Catalyst Project Report – Final report

VR N based on variable legume crop

Grower Information	
Grower Name:	Tony, John and Mark Bugeja
Entity Name:	J & J BUGEJA & SONS
Trial Farm No/Name:	MKY-04074B - Rosella
Mill Area:	Mackay Sugar
Total Farm Area ha:	82.73
No. Years Farming:	50 years – 3 generations
Trial Subdistrict:	Rosella
Area under Cane ha:	256 ha all farms combined

Background Information

Aim:

To use crop sensors to spatially locate variations in soybean yield and to create nitrogen application maps to match the variability without having a negative impact on sugarcane yield.

Background: (Rationale for why this might work)

Soybean are commonly planted during a fallow season to assist in fixing nitrogen in the soil for the following cane crop. The yield of the soybean crop is a reliable indicator of how much nitrogen the soybean plant will have fixed. As is the case with most agricultural crops, variability in yields often exists in the soybean crops and hence the amount of nitrogen that it has fixed. Low yielding crops will fix less nitrogen to the soil than high yielding crops and therefore needs to be accounted for when calculating the N requirements for the subsequent cane crops.

This trial involves the use of sensors to identify the location and the variability of the soybean crops. The locations of varying soybean yields where varying rates of nitrogen will be fixed will determine the rates of nitrogen required to be added during the topdressing phase.

Potential Water Quality Benefit:

Reduction in nitrogen use per hectare and an increase in nitrogen use efficiency

Expected Outcome of Trial:

Nutrient application better matching plant and soil requirements

Service provider contact: Farmacist

Where did this idea come from: Grower/Farmacist

Plan - Project Activities	**Date:** (mth/year to be undertaken)	**Activities** :(breakdown of each activity for each stage)
Stage 1	**March 2016**	Crop Sensor Scan
Stage 2	**March 2016**	Soil sample Biomass sample soy beans
Stage 3	**April 2016**	Plant cane
Stage 4	**May 2016**	Soil sample Biomass sample cane
Stage 5	**May 2016**	Fertilise according to the variability in legume yields
Stage 6	**March 2017**	Crop sensor scan new soybean field and repeat stages 2-5 for this paddock.
Stage 7	**August 2017**	Harvest production
Stage 8	**May 2018**	Soil sample Biomass sample cane
Stage 9	**August 2018**	Harvest Production

Project Trial site details	
Trial Crop:	Soybeans and Sugarcane
Variety: **Rat/Plt:**	
Trial Block No/Name:	MKY-04074B-14-6 & 14-7
Trial Block Size Ha:	9.21ha
Trial Block Position (GPS):	149.132223, -21.239817
Soil Type:	Sandy Loam

Block History, Trial Design:

Electromagnetic induction (EM38) and electrical resistivity technologies for measuring soil electrical conductivity (EC) are used to spatially define the boundaries of soils with varying properties. The trial site was EC mapped in 2011 that gives an indication of soils within the site where properties may differ (Figure 1).

Following the growing of a soybean crop on the site, the grower proceeded with the rolling and spraying out of the crop prior to the planting of cane in April 2016. Two (2) OptRx sensors were fitted to the tractor and data was captured during the soybean rolling activity (Figure 3). The OptRx sensors measures NDVI values which gives an indication of plant health and biomass. RTK GPS position data is captured along with the NDVI readings that enables the locations soybean yields to be mapped (Figure 2). When compared to the EC soil boundary map the lighter textured soils correspond to lower EC values (red colour) and heavier textured soils such as clays will correspond to higher EC values (Blue colours).

