Project Catalyst Trial Report

High Organic Carbon Soils Low in the Landscape

Grower Information

Grower Name:	Darryl Thomsett
Entity Name:	Thomsett Bros
Trial Farm No/Name:	PCK-00782A
Mill Area:	Plane Creek
Total Farm Area ha:	629
No. Years Farming:	45 years
Trial Subdistrict:	Koumala
Area under Cane ha:	550

Trial Status

Completed

Author: Katelin Reddacliff (Farmacist). For further information contact Katelin on Mb. 0439 072 611.

Background Information

Aim: To evaluate the use of nitrogen (N) enhanced efficiency fertilisers (EEF) on high organic carbon soils with poor internal drainage.

Background:

Soils low in the landscape often have poor internal drainage, which leads to waterlogging following high rainfall events. Waterlogging causes denitrification and reduces N fertiliser efficiency. Often these soils have high organic carbon. Under the industry's Six-Easy-Steps (6ES) guidelines, reduced rates of N application are required on these soils types to account for the contribution of potentially mineralisable N from soil sources. Growers often observe crops on these soils underperform and suffer premature yellowing, thought likely to be due to insufficient N when waterlogged. This trial was established to evaluate the potential for N EEFs to improve N use efficiency (NUE), increase crop yield and minimise losses to the environment on these soils.

Potential Water Quality Benefit:

EEF fertiliser technologies have potential to release N to better match plant uptake demand. If NUE is increased, loss pathways via surface run-off, denitrification and volatilisation are greatly mitigated.

Expected Outcome of Trial:

It is expected that all treatments will yield the same. There may be NUE outcomes that favour the use of N EEFs dependent on the seasonal conditions over the three-year period.

Service provider contact: Farmacist Pty Ltd

Where did this idea come from: Daryl Thomsett

Plan - Project Activities		
	Date:	**Activities:**
Stage 1	**October 2017**	Harvest Plant cane crop
Stage 2	**November 2017**	Apply fertiliser treatments as per trial design
Stage 3	**February 2018**	Leaf samples collected to analyse N uptake
Stage 4	**October 2018**	Harvest trial site (1)
Stage 5	**November 2018**	Re-apply fertiliser treatments
Stage 6	**February 2019**	Leaf samples collected to analyse N uptake
Stage 7	**October 2019**	Harvest trial site (2)
Stage 8	**November 2019**	Re-apply fertiliser treatments
Stage 9	**March 2020**	Leaf samples collected to analyse N uptake
Stage 10	**October 2020**	Harvest trial site (3)

Project Trial site details	
Trial Crop:	Sugarcane
Variety: **Rat/Plt:**	Q240 2016 = 1st Ratoon
Trial Block No/Name:	7-1
Trial Block Size Ha:	7.8ha
Trial Block Position (GPS):	149.29, -21.6
Soil Type:	Bell Vertosol - black, self-mulching, cracking clay

Block History, Trial Design

History

The trial block had been producing sugarcane for over 20 years. Yields have been variable, higher in dry years and lower in wetter years.

Trial design

Figure 1 shows the layout of the four treatments applied to the paddock with three replications. Tables 1 and 2 show the products, application rates and nutrients applied for all treatments.

