Project Catalyst Trial Report

Sub Surface Liquid Fertiliser

Grower Information	
Grower Name:	Sam Deguara
Entity Name:	SS Deguara
Trial Farm No/Name:	MKY-3134A-1-1
Mill Area:	Mackay Sugar
Total Farm Area ha:	56.5
Number of Years Farming:	10 years – 3rd Generation
Trial Sub-district:	North Eton - Sandy Creek
Area under Cane (ha):	50.5

Trial Status

Completed

Author: Zoe Eagger (Farmacist). For further information contact Zoe on Mb 0436 004 437.

Background Information

Aim: To compare the cane yield and soil nutrient status of treatments sub-surface and surface applied with liquid fertiliser.

Background:

The Deguara family is associated with early adoption of new innovations. In 2015, after witnessing a speciality sub-surface "Dunder" liquid applicator in the Burdekin region, and deciding that this method of fertiliser application could benefit their operations, the Deguara's set-out to build such an implement.

There are higher loss risks associated with fertilisers surface applied than fertilisers applied to the sub-surface. Liquid fertiliser, supplied as Dunder, is traditionally applied onto the surface with irrigation; used to incorporate the fertiliser into the soil.

The Deguara's sought to apply liquid fertiliser into the sub-surface of the soil at an approximate depth of 100mm. Their rationale was that nutrients would be more readily available to the plant and the practice would reduce the risk of loss by either volatilisation or run-off after rainfall events or irrigation.

The Deguara family retrofitted their current Confidor applicator with a standard variable rate Dunder control system. This allowed them to conduct two activities at once, if required, reducing labour input costs. The implement covers three beds and travels at 8km/hr. The discs open the ground and high pressure angled nozzles apply the Dunder at around 100 mm depth. A chain then closes the incision. A small tank that holds 4.5 m^3 of Dunder follows behind.

Potential Water Quality Benefit:

Reduced risk of nutrient movement off site with improved yields.

Expected Outcome of Trial:

The plant will access the nutrients at a faster rate improving 'Nitrogen Use Efficiency' and reducing the risk of nutrient loss.

Service Provider Contact: Farmacist Pty Ltd

Where Did This Idea Come From? Sam Deguara

Plan – Project Activities		
	Date:	**Activities:**
Stage 1	September 2016	2016 cane crop harvested
Stage 2	October 2016	Nutrients applied as per trial design
Stage 3	September 2017	Harvest trial (1)
Stage 4	October 2017	Reapply treatments
Stage 5	December 2017	Rainfall simulation
Stage 6	June 2018	Sugar cane biomass samples
Stage 7	September 2018	Harvest trial (2)
Stage 8	October 2018	Reapply treatments
Stage 9	June 2019	Sugar cane biomass samples
Stage 10	October 2019	Harvest trial (3)
Stage 11	October 2019	Reapply treatments
Stage 12	August 2020	Harvest trial

Project Trial Site Details	
Trial Crop:	2016-2018 = Q138 2018-2020 = Q240
Variety: **Rat/Plt:**	2017 harvest = Q138 3R 2018 harvest = Q138 4R 2019 harvest = Q240 2R
Trial Block No/Name:	1-1 yrs 2016- 2018 1-2 yrs 2018 - 2019
Trial Block Size Ha:	6.7ha
Trial Block Position (GPS):	148.930054, -21.221815
Soil Type:	Victoria Plains – Black Earth

Trial Design

Trial design remained constant on both the original trial site and the new trial site. Product and rate changed each year (Figure 3); however, the total applied nutrient rate adhered to the paddock required 'Six Easy Steps' recommended rate.

Trial design for the 2016 application of nutrients (harvested in 2017) are shown in Figures 1 and 2 with the rates and nutrients applied represented in Tables 1 and 2.

