2019 Annual Report

Sugar Research Institute of Fiji

PARLIAMENT OF FIJI
PARLIAMENTARY PAPER NO. 172 OF 2019

FOREWORD

Two tropical cyclones – TC Mona in January and TC Sarai in December brought heavy rainfall and affected the cane production. There was an increase of 0.1m tonnes of cane in 2019 compared to 2018. The breeding program activities progressed smoothly in 2019, 337 crosses were set that included 152 bi-parental and 185 poly crosses using 57 female and 201 male parents. A new flowering bed was established with 120 varieties from the germplasm collection and 20 overseas varieties from VISA Cane. A total of 319 packets of fuzz was sown from the crosses made in 2019. Fuzz germination was poor, and 4,200 seedlings were obtained. The evaluation, selection and advancement of varieties from different stages in the plant breeding program were carried out successfully. One promising variety LF11-233 has been identified and seed cane multiplication was done in 2019 with the intention of planting the large mill trial in 2020.A project was initiated to study the effect of cane delay on sugar losses and the results showed that losses were accelerated after 48 hours. A total of 1517 soil and 72 foliar samples were analysed for fertilizer recommendations and research trials. The protection of the industry against diseases and pest is a high priority task and the Institute has managed this very well. Routine screening of the major disease in Fiji, Fiji leaf gall (FLG) disease continued during the year. A pot trial was conducted to screen selected sugarcane varieties for their response and tolerance to plant parasitic nematodes. As part of the integrated pest management of the major pest Cane Weevil Borer (CWB), 160 split bait traps were placed in farmers' fields. The Crop Protection unit inspected 1959 farms covering an area of 6424 hectares and removed 3112 diseased FLG stools. Fiji is the only country in the world that has not been affected by SMUT disease. An incursion plan in collaboration with the Biosecurity has been put in place to encounter this disease. Three trials were conducted on nitrogen fixing bacteria and no significant changes were observed on yield. One hundred fourteen farms were surveyed for termite infestation out of which 20 farms were infested. The production of hot water treatment seed cane continued during the year. The tissue culture laboratory that was set up last year started culturing of cane to produce seedlings for planting. 2000 tissue culture seedlings were planted in the field and approximately 10,000 seedlings are in the laboratory to be planted next year. The Institute continued to disseminate information through the technology transfer program to the farmers. Under this program on field demonstrations on key issues that will improve production are conducted. In 2019, soil health improvement was the major topic under technology transfer and 15 green manuring trials were established. The crop used in these trials was black gram.

I acknowledge the contributions from all the staff in our substations and the head office for their support and commitment to the Institute and I would also like to thank the Chairman and other board members for their guidance and support.

Acting Chief Executive Officer

Prem N. Naidu

PARLIAMENT OF FIJI
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MISSION STATEMENT

To advance the industry by excellence in technology transfer emanating from research results through science that supports innovative activities in sugar related industries and to make the Fiji Sugar Industry productive and sustainable.

BOARD MEMBERS

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Dr. Sanjay Anand

Mr. Graham Clark

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Dr. Sanjay Anand

Mr. Ashween Nischal Ram

Mr. Graham Clark

CONTENTS

Research & Development

May – Driest month

16,300+ test clones

1,500+ soil samples

6,400+ ha inspected

METEOROLOGY

Highlights

1. TC Mona - developed in January, attained maximum intensity of a Category 2 system and inflicted heavy rain which resulted in flooding around the country.
2. Looking at all the mill areas, May was the driest month while January, February, March and April were the wetter months.
3. Labasa mill recorded the highest annual rainfall of 2353mm while Lautoka mill recorded the least annual rainfall of 1354mm.
4. Refresher training on "Climate Observation" was conducted by Sajiva during the latter half of the year.
5. National Climate Outlook Forum was held in Nadi in November to discuss the following:
    a. specific factors affecting user outcomes
    b. Co-design tailored products to address decision-making needs
    c. climate information, including uncertainties and limitations are communicated, interpreted and understood by stakeholders and users
    d. user views and obtain feedback for improvement of climate products, services and accessibility
6. TC Sarai - formed towards the end of December and was a Category 2 system with significant rainfall being observed which led to flooding in some parts of Fiji.

Introduction

The Meteorological Station at Sugar Research Institute of Fiji (SRIF) is equipped with a range of meteorological instruments and maintained with the help of the Fiji Meteorological Service (FMS) at its head office in Lautoka and three other daily Climatological recording centers. Climatological station is manned by observers who take climate readings of temperatures (dry bulb, wet bulb, maximum and minimum), earth temperatures situated at depths of 5cm, 10cm and 50cm, 24 hours rainfall, amount of cloud, visibility, wind force and wind direction at 9am daily.

At the end of each month, data is compiled in a designated F211 form and forwarded to the Regional Specialized Meteorological Centre Nadi. Similarly, rainfall figures from each sector from the eight districts are compiled and kept for our records. The climate data is used to produce climate summary and predicting of weather forecast for the country. The Research Institute provides a summary statement towards the Fiji Sugar Cane Rainfall Outlook (FSCRO) which becomes an advice to farmers on possible farm activities such as land preparation, cultivation, fertilizer application, weedicide application and harvesting for sugarcane areas.

El Niño Southern Oscillation (ENSO)

ENSO is an irregular cycle of persistent warming and cooling of Sea surface temperatures in the tropical Pacific Ocean. The warm extreme is known is El Niño and the cold extreme, La Niña. Scientists now refer to an El Niño event as sustained warming over a large part of central and eastern equatorial Pacific Ocean. This warming is usually accompanied by persistent negative values of Southern Oscillation Index (SOI), a decrease in the strength or reversal of the trade winds, increase in cloudiness in the Pacific and reductions in rainfall over most of Fiji which can, especially during moderate to strong events, lead to drought. La Niña is a sustained cooling of the Pacific Ocean. The cooling is usually accompanied by persistent positive values of SOI, and increase in strength of the trade winds, decrease in cloudiness and higher than average rainfall for most of Fiji with frequent and sometimes severe flooding, especially during the wet season (November to April).

Rainfall

Fiji enjoys a tropical maritime climate without extremes of heat or cold. The peak period for cyclones in the region is usually from November to April. The annual average rainfall is between 2000mm to 3000mm. From the table below, it can be seen that the total rainfall for all mills, except Lautoka, was in the annual average rainfall range. Generally (table 1 below), May was the driest month while January to April were the wetter months. Labasa mill recorded the highest annual rainfall while Lautoka mill recorded the least annual rainfall.

Table 1: Rainfall (mm) figures for All Mills for 2019

Month	Lautoka mill		Rarawai mill		Labasa mill		Penang mill		Sum
	Rainfall (mm)	Rain Days	Rainfall (mm)	Rain Days	Rainfall (mm)	Rain Days	Rainfall (mm)	Rain Days	Rainfall (mm)
January	220	20	523	19	491	28	295	28	1530
February	220	16	214	12	272	18	255	24	960
March	187	19	314	12	270	18	240	22	1010
April	239	17	278	14	369	14	498	23	1384
May	6	2	4	3	15	2	20	7	44
June	12	3	127	6	127	4	53	5	318
July	61	4	49	5	29	2	56	14	196
August	10	1	13	2	41	2	197	6	261
September	86	6	131	5	85	3	75	7	376
October	86	9	85	11	185	9	44	11	400
November	69	6	108	8	57	7	97	9	331
December	158	8	190	7	414	15	160	9	923
Total	1354	111	2036	104	2353	122	1990	165	
Average	113	9	170	9	196	10	166	14	

Lautoka Mill

Table 2: Monthly Rainfall figures for Lautoka Mill with the Long-Term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Avg.
Monthly rainfall	220	220	187	239	6	12	61	10	86	86	69	158	1354	113
No. of rain days	20	16	19	17	2	3	4	1	6	9	6	8	111	9
49 yrs. Avg. (1970-2018)	360	327	320	195	86	68	50	69	74	101	134	194	1977	277
% of Avg.	61	67	58	123	7	18	122	15	116	85	52	82	68	41

Rarawai Mill

Table 3: Monthly Rainfall figures for Rarawai Mill with the Long-Term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Avg.
Monthly rainfall	523	214	314	278	4	127	49	13	131	85	108	190	2036	170
No. of rain days	19	12	12	14	3	6	5	2	5	11	8	7	104	9
49 yrs. avg. (1970-2018)	384	354	358	204	90	78	39	63	73	105	150	237	2135	302
% of avg.	136	60	88	137	4	163	126	21	178	81	72	80	95	56

Penang Mill

Table 4: Monthly Rainfall figures for Penang Mill with the Long-Term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Avg.
Monthly rainfall	491	272	270	369	15	127	29	41	85	185	57	414	2355	196
No. of rain days	28	18	18	14	2	4	2	2	3	9	7	15	122	10
49 yrs. avg. (1970-2018)	415	357	363	260	147	101	48	70	84	115	148	263	2370	198
% of avg.	118	76	74	142	10	125	60	59	101	162	38	158	99	99

Labasa Mill

Table 5: Monthly Rainfall figures for Labasa Mill with the Long-Term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Avg.
Monthly rainfall	295	255	240	498	20	53	56	197	75	44	97	160	1990	166
No. of rain days	28	24	22	23	7	5	14	6	7	11	9	9	165	14
49 yrs. avg. (1970-2018)	385	369	363	256	104	74	49	56	76	121	178	252	2283	322
% of avg.	77	69	66	195	19	72	114	352	99	36	54	63	87	52

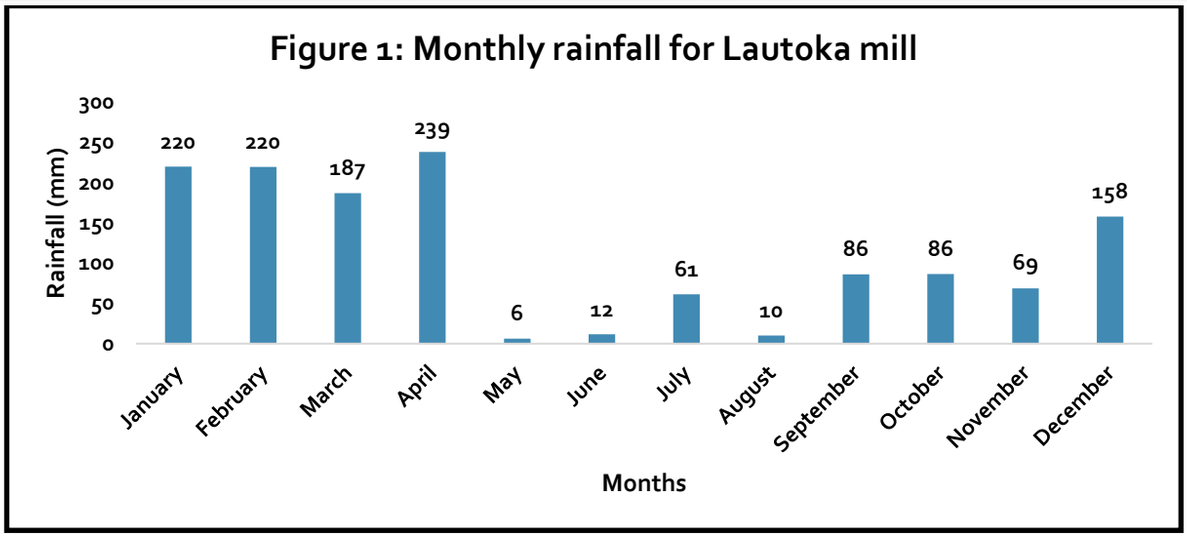


Figure 1: Monthly rainfall for Lautoka mill
Rainfall (mm)
300
250
200
150
100
50
0
220
220
187
239
6
12
61
10
86
86
69
158
January
February
March
April
May
June
July
August
September
October
November
December
Months

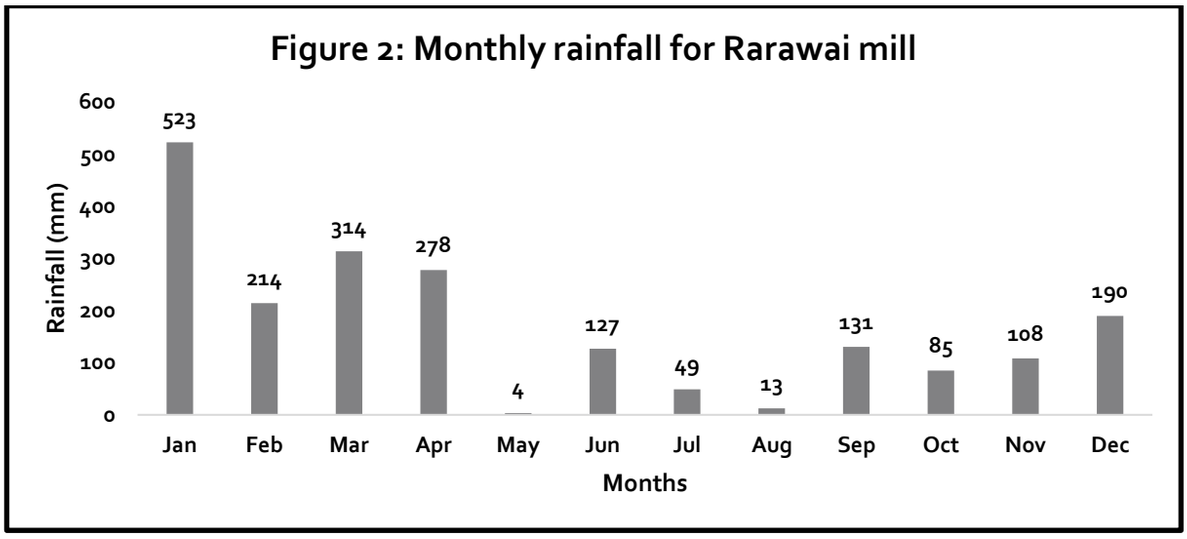


Figure 2: Monthly rainfall for Rarawai mill
Rainfall (mm)
600
500
400
300
200
100
0
523
214
314
278
4
127
49
13
131
85
108
190
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

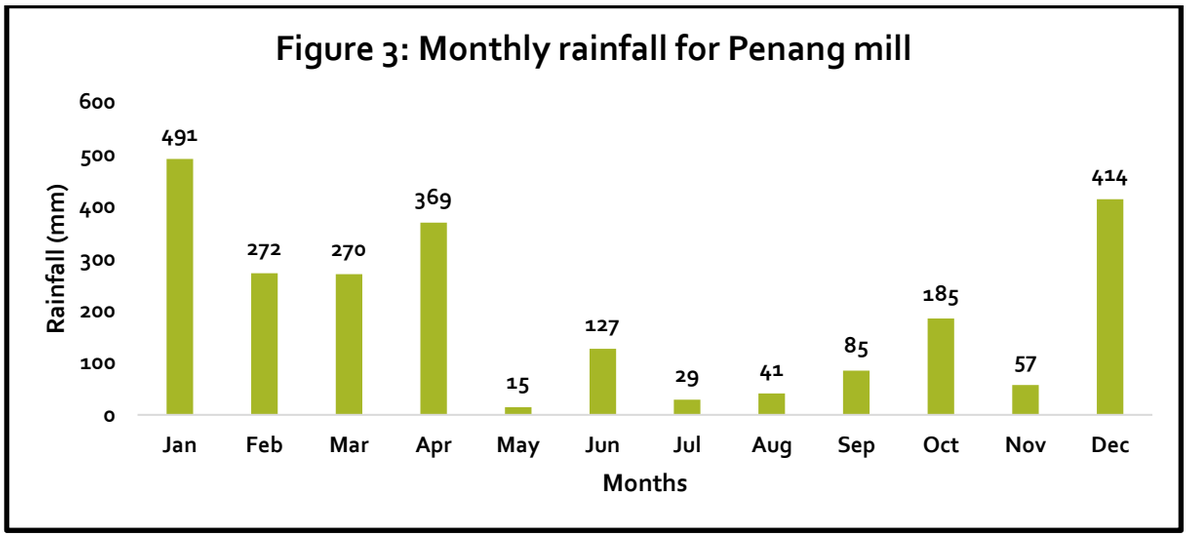


Figure 3: Monthly rainfall for Penang mill
Rainfall (mm)
600
500
400
300
200
100
0
491
272
270
369
15
127
29
41
85
185
57
414
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months

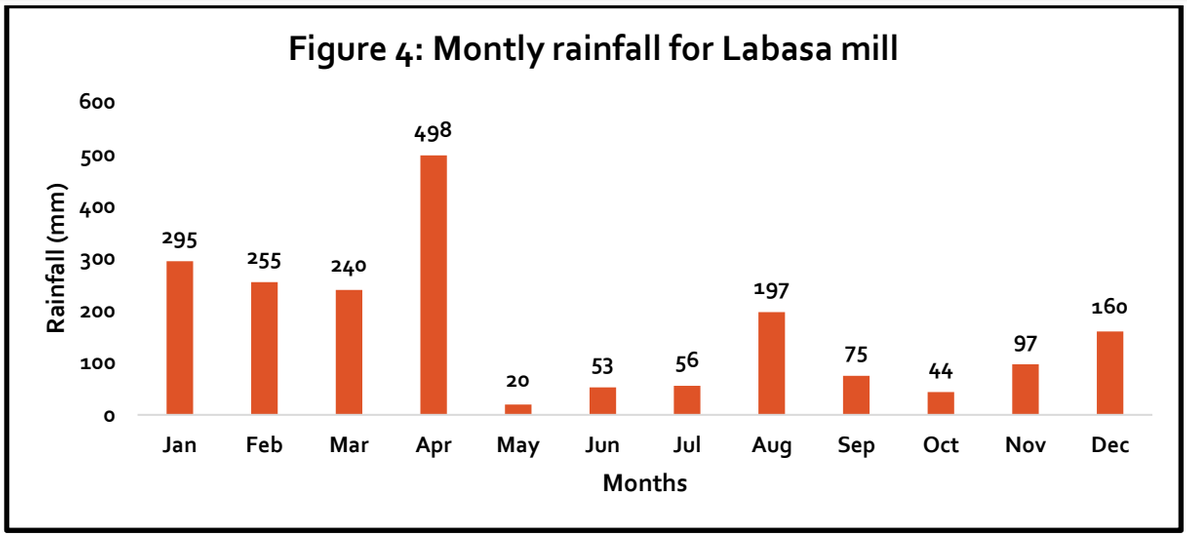


Table 6: Rainfall (mm) figures for each Sector of the Lautoka Mill

Sector	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Sector Avg.	Mill Avg.
Drasa	409	202	222	252	0	73	13	0	103	65	133	208	1681	140	
Saweni	360	176	219	320	0	66	96	21	124	59	58	168	1668	139	
Natova	428	127	284	401	0	142	188	13	198	136	96	357	2369	197	
Legalega	390	77	309	411	6	61	73	0	71	118	54	198	1767	147	
Meigunyah	336	57	235	342	3	65	65	0	75	130	49	155	1512	126	
Yako	292	62	114	216	1	111	33	0	28	38	40	88	1022	85	138
Malolo	525	74	330	548	1	109	86	0	125	186	209	178	2369	197	
Nawaicoba	304	74	273	412	3	60	50	0	99	141	116	137	1669	139	
Lomawai	218	119	119	207	1	70	53	42	57	75	83	218	1260	105	
Cuvu	401	64	73	181	31	26	116	41	58	191	138	103	1423	119	
Olosara	234	143	136	275	39	85	233	47	81	113	151	90	1626	136	

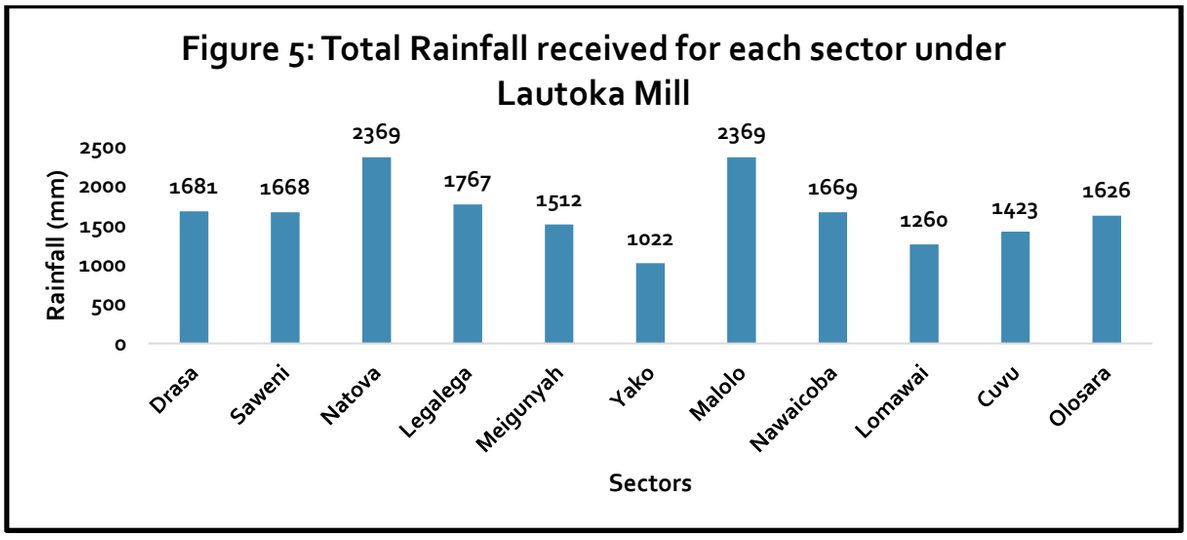


Table 7: Rainfall (mm) figures for each sector of the Rarawai Mill

Sector	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Sect Avg.	Mill Avg.
Varoko	546	196	296	128	7	99	47	0	116	54	86	192	1767	147	165
Mota	803	213	403	286	0	163	53	33	184	84	149	352	2721	227	
Koronubu	435	302	352	247	0	110	28	20	118	68	95	251	2026	169	
Rarawai	523	214	314	278	4	127	49	13	131	85	108	190	2035	170	
Veisaru	475	308	320	205	10	95	36	13	142	42	100	138	1883	157	
Varavu	338	168	322	317	0	126	20	0	61	25	82	174	1633	136	
Naloto	640	165	355	343	0	136	54	16	211	67	206	317	2510	209	
Tagitagi	323	146	355	261	0	115	53	32	139	33	100	235	1792	149	
Drumasi	229	275	303	233	4	88	52	48	155	20	130	245	1782	149	
Yaladro	258	109	335	257	0	90	46	36	136	24	86	234	1611	134	

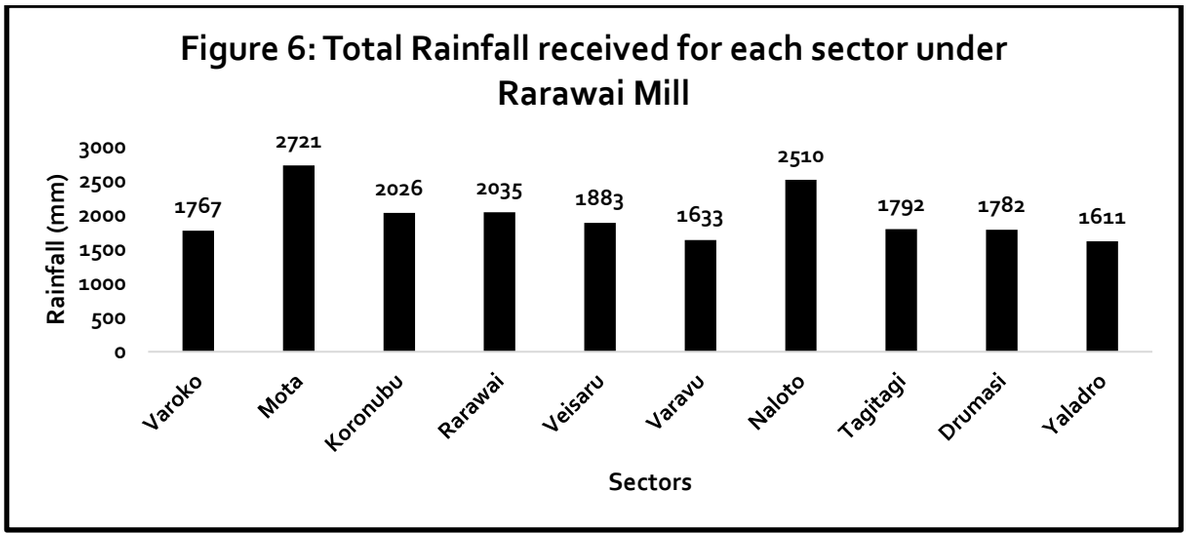


Table 8: Rainfall (mm) figures for each sector of the Penang Mill

Sector	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Sect Avg.	Mill Avg.
Ellington I	74	160	161	295	5	41	75	19	41	70	40	138	1116	93	148
Malau	295	255	240	475	22	64	52	17	75	41	97	160	1791	149	
Nanuku	332	180	210	278	0	53	5	1	68	12	89	114	1341	112	
Ellington II	375	333	275	785	27	170	163	57	120	73	184	304	2865	239	

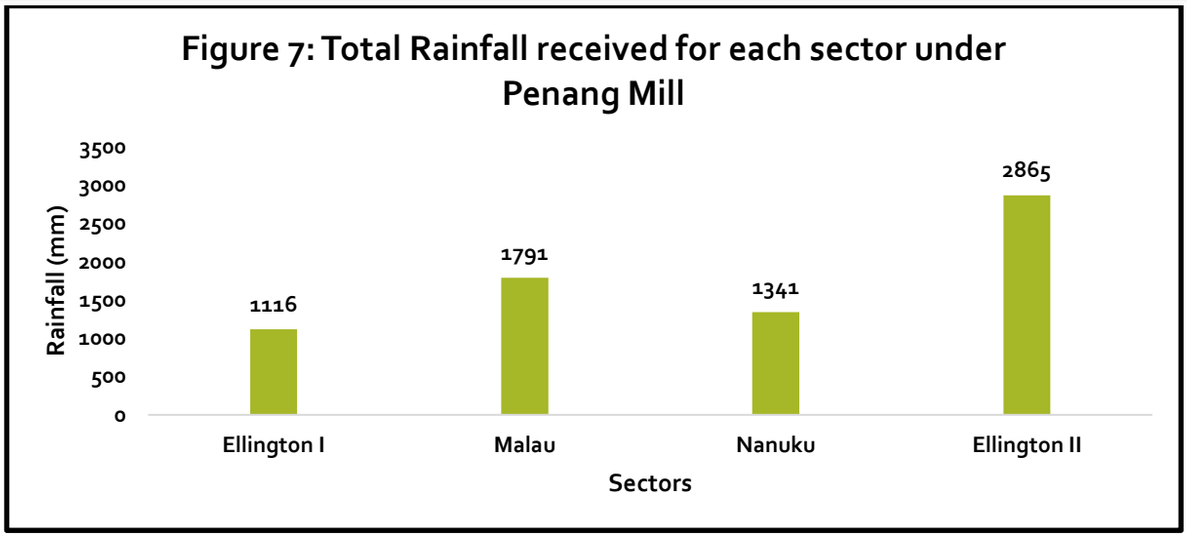


Table 9: Rainfall (mm) figures for each sector of the Labasa Mill

Sector	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Sect Avg.	Mill Avg.
Waiqele	518	362	269	369	16	130	48	50	79	135	140	267	2383	199	
Wailevu	474	291	314	288	42	152	40	31	72	119	97	325	2245	187	
Vunimoli	649	403	358	530	23	175	76	61	94	133	156	426	3084	257	
Labasa	491	272	270	369	15	127	29	41	85	185	57	414	2353	196	214
Bucaisau	430	341	284	349	51	194	30	19	120	137	88	322	2365	197	
Wainikoro	590	314	286	500	54	169	28	68	143	239	63	400	2852	238	
Seaqaqa	596	234	372	336	21	110	107	36	70	160	291	345	2677	223	

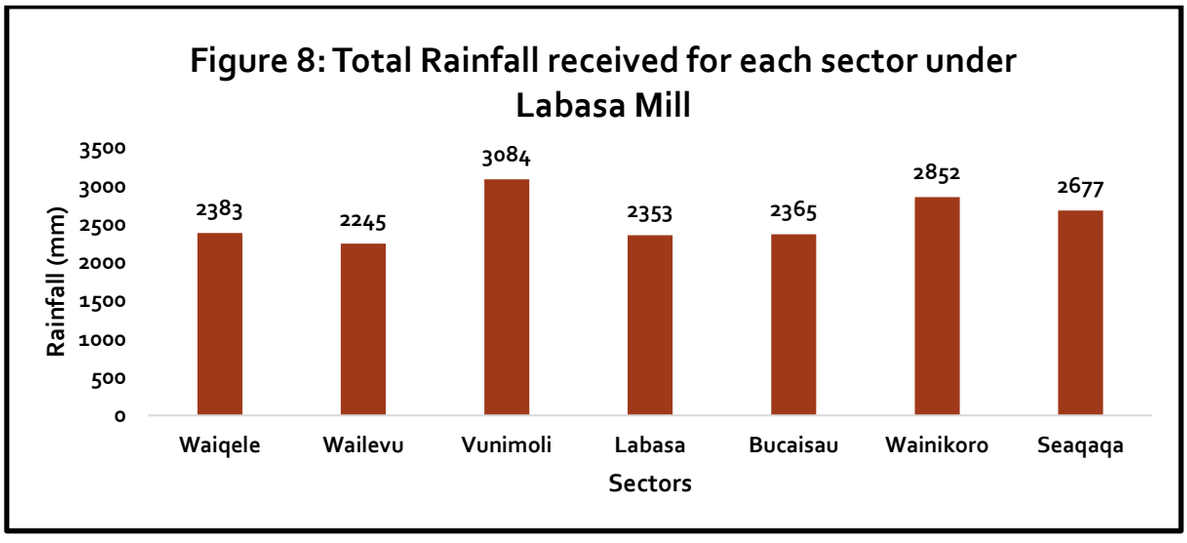


Table 10: Total Rainfall Figures for all the Four Mills for the past 24 years

Years	Lautoka	Rarawai	Penang	Labasa
1996	2242	2704	2404	2716
1997	2319	2648	3174	2734
1998	1213	1266	1274	1585
1999	3457	3354	3848	3141
2000	3017	3464	3750	3655
2001	2041	2121	2114	2147
2002	1704	1741	1819	2418
2003	1459	2033	1886	1834
2004	1488	1955	1573	1568
2005	1580	1749	1517	1794
2006	1844	2194	1824	1429
2007	2337	2805	2616	2786
2008	2502	3052	3380	2612
2009	2870	3556	3041	2480
2010	1228	1686	1644	2321
2011	3028	3140	3239	2831
2012	3744	3265	3957	2894
2013	2501	2353	2343	2757
2014	1199	1318	2110	1654
2015	1043	1158	1310	1168
2016	2098	1883	2126	1773
2017	1739	2134	1802	2122
2018	2129	2228	2940	2971
2019	1354	2036	1990	2355