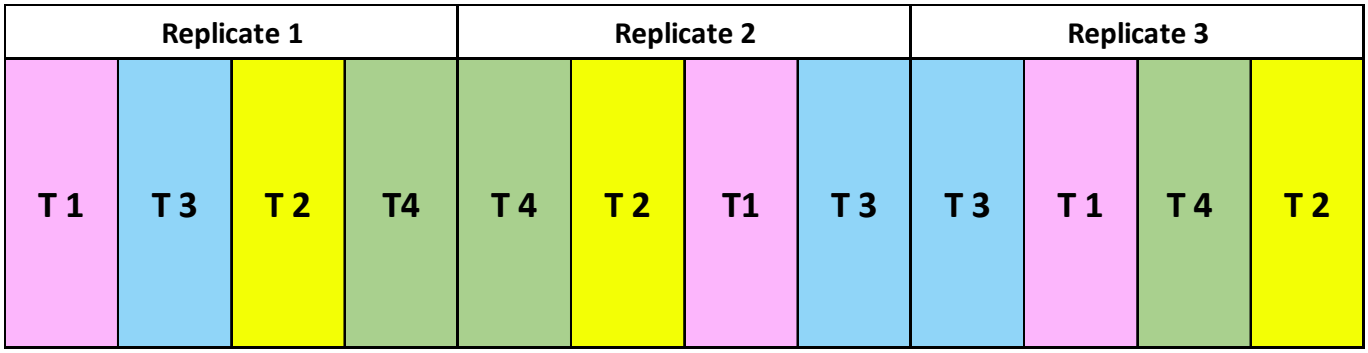


Figure 1 - Trial layout of treatments and replicates.

Treatments:

The four treatments applied in this trial consist of 6ES N rates versus Grower Standard, as well as EEF versus a Non-EEF. During the last year of the trial (2019-2020 crop), a granular alternative to the previous Dunder products was used due to the availability of the fertiliser application equipment. Product details are demonstrated in Tables 1 and 2.

- Treatment 1 (T1) – 6ES N rate
- Treatment 2 (T2) – Grower Standard N rate
- Treatment 3 (T3) – 6ES N rate as EEF fertiliser (Entec blend)
- Treatment 4 (T4) – Grower Standard as EEF fertiliser (Entec blend)

*6ES = Six-Easy-Steps

Table 1 - Product, application rates and nutrients applied 2017-2019.

Treatment	Product	Rate	N (Kg/ha)	P (kg/ha)	K (kg/ha)	S (kg/ha)
T1	Hi K Ratooner	4.0m^3/ha	111	19	105	27
T2	MKY190P	4.2m^3/ha	160	15	108	26
T3	Entec Blend	567 kg/ha	110	19	105	27
T4	Entec Blend	667 kg/ha	160	15	108	26

Table 2 - Product, application rates and nutrients applied 2019-2020.

Treatment	Product	Rate (kg/ha)	N (Kg/ha)	P (kg/ha	K (kg/ha)	S (kg/ha)
T1	Urea Blend	537	110	15	110	15
T2	Urea Blend	646	160	15	110	15
T3	Entec Blend	537	110	15	110	15
T4	Entec Blend	646	160	15	110	15

Figure 2. Darryl Thomsett observing early growth of in the trial.

Results

Leaf samples 2018

Leaf samples were collected in March 2018 following the standard third leaf sampling protocol with results ranging from 1.5 to 1.6 % of N as shown in Table 3. The critical value for N content of crops at this age is 1.8%, indicating that all the treatments were below the optimal levels of leaf N content at this growth stage.

Table 3 - Leaf sample results from March 2018

	T1 - Dunder N @ 110 kg/ha	T2 - Dunder N @ 160 kg/ha	T3 - Entec N @ 110 kg/ha	T4 - Entec N @ 160 kg/ha
Nitrogen % Dumas	1.63	1.5	1.6	1.55

Harvest 2018

Cane yields at harvest showed no differences across the treatments with yields ranging from 71 to 75 t/ha (Figure 3). Sugar yields showed similar trends ranging from 13.2 to 13.7 t/ha (Figure 4).

