REDUCING ACID SOIL VARIABILITY USING VARIABLE RATE LIMING

Soil acidity is an on-going issue for Warwick Read who manages mixed farm enterprises across two properties in the high rainfall zone of south-west Victoria.

The negative impacts of soil acidity on farm productivity was quickly identified when the Reads started growing crops.

"Right from our very first hectare of crop we could see that our biggest constraint was the acidification of soils, and this was causing poor yields," said Warwick.

This was the catalyst to start working with Precision Agriculture to address acidity.

Picture: Warwick Read farming enterprise in Western Victoria

MAPPING

Warrick engaged Precision Agriculture to grid map soil pH in 2017/18 on two separate properties, that they then variable rate limed based on the results.

In 2019/20 Warrick decided to re-map five of those paddocks from each property and assess the effectiveness of the past variable rate lime applications and to re-evaluate pH targets and lime rates going into the future.

Kirsten Barlow, a soil scientist with Precision Agriculture said that the variable lime rates for each paddock in 2017/2018 were calculated using soil texture as a surrogate for pH buffering capacity which were taken from one to two points in each paddock.

"Lime rates are calculated based on the target pH you want multiplied by the soil pH buffering capacity. This buffering capacity determines how easily the soil pH changes and is determined by clay content and soil organic carbon. Soil texture reflects clay content and so is commonly used to calculate lime rates. Sands are low in clay content and so acidify more easily but also don't resist pH change as much as clay soils and therefore need less lime," she said.

FARM SNAPSHOT

Producer: Warwick Read

Location: Beaufort, Victoria

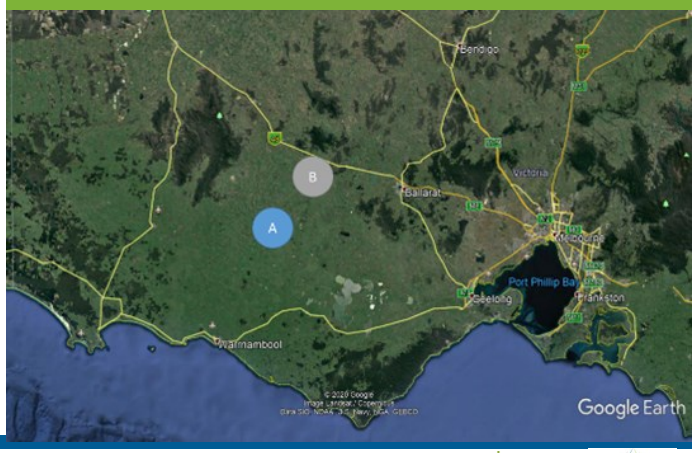
Annual Average Rainfall: 500mm

Soil Type:

A. Earlston Peak: Sodsols

B. St Marnocks: Mixture of Ferrosols, Chromosols and Sodosols

Enterprise: Mixed Farming



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RESULTS

The Earlston Peak property consists of Sodosols, which are strong texture contrast soils but vary with sandy loam to clay loam surface soils. The soils on St Marnocks property are even more variable with a mix of ferrosols, chromosols, vertosols and sodosols. On average the pH range of the five paddocks on St Marnocks was 2.3 pH units or double the variation (1.2 pH units) observed on Earlston Peak in 2017/2018.

A summary of these results are shown in Table 1 and Table 2.

