

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:	35 years
Trial Subdistrict:	Dawlish
Area under Cane ha:	183ha

Trial Status

Completed

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 when 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 to the soil and crop growth, but the area is still not meeting its 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: Katelin Reddacliff, Farmacist (0439 072 611)

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 1 st ratoons
Stage 7	October 2018	1st ratoon harvest
Stage 8	October 2019	2nd ratoon harvest
Stage 9	October 2020	3rd ratoon harvest
Stage 10	December 2021	4 th ratoon trial harvest, wet harvest, only 1 replicate able to be cut

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 presently growing Q208 and has elevated pachymetra levels on the low Electroconductivity (EC) soil zones of the block.

Q138 was planted as the standard variety 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.

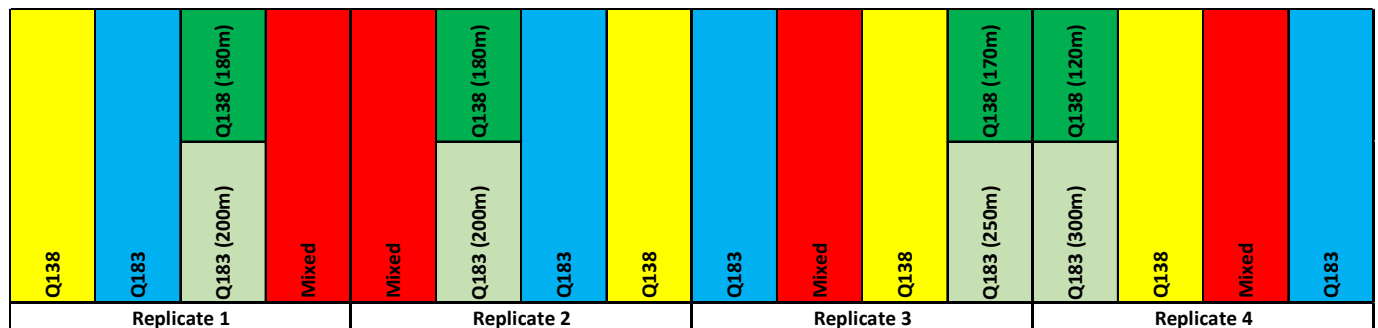


Figure 1 – Four treatment and replicate trial layout

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.

