Soil grid mapping and VR application of lime and nutrients

Department of Agriculture and Fisheries

Greenvale, Tasmania

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Key outcomes

- Soil grid mapping identified opportunities for variable rate (VR) applications for lime, potassium and phosphorus.
- Targeted VR applications for lime, potassium and phosphorus mean they are applied where needed.

Background

Greenvale Pastoral Company is Rob and Eliza Tole's family owned and operated business. They are engaged in mixed cropping and lamb production. Crops are contract grown for the processing vegetable sector (peas), pharmaceuticals (poppies) and seed (seed potatoes, grass seed, clover seed, hemp).

Motivation for using precision agriculture (PA)

The Toles are using technology to intensify their operation, rather than expanding production through land acquisition. Productivity is the main driver, as the Toles seek to produce more t/ha of crop or more kg/ha of lamb each year through the use of PA technologies and sustainable management.

Activities

Rob first conducted nutrient grid mapping in 2016. Two of these previously mapped paddocks were re-mapped in 2018, along with another five paddocks. In 2019 these seven paddocks were re-mapped after VR lime and nutrient treatments.

Grid mapping was completed at resolutions of one sample per 1.0 or 1.5 ha. Sampling was to 10 cm and analyses included pH, nutrients (P, K, Ca, Mg, Na), exchangeable cations (K, Ca, Mg, Na), cation exchange capacity (CEC) and Ca:Mg ratio. The pH, P and K results were used to generate VR application prescription maps.

Soil pH

Rob recognises that it will always be a challenge to achieve pH 7 in his soil types, so he aims for a soil pH of 6. Lime is applied at five different application rates to help achieve more even soil pH across the production area.

Grower: Rob and Eliza Tole

Location: Cressy, Tasmania

Area: 260 ha cropping (irrigated), 230 ha grazing, 35 ha forestry

What they grow: Peas, seed potatoes, poppies, grass seed, clover seed, hemp, pasture and sheep (1900 ewes, trading 12,000 to 14,000 lambs/yr)

Soils: black cracking clay (Vertosol), Panshanger sand (Tenosol)

Topography: flat to slightly undulating

Average annual rainfall: 660 mm

Precision technologies implemented:

- RTK guidance – 2002
- Remote control of pivot irrigators and VR irrigation – 2014
- Grid mapping for pH, nutrients, VR spreading and UAV for crop scouting – 2016
- Elevation mapping for surface drainage – 2017
- Land forming using TerraDesign and iGrade control – 2018

"It is important to identify which approach is going to give the best return first up, as each paddock and situation has its own challenges." – Rob Tole