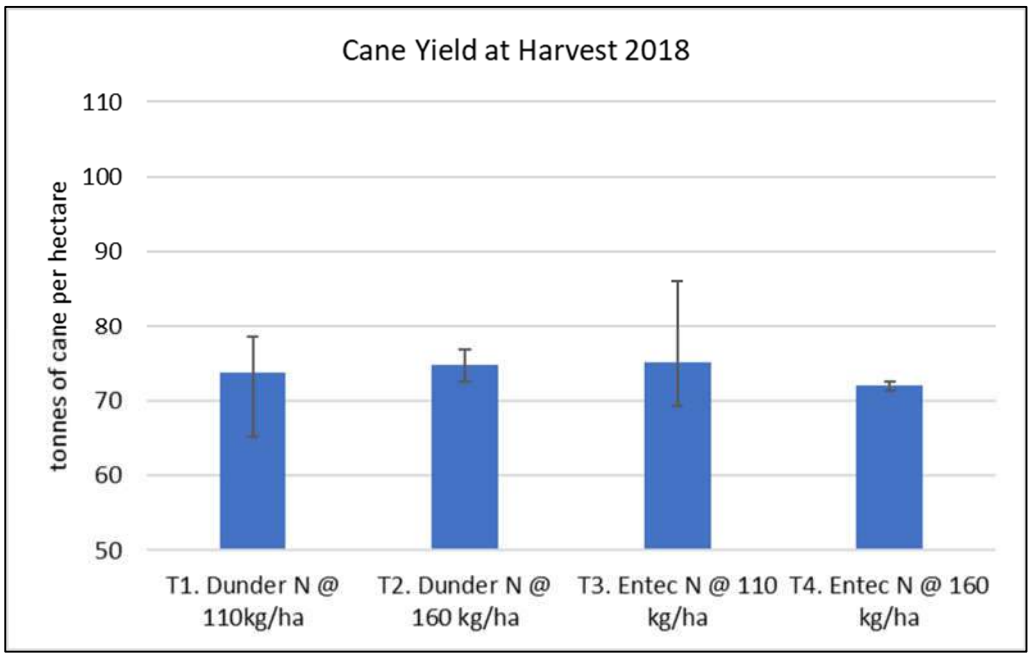


Figure 3 - Cane yield at harvest in 2018

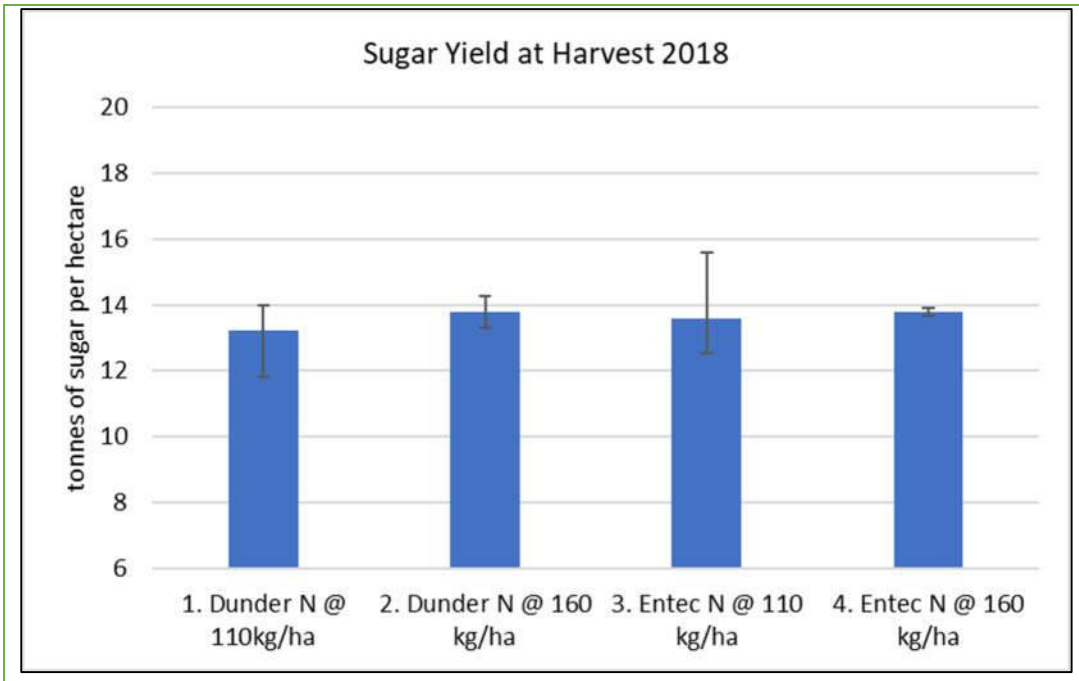
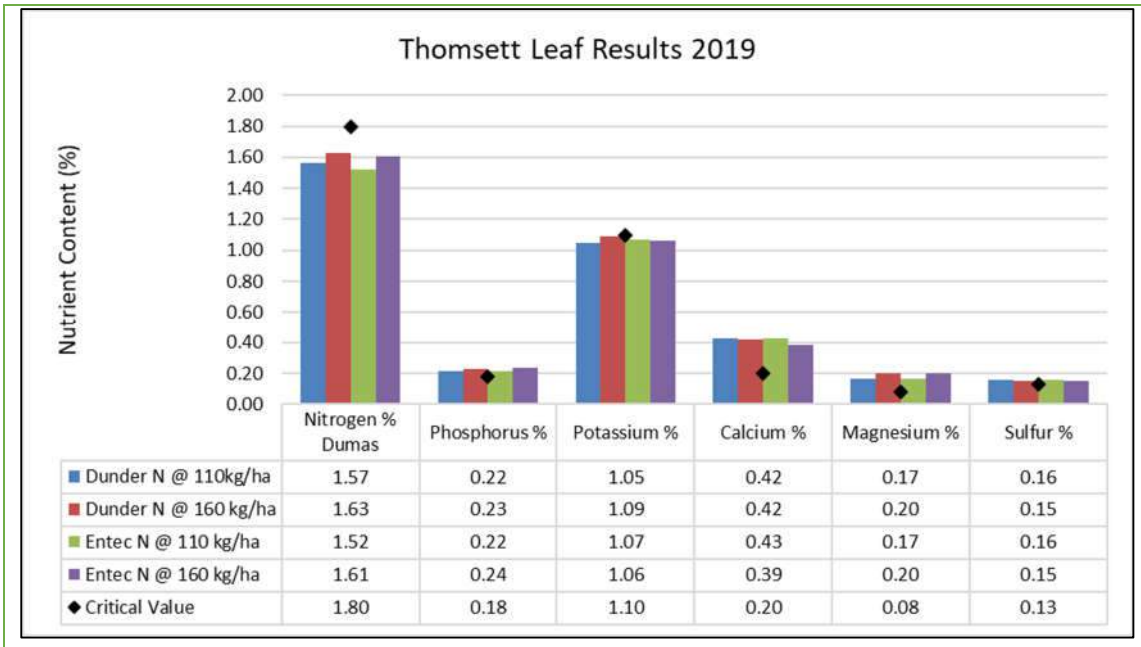


