Project Catalyst Trial Report

Match Variety to Soil Type

Grower Information	
Grower Name:	Manuel Muscat
Entity Name:	Muscat JFM and R Pty Ltd
Trial Farm No/Name:	PCK-0305A
Mill Area:	Plane Creek
Total Farm Area ha:	210ha
No. Years Farming:	35ha
Trial Subdistrict:	Dawlish
Area under Cane ha:	183ha

Trial Status

Completed

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Background Information

Aim: To increase crop yield on marginal soils, leading to increased soil cover, reduced soil losses, increased nutrient use efficiency and increased profitability.

Background:

Sodic soils have poor soil structure which limits water infiltration, percolation and nutrient availability. High sodicity levels causes clay particles to swell excessively when wet to the point they separate and disperse. This results in structural collapse of the soil profile and as the soil dries out it becomes very hard. Typical impacts of sodic soils on sugarcane crops include poor strike rate of plant cane, constrained growth, yield decline after plant cane and thinner trash blanket which often results in weed infestation. Amelioration with gypsum or mill ash is very expensive and often only partly rectifies the soil problems.

Historically, Q138 has been a variety to perform best on sodic soils, primarily through its improved ratooning. However, Q138 is a low CCS variety, limiting crop value, particularly grown on soils where higher CCS varieties could be grown.

A trial was established on Manuel Muscat's property in a block that had a history of poor yield due to a large zone of sodic soil. Both gypsum and mill ash had been applied to the sodic area over the years. This amelioration had made some improvements soil and crop growth, but the area is still not meeting yield potential.

Potential Water Quality Benefit:

Increasing cane yield will increase the amount of trash cover left after harvest – this protects the soil from dispersion and erosion. Increased cane yield will also result in increased nitrogen uptake into the crop, reducing risk of loss in runoff water.

Expected Outcome of Trial:

Better matching varieties to soil types within the field is likely to result in increased yield and profitability and have the additional benefits of increased nutrient uptake and reduced soil losses.

Service provider contact: Farmacist Pty Ltd

Where did this idea come from: Grower/Farmacist

Plan - Project Activities		
	Date	**Activities :**
Stage 1	**May 2015**	Plan trial, consider variety options, (plant mixed & straight variety), clean seed sources for the trial.
Stage 2	**July 2016**	EM map and soil sample to assess soil constraints
Stage 3	**September 2016**	Plant sugarcane following trial design
Stage 4	**August 2017**	Plant cane harvest
Stage 5	**October 2017**	Catalyst grower bus trip to inspect 1st ratoons
Stage 7	**October 2018**	1st ratoon harvest
Stage 8	**October 2019**	2nd ratoon harvest
Stage 9	**October 2020**	3rd ratoon harvest

Project Trial site details	
Trial Crop:	Sugarcane
Variety: Rat/Plt:	Q183 and Q138
Trial Block No/Name:	PCK-305A-12-02
Trial Block Size Ha:	11.9ha
Trial Block Position (GPS):	149.150, -21.416
Soil Type:	Sunnyside Sodosol – silty, alkaline, bleached, mottled, grey duplex soil

Block History, Trial Design

Planning for the trial began a year prior to planting as appropriate planting material was needed to plant the trial. A decision was made to use two pachymetra resistant varieties as the block was growing Q208 and pachymetra was likely to be an issue on the low Electroconductivity (EC) soil zones of the block.

Q138 was planted as the standard for sodic soils and Q183 as the comparison variety.

The planting material required for the mixed treatment strips was firstly hand-cut and loaded onto a planting trailer with a division installed. The Q138 was stacked on one side of the trailer and Q183 on the other. This material was then planted with a Don Gough whole stalk planter, with alternating varieties fed into the machine. The following year the mixed planting material was simply cut with the billet harvester and planted as normal.

The trial was designed with 4 treatments, each with four replicates (Figure 1):

Treatment 1- Q138 strips planted full length of the field
Treatment 2- Q183 strips planted full length of the field
Treatment 3- Q138 planted in the sodic area & Q183 planted in the non-sodic area of rows. This treatment required the planter to traverse each row twice.
Treatment 4- Mixed Q138 + Q183 planted full length of the field.