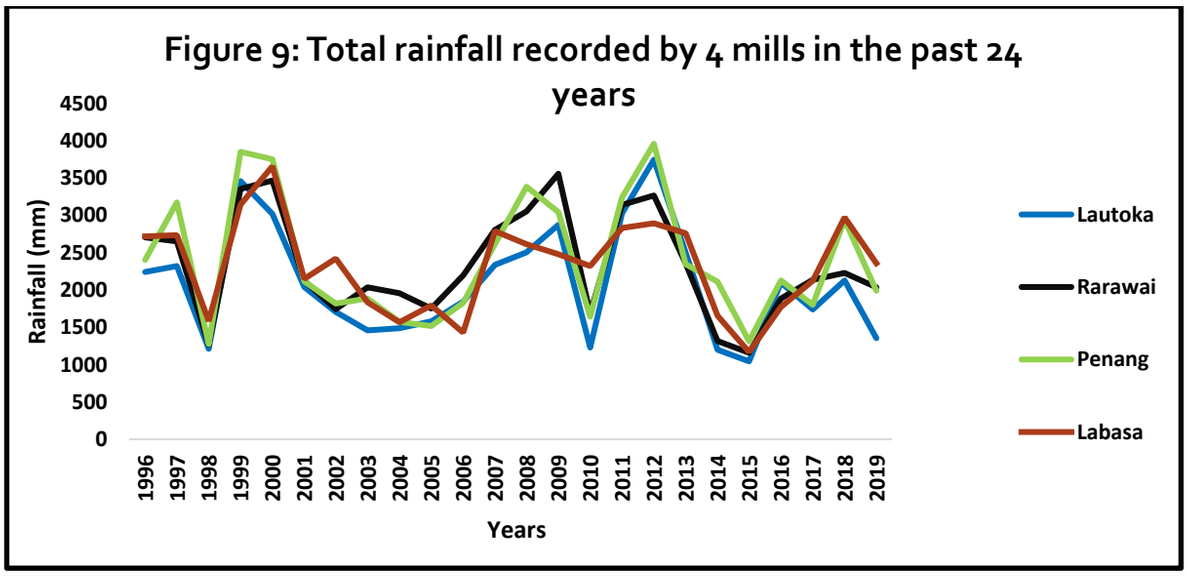


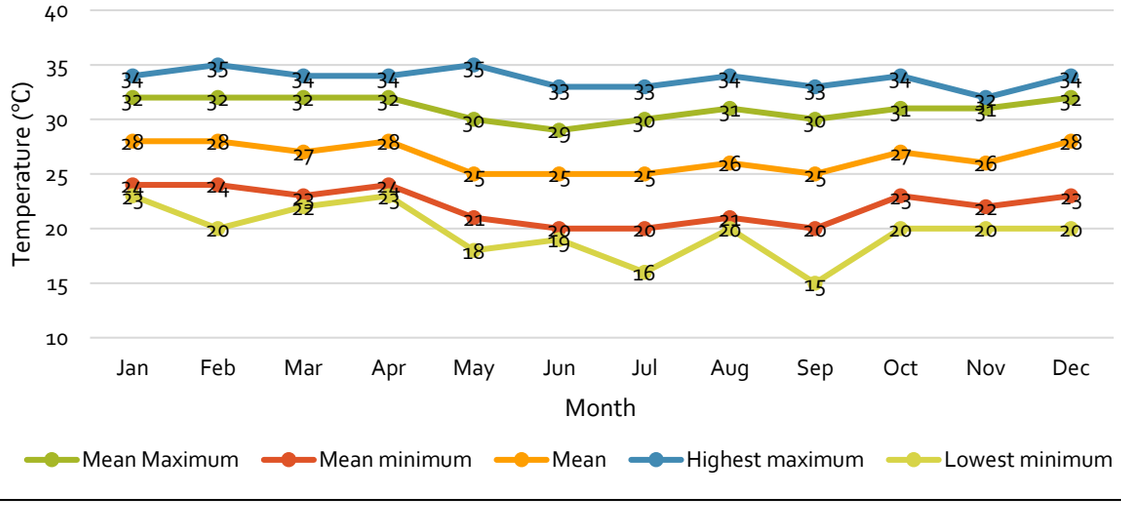
Table 11: Meteorological data for Sugar Research Institute of Fiji, Lautoka 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Relative Humidity (%)	74	82	79	77	77	88	95	97	95	84	78	76	83
50 yrs. avg	75	77	75	74	74	72	70	69	70	66	69	72	72
Air Temperature													
Mean Maximum	32	32	32	32	30	29	30	31	30	31	31	32	31
50 yrs. avg	32	31	31	31	30	28	28	28	29	31	31	31	30
Mean minimum	24	24	23	24	21	20	20	21	20	23	22	23	23
50 yrs. avg	24	24	24	24	22	20	20	20	21	26	23	23	23
Mean	28	28	27	28	25	25	25	26	25	27	26	28	26
Highest maximum	34	35	34	34	35	33	33	34	33	34	32	34	34
Lowest minimum	23	20	22	23	18	19	16	20	15	20	20	20	19
Evaporation													
Raised pan	165	162	233	227	179	118	114	331	292	132	364	122	203
Earth thermometers													
5cm	29	29	28	29	26	25	25	27	27	28	28	29	27
50 yrs. avg	27	29	29	27	26	24	24	24	26	27	29	29	27
10cm	29	29	28	28	25	25	25	26	25	27	27	28	27
50 yrs. avg	29	28	26	27	24	24	23	24	28	27	28	28	26
30cm	30	30	29	29	27	27	26	27	27	28	28	29	28
4 yrs. avg	30	29	29	29	28	27	27	27	27	29	29	29	28

Temperatures

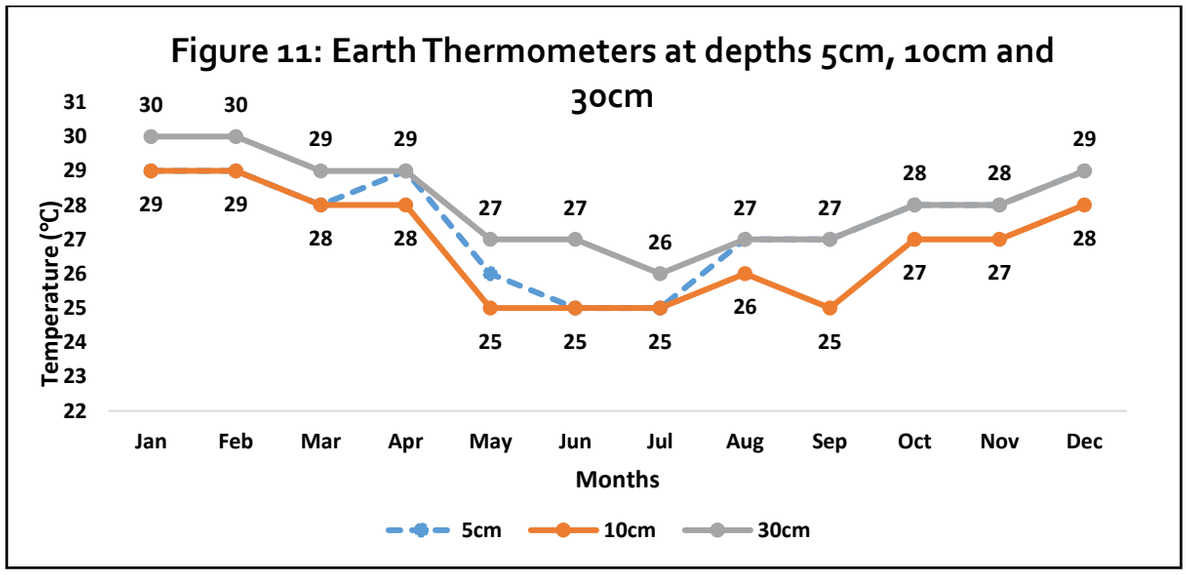
The highest maximum temperature of 35°C was recorded for the month of February and May while the lowest minimum temperature of 15°C was recorded for the month of September.

Figure 10: Graph showing mean maximum, mean minimum and mean (maximum + minimum) with higest maximum and lowest minimum



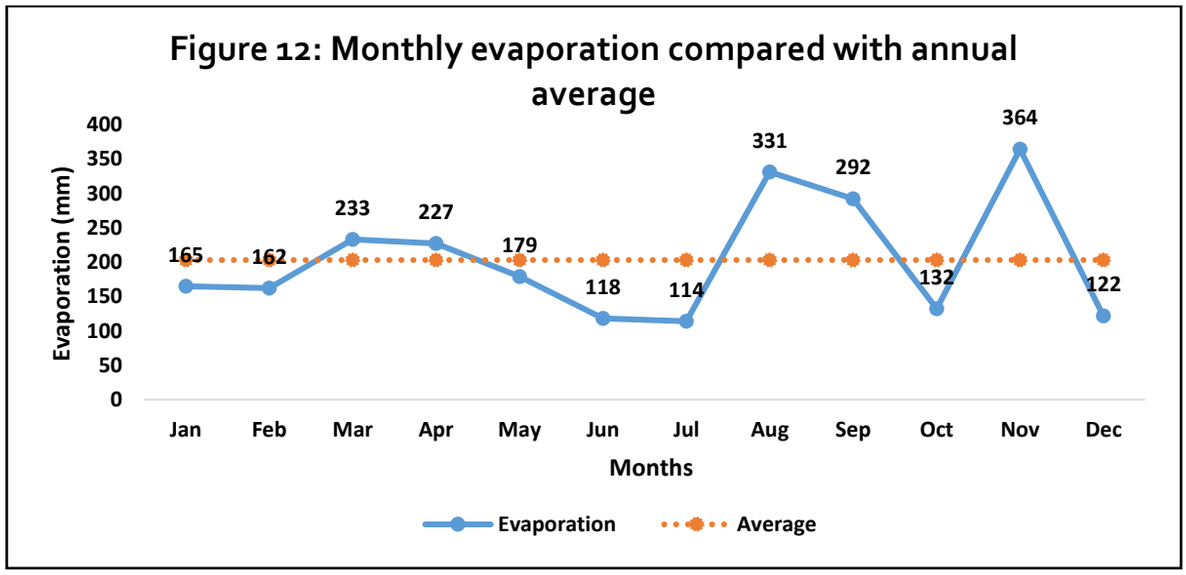
Earth Thermometers

The earth thermometers at SRIF are at depths of 5cm, 10cm and 30cm. The 50 years average of thermometers at depths 5cm and 10cm were calculated to be 27°C and 26°C respectively. The 30cm thermometer was newly installed in 2016, thus, the 4 years average calculated was 28°C.



Evaporation

The average evaporation for this year was calculated to be 203mm. The pan is constantly monitored and cleaned for dirt/debris and algae growth.



Relative Humidity

The average humidity for the year was calculated to be 83%. This value was 11% higher than the 50-year average.

Sunshine

There is currently no sunshine recorder installed at the Drasa station (V77555) but a request has been made to FMS to have a recorder installed at the site.

National climate outlook forum

A stakeholder consultation was held in Nadi in December. Topics that were covered included;

1. Products and services offered by FMS
2. Translating climate outlook products into sector specific statement/advisories
3. Group presentation of sector specific organisations
4. Impact-based forecasting & risk-based warnings

The main objective of the forum was to coordinate institutions and enable these partners to work together. One way to understand the difference between weather, climate variability and climate change is to think about how they operate on different time scales.

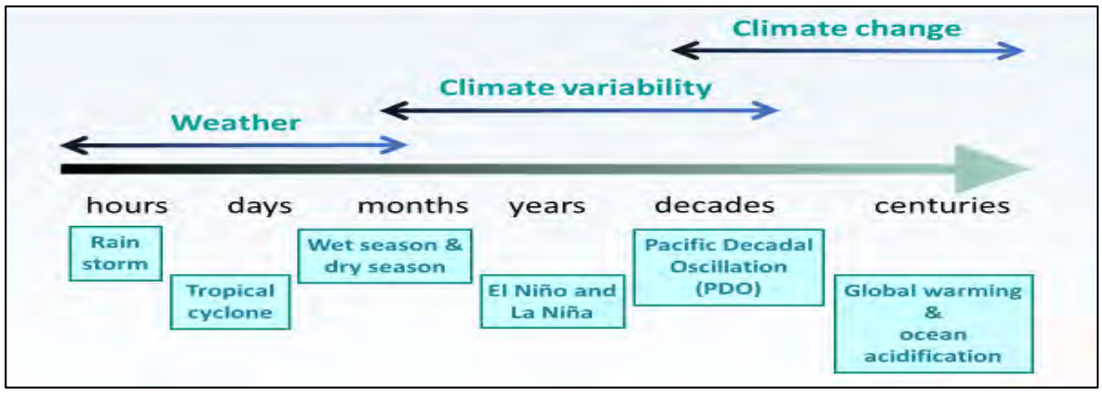
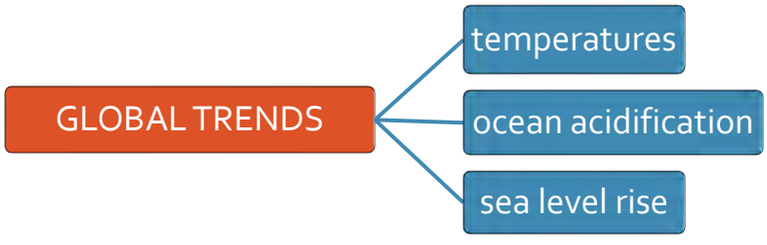


Figure 15: Different timescales

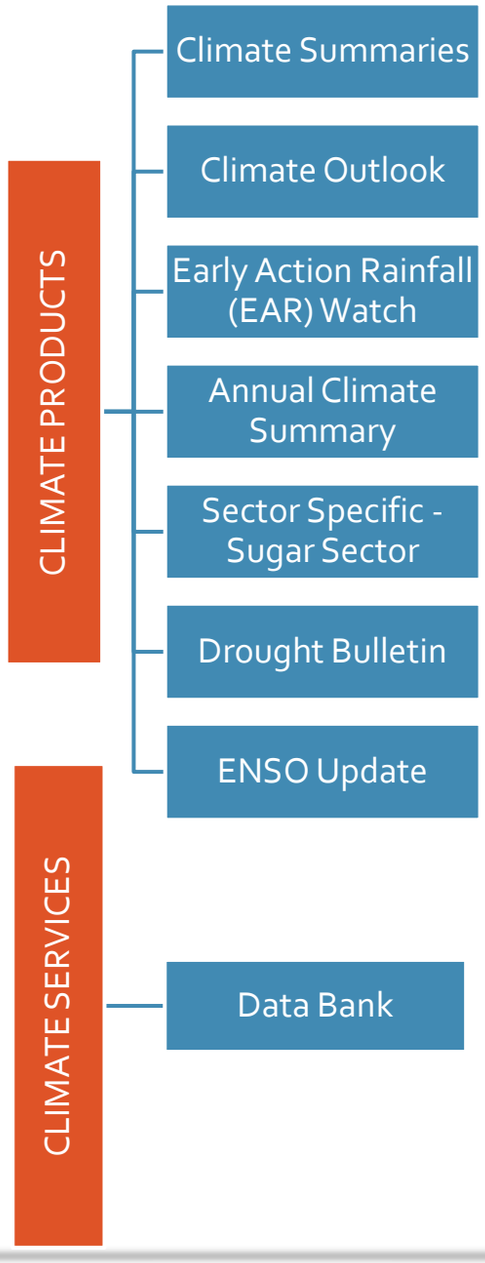
Some of the global trends that were looked into:



Some of the climate projections included:

1. Air Temperature - indicate that the annual average air temperature will increase in the future
2. Ocean acidification - acidity of sea waters in the Fiji region will continue to increase over the 21st century
3. Sea level - sea level is expected to continue to rise in Fiji over the 21st century.
4. Tropical cyclones - projections tend to show a decrease in frequency of tropical cyclones

Some of the climate products and services include:



CROP IMPROVEMENT

Highlights

- ✓ Expansion of the current genetic pool with the introduction of 120 overseas varieties to the Dobuilevu arrowing bed.
- ✓ Successfully planted the large mill trial for promising variety LF11-233

Recommendation

- ✓ Manual harvesting of germplasm.
- ✓ Stage 4 varieties to be included into germplasm for expanding genetic base.

Germplasm

The SRIF germplasm is located at Drasa Estate in Lautoka and at Rarawai Estate in Ba. In the past years the evaluation and use of the germplasm has been limited. Mechanical harvesting of the germplasm in Drasa and Rarawai has resulted in damage to stools and a loss of whole plots.

Some plots have mixed canes (volunteers) probably due to scattering of billets (canes) during harvesting. Due to growth of these volunteer canes in the roadways (gaps) separating the plots was difficult. In 2017 a project was initiated to replant the available varieties present in the old germplasm which was located in Drasa. Total of 320 varieties were planted in Drasa and Rarawai in replicate plots.

These varieties are being evaluated and characterized. The plant crop was evaluated in 2018 by sending samples to the small mill for biochemical analysis and each plot was harvested and weighed to get an estimate of yield. This year 2019, second evaluation were conducted by using the same procedure and the data gathered was used to select varieties for the flowering bed.

Total of 120 varieties from Rarawai germplasm have been transferred to the flowering bed after the first ratoon evaluation. The selected varieties are mainly with high POCS percentage and profuse flowering records. After evaluating the plant and first ratoon crop few varieties have shown outstanding traits in terms of biochemical data. Few have high POCS percentage, some have high fiber, and some have high dry weight. Field assessment was carried out to

note some physical characters. Few varieties have shown desirable features in terms of vigorous stool growth, stalk size and heights.

Figure1: Weighing of Drasa & Rarawai Germplasm

These 640 varieties (replicate of 320 varieties) will be characterized according to desirable traits and will be planted accordingly in different plots for breeding in 2020.

Flowering Beds

Figure 2: Planting 120 varieties in Dobuilevu flowering bed (transferred from Rarawai germplasm)

Flowers used for 2019 crossing was from the flowering bed in Dobuilevu, germplasm in Rarawai and Drasa and also farmer's field in Vunikavikaloa. The flowering beds consists of 10 beds, 240 plots and 480 varieties to choose from for crossing. Some of the varieties have flowered profusely while others did not flower at all. A total of 120 varieties transferred from Rarawai germplasm have been planted in Dobuilevu. The flowers from these varieties will be used during the 2020 crossing season. Total of 20 varieties from visa cane have been planted in propagated plots in Dobuilevu which will be introduced to the flowering bed in 2020.

Crossing

The 2019 crossing season commenced on 13th May and ended on 15th June. Total of 337 crosses were set-up (152 bi-parental and 185 poly) using 57 varieties as female and 201 varieties as male parents.

Table 1: Cross combination count

Crossing combinations	Female	Male
Bi-parental	32	57
Poly crosses	25	144
Experimental	6	12

The original plan was to set-up Bi-parental crosses in the new crossing shed, but the breeding shed was not ready therefore 2 temporary tents were set- up for poly-crosses and bi-parental crosses were set in the open without lanterns. The varieties available from the germplasm to set crosses have almost exhausted as there has been no expansion of the collection. All or most varieties in the flowering bed cannot be productively utilized because of space limitations for setting crosses, speed of flowering and timing of flowering. When varieties flower early in the season, they are underutilized because of the limited number of varieties available and it is difficult to find desired parents to make the crosses. The area available for setting crosses at the station is scattered over a large area. It takes a long time to cover the area to tap the male flowers to shed pollen during anther dehiscence. The actual time available for the pollen to be viable is between 20-25 minutes and it is not practical to pollinate all crosses in this time due to the large area that has to be covered. The delay in tapping flowers could have an effect on seed set. In addition, the variable climatic conditions (off season rainfall and morning dew) also affect pollination and fuzz germination. In light of above concerns it is recommended that the photo period house or alternative is installed so that flowering is delayed in some early flowering parents and experimental crosses could be made.

Figure 3: LEFT - Temporary tents for poly crosses RIGHT - Collected pollen at Dobuilevu

Fuzz Sowing and Raising of Seedlings

In 2019 fuzz sowing was delayed due to unviability of fuzz since no fuzz were in stock. Sowing commenced on 26th July and ended on 14th August. A total of 319 packets of fuzz were sown from the 2019 crossing. Total of 184 packets germinated (58%) and produced 4200 seedlings. The number of seedlings that germinate per cross varies substantially from as low as one to more than 460.

Early Stage Selection

Plant breeding program consist of four different stages from fuzz sowing to varietal release. In the stage one trials, the seedlings from the crosses are planted side by side in the field with the standards in rows of 20 seedlings. The selection criterion is limited to the most basic inherited character i.e. sugar which is estimated on the basis of the brix. Brix is a measure of total soluble solids in cane juice. In some cases, the clone appeal is taken into consideration in terms of physical appeal and agronomic desirability. This year there were four series of stage one trials which are LF2016 and LF2017 which were brixed and LF2018 and LF2019 that were planted. The four series in stage 1 is due to the rehabilitation program which was initiated after cyclone Winston left severe damages in the breeding program. Efforts was put in place in previous years to rectify measures and put the program back on track but due to some factors such as fuzz availability and weather pattern played a major role in this back log.

LF2016 STAGE 1

The trial was brixed and selection was made in 2018 but due to severe drought after planting the germination percentage was less than 5% therefore it was ploughed out. Brixing and selection was again carried out this year.

Figure 4: LF2016 Stage1- Brixing and Selection

TRIAL DETAIL

The trial consists of 4800 varieties which was planted in 2017. A total of 238 cultivars were advanced to single line six meters plot trial stage two. The brixing and selection was carried out in September.

Table 2: Selection ranges

Standard Varieties	Standards Average Brix	Selection Range (Brix)	No of varieties Selected
Qamea	24.0	≥ 24.0	35
Naidiri	23.0	23.0 – 23.9	67
Kaba	22.0	22.0 – 22.9	81
Viwa	20.5	20.5 – 21.9	44
		18.0 - 20.5	14

Few selected varieties with desirable traits but had relatively low brix been also selected and will be assessed in stage 2.

LF2017 STAGE 1

This trial was planted on May 2018 and scheduled for evaluation in May 2019. Due to the vigorous growth of cane in this trial, a decision was made to brix the trial earlier to avoid deterioration of seed cane material. Pre-brixing was carried out in February and average brix for standards was used as the bench mark of selection. Mana had the lowest brix mean of

12.8, Naidiri 13.8 and Kaba with the highest 15.0. Since February falls in the grand growth phase, 10 varieties were randomly picked from the field for pre-brixing and all these varieties brix was above the lowest standard brix.

STANDARD

Table 3: Commercial brix

Commercial varieties	Mana	Naidiri	Kaba
Brix 1	13.0	10.0	15.0
Brix 2	14.0	15.0	16.0
Brix 3	12.0	15.0	15.0
Brix 1	11.0	13.0	16.0
Brix 2	15.0	15.0	14.0
Brix 3	12.0	15.0	14.0
Average	12.8	13.8	15.0

VARIETIES

Table 4: Test varieties brix

Variety	1504	1653	1783	1716	1646	1716	1731	1643	1643	1643
Brix 1	14.0	17.0	16.0	10.0	16.0	18.0	12.0	10.0	16.0	12.0
Brix 2	15.0	17.0	17.0	15.0	16.0	12.0	17.0	20.0	15.0	15.0
Brix 3	15.0	15.0	17.0	18.0	14.0	14.0	16.0	14.0	14.0	15.0
Average	14.7	16.3	16.7	14.3	15.3	14.7	15.0	14.7	15.0	14.0

Brixing for the LF2017 Stage 1 was carried out in April. The standard average brix had increased compared to pre-brixing in February.

Table 5: Brix selection range based on commercial varieties

Standard Varieties	Standards Average Brix	Selection Range (Brix)	No of varieties Selected
Viwa	15.5	≥ 15.5	251
Naidiri	15.3	15.3 – 15.5	16
Kaba	15.3	"	"
Mana	15.2	15.2 – 15.3	13
		14.4 - 15.2	10

Total of 290 varieties were selected and progressed to stage 2 trial. Majority of the selected varieties had a higher brix than the four standards, 29 were within the range and 10 had lower brix than standard but got selected because of good physical appearance.

LF2018 STAGE 1

Total of 6300 seedlings were planted as LF2018 Stage 1 in Rarawai Estate field 6 on 13th February. The moisture level of the soil was in good condition due to continuous rain prior to the time of planting which enhanced seedling establishment.

Figure 5: Transplanting LF2018 Stage 1

LF2019 STAGE 1

The LF2019 series stage 1 single stools were planted in Field 6 at Rarawai Estate in December 2019. 4440 seedlings that were 98% of the total potted (4500) were transplanted in an area of 1.24 acres as single stools. The field was irrigated prior to planting and also received rainfall (368.2 mm) within two weeks after planting. The seedlings have established well.

Figure 6: LF2019 Stage 1 Seedling transplanted in Field 6

LF2014 STAGE 2 FINAL ASSESSMENT

According to the small mill analysis a total of 154 varieties were well above standard varieties (Brix, POCS, and Purity). After the first-round field assessment and comparison with biochemical data, a total of 62 varieties were selected. A total of 57 varieties were advanced to stage 3 observation plot trial. Data record for these 57 varieties will be kept for further assessment on second ratoon crop.

LF2016 STAGE 2

Total of 238 clones advanced to Stage 2 single line trial. The field was well prepared and irrigation was done pre and post planting when needed. Among the selected clones, 10 are the hybrid progenies which will be closely monitored in stage 2 and stage 3 trials.

LF2017 STAGE 2

The LF2017 Stage 2 trial was planted in April 2019. Total of 290 clones were selected for this Stage 2 trial. The field was well prepared and irrigation was done pre and post planting. Evaluation and selection for stage 3 will be carried out in 2020.

LF2014 STAGE 3

The trial was planted in October 2019. The selection was carried out this year by reassessing the selected varieties using biochemical data and field evaluation. Total of 57 varieties were selected and advanced to stage 3 observation plot. All the maintenance work in this trial was done on a timely basis.

Advanced Stage Trials

Advance Stage trials are the final set of trials done before identifying varieties with improved potential for commercial cultivation. The seedbed for varieties identified in Stage 3 is established in advance and planted in the following year March-April planting season at all mill location thus referred to as multi location or Genetic x Environment assessment trials. The trials are planted using statistical design (RCBD – randomized complete block design) in four replicates at each location and the biochemical, field and yield assessments are carried for 3 crop cycles – plant (P), first ratoon (1R) and second ratoon (2R).

The seed cane propagation for varieties showing good data in plant crop is initiated using seed cane form the Stage 4 trial as well as the Stage 4 seed bed. These varieties are further scrutinized using first ratoon data and varieties are selected for farmer feel effect (FFE). The

field observation data, disease data and biochemical data together with yield data form an integral part of selection. In 2019, LF2012 series was in second crop cycle i.e. first ratoon, LF2013 series was in first crop cycle i.e. plant crop whilst LF2015 series was established and first crop cycle will be analysed in 2020. Following are details of evaluation carried out for respective trials in 2019.

LF2012 Series

The trials for this series were established in 2017 at all mill locations namely Rarawai, Drasa, Penang and Labasa and plant crop was evaluated in 2018. In 2019, the second crop cycle assessments were carried out and the details of selection from Rarawai, Drasa and Penang are presented below. The black highlighted are based on data being better or equal to standards (commercial varieties planted with the trial).

Table 6: Bio-chemical data for LF2012 varieties in 3 locations

Variety	Rarawai				Drasa				Penang			
	Tph	Fiber	Pocs	Tsh	Tph	Fiber	Pocs	Tsh	Tph	Fiber	Pocs	Tsh
LF12-112	65	9.6	13.2	9	82	10.5	13.3	11	49	9.5	12.7	6
LF12-114	86	11.3	12.2	11	69	12.5	12.9	9	56	13.3	12.1	7
LF12-153	78	10.4	13.3	10	79	11.8	14.4	11	54	10.9	13.7	8
LF12-154	25	11.4	13.5	3	71	10.6	14.2	10	59	11.1	12.0	7
LF12-2	89	9.1	12.4	11	47	9.3	14.9	7	60	9.4	14.2	8
LF12-22	85	12.2	11.7	10	81	14.2	12.5	10	61	13.8	13.1	8
LF12-233	105	10.6	10.7	12	81	11.6	12.6	11	80	11.4	12.4	10
LF12-253	75	13.2	11.2	8	54	14.7	12.7	7	51	13.0	11.7	6
LF12-255	67	11.8	11.2	8	61	12.8	11.6	8	56	13.1	10.2	6
LF12-276	67	8.4	13.4	9	55	8.7	14	8	61	9.0	14.6	9
LF12-282	85	11.6	12.3	11	77	11.4	12.8	10	49	11.8	13.0	6
LF12-31	90	9.0	10.2	9	83	10.1	11.6	10	58	9.8	10.2	6
LF12-34	63	11.2	12.9	8	57	11.1	14.7	8	58	12.2	12.9	7
LF12-40	85	12.5	13.7	12	41	13.9	13.5	6	60	12.7	12.7	8
LF12-63	88	12.1	11.4	10	121	11.6	11.1	13	60	12.0	11.5	7
LF12-74	55	13.2	11.1	7	64	12.1	12.9	8	54	14.0	10.2	6
LF12-76	95	10.5	11.5	11	54	10.3	12.5	7	51	10.8	12.5	6
Mana	84	8.4	12.1	11	70	8.8	13.7	10	56	8.6	12.6	7
Naidiri	75	10.0	13.2	10	63	10.4	14.6	9	62	10.6	13.5	9
Ragnar	74	9.0	12.1	9	-	-	-	-	49	9.8	12.4	6

better than data of standard varieties

Based on the above presented data, LF12- 153, LF12-2 and LF12-40 are consistent at least at 2 mills whereas LF12-282 could be re-looked in second ratoon. Except for LF12-40, the seed cane for other 2 varieties are already being propagated based on plant crop data.

LF2013 series

The trials for this series were established at all mill locations in 2018 and first crop cycle was evaluated in 2019. The data from two mill locations is presented below:

Table 7: Bio-chemical data for LF2013 varieties in 2 locations

Variety	Rarawai				Penang			
	Tph	Fiber	Pocs	Tsh	Tph	Fiber	Pocs	Tsh
LF13-116	98	8.6	12.5	12	104	8.2	9.4	10
LF13-238	92	9.7	13.4	12	50	10.0	11.7	6
LF13-405	78	9.0	13.4	8	77	9.3	9.4	7
LF13-410	90	9.0	13.2	12	82	7.9	9.5	8
LF13-427	108	8.9	12.2	13	98	9.5	11.7	11
LF13-441	96	8.0	13.5	13	85	8.2	10.4	9
LF13-452	107	9.6	13.7	15	68	8.2	10.5	7
LF13-454	140	9.8	12.4	17	122	9.2	8.8	11
LF13-460	74	9.8	11.9	9	113	8.5	8.2	9
LF13-468	114	9.1	12.1	14	131	8.8	9.3	12
LF13-485	104	8.1	12.7	13	100	9.0	10.7	11
LF13-543	93	15.4	10.5	10	86	12.7	7.7	7
LF14-452	87	10.2	14.5	13	-	-	-	-
Mana	113	7.8	12.5	14	99	7.6	10.4	10
Naidiri	121	9.8	13.9	17	87	9.8	11.2	10

better than data of standard varieties

Figure 7: LF2013 harvesting

Based on the above presented data, none of the varieties are adapted to both trial locations, instead, variety LF13-454 is better suited to Rarawai mill area with bio-chemical performance being better than the standard commercial varieties Mana and Naidiri. Similarly, LF13-427 and LF13-485 are both suited for Penang (Rakiraki region) when comparing to the standard commercial varieties planted in the same location.

Farmer Feel Effect

The five varieties from LF2009 series that were planted in 2 farms in 2018 were closely monitored and farmer feedback noted. The variety highlighted (LF09-1707) below has been identified for large mill trial and seed cane propagation for this variety has been initiated.