Figure 4 - Sugar yield at harvest in 2018.

Leaf Samples 2019

Leaf samples were collected in March 2019 following the standard third leaf sampling protocol with similar results to 2018, ranging from 1.5 to 1.6 % N, shown in Figure 5. The critical value for N content of crops at this age is 1.8%, indicating once again that all treatments were below the optimal levels of N. The higher N rate treatments (T2 & T4) had slightly higher N contents, however, this difference is not significant.

During 2019, a full tissue analysis was completed with a summary of results shown in Figure 5. Most nutrients are above or close to critical values, except for N and Potassium (P). Differences between treatments were minimal, with the rates indicating no clear trends of higher or lower nutrient concentrations.



	Nitrogen % Dumas	Phosphorus %	Potassium %	Calcium %	Magnesium %	Sulfur %
Dunder N @ 110kg/ha	1.57	0.22	1.05	0.42	0.17	0.16
Dunder N @ 160 kg/ha	1.63	0.23	1.09	0.42	0.20	0.15
Entec N @ 110 kg/ha	1.52	0.22	1.07	0.43	0.17	0.16
Entec N @ 160 kg/ha	1.61	0.24	1.06	0.39	0.20	0.15
Critical Value	1.80	0.18	1.10	0.20	0.08	0.13

Figure 5 - Leaf results March 2019

Harvest 2019

The 2019 harvest data (Figure 6) suggests that the treatments had no significant difference in cane yield.
Sugar yields (Figure 7) also showed no significant difference between treatments with sugar yields ranging from 14.6 to 15.3 tS/ha.

