
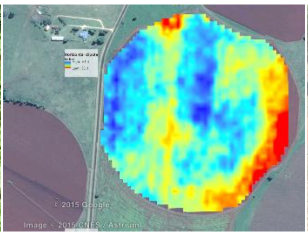

Variable rate technology for vegetable production in Great Barrier Reef Catchments

July 2018 Project update

The three year project *'Maximising the efficacy of variable rate technology (VRT) to reduce nutrient use and sediment transport in vegetable and melon production'*, commenced in September 2017.

This project aims to advance the adoption of variable rate (VR) technology and practices to optimise the placement of fertiliser, amendments and irrigation in intensively cropped and irrigated horticulture in Great Barrier Reef catchments.

The key areas of investigation are:

- Identify variability in soil characteristics, yield and nutrient budgets,
- Identifying soil amendments and variable rates that improve soil health and nutrient availability,
- Undertake modelling to assess options for managing runoff, erosion and drainage,
- Demonstrate the cost - benefit of site-specific crop management.

Demonstration sites

There are three commercial, on-farm demonstration sites:

1. Melon production at Horseshoe Lagoon, in the Burdekin Catchment, Haughton River Basin,
2. Capsicum and cucumber production at Bowen in the Burdekin Catchment, Don River Basin,
3. Potato production at East Barron in the Wet Tropics Catchment, Barron River Basin.

Horseshoe Lagoon, Haughton River Basin

Tom and Michelle Pontarelli have diversified from cane into melon production in the last few years. Pontarelli Farms is located west of Ayr between the Haughton River and Barratta Creek. Their location in the heart of North Queensland's cane country and the Great Barrier Reef, has encouraged adoption of innovative water and nutrient efficient practices, including trialling precision agriculture (PA) and variable rate practices.

In September 2017, 50 hectares of Pontarelli Farms destined for melon production in the 2017-18 season was mapped using Vantage's Soil Information Systems (SiS) method, see: agriculture.trimble.com/software/soil-information-system/). This method uses electromagnetic induction (EMI) to map soil characteristics based on moisture, clay and salt concentration.

Software analyses the data to define zones of variability across the mapped area for same-day ground-truthing. Soil physical characteristics, including compaction and horizon depths are collected, along with soil cores for chemical analysis.

Mapping software is used to visualise the extent of spatial variability and delineate zones for VR management. Here, **87% of the 50 ha mapped was affected by moderate to highly sodic subsoils** (>6% exchangeable sodium or ESP).

At the end of September 2017, 31 ha of land affected by sub-soil sodicity was treated with a high rate gypsum VR prescription. In place of the traditional 7 t/ha rate applied every year, the new VR gypsum rate ranged from 2.5 to 10 t/ha. The VR gypsum prescription applied at this site can be seen in *Figure 1*.

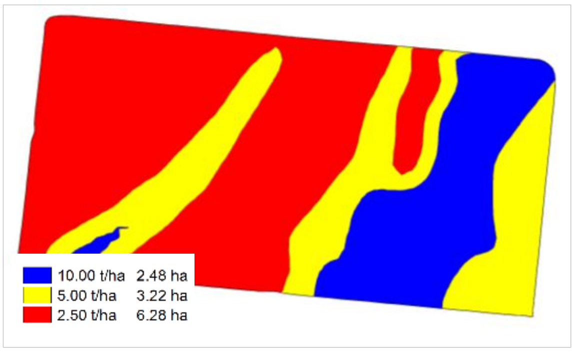

Figure 1: A 12 ha VR gypsum prescription at Block 90 spread between 2.5 to 10 t/ha for remediation of high sodium concentrations in melon production.

By applying high gypsum rates only where they were needed, the Pontarelli's **saved $708/ha in gypsum costs in the first year of VR adoption**.

In April 2018 follow-up soil sampling took place on the 31 ha treated. This revealed promising changes in sub-soil sodicity after one high-rate gypsum application paired with leaching rainfall over the wet season, see *Figure 2*. The timing and amount of gypsum applied using VRT was so effective that **of the original 21 sub-soil cores, 89% returned a result of <6% ESP** in the follow-up analysis in April 2018.