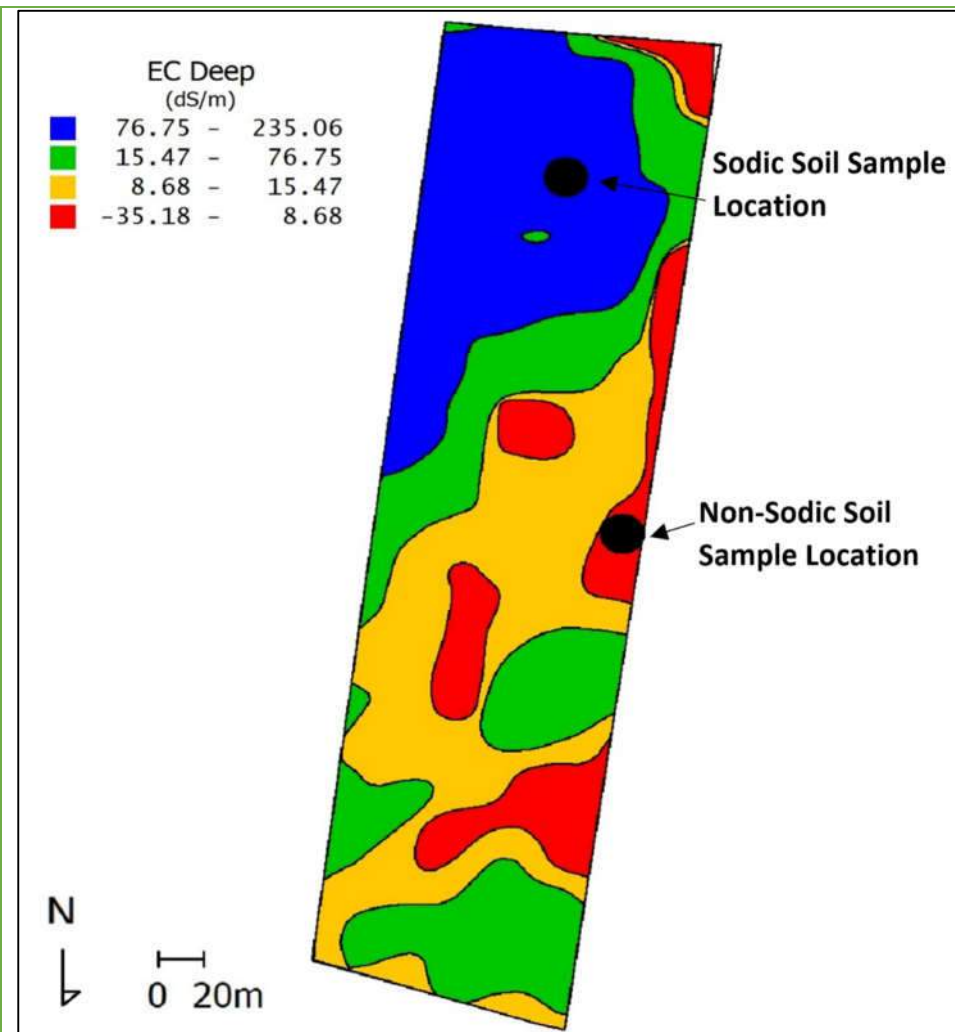


Figure 2 - EC map of paddock soil textures and soil sample locations

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.

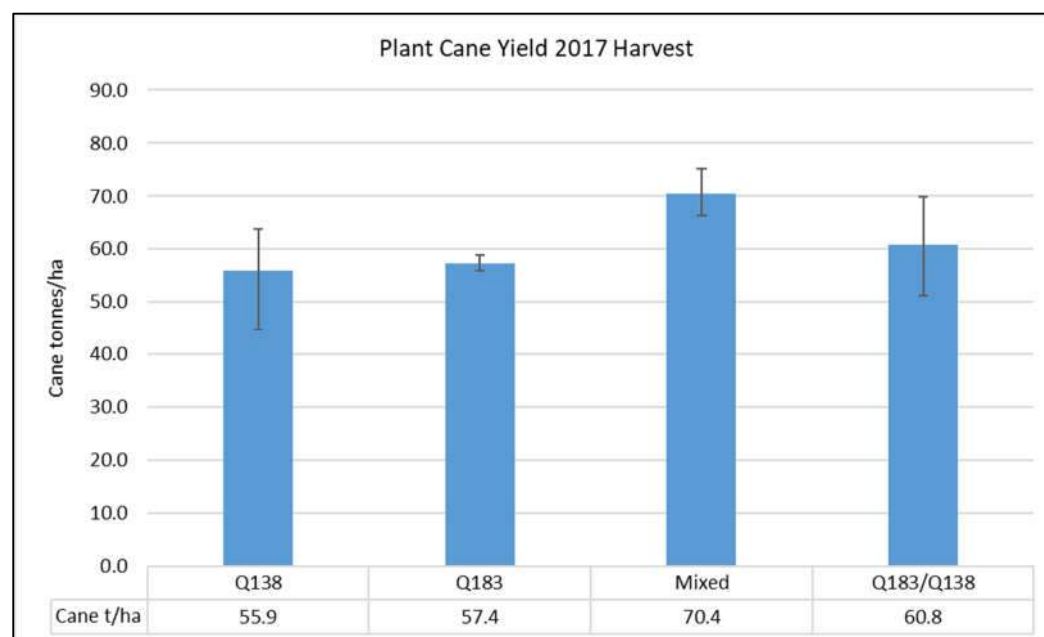


Figure 4 - Yield results from plant cane 2017 harvest

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.