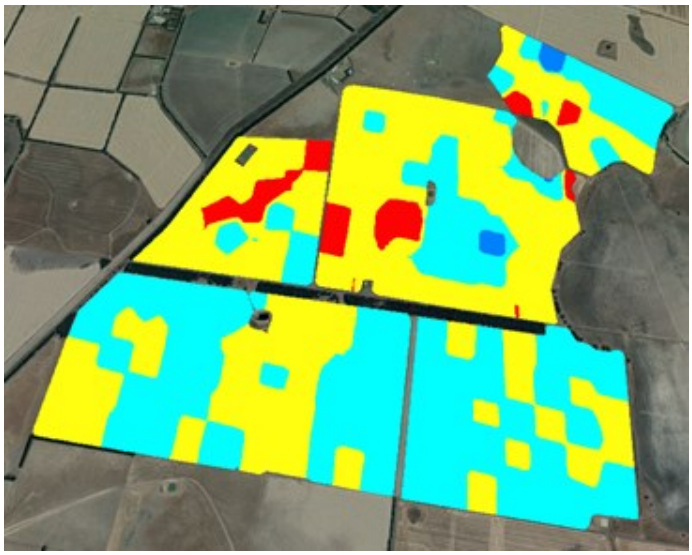
"You can see the variability by the different colours of the 2017/2018 maps, with 56 to 58% of the paddocks on both properties having a pH less than 5.2 which was Warwick's target.

"The inherent variability in soil types and likely management history are reflected in the pH results. Cover paddocks with nitrate leaching, old tree sites, hay cutting, and plant removal and production all contribute to different rates of acidification and therefore different areas of pH," said Kirsten.

In 2019/20 the same five paddocks in both properties had more even pH.

"The 2019/20 maps clearly show the increase in soil pH, with 10% having a pH less than 5.2 in Earlston Peak and only 5% in St Marnocks and there is reduced pH variability," said Kirsten.

EARLSTON PEAK



Above: Earlston Peak 2017/18 pH mapping

Below: Earlston Peak 2019/20 pH mapping following liming shows more even pH across the 5 paddocks.

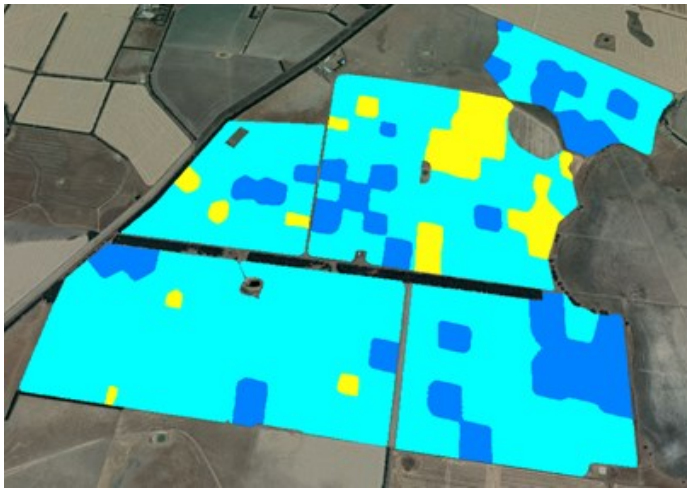


TABLE 1. EARLSTON PEAK RESULTS SUMMARY

Key measurement	2017/2018	2019/2020
% of paddocks area less than 5.2	56%	10%
Average pH (Units)	5.2	5.6
pH range (Units)	4.6-6.8	4.8-6.4
Average pH range (Units)	1.2	1.0
Average Coefficient of Variation	5.2%	4.2%
Conabar within paddock variation (Units)	0.7	0.8
Eliyar within paddock variation (Units)	2.1	1.5
Myuna within paddock variation (Units)	0.9	1.2
Ennerdale within paddock variation (Units)	2.1	0.9
Red gums within paddock variation (Units)	0.8	0.9