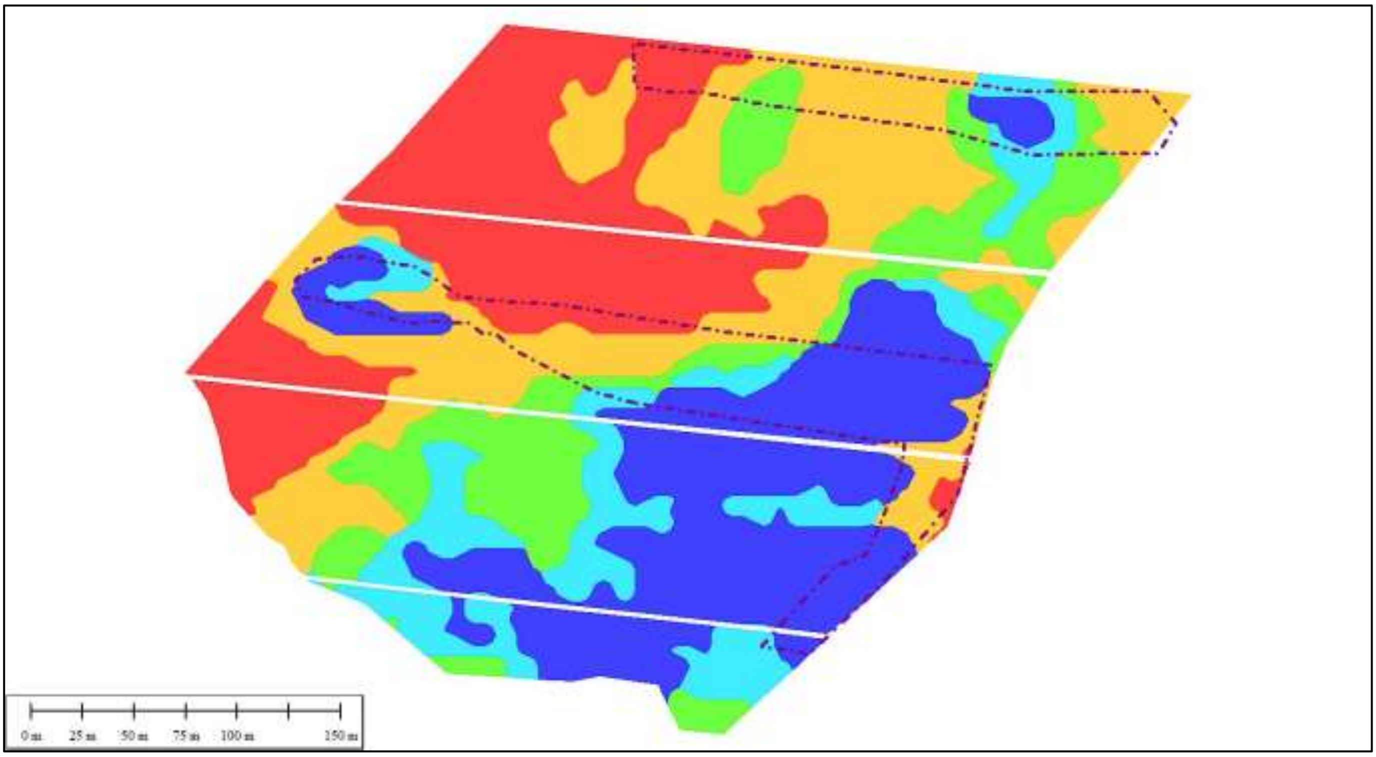

Figure 1 - EC soil boundary map

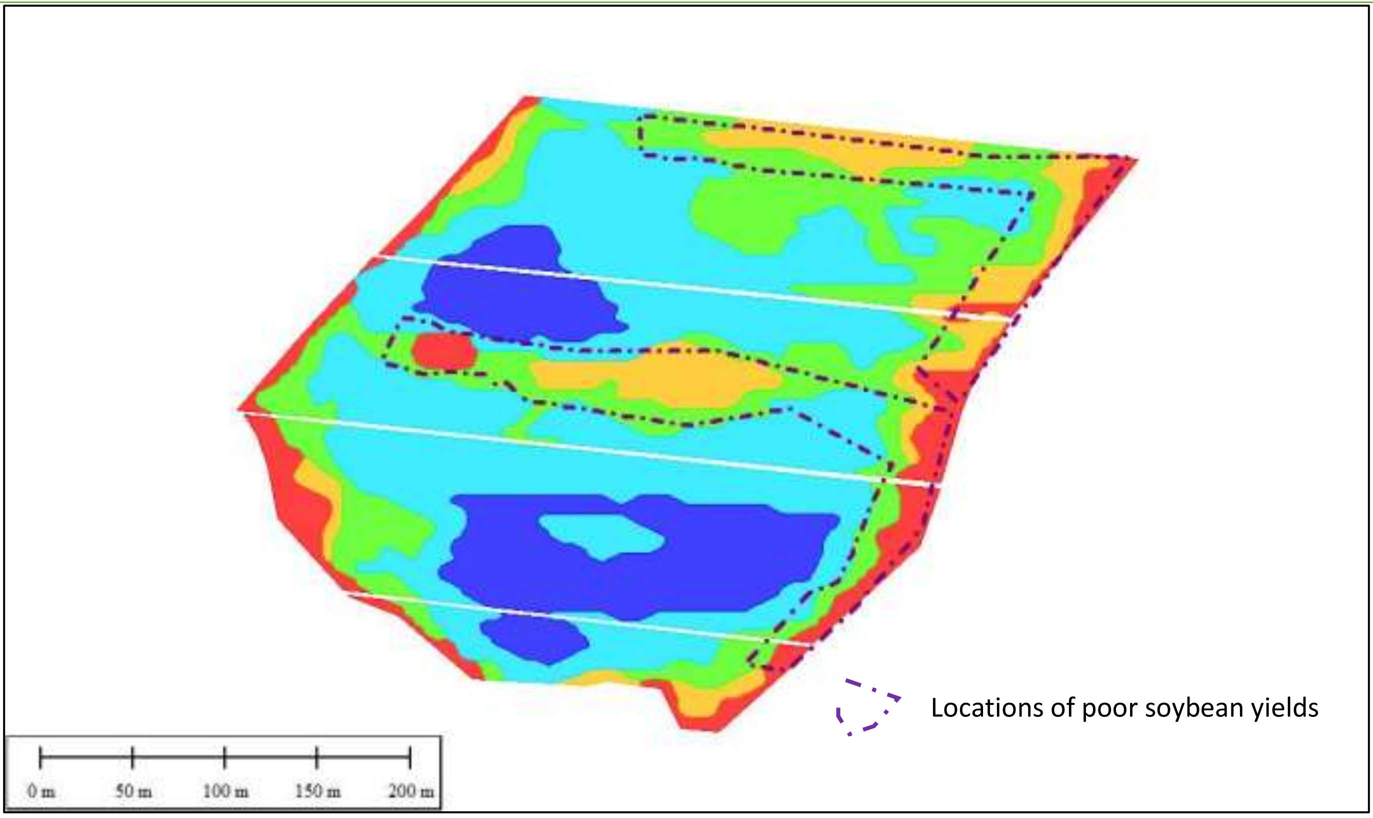

Figure 2- NDVI map as generated from OptRx sensor with locations of poor yielding soybean

Figure 3 – Front mounted OptiRx Sensor on the tractor used to roll the soybean crop

Soil samples, leaf samples and biomass samples have been taken from the site in paired locations in high and low yielding area of the soybean crop (Figure 4).