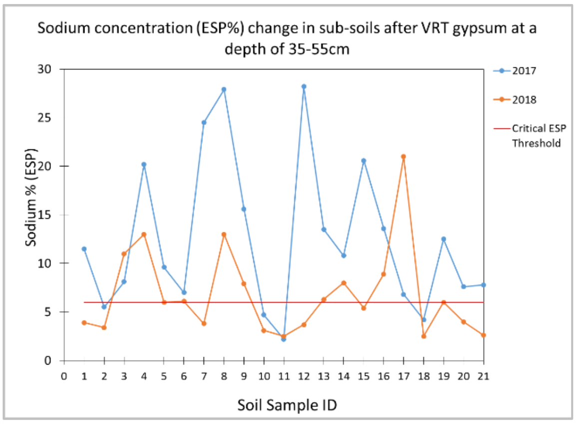

Figure 2: Soil core results from 2017 and 2018 show a significant reduction in sodicity (ESP) after only one high-rate VRT gypsum application.

A second VR gypsum application was applied to two individual sites in May 2018 in preparation for transplanting melon seedlings. These soil sampling sites will continue to be monitored throughout the 2018 season along with melon nutrient accumulation and yield.

Bowen, Don River Basin

Phantom Farms, owned and operated by Carl and Trudy Walker, is located about 3 km from the mouth of the Don River, near the Bowen Township. The primary vegetable crop is capsicum, see *Figure 3*, including yellow, green and red varieties with specialty cucumber and tomato lines. The farm acquired GPS guidance and auto-steer technology in 2010 after receiving a Reef Rescue grant to improve soil health and management. Since then Phantom Farms have been trialling several VRT practices to address soil and crop variability.

Figure 3: Capsicum seedlings newly transplanted into mulched beds at Phantom Farms in June 2018.

In April 2016[1], the first VR application of gypsum (in intensive vegetable production in Queensland) was applied to **manage 53% of the farm affected by sodicity (>6% ESP),** see *Figure 4*. This operation applied gypsum rates between 0 to 5 t/ha across 32 hectares, to manage severe sodicity.

Sodicity of this magnitude has the potential to reduce yield of capsicums by up to 60%[2]. Yield assessments performed in late 2017 showed some yield improvements in the moderate (4 to 6% ESP) and high (6 to 10% ESP) salinity zones respectively from 2016. However, **overall yield data was highly variable between seasons** and this makes it difficult to detect trends between yield and sodicity.

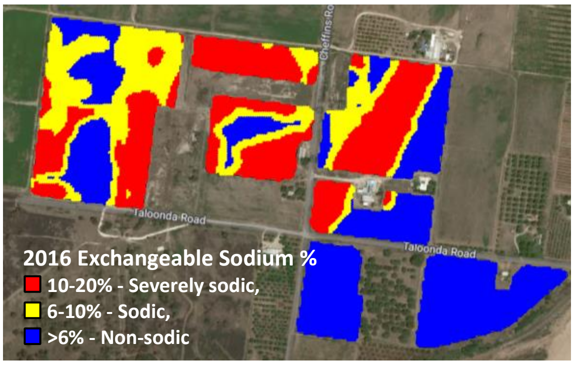

Figure 4: Soil EMI and core analysis mapping in 2016 revealed that 53% of Phantom Farms was affected by sodicty (>6%ESP).

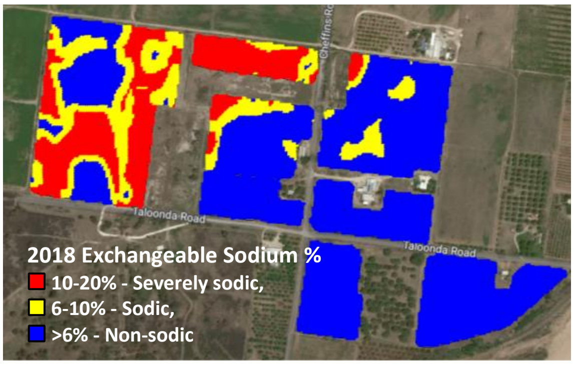

Figure 5: Re-analysis of the same soil cores in 2018 shows a 58% reduction in land affected by sodicity (>6% ESP) since VRT treatment began in 2016.

In February 2018, the farm was re-analysed using Vantage's SiS. This confirmed **a 43% reduction in land affected by sodicity within two years of repeated VR gypsum applications**, see *Figure 5*.

The VR prescription created to remediate severe sodicity was revised in March 2018 and reduced in zones where sodicity has fallen below 4% ESP. This is an important step in the adoption of new practices because in this case, revision of the gypsum VRT application has **reduced sodicity management costs by $86/ha**. In zones where sodicity remains above 6% ESP, high rates of 7t/ha of gypsum are maintained.