Hort Innovation Strategic levy investment | VEGETABLE FUND

Queensland Government

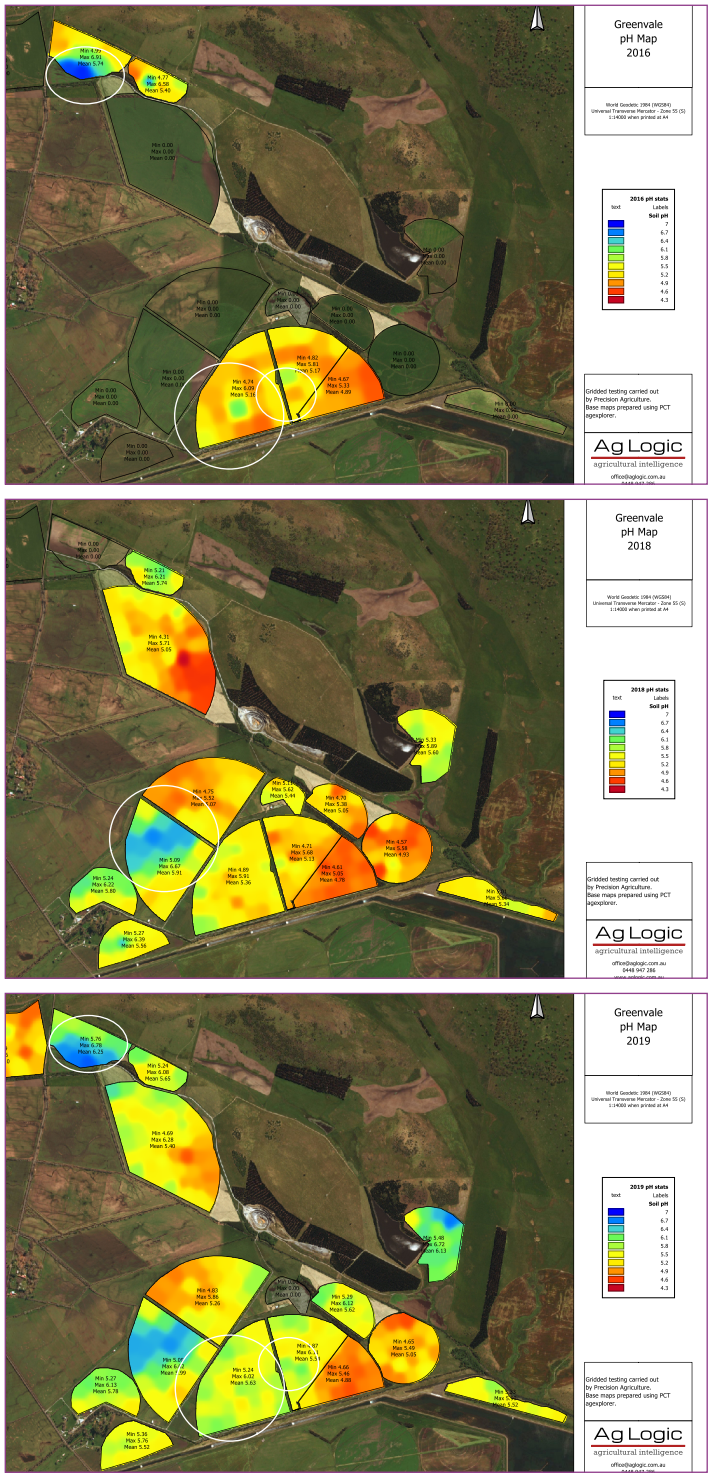

Figure 1. Soil pH over time following VR lime applications. Note increasing soil pH values over time as highlighted by the white circles.

Figure 1 compares pH results from grid mapping pre 2016/18 and post 2019 VR lime applications. Comparing the data from these two years of sampling, the VR lime operation increased the mean pH by up to 0.51 pH units.

Rob had previously not applied lime to areas with soil greater than pH 5.5, however, he has recently started applying maintenance rates of 1 to 2 t/ha to areas of soil pH 6 or greater. Remapping has also highlighted that some areas that were previously over pH 6 have declined to less than pH 6 over time.

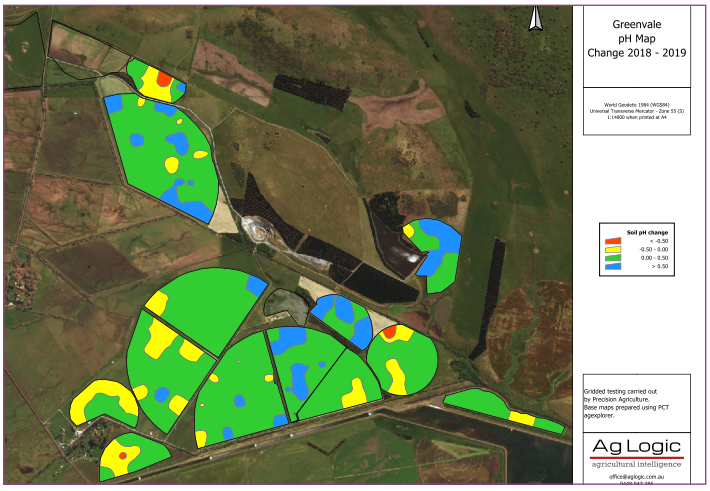

Figure 2. Soil pH change from 2018 to 2019 resulting from VR applications and based on soil grid mapping.

