Lessons from the Field

Translating Precision Agriculture Data: Fresh Select

National Vegetable Extension Network

VICTORIA - NORTHERN, WESTERN & SOUTH EASTERN

Precision Agriculture in Vegetable Production

Precision agriculture (PA) refers to technologies that improve productivity by considering the variability of agricultural land and crop growth at sub-farm, row or plant scale. Also known as 'site-specific crop management', PA can ensure the right crop management strategies are implemented in the right place at the right time.

Despite the theoretical benefits of PA, the rate of adoption by growers of many crops remains low and, in some industries, is negligible.

In Victorian vegetable production, PA is in its early days. Compare this with broadacre systems, in which, for example, EM38 mapping and associated variable rate application of different inputs have been utilised for several decades. Uptake of controlled traffic farming (CTF) and auto-steer technology has also been significant in broadacre over the last decade. In horticulture, the practical application of EM38 mapping to inform decision-making has only begun to be trialled in the past couple of years.

Details of when, why and how precision technologies may be best used in horticulture are still open to interpretation. **When is it financially beneficial to use PA in vegetable production? How do we translate data into management decisions? And what are the barriers to more widespread use of PA in vegetables?**

One study in Australian grains (2011) measured potential monetary benefit of EM38 mapping (which measures spatial variations in electrical conductivity of the soil) to growers at $14–46 per hectare per year for fertiliser and $69 per ha per year for gypsum. But how might these figures compare with vegetable production, intensively practiced over much smaller areas with multiple crop rotations?

Case study: soil salts in Werribee South

Overview

Headquartered in Melbourne's Werribee South region, Fresh Select is one of the largest lettuce and brassica growers in Australia. As a leader in innovation, sustainable farming techniques and responsible practices, they have also been one of the first to trial PA technology in vegetables.

The problem

The Werribee South vegetable growing region is challenged by sodic-saline soils arising from historic sodicity and salinity, saline recycled and river irrigation water, and reliance on irrigation due to low rainfall. Prolonged drought has further reduced irrigation water quality and quantity, and dealing with soil salts pose a major issue for vegetable growers in the region.

Figure 1: Soils in Werribee South

Hort Innovation Strategic levy investment | VEGETABLE FUND

This project has been funded by Hort Innovation using the vegetable research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

SoilWealth NURTURING CROPS | Integrated Crop Protection PROTECTING CROPS | Stuart Grigg Ag-Hort Consulting | RMCG | FRESH SELECT

Sodicity is best measured by exchangeable sodium. Soils with exchangeable sodium greater than 6% are considered sodic, and those greater than 15% strongly sodic. In Werribee South, ESP can measure up to 12%, adversely affecting the soil structure.

Salinity is a measure of all the soluble salts in the soil. Impacts on crop productivity can be particularly challenging during dry periods when irrigation water (sourced recycled water from Western Treatment Plant and river water from the Werribee River) also becomes more saline .

The 'double whammy' of sodicity and salinity in Werribee South can cause:

- Surface crusting
- Reduced seedling emergence
- Reduced soil aeration
- Increased run-off
- Low organic matter
- Low microbial activity
- Poor establishment, growth, plant vigour and/or tip burn.

Why and what type of PA?

Management of sodic soils has historically involved input of gypsum to improve soil structure. However, longer-term management strategies are needed.

Management of salinity has generally involved careful fertilisation to mitigate the effects of salinity on the plant by balancing the cation exchange ratio to avoid nutrient deficiencies, and careful irrigation to avoid flushing nutrients out of the system and to maintain stable moisture levels.

Due to the potential variability of sodicity within and between fields, Fresh Select's agronomist, Stuart Grigg, supported by Hort Innovation project Soil Wealth and Integrated Crop Protection, has recently begun to trial PA technologies to improve decision-making regarding soil salts. Starting with EM38 mapping and matched gridded soil samples, with the aim of treating the problem areas with variable rate application of soil ameliorants such as gypsum and compost.

Translating PA results

Interpretation of EM data can be a complex process, as electrical conductivity measures soil water content, clay content and salts.

The EM38 map of the trial block shows higher EC at the edges (blue/green, Figure 2).

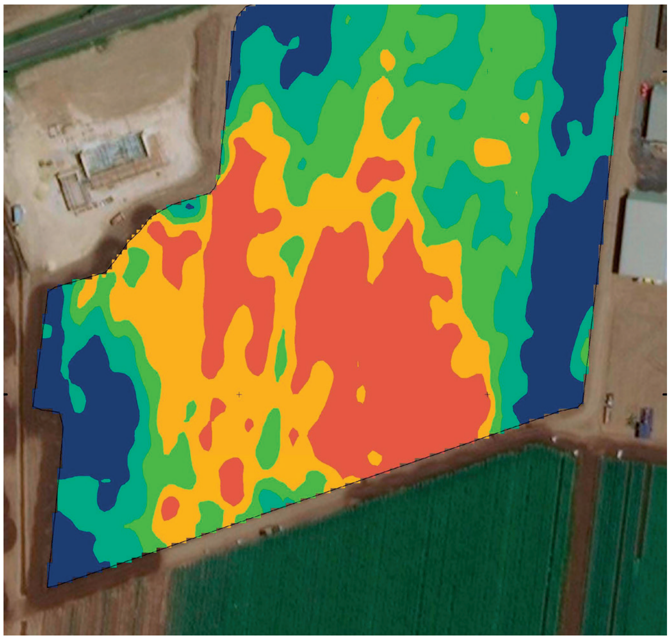

Figure 2: Section of EM38 map – electrical conductivity at 0-0.75 m depth; legend in mS/m. Width of field approx. 230 m.