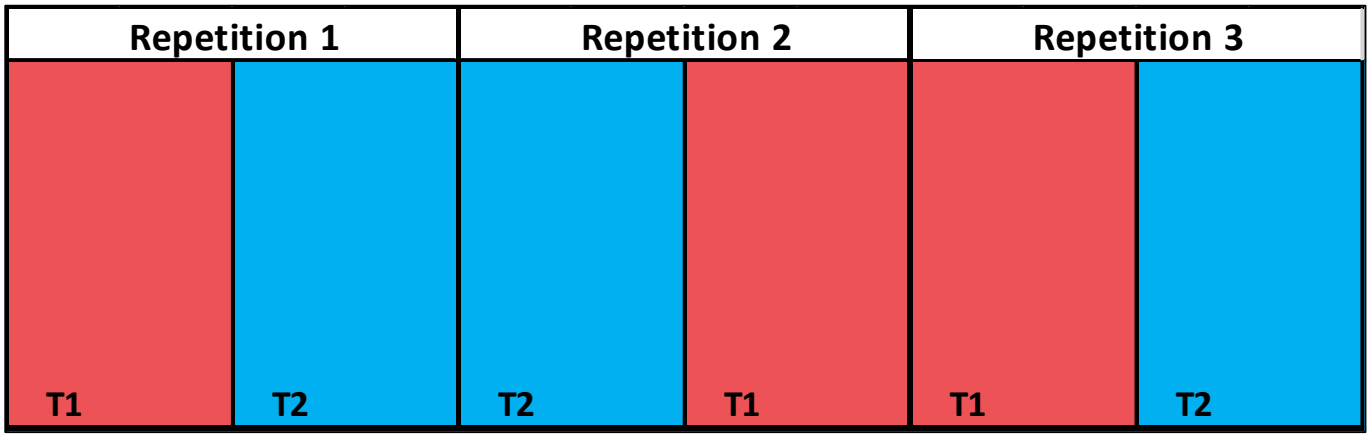


Figure 1 - Trial design for 2016 application to be harvested 2017

Table 1 - Product, rates and nutrient applied 2016 for 2017 harvest

Treatment/Product	Rate	N	P	K	S
T1 Dunder LOS+P	3.5	160	16.5	89	25.6
T2 Dunder LOS+P	3.5	160	16.5	89	25.6

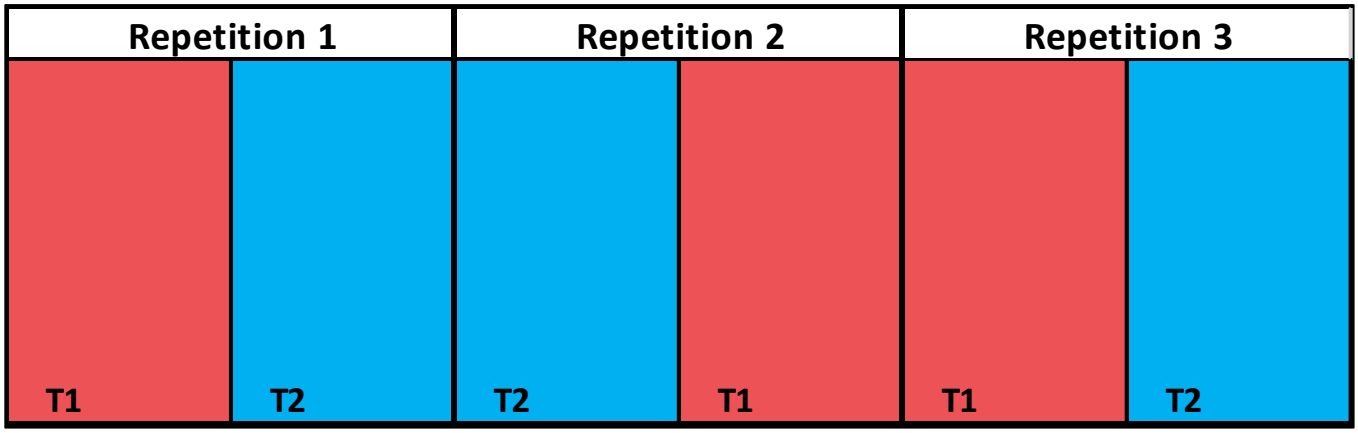


Figure 2 - Trial design for 2017 application to be harvested in 2018

Table 2 - Product, rates and nutrient applied 2017 for 2018 harvest

Treatment/Product	Rate	N	P	K	S
T1 MKY 140 P	4.3	155	13	124	25.6
T2 MKY 140 P	4.3	155	13	124	25.6

Results

2017 Harvest

Cane yield results for each of the replications of the 2017 harvest is shown in Figure 3 and sugar yield in Figure 4. The average tonnage of cane per hectare (t/ha) between the treatments was very similar, with 63.1t/ha for the subsurface application and 62.9t/ha for the surface application. The average was 9.1t/ha for the surface and 8.5t/ha for the sub-surface treatments.