Rob also had results presented as soil pH change so he can assess the impact following each VR application (Figure 2).

Nutrients – Potassium (K) and Phosphorus (P)

Soil grid mapping also formed the basis for variable rate application of P and K. Figure 3 (next page, left) depicts the prescription map for VR potassium in 2018. The extent of variability is evident in this map with some fields ranging in potassium rates from 0 to 270 kg/ha, highlighting the inadequacy of blanket rate application of K.

Figure 3 (next page, right) highlights the changes in soil potassium levels between 2018 and 2019 post VR potassium operations. Generally, potassium levels increased across the farm by up to 200 mg/kg.

Similarly, Figure 4 (next page, left) shows the 2018 prescription map for phosphorus. While there was a large area of the farm that didn't receive any phosphorus, some selected fields showed wide variability in applied rates.

Outcomes and next steps

Rob's first experience of grid mapping and VR applications for lime and fertiliser, achieved input savings sufficient to offset the costs of the grid soil mapping and data processing. Overall, the annual lime budget has remained relatively stable.

All fertiliser and lime applications are now applied using VR technology. Rob owns an Amazone™ VR fertiliser spreader and engages a contractor to apply VR lime. He is also accessing satellite imagery through the DataFarming platform to assist in identifying zones and crop responses to VR application. Access to timely, cloud-free imagery is a key challenge.

"When all the different technologies and approaches are put together, I am confident we are greatly reducing the risk of crop losses while also opening opportunities to greatly increase production."