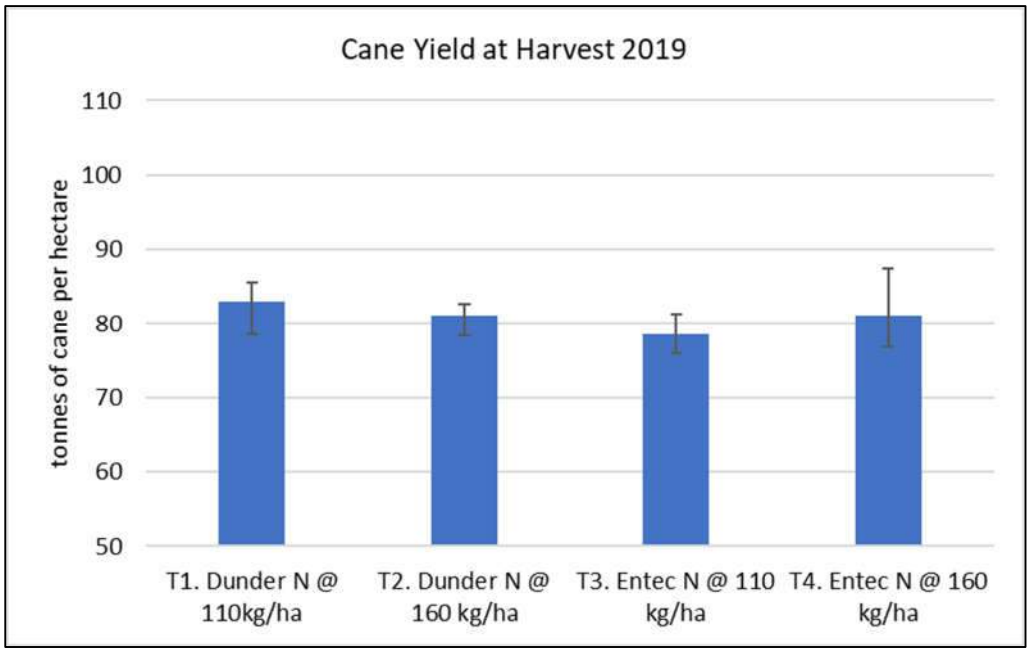


Figure 6 - Cane yield at harvest in 2019