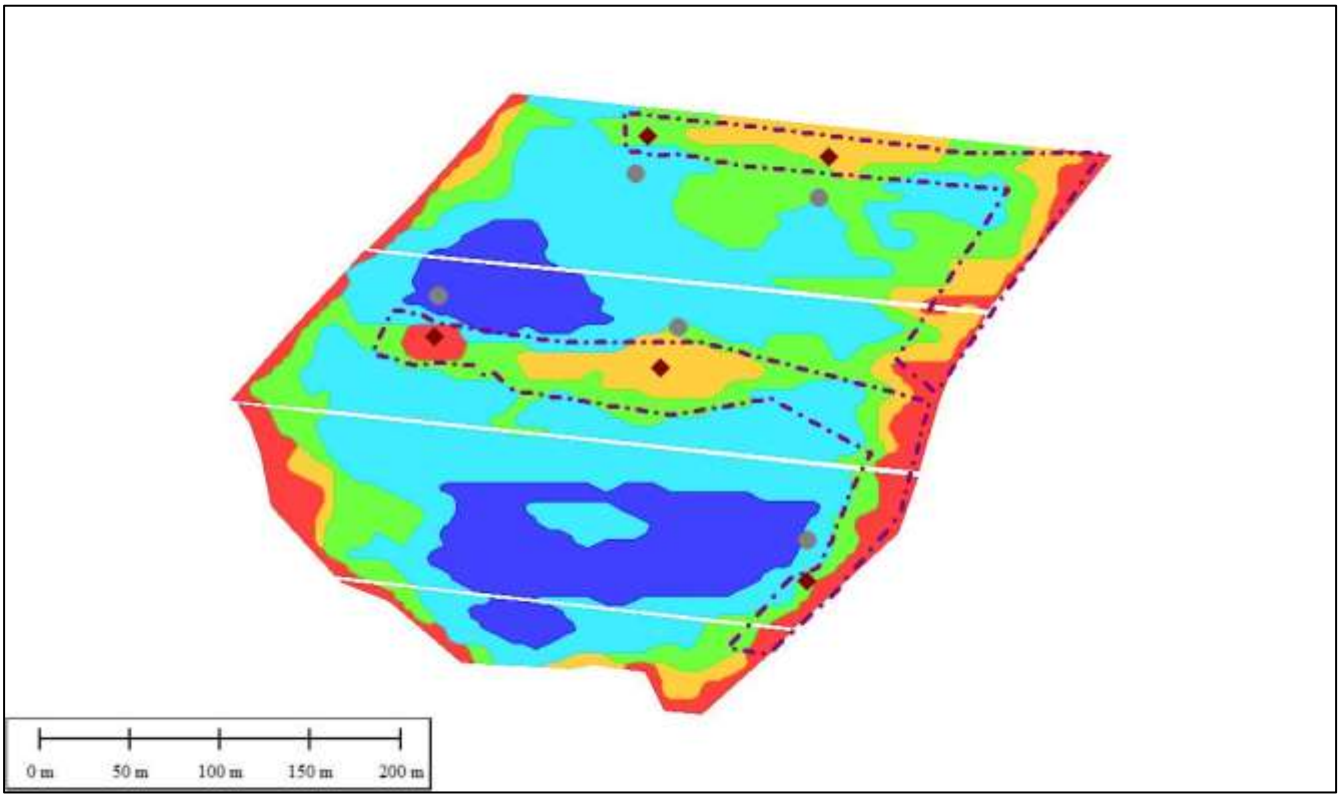

Figure 4 – Locations of paired sampling sites in high and low yielding areas.

Samples locations from low soybean yields

Results:

Soil sample results from the paired sites indicated significant differences in nitrate nitrogen results between low and high yielding soybean locations (Figure 5). These results are the basis of the application rates of urea topup within the low yielding soybean locations.