The treatment position was randomised within each replicate. Each treatment strip was 4 rows wide to ensure the entire trial layout was located within the sodic soil zone. Therefore, there was insufficient cane in each treatment to provide a mill CCS sample. For this reason, only yield data is presented for the trial.

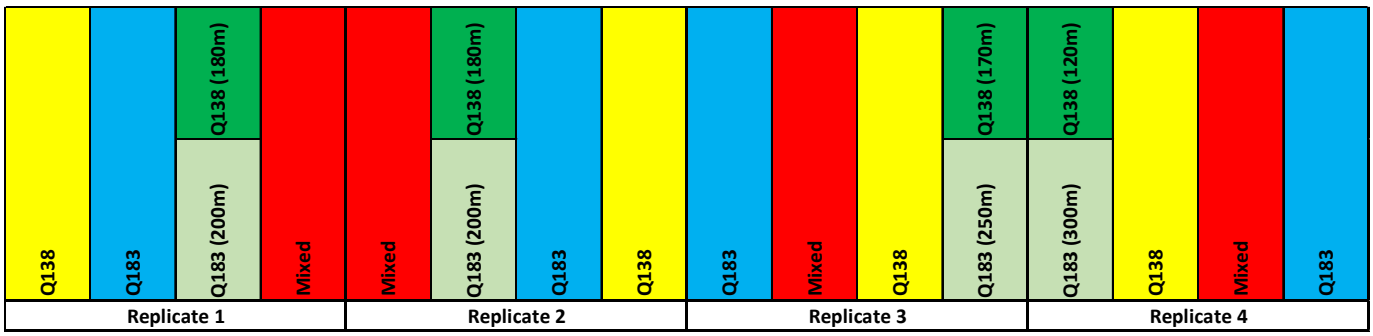


Figure 1 – Four treatment and replicate trial layout

The trial layout shown in Figure 1 was overlaid over the EC map shown in Figure 2 to ensure that all treatments intersected the sodic soil zone of the paddock. Figure 2 shows the variations in EC readings across the paddock.