– Rob Tole

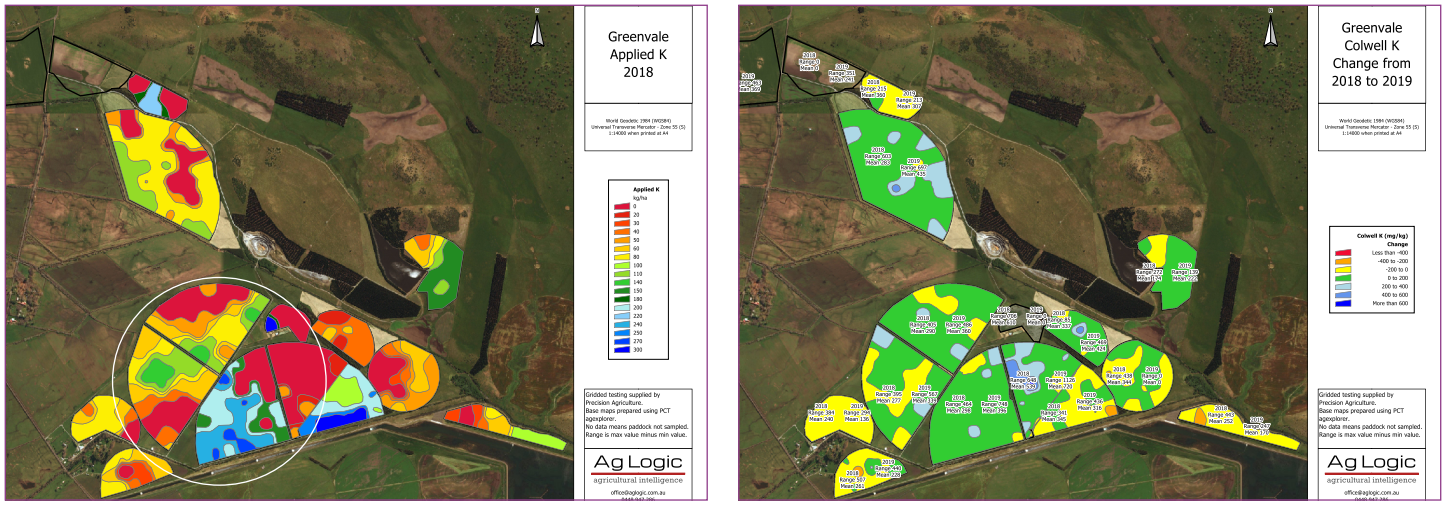

Figure 3. Left: Applied potassium prescription map across the farm for 2018 based on soil grid mapping. Note in some fields (highlighted by the white circle) the rates vary significantly. Right: Soil Colwell K changes (mg/kg) change from 2018 to 2019 resulting from VR applications and based on soil grid mapping.

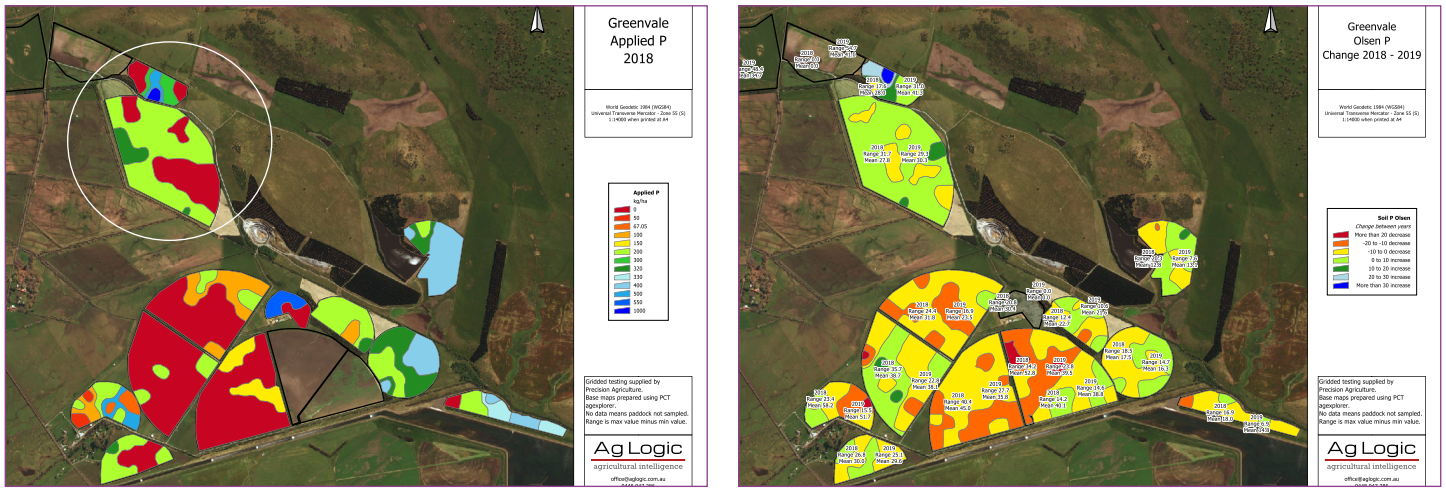

Figure 4. Left: Applied phosphorus prescription map across the farm for 2018 based on soil grid mapping. Note significant increase in rate across the highlighted field (white circle) from 0 to 300 kg/ha. Right: Soil Colwell P changes (mg/kg) from 2018 to 2019 resulting from VR applications and based on soil grid mapping.

Compatibility of machinery and software has been an ongoing challenge, although adoption of ISOBUS in 2017 solved many of the issues of various controllers and monitors not communicating with each other.

Rob is still determining how he will use soil grid mapping into the future as he considers:

- Is grid mapping routinely repeated and if so, is it done across the whole farm every three years or done on one third of the farm each year?
- If variability is reduced through VR applications does he revert to blanket applications?

PA service providers: Ag Logic™; Altrac Spreading
Agronomist: Tom Graesser

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