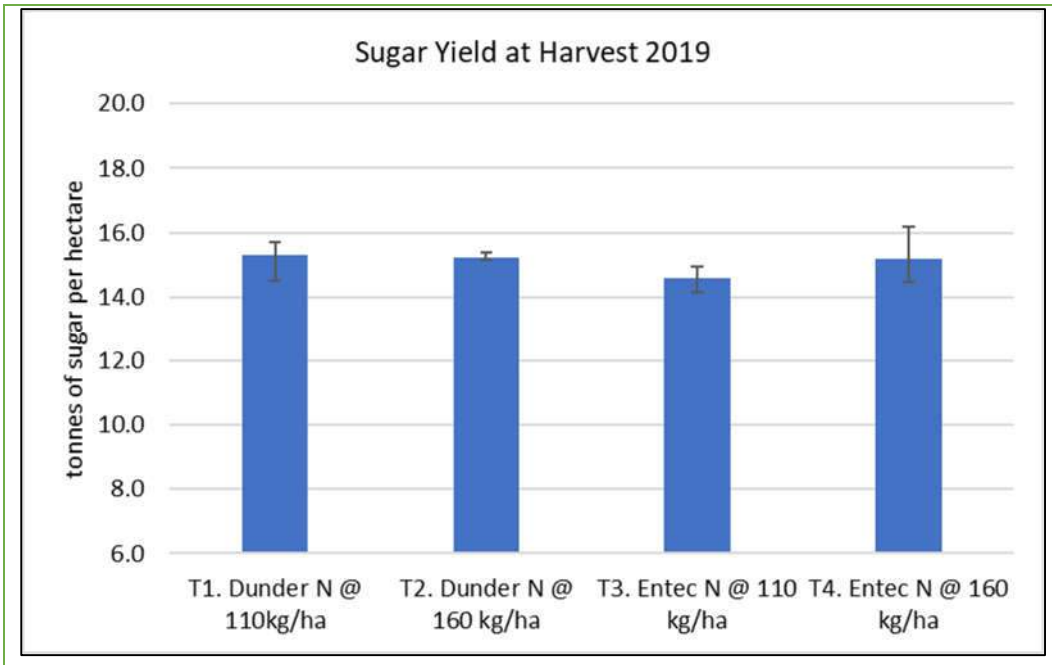
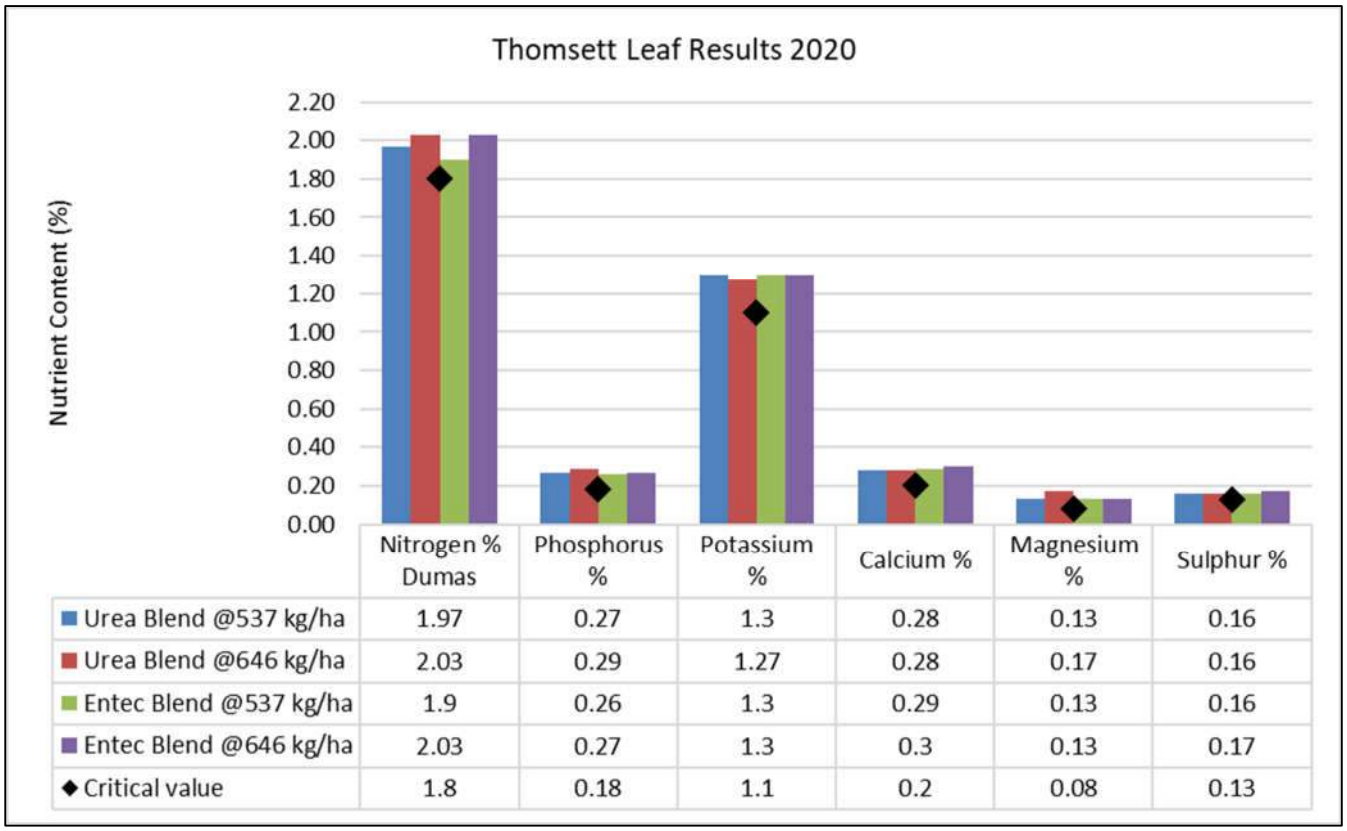