Table 8: Bio-chemical data for LF2013 varieties in 2 locations

Variety	Fiber			Pocs			Tph			Tsh		
	P	1R	2R	P	1R	2R	P	1R	2R	P	1R	2R
LF09-1536	10.9	12.9	8.4	14.9	7.2	13.1	122	105	44	18.0	5.0	6.0
LF09-1558	12.3	13.5	8.4	13.0	13.8	12.8	111	122	52	14.0	13.0	7.0
LF09-1632	10.1	12.7	8.0	15.3	14.5	13.8	104	114	62	16.0	12.0	9.0
LF09-1707	11.2	12.7	8.5	15.6	10.5	13.2	144	125	57	22.0	10.0	7.0
LF09-635	9.5	15.5	8.2	15.6	5.9	13.8	106	104	59	17.0	7.0	8.0
Mana	9.3	13.3	7.2	15.5	9.7	14.3	125	128	49	19.0	9.0	7.0
Kaba	9.6	12.0	9.0	13.8	7.9	13.5	133	118	46	18.0	6.0	6.0
Naidiri	11.0	13.1	9.4	15.7	7.7	13.3	92	102	35	14.0	6.0	5.0

*P – Plant, 1R – first ratoon, 2R – second ratoon

Large Mill Trial

LF2011 series

The LF2011 series stage 4 was established in 2015 and one variety has been identified and currently seedbed has been established to plant LMT in March-April 2020. The data for this variety in comparison to standards is provided in the table below. The large mill trial for this variety is planned in year 2021 and to be released either same year or 2022.

Table 9: Bio-chemical data for LF2013 varieties in 2 locations

Variety	Fiber			Pocs			Tph			Tsh		
	P	1R	2R	P	P	1R	2R	P	P	1R	2R	P
LF11-233	8.1	10.1	10.5	13.0	12.5	14.7	106	91	77	13.8	12.8	11.3
MANA	6.9	9.0	9.6	13.4	12.1	15.0	116	125	62	16.0	15.0	10.0
NAIDIRI	9.4	10.4	10.1	11.8	13.3	16.1	114	135	70	14.0	18.0	11.0

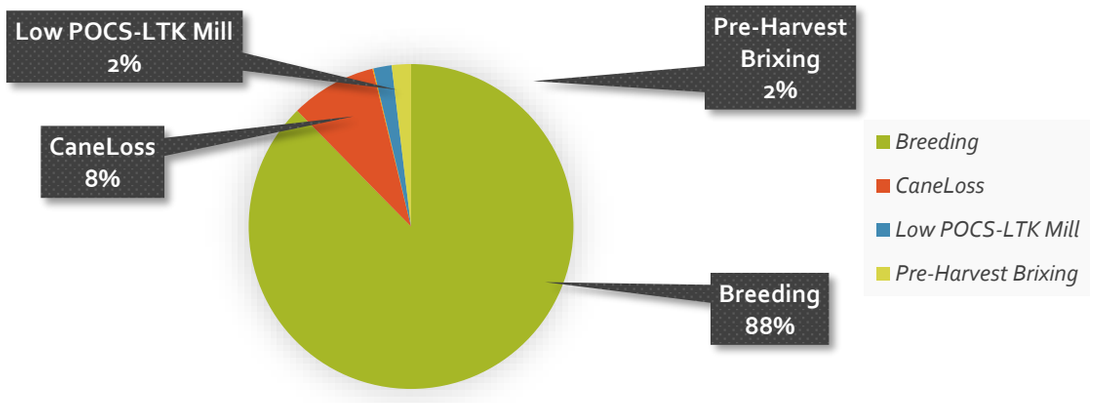
*P – Plant, 1R – first ratoon, 2R – second ratoon

CROP MANAGEMENT

Biochemical analysis of Sugarcane

The small mil provides necessary information on cane such as %pol, %brix, %fiber and the %POCS on various ongoing trials. These analyses also quantify the purity of sugarcane. It is a vital aspect for varietal selection determination from initial stage till the final stage of breeding. This analysis is carried out to quantify the quality of sugarcane in response to various agronomic practices, impacts of pest and diseases, experiment or as field audit. A total of 2025 samples were crushed and analyzed in 2019. The breeding trials had the majority of samples crushed and analyzed.

Figure 1: Summary of the Biochemical Analysis 2019



Experiment to determine the effect of Cane delay on Sugar Losses

Abstract

The impact of time delay between harvest to crush of green and burnt cane is one of the major issues facing the Sugar Industry in Fiji. The delay contributes to juice viscosity, factory processing problem and sucrose deterioration of green and burnt cane from cut to crush. Sucrose is the chief component of cane that is refined to table sugar. It is a disaccharide which is composed of 2 monosaccharide (fructose & glucose). An experiment was carried out to determine the sucrose deterioration in the green and burnt cane composing of 5 treatments (whole stalk, 6" billet, 8" billet, 10" billet, 12" billet). This experiment was carried out over 10 days in a planned interval for crushing the samples and analyzing through NIR and Polarimeter.

Introduction

Sugarcane is considered to be a perishable commodity which must be processed into sugar as soon as it is harvested (Sugar Tech 2009 Vol.11 No.2 pp.109-123 ref). One of the major challenges in obtaining high recoverable sugar or sucrose is the delay between cut to crush which causes sugar losses in milling. In sugarcane, sucrose is a chief component that is refined to table sugar.

The cut to crush delay lowers sucrose content which leads to the reduction of recoverable sugar and problem in milling (Gillian, E., Jacob, K., Anthony, P., Benjamin, L., (2008)). A few of the sugar technologists have reported that several products cause sucrose deterioration and delay of cut to crush were used to determine factory processing difficulties (Eggleston, Legendre, & Richard 2001a, b, in press: Lionnet, 1996: Morel du boil, 1995). The losses caused by delay from cut to crush is not quantified and is a problem as recoverable sugar reduces and Total Soluble Solids (TSS-Fiber) increases.

Materials and Methods

The experiment was carried out over 10 days at the institute where 170 cane samples were cut from SRIF estate. It was analyzed through the NIR, juice extracted through a cover press and read through Polarimeter and fiber weighed and oven dried for 3 days with the object of sucrose deterioration analysis in 10 days period. There were 2 plots chosen for the experiment opposite to each other, one plot was burnt for the burnt cane samples. The cane was burnt prior to the harvesting day, in the afternoon at 2pm. Harvesting of the burnt and green cane was carried out at 6am the next day and sampling was done as soon as the cane was harvested.

Table 1: 5 treatments of the burnt and green cane

	Green	Burnt
Whole stalk	✓	✓
6-inch billet (6″ billet)	✓	✓
8-inch billet (8″ billet)	✓	✓
10-inch billet (10″ billet)	✓	✓
12-inch billet (12″ billet)	✓	✓

In a sample there were 6 stalks tied together, 85 samples were from burnt and 85 samples green cane. The burnt cane was harvested first and sampled followed by the green cane. The cane samples were cut into respective billet treatment size. The billeted cane samples were stored into allocated caged bin.

The analysis procedure of each sample at different hour

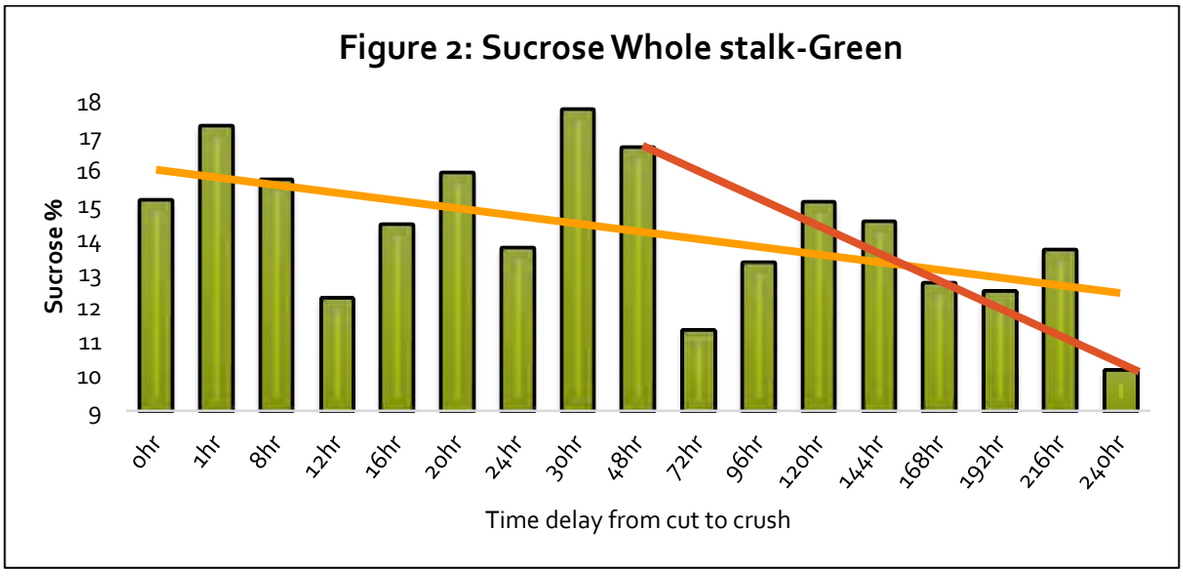
The analysis was carried out according to time delay as follows 0hr, 4hr, 8hr, 12hr, 16hr, 20hr, and 24hr for day 1 following by 30hr and 48hr on day 2. Thereafter the analysis was carried out at 24hr interval from day 3 to day 10.

Results and Discussion

In this experiment 5 treatments, Whole stalk, 6" billet, 8" billet, 10" billet and 12" billet of the Green and Burnt cane samples were analyzed. There was only one commercial variety (Mana) that was used for the experiment. It has been observed from the data that the total soluble sugar (TSS) ranges from 7%- 13% for green, 7%-13% for burnt within 10days and sucrose range falls between 17%-7% for green and burnt within 10days. The analysis was conducted to assess sucrose loss in cane delay from cut to crushing. The orange line on the graph shows the linear decline trend and the red line shows the day from which there is accelerated decline in sucrose.

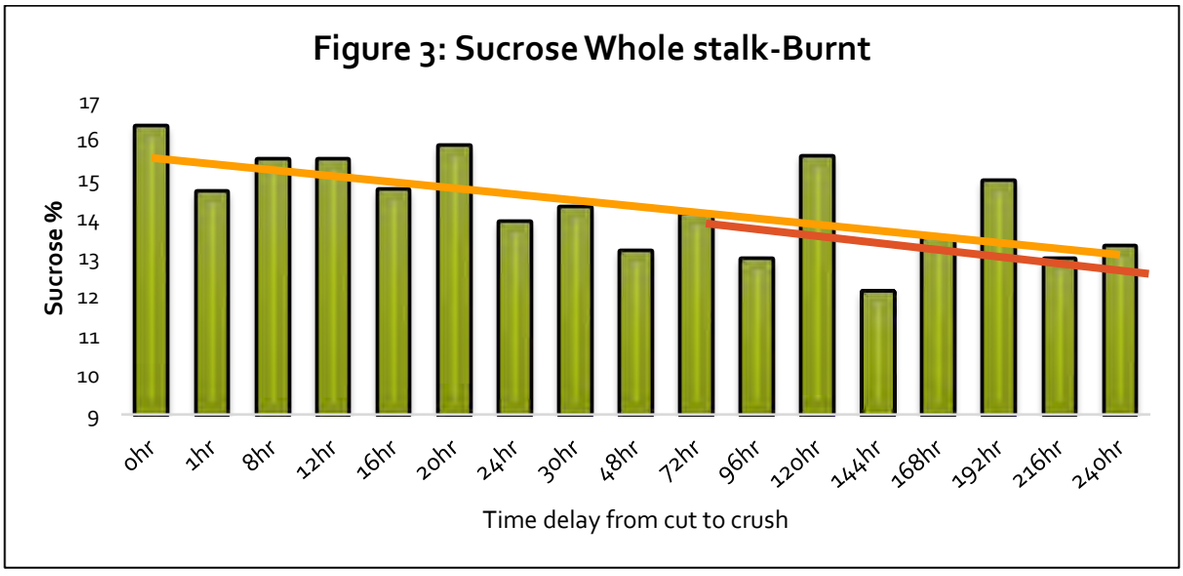
Sucrose content for cut to crush delay samples

Whole stalk green cane



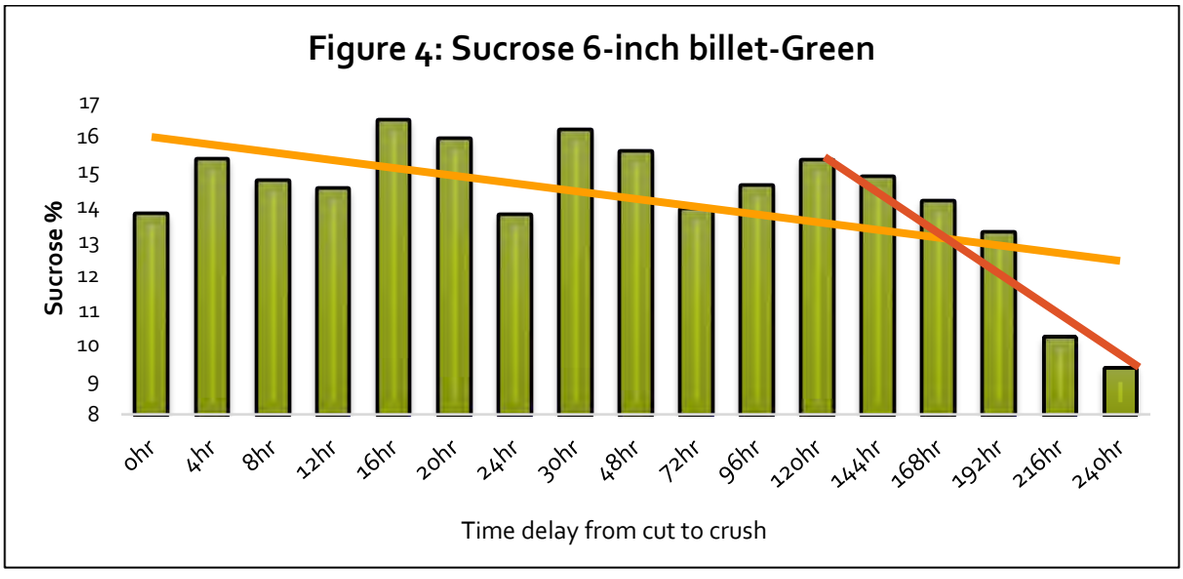
The sucrose content over 10 days ranged between 10.0 – 17.8%. There was a slight decrease in sucrose for cut to crush delay at 12, 24 and 72 hours. After 48 hours, there was an accelerated decline in sucrose from 16.7% to 10.1% on day 3 on day 10. The cut to crush delay of the Green Whole stalk Sugarcane to obtain high sucrose (>12.0%) is within 48 hours. After 48 hours, there is rapid decline in sucrose content. The low sucrose values for cut to crush delay of 12, 24, 72 and 96 hours could be due to sampling error.

Whole stalk burnt cane



The sucrose content over 10 days ranged between 12.0% – 16.4%. There was a slight decrease in sucrose for cut to crush delay from 0 to 16hours. After 72 hours, there was an accelerated decline in sucrose from 14.0% to 12.0% on day 6. The cut to crush delay of the Burnt Whole stalk Sugarcane to obtain high sucrose (>14.0%) is within 72 hours. After 72 hours, there is rapid decline in sucrose content. The high sucrose values for cut to crush delay of 120, 168 and 192 hours could be due to sampling error.

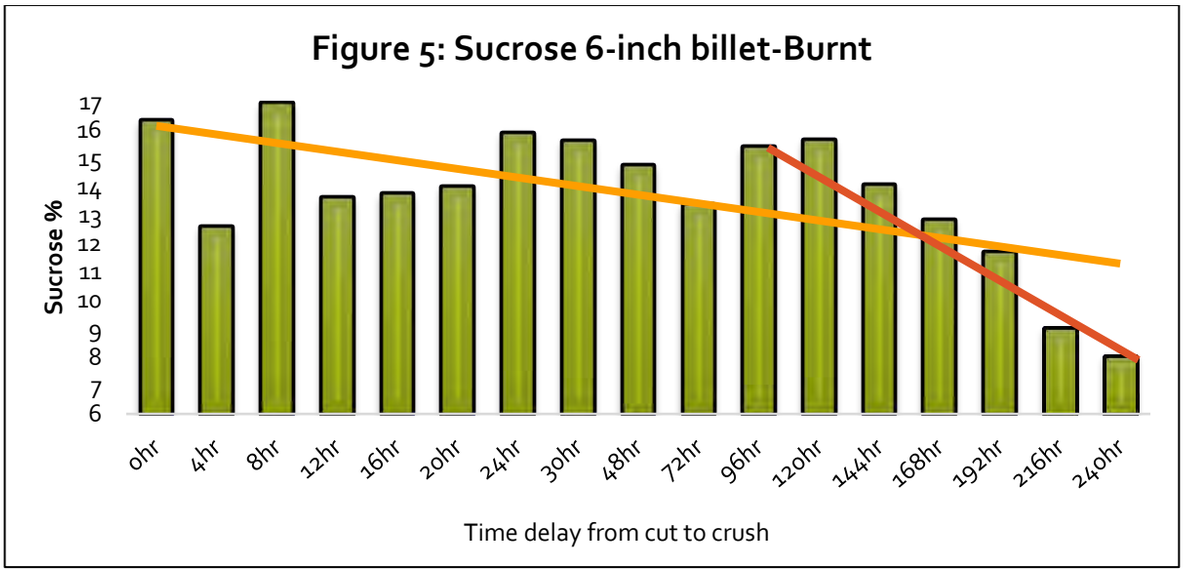
6-inch billet green cane



The sucrose content over 10 days ranged between 9.3% – 16.5%. There was a slight decrease in sucrose for cut to crush delay on the 24th hour. After the 120th hour, there was an accelerated decline in sucrose from 15.3% - 9.3%. The cut to crush delay of the green 6-inch billet sugarcane to obtain high sucrose (>15.3%) is within 120 hours. After the 120th hour

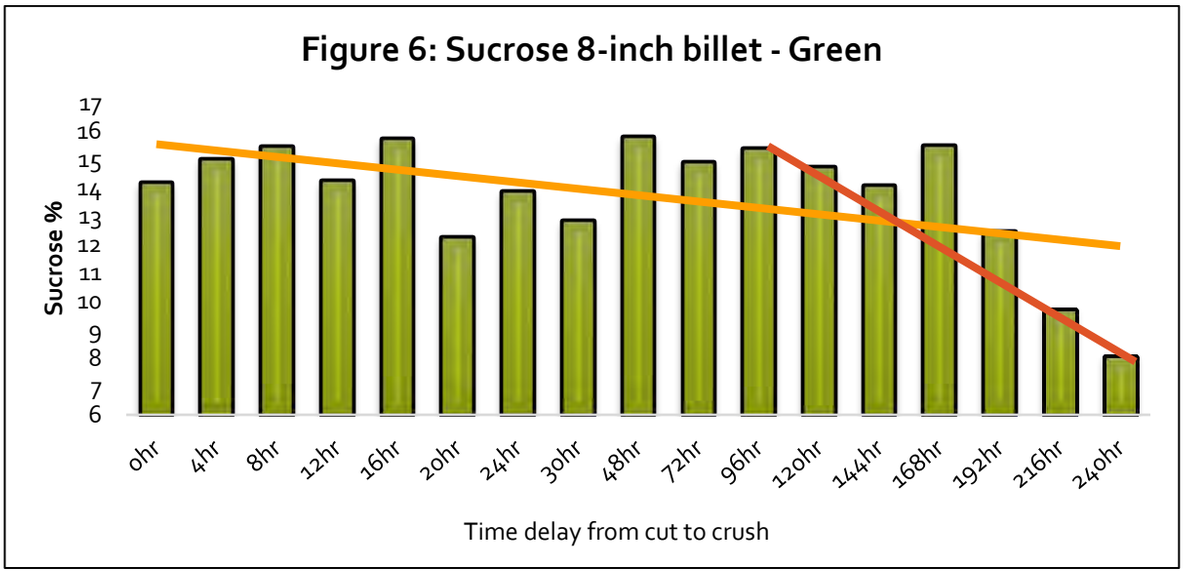
there is a rapid decline in sucrose content. The high sucrose values for cut to crush delay of 16, 20, 30, and 48th hour could be due to sampling error.

6-inch billet treatment - Burnt



The sucrose content within 5 days ranged between 12.6% - 16.3 %. There was a slight decrease in sucrose for cut to crush delay on the 4, 12-20, and 72 hours. After 96 hours, there was an accelerated decline in sucrose from 15.4% – 8.0% on day 10. The cut to crush delay of the Burnt 6-inch billet sugarcane to obtain high sucrose (>15.4%) is within 96 hours. After 96 hours, there is rapid decline in sucrose content. The high sucrose values for cut to crush delay of 8, 24, 96, 120 and 148 hours could be due to sampling error.

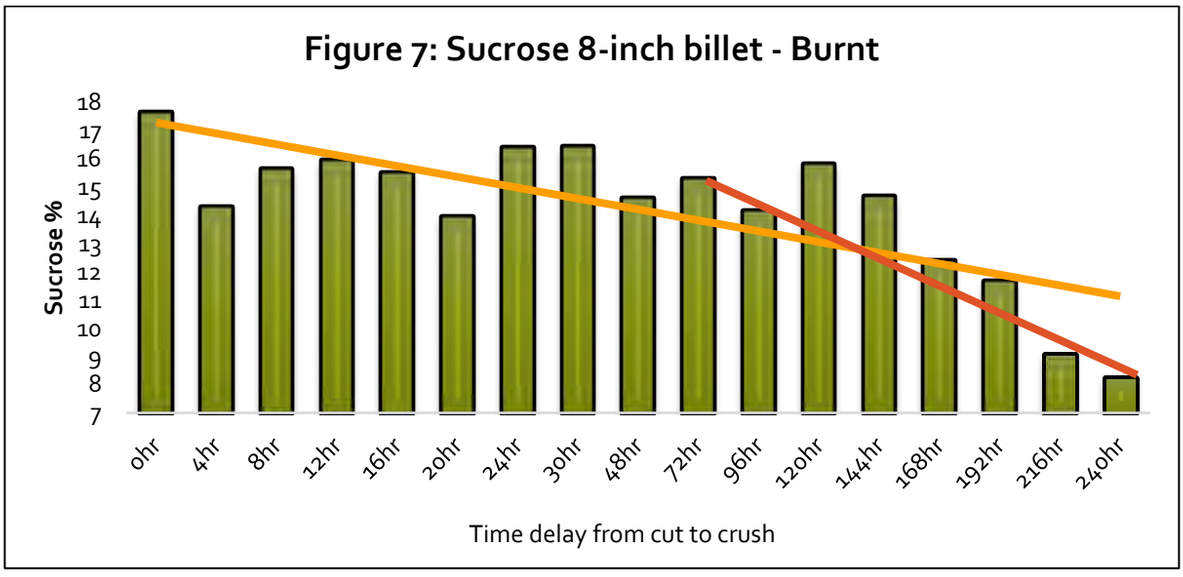
8-inch billet treatment - Green



The sucrose content within 7 days ranged between 12.2% - 15.8%. There was a slight decrease in sucrose for cut to crush delay on the 8,20 – 30 hours. After 96 hours, there was an accelerated decline in sucrose from 15.4% - 12.2% on day 10.

The cut to crush delay of the Green 8-inch billet sugarcane to obtain high sucrose (>15.4%) is within 96 hours. After 96 hours, there is rapid decline in sucrose content. The low sucrose values for cut to crush delay of 20 and 30th hour could be due to sampling error.

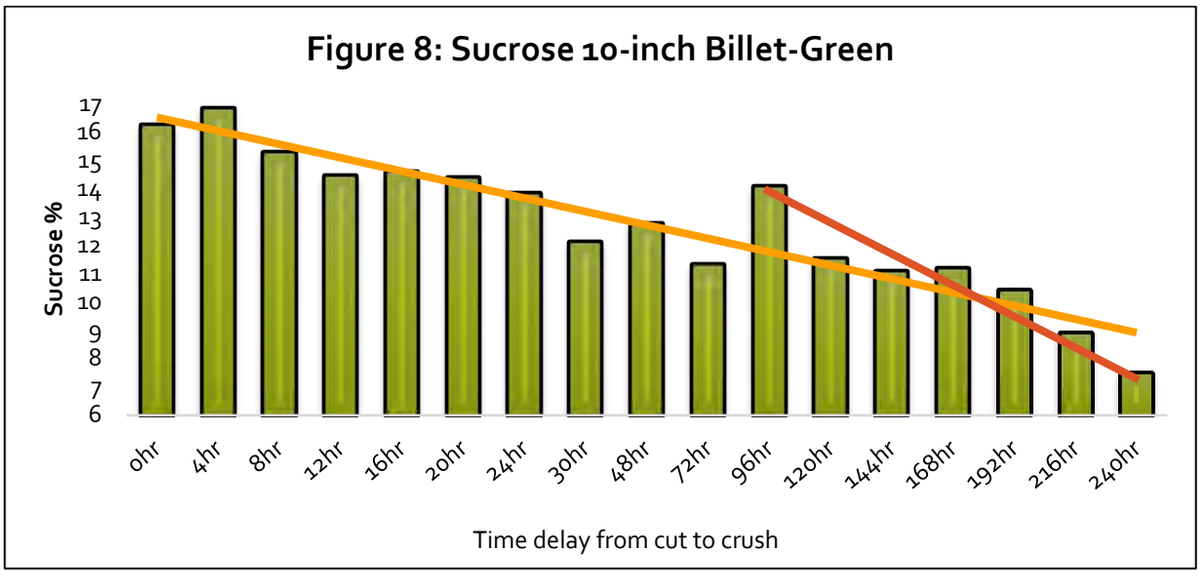
8-inch billet treatment - Burnt



The sucrose content within 7 days ranged between 11.6% – 17.7 %. There was a slight decrease in sucrose for cut to crush delay on the 20th hour. After 72 hours, there was an accelerated decline in sucrose from 15.3% – 8.2% on day 10.

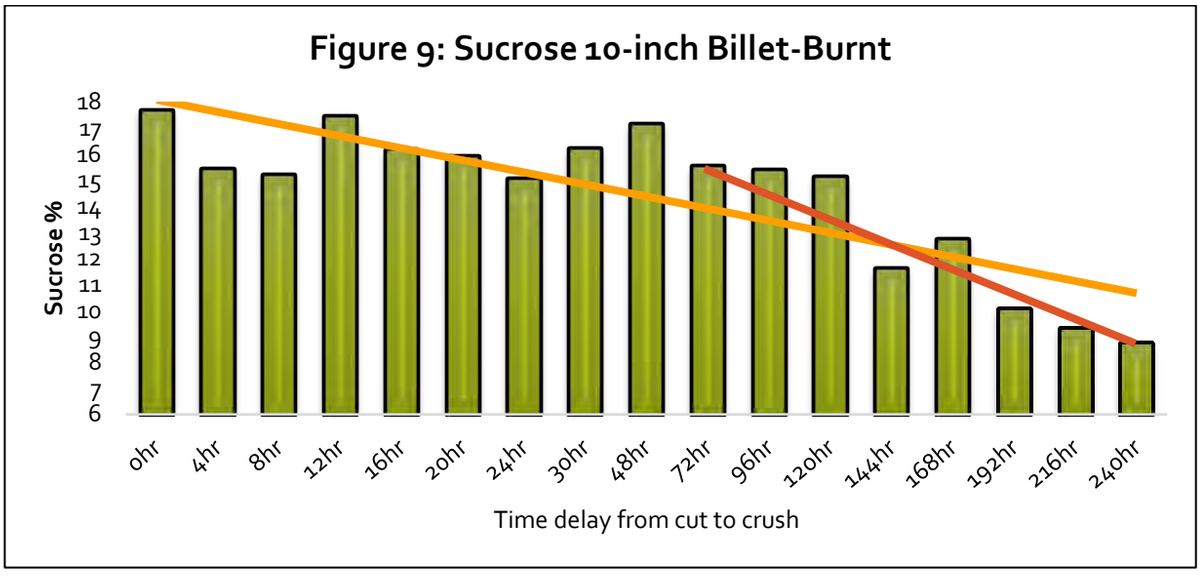
The cut to crush delay of the Burnt 8-inch billet sugarcane to obtain high sucrose (>15.3%) is within 72 hours. After 72 hours, there is rapid decline in sucrose content. The high sucrose values for cut to crush delay of 120 and 144 hour could be due to sampling error.

10-inch billet treatment – Green



The sucrose content within 4 days ranged between 11.3% – 16.8 %. There was a slight decrease in sucrose for cut to crush delay on the 24th hour. The cut to crush delay of the Green 10-inch billet sugarcane to obtain high sucrose (>11.3%) is within 72 hours. After 72 hours, there is rapid decline in sucrose content from 11.5% – 7.5% on day 10. The high sucrose values for cut to crush delay of the 96th hour could be due to sampling error.

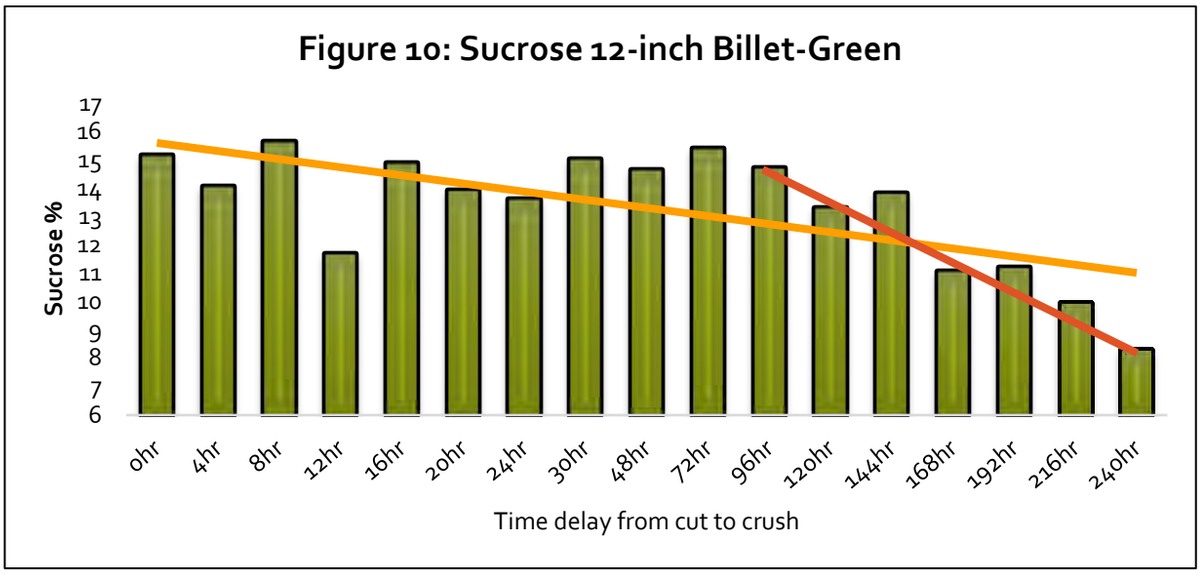
10-inch billet treatment – Burnt



The sucrose content over 5 days ranged between 15.0% – 17.7%. After 120 hours, there was an accelerated decline in sucrose from 12.7% on day 5 to 8.7% on day 10. The cut to crush delay of the Burnt 10-inch billet Sugarcane to obtain high sucrose (>15.5%) is within 72

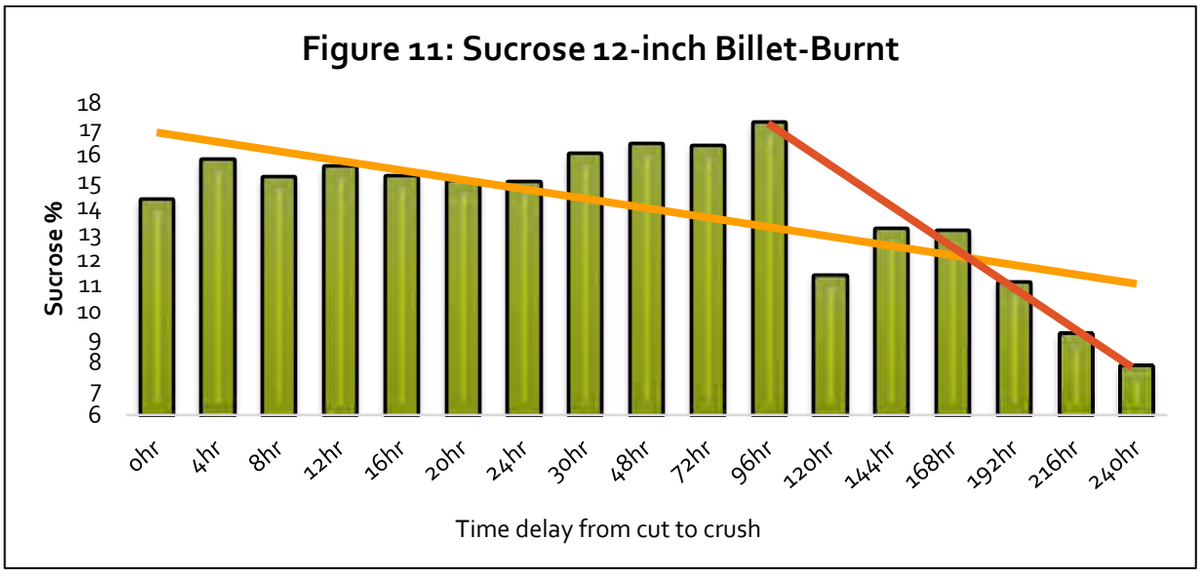
hours. After 72 hours, there is decline in sucrose content. The low sucrose values for cut to crush delay of 4 and 8 hours could be due to sampling error.