This work highlighted other applications of VRT in vegetable production including remediating pH to increase bioavailability of essential plant-nutrients, and balancing cation exchange capacity. This will be investigated in the months to come.

East Barron River, Barron River Basin

At North Qual, the Cuda family grows fresh and processing potatoes on the deep red soils of the Atherton Tablelands. North Qual was engaged in previous VR projects to demonstrate the benefits of addressing soil variability and optimising potato yield monitoring.

Figure 6: The potato crop was sampled during flowering to measure above-ground biomass nutrient uptake to develop partial nutrient budgets for the NPK rate strip-trial.

In 2017, soil physical and chemical analysis of a 40 ha pivot-irrigated field identified variability in phosphorus availability. This site was used to conduct a fertiliser strip trial investigating nutrient removal and yield under reduced rates of pre-plant fertiliser.

Strip-trial treatments were comprised of 50%, 75% and 100% of the agronomist-recommended rate of an experimental fertiliser blend of nitrogen, phosphorus and potassium (N, P and K). The strip-trial treatments were applied prior to planting seed potato in June 2017.

Above-ground biomass assessments (see *Figure 6*) were performed in October 2017, followed by harvest yield assessments in November 2017 for total and marketable potato tuber yield. Nutrient analysis of plant, tuber and soil samples were also processed to develop partial nutrient budgets for potato.

Yield assessments revealed very high variability in yield data within treatments, with no significant differences between treatments. However, **nutrient uptake correlated highly with yields (89-99% significance)** and did not reach maximum nutrient uptake and potentially maximum yield due to other environmental or agronomic influences, see *Figure 7*.

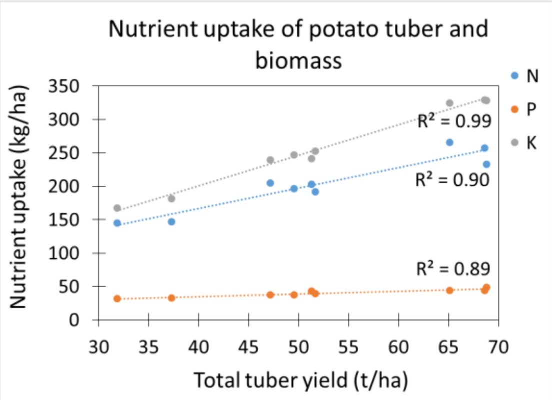

Figure 7: Uptake of nitrogen, phosphorus and potassium in potato tubers and above ground biomass is highly correlated with yield (n=9).

This strip trial is limited in it's findings and further work is needed to determine ideal NPK rates for potato at this site.

Analysis of soil and tissue sampling at flowering and harvest found several micronutrient imbalances that are linked to pH. At this site, pH is consistently below 5.5 and this affects the bioavailability of micro-nutrients. The project team will have to look deeper into soil physical and chemical characteristics to identify yield limiting factors in potato.

The next six months

Over the next six months, the project team will be investigating other soil physical and chemical properties, particular plant-essential nutrients, and their effect on horticultural crops in more depth starting with strip-trials in Bowen capsicums.

Burdekin melon yield monitoring and nutrient budgeting is a priority for 2018. Yield and plant sampling will be intensified in order to account for inherent variability in horticulture.

Aerial biomass imagery is also being considered to identify ideal sampling locations in short season capsicum and melon production to understand crop variability.

In Atherton, the potato yield monitor requires further work to improve ease of data collection and satellite imagery will be used to assist in identifying yield limiting soil characteristics.

Drainage and runoff modelling will be investigated in Atherton and Bowen to determine strategies to enhance irrigation scheduling techniques to improve infiltration and nutrient use efficiency, and manage salinity influences at each site respectively.

More information

For more information contact Sarah Limpus on 0747979725 at the Bowen Research Station.

This project was funded by Queensland Government Reef Water Quality program.

References

1. Limpus, S., Layden, I., and O'Halloran, J., (2016), "*Adoption of variable rate technology in Queensland's intensive vegetable production systems*", Department of Agriculture and Fisheries, Bowen, Queensland, Australia
2. Ayers, R. and Westcot, W., (1983), "*Water quality for agriculture*", Irrigation and Drainage Paper Number 29, FAO, Rome, Italy