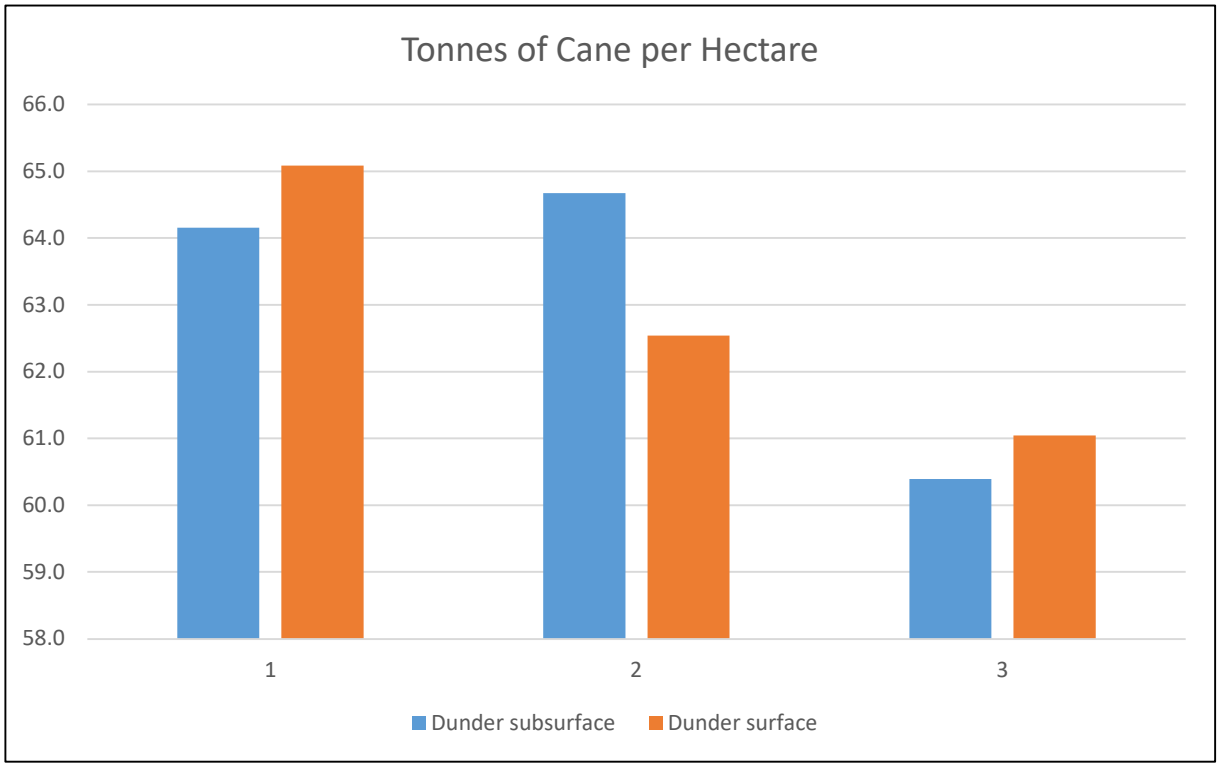


Figure 3 - Cane yields 2017 harvest

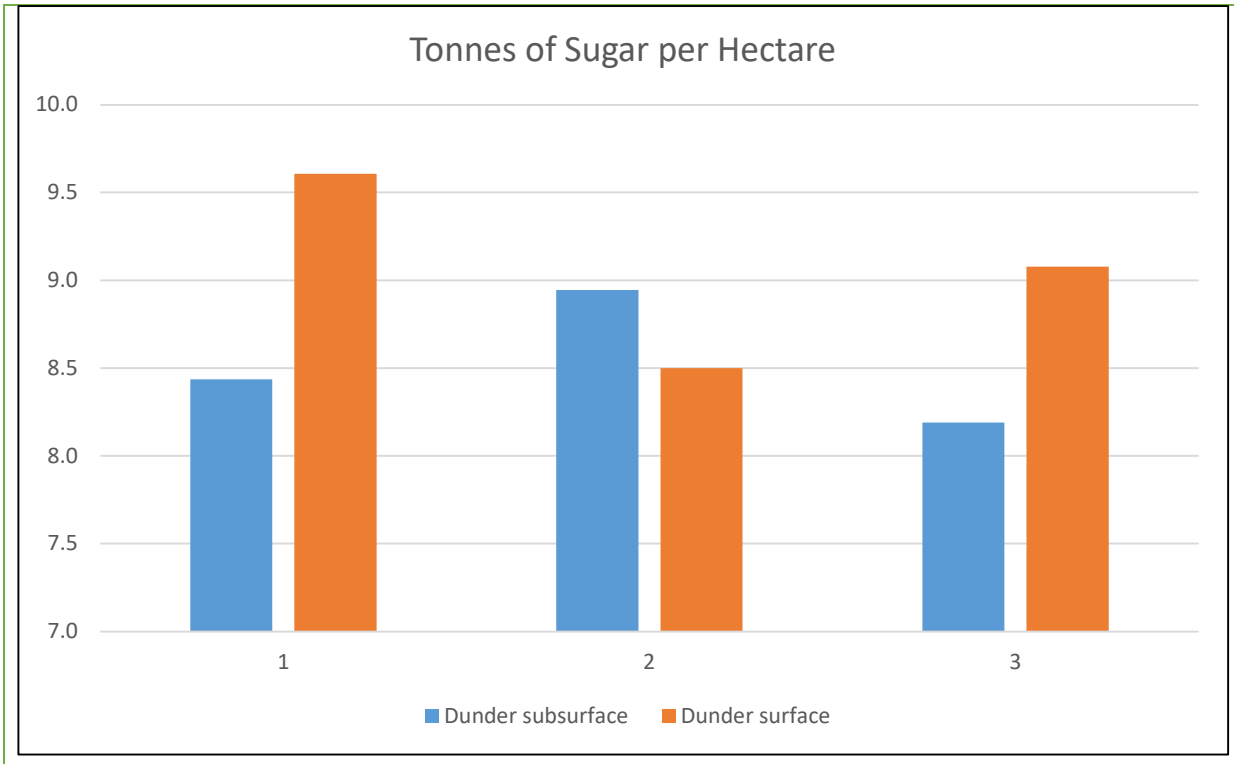


Figure 4 - Sugar yields 2017 harvest

2018 Harvest Results

Cane yield results for each of the treatments of the 2018 harvest are shown in Figure 5 and sugar yield in Figure 6. Similar to the 2017 harvest, it was determined that there were no significant differences between the surface applied and sub-surface applied treatments.