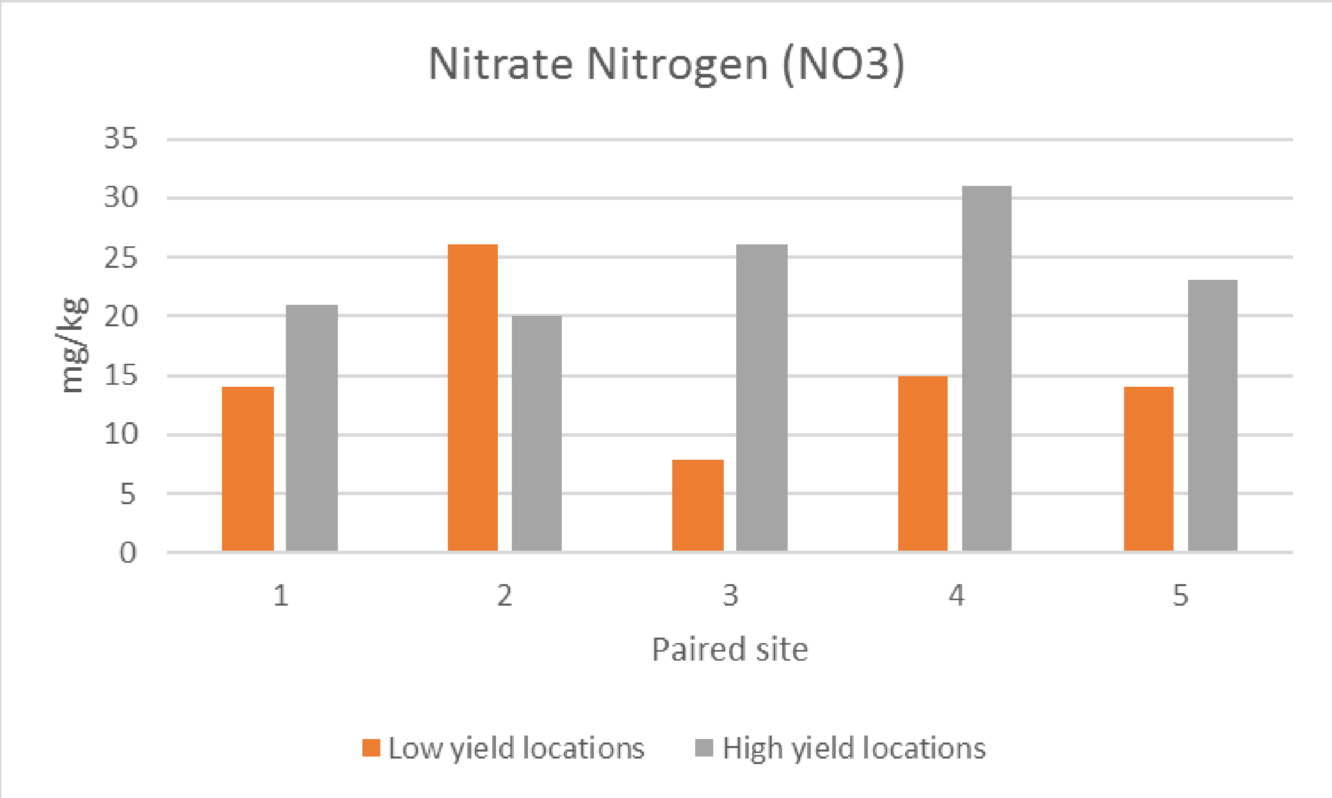

Figure 5 - Nitrate Nitrogen for in soil from high and low yielding soybean sites.

Treatments: as per Table 1

1. Poor soybean locations – Urea topdress @ 270 kg/ha – 125 kg N/ha
2. All other locations – Zero N applied

Table 1 - Rates as applied to the site for the 2017 harvest

Timing	Product @ Rate	N (kg/ha	P (kg/ha	K (kg/ha)	S (kg/ha)
Preplant	Soystarter @3.6m3	27	12	98	18
Topdress	Urea @ 270kg/ha	125	0	0	0
Total		152	12	98	18
Preplant	Soystarter @3.6m3	27	12	98	18
Topdress	Nil	0	0	0	0
Total		27	12	98	18

Crop yield results indicated no difference in final cane crop yields (Figure 6). This would indicate that the low producing soybean crop produced minimal N and the cane crop achieved was due to the application of the full nutrient rate. This is then compared to the high yielding soybean crop which produced ample amounts of N and therefore only required the minimum amount of N for the cane crop. Analysis indicated savings of > $3000 if fertiliser costs by applying VR nutrients as compared to the full application rate within this block.