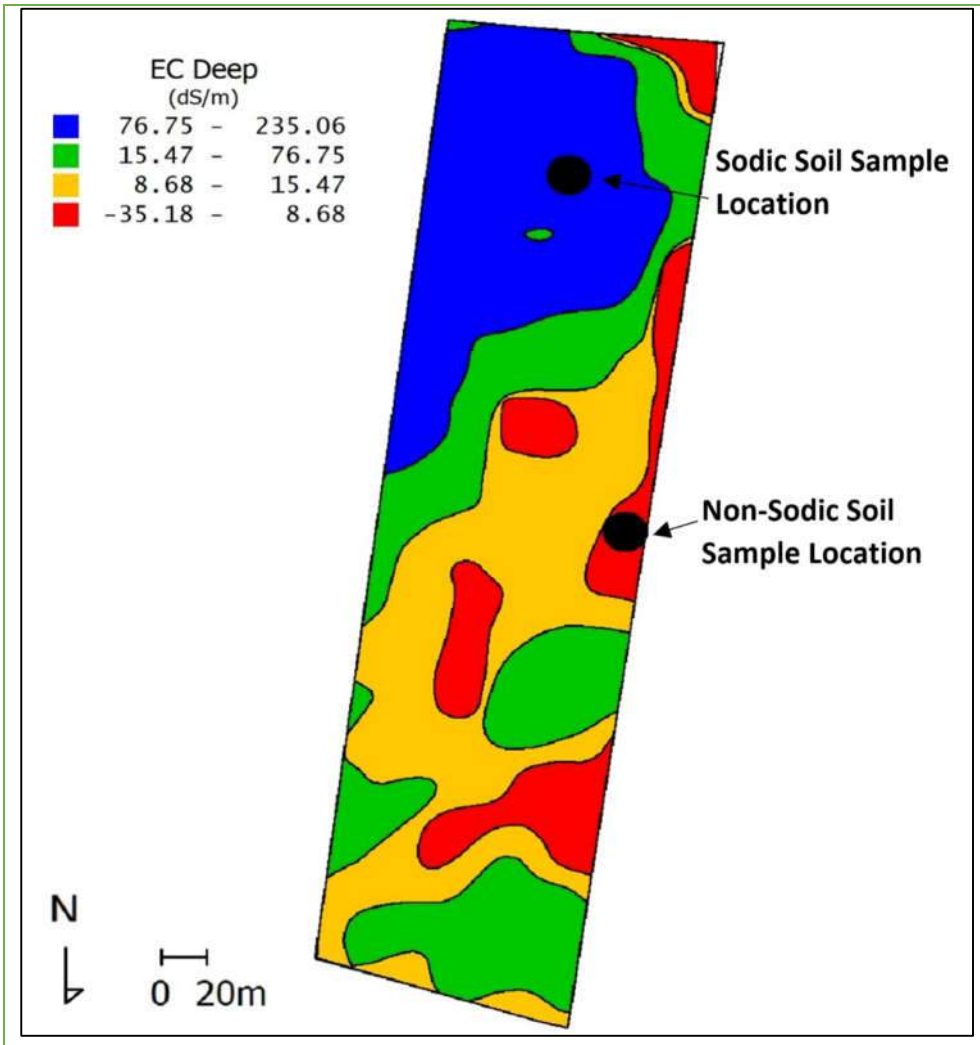


Figure 2 - EC map of paddock soil textures and soil sample locations

While the block is 11.9ha, the trial was planted across only 1.6ha to ensure each treatment was located within the main sodic soil zone. The Blue zone in Figure 2 indicates the section of the paddock that the trial is located and is where the highest contrast occurs from one end of the paddock to the other. This blue region is considered sodic as illustrated in the sample results in Table 1.

Figure 3 - Aerial image of trial taken in March 2017 (plant cane). Sodic area paddock is at the top of the image.

Results

Soil samples were collected from the high and low EC zones of the field to a depth of 200mm. A summary of the laboratory analysis is presented in Table 1. Sample results from the high EC zone (blue), confirm this zone is sodic with an ESP of 19.83, despite historical treatments of mill ash and gypsum. In comparison, the low EC zone (red) returned an ESP of 3.84, confirming this zone is non-sodic.

Table 1 - Summary of soil analysis results of the sodic and non-sodic areas

Analyte / Assay	Units	Blue Zone	Red Zone
pH (1:5 Water)		7.99	5.91
ECSE	dS/m	1.032	0.225
Chloride	mg/kg	40	11
Organic Carbon (OC)	%	1.06	0.78
Phosphorus (Colwell)	mg/kg	44	20
Sodium % of Cations (ESP)	**%**	**19.83**	**3.84**
Cation Exchange Capacity	Meq/100g	9.6	4.2

Harvest Yields

Plant Cane

The plant crop was harvested in August 2017. Damage from cyclone Debbie in March 2017 contributed towards the poor plant cane yields achieved at this site. Figure 4 shows the crop yield for each treatment and associated error bars. Despite the damage and water logging associated with the cyclone, the mixed variety treatment yielded significantly higher than the other treatments.