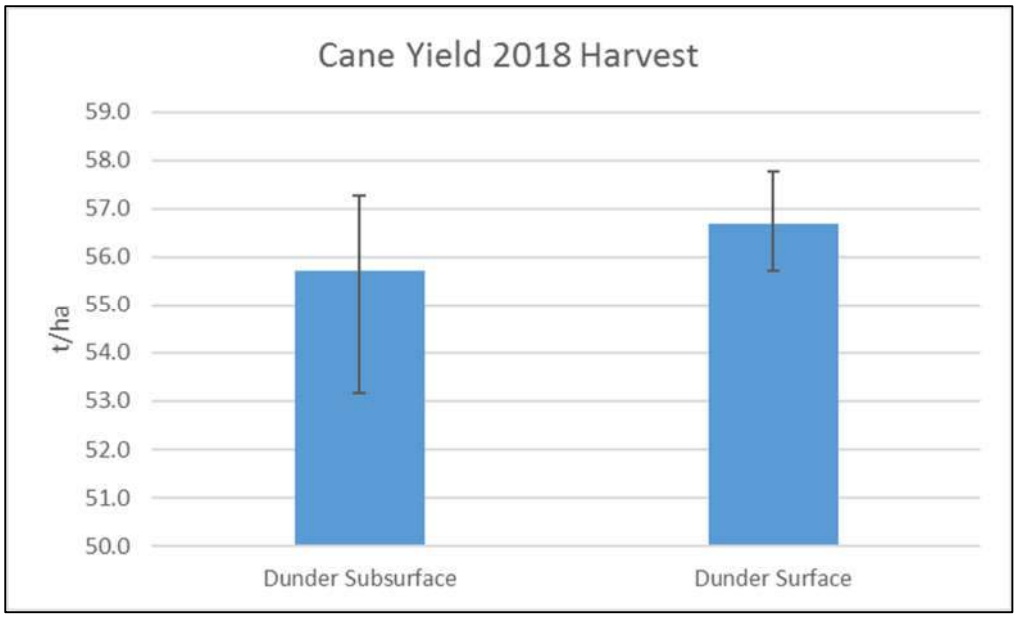


Figure 5 - Cane yields 2018 harvest

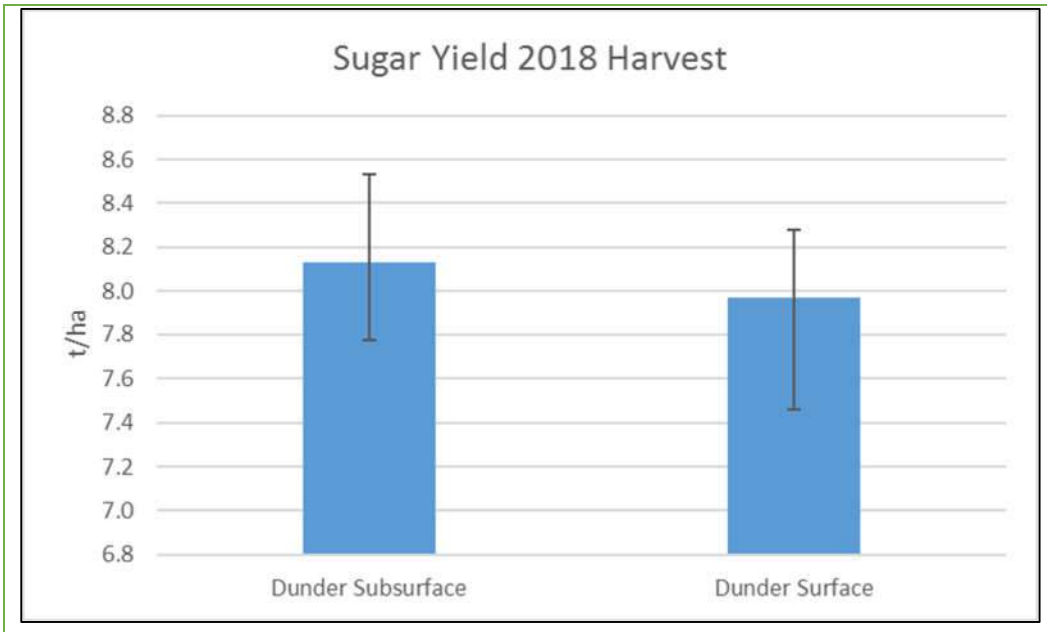
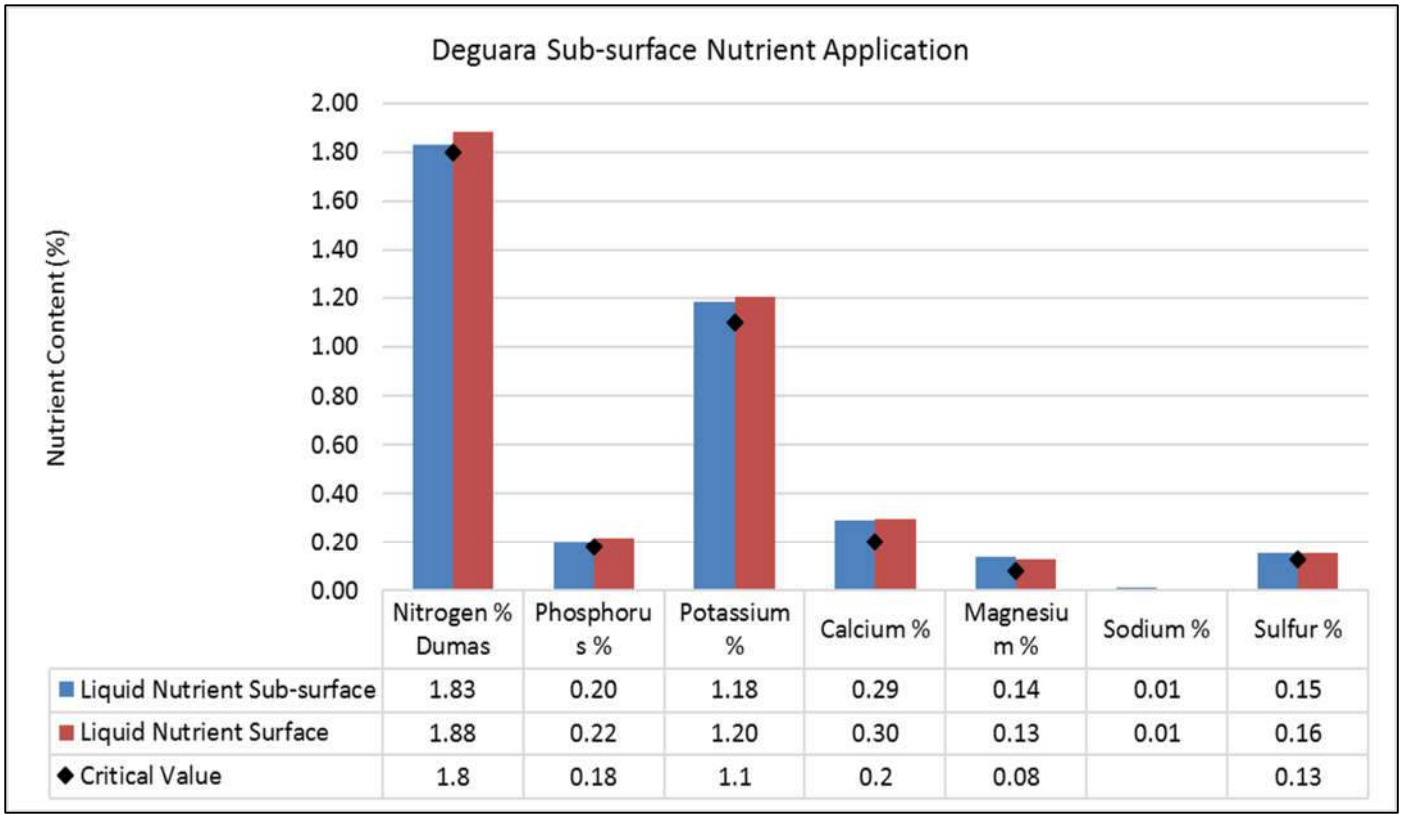


Figure 6 - Sugar yields 2018 harvest

2019 Leaf Sample Results

Leaf samples were taken in March 2019 (Figure 7) to compare the nutrient content of different treatments. All nutrients were above critical values, indicating that there was no deficiency for either treatment. The surface applied treatment had slightly higher nutrition values for most of the nutrients. However, these are not significant enough to cause any variation in the final yield values.