12-inch billet treatment – Green



The sucrose content over 3 days ranged between 15.6% – 11.7 %. There was a slight decrease in sucrose for cut to crush delay on the 12 hours. After 96 hours, there was an accelerated decline in sucrose from 14.7% on day 4 to 8.3% on day 10. The cut to crush delay of the Green 12-inch billet Sugarcane to obtain high sucrose (>11.7%) is within 96 hours. The low sucrose values for cut to crush delay of 4 and 12 hours could be due to sampling error.

12-inch billet treatment – Burnt

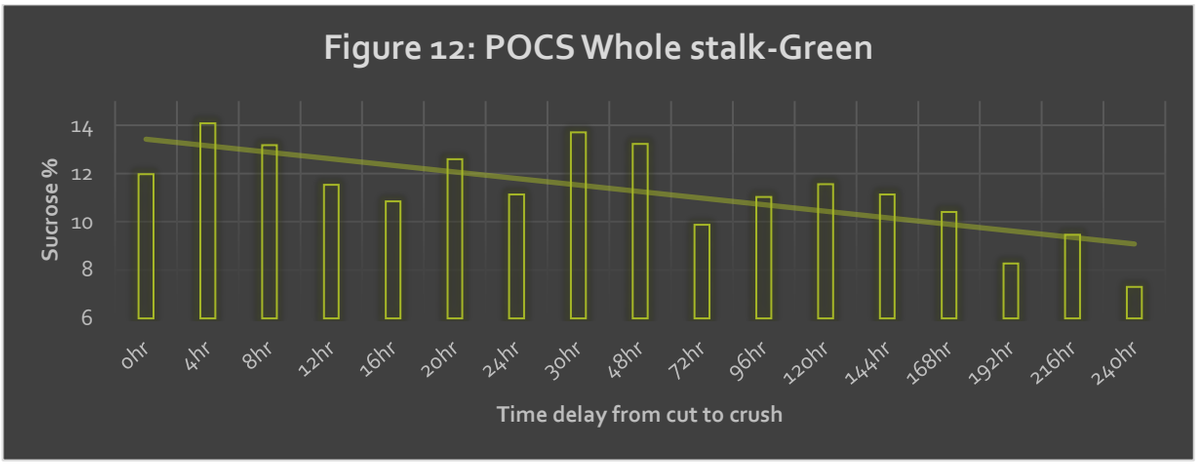


The sucrose content over 4 days ranged between 17.2% – 14.2 %. There was a slight increase in sucrose for cut to crush delay from 30 – 96 hours and this could be due to sampling error.

After 96 hours, there was an accelerated decline in sucrose from 13.1% on day 4 to 7.9% on day 10. The cut to crush delay of the Burnt 12-inch billet Sugarcane to obtain high sucrose (>14.2%) is within 96 hours. The low sucrose values for cut to crush delay of 0 and 8 hours could be due to sampling error.

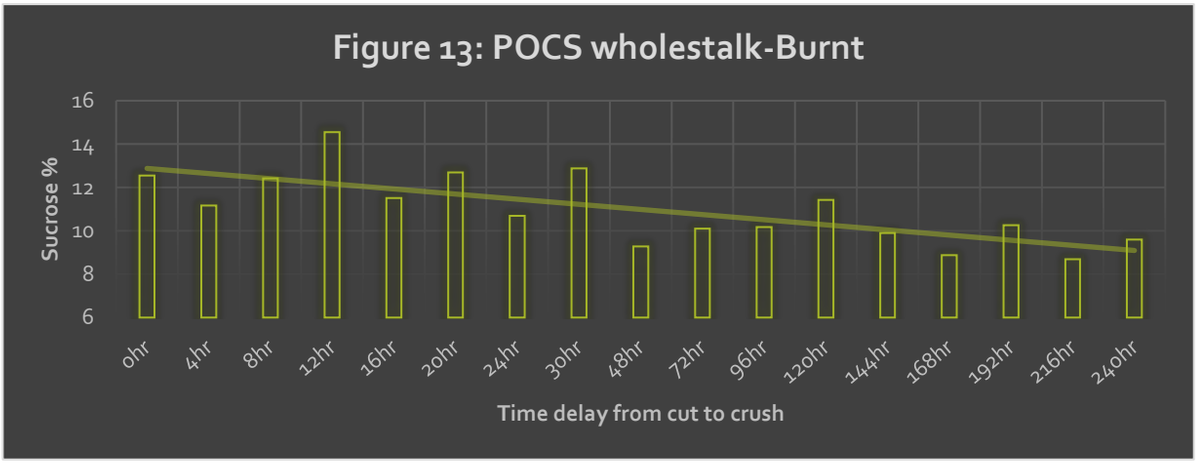
POCS

Whole stalk treatment - Green



The POCS content over 10 days ranged between 7.3% – 14.1%. There was slight decrease in POCS for cut to crush delay from 4 – 16 hours. After 48 hours, there was an accelerated decline in POCS from 11.6% to 7.3% on day 2. The cut to crush delay of the Green Whole stalk Sugarcane to obtain high POCS (>10.8%) is within 48 hours. After 48 hours, there is rapid decline in POCS content.

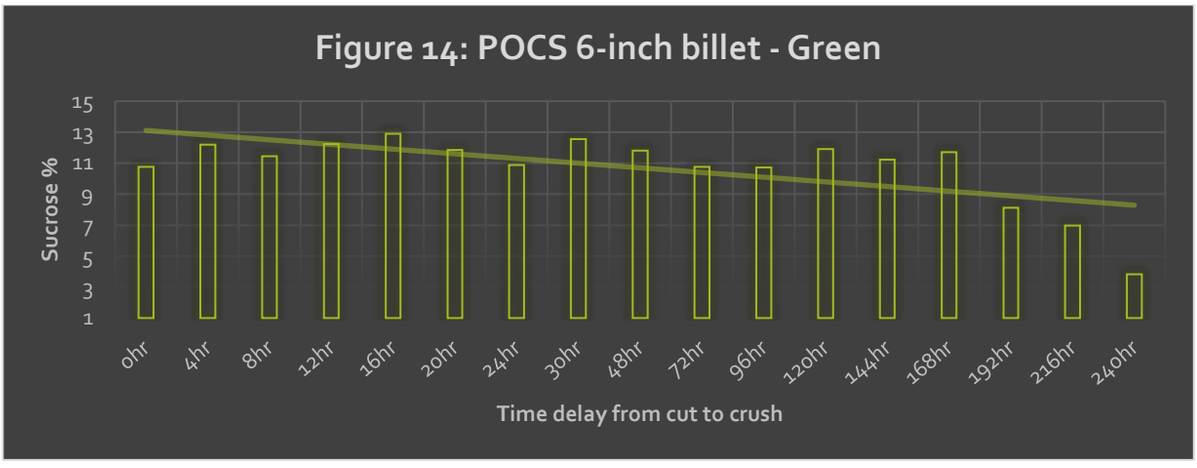
Whole stalk treatment – Burnt



The POCS content over 10 days ranged between 8.7% – 14.6 %. There was slight decrease in POCS for cut to crush delay from 12 - 24 hours. After 120 hours, there was an accelerated

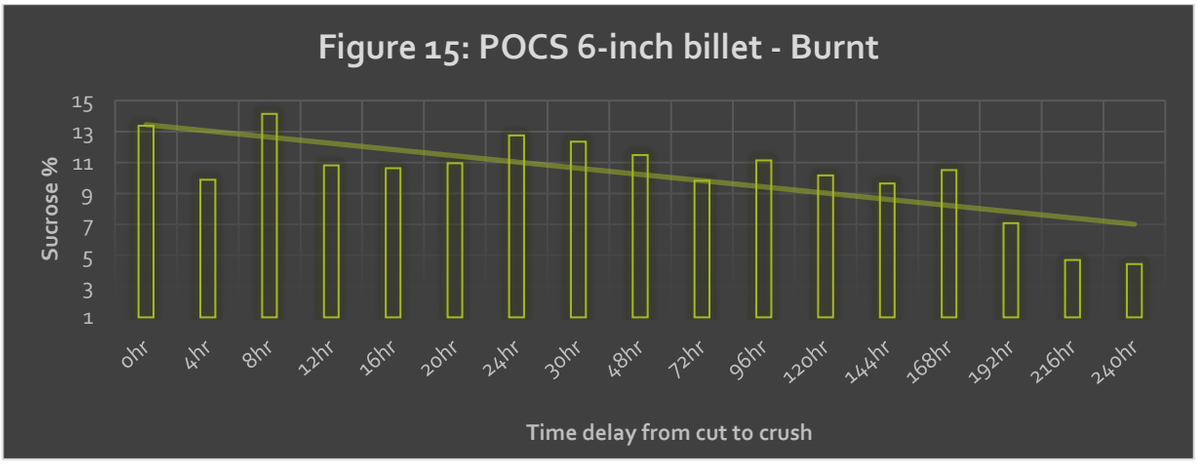
decline in POCS from 10.3% to 8.7% on day 5. The cut to crush delay of the Burnt Whole stalk Sugarcane to obtain high POCS (12.9%) is within 30 hours. After 30 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 120, 192 and 240 hours could be due to sampling error.

6-inch billet treatment – Green



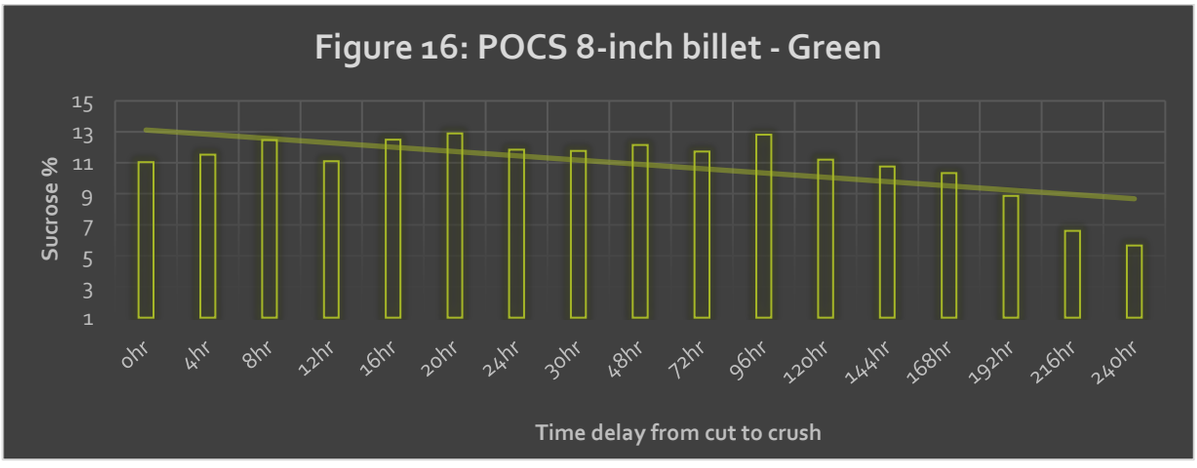
The POCS content over 8 days ranged between 8.1% – 12.9%. There was slight decrease in POCS for cut to crush delay from 16 - 20 hours and 30 – 96 hours. After 168 hours, there was an accelerated decline in POCS from 8.12 % on day 7. The cut to crush delay of the Green 6-inch billet Sugarcane to obtain high POCS (11.8%) is within 48 hours. After 48 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 120, 144 and 168 hours could be due to sampling error.

6-inch billet treatment - Burnt



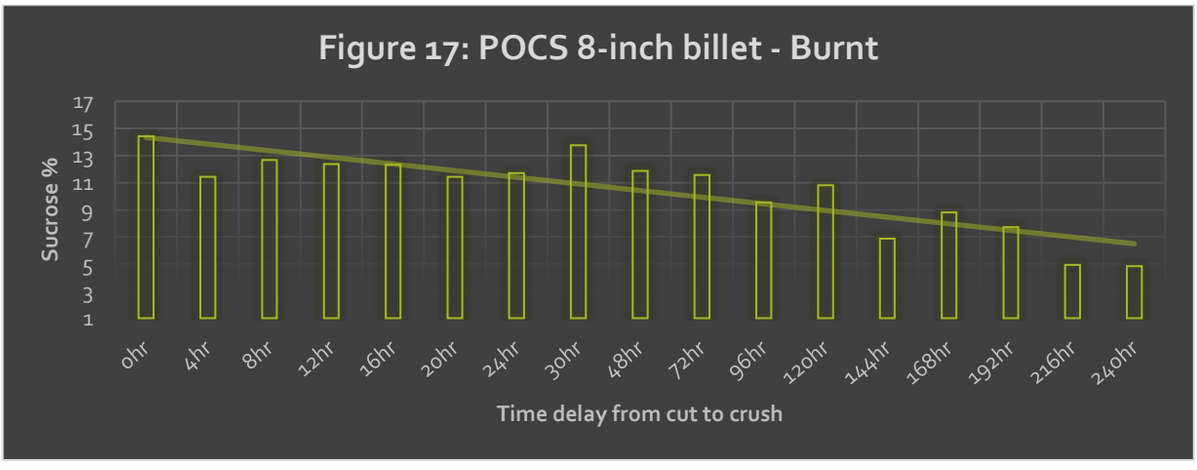
The POCS content over 8 days ranged between 4.4% – 14.5 %. There was slight decrease in POCS for cut to crush delay from 4, 12 - 20 hours. After 48 hours, there was an accelerated decline in POCS from 11.1 % on day 7. The cut to crush delay of the Burnt 6-inch billet Sugarcane to obtain high POCS (>11.1%) is within 48 hours. After 48 hours, there is rapid decline in POCS content. The low POCS values for cut to crush delay of 4, 12 - 20 hours could be due to sampling error.

8-inch billet treatment – Green



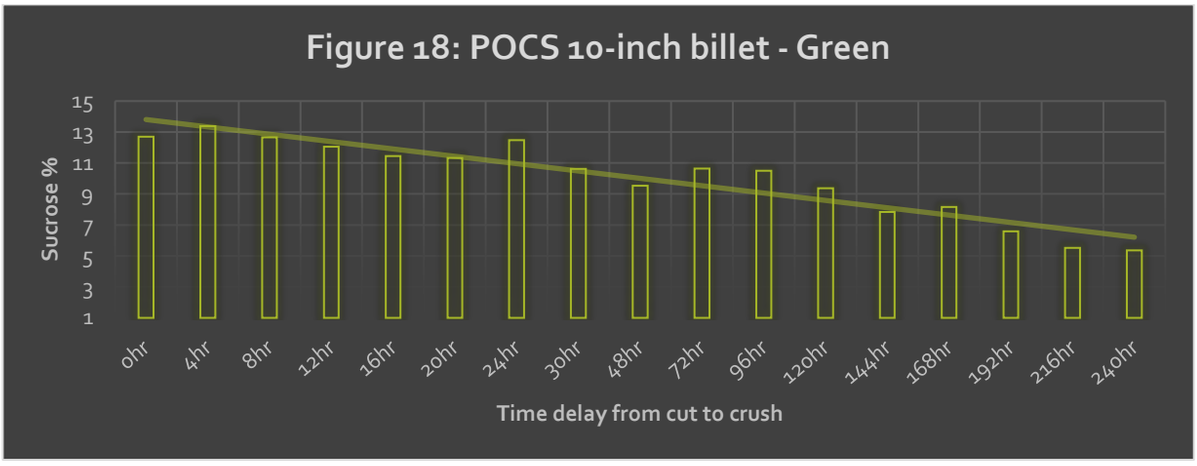
The POCS content over 9 days ranged between 8.9% – 12.1%. After 96 hours, there was an accelerated decline in POCS from 12.8 % on day 7. The cut to crush delay of the Green 8-inch billet Sugarcane to obtain high POCS (>12.1%) is within 48 hours. After 48 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 72 and 120 hours could be due to sampling error.

8-inch billeted treatment – Burnt



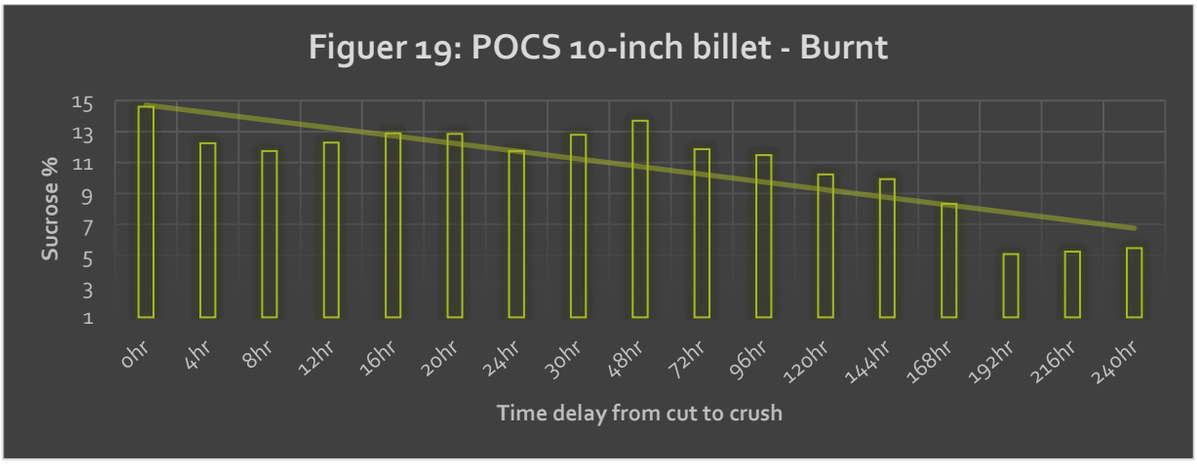
The POCS content over 8 days ranged between 4.5% – 14.5%. After 48 hours, there was an accelerated decline in POCS from 11.9% on day 2. The cut to crush delay of the Burnt 8-inch billet sugarcane to obtain high POCS (>11.9%) is within 48 hours. After 48 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 30 hours could be due to sampling error.

10-inch billet treatment – Green



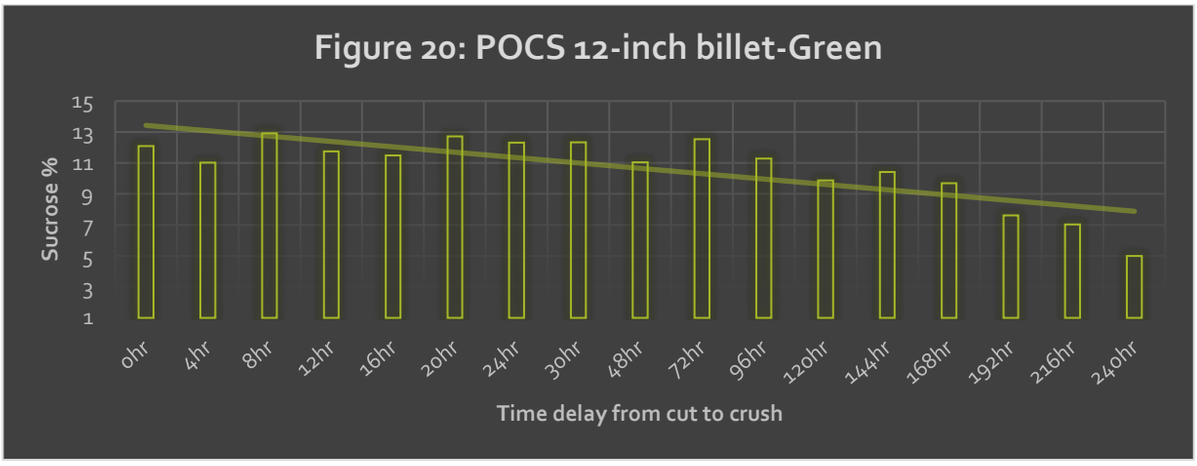
The POCS content over 8 days ranged between 5.4% – 13.4%. After 72 hours, there was an accelerated decline in POCS from 10.6% on day 5. The cut to crush delay of the Green 10-inch billet Sugarcane to obtain high POCS (>10.6%) is within 72 hours. After 72 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 24, 72-96 hours could be due to sampling error.

10-inch billet treatment - Burnt



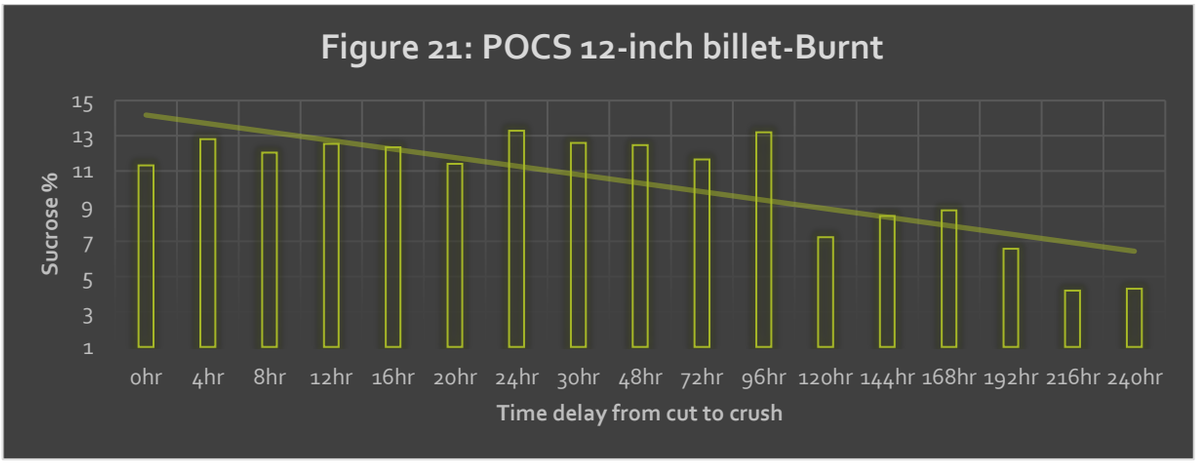
The POCS content over 7 days ranged between 5.0% – 14.6%. After 48 hours, there was an accelerated decline in POCS from 13.7% – 5.08% on day 4 to day 10. The cut to crush delay of the Burnt 10-inch billet Sugarcane to obtain high POCS (>13.7%) is within 48 hours. After 48 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 72 hours could be due to sampling error.

12-inch billet treatment – Green



The POCS content over 9 days ranged between 7.6% – 13.0%. After 72 hours, there was an accelerated decline in POCS from 12.5% – 7.6% on day 4 to day 10. The cut to crush delay of the Green 10-inch billet Sugarcane to obtain high POCS (>12.5%) is within 72 hours. After 72 hours, there is rapid decline in POCS content. The high POCS values for cut to crush delay of 96 and 144 hours could be due to sampling error.

12-inch billet treatment – Burnt



The POCS content over 8 days ranged between 13.3% - 6.6%. After 48 hours, there was an accelerated decline in POCS from 12.5% – 6.6% on day 2 to day 10. The cut to crush delay of the Burnt 10-inch billet Sugarcane to obtain high POCS (>12.5%) is within 48 hours. The high POCS values for cut to crush delay of 72 and 96 hours could be due to sampling error.

POCS

Table 2: Pocs reading for green and burnt cane over the crushing period

Treatment →	Green					Burnt				
Crushing Period (hrs.) ↓	Whole stalk	Billet sizes				Whole stalk				
		6″	8″	10″	12″		6″	8″	10″	12″
0hr	11.97	10.75	11.04	12.69	12.10	12.55	13.37	14.44	14.60	11.32
4hr	14.08	12.19	11.54	13.38	11.02	11.17	9.89	11.42	12.26	12.81
8hr	13.17	11.45	12.48	12.67	12.92	12.42	14.15	12.67	11.74	12.05
12hr	11.53	12.24	11.10	12.04	11.75	14.56	10.82	12.37	12.29	12.55
16hr	10.84	12.91	12.50	11.45	11.49	11.51	10.63	12.34	12.88	12.35
20hr	12.59	11.85	12.91	11.32	12.72	12.70	10.96	11.42	12.84	11.41
24hr	11.13	10.89	11.85	12.47	12.32	10.70	12.74	11.71	11.74	13.29
30hr	13.70	12.55	11.76	10.62	12.33	12.87	12.35	13.76	12.80	12.60
48hr	13.23	11.82	12.15	9.52	11.05	9.28	11.47	11.87	13.71	12.46
72hr	9.88	10.75	11.73	10.63	12.53	10.11	9.83	11.58	11.86	11.66
96hr	11.02	10.72	12.82	10.51	11.28	10.17	11.14	9.55	11.49	13.19
120hr	11.56	11.92	11.21	9.37	9.88	11.42	10.17	10.82	10.24	7.24
144hr	11.13	11.23	10.75	7.84	10.42	9.89	9.64	6.87	9.93	8.44
168hr	10.40	11.70	10.34	8.16	9.69	8.87	10.50	8.80	8.34	8.76
192hr	8.27	8.13	8.87	6.59	7.62	10.25	7.09	7.71	5.08	6.59
216hr	9.47	6.97	6.61	5.52	7.03	8.69	4.70	4.93	5.25	4.20
240hr	7.30	3.84	5.65	5.36	5.00	9.59	4.43	4.84	5.46	4.31

Conclusion

The experiment was based on the effect of cane delay on sugar losses and to find out how treatments deteriorates on day or on hour basis. The experimental data of each treatment showed that each treatment has an effect on the delay of cane sugar losses differently.

It has been observed from the data above that irrespective of the billet sizes of green and burnt cane samples, rapid decline of POCS and sucrose occurs after 2 days. According to the results, the suitable period for harvesting and crushing is within 2 days. After 2 days there is a rapid decline in POCS and sucrose percent of the green cane. In regards to the burnt cane, the suitable period for burnt cane to be harvested and crushed is within 1 day.

Low POCS in Lautoka Mill

Investigation on the causes of low POCS at Lautoka mill (2019 crushing). Parameters investigated – Maturity of cane, cane samples from Mill analysis, high extraneous matter and effect of weather.

Maturity of cane (Low POCS in field)

Determine cane maturity (field brixing) of standing cane - this will help us determine whether the raw material (cane) is ready for harvesting. The same fields cane was to be sampled from the factory.

Table 3: Cane Analysis from farmers field at Drasa (composite sample)

Farm Number	Brix	Purity	POCS	Fiber
14134	15.4	88.8	12.4	9.4
115	14.7	85.7	11.2	8.6
47	14.3	84.4	10.6	7.9
115	13.7	84.8	10.3	8.0

Cane Samples from Mill Analysis

Table 4: Cane Analysis from farmers field at Drasa (composite sample)

Truck Number	Brix	Purity	POCS	Fiber
CM-928	16.1	90.9	13.4	9.5
BF-428	13.4	85.0	10.0	10.3
AZ 227	14.7	86.5	11.3	9.1

The above results show that fiber content in cane was low both from field samples and when the same cane was crushed in the Mill. Low fiber content will influence sugar content and is also an indication of immature cane.

High Extraneous matter

High extraneous matter is due to Harvester size. Most of the harvesters are CASE 4000. Following was noticed when CASE 4000 is in operation – loss of cane in the field that is this harvester is not able to collect all the cane when cutting and the elevator of this harvester is shorter than CASE 7000 that is used by the Miller. Due to this more trash remains in the harvested cane. CASE 4000 has a single exhaust fan compared to CASE 7000.

Effect of weather

The effect of weather was also studied to ascertain its effect on maturity of cane.

Table 5: Maximum and minimum temperature with rainfall 2019 maturity season

	Lautoka				Rarawai				Labasa			
	Max	Min	Diff	Rain	Max	Min	Diff	Rain	Max	Min	Diff	Rain
Apr	32.4	24.5	7.9	23.9	31.8	23.2	8.6	35.3				333.7
May	29.9	20.6	9.3	4.7	30.8	18.6	12.2	47.4	32.0	20.3	11.7	17.7
Jun	29.2	20.3	8.9	27.8	29.7	18.5	11.2	14.1	30.9	22.1	8.8	100.4
Jul	29.9	19.9	10.0	40.0	30.3	18.6	11.7	3.0	30.7	20.1	10.6	137.9
Aug	30.8	21.1	9.7	40.0	30.3	19.0	11.3	34.8	30.1	22.2	7.9	72.6
Sep	30.0	20.0	10.0	111.0	30.3	18.2	12.1	9.0	30.4	21.0	9.4	
Avg.	30.4	21.1	9.3	41.2	30.5	19.4	11.2	23.9	30.8	21.1	9.7	82.2

Analyzing the weather data, Rarawai had favourable conditions (lower minimum temperatures during maturing phase) compared to other mills but due to the dominance of Mana a mid to late maturing variety sugar content was lower at Rarawai than Labasa. At Labasa, the dominant variety is Naidiri which is an early maturing variety that has the ability to retain sugar levels throughout the season.

The presence of Naidiri at Labasa contributes to better sugar content in cane. From the analysis of weather data, the minimum temperatures have not played a significant role in maturity of cane. Other factors that contribute to low sugar content are time of fertilization. The correct time for fertilizer application is when ratoon crops are 2-4 weeks old. If there is late, application of fertilizer, cane will continue to grow even in the crushing season and this affects maturity.

Effect of Rainfall

The table below shows the rainfall received in the Lautoka Mill sectors. The peak rainy season is from January to March and in April rain starts to ease off but in 2019 good rainfall was received in April and rain continued to fall during June and July. The rainfall during April, June and July favoured cane growth and adversely affected maturing. This could also be a contributing factor to low sugar content at Lautoka mill.