Figure 7 - Sugar yield at harvest in 2019

Figure 8 - 2019 fertiliser application – Katelin Reddacliff and Rob Thomsett showing the stool zippa fitted to the applicator

Leaf samples 2020

During 2020, full tissue analysis was completed for each treatment with the results shown in Figure 9 below. All nutrients were above critical values. This is the first year where 3rd leaf N content was above the critical value. A Stool Zippa was fitted to the fertiliser applicator for the product applications in 2019. This ensured the slot where the fertiliser was placed was closed completely. This can be difficult to achieve on heavy soils but is very important to ensure that excess N is not lost from the EEF product due to volatilisation. It is likely the Stool Zippa reduced volatilisation losses from all treatments.



	Nitrogen % Dumas	Phosphorus %	Potassium %	Calcium %	Magnesium %	Sulphur %
Urea Blend @537 kg/ha	1.97	0.27	1.3	0.28	0.13	0.16
Urea Blend @646 kg/ha	2.03	0.29	1.27	0.28	0.17	0.16
Entec Blend @537 kg/ha	1.9	0.26	1.3	0.29	0.13	0.16
Entec Blend @646 kg/ha	2.03	0.27	1.3	0.3	0.13	0.17
◆ Critical value	1.8	0.18	1.1	0.2	0.08	0.13

Figure 9 - Leaf results March 2020

Harvest 2020

The 2020 harvest data (Figure 10) displays greater variability between treatments compared to the previous years. The 6ES N rate treatments (T1 & T3) indicate higher yields ranging from 74 – 84 tC/ha, compared to the grower standard N rate (T2 & T4) yielding between 66-68 tC/ha. However, there is very little difference between EEF vs non-EEF treatments.

Sugar yields for 2020 showed similar trends (Figure 11), where there were no significant differences between treatments, however the 6ES rates indicated higher yield compared to the grower standard N Rate treatments.