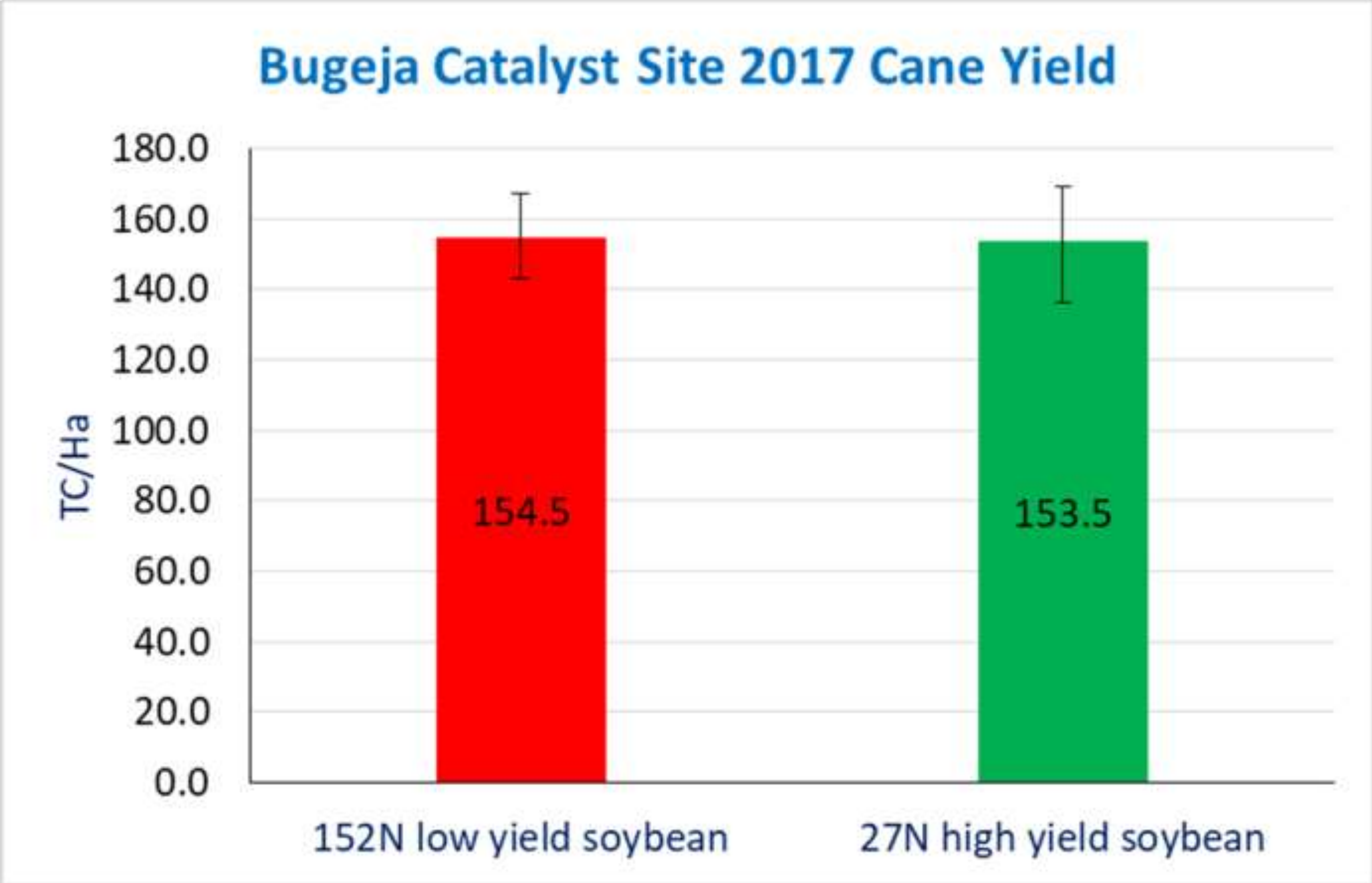

Figure 6 - Cane yield (2017) for the high vs low nitrogen application treatments.

Location for the 2017 site was based on soybean crop yields as shown in Figure 7. The profile of the soil in the different locations is also highlighted in Figure 7. It is clearly visible that soil types are influencing the soybean yield. The soil in the lower producing area is predominately heavy clay prone to water logging while the higher producing location has more loam within the top soil over a clay base which has better permeability and is not as prone to water logging. In saying this, cane is not as susceptible to waterlogging as soybean and therefore could still have a high yield performance, hence, top up nitrogen could be required.