Table 7: 2019 Lautoka Mill rainfall (mm)

Month	Drasa	Lautoka	Saweni	Natova	Legalega	Meigunyah	Yako	Malolo	Nawaicoba	Lomawai	Cuvu	Olosara	Avg
Jan	409	220	360	428	390	336	292	525	304	218	401	234	343
Feb	202	220	176	127	77	57	62	74	74	119	64	143	116
March	222	187	219	284	309	235	114	330	273	119	73	136	208
April	252	329	320	401	411	342	216	548	412	207	181	275	324
May	0	6	0	0	6	3	1	1	3	1	31	39	8
June	73	12	66	142	61	65	111	109	60	70	26	85	73
July	13	61	96	188	73	65	33	86	50	53	116	233	89

Pacific Community Resilience Case Study

Two researchers from the Institute for Sustainable Futures (ISF), University of Technology Sydney (UTS) are undertaking a study to capture insights about changes in community resilience to climate change and disasters in the Pacific, focusing on 4 Pacific Island Countries: Vanuatu, Fiji, Tonga and Kiribati. This research will provide significant learning on community resilience to climate change and disaster risks in the Pacific. In Fiji, the research focused on the Climate and Ocean Support Program for the Pacific (COSPPac). Researchers aimed to understand the contributions this program was making to community resilience, focusing on the sugarcane farming industry in selected communities in western Viti Levu. This research project was funded by DFAT, through the Australia Pacific Climate Partnership. As part of this research, ISF researchers undertook consultations including interviews, focus group discussions and workshops with community members in western Viti Levu.

Outputs

One of the objectives of this project is to contribute to learning on community resilience to climate change and disaster risks in the Pacific. This will be done through developing a range of outputs that are relevant to various audiences, including communities involved in the research.

Interviews

Upstream Interview

The case study involved interviews with the sugar industry stakeholders. The stakeholders were asked about their understanding and the engagement with the COSPPac program.

Discussion was also based on perceptions of climate change and perceived changes in resilience over recent years. Stakeholders interviewed included representatives from the Sugar Industry along with Ministry of Agriculture and Fiji Meteorological Services.

Community Interview

Sugarcane farmers were also interviewed about their understanding and the engagement with the COSPPac program. Discussion was also based on perceptions of climate change and perceived changes in resilience over recent years. Community members interviewed included sugarcane farmers, persons with disabilities and elderly people on life history.

Figure 22: Discussion with a lady farmer (left) and a person with disability (right)

Focus group discussion

A group discussion with men and women was carried out. Each separate gender had their views on climate change and the impact it had on their lives and the lives of their family.

Figure 23 & 24: LEFT - Women attending group discussion, RIGHT - Workshop attended by community members

Workshop

A presentation was made to the community on the final day of the case study. The major findings were discussed and suggestions for improvement was noted as follows:

Major Findings

- ✓ Most villagers were unaware of the COSPPac program
- ✓ Most villagers get their weather forecast by listening to the radio and rarely from the FMS products that FMS releases.
- ✓ Perception of climate change –past natural disasters had a devastating effect on many communities, but the recovery period also brought opportunities for developing tighter social connections and infrastructural development.
- ✓ Environmental challengers have not made people "helpless" but given them an optimistic outlook on life.

Suggestions for improvements

- ✓ The ISF, UTS team to discuss in advance the date(s) of interview and discussion with the farmers and the community residents.

Analytical Laboratory

Introduction

The analytical laboratory acts as a link between the growers and the industry by providing analytical services for advisory and research programs. This service is essential due to the rising cost of fertilizers and to maintain optimum production in the future.

Analytical services provided at SRIF analytical laboratory includes soil, foliar and cane analysis. Soil and leaf samples are received from all sugar cane districts namely Penang, Rarawai, Lautoka and Labasa for fertilizer recommendation and from SRIF research trials. At the analytical laboratory at SRIF; all analytical procedures are fully documented.

The in-house validated analytical methods will deliver consistent and reliable lab reports on the samples. Soil and leaf testing for recommended fertilizer – all cane farmers planning to plant must have their soils analyzed to get the correct recommendation for optimum production.

Beneficiaries

Farmers - fertilizer advisory service (FAS) which includes fertilizer recommendation and soil status for new farm assessment is provided to the sugarcane farmers and those that want to venture into sugarcane farming. The laboratory gives fertilizer recommendations to growers in the cane area on the basis of soil and leaf sample analysis from their fields.

Soil Analysis

A total of one thousand five hundred and seventeen (1517) soil samples were received for analysis comprising of one thousand and thirty-four (1034) advisory soil samples and four hundred and eighty-three (483) research soil samples. Reports are released by email as soon as they become available from the laboratory to the FSC extension staffs. The laboratory staff is equipped to process samples quickly and efficiently. The analysis is completed within two-six weeks from the date samples are received.

Table 8: Summary of soil samples for 2018

Mill	Advisory	Research	Total
Lautoka	251	295	546
Rarawai	401	84	485
Penang	60	34	94
Labasa	322	70	392
Total	1034	483	1517

Sugar Industry Tribunal Request

The Sugar Industry Tribunal requested for a re-assessment of the land in Agriculture lease No. 21498 in Labasa for its suitability for cane cultivation. The soil samples were taken from this field and forwarded to the Institute for chemical analysis to determine whether it is suitable for cane cultivation.

The nutrient rating of the field is as below; pH - all the composite samples indicates that the field is acidic in nature. Phosphorus - is generally present in very low levels. Exchangeable Bases – Cations. Based on ammonium acetate method, Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na) levels are as follows;

- Calcium & Magnesium– very high
- Potassium & Sodium – high
- Electrical Conductivity - EC rating of 0.85 mS/cm indicates that the top soil (0-20cm) is highly saline and may have serious effect on growth of sugarcane.

Recommendation

The institute advised that major drainage work needs to be carried out on this land before cane can be planted and to plant a cover crop after incorporating lime, the cover crop should be ploughed into the soil to improve the organic matter content.

Leaf Analysis

The analytical laboratory had received 78 plant samples for analysis. 52 samples have been analyzed and fertilizer recommendations sent for the next year ratoon crop.

Labasa laboratory setup and training

A laboratory similar to the one at Drasa, Lautoka is being setup in Labasa and should be operational in 2020. All soil and water samples from Vanua Levu will be analyzed at this laboratory, and fertilizer recommendations sent to the FSC extension team.

Leaf samples will be sent to Drasa laboratory for analysis and fertilizer recommendations as there is no setup to carry out plant digestion at Labasa. The soil samples will be analyzed by the Atomic Absorption Spectrophotometer (AAS500). This instrument has the ability to analyze macronutrients (calcium, magnesium and potassium).

Labasa substation continues to operate small mill using the classic method i.e. the disintegrator for shredding and grinding the cane samples, juice extractor for extracting the juice from the grinded bagasse, Polarimeter and refractometer for the sugar analysis. Lead Acetate is still in use to clarify the juice. A total of 120 cane samples were analyzed at Labasa laboratory.

Studies on Micronutrient Status of Soils in the Sugar belt

Introduction

A recent survey carried out on micronutrient by SRIF in 2014 and 2015 indicated that sugarcane soils are deficient in Zinc, along with other micronutrients such as iron and copper, while adequate amounts of other nutrients were found. This led to a planned detailed study of the micronutrient status in the sugarcane soils.

Micronutrients are those elements which are needed in very small (micro) quantities that are essential for plant growth. The essential micronutrients include boron (B), copper (Cu), iron

(Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn). In soils the main source of micronutrients is the parent material from which the soil was formed. Iron is most abundant as it forms major constituent of ferromagnesian minerals. Zinc, copper, and molybdenum originate from sulfides of igneous rocks. Zinc, copper and manganese also occur in ferromagnesian minerals.

Boron is found largely as the borosilicate mineral, tourmaline. According to Nixon (2005), little information is available on the micronutrient requirements of sugarcane. Studies conducted on sugarcane in South Africa and Malawi revealed iron, zinc, manganese, boron and copper deficiencies (Nixon, 2005). Years of mono-cropping, trash burning and improper cultivation practices contributes to declining nutrient content in soil.

Objectives

The project aims to measure micronutrients in sugarcane growing soils and address deficiencies. Thus, the project will be implemented in two phases. Soil samples will be collected from each sector for determination of nutrient content. Field trials will then be laid to determine rates of micronutrient fertilizer required for good growth of sugarcane plants.

Methodology

The project started with taking soil samples at depths of 0 – 20 cm and 20 – 40 cm from growers' field. Soil samples were taken from land which were under preparation for next planting season. Soil samples were dried, grinded and analyzed for potassium, calcium, phosphorous, nitrogen, organic matter, pH, copper, zinc, manganese and iron. Results were analyzed to map areas with micronutrient deficiencies.

Results

272 soil samples were collected from different sectors and the analysis is in progress. The results of the soil samples will be presented in 2020. Based on the results, trials will be conducted to address the micronutrient deficiencies.

CROP PROTECTION

Nematodes

Screening Sugarcane Varieties for tolerance to Plant-Parasitic Nematodes

Nematodes are the most abundant multicellular individuals on earth, which feeds on a wide range of agricultural products including sugarcane. This organism is not visible to the naked eyes except under the microscope in laboratories. In the field agriculturist will not be able to identify the nematodes causing damage to crops.

It can only be identified by carrying out soil samples and undertaking nematodes population count. The first nematodes study was carried out in Fiji by Cobb on banana. In 1977, Kirby conducted a study on nematodes associated with sugarcane in Fiji and in 1976; experiments were conducted on the effects of nematicides and rainfall on the population densities of soil-borne nematodes in Fiji by Ram Narain and Dr. Krishnamurthi. No studies have been carried out on nematodes associated with sugarcane in Fiji.

The importance of implementing the resistance and biological suppression of nematodes in Fiji sugarcane is to improve on production of sugar. The aim of this project is to test and identify sugarcane varieties that are resistant to plant parasitic nematodes. The pot trial was conducted on 19th September 2019 in a poly-house at Drasa, Lautoka. This study was carried out with the aim of screening selected sugarcane commercial varieties for their response to nematodes and tolerances.

The experiment consists of eight varieties of sugarcane planted in 5L pots with treated and untreated soil. The trials were conducted in pots arranged in a randomized complete block design with treated and untreated soil with four replications. The untreated soil was collected from farmer's field which showed high density of plant parasitic nematodes.

The untreated soil was sterilized at 120◦c for 20 minutes to get treated soil. Data on growth was recorded at 48 days after planting. The growth measurement was subjected to general ANOVA using statistic 9. When AVOVA indicated significant differences among treatments, means were separated using the Fisher' protected LSD test at 5% probability level.

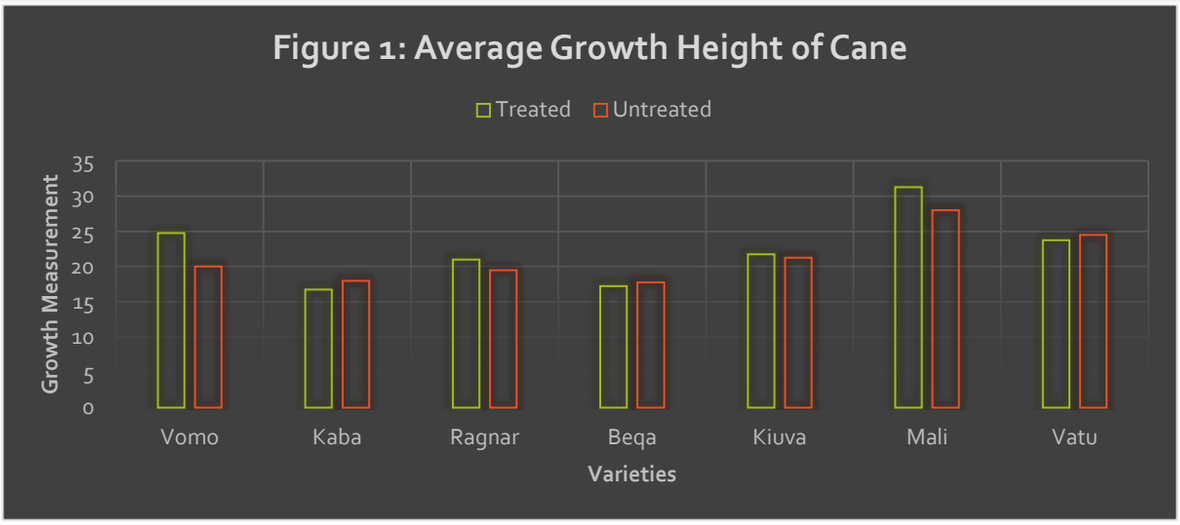


Figure 1 is showing that growth in Vomo and Mali varieties are affected by plant parasitic nematodes in untreated soil at 48 days after planting where as Kaba and Vatu are able to withstand the consequence of nematodes in the untreated soil.

Table 1: Analysis of variances

Source	DF	SS	MS	F	5 %
Replication	3	57.500	19.167		
Variety	6	860.214	143.369	8.85	0.0001
*Error Replication*Variety*	18	291.50	16.194		
Treatment	1	16.071	16.071	0.64	0.4325
*Variety*Treatment*	6	59.929	9.988	0.40	0.8719
*Error Replication*Variety*Treatment*	21	527.000	25.095		
Total	55				

CV= Replication*Variety = 18.44

CV=Replication*Variety*Treatment = 22.96

The result of this study show that the average growth of cane was high in treated soil (22.4cm) than in untreated soil (21.3cm). The growth measurement at 48days was not significantly different (P<0.05) among the treatment as shown in ANOVA table 1 above.

Figure 2: Nematode screening (plot trial) at Lautoka

Fiji Leaf Gall Disease

Screening clones from stage 3 LF2016 series for FLG resistance

Fiji leaf gall (FLG, Fiji disease) was first described in Fiji and is widespread in the Fiji Islands. FLG threatened the existence of the Fiji Sugar industry in the late 1800s and there have been periodic outbreaks.

The primary method of managing FLG is varietal resistance. Resistant varieties have been successfully used in Australia and Fiji to manage outbreaks of FLG. Mana the dominant variety in the Fiji Sugar Industry is intermediate to susceptible to FLG. FLG is spread by a vector (disease carrying agent), called plant hopper (*Perkinsiella vitiensis*).

The aim of this routine project is to conduct screening of hybrid clones from stage 3 (LF 2015) series for Fiji leaf gall resistance. Hopper survey of cane field and potting of infected susceptible variety Fiji 10 is done around February/ April each year to find out if sufficient hopper is available for collection. The selected field should not have fully grown cane. The collection begins as soon as the hoppers are discernible.

They are guided into the test tubes in the proportion of one male to every ten females and then transferred to the hopper cages. Each cage has approximately 1000 hoppers. These are then put over infected Fiji 10 plants, which have been planted in 5-pint planters. The caged plants are placed on the cement pad and care is taken to ensure that no ants or other insects can get to the caged plants, as ants devour the eggs of hoppers.

The tested varieties 12 single-eye setts are planted. Of these only 6 are selected which have an even growth. At the 2-leaf stage the 6 replications of each variety are placed in the insectary and the newly bred hoppers are released at the rate of 20 per plant. They are allowed to feed on the test varieties for 14 days. During this period, as they puncture the stalk and leaves, the virus is passed on to the plants through the saliva. On the 14th day the hoppers are killed by spraying with a household insecticide. During the 14-day period watering of the trial is avoided as it may lead to the death of the hoppers.

On completion of the 14-day period of infection the varieties are shifted from the insectary on to the ground and fertilized. A rapid growth of the plants is necessary as it helps in clear distinction of the disease symptoms. A total of 84 clones were received from stages 3 - LF 2015 series for screening against Fiji Disease Virus. Screening the plants begins 30 days after the day of inoculation, and continued every alternate day till the plants are 100 days old. The study has showed that 65.5% clones were resistant, 11.9% clones were moderate and 22.6% clones were susceptible.

Figure 3: Chopping and potting of F.10 for screening LF2015 series

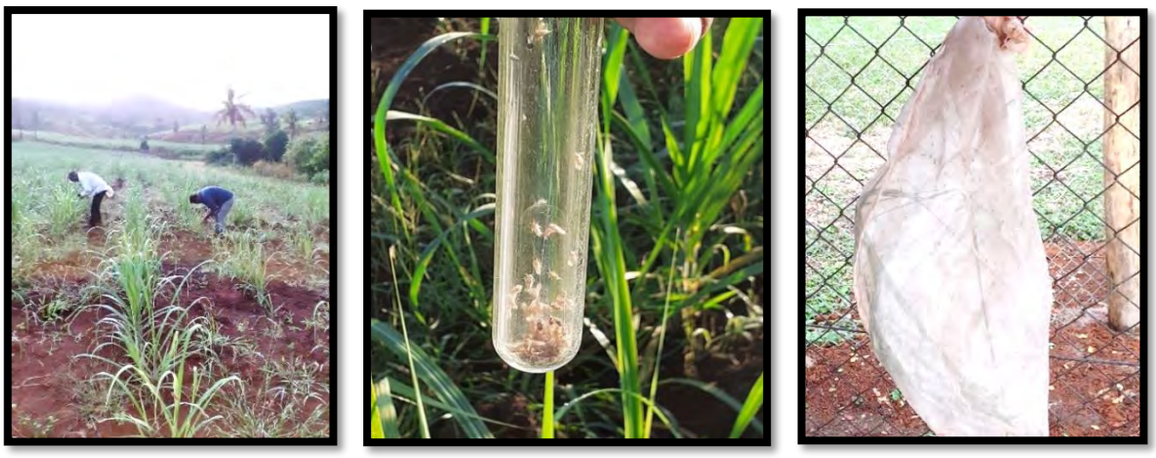


Figure 4: Collection of plant hoppers (left) using test tube (middle) from commercial farms and filling up cages (right) for breeding on host plant.

Figures 5: Selection of test clones and randomly arranged inside the insectary for release of vectors.

Figure 6: Successfully bred nymphs and release on test clones for inoculation.

Cane Weevil Borer

Cane weevil borer, *Rhabdoscelus obscurus* is an introduced pest of sugarcane in Fiji. CWB is prevalent in all the sectors of the cane belt and is a major concern to the industry. Infestation by CWB results in reduction percentage of purity of cane (pocs). The internal chewing and tunneling of the borer larvae within the stalk internodes directly decrease the amount of juice that can be extracted and the percentage of sucrose that is present in the juice. This leads to a corresponding decrease of juice purity and an increase in total organic non-sugars such as dextran. Damaged stalks are lighter and do not keep as well as undamaged cane after they are cut for milling. The objective of this project was to contain and minimize the spread of Cane Weevil Borer in the sugarcane growing areas.

Preparation and placement of split-cane traps

160 traps were laid on a farm in Legalega sector after receiving a complaint from the FSC field team on spindle begin dried. Upon investigation it was found that the crop was damage by CWB larva and rat. The trap was laid on this farm (18574). A total of 17, 247 adults were trapped out of which 7526 were male and 9721 were female.

Damage Assessment

Fields were randomly selected to analyse the damage caused by CWB in cane belt area of Viti Levu and Vanua Levu. 10 farms per sector was selected during the harvesting period. 100 stalks per farm was analyzed. The parameters were recorded such as total internodes, damage internodes, length of stalk, length of infected stalks, total weight and infected weight. The collected data was further analyzed to obtain % infestation, % internode, % length damage and % weight affected. 143 farms were analysed for CWB damage in Viti Levu and Vanua Levu. 123 farms were from Viti Levu and 20 farms were from Vanua Levu (table 2).

Table 2: Showing the incident of borer level in each sector.

Sector	No. of Sample	% Infestation	% Internode Damaged	% Length Infested	% Weight affected
Legalega	100	3.0	0.5	0.3	2.2
Malolo	500	7.2	0.9	0.8	8.6
Meigunyah	500	10.0	1.4	1.3	5.1
Olosara	250	6.8	1.7	1.2	4.8
Drasa	500	6.0	0.9	0.9	7.9
Lautoka	200	14.5	2.1	1.1	4.2
Natova	500	6.4	1.3	0.7	4.8
Lovu	500	6.6	1.3	0.6	5.5
Lomawai	500	12.6	4.0	1.5	7.0
Varoko	500	10.4	1.6	0.9	6.4

Roguing

The roguing team covered an area of 6,424 ha during their crop inspection. Of this total 1,707 ha plant crops and 4,719 ha were ratoon cane.

Table 3: Rouging areas inspected January-November 2019 (ha)

Month	Lautoka		Rarawai		Labasa		Penang	
	P	R	P	R	P	R	P	R
JAN	31	202	0	15	78	51	2	0
FEB	33	271	13	140	56	73	1	0
MAR	68	220	0	22	80	42	1	0
APR	151	66	32	48	76	57	10	0
MAY	93	165	62	88	91	60	24	0
JUN	44	234	80	102	96	27	39	0
JUL	41	283	63	626	60	81	21	0
AUG	51	200	31	37	55	525	0	0
SEP	43	189	32	36	53	59	2	4
OCT	24	136	2	44	15	124	0	17
NOV	22	244	1	54	27	123	0	53
DEC	0	0	0	0	0	0	0	0
Total	601	2210	316	1212	687	1222	100	74

**P – Plant crop and R – Ratoon crop*

The trend on which Fiji Leaf Gall Disease is increasing in the sugarcane farms is an indication that the disease can flare up at any time given the availability of the pathogen *(Perkinsiella vitiensis*), weather conditions and planting of only one major variety – Mana. Also, the planting of Saccharum edule –Duruka, an alternate host of Fiji Leaf Gall Disease planted along and near cane fields contributes to the increasing number of the disease found in some Districts.

Table 4: Summarized Rouging Report from January-November 2019

Mill District	No. of Farms Inspected	No. of farms infested	% farm infested	Area Rouged (Ha)		No. of FLGD stools Rouged
				Plant	Ratoon	
Lautoka	477	2	0.4	139	1228	17
Nadi	267	21.32	8.0	284	533	109
Labasa	353	0	0.0	687	1223	0
Sigatoka	306	57	18.6	179	449	2728
Ba/Tavua	425	13	3.1	316	1213	258
Penang	131	0	0.0	100	74	0
Total	1,959	93	30.1	1,705	4,720	3,112

This can be credited to disease free area or good field management practices used by farmers such as having a good, healthy and clean planting material. Sigatoka have the most stools infected in 2019. Out of the total 1959 farms inspected 3112 stools were rouged. During the inspection of major diseases in commercial cane field, the DCU team also identifies the minor sugarcane diseases, which has no economic effect on cane yield.

Figure 7: Minor diseases of sugarcane – Brown Rust, Ring spot and Red Leaf Spot.

Seed Cane Certification

Seed cane is defined as any sugarcane plant material which is intended for use in the propagation of sugarcane. Planting good quality seed cane is crucial for profitable sugarcane production.

The potential yield of a crop will not be attained if seed cane of poor quality is planted. In spite of this, seed cane production is an aspect of sugarcane management that is often neglected due to the limitation of resources. This year the institute received complaints on unapproved varieties being planted, poor germination due to sett rot (fusarium and pineapple rot) and termite infestation.

The reason being, the growers have used uncertified planting material. Total of 72 farms were identified planted with unapproved variety mixed with other variety. 32.28 ha of unapproved varieties was planted at Nasorowaqa estate. All plant cane in all the sectors have been inspected by SRIF Disease Control (DCU) that may be used for seed material. Of the 1, 705 ha plant cane inspected, only 15.01% qualified to be used as seed material.

Sugarcane Smut

Introduction

Sugarcane smut is a major fungal disease caused by *Sporisorium scitamineum (Ustilago scitamineum).* It was one of the first sugarcane diseases to be recognized, as the conspicuous symptoms made diagnosis easy. McMartin (1945), quoting from an 1882 report by the committee of the Victoria Planters' Association, states that the disease was first discovered in Natal around 1877, during the early days of sugarcane culture. Specimens of the disease, which were the first to appear in Europe, were forwarded to Kew, where the fungus was identified as *Ustilago sacchari* Rabenh., an organism which had previously been found in India on *Saccharum spontaneum L*. (King, 1956). The name was later changed to *U. scitaminea Syd*. In these early years, smut was reported to be making after-effects in the variety known as 'china cane', which was destroyed by it (Antoine, 1961).

Control measures aimed at the destruction of infected stools were successful and it was not until more than 60 years later that the disease was again observed. McMartin (1945, 1949) records its spread in susceptible varieties in 1945 and these were immediately withdrawn from cultivation (Antoine, 1961). Smut causes a whip-like structure, dusty black in color and in susceptible varieties may lead to a grassy growth habit. The conspicuous symptom is the sorus (whip), which is a modified inflorescence (Smut Fungi of Australia, 2013). Smut varietal resistance is the most effective management option, along with the use of disease free seedcane. On smaller scale operations hot water treatment of seedcane and rogueing of infected plants can also assist in management of the disease. The main mode of spore dispersal is the wind but the disease also spreads through the use of infected cuttings and spores spread via harvesters. Sugarcane smut is a devastating disease in sugarcane growing areas globally (Waktola, 2014).

Contextual

Description

Smut, one of the most easily recognized diseases, has a black whip of varying thickness. The whip is initially covered by a thin membrane, giving it a slivery-grey appearance; when these ruptures, the black, powdery spores become more highly visible. The whip is unbranched and is made up of a hard core of parenchyma and fibro-vascular elements surrounded by millions of chlamydospores that resembles soot – hence the name 'smut'. The spores are very small (6-8 µm) and feel smooth when rubbed between one's fingers.

Symptoms

The earliest symptoms in an infected stool include long, slender grass-like shoots with long internodes that grow faster than healthy cane. Leaves may be short and stiff and carried at a more acute angle.

Life Cycle

When an infected sett is planted, some or all of the subsequent shoots may develop whips. Spores are released from the whip and then dispersed via the wind, some travelling long distances (many kilometers) landing on the soil may infect young shoots emerging through the soil, either in the plant or ratoon crop. These spores do not usually infect mature shoots. though many fall close to the infected stool. Spores landing on the axial buds of adjoining healthy stalks may infect these buds, leading to disease in the cane planted from this material. Alternatively, spores landing on the soil may infect young shoots emerging through the soil, either in the plant or ratoon crop. These spores do not usually infect mature shoots. The teliospores may survive in the soil for long periods, up to 12 months – depending on environmental conditions. Dry conditions favour spore longevity while wet soil leads to fairly rapid loss of spore viability (a matter of weeks). The primary spread of the disease is through spore dispersal; diseased seed-pieces (setts) also pose a significant risk. Rapid secondary spread of the disease within a crop occurs via wind-blown spores. Hot dry conditions favour smut; a higher level of varietal resistance is needed in dry areas while regions with relatively high rainfall may be able to plant varieties of greater susceptibility.

Status In Fiji

Smut occurs in all sugarcane cropping countries except for Fiji. It is important therefore that strict quarantine border controls are applied when people move between countries growing sugarcane and Fiji. Not much can be done to prevent wind-borne spread over long distances and this is how smut was thought to have spread to many countries around the world.

Strategy – Immediate Action Plan

Running of smut spore traps

Spore samplers are to be placed in the major port of entries for firsthand detection of smut spores. SRIF will be working diligently with Biosecurity Authority of Fiji for the analysis of the tapes.

Spore identification

Confirmation of smut spore identity will be needed; two techniques will be used - light microscopy and a molecular test (PCR).

Establishment of Smut Technical Committee (STC)

If an incursion were to occur, a team representing appropriate authoritative institutes will be formed; the technical committee will comprise members from:

- Sugar research institute of Fiji
- Fiji sugar cooperation
- Biosecurity authority of Fiji
- Ministry of Agriculture
- Fiji Ports
- Sugar Cane Growers Council
- Sugar Cane Growers Fund
- Invited Scientist (Plant Pathologist)

Role of the STC

- Development of an Emergency Response Plan SOP. This will be a key document to guide actions to be taken at the time of the identification of an incursion
- Advise Biosecurity Authority of Fiji on any possible Biosecurity Emergency declaration that needs to be made when an incursion is first identified.
- The STC will liaise with other government agencies as well as international organizations/ parties.
- Decide on the details of the delimiting survey SOP, depending on where the incursion first occurs.
- Decide on the emergency response budget allocation.

Initial preparations

A "smut resistant seedcane variety multiplication" project should be initiated. To prepare and propagate significant quantities of smut-free seedcane of resistant varieties for assessment and distribution, pre-smut incursion.

The most judicious, positive long term approach rests with resistant varieties. Thus taking into consideration the smut resistance ratings, the most resistant varieties should be multiplied for potential distribution.

Resistant varieties

Detailed below are the smut resistance ratings for current commercial Fijian varieties, as predicted by resistance screening undertaken by Sugar Research Australia.

Table 5: List of commercial varieties and SMUT resistance ratings

Variety	Rating Number	*Rating Class
KIUVA	1	HR
VOMO	1	HR
VATU	4	IR
AIWA	5	I
BEQA	5	I
GALOA	5	I
QAMEA	5	I
MANA	5	I
RAGNAR	5	I
MQ33-371	6	IS
KABA	7	S
LF91-1925	7	S
YASAWA	7	S
NAIDIRI	7	S
LF05-1502	8	HS
MALI	8	HS

**HR- highly resistant, IR- intermediately resistant, I- intermediate*
IS- intermediately susceptible, HS- highly susceptible

Figure 8: SMUT infected sugarcane, Photo credit: Harry Dass, Research Officer, Mauritius Sugar Research Institute.

Nitrogen-Fixing Bacteria

Introduction

Nitrogen is abundant in nature, it often limits plant productivity because atmospheric nitrogen is only available to a very range of organisms symbiotically associates with higher plants and non-symbiotically. Nitrogen in legumes originates from nitrogen in the air, as well as nitrate and ammonium in soil solution. Much of the nitrogen required for plant growth is from fixed nitrogen. Most fixed nitrogen is thought to come from nitrogen-fixing symbionts, such as *Rhizobium, Bradyrhizobium, Mesorhizobium,* or *Sinorhizobium,* in the nodules of leguminous plants. However, much nitrogen continues to be taken up by plants even after the flowering stage, at which stage the nitrogen fixation of nodules begins to decrease rapidly.

Nitrogen absorbed by legumes in the later stages are thought to be inorganic nitrogen compounds formed from decomposition of organic matter in the soil. Bio fertilizer is important in crop farming systems because it is an inexpensive source of nitrogen for higher yields of crops. This process diminishes the need for expensive chemical fertilizer. Thus the extensive use of bio fertilizers would provide economic benefits to farmers, improve the socioeconomic condition of people and preserve natural resources.Three Nitrogen fixing trials were planted in Lautoka (31/05), Nadi (23/05) and Labasa (04/06).

Discussion

The extraction of N- fixing soil microbes were successfully isolated.

A number of plates were sent to CABI for ID and was identified as *Azotobacter* and *Rhizobium tropici.* Along with these N-fixing bacteria an aquatic bacteria of family Rhodobacteraecae, found in the marine was present, this could be the result of flooding, however, further studies may be done in the future to calculate the impact of such bacteria on sugarcane health. The identified N-fixing bacteria was mass produced and added to sterile compost,which acted as a carrier. This was mixed with top soil and filled in pots.Four commercial varieties (Naidiri, Mana, Kiuva, Viwa) and a promising variety (LF11-233) was planted. Trials on sugarcane against soil microbes was carried out in SRIF nursery.

Pot trial

5 varieties potted with compost

5 varieties potted with sterilized compost + bacteria

(4 reps)

Leaf height Statistical Analysis

It can be concluded from the pot trials that there was no significant difference between the inoculated and uninoculated pot trials. However, Kiuva showed positive results. The little difference in comparison to the expectations could also be due to the placement of the pots in the greenhouse that was subjected to uncontrolled rainfall.

Field Trial

Three field trials were planted in Lautoka, Nadi and Labasa. A randomized complete block design was adopted. Irrigation was provided as well normal fertilizer and weedicide application.

Treatments

Table 6: List of treatments for the trial

Treatment No.	*Treatment*
T1	Dip sett in bacteria
T2	Compost with bacteria
T3	Millmud
T4	Control
T5	Millmud with bacteria

Drasa Trial

Figure 9: Drasa F 11 Trial Planting

Figure 10: Trial planting in Labasa

Figure 11: Trial Marking and cane dipping in bacteria as a treatment

Figure 12: Trial planting in Malolo, Nadi.