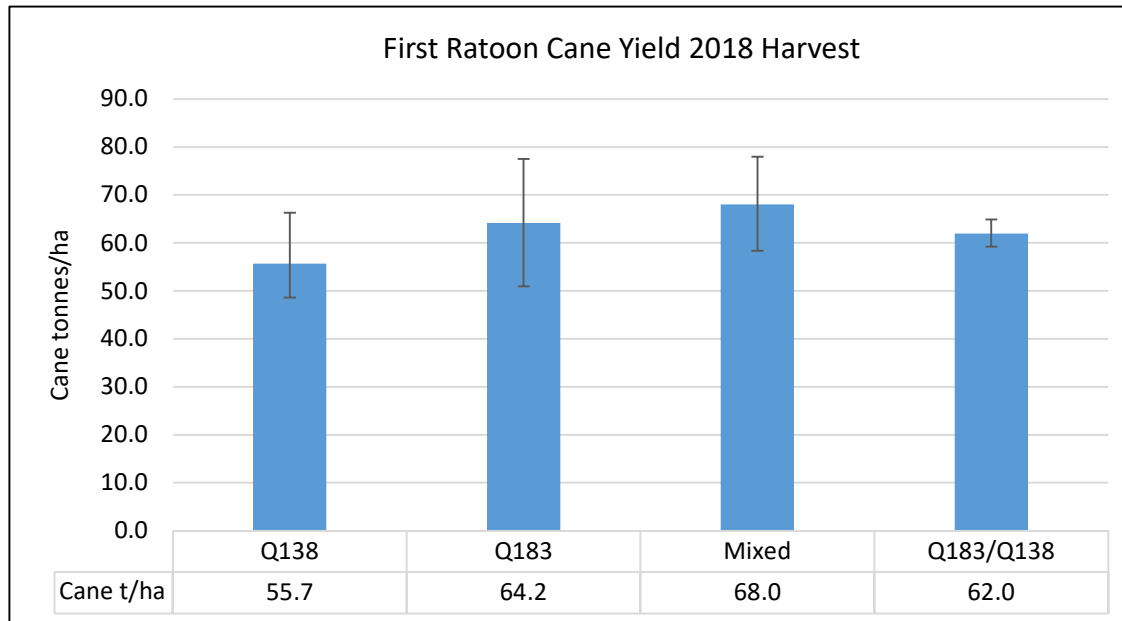


Figure 5 - Yield results from 2018 harvest

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.

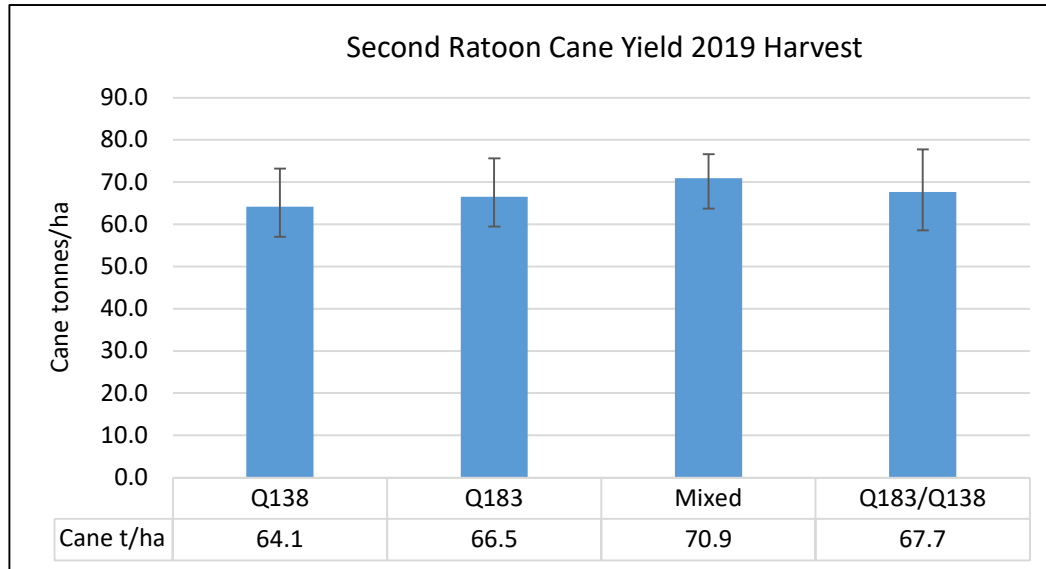


Figure 6 - Yield results from 2019 harvest

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.