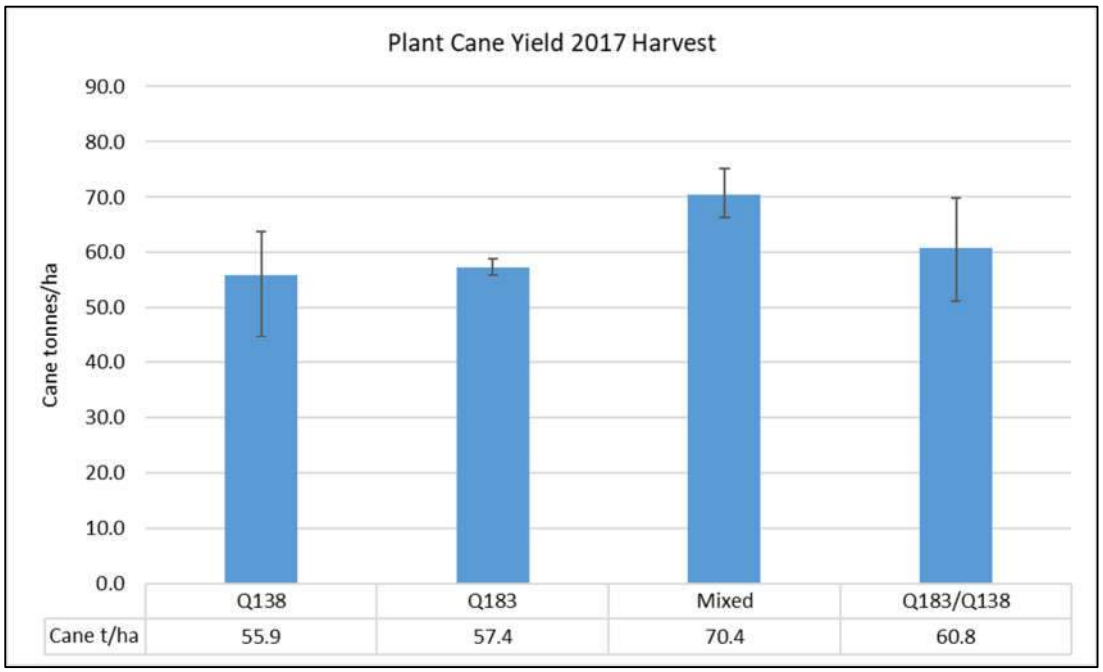


Figure 4 - Yield results from plant cane 2017 harvest

The 2017 results indicate that the mixing of Q138 & Q183 billets together and planting the mix across the paddock, produced the highest yield of all treatments. The targeted planting of Q183 & Q138 gave a higher mean yield than both the Q138 and Q183 individual variety treatments.

First Ratoon Harvest

Wet soil conditions saw the first ratoon harvest delayed until October 2018.