Statistical analysis was done for the Drasa, Lautoka, and trial showed some differences, however, it was insignificant. Further analysis was done through using LSD All- Pairwise comparisons which showed more groups formation at 5 months. Data collection will take place until harvesting.

Termites

Introduction

Termites are a social insect of the order Isoptera. They are pale and soft bodied. Subterranean termites are considered one of the most economically important pests in the world. They are also the most destructive and economically important insect pest of wood and other cellulose products.

Termites have specialized castes to perform specific colony functions. The termite colony has three castes: workers, soldiers, and the reproductive (queens and males). The life cycle starts when the alate adults have been retained by a caste for a single seasonal migration or dispersal. The winged forms with long wing-pads are usually present in the colony few months before the flight. The emergence is related to a series of changes in the activity of the colony. Soon after reaching maturity, alates (male and female) leave the nest in a swarm and fly up into the air.

Once the size of colony reaches a certain point, the reproduction process launched. However, the time which is needed for reaching that level of size to alert the production process varied between the different species. In addition, before the alate flight, they assemble away from the main colony and then they leave from holes, slited in the ground, mound and or wood.

During late September, swarms of the reproductive caste may be noticed in infested buildings and trees. These dark-colored, winged termites are the stage most commonly seen, since the other castes do not expose themselves to light. Winged termites are attracted to light, and when they emerge within buildings, they swarm about doors and windows. After crawling or fluttering about for a short time, the termites break off their wings and locate a mate.

Mating occurs after the male and female have make the first chamber. The female (queen) lays the eggs after few days or (3-6) weeks from the establishing of the pair in their first chamber after which the incomplete metamorphosis begins. A queen lays approximately 1000 eggs per day. (Biosecurity Authority of Fiji factsheet), workers are responsible for constructing tunnels and chambers as well as feeding and grooming other termite castes. Soldier termites are useful in combat and protecting the colony, however, are incapable of feeding themselves.

The cane infested with termite shows symptoms of yellow and drying of outer leaves. Millable canes are tunneled and are filled with soil within the coning epidermis; termites feed on the inner tissues, the rind remains intact and is filled with moist soil. The damage infestation by *Coptotermes gestroi* on sugarcane is approximately 60cm from the base of the millable stalk. Asian subterranean termites, *Coptotermes gestroi*. dwell in nests and/or trees and attain moisture source through mud tubes.

The cavity of the colony of the subterranean termites may range from 6m to 7m deep into the ground to protect termites from extreme weather conditions, wildfire and calamities so that termites travel through earthen (mud) tubes to reach food sources. These insect pest affects the sugarcane crop from the germination stage to the millable canes.

Discussion

Termites in sugarcane is currently confined in the Lautoka district. A survey on the termite infestation was carried out jointly with Biosecurity Authority of Fiji and the Institute in 2014 (OPERATION KADIVUKA). The number of infested farms recorded in this survey was 45.

The number of farms declined over the years with the use of bait traps from 45 to 16 farms in 2018. A survey was undertaken beginning from mid- October to ascertain the current status of the spread/ infestation level of termites.

Due to limited resources this survey was not completed in 2019 and would continue in 2020 after which a report will be prepared. Till date, a total of 114 farms has been surveyed from October till December. Out of the 114 surveyed 20 farms were found infested, all in the Lautoka, Drasa and Lovu sector.

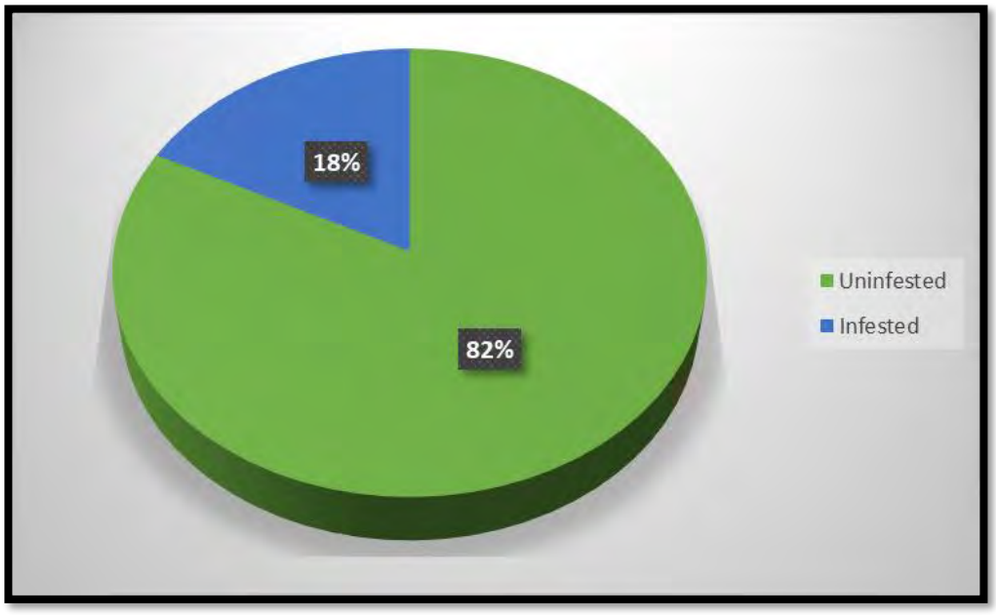


Figure 13: Percentage of infested and uninfested farms

Two farms were sprayed with Attrathor on trial basis and according to visual analysis there has been no incidence of termite attack yet.

Seedcane Inspection

Management and consistent monitoring had continued by a collaborative work between Sugar Research Institute of Fiji and the Biosecurity Authority of Fiji. Plan is underway for seed cane sources to be branched out to cater for clean seed materials.

Figure 14: Seedcane inspection by BAF and SRIF

Figure 15: Field training with BAF Staffs and SRIF staffs

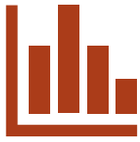
Crop Production

3,500+ tonnes

seed cane

10,100+ Tissue

Culture Plants



1.8M+ tonnes

cane crushed

SEED CANE PRODUCTION

Lautoka Mill Area

About 285 tonnes seedcane from the mother and distribution plots planted in 2018 was taken by farmers in near by locality and Nadi district. Majority of the seedcane was taken by Tunalia Joint Venture project which was faciliated by SRIF. A total of 15 hectares of sugarcane has been established in Tunalia joint venture farm as distribution plot.

A major setback for seedcane project is restriction of seedcane movement from Lautoka district imposed by Biosecuirty authority of Fiji due to termite infestation in nearby sugarcane farms. Mother plots will now be establsihed in Nadi and Sigatoka Districts.

Figure 1: Good quality and vigorously growing seed cane in SRIF MO in Drasa.

Labasa Mill Area

Seed cane inspection initiative started this year with the aim of improving the quality and quantity of sugarcane in Labasa. Most of the farms inspected has not been approved for seed cane distribution because of the mixed varieties planted in the field and also planting of

unapproved varieties which almost dominating the whole field. Farmers were encouraged to improve on their seed cane production by planting one common variety in their field. The breakdown of farms certified is in the table below.

Rarawai Mill Area

The seed cane production from hot water treated seed cane was continued in 2019. The following table summarizes the varieties with approximate tonnes that was available for distribution. Unfortunately, the uptake had been very low due to following reasons:

1. Planting outside normal planting/ re-planting window hence seed cane not ready.
2. Lack of irrigation resources with farmers hence delay in uptake of seed cane.
3. Poor link between FSC extension and SRIF.
4. Indiscriminate burning at the Estate.

Table 1: Seed cane plot summary

Variety	Crop	Area	Approximate Tons
Naidiri	2R	0.4	30
Kaba	2R	0.4	30
KABA	1R	0.7	60
Mana	P	0.5	35
Mana	1R	0.1	10
Qamea	2R	0.5	30
LF91-1925	2R	0.5	30

The following table summarizes the seed cane plots established in 2019 for distribution in 2020 season.

Table 2:

Variety	Area (Ha)	Approx. Tonnes
Mana	0.4	30
Qamea	0.3	25
Kaba	0.2	15
LF91-1925	0.3	25
Viwa	0.1	10

A lot of resources and time is being put in establishing the clean seed cane hence farmer uptake needs to be addressed via more astringent measures. SRIF had embarked in certifying seed cane and this needs to be a mandatory requirement before planting is approved at sector level.

TISSUE CULTURE

Summary

After a decade of small-scale production in 2017 a new proposal was set forth to continue plant tissue culture but in micropropagation to produce seed cane material. The idea to produce it as quality seed cane material, hence tissue culture lab was renovated and extended after a short training in micropropagation in 2018 to fully start with the production. A total of 10,170 plantlets were achieved through the process of micro propagation divided into stages as Initiation, Multiplication, Shooting, Rooting and Acclimatization. The year also marked as a recognition of tissue culture through an official opening and first set of tissue culture raised plantlets planted in the field.

Introduction

Plant tissue culture is a collection of micro techniques used to maintain and grow plant cells under sterile conditions on a nutrient culture medium of known composition. Tissue culture is applied in plant research for growing of new plants, which in some cases undergo genetic alterations. The plant of interest is taken through the tissue culture process and grown under sterile conditions to prevent various types of microorganisms from affecting the process. Tissue culture technique is used for rapid propagation of plants in a short time under controlled conditions. The seedlings produced in the process are free of bacterial and fungal diseases. A whole plant can be regenerated from a small tissue or plant cells in a suitable culture medium under controlled environment. The plantlets produced are called tissue-culture raised plants. Plant tissue culture is widely used to produce clones of a plant in a method known as micro-propagation where the plantlets produced are a true copy of the mother plant and show characteristics identical to the mother plant.

Project Details

The major focus of sugarcane tissue culture at the institute is to produce disease free planting materials of clones with selected varieties, which aids in seed cane production and acts as a substitute method in event of any viral disease outbreak. The lab work comprises Inoculation from the very first stage to sub culturing in intervals of 15-20 days to different stages till Rooting stage, medium preparation (with macronutrients, micronutrients and plant growth hormones for the explant to survive in a controlled environment). Cleaning procedures includes glass wares cleaning, general lab cleaning and sterilization practices. There is a total of 5 varieties propagated in the lab: Qamea, Viwa, Aiwa, LF91-1925 and Naidiri.

Graphical Analysis

This will supplement the seed material being produced through hot water treatment to provide quality and clean seed material to the growers. The current lab set up has space limitation with a total of 10,170 plantlets with increasing number of new plantlets. The trend below shows the progress from the time procedures were changed and how it has been performing.

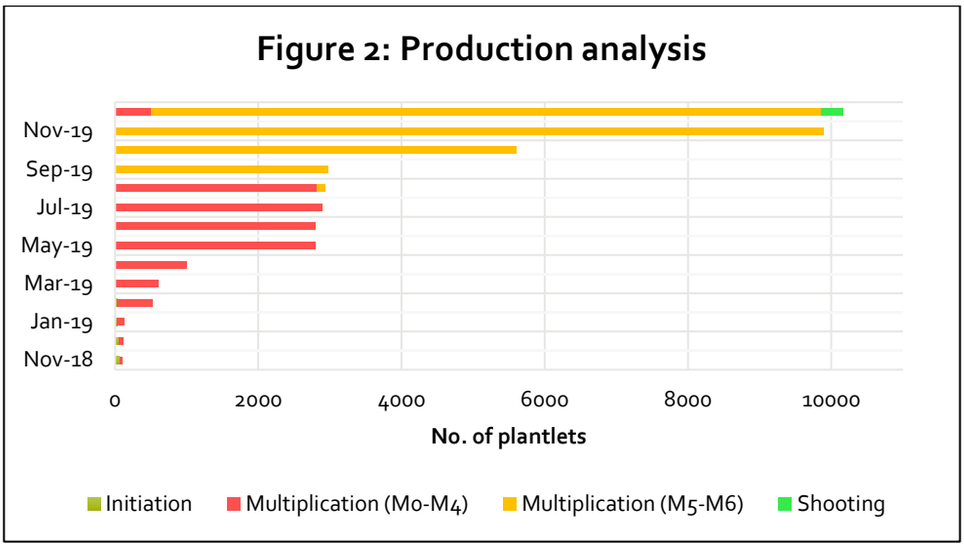


Figure 3: Multiplication stage

Conclusion

The farmers can receive seed cane stalks from the tissue cultured sugarcane after 18-24 months from the initial production of the seed cane material to the field. It has been a successful year as the production of 10,000 plantlets were achieved and first hardening trial successfully transferred to the field.

Appendix 1: Main features of 2019 season compared with 2018										
Mill →	Lautoka		Rarawai		Labasa		Penang		All mills	
Year →	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Total registrations (Numbers)	5425	5474	5357	5370	4117	4151	1747	1759	16646	16754
Total farm basic allotments (tonnes)	948321	957700	964105	966969	929944	941352	274458	276654	3116828	3142675
Total registered area (hectares)	22967	23119	22182	22229	20049	19780	8069	8046	73267	73174
Total area cultivated (hectares)	10990	21156	10956	11052	15338	21156	3497	3413	40781	56777
Total area harvested (hectares)	9132	9283	10225	10895	14473	14214	3275	3251	37105	37643
Total farm harvest quotas (tonnes)	Open									
Sugar make actual (tonnes)	57856	58439	38017	44830	64332	65435	N/A	N/A	57856	168702
Tonnes 94 N.T sugar	60256	60825	42947	48001	67011	68007	N/A	N/A	60256	58944
Yield tonnes 94 N.T. sugar per hectare	7	7	4	4	5	5	N/A	N/A	7	6
Tonnes cane per tonnes sugar 94 N.T.	11	11	12	11	9	10	N/A	N/A	11	11
%POCS	11	10	10	10	12	11	N/A	N/A	11	10.35
Cane purity average for season	81	79	77	80	82	81	N/A	N/A	81	80.2
Tonnes cane harvested	457480	474914	479625	523920	620328	661919	139937	145808	1697370	1806561
Tonnes cane crushed	457480	657160	466233	487428	620328	661919	NIL	NIL	1544041	1806507

Appendix 2: Monthly rainfall(mm) for 2019 compared with long term average														
Mills	No. of years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lautoka	2019 actual	220	220	187	239	6	12	61	10	86	86	69	158	1354
	110 yrs. avg. to 2019	306	326	322	185	96	65	51	67	72	91	125	189	1895
Rarawai	2019 actual	523	214	314	278	4	127	49	13	131	85	108	190	2036
	133 yrs. avg. to 2019	358	360	358	285	78	39	29	92	100	143	216	238	2296
Labasa	2019 actual	491	272	270	369	15	127	29	41	85	185	57	414	2355
	130 yrs. avg. to 2019	361	364	378	239	108	65	47	52	101	103	202	253	2274
Penang	2019 actual	295	255	240	498	20	53	56	197	75	44	97	160	1990
	121 yrs. avg. to 2019	431	358	401	377	121	72	52	93	85	144	152	245	2530

Appendix 3: Crop production details										
	Lautoka		Rarawai		Labasa		Penang		All mills	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Areas harvested (hectares)										
Plant	756	777	1799	1309	1673	1812	452	428	4680	4326
First ratoon	653	765	1340	1716	1908	1929	193	342	4094	4751
2nd ratoon	478	590	400	1174	1351	1687	306	228	2535	3679
Other ratoons	7245	7151	6686	6696	9541	8786	2324	2254	25796	24888
Total	9132	9283	10225	10895	14473	14214	3275	3251	37105	37643
Cane harvested (tonnes)										
Plant	44428	45714	96398	67825	80177	88806	16134	22164	237137	224509
First ratoon	39011	45664	70173	87813	94983	105423	11386	16758	215553	255658
2nd ratoon	25896	33250	18662	57904	59588	83429	17847	11186	121633	185769
Other ratoons	348146	350286	294392	310378	385580	384261	94571	95700	1122689	1140626
Total	457480	474914	479625	523920	620328	661919	139937	145808	1697370	1806562
Yield tonnes cane per hectare (tch)										
Plant	58.8	58.8	53.6	52.0	47.9	49.0	35.7	52.0	49.0	52.0
First ratoon	59.8	59.7	52.4	51.0	49.8	55.0	58.9	49.0	55.2	54.0
2nd ratoon	54.1	56.4	46.7	49.0	44.1	49.0	58.3	49.0	50.8	50.0
Other ratoons	48.1	49.0	44.0	46.0	40.4	44.0	40.7	42.0	43.3	46.0
Avg. yield/ha	50.1	55.0	46.9	49.0	42.9	49.0	42.7	47.0	45.7	50.0
Varieties crushed (% of total cane harvested)										
Ragnar	1.5	0.6	0.3	0.5	20.2	20.7	0.7	0.0	5.7	9.1
Aiwa	0.0	0.7	0.3	0.2	0.1	0.1	nil	0.1	0.1	0.3
Beqa	1.2	0.1	nil	nil	nil	0.0	nil	0.0	0.3	0.0
Galoa	0.7	0.1	nil	nil	5.5	4.5	nil	0.0	1.6	1.7
Kaba	2.7	2.0	6.0	6.4	0.5	0.2	0.2	0.1	2.4	2.5
Mali	0.0	0.1	0.3	0.1	8.9	7.5	0.1	0.0	2.3	2.8
Mana	90.6	91.7	90.3	90.1	0.0	0.0	96.5	97.0	69.4	56.8
Naidiri	2.1	2.5	1.2	0.7	45.4	49.4	2.2	2.6	12.7	19.2
Vatu	0.1	0.0	nil	nil	10.3	8.7	nil	0.0	2.6	3.2
Waya	0.1	0.0	0.3	0.3	5.4	4.6	0.1	0.0	1.5	1.7
LF91-1925	0.4	1.3	1.0	1.3	2.7	3.1	nil	0.0	1.0	1.8
Kiuva	0.4	0.4	nil	nil	0.3	0.5	nil	0.0	0.2	0.3
Qamea	0.1	0.3	nil	nil	nil	nil	nil	0.0	0.0	0.0
Viwa	nil	0.1	nil	nil	0.3	0.2	nil	0.0	0.1	0.1
Expt./Others	nil	0.1	0.3	0.3	0.5	0.4	0.1	0.1	0.2	0.3
Total	100	100	100	100	100	100	100	100	100	100

Appendix 4: Rainfall (mm) at mill centres										
Mill	For 12 months ended 31st December					For 12 months ended 30th September				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Lautoka	974	2072	1721	2129	1354	991	1666	1380	2070	1442
Rarawai	1101	1908	1993	2228	2036	998	1768	1547	2286	2042
Labasa	1167	1773	2122	2971	2355	1519	1167	1471	2981	2099
Penang	1310	2086	1799	2940	1990	5452	1685	1711	2787	2171

Appendix 5: Rainfall distribution affecting 2019 crop(mm)					
Month	Period	Lautoka	Rarawai	Labasa	Penang
Month	Period	Lautoka	Rarawai	Labasa	Penang
Jul-18	Early	nil	nil	6.9	6.4
	Mid	1	nil	18.5	2.1
	Late	nil	nil	nil	0.4
Aug-18	Early	nil	Nil	nil	117.5
	Mid	nil	Nil	nil	79.4
	Late	nil	Nil	nil	2.1
Sep-18	Early	25.5	11.2	10	14.9
	Mid	nil	5.5	8.0	2.8
	Late	nil	Nil	55.7	17.5
Oct-18	Early	38.5	75.5	62.8	83.3
	Mid	88.4	58.5	180.0	198.5
	Late	82.0	37.2	40.2	58.6
Nov-18	Early	5.3	Nil	Nil	Nil
	Mid	41.2	57.9	27.3	58.8
	Late	33.9	25.3	3.7	10.8
Dec-18	Early	29.1	29.8	56.3	54.2
	Mid	18.9	104.9	23.4	6.9
	Late	63.6	Nil	6.4	10.4
Jan-19	Early	24.6	34.4	197.9	58.6
	Mid	127.6	240.8	164.9	175.3
	Late	67.7	248.0	138.7	61.3
Feb-19	Early	77.9	57.0	117.5	118.5
	Mid	138.6	157.2	118.1	78.9
	Late	3.0	Nil	36.0	57.4
Mar-19	Early	125.5	117.4	75.9	115.0
	Mid	17.6	Nil	73.8	11.1
	Late	43.8	196.8	119.8	113.5
Apr-19	Early	44.7	27.0	77.6	5.8
	Mid	154.5	95.0	114.4	107.8
	Late	129.3	156.0	176.9	361.2
May-19	Early	Nil	1.4	13.5	13.9
	Mid	6.2	2.2	1.0	7.6
	Late	Nil	Nil	Nil	Nil
Jun-19	Early	3.1	14.8	43.3	15.0
	Mid	2.2	39.5	2.0	3.8
	Late	6.5	72.4	81.4	45.0
Early - 1st to 10th of the month Mid - 11th to 20th of the month Late - 21st to end of the month					

Appendix 6: Hectares harvested										
Mills		Average for period of five seasons					Last four seasons individually			
	Crop	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	P	3634	2944	1042	788	775	515	637	756	777
	R	20580	19701	19730	14614	10630	8105	9476	8376	2835
	Total	24214	22645	20772	15402	11405	10122	10113	9132	9283
Rarawai	P	2899	3164	1055	1127	953	403	1309	1799	1309
	R	17360	14613	17585	14553	11367	9610	8968	8426	3195
	Total	20259	17777	18640	15680	12320	10013	10277	10225	10895
Labasa	P	3120	2597	1269	1116	1403	1027	2008	1673	1812
	R	19604	18348	15911	14039	11500	12423	12238	12800	4134
	Total	22724	20945	17180	15155	12903	13450	14246	14473	14214
Penang	P	1386	1120	542	339	368	302	226	452	428
	R	4958	4674	4568	3991	3142	2907	3178	2823	941
	Total	6344	5794	5110	4330	3510	3209	3404	3275	3251
All mills	P	11039	9825	3908	3369	3499	2247	4180	4680	4326
	R	62502	57336	57794	47197	36640	35292	33860	32425	11106
	Total	73541	67161	61702	50567	40139	36794	38040	37105	37643

Appendix 7: Tonnes of cane harvested									
Mills	Average for period of five seasons					Last four seasons individually			
	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	1283569	1216597	971454	763321	516159	372288	429570	457480	474914
Rarawai	1017374	957507	878509	738316	551682	269800	407861	479625	394164
Labasa	1166055	1017061	840388	695728	547372	653353	675731	620328	661919
Penang	291206	309205	239044	213253	170698	91806	118231	139937	NIL
All mills	3758204	3500370	2929395	2410619	1785912	1387247	1631393	1697370	1530997

Appendix 8: Tonnes of cane per hectare harvested										
Mills		Average for period of five seasons					Last four seasons individually			
	Crop	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	P	64.7	64.2	63.9	67.2	57.7	48.9	54.6	58.8	58.8
	R	51.2	51.4	45.9	47.6	44.3	35.0	46.2	41.7	55.0
	Total	52.4	53.7	46.8	49.1	45.2	36.8	42.5	42.5	51.0
Rarawai	P	61.2	62.1	59.6	58.8	56.7	49.6	47.8	58.8	52.0
	R	48.1	52.9	46.4	44.8	43.8	26.6	43.0	54.0	49.0
	Total	50.1	53.9	47.1	46.5	44.8	26.9	39.7	56.4	48.0
Labasa	P	59.3	56.5	59.7	56.7	53.4	55.1	48.3	47.9	49.0
	R	50.4	47.4	47.6	43.5	41.4	46.1	47.5	44.8	49.0
	Total	51.3	48.6	48.9	45.8	42.7	48.6	47.4	46.4	47.0
Penang	P	57.2	62.6	54.2	56.3	50.6	32.2	37.2	35.7	52.0
	R	43.1	51.2	46.4	48.3	48.4	28.9	33.1	52.6	47.0
	Total	46.0	53.3	46.8	49.1	48.6	28.6	34.7	44.2	45.0
All	P	61.2	61.8	58.3	59.5	55.3	46.5	47.0	50.3	52.0
Mills	R	48.1	50.0	46.0	45.8	43.5	37.1	42.5	48.3	50.0
	Total	50.2	52.1	47.5	47.3	44.5	35.2	41.1	49.3	48.0

Appendix 9: Hectares harvested in relation to registered area and cultivated area (ha)					
Mills	2019 hectares (A)			Hectares harvested as % of various categories "A"	
	Registered (1)	Cultivated (2)	Harvested	(1)	(2)
Lautoka	23119	10066	9283	40.2	43.5
Rarawai	22229	11052	10895	49.0	49.7
Labasa	19780	15748	14214	71.9	91.0
Penang	3413	3413	3251	95.3	100.0
Total	56771	40279	37643	66.3	94.0

Appendix 10: Plant cane harvested as percentage of total cane harvested									
Mills	Average for period of five seasons					Last four seasons individually			
	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	15.0	13.0	5.0	5.5	8.5	6.8	8.1	9.7	10.0
Rarawai	14.0	18.0	6.0	8.2	9.7	5.3	15.3	20.1	13.0
Labasa	14.0	12.0	7.0	8.2	13.4	8.7	14.4	12.9	13.0
Penang	23.0	19.0	11.0	8.2	10.7	10.6	7.1	11.5	15.2
All mills	16.0	15.0	7.0	7.4	10.5	6.1	11.2	13.6	12.4

Appendix 11: Plant, ratoon yields and percentage of total area harvested - 2019 Crop										
Mills	Plant			First ratoon			Other ratoons			All cane	
	tch	Area ha	% of Area	tch	Area ha	% of Area	tch	Area ha	% of Area	tch	Area ha
Lautoka	58.8	777	8.4	60.0	765	8.0	53.0	7741	83	51.2	9283
Rarawai	52.0	1309	12.0	51.0	1716	16.0	46.0	7870	72	48.0	10895
Labasa	49.0	1812	12.7	55.0	1929	14.0	47.0	10473	74	47.0	14214
Penang	52.0	428	13.0	49.0	342	11.0	46.0	2482	76	45.0	3252
All Mills	52.0	4326	12.0	54.0	4751	13.0	48.0	28566	76	48.0	37643

Appendix 12: Seasonal %POCS in cane									
Mills	Rough average for period of five seasons					Last four seasons individually			
	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	12.5	11.4	11.5	10.8	11.4	10.7	11.8	10.6	10.0
Rarawai	12.9	11.4	11.9	10.9	11.3	9.7	11.4	10.0	10.0
Labasa	12.1	11.1	11.5	10.7	11.5	11.7	11.1	11.5	10.8
Penang	12.6	11.1	11.9	11.1	11.1	NIL	NIL	NIL	NIL
All Mill Avg.	12.5	11.2	11.7	11.0	11.4	10.6	11.6	10.6	10.4

Appendix 13: Weekly POCS in cane 2019 season				
week	Lautoka	Rarawai	Labasa	Week average
1	9.39	10.34	11.65	10.46
2	9.45	10.64	10.36	10.15
3	10.12	10.83	10.25	10.40
4	10.56	10.81	10.35	10.57
5	10.49	10.96	10.39	10.61
6	10.44	10.98	11.09	10.84
7	10.23	11.02	10.79	10.68
8	10.06	10.93	10.76	10.58
9	10.34	10.79	11.16	10.76
10	10.24	10.84	11.03	10.70
11	10.07	10.73	11.17	10.66
12	10.26	10.84	11.18	10.76
13	10.44	10.74	11.05	10.74
14	10.42	10.13	11.01	10.52
15	10.45	9.97	10.98	10.47
16	10.52	10.01	11.06	10.53
17	10.42	9.65	11.04	10.37
18	10.06	9.97	10.92	10.32
19	9.92	9.00	10.78	9.90
20	9.42	9.20	10.67	9.76
21	8.61	9.70	10.40	9.57
22	9.43	9.20	10.04	9.56
23	8.41		10.04	9.23
24	8.94		9.93	9.44
25	8.71		9.72	9.22
26	9.53			9.53
27	9.16			9.16
Average	**9.86**	**10.33**	**10.71**	**10.20**

Note – Penang mill did not operate damaged by Cyclone Winston

Appendix 14: Sugar produced (tonnes 94 N.T. equivalent)									
Mills	Tonnes sugar 94 N.T equivalent								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
Lautoka	50306	48129	41874	76456	63784	40595	52021	60256	60825
Rarawai	61028	45732	60039	68277	61083	25979	57167	42708	44830
Labasa	45146	45398	63423	69647	82744	76466	67010	64332	65435
Penang	16838	19908	19258	21684	18731	N/A	N/A	N/A	N/A
All mills	173318	159166	184594	236065	226342	143040	176198	167296	168702

Appendix 15: Sugar tonnes 94 N.T equivalent per hectare (tsh)										
Mills	Average for period of five seasons					Last five seasons individually				
	1991/1995	1996/2000	2001/2005	2006/2010	2011/2015	2015	2016	2017	2018	2019
Lautoka	6.2	5.6	4.9	4.4	4.9	5.9	4.0	8.4	10.5	11.0
Rarawai	6.3	5.6	5.4	4.0	4.9	5.2	2.6	8.7	11.2	10.0
Labasa	6.0	5.0	5.0	4.0	5.1	6.4	5.7	9.3	9.3	10.0
Penang	5.5	5.4	4.7	5.4	5.5	5.2	NIL	5.7	NIL	NIL
Average	6.1	5.4	5.1	4.3	5.1	5.8	3.9	8.0	10.3	10.0

Appendix 16: Length of season (weeks) - Start and finish of crushing (date)									
Mills	Average length of season (5 yearly)					Last four seasons individually			
	1991/ 1995	1996/ 2000	2001/ 2005	2006/ 2010	2011/ 2015	2016	2017	2018	2019
Lautoka	28.0	29.7	27.6	27.0		21.0	19.1	24	26
						20/06/16 To 16/11/16	06/06/17 To 17/10/17	09/07/18 To 17/10/18	13/06/2019 To 15/12/2019
Rarawai	25.3	26.5	24.2	28.0	22.1	19.0	20.5	22.9	22
						20/07/16 To 31/11/16	07/06/17 To 28/10/17	17/07/18 To 24/12/18	08/07/2019 To 09/12/2019
Labasa	29.4	30.7	24.1	25.9	18.7	20.4	24.4	26	25
						16/06/16 To 06/11/16	01/06/17 To 19/11/17	19/06/18 To 12/12/18	12/06/2019 To 05/12/2019
Penang	21.5	26.2	20.4	22.5	18.1	No crushing	No crushing	No crushing	No crushing
All mills	26.1	28.2	24.1	25.9		20.1	21.3	24.3	25

Appendix 17: Varieties Percent of hectares harvested										
	Lautoka		Rarawai		Labasa		Penang		All Mills	
Varieties	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Ragnar	1.5	0.6	0.3	0.5	20.2	20.7	0.7	0.0	5.7	9.1
Waya	0.1	2.0	0.3	0.3	5.4	4.6	0.1	0.0	1.5	1.7
Mali	0.0	0.0	0.3	0.1	8.9	7.5	0.1	0.0	2.3	2.8
Galoa	0.7	0.1	0.0	0.0	5.5	4.5	0.0	0.0	1.6	1.7
Aiwa	0.0	0.7	0.3	0.2	0.1	0.1	0.0	0.1	0.1	0.3
Mana	90.6	91.7	90.3	90.1	2.7	0.0	96.5	97.0	70.0	56.8
LF91-1925	0.4	1.3	1.0	1.3	0.0	3.1	0.0	0.0	0.4	1.8
Kaba	2.7	2.0	6.0	6.4	0.5	0.2	0.2	0.1	2.4	2.5
Vatu	0.1	0.0	0.0	0.0	10.3	8.7	0.0	0.0	2.6	3.2
Beqa	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Naidiri	2.1	2.5	1.2	0.7	45.4	49.4	2.2	2.6	12.7	19.2
Kiuva	0.4	0.4	0.0	0.0	0.3	0.5	0.0	0.0	0.2	0.3
Qamea	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Viwa	-	0.1	0.0	0.0	0.3	0.2	0.0	0.0	0.1	0.1
Exp.	-	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Others	0.0	0.1	0.3	0.3	0.5	0.4	0.1	0.1	0.2	0.3