Figure 7- Manuel standing in front of the trial during the 3rd ratoon growing season. (December 2019)

Third Ratoon Harvest

The third ratoon crop was harvested in October 2020. Mean harvest yields for each treatment are displayed in Figure 8.

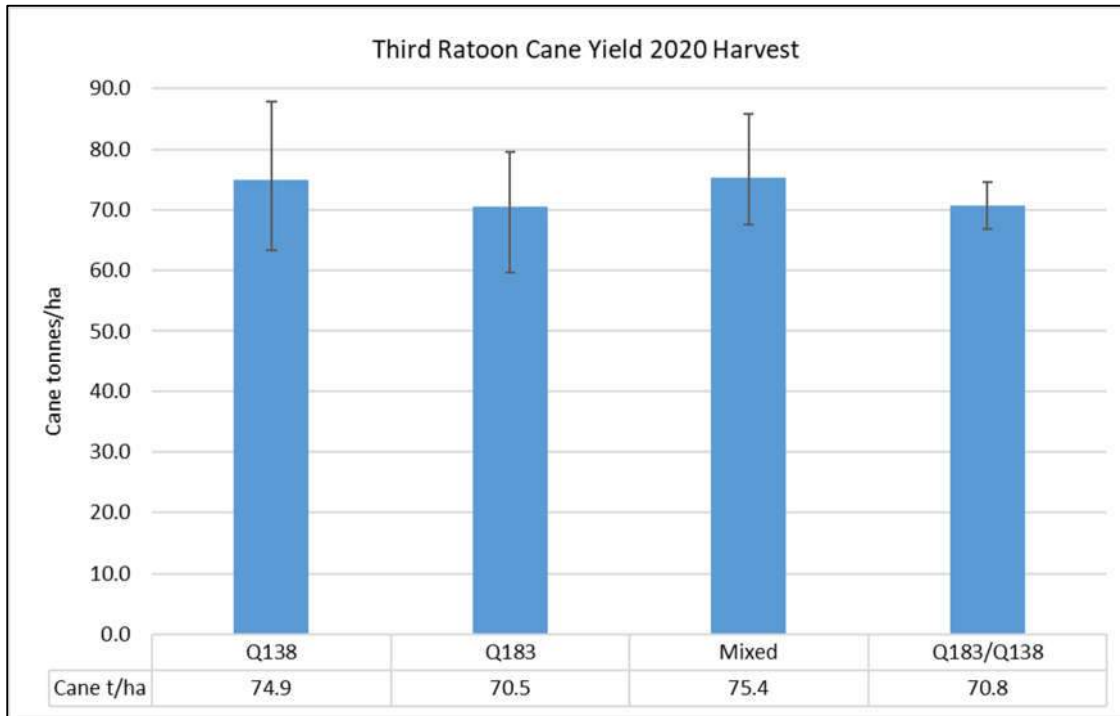


Figure 8 - Yield results from 2020 harvest

Results from the 2020 harvest (Figure 8) 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.

Fourth Ratoon Harvest

Due to wet harvest conditions, only one replicate of the trial was able to be harvested in December 2021. This harvest data has not been presented and is not included in the overall trials results shown below in Figure 9, due to the incomplete nature of the data.