The gridded soil samples found that the whole field is sodic, and there is some variation in the degree of sodicity. The EM38 map somewhat aligned with exchangeable sodium (Figure 3), but the EC variability was not completely explained by sodicity.

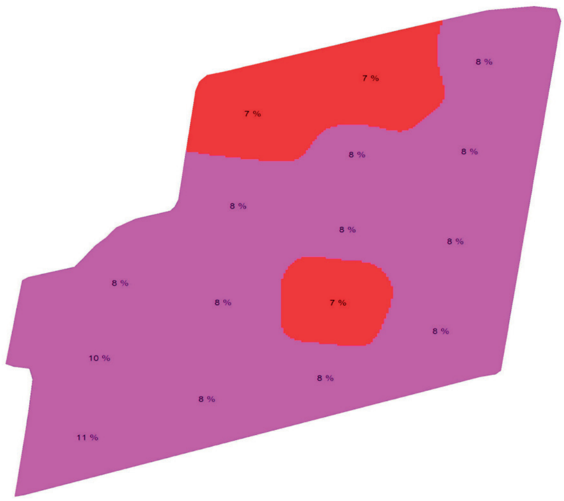

Figure 3: Section of grid sampled exchangeable sodium (0-20 cm depth).

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Of the soil sample results (e.g. nutrient levels), chloride aligned most closely with the EM map pattern (Figure 4), likely indicating that salinity (NaCl is one of the most common soluble salts) may be the cause of the higher EC areas on the EM38 map.

Also, the 'shovel test' showed that the bottom left corner of the field had higher soil moisture, which would also contribute to the EC.

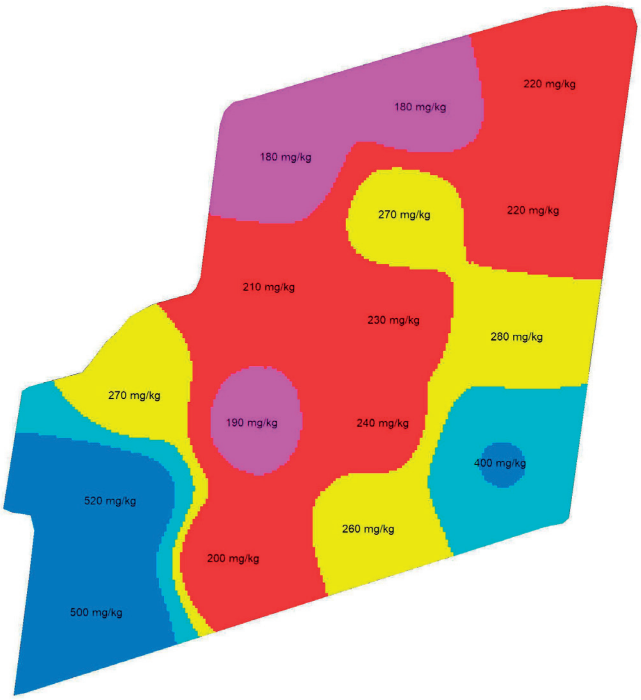

Figure 4: Section of chloride grid samples (0-20 cm depth).

Decision-making with PA

In accordance with the data collected, a variable rate map was generated to apply a higher rate of gypsum in the most sodic areas. Further, compost is being trialled to mitigate some of the effects of salinity. The EM38 map and gridded soil samples will provide a detailed foundation of data on which to observe improvements made by future decision-making at the site.

So, what do these early results tell us about PA in vegetable production? Firstly, ground truthing is key. In this case, the gridded soil samples were necessary to identify the likely causes of the EM38 results.

Secondly, PA may not always give you a straightforward answer. To benefit from the use of PA, growers must ensure they have or can outsource the skills or resources required to translate existing PA data into meaningful management decisions.

Moving forward

The next steps for the Werribee demo site are to test the nutrient levels and plan growth measures to determine whether variable rate gypsum and compost addition have improved the parameters associated with salinity and sodicity.

Into the future, the main gaps in extending the reach of PA in vegetable production include determining how best and when best to use these technologies, including cost-benefit calculations. Other barriers include limited service providers and machinery ownership capacity, and ensuring that the different types of technology are aligned, such as data and mapping programs with tractors and sprayers.

Additional Resources

Literature Review - VG16009 Adoption of precision systems technology in vegetable production
This literature review outlines progress in the application of precision agriculture (PA) technologies to vegetable production systems.

https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/literature-review-of-adoption-of-precision-system-technologies-in-vegetable-production/

Fact Sheet - Precision Agriculture in Vegetable Production
This fact sheet provides information on the different types of PA technologies that are available, what they do, and how they have the potential to benefit your farming system.

https://www.soilwealth.com.au/resources/fact-sheets/crop-management/precision-agriculture-in-vegetable-production/

Case Study - Exploring the application of precision agriculture: Koo Wee Rup demonstration site case study
Schreurs & Sons and the Soil Wealth ICP team partnered to explore the application of precision agriculture in celery, leek and baby leaf production systems.

https://www.soilwealth.com.au/resources/case-studies/exploring-the-application-of-precision-agriculture-koo-wee-rup-demonstration-site-case-study/

Society of Precision Agriculture
Australia's leading independent precision agriculture research, development and extension organisation

https://spaa.com.au