	Nitrogen % Dumas	Phosphorus %	Potassium %	Calcium %	Magnesium %	Sodium %	Sulfur %
Liquid Nutrient Sub-surface	1.83	0.20	1.18	0.29	0.14	0.01	0.15
Liquid Nutrient Surface	1.88	0.22	1.20	0.30	0.13	0.01	0.16
Critical Value	1.8	0.18	1.1	0.2	0.08		0.13

Figure 7- Leaf sample results 2019

2019 Harvest Results

Cane yield results for each of the treatments of the 2019 harvest are shown in Figure 8 and sugar yield in Figure 9. It should be noted that the trial site was moved to a younger ratoon block of the same soil type to reduce the likelihood of any variables associated with older ratoons. The grower standard of surface application resulted in a higher cane yield by 3.8t/ha and additionally a higher sugar yield of 0.7t/ha when compared to the sub-surface treatment.

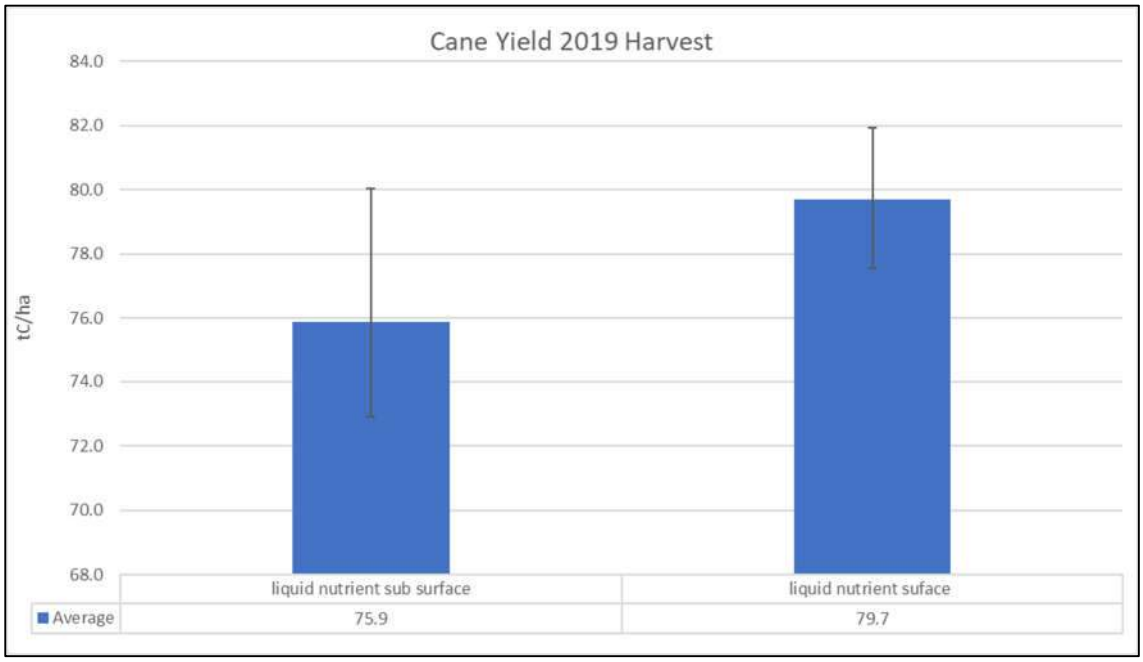


Figure 8 Cane Yield 2019

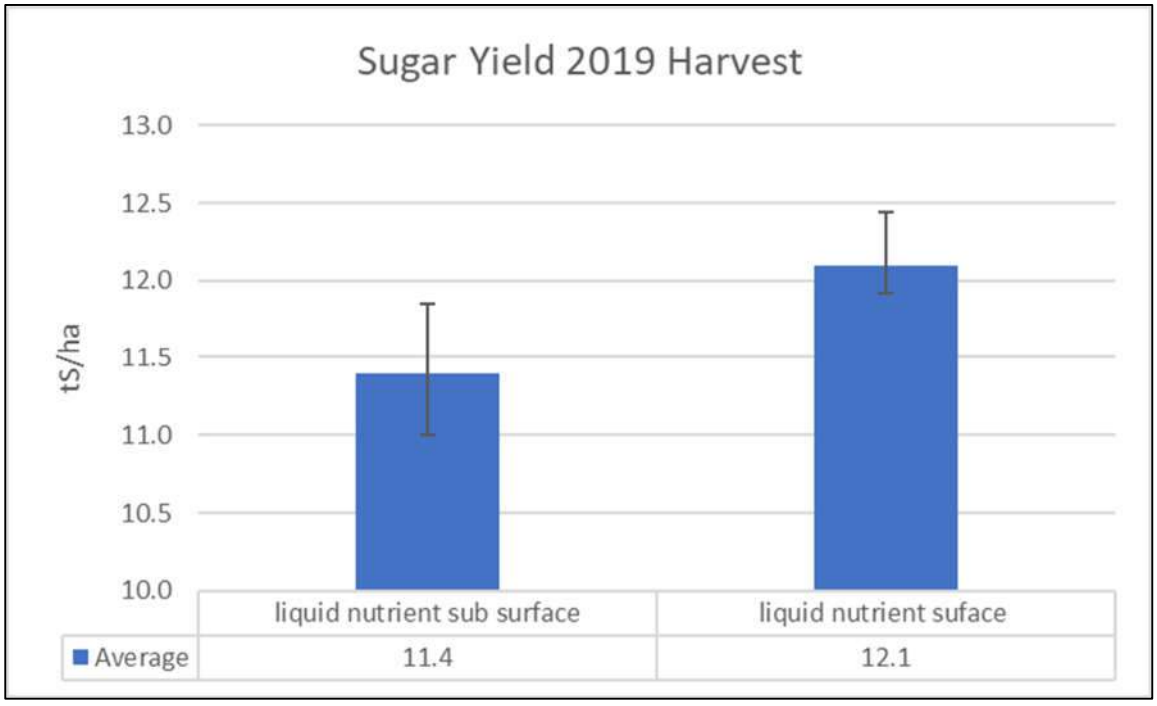


Figure 9 Sugar Yield 2019

2020 Harvest Results

Cane yield results for each of the treatments of the 2020 harvest are shown in Figure 10 and sugar yield in Figure 11. The results show that the surface applied Dunder produced a higher cane and sugar yield. Overall, block yield had improved, likely due to improved irrigation as a lateral irrigator was installed. 2020 was the final year for the crop, the grower has since ploughed this block in and is growing soybeans.