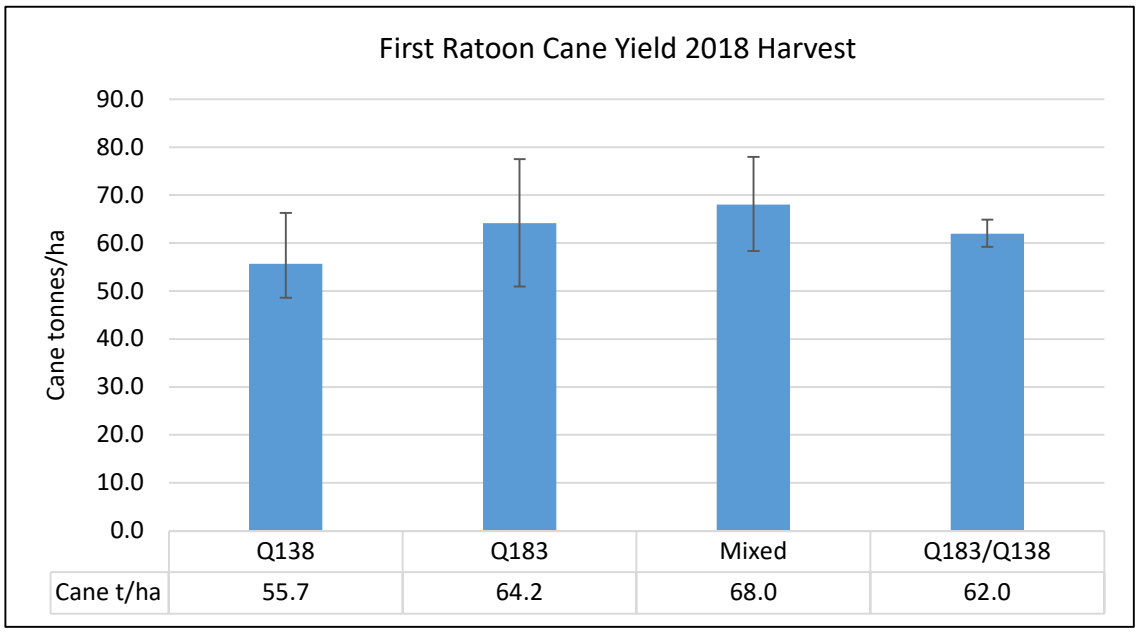


Figure 5 - Yield results from 2018 harvest

The mixed variety treatment produced the highest mean yield again in the first ratoon crop, although the difference was not statistically significant (Figure 5). Similar to the plant crop, the Q138 standard treatment was the lowest yielding treatment in the 1st ratoon crop.

Second Ratoon Harvest

The second ratoon crop was harvested in October 2019. Mean harvest yields for each treatment are presented in Figure 6.

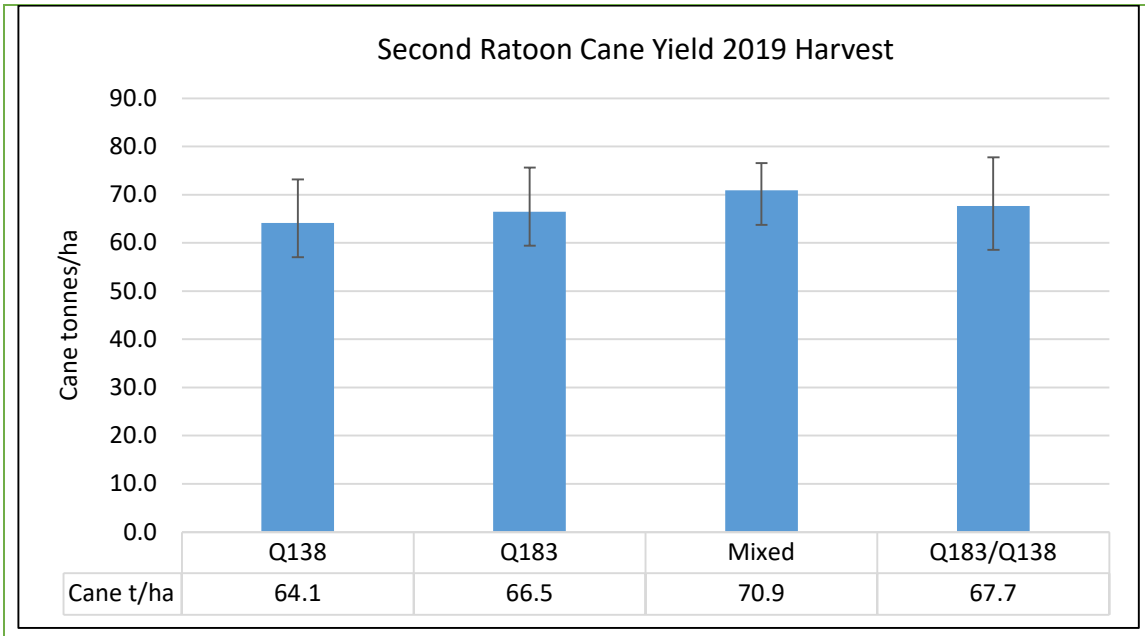


Figure 6 - Yield results from 2019 harvest

Similar to the previous years, the mixed variety treatment produced the highest mean yield at the 2nd ratoon harvest (Figure 6). Q138 again yielded the lowest mean tonnes per hectare (tC/ha) of all treatments. Overall paddock yield improved from the previous year due to more favourable growing conditions.

Third Ratoon Harvest

The third ratoon crop was harvested in October 2020. Mean harvest yields for each treatment are displayed in Figure 7.