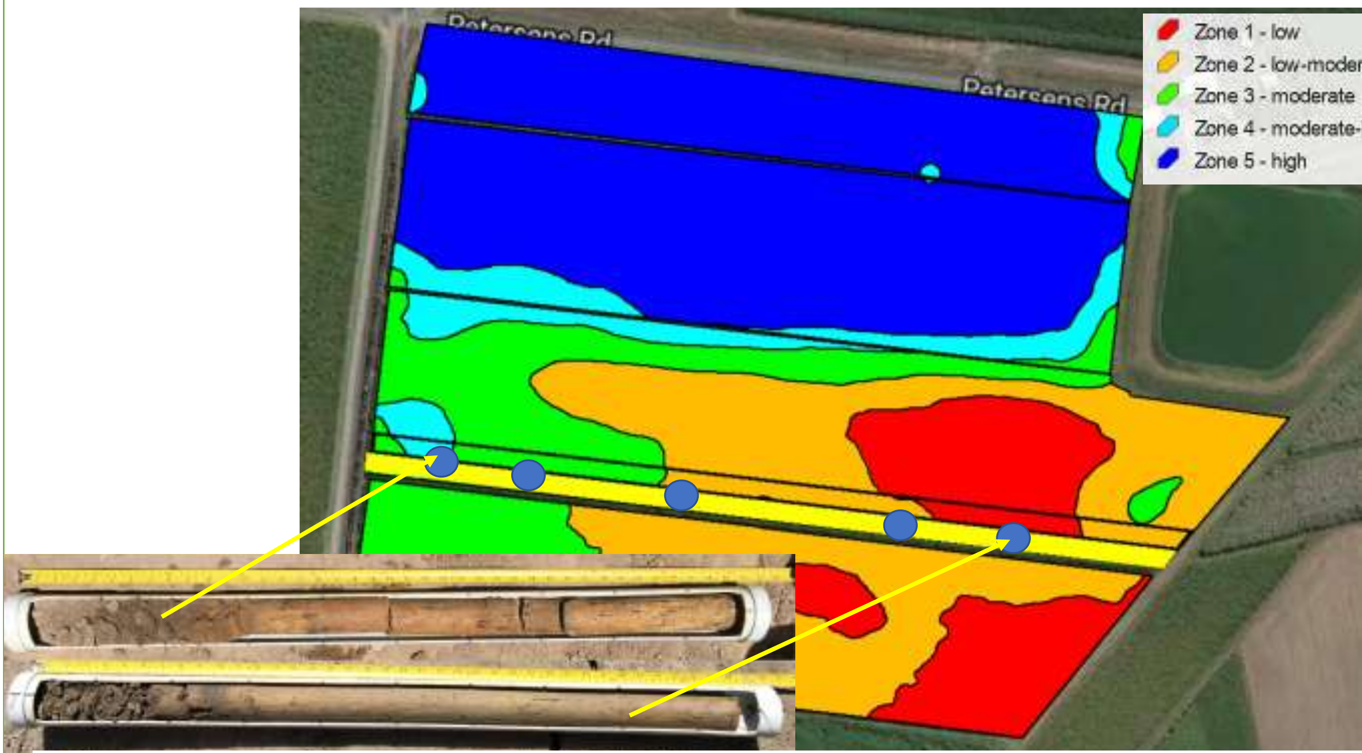

Figure 7 – Soybean yield zones and soil profiles for the 2017 site

As shown in Figure 7, a section of the paddock (highlighted yellow) was applied as variable rate nitrogen and a section beside this was applied as standard flat rate. After the soybean crop in 2017, nitrate levels were tested with results shown in Table 2 below. Due to weather events and paddock factors, soil nitrate levels showed minimal differences across the different yielding areas of the paddock. For this reason, both treatments received a preplant fertiliser brew that included 126 kg N/ha and the full rate nitrogen treatment received a further top dress of 30 kgN/ha.

Table 2 - Soil nitrate found in high and low yielding soybean areas.

	Soil Kg N/ha
Full Nitrogen	29.4
VR Nitrogen	31.1

Leaf samples taken in February 2018 showed all samples sitting just below the critical value for nitrogen, which is 1.8%. Results for these samples can be seen in table 3 below. This shows that the variable rate treatments were supplied with the same amount of nitrogen, whether from soybean or fertiliser, as the full flat rate treatments at this stage of the crop.

Table 3 - Nitrogen content of sugar cane plants taken at approximately 6 months after planting.

	Paddock Zones				
	Red	Orange	Yellow	L Green	D Green
Mean N%	1.65	1.74	1.74	1.62	1.7

Biomass samples were taken at the time of the 2018 harvest to assess variances in nitrogen uptake. As shown in Figure 8 below, no differences were apparent in the nitrogen present in the plant at the time of harvest. Large variances were seen across the paddock within treatments indicating that any differences seen are not due to fertilising/treatment effects.