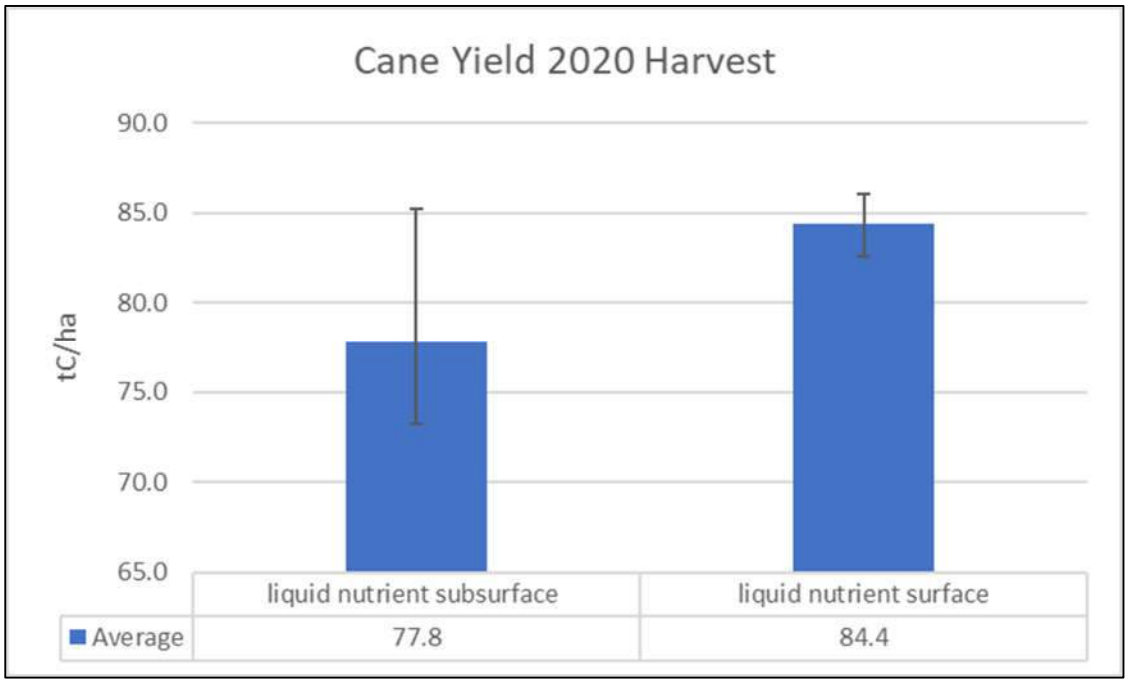


Figure 10 Cane Yield 2020

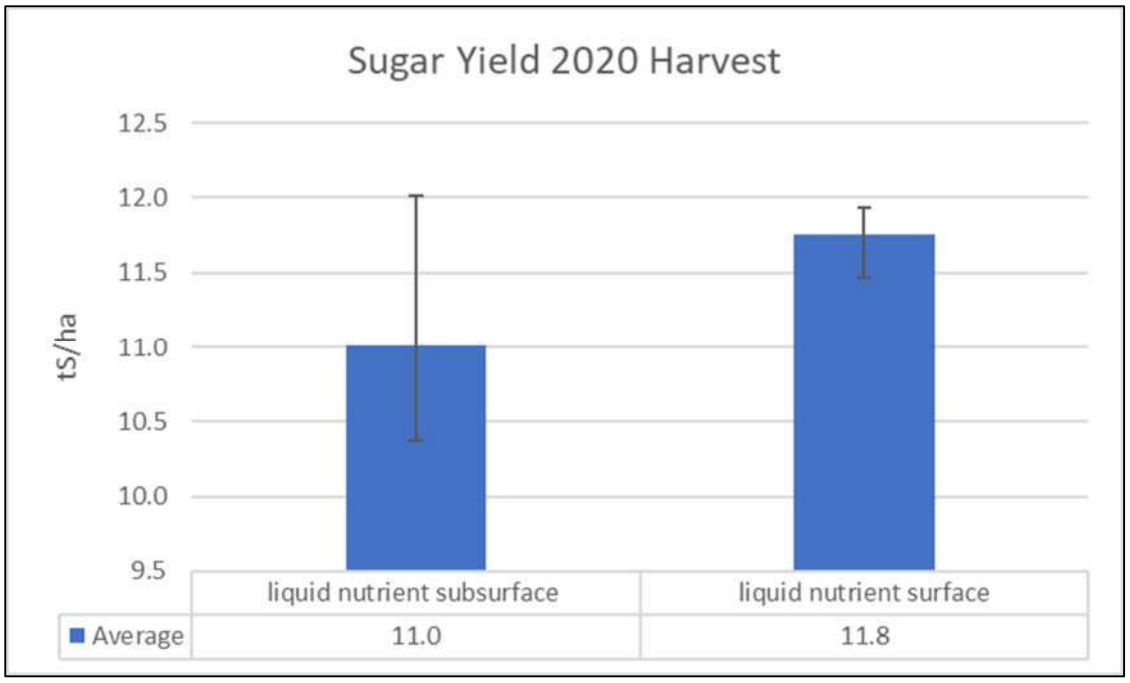


Figure 11 Sugar Yield 2020

Conclusions and comments

The trial results from all years were analysed using R Studio lme4 REML, followed by an analysis of variance to determine significance of difference at the P=0.05 level. This analysis determined there was significant difference between both treatments.

Treatment 2, the surface applied Dunder trial, performed best on cane yield, sugar yield and nutrient use efficiency results. A comprehensive investigation into all parameters needs to be undertaken before any definitive conclusions can be made.

There was an increase in cane yield differences between the two treatments in the final 2020 harvest when the crop received more irrigation than the previous year. When there were fewer irrigation events, and on an older ratoon crop, the surface applied treatment yielded similarly to the sub-surface treatment.

Traditionally, Dunder is applied on the surface, but this raises concerns regarding losses of fertiliser to run-off water. The first year of water quality samples indicated that there was a 50% decrease of dissolved inorganic nitrogen (DIN) in the initial sample and 11% decrease in total nitrogen leaving the paddock. The second year's water quality report unfortunately did not indicate any improvement in the water quality from the subsurface Dunder.

The Department of Agriculture ran an economic analysis on the treatments and determined that over the life of the applicator (40 years over 600ha) that it was more economical to run the sub-surface applicator.

By applying Dunder to the sub-surface, this trial has indicated that it is possible to achieve similar annual cane and sugar yield as surface applied Dunder. As explained, surface applied Dunder yielded statistically higher over the life of the trial. However, more work is needed across soil types, crop age, variety and under different management systems to fully evaluate if there are benefits to applying Dunder to the sub-surface.

Advantages of this Practice Change:

- Some indication that there is reduced loss of nutrients.
- Placement of fertiliser is directly applied in the root zone of the plant.

Disadvantages of this Practice Change:

- Initial increased time and labour cost, impacting profitability.

Will you be using this practice in the future?

"We are happy to keep applying subsurface Dunder, particularly for the reason we can apply Confidor at the same time. This saves time and increases our efficiency. We want to increase the Dunder tank storage to 8m^3 to bring the equipment to farm scale. Even though this trial showed no real yield increase, that is fine, the water quality and time saving benefits are enough for us to continue this practice" - Sam Deguara (2020)

% of farm you would be confident to use this practice: 15 – 20 % with opportunities to increase over time.