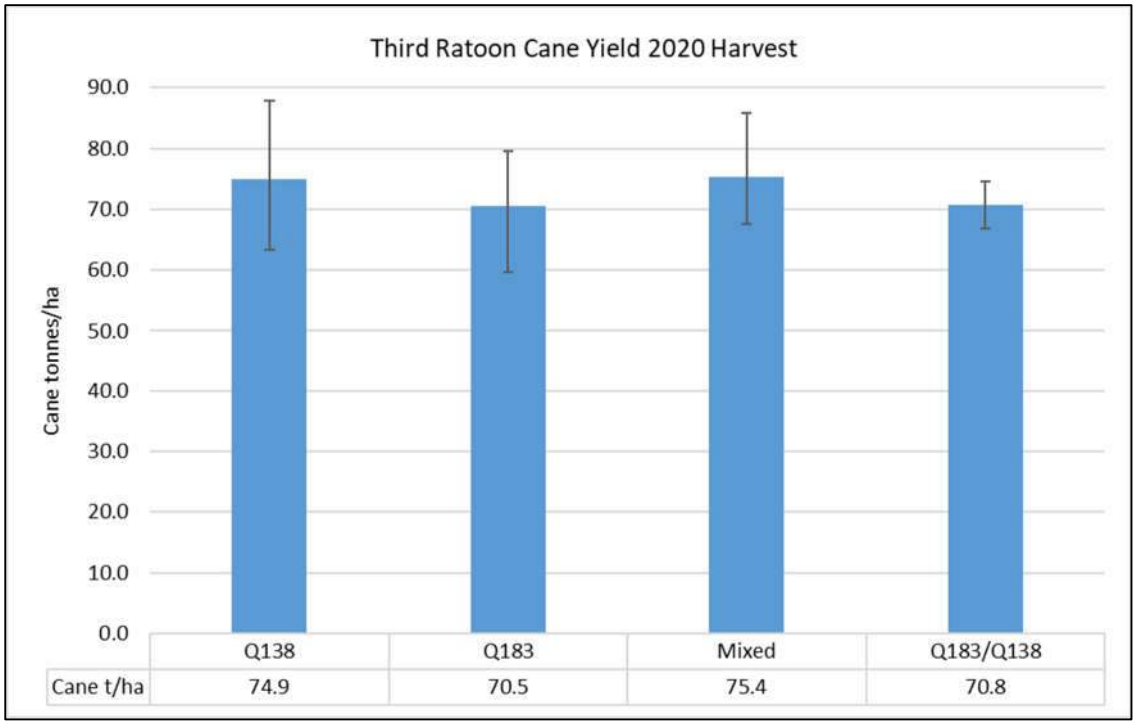
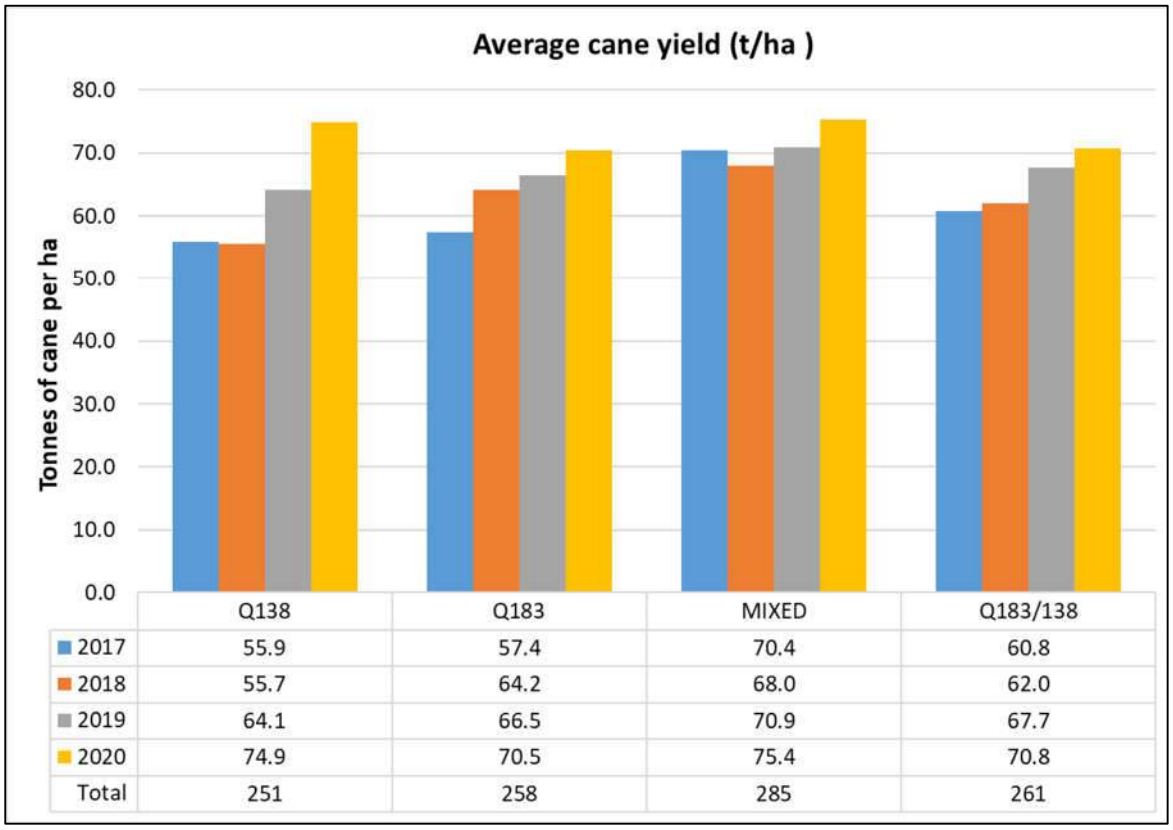