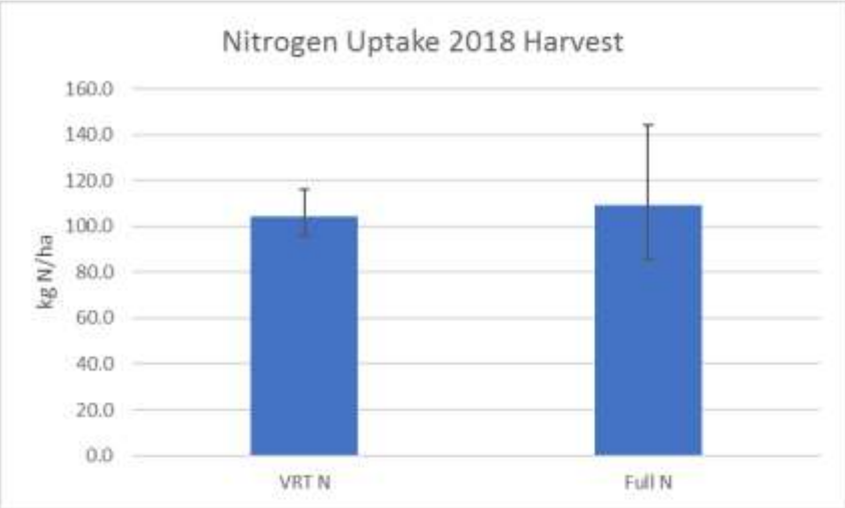

Figure 8 – Nitrogen taken up by plant at time of harvest.

Yield at harvest in 2018 was collected, and once again no differences were observed between the different nitrogen treatments as shown in Figure 9 below.

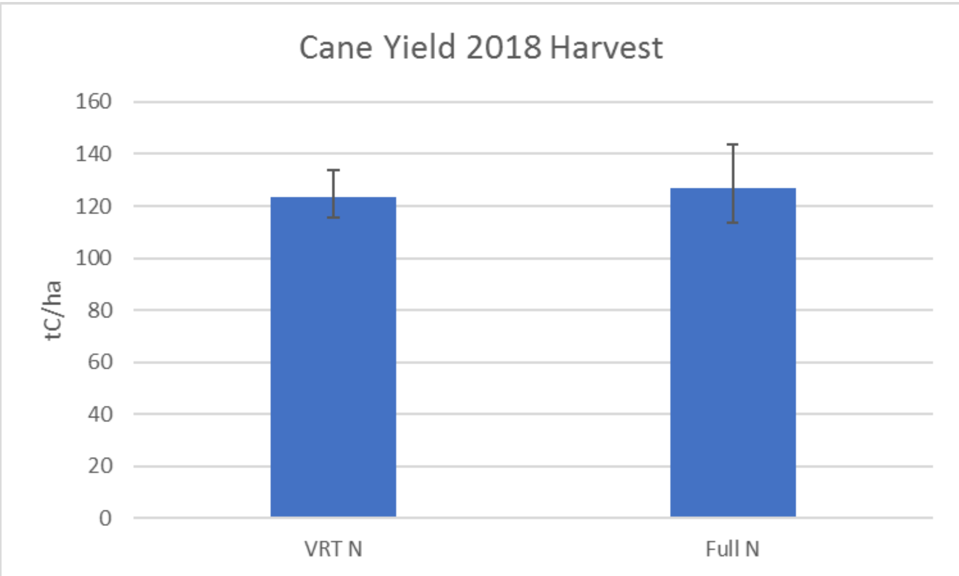

Figure 9 - Final cane yield at harvest in 2018.

Conclusions and comments

By applying variable rate nitrogen according to maps created from soybean health/biomass, nitrogen applied across a paddock has been effectively reduced. No negative yield impacts have been observed by carrying out this process. Where soybean crops are variable and require topdressing, it is adequate to only topdress the areas of poor growth. In saying this, it is vital to check soil nitrogen status either by laboratory results or by using nitrate test strips, as weather and soil conditions can influence nitrogen processes and its availability to the crop.

Advantages of this Practice Change:

Reduced nitrogen application.
Lower input costs.

Disadvantages of this Practice Change:

For a single grower to invest in sensors it would be a high cost.

Will you be using this practice in the future:

Yes

% of farm you would be confident to use this practice:

In locations where variability in the legume crop is sufficient to adopt variable rate application

Project site complete