Appendix 18: Area planted in hectares as % of registered and cultivated areas									
Mills	Hectares planted			Hectares planted as % of registered area			Hectares planted as % of cultivated area		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Lautoka	892.4	860.9	560.8	3.9	3.7	2.4	8.1	7.8	6.0
Rarawai	2163.2	1705.8	921.8	9.8	7.7	4.1	18.2	15.6	8.3
Labasa	2160.2	2035.2	1186.4	11.2	10.2	6.0	15.2	13.3	8.3
Penang	418.2	476.2	386.9	5.2	5.9	4.8	12.2	13.6	11.3
Total	5634.0	5077.1	3055.9	7.8	6.9	4.2	14.0	12.5	5.4

Appendix 19: Percentage of total area planted by different varieties over three years

		Lautoka		Rarawai		Labasa		Penang		All mills	
Year	Varieties	%	Area ha	%	Area ha	%	Area ha	%	Area ha	%	Area ha
2017		0.2	1.7	0.1	1.8	13.5	291	-	-		
2018	Ragnar	0.2	2.1	-	-	8.3	169.4	-	-	3.4	171.5
2019											
2017		-	-	0.2	4.0	1.8	38.7	-	-		
2018	Waya	-	-	0.2	2.6	2.0	40.8	-	-	-	-
2019											
2017		93.2	831.4	92.7	2005.5	-	-	88.5	370.0		
2018	Mana	96.3	829.4	97.7	1666.5	-	-	94.4	449.3	58.0	2945.2
2019											
2017		0.0	0.4	-	-	3.7	79.8	-	-		
2018	Galoa	-	-	-	-	2.8	57.8	-	-	1.1	57.8
2019											
2017		-	-	-	-	12.4		-	-		
2018	Vatu	-	-	-	-	4.8	97.8	-	-	1.9	97.8
2019											
2017		-	-	-	-	5.2	112.7	-	-		
2018	Mali	-	-	-	-	3.0	60.8	-	-	1.2	60.8
2019											
2017		0.6	5.7	0.0	1.0	0.4	0.0	-	-		
2018	Aiwa	0.3	2.4	0.2	3.2	0.0	0.2	-	-	0.1	5.8
2019											
2017		-	-	-	-	0.0	0.0	-	-		
2018	Beqa	0.1	0.7	-	-	-	-	-	-	0.0	0.7
2019											
2017		0.8	7.4	5.2	112.2	0.3	6.4	-	-		
2018	Kaba	0.5	4.1	1.8	30	0.2	4.4	-	-	0.8	38.5
2019											
2017		3.6	32.5	1.1	24.3	62.3	1347	8.8	36.8		
2018	Naidiri	0.8	7.1	0.0	0.6	72.7	1478.8	5.6	26.9	29.8	1513.4
2019											
2017		-	-	-	-	0.2	5.3	-	-		
2018	Kiuva	0.0	0.3	-	-	0.4	8.1	-	-	0.2	8.4
2019											
2017		0.8	7.2	0.4	7.9	6.3	136	0.4	1.8		
2018	LF91-1925	0.7	6.2	0.1	1.3	4.8	98.1	-	-	2.1	105.6
2019											
2017		-	-	-	-	-	-	-	-	-	-
2018	Qamea	-	-	0.1	1.6	0.5	11.1	0.0	0.4	0.3	13.8
2019											
2017		-	-		-	-	-	-	-	-	-
2018	Experiment	-	-			-	-				
2019											
2017		0.5	4.1	0.3	6.5	1.1	23.2	-	-		
2018	Others	-	-	-	-	-	-	-	-	-	-
2019											

Appendix 20: Cane transport in Fiji (tonnes of cane harvested and actual method of delivery)									
Mills	Year	Delivered portable line		Winch trailer or lorry to mainline		Lorry direct to mill carrier		Total	
		Tonnes	% of Total	Tonnes	% of Total	Tonnes	% of Total	Tonnes	% of Total
Lautoka	2011	9491	1.5	144569	22.2	498273	76.4	652333	100
	2012	2065	0.4	113819	23.6	365599	75.9	481483	100
	2013	12464	1.7	168852	23.3	544730	75.0	726046	100
	2014	1436	0.3	116328	22.4	402500	77.4	520264	100
	2015	nil	nil	111036	21.3	410029	78.7	521065	100
	2016	50	.01	85410	22.9	286831	77.0	372291	100
	2017	168	0.0	73141	17.0	356261	82.9	429570	100
	2018	nil	nil	70995	15.5	386486	84.5	457481	100
	2019	1308	0.3	129966	27.4	343641	72.4	474915	100
Rarawai	2011	23586	3.6	332792	50.1	307396	46.3	663774	100
	2012	14772	3.6	106393	24.9	387485	71.4	508650	100
	2013	22054	6.3	104779	30.2	220584	64.0	347417	100
	2014	14006	2.2	113691	18.0	468653	79.8	596350	100
	2015	12032	2.5	93635	19.1	385098	78.5	490765	100
	2016	8189	3.0	45598	16.6	221077	80.4	274864	100
	2017	5577	1.4	52370	12.8	349914	85.8	407861	100
	2018	1132	0.2	67303	14.0	411190	85.7	479625	100
	2019	760	0.1	62239	11.9	460921	88.0	523920	100
Labasa	2011	nil	nil	162856	29.0	407610	71.0	570466	100
	2012	840	0.2	117543	28.4	294902	71.4	413285	100
	2013	nil	nil	137018	25.1	409138	75.0	546156	100
	2014	nil	nil	149353	27.4	395000	72.6	544353	100
	2015	nil	nil	181420	27.4	481180	72.6	662600	100
	2016	nil	nil	178355	26.0	508736	74.0	687091	100
	2017	12012	1.8	130502	19.3	533217	78.9	675731	100
	2018	nil	nil	164846	26.6	455482	73.4	620328	100
	2019	23930	3.6	127294	19.2	510695	77.2	661919	100
Penang	2011	nil	nil	55422	26.5	153438	73.5	208860	100
	2012	nil	nil	38712	27.0	104856	73.0	143568	100
	2013	nil	nil	40797	26.0	118923	75.0	159720	100
	2014	nil	nil	36454	21.3	134760	78.7	171214	100
	2015	nil	nil	31707	18.6	138422	81.4	170129	100
	2016	nil	nil	nil	nil	91806	100.0	91806	100
	2017	nil	nil	nil	nil	118231	100.0	118231	100
	2018	nil	nil	nil	nil	139938	100.0	139938	100
	2019	nil	nil	nil	nil	145809	100.0	145809	100
All mills	2011	33077	1.6	695639	33.2	1366717	65.2	2095433	100
	2012	17677	1.1	376467	24.3	1152842	74.5	1546986	100
	2013	8630	2.0	451446	26.2	1293375	74.1	1779339	100
	2014	15442	0.8	415826	22.7	1400913	76.5	1832181	100
	2015	12032	0.7	417798	22.7	1414729	76.6	1844559	100
	2016	8239	0.5	309363	21.7	1108450	77.7	1426052	100
	2017	1775.7	1.1	256013	15.7	1357623	83.7	1631393	100
	2018	1132	0.07	303144	17.86	1393096	82.1	1697372	100
	2019	25998	1.4	319499	17.7	1461066	80.9	1806564	100

Appendix 21: Percentage burnt cane of total tonnes crushed										
Year	Lautoka		Rarawai		Labasa		Penang		Average	
	%	Total	%	Total	%	Total	%	Total	%	Total
1981	17.6	1444504	21.2	1248910	19.4	930265	17.0	307753	18.8	3,931,432
1982	23.2	1507831	24.8	1100133	13.6	1140552	13.2	326348	18.7	4,074,864
1983	18.3	639823	18.4	561774	18.0	761454	12.0	239482	16.7	2,202,533
1984	25.1	1731580	8.2	1146140	12.9	1136737	10.0	382030	14.1	4,396,487
1985	28.6	947593	25.2	864264	22.4	934166	16.2	296418	23.1	3,042,441
1986	29.5	1526648	15.1	1204661	15.1	1017372	11.3	360284	17.8	4,108,965
1987	23.8	1090111	34.2	685994	20.9	877652	19.0	306706	24.5	2,960,463
1988	37.7	1116916	15.2	742128	16.0	1034788	19.2	291440	22.0	3,185,272
1989	20.6	1537337	13.6	1250977	12.7	974201	10.0	336418	14.2	4,098,933
1990	24.3	1347531	30.4	1148070	13.7	1171817	14.6	348110	20.8	4,015,528
1991	42.5	1112957	46.4	961961	32.0	1029223	27.6	276261	37.1	3,380,402
1992	52.5	1109778	52.1	962936	44.4	1162108	41.1	297818	47.5	3,532,640
1993	35.6	1341537	33.4	1013627	29.2	1124357	19.4	224383	29.4	3,703,904
1994	39.0	1337977	36.0	1104246	27.0	1298285	19.8	323743	30.5	4,064,251
1995	43.4	1515880	42.5	1044098	37.6	1216290	28.7	333790	38.1	4,110,058
1996	54.8	1561446	48.1	1229978	39.9	1238443	33.2	349348	44.0	4,379,215
1997	50.7	1160879	49.1	906495	33.5	910137	34.8	302095	42.0	3,279,606
1998	67.0	625763	67.7	406811	54.5	832622	44.6	232825	58.5	2,098,021
1999	41.6	1433143	39.8	992968	17.0	1192735	26.3	339292	32.4	3,958,138
2000	56.1	1301752	54.6	1251282	37.8	911370	49.0	322475	50.6	3,786,879
2001	56.7	906743	50.3	844411	18.9	845444	49.5	208183	42.9	2,804,781
2002	46.8	1137123	41.8	1071579	21.4	938450	33.9	275431	37.1	3,422,583
2003	40.1	890499	32.8	836728	29.3	638851	22.0	243602	33.4	2,609,680
2004	42.7	1032127	39.5	878121	18.3	848533	35.5	242408	34.3	3,001,189
2005	44.4	890779	38.4	761704	25.0	910663	34.9	225594	35.7	2,788,740
2006	60.5	1051097	58.5	1039474	34.4	871031	46.5	264498	51.7	3,226,100
2007	39.0	741231	40.5	738478	39.1	769138	53.5	229844	40.8	2,478,691
2008	50.9	770569	53.6	732165	49.1	604314	48.5	214572	51.1	2,321,620
2009	43.5	726046	33.3	659351	18.6	679584	28.8	181650	31.8	2,246,631
2010	30.4	527663	33.6	522114	18.6	554575	16.3	175701	25.0	1,780,053
2011	28.5	652333	28.2	663774	17.9	570468	26.6	208860	25.3	2,095,435
2012	43.8	481483	44.7	508638	18.7	413285	28.3	143568	35.9	1,546,974
2013	77.8	726046	31.9	347417	14.2	546156	27.0	159720	37.7	1,779,339
2014	50.7	520264	49.9	596350	22.0	544353	28.0	171214	39.9	1,832,181
2015	47.0	244680	48.5	238167	27.7	183840	31.0	52688	39.0	719375
2016	75.7	281824	89.7	242008	81.6	220034	50.2	85336	74.3	829202
2017	24.9	214336	20.9	170472	30.5	206433	34.3	40552	34.3	40552
2018	64.2	293513	57.8	365936	28.9	274535	60.9	85262	55.6	943378
2019	58.0	274535	61.0	319637	34.0	223388	47.0	67498	58.0	885058

Technology Transfer

15+ Information Days

15+ Demo Plots

OVERVIEW

The transfer of knowledge from research into farming practice is constant requirement for the industry to develop new ways of working and thinking. Technology transfer involves transfer of knowledge and technical -knowhow as well as physical devices and equipment's. Under Technology transfer SRIF has following programs; Grower demonstration trials, Seed cane Nurseries, Estate farms and improving Soil health initiatives such as Green Manure.

Under these programs SRIF demonstrates best management practices related to sugarcane farming by advocating on importance of fallow management, quality seed cane, variety diversification, crop establishment, nutrient management, timely weed control and fertilizer application, pest and disease control, irrigation and drainage management and best harvesting practices.

To successfully carry out technology transfer work, the following needs to be adopted:

- ✓ FSC to dedicate full time farm advisory officers or SRIF recruits additional Technical staff at district level to fulfill the demand for technical support needed by farmers.
- ✓ SRIF should recruit a set of support staff at district level to assist in technology transfer initiatives such as assist in planting demo plots and seed cane nurseries.
- ✓ Grower demonstration trial and field information days process needs to be reviewed and only farmers who are committed and have potential should be encouraged to participate.
- ✓ Industry stakeholders should implement measures to control increasing burnt cane issues.
- ✓ 10-wheeler and 12-wheeler trucks should not be allowed to transport mechanically harvested sugarcane as they do substantial damage to the crop.
- ✓ More research should be done on new weedicides that are available overseas as Glyphosate will be banned in near future and some residual herbicides currently been used in Fiji might as well be banned in future due to its effects on environment and marine ecosystem.
- ✓ More trials on best irrigation option for Fiji Sugar Industry to be considered.
- ✓ More demonstration plots should be established in the sectors for the farmers to make them aware of the varieties and technologies developed by SRIF. Mechanization, legumes and weed management should be the major focus due to yield being lost in field by excessive weeds, lack of labour and depleting soil health.

- ✓ Legume crop should be intercropped with sugar cane to reduce the usage of chemical fertilizer since it fixes nitrogen from the atmosphere in the soil. It gives additional income to the farmer as cash crop. It should also be incorporated as green manuring to improve soil health which is deteriorating due to continuous mono culturing of sugarcane crop and use of chemical fertilizers.
- ✓ Clean seed material should be used by the farmers in order to prevent spreading of ratoon stunting disease. More hot water treated seed cane nurseries should be established in the sectors for the farmers convenience. This will minimise cost of transportation of seed cane and encourage farmers to use the clean seed material in their farms.
- ✓ Harvesting with the harvesters in the farms should be monitored and controlled to avoid unnecessarily soil compaction which can lead to yield decline in the coming future of the sugarcane farming. The traffic should be controlled well in the farm during harvesting.
- ✓ More focus should be given to farmers who are in production rather than the nil producing farmers. Most of the nil producing farmers are not living on their farm or have settled somewhere else doing other jobs to earn their living therefore it is hard to bring them in production.

LAUTOKA MILL

The sugarcane from 10 grower demonstration trials, which were planted in 2018, were harvested. The results/yields from each plot, is given below in this report. In early 2019, 5 field information days were held in some of the Grower Demonstration trials which were established in 2019.

Four additional Grower Demonstration trials, were planted in 2019 in Malolo, Meigunyah, and Lovu Sector. The major themes covered in these demonstration trials are; transition to farm mechanization, soil health, importance of good land preparation, quality Seed cane, timely weed control and fertilizer application. Two Green Manure trials, was planted in February 2019, in farm number 167 in Lovu Sector and SRIF Drasa Estate.

Despite late planting of the green manure black gram, the trial planted on farm number 167 in Lovu Sector did grow well and a major field day was organized which had 200 participants including farmers and industry stakeholders. During the field day, participants also, visited

SRIF Drasa estate to see the impacts of green manuring for sugarcane growth and demonstration of pulse planter, which SRIF uses to plant urd and moong. Towards the end of the year a meeting was, held with Fiji Sugar Corporation's Extension team to discuss planting green manure trials in each of the sector in all mill areas. 15 hectares of Seed cane distribution plot was, planted in Tunalia Joint venture Farm, in Nadi. The varieties planted in these plots include; Naidiri, Mana, Viwa and Qamea.

Improving Soil Heath: Green Manure and sugarcane Trash incorporation trials

Declining soil fertility due to decades of mono cropping with sugarcane in cane areas of Fiji is a major concern for sustainability of Fiji sugar industry. Trials were planted in SRIF Drasa Estate using legume crops such as urd and moong.

At flowering stage, these plants were incorporated, and left to decay in soil, before next crop of sugarcane was planted. Additional two green manure trials were planted in SRIF Drasa estate in 2018 with different varieties of sugarcane planted after green manure was incorporated in the soil. The sugarcane crop was harvested in 2019 season and the results are shown in the table below:

Table 1: Past 3 years production comparison

Year GM trial planted	Farm	Grower Name	Area (Ha)	Crop	Varieties	Production	Tph
2016	11902	SRIF - F/24 dual row	3	3rd ratoon	Viwa, LF91, Qamea, Naidiri	335.94	111.98
2017	11902	SRIF - F/24	2.5	1st Ratoon	Naidiri	270.4	108.16
2018	11902	SRIF - F/11	1.5	Plant	Viwa	204.61	136.41
2018	11902	SRIF - F/8	3.4	Plant	Naidiri, Bea, Aiwa, Kaba, Mana	376.97	110.87
2018	2140	Upendra - Meigunyah Sector	0.5	Plant	Naidiri/Viwa	45	90

Figure 1: Green manure soil conditioning before planting sugarcane

In addition to planting green manure, incorporating of sugarcane trash into the soil also enables organic matter retention and nutrient recycling. It is, estimated that 6 to 8 tonnes of trash is produced per hectare depending on the sugarcane variety. In 2019, two plots in SRIF Drasa estate were ploughed out together with the trash; this is something different in comparison to the past where trash was burnt before ploughing to allow for easier cultivation. Trash incorporation (Trash decomposition took 2 to 3 months) in soil as many benefits and it should be always encouraged. The disc plough was sharpened before use for added ease of trash incorporation.

Figure 2: Sugarcane trash incorporated in soil during ploughing

Improving soil fertility is a long process, therefore to improve and sustain sugar production in Fiji, good husbandry practices such as good fallow management with green manure crops, trash conservation, minimum/zero tillage, Green Cane harvesting and soil conversation needs to be practiced by all farmers. To achieve this continuous capacity building training and empowerment for farmers is required.

Grower Demonstration Trials and field information days

Grower demonstration trial and field information days are most commonly used technique to demonstrate the new/improved technologies and share research findings with farmers in Fiji sugar industry. The following topics are, covered in the grower demonstration trials and respective field information days;

- ✓ Importance of improving Soil Health through Green Manuring
- ✓ Good Land Preparation and Soil Sampling
- ✓ Sugarcane Varieties & Quality Seed cane.
- ✓ Mechanical Planting of Sugarcane using whole stalk cane planter.
- ✓ Mechanical spraying (pre-emergence and Post emergence).
- ✓ Importance of Blend A and Blend B application.
- ✓ Importance of changing farm layout to suit mechanical harvesting.
- ✓ Benefits of using Mill mud.
- ✓ Integrated weed Management
- ✓ Timeliness of operations
- ✓ Benefits of intercropping
- ✓ Irrigation

The following are results from the 2018 Grower demonstration trials harvested in 2019.

Table 2: List of grower demonstration trials for 2019

District	Sector	Farm #	Area (Ha)	Date Planted	Tonnes Harvested	TpHa	Variety
Lautoka	Drasa	8087	0.6	21/06/18	72	120.0	Viwa/Mana
Nadi	Meigunyah	2140	0.5	29/06/18	45	90.0	Naidiri/Viwa
Nadi	Qeleloa	2426	0.73	28/06/18	86	117.8	Mana/Viwa
Nadi	Nawaicoba	10726	1.0	27/06/18	110	110.0	Mana/Viwa/Qamea
Sigatoka	Olosara	5695	0.7	06/07/18	79	112.4	Viwa/Naidiri
Sigatoka	Olosara	5533	0.4	20/06/18	30	75.0	Kaba
Sigatoka	Lomawai	11237	0.4	07/07/18	30	75.0	Naidiri/Viwa/Mana
Lautoka	Lovu	19085	1.7	03/12/18	210	127.2	Naidiri/Mana
Lautoka	Lovu	18162	1.0	19/12/18	122	122.1	Naidiri
Lautoka	Natova	866	1.0	02/12/18	100	100.3	Mana

The above results show that in order to achieve high yields; best management practices need to be adopted. These plots will be maintained as first ratoon, best ratoon management practices will be implemented and field days will be organized to share above results with neighboring farmers. In 2019, additional four grower demonstration trials were, planted in Lautoka and Nadi districts. The following are the details of demo plots planted in 2019.

Table 3: Additional grower demonstration trials for Nadi & Lautoka districts

District	Sector /Location	Topic	Theme/attendance
Lautoka	Lovu Est of Shiu Nadan Farm # 167	Green Manure Farm Mechanization/Varietal Spread	Importance of improving soil health, Farm Mechanization 200 farmers/industry personnel attended this field day.
Nadi	Malolo Tunalia Joint Venture farm	Farm Mechanization/timely operations	Importance of Land preparation Timely weed control Field day to be organized in 2020
Nadi	Meigunyah, Est of Aziz Mohammed Farm # 2270	Farm Mechanization/ integrated weed control	Transition to farm Mechanization Timely weed control
Lautoka	Lovu Farm # 135 Velaidhan	Farm Mechanization + Varietal Spread	Mechanical planting Varietal Spread Timely planting and operations

Figure 3 & 4: LEFT - Grower demo plot planting on farm number 167 in Lovu Sector, RIGHT - A mini-field information day was, organized for field staff at Tunalia JV

Figure 5: A well establish plant cane in Tunalia Demo plot.

2018 drip irrigation trial results

The 3.8 ha drip irrigation trial which was established in FSC Drasa estate in 2018 was harvested in 2019. The following table shows the results and the summary of cost benefit analysis (CBA).

Table 4: Drip Irrigation trial CBA summary

Crop	Treatment	Area (ha)	Tonnes	Tph	Cost/ha	Income/ha	GM/ha	GM/tonne
Ratoon	Drip trial	1.08	109.97	101.8	$13,171.27	$8,655.55	$(4,515.72)	$(44.35)
	Control	1.08	102.6	95.0	$3,569.50	$8,075.00	$4,505.50	$47.43
Plant	Drip tape in every row	1.60	147.5	92.2	$3,171.27	$7,838.06	$(5,333.21)	$(57.84)
	Drip tape in alternate row	1.19	94.8	79.7	$13,169.92	$6,770.71	$(6,399.21)	$(80.34)

*GM – gross margin

Notes

- For ratoon crop, the return on investment was negative in drip trial plot as the yield difference compared with control ratoon plot was only 6.83 tonnes.
- For plant crop, both plots had negative return on investment, however plot which has drip tapes in every row had better yield compared to alternate row plot.
- The trial was, planted in early November, and early onset of rainy season defeated the overall objective of this trial.
- With the favorable weather conditions prevailing throughout the 2019 season, the yield in control ratoon plot was much higher than expected.
- The reasons for high cost of setting up drip irrigation are as follows:
    - About 95% of the drip irrigation material were imported from Australia
    - The distance from water source (Matawalu River) to trial site - 1.7Km, which required 1.7Km long 4 inch lay flat pipe which is very expensive and also it requires high powered water pump(20hp) to push water through this distance.
    - Laying of drip tapes, operating water pump after hours due high/low tide and collection of drip tapes in 3.8ha, matured/lodged sugarcane is very Labour intensive.
    - Since the trial site was close to main highway and an access road crossing the fields, some drip tapes and main line pipes were damaged which needed to be, replaced this required additional funds.

Figure 6: showing well established crop and collection of drip tapes from the trial

Some of the constraints and challenges faced in technology transfer initiatives are:

- Availability of FSC sector team leaders to participate and assist in Technology transfer activities taken by SRIF.
- Lack of support staff at district level to facilitate Technology transfer activities.
- Lack of interest from farmers to participate in field information/ FFS days.
- Increase in percentage of burnt cane harvesting.
- Outbreak of Termite infestation in Lautoka district, which restricts movement of seed cane from Lautoka to other districts.

SRIF is achieving some good yields in its estate farms and the grower demonstration trials planted, in different localities in different sectors. These are results of continued research and innovation.

In order to replicate these results and improve the national sugarcane production, SRIF will require additional funding to have additional sets of equipment's, recruit additional technical staff and support staff at district level. Support from industry stakeholders especially FSC Extension team will be vital to train farmers on new innovative techniques and ideas to improve sugarcane yield in Fiji.

LABASA MILL

A total of twelve demonstration plots were established in all the ten sectors of Vanua Levu. Mainly the focus was on weed management, varieties, mill mud application, inter cropping and mechanization. Out of twelve demonstration plots, eight field days were successfully conducted in sectors. Hot water treatment plant was established at Labasa substation in 2018. Total of 7.5-hectare hot water treated seed bed (mother plot) were established in Vanua Levu. The mother plot that was established in the year 2018 was used to establish 15.78 hectares of distribution plot in all the ten sectors of Vanua Levu. Total of three hundred tonnes of seed cane was utilised by the farmers for planting in their field and sixty tonnes of cane was used for establishing the mother plot. To improve soil heath which has deteriorated due to continuous mono culturing of sugar cane from past decades, green manuring has been re-introduced. The decline in soil organic matter and the acidic nature of the soil is attributed by the use of heavy machineries by farmers and soil erosion activities. To overcome this problem farmers are advised to plant green manure crop and use soil amendments like lime to increase soil pH and improve organic matter content. The major challenges for researchers are to disseminate the techniques developed by SRIF to the farmers. The new systems and methods developed by researchers are more cost effective and environment friendly. The major concern in today's era is depleting soil health, weed management, use of appropriate varieties, adaptation to new machineries and its operations. Taking this in consideration SRIF is transferring ideas and methods to the farmers through planting demonstration plots and conducting field days in the sectors for the farmers. The demonstration plot established in the sectors are given in the table below.

Table 5: List of demonstration plots

Sectors	Demo plots
Wainikoro and Daku	Methods of planting and the importance of blend A + Lime during planting. Integrated weed management - Intercropping (Watermelon)
Bucaisau	Integrated weed management Intercropping with integration of fruit trees on the boarders Quality seed cane and Varieties
Solove + Natua + Bulivou	Varieties Quality seed cane Intercropping (watermelon and cowpea)
Waiqele	Varieties and quality seed cane Fallow land with leguminous crop (cowpea). Trash conservation
Labasa + Vunimoli	Spraying urea (5%) on trash for faster decomposition Quality seed cane + Varieties Application of Mill Mud and its benefits.

Integrated weed management

Weed management is very important cultivation aspect towards yield. Timely application of herbicides and weeding is vital towards sugarcane growth. Pre and post emergent should be done on time and spot manual weeding is required if some of the weeds are not killed by the post emergent herbicide used in Fiji.

To make aware of the importance of integrated weed management, two field days were conducted in the farmer fields. The pictures below show the demonstration done in the field and turn out during the field day.

Figure 7: Integrated weed management (IWM) practice & without IWM comparative demo plot

Figure 8 & 9: LEFT - Integrated weed management field at Bucaisau sector, RIGHT - Boom sprayer demonstration for the farmers

Importance of good land preparation and liming

Farmers needs to know the importance of good land preparation. The soil should reach fine tilth stage before planting to achieve good germination. Proper land preparation procedure should be followed with two ploughing and two harrowing in eight-week interval.

A demonstration was done in Wainikoro sector to highlight this activity and application of lime in the field. Soils which has low pH needs to be applied with lime in order to raise the soil pH to 6.5 so that plants are able to effectively absorb nutrients from the soil. The picture below shows the demonstration done in the field.

Figure 10 & 11: LEFT - Good land preparation demonstration, RIGHT - Liming, blend A and planting demonstration

Integration of fruit trees on the boarders of the sugar cane field

Climate change is affecting the weather and seasons of planting. Frequent droughts and unexpected natural disasters are becoming more severe.

To mitigate this problem food security is important and one of the measures taken up by ministry of agriculture together with SRIF is to integrate fruit trees with sugar cane on the boarders of the sugarcane fields.

This will generate additional income for the farmers and reduce carbon dioxide from the atmosphere. The picture below shows the planting of banana suckers on the boarders of a demonstration plot for the farmers.

Figure 12: Planting of banana suckers on the boarders of sugarcane field

Varieties

Varieties play vital role in the production of quality sugar by the mill. SRIF is dedicated to continue breeding high sugar, disease resistance, drought tolerant and early maturing varieties. The two new varieties released (Viwa and Qamea) has these characteristics. Viwa is mid to late maturing and is highly suited for mechanical harvesting where as Qamea is early maturing and fast growing. Five field days were conducted in Bucaisau, Solove and Natua sector. These two new varieties were introduced to the farmers and its characteristics were demonstrated on the farmer fields. Farmers were advised to plant these two varieties and also Naidiri as these are high sugar yielding and suitable for poor soil types. The pictures below show the varieties in the field and the farmers turnout in the field days:

Figure 13 & 14: LEFT - Qamea variety in Bucaisau sector, RIGHT - Farmers viewing Viwa variety and its characteristic in Natua sector

Green manuring

Green manuring is the key focus method used to improve soil heath and the institute targeted to plant green manure demonstration plots in all sectors and create awareness for the farmers. A new legume planter has been purchased with European union funds for high density planting. Using this planter, demo plots were planted towards the end of the year as this is the season of planting green manuring needs high rainfall for vigorous growth and decomposition. The pictures below show the planter in use and field day conducted for farmers in Waiqele sector.

Figure 15 & 16: LEFT - Legume planter planting urd as green manure crop in Batinikama, RIGHT - Field day conducted in Waiqele sector on green manuring with cowpea

Table 6: Green manure plots planted in the sectors

Sectors	Crop
Nakiko Estate	Urd Bean
Solove	Urd Bean + Cowpea
Bucaisau	Cowpea
Waiqele	Cowpea
Labasa	Urd
Natua	Urd

Urea Blanket spraying on thrash at 5% rate

Nitrogen is the component that is needed for faster bacterial activities which increases the rate of thrash decomposition in the field. This will enable the plants to uptake and utilize the nutrient that is in the trash. After the urea is sprayed it reduces the risk of trash burning.

SRIF has taken initiative to educate farmers on the effects of urea spraying and how it can reduce fertilizer cost and increase organic matter content in the soil at faster rate with the

use of urea. The pictures below show a demonstration held for the farmers in the Vunimoli sector to create awareness on urea spraying.


Figure 17 & 18: LEFT - Urea sprayed at 5 % in the demonstration plot, RIGHT - Farmers observing and learning about the urea spraying operation in the field

Mechanization

Farmers are turning to adapt machinery which carries out land preparation, planting, herbicide spraying and harvesting work for them in the field. Labour is becoming scarce day by day in Fiji. Therefore, SRIF intends to educate farmers on machinery such as planters, boom sprayers, fertilizer applicators, mill mud and lime applicator and other implements that requires minimum labour to operate. Keeping this in mind a demonstration was carried out on how to use cutter planter and boom sprayer for dual purpose as for herbicide and urea spraying. Also, legume planter and mill spreader were demonstrated to the farmers. After the demonstration, more farmers were willing to adopt the planter planting method and use the boom sprayer to get their fields sprayed with herbicides.

Inter-cropping

Sugarcane is cropped as a soul crop for many years in same particular piece of land. It is known that sugarcane is a heavy feeder of nutrients and it exhausts the soil when it is continuously monocropped. Soil is a living entity which needs time to replenish itself. This can be done by fallowing the land, adding organic amendment and cultivating inter-crop together with sugarcane crop. Keeping this in mind there was an inter-crop demonstration plot planted in the Vunimoli sector. The legume used was cowpea with sugarcane. The importance of legume was discussed with farmers in the field day. The pictures below show the field and the participants of the field day.

