indication is that salinity is the main limiting factor to crop yield and quality.

Management options

A VR prescription map was created based on the EM38 and ground-truthing grid survey data.

Two main zones (Figure 3) were identified for variable rate gypsum: 5 t/ha in the high EC (higher saline) red zone, and 3 t/ha in the lower EC (low saline) blue zone. A spreading contractor with VR capability was contracted to apply the gypsum.

The objectives for using gypsum to manage the variability and optimise productivity in the field are to:

- alleviate the impact of salinity on crops and reduce variability,
- enhance friability of the soil and improve drainage,
- reduce surface sealing and crusting of the soil in the more sodic areas of the field.

"We now have the confidence to use variable rate applications of gypsum when looking to manage sodicity and salinity challenges."
– Shane Sutherland and Stuart Grigg

Figure 3. VR prescription map (gypsum).

Costs

EM38 soil mapping is generally one of the most cost effective soil mapping techniques. In this case, due to the small areas involved for the case study field, a day rate of $2500 was charged rather than the usual $15/ha rate for areas over 15 ha.

Grid mapping at a resolution of 1 sample per 0.25 ha, with soil characteristics and nutrient analyses (pH, EC, Exchangeable cations, CEC, and nutrients), would incur a cost of approximately $230/ha. Lower resolution sampling (0.5 ha) and analysis costs approximately $120/ha.

Figure 4. Stuart Grigg using his drone, which will be used to assess the effectiveness of the VR management.

Challenges

The nature of intensive vegetable cropping systems often means that only small areas of fallow are available for soil sensing operations at any one time. This can increase the costs involved in collecting the soil sensing data.

Grid mapping is a more expensive option than EM surveys but costs are quickly offset in high value vegetable production with yield improvements.

Next steps in precision agriculture (PA)

The next steps in precision agriculture for Fresh Select include:

- re-mapping the case study field in 2020 to assess the impact of the VR gypsum application. This mapping data will be overlaid with the data from this case study in Google Earth to look for changes in soil characteristics.
- using post-VR drone crop sensing imagery to observe the effectiveness of the site-specific management of the field in terms of crop uniformity.

Service providers: Precision Agriculture
Agronomist: Stuart Grigg, Ag-Hort Consulting

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Costs presented in this document were accurate as of October 2019. These will change over time and between data processing service providers.

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