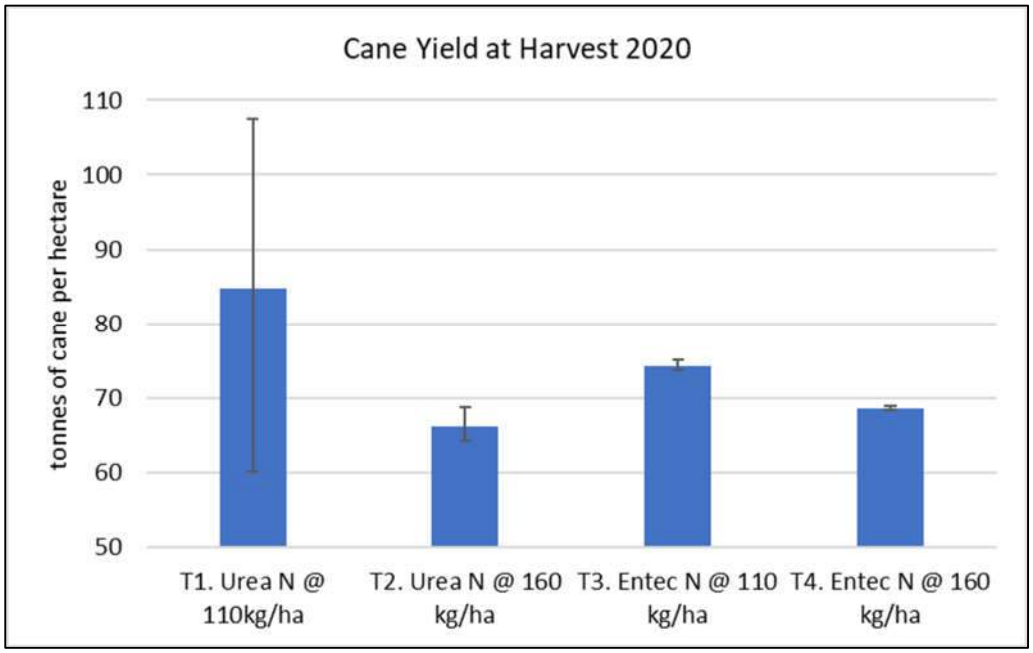


Figure 10 - Cane yield at harvest in 2020

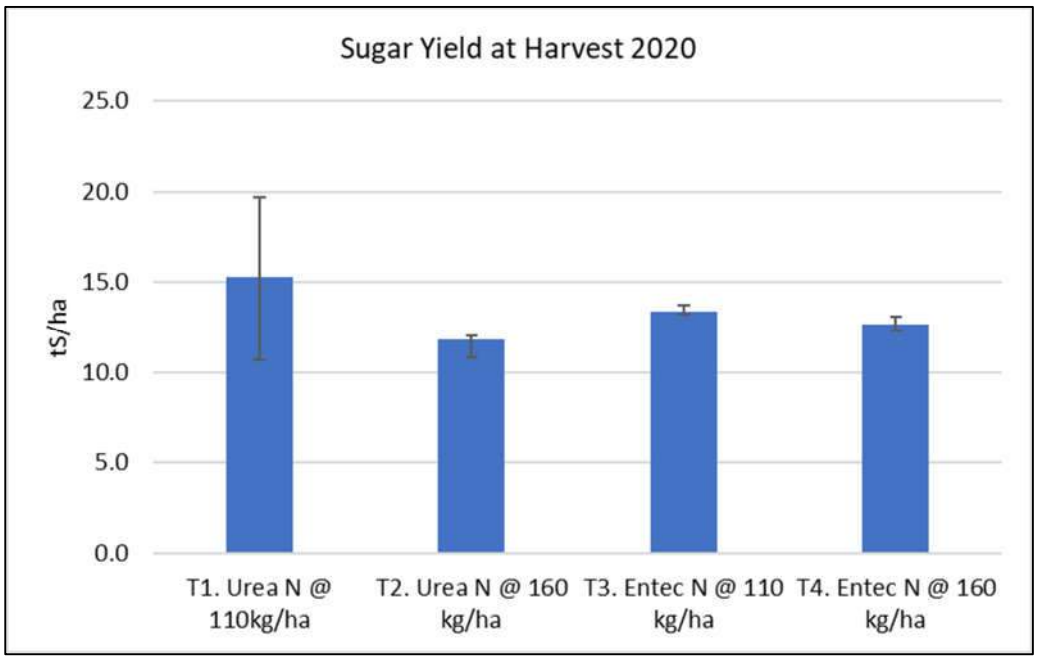


Figure 11 - Sugar yield at harvest in 2020

Conclusions and comments

Over the past three years, the results indicate no significant difference between trial treatments for cane yield or sugar yield. There were no significant differences between fertiliser type (granular or Dunder) or EEF vs standard (Entec vs urea).

However, all treatments returned 3rd leaf N results below the critical value for the first two years of the trial. This suggests that the crop yield may have been reduced due to insufficient N supply to the crop for those years. The EEF treatments did not provide improved N uptake when measured as 3rd leaf N content.

The addition of a Stool Zippa to the fertiliser applicator is likely to have improved N fertiliser uptake in the 2020 crop, due to closing the fertiliser slot completely, removing the risk of volatilisation. Stool Zippas are recommended for all fertiliser applicators applying product to heavy clay soils.

Advantages of this Practice Change:

Additional work needs to be undertaken to improve crop yields and N management on heavy soil types with high organic carbon content.

Disadvantages of this Practice Change:

EEFs are more expensive than non-EEF N products. A yield benefit needs to be achieved to make these products viable. Stool Zippas were fitted to the fertiliser applicator for the product applications in 2019. This ensured the slot where the fertiliser was placed was closed completely. This can be difficult to achieve on heavy soils but is very important to ensure that excess N is not lost from the EEF product due to volatilisation.

Will you be using this practice in the future:
This practice is still under evaluation, it will be utilised in specific farm management zones.

% of farm you would be confident to use this practice:
Approximately 20% of the combined farm areas could use this practice in the future after continued evaluation.