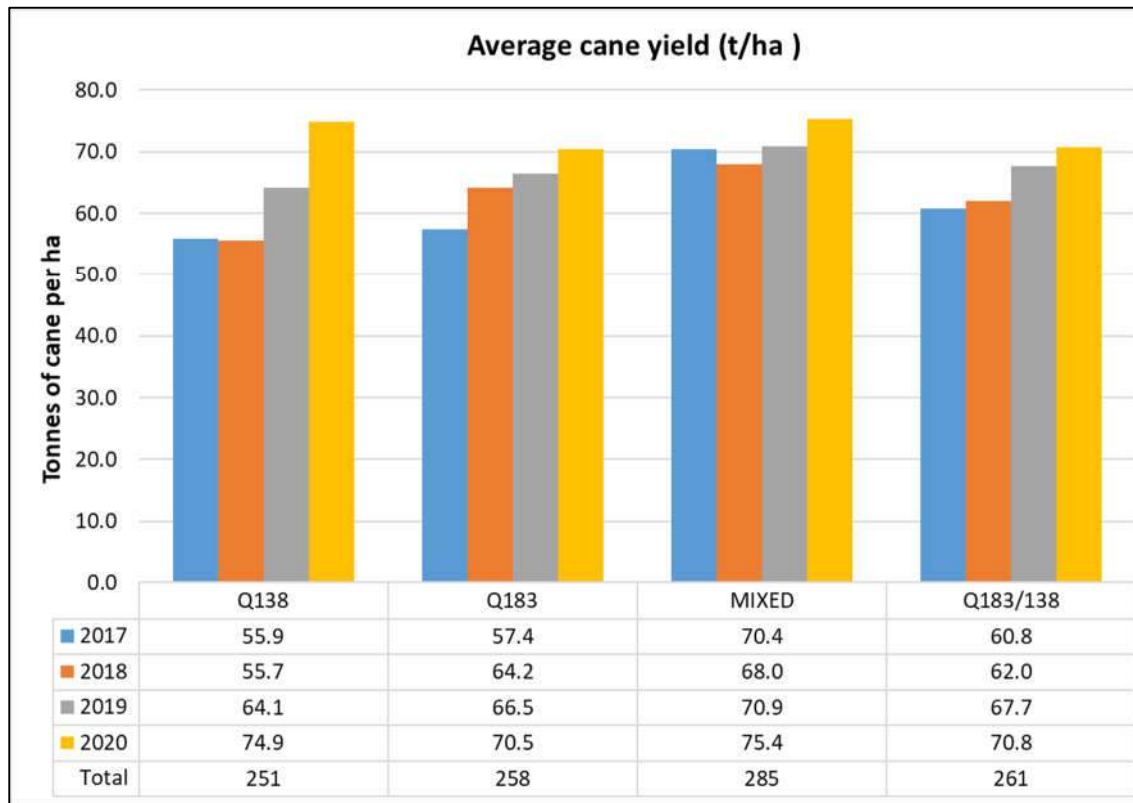


Figure 9 - Yield results from the duration of the trial (2017 – 2020).

Figure 9 provides a summary of the yield data collected over the duration of the trial (2017-2020). This data highlights that the mixed variety treatment consistently provided the highest mean yield of all treatments. Over the four trial harvests, the mixed variety treatment has produced 23.4tC/ha more than the next nearest treatment (targeted variety planting, Q183+Q138).

At an estimated gross cane value of \$45 per tonne, the mixed variety treatment delivered an additional \$1053/ha in revenue for the crop cycle.

The mixed variety treatment also yielded 26.1 tonnes of cane per hectare higher than the best straight variety treatment (Q183), worth an additional \$1174.5/ha gross income over the crop cycle.



Figure 10- Sodic soils affecting Q183 ratooning after the 4th ratoon harvest – gaps increasing

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:

Forward planning for variety needs is important. It is also important to experiment with different variety mixes – Manuel has propagated more than 12 different mixes in order to identify mixes that appear compatible. He has found that Q208 for example, generally gets out competed by other varieties and so is not ideally suited to mixed variety planting.

There is some additional labour requirement to do the initial planting of a mixed variety source – this is usually done by whole stick planting. Using tissue culture seedlings to undertake the initial planting would reduce this labour requirement.

Will you be using this practice in the future?

Yes, Manuel will continue to use this practice. In 2021, a new mixed variety trial was established (Figure 11) to gain more data for evaluation on different soil types and for extension of the idea to other growers. The new trial involves a mixture of Q183 and SRA 9 compared to straight planting of those varieties (trial plan Figure 12).



Figure 11- Manuel holds Q183 (L) and SRA9 stalks in the new mixed variety trial

Replicate	Treatment	Rows	Variety
1	1	6	Q183 + SRA 9
	3	6	Q183
	2	6	SRA 9
2	3	6	Q183
	2	6	SRA 9
	1	6	Q183 + SRA 9
3	2	6	SRA 9
	1	6	Q183 + SRA 9
	3	6	Q183
4	1	6	Q183 + SRA 9
	2	6	SRA 9
	3	6	Q183

Figure 12- Trial layout for the new trial for harvest in 2022

% 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.