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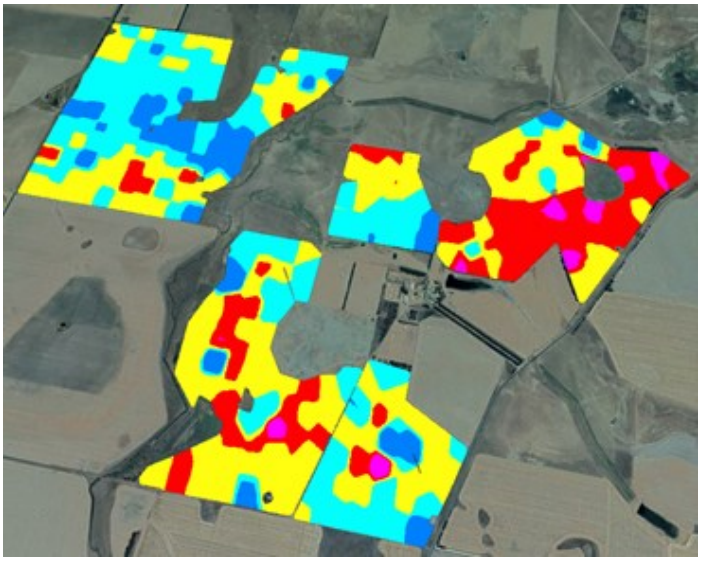
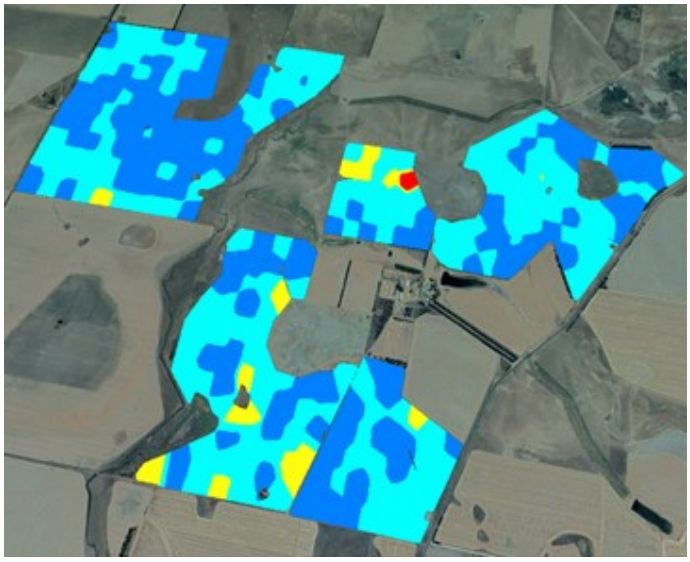
ST MARNOCKS



Left: St Marnocks 2017/18 pH mapping



Right: St Marnocks 2019/20 pH mapping

TABLE 2. ST MARNOCKS SUMMARY OF RESULTS

Key measurement	2017/2018	2019/2020
% of paddocks area less than 5.2	58%	5%
Average pH (Units)	5.2	5.7
pH range (Units)	4.3-7.6	4.7-6.9
Average pH range (Units)	2.3	1.9
Average Coefficient of Variation	8.5%	6.6%
Thistley within paddock variation (Units)	2.1	2.1
Airstrip within paddock variation (Units)	1.8	1.7
Lewis within paddock variation (Units)	3.2	1.8
Pines within paddock variation (Units)	2.6	1.7
Challicum within paddock variation (Units)	1.9	1.8

KEY LESSONS

Because the paddock variability was high, a standard soil sample would have hidden highly acidic areas.

"This level of variability would not have been identified from a transect sample, the ability to target the applied lime ensured the most acidic areas were limed, while other areas weren't. In some of these paddocks an average pH may have resulted in zero lime application despite significant areas of acid soils," said Kirsten.

Precision Agriculture has been moving away from the use of one or two soil texture measurements within a paddock to calculate the lime requirements. Instead, they are increasingly using the NSW DPI guidelines which use the soils Cation Exchange Capacity (CEC) to estimate the soils pH buffering capacity and therefore lime requirements. CEC can be measured on all the grid data allowing for a more targeted lime strategy, as well as additional soil information on exchangeable potassium and magnesium levels and potential sodicity.

For Warwick the additional data has resulted in a more targeted lime program and reinforced their use of soil mapping to make better decisions.

"For us it has been about the reallocation of resources, rather than a saving, and after 5 to 6 years in the program we have really seen the benefits in terms of our soils and productivity," said Warwick.

With acidification occurring as the natural process of farming, Warwick is committed to continue to monitor through soil mapping to make sure their lime program is on track.

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