Figure 7 - Yield results from 2020 harvest

Results from the 2020 harvest (Figure 7) showed little yield variation between treatments. While the mixed variety treatment did again produce the highest mean yield (although not statistically significant), the relative performance of Q138 improved. This is a feature of Q138 that is favoured by growers in poorer soil types- it tends to persist and produce higher yields in older ratoons.



	Q138	Q183	MIXED	Q183/138
2017	55.9	57.4	70.4	60.8
2018	55.7	64.2	68.0	62.0
2019	64.1	66.5	70.9	67.7
2020	74.9	70.5	75.4	70.8
Total	251	258	285	261

Figure 8 - Yield results from the duration of the trial (2017 – 2020).

Figure 8 provides a summary of the yield data collected over the duration of the trial (2017-2020). It demonstrates that the mixed variety treatment consistently yielded the highest. Additionally, the yields seem to have an increasing trend each year across the trial.

Over the life of the trial to date, the mixed variety treatment has produced 23.4tC/ha more than the next nearest treatment (targeted variety planting). At an estimated gross value of $42/tC, the mixed variety delivered an additional $982/ha. It also yielded 26.1 tC/ha better than the best straight variety treatment (Q183), worth an additional $1096/ha gross income over the life of the trial.

Figure 9- Manuel standing in front of the trial during the 3rd ratoon growing season. (December 2019)

Conclusions and comments

This trial has demonstrated that altering varieties to respond to varying soil characteristics/ constraints can benefit yield and income per hectare. This practice may not be beneficial in paddocks that are uniform or consistently high yielding across the paddock, however, in areas that do not respond to amelioration management, changing varieties to suit the soil type may be an effective way to utilise the area to capacity.

This trial has shown that matching varieties to soil types, either through mixed variety planting or targeted variety planting, results in superior crop production, income and likely benefits to water quality.

Further work is required to understand varieties that are suitable for mixed planting and not excessively competitive.

Advantages of this Practice Change:
Improved yield, leading to increased profitability, soil protection and nutrient use efficiency.

Disadvantages of this Practice Change:
Slightly increased time to plant and forward planning for variety needs. Use of tissue cultured plantlets will likely reduce the labour requirement for the initial mixed plant source establishment.

Will you be using this practice in the future? Yes

% of farm you would be confident to use this practice:
Manuel currently has approximately 10% of the farm planted to mixed varieties. He is undertaking further trial work with Farmacist to identify compatible varieties for mixed planting on other fields and soil types.