Figure 19: Field cultivated with inter crop water melon (Daku sector)

Quality seed cane

It is in the best interest of the farmers that they plant clean and quality seed materials in order to avoid cane sugar yield loss by diseases and unapproved varieties. SRIF has established a hot water treatment plant in Labasa with the aid from European Union. This treatment plant was used in 2019 to treat and plant 7.5 hectares of mother plot in estate and farmers field. One of the major diseases that threatens the quality of seed cane and can lead to yield loss is ratoon stunting disease (*Leifonia xyli* subsp. *Xyli*) which is prevalent in Fiji (Johnson et al, 2006) and can cause loss up to 27% annually (Johnson and Tyagi, 2010). Hot water treatment of seed cane kills the bacteria and avoids its spreading from one farm to the other as this is one of the modes of transmission. Farmers should use clean sterilized equipment to harvest seed cane before taking it for planting in the field. Approximately 16 hectares of distribution plot has been established in all the sectors. The planted seed bed will be used by the farmers in the coming planting window of 2020. By having the seedbeds in the sectors makes it convenient for the farmers to take the seed cane from the distribution plot established. The reason for establishing the seed bed in the sectors are to reduce transportation cost for the farmers. Farmers learn more once they are demonstrated the activities on the field and tend to adopt the ideas which they implement in the field. Also, technical advice was provided to the new venturing farmers in the industry. In the coming 2020 season more demos will be done for the farmers and seedbeds will be established in the sectors.

RARAWAI MILL

Introduction

Weeds and nutrients are two crucial factors that has been affecting the production of sugarcane. Research has found that weeds contribute between 20-70% yield loss depending upon the severity of infestation. Sugarcane is planted with a relatively wider row spacing, sugarcane growth is very slow in the initial stages, the crop is grown under abundant water and nutrient supply conditions and generally trash is not retained in ratoon crops, gives opportunity for weeds to intensify.

Weeds can be controlled using a combination of chemical, mechanical and manual methods. Sugarcane plants require essential nutrients for growth and maturity. The cane and sugar yields are affected if the quantities of required nutrients are reduced. Soil analysis gives an indication of soil health status, thus helps make good nutrient management decisions and provides accurate fertilizer quantities to be applied for optimum yield.

In the past, sugarcane farmers used to inculcate methods for soil management which in turn controlled the weed population, managed nutrients and soil at the same time. Application of mill mud, sand, keeping fallow land, crop rotation and intercropping are some of the ways to improve and maintain soil health. Many of these techniques have been detached by current farmers, thus, issues of soil, weeds and nutrient management is intensifying. Educating farmers on best farming practices is important for the realization of optimum production. A recent plan was initiated by SRIF to demonstrate best weeds and nutrients management in all sectors.

Objectives

- ✓ Demonstrate chemical, mechanical and manual methods of weed control using an integrated approach for weed control.
- ✓ Demonstrate integrated nutrient management using mill mud, cover crops, and intercrops where possible.
- ✓ Educate farmers on importance of soil and leaf sampling

Methodology

The planned activities of the demonstration plot included planting of demonstration trials in all sectors, holding field days and demonstrating best practices such as application of

recommended rates of fertilizer and weedicide application, appropriate cultivation practices, and harvesting techniques.

Results

A total of 9 demonstration plots were established on green manure (urd) in Rarawai, Tavua and Penang district.

Figure 28: Planting of Urd at Rarawai sector

Figure 29: Mill mud spreader

To demonstrate nutrient management, 3 trials were established on mill mud applications in Rarawai district. In two trials, mill mud was applied in the drills and in the third trial mill mud was broadcast using a spreader. For weed management demonstration, 3 plots were established in Sigatoka, Tavua and Penang district. Information days will be held in all the trials in 2020.

Table 7: Rarawai mill area: Demo plots

Sector	Farm no.	Farmer name	Rate of seeds planted	Planting technique	Area (ha)
Varoko	8635	Veena Kiran Sharma	15 kg/ha	Mechanical legume planter	0.4
Rarawai	1623	Bindra Mati	15 kg/ha	Mechanical legume planter	0.4
Koronubu	1283	Pushpa Wati	15 kg/ha	Mechanical legume planter	0.4
Veisaru	18926	Jainendra Singh	15 kg/ha	Mechanical legume planter	0.4
Moto	22027	Mary Shaw	15 kg/ha	Mechanical legume planter	0.4
Drumasi	3912	Mustaq Khan	15 kg/ha	Mechanical legume planter	0.2
Ellington 1	3209	Luke Caucaugasa	15 kg/ha	Mechanical legume planter	0.4
Ellington 2	14107	Gajraj	15 kg/ha	Mechanical legume planter	0.1
Dobuilevu	14148	SRIF	15 kg/ha	Mechanical legume planter	0.3

Table 8: Rarawai mill area: Nutrient management using mill mud applications

Sector	Farm no.	Farmer name	Date planted	Varieties planted	Planting technique
Koronubu	1289	Nilesh	30-11-2019	Mana	Applied by mill mud spreader and incorporated
Veisaru	28192	Ellas Muni Lata	21-11-2019	Mana	Manual. Mill mud applied in drills

Table 9: Weed management demo plot in Rarawai

Sector	Farm No.	Farmer Name	Varieties planted	Activity
Ellington 2	14017	Gajraj	Viwa, Qamea, Naidiri	Pre-emergence using Velpar @ 4kg/ha

SRIF ESTATES

4,000+ Tonnes Harvested

Approx. 74tph yield

DRASA ESTATE

SRIF Drasa Estate

A total of 2832 tonnes of sugarcane was harvested from SRIF Drasa estate farm for 2019 season. 2688 tonnes was harvested and sent to the mill while growers took 144 tonnes as seed cane. 16.81 % (451.87 tonnes) of sugarcane was, harvested as burnt cane, which was all due to case of arson and 83.19% (2236 tonnes) was, harvested as green cane. All sugarcane except for seed cane was harvested mechanically and about 35% (949.40 tonnes) was transported through rail using cages bins at the cost of $22.50 per tonne and remaining 65% (1738.47tonnes) was transported using Lorry at the cost of $28.50 per tonne. Total crop increased by almost 30% compared to 2018 season. Favorable weather conditions, Good fallow management with green manure crops, use of Quality seed cane, timely weed control and fertilizer application contributed to this increase in production.

Table 1: Drasa Estate 2019 Production Record

Field	Plot	Area (Ha)	Tonnes	Tph	Variety
7		4	396.84	99.21	Ragnar, Naidiri, Aiwa, Beqa
8		3.4	376.97	110.87	Naidiri, Ragnar, Aiwa, Beqa, Kaba, Mana
11		1.5	204.61	136.41	Viwa
24	1, 2 ,3 &4	20	1673.66	83.68	commercial varieties and research plots
25	1	1	95.467	95.467	Viwa
	2	0.6	84.45	140.75	Aiwa
Total		30.5	2831.997	92.85	

Constraints and challenges

Loss of sugarcane due to mechanical harvesting and use of 10 and 12-wheeler trucks for sugarcane transporting. Limited options available for weedicides, which may lead to weeds building resistance to certain weedicides

Figure 1 & 2: LEFT - Sugarcane harvesting and transporting using cage bins, RIGHT - Fertilizer application using side dresser/ratoon king

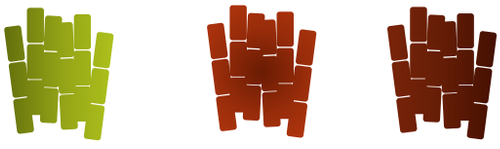
LABASA ESTATE

Labasa has an area of thirteen hectares of land for research trials and hot water treated seed cane. Out of 13 hectares land, 5 hectares is kept fallow for every season heat treated seed bed planting. Around 5 hectares of cane were harvested in the estate which were not suitable for seed cane. Total of 265 tonnes of cane was sent to mill for crushing and three hundred and fifty tonnes of cane was utilised from the mother plot for the establishment of the distribution plot in the ten-sector area. The seven and half hectare seed bed established in the estate will be ready for planting in the coming planting window as distribution plot. The growth of the seed cane was affected due to below average rainfall achieved during the year but with some rain during the season the cane regained itself. The seed cane should be available to the farmers in the coming planting season. The fields that have been ploughed out and planted with green manure crop to improve the soil health. the green manure crop will be ploughed in February, 2020 and will be used for planting cane in May, 2020. The major objective of the estate land is to produce hot water treated seed cane for the farmers. Quality seed cane will ensure good germination and the cane will be free from disease which will ensure high yield for the farmers. By establishing seed bed will ensure that no unapproved and mixture of the varieties are planted by the farmers.

RARAWAI ESTATE

Rarawai Estate has a total of 20.3 ha available for cultivation. Greater portion of this area is used for Research Trials (mostly Plant Breeding Early Stages and Advance Stage trials). Remaining area is used for commercial seed cane production using hot water treated seed cane. In 2019, a total of 1004.01 tonnes was harvested from an area of 16.8 ha whereas remaining 2.8 and 0.7 ha was under fallow and seed cane harvested respectively. The research trials yields are low due to roadways and test varieties in early selection stages whereas the commercials have many old ratoons that are ear-marked for re-planting. The depleting soil health may be a contributing factor and green manuring was conducted in 2 plots results to be seen in coming years. The green manuring will be continued in other fields. Plans have been put in place to plough out un-economical ratoons and establish new commercial seed cane plots.

Approved Varieties



The list of sugarcane varieties approved for planting has been revised to include maturity trends. Varieties that are no longer planted have been removed from the approved varieties list. The varieties are recommended to growers on their soil type. The growers have a choice of at least three varieties to plant on their farms as laid down in the Master Award.

Mill/Sectors	Soil types	Varieties recommended on maturity trends	
		Early – mid maturing	Mid – late maturing
Lautoka/Olosara	Rich alluvial soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Cuvu	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Viwa
Lautoka/Lomawai	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Lautoka/Yako	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Lautoka/Nawaicoba	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Lautoka/Malolo	Flat Fertile soil	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Qeleloa	Rich alluvial soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Meigunyah	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Legalega	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa

Mill/Sectors	Soil types	Varieties recommended on maturity trends	
		Early – mid maturing	Mid – late maturing
Lautoka/Natova	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Lautoka/Lautoka	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Saweni	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
Lautoka/Saweni	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Lautoka/Lovu	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Lautoka/Drasa	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Sandy soils	LF91-1925	Kaba, Mana, Galoa
Rarawai/Varoko	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Mota	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Naloto	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Koronubu	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Veisaru	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa

Mill/Sectors	Soil types	Varieties recommended on maturity trends	
		Early – mid maturing	Mid – late maturing
Rarawai/Veisaru	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Rarawai	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Varavu	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Tagitagi	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Mana, Kaba, Vatu, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Saline areas	Naidiri, LF91-1925	Kaba, Mana, Galoa
Rarawai/Yaladro	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
Rarawai/Drumasi	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Mana, Kaba, Vatu, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Saline areas	Naidiri, LF91-1925	Kaba, Mana, Galoa
Labasa/Waiqele	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Mali, Viwa
Labasa/Wailevu	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Mali, Viwa
	Saline soils	Naidiri, LF91-1925	Galoa, Vatu
Labasa/Vunimoli	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Mali, Viwa
Labasa/Labasa	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
Labasa/Labasa	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Mali, Viwa
	Saline soils	Naidiri, LF91-1925	Galoa, Vatu, Mali

Mill/Sectors	Soil types	Varieties recommended on maturity trends	
		Early – mid maturing	Mid – late maturing
Labasa/Bucaisau	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Waya, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Waya, Mali, Viwa
	Saline soils	Naidiri, LF91-1925	Galoa, Vatu, Mali
Labasa/Wainikoro	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Waya, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Waya, Mali, Viwa
	Saline soils	Naidiri, LF91-1925	Galoa, Vatu, Mali
Labasa/Daku	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Waya, Viwa
	Poor soils	Naidiri, LF91-1925, Qamea	Kaba, Waya, Mali, Viwa
Labasa/Natua	Poor soils	Aiwa, Naidiri, LF91-1925, Qamea	Ragnar, Kaba, Mali, Viwa
Labasa/Solove	Poor soils	Aiwa, Naidiri, LF91-1925, Qamea	Ragnar, Kaba, Mali, Viwa
Labasa/Bulivou	Poor soils	Aiwa, Naidiri, LF91-1925, Qamea	Ragnar, Kaba, Mali, Viwa
Penang/Nanuku	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Salt affected areas	Naidiri, LF91-1925	Galoa
	Viti Vanua area	Naidiri, LF91-1925, Qamea	Mana, Kaba, Kiuva, Mali, Viwa
Penang/Malau	Rich alluvial soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Mali, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Salt affected areas	Naidiri, LF91-1925	Galoa
Penang/Ellington	Flat Fertile soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Kiuva, Viwa
	Medium soils	Aiwa, Beqa, Naidiri, LF91-1925	Ragnar, Kaba, Vatu, Kiuva, Mali, Viwa
	Poor soils	LF91-1925, Qamea	Kaba, Mana, Viwa
	Salt affected areas	Naidiri, LF91-1925	Galoa

ABBREVIATIONS

SRIF	-	Sugar Research Institute of Fiji
FSC	-	Fiji Sugar Corporation Ltd
SIT	-	Sugar Industry Tribunal
SCGC	-	Sugar Cane Growers Council
SCGF	-	Sugar Cane Growers Fund
MoS	-	Ministry of Sugar
SPF	-	South Pacific Fertilizers
FMS	-	Fiji Meteorological Services
EU	-	European Union
POCS or pocs or Pocs	-	Pure obtainable cane sugar
SUC or Suc	-	Sucrose
NPK	-	Nitrogen, Phosphorus, Potassium
N	-	Nitrogen
P	-	Phosphorus
K	-	Potassium
RCBD	-	Randomized Complete Block Design
Rep	-	Replication
Trt or Trts	-	Treatment(s)
Tph or Tpha	-	Tonnes cane per hectare
Tsh or Tsha	-	Tonnes sugar per hectare
TC/TS or tc/ts	-	Tonnes cane per tonnes sugar (tonnes of cane required to produce 1 ton of sugar)
AVG./Avg.	-	Average
LF[YEAR]	-	Lautoka Fiji [year in which the fuzz was planted], e.g. LF2014
G x E	-	Genetic by Environment
FFE	-	Farmer Feel Effect
QBPS	-	Quality Based Payment Scheme
FSI	-	Fijian Sugar Industry
ASPAC	-	Australian Soil and Plant Analysis Council
LBC	-	Lime Buffering Capacity
FTIR	-	Frontier Transform Infra-Red
CQD	-	Cane Quality Department
IMG	-	Industry Management Group
UV-VIS	-	Ultra violet visible light spectrum
RMSECV	-	Root Mean Square Error of Cross validation
SOI	-	Southern Oscillation Index
ENSO	-	El Niño Southern Oscillation
STC	-	Smut Technical Committee
COSPPac	-	Climate and Ocean Support Program for the Pacific
CBA	-	Cost Benefit Analysis

GLOSSARY

Clones / Varieties	The distinct individual sugarcane type that can be identified by numerous attributes or a combination of it, such as stalk color, stalk shape, leaf type, etc.
Series	When used in the context of plant breeding, it refers to a set of clones or varieties distinguished by the year in which those clones or varieties were initially planted from fuzz (seed) stage.
Germplasm	A collection of clones that has recorded desirable traits such as high fiber, disease tolerant, etc.
Fuzz	Sugarcane seeds, not to be confused with seeds commonly referred to in the sugar industry as the stalks of sugarcane used for planting. Seeds in this case are all different varieties, much like seeds of beans, cucumbers or chilies.
Ratoon	Commonly referred to the sugarcane crop that established or grew after the initial plant crop was harvested.
Breeding Plots / Flowering Beds	Small areas planted with sugarcane for the purpose of harvesting flowers from.
Gene Pool	Basically, referring to the Germplasm from a genetics point of view.
Standards	Sugarcane varieties that have already been released to growers to plant for commercial use.
Brix	Measure of dissolved solids in sugar juice, liquor or syrup using a refractometer.
G X E trials	Genetic by Environment trials to test the interaction of the genetic attributes of varieties against environmental conditions.
Supply	The term is normally used when "supplying" seed cane referring to sugarcane field that have
Phytotoxic	Poisonous to plants.
Farmorganix/Stand Up SummaGrow	Brand names of new organic fertilizers being tested at SRIF.
Spectra-Cane	High-speed fully automated sugarcane analyzer that uses Near-Infrared (NIR) to monitor the sugar content upon analyzing disintegrated cane. The instrument requires minimal intervention from the operator once the sample has been fed into the disintegrator at the start of the process.
%brix	Total soluble solutes in cane juice
Polarization (or Pol)	The apparent sucrose content expressed as a mass percent measured by the optical rotation of polarized light passing through a sugar solution.
%pol	Percent total sucrose in cane juice

Fiber	The dry fibrous insoluble structure of the cane plant. Generally taken to mean all insoluble material in the cane delivered to a mill, and therefore includes soil or other extraneous insoluble matter in cane.
%fiber	Percent of fiber present in sugarcane
Purity	The true purity is the sucrose content as a percent of the dry substances or dissolved solids content. The solids consist of sugar plus non-sucrose components such as invert, ash and colorants. Apparent purity is expressed as polarization dived by refractometer Brix multiplied by 100.
POCS	Pure Obtainable Cane Sugar. A measure of total recoverable sugar in the cane. A formula based on assumption that sugarcane contains pure sugar, impurities, water and fiber only. It assumes that only pure sugar is made, and that for every kilogram of impurities which goes to the factory, half a kilogram of sugar accompanies it.
LBC	Lime Buffering Capacity. It is modified from the original method which is used for the purpose of agricultural crops. It is a potentiometric method used for determining the amount of lime required for the soil to raise the pH based on the buffering capacity of the soil. LBC is a more efficient routine determination as compared to pH buffering capacity method in regards to result throughput.
RMSECV	RMSECV: errors are calculated on test/train splits using a cross validation scheme for the splitting. If the splitting of the data is done correctly, this gives a good estimate on how the model built on the data set at hand performs for unknown cases. However, due to the resampling nature of the approach, it actually measures performance for unknown cases that were obtained among the calibration cases. In simple, it is a formula used to build a model from a data set, as a validation of two data set. Thus, confirms data set from a new approach against the data set of the original method validating the performance of the origin of the new data set as similar to the existing method.
CQD	The body within the Fiji Sugar Industry Tribunal charged with implementing the QBPS procedures.
IMG	A group set up within each mill area, comprising representatives of the mill owner, the cane growers and the Tribunal to act as a point of contact between the CQD and the local industry.
UV-VIS spectrophotometer	Ultra violet visible light spectrum instrument. Is used to determine analyte concentrations by the absorption of light across the ultraviolet and visible light wavelengths through sugar cane juice, sugar and sugar by-products.
Nematology	The scientific study of nematode worms.
Pathology	The science of the causes and effects of diseases

FINANCIALS

Sugar Research Institute of Fiji

Financial Statements

For the Year Ended 31 December 2019

Building a better working world

SUGAR RESEARCH INSTITUTE OF FIJI

FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 DECEMBER 2019

Contents

SUGAR RESEARCH INSTITUTE OF FIJI
DIRECTOR'S REPORT
FOR THE YEAR ENDED 31 DECEMBER 2019

In accordance with a resolution of the Board of Directors, the Directors herewith submit the statement of financial position of Sugar Research Institute of Fiji ("the Institute") as at 31 December 2019, the related statement of activities and other comprehensive income and statement of cash flows for the year ended on that date and report as follows:

Board Directors

The Board Directors in office during the year end at the date of this report are:

- Professor Rajesh Chandra - Chairman (Expired - February 2020)
- Mr Prakash Chand - Chairman (Effective - March 2020)
- Dr Sanjay Anand
- Mr Graham Clark
- Ms Reshmi Kumari
- Professor Ravendra Naidu
- Mr Ashween Nischal Ram
- Mr Raj Sharma

State of affairs

In the opinion of the Board the accompanying statement of financial position gives a true and fair view of the state of affairs of the Institute as at 31 December 2019 and the accompanying statement of activities and other comprehensive income and the statement of cash flows give a true and fair view of the results, and cashflows of the Institute for the year then ended.

Principal activity

The functions of the Institute are outlined under the Sugar Research Institute of Fiji Act No 14 of 2005, which includes promoting by means of research and investigation, the technical advancement, efficiency and productivity of the sugar industry, and to provide its functions, powers, administration and finance and for related matters.

Current assets

The Directors took reasonable steps before the Institute's financial statements were made out to ascertain that the current assets of the Institute were shown in the accounting records at a value equal to or below the value that would be expected to be realised in the ordinary course of business.

As at the date of this report, the Director are not aware of any circumstances, which would render the values attributed to current assets in the Institute's financial statements misleading.

Receivables

The Directors took reasonable steps before the Institute's financials statements were made out to ascertain that all known bad debts were written off and adequate allowance was made for impairment loss.

At the date of this report, the Directors are not aware of any circumstances which would render the above assessment inadequate extent.

Related party transactions

All related party transactions have been adequately recorded in the financial statements.

Unusual transactions

Apart from these matters and other matters specifically referred to in the financial statements, in the opinion of the Director, the results of the operations of the Institute during the financial year were not substantially affected by any item, transaction or event of a material unusual nature, nor has there arisen between the end of the financial year and the date of this report any item, transaction or event of a material unusual nature likely, in the opinion of the Directors, to affect substantially the results of the operations of the Institute in the current financial year, other than those reflected in the financial statements.

Going concern

The Institute's ability to continue to operate on a going concern basis is dependent on it receiving ongoing financial support from Government of Fiji, Stakeholders in the Sugar Industry and other Donor Agencies. The Board Members consider the application of the going concern principle to be appropriate in the preparation of these financial statements as the Institute will continue to receive ongoing support from the Government and the Stakeholders in the Sugar Industry, which will enable the Institute to meet its funding requirements for operations and to meet its obligations as and when they fall due. The Institute receives funds from the Government, Fiji Sugar Corporation, and Growers through Fiji Sugar Corporation.

Further, the Institute incurred negative cash flows from operations of $474,917 during the year ended 31 December 2019 and positive working capital of $1,463,530 after reclassification of certain related party receivables to non-current assets.

Accordingly, these financial statements have been prepared on going concern basis and do not include any adjustments relating to the recoverability and classification of recorded asset amounts or to the amounts and classification of labilities that may be necessary should the necessary should the Institute be unable to continue as a going concern.

Events subsequent to balance date

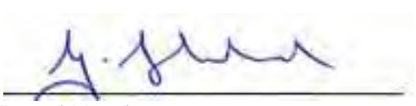
Subsequent to end of the financial year, the COVID-19 outbreak was declared a pandemic by the World Health Organization in March 2020. We have not seen a significant impact on our business to date. The outbreak and the response of Governments in dealing with the pandemic is interfering with general activity levels within the community, the economy and the operations of our business. The scale and duration of these developments remain uncertain as at the date of this report however they will have an impact on our earnings, cash flow and financial condition.

It is not possible to estimate the impact of the outbreak's near-term and longer effects or Governments' varying efforts to combat the outbreak and support businesses. This being the case, we do not consider it practicable to provide a quantitative or qualitative estimate of the potential impact of this outbreak on the Company at this time.

The financial statements have been prepared based upon conditions existing at 31 December 2019 and considering those events occurring subsequent to that date, that provide evidence of conditions that existed at the end of the reporting period. As the outbreak of COVID-19 occurred after 31 December 2019, its impact is considered an event that is indicative of conditions that arose after the reporting period and accordingly, no adjustments have been made to financial statements as at 31 December 2019 for the impacts of COVID-19.

Apart from the exception above, no other matters or circumstances have arisen since the end of the financial year which significantly affected or may significantly affect the operations of the Company, the results of those operations, or the state of affairs of the Company in future financial years.

For and on behalf of the Board of Directors in accordance with a resolution of the Directors this 1st day of May 2020.



Board Member

Board Member

1st Floor 131 Vitogo Parade
Lautoka Fiji
PO Box 1068 Lautoka Fiji

Tel: +679 666 2413
Fax: +679 666 7282
ey.com

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Independent Auditor's Report

To the Board Members of Sugar Research Institute of Fiji

Report on the Audit of the Financial Statements

Opinion

We have audited the financial statements of Sugar Research Institute of Fiji ("the Institute"), which comprise the statement of financial position as at 31 December 2019, the statement of activities and other comprehensive income and the statement of cash flows for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

In our opinion, the accompanying financial statements give a true and fair view of the financial position of the Institute as at 31 December 2019, and of its financial performance and its cash flows for the year then ended in accordance with International Financial Reporting Standards for Small and Medium-sized Entities ("IFRS for SMEs").

Basis for Opinion

We conducted our audit in accordance with International Standards on Auditing (ISA). Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Institute in accordance with the International Ethics Standards Board for Accountant's Code of Ethics for Professional Accountants (IESBA Code) together with the ethical requirements that are relevant to our audit of the financial statements in Fiji and we have fulfilled our other ethical responsibilities in accordance with these requirements and the IESBA Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Material Uncertainty Related to Going Concern

We draw attention to Note 1.2(b) in the financial statements, which refers to the preparation of the Institute's financial statements on a going concern basis. The Institute incurred negative cash flows from operations of $474,917 during the year ended 31 December 2019. The Institute has operating expenditure commitments of approximately $3 million for the financial year ending 31 December 2020 and is most likely to require further funding to meet its working capital requirements and fund its operating activities.

The appropriateness of the going concern assumption on which the financial statements are prepared is critically dependent on Government and the stakeholders support to the Institute, as disclosed in Note 1.2(b), to enable the Institute to continue operations for the foreseeable future.

The events or conditions outlined above indicate that a material uncertainty exists that may cast significant doubt on the Institute's ability to continue as a going concern. The financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or to the amounts and classification of liabilities that might be necessary should the Institute not continue as a going concern. Our opinion is not modified in respect of this matter.

Emphasis of Matter: Subsequent Events - Impact of the Coronavirus (COVID-19) Outbreak

We draw attention to Note 12 of the financial statements which notes the World Health Organisation's declaration of the outbreak of COVID-19 as a global pandemic subsequent to 31 December 2019 and how this has been considered by the Directors in the preparation of the financial report. As set out in Note 12, no adjustments have been made to financial statements as at 31 December 2019 for the impacts of COVID-19. Our opinion is not modified in respect of this matter.

Other Matter

The financial statements of the Institute for the year ended 31 December 2018 was audited by another auditor who expressed an unmodified opinion on that financial report on 15 July 2019.

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1st Floor 131 Vitogo Parade
Lautoka Fiji
PO Box 1068 Lautoka Fiji

Tel: +679 666 2413
Fax: +679 666 7282
ey.com

Independent Auditor's Report (continued)

Responsibilities of Management and those charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with IFRS for SMEs, and for such internal control as management determine is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Institutes' ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the management either intend to liquidate the Institute or to cease operations, or have no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the Institute's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISA will always detect a material misstatement when it exists. Misstatements can arise from fraud and error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with ISA, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Institute's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of the management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Institute's ability to continue as a going concern. If we conclude that material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures, are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Institute to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

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Independent Auditor's Report (continued)

Auditor's Responsibilities for the Audit of the Financial Statements (continued)

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

Report on Other Legal and Regulatory Requirements

We have obtained all the information and explanations which, to the best of our knowledge and belief, were necessary for the purpose of the audit.

In our opinion

i) proper books of account have been kept by the Institute, sufficient to enable financial statements to be prepared, so far as it appears from our examination of those books; and

ii) to the best of our information and according to the information and explanations given to us the financial statements give the information required by the Sugar Research Institute of Fiji Act 2005, in the manner so required.

Ernst & Young

Ernst & Young
Chartered Accountants

Shaneel Nandan
Partner
Lautoka, Fiji
1st May 2020

SUGAR RESEARCH INSTITUTE OF FIJI
STATEMENT OF ACTIVITIES AND OTHER COMPREHENSIVE INCOME
FOR THE YEAR ENDED 31 DECEMBER 2019

	Notes	2019	2018
		$	$
Contributions and grants	2.1	2,662,462	3,457,237
Estate income		357,299	174,951
Other income	2.2	89,113	137,411
Total income		3,108,874	3,769,599
Cost of operations	2.3	(1,752,999)	(2,624,869)
Administrative expenses	2.4	(1,363,200)	(1,161,750)
Deficit from operations		(7,325)	(17,020)
Finance income	2.6	8,148	17,739
Finance expense		(823)	(719)
Deficit before tax		-	-
Income tax expense		-	-
Balance at the beginning of the year		-	-
Deficit for the year		-	-

The accompanying notes form an integral part of the statement of activities and other comprehensive income.

SUGAR RESEARCH INSTITUTE OF FIJI
STATEMENT OF FINANCIAL POSITION
AS AT 31 DECEMBER 2019

	Notes	2019	2018
Assets		$	$
Current assets			
Cash and cash equivalents	3	421,541	1,339,941
Receivables and prepayments	4	194,352	204,710
Receivables from related parties	10(b)	1,400,688	1,123,853
		2,016,581	2,668,504
Non-current assets			
Property, plant and equipment	5	5,958,082	5,979,253
Intangible assets	6	23,046	1,957
Receivables from related parties	10(b)	6,520,169	6,222,004
		12,501,297	12,203,214
Total assets		14,517,878	14,871,718
Current liabilities			
Deferred income	8	421,541	525,789
Trade and other payables	7	89,813	114,975
Employee benefits	9	41,697	32,165
		553,051	672,929
Non-current liabilities			
Deferred income	8	11,699,142	11,933,104
Payable to related parties	10(c)	2,265,685	2,265,685
		13,964,827	14,198,789
Total liabilities		14,517,878	14,871,718
Net assets		-	-
Funds employed			
Funds employed		-	-
Total funds employed		-	-

Signed on behalf of the Board.

Board Member

Board Member

The accompanying notes form an integral part of the statement of financial position.

SUGAR RESEARCH INSTITUTE OF FIJI
STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 31 DECEMBER 2019

	Note	2019	2018
		$	$
Cash flows from Operating Activities			
Receipts from stakeholders and donors		2,174,456	4,772,793
Payments to suppliers and employees		(2,656,698)	(3,379,672)
Interest and bank charges paid		(823)	-
Interest received		8,148	17,739
Net cash (used in) / provided by operating activities		(474,917)	1,410,860
Cash flows used in Investing Activities			
Acquisition of property, plant and equipment		(438,330)	(2,341,158)
Payment of intangible assets		(26,361)	-
Proceeds from disposal of property, plant and equipment		21,208	29,809
Net cash flows (used in) investing activities		(443,483)	(2,311,349)
Net (decrease) in cash and cash equivalents		(918,400)	(900,489)
Cash and cash equivalents at 1 January		1,339,941	2,240,430
Cash and cash equivalent at 31 December	3	421,541	1,339,941

The accompanying notes form an integral part of the statement of cash flows.

1. Reporting entity

The financial statements of Sugar Research Institute of Fiji for the year ended 31 December 2019 were authorised for issue in accordance with a resolution of the Directors on 1st May 2020. Sugar Research Institute of Fiji ("the Institute") is a body corporate domiciled in Fiji, established under the Sugar Research Institute of Fiji Act 2005. The address of the Institute's registered office is Drasa, Lautoka.

The principal activity of the Institute is described in Note 14.

1.2 Basis of preparation of financial statements

(a) The financial statements of the Institute have been prepared in accordance with International Financial Reporting Standard for Small and Medium-sized Entities (IFRS for SMEs) issued by the International Accounting Standards Board. The financial statements have been prepared on a historical cost basis except where stated.

(b) Going concern

The Institute's ability to continue to operate on a going concern basis is dependent on it receiving ongoing financial support from Government of Fiji, Stakeholders in the Sugar Industry and other Donor Agencies. The Board Members consider the application of the going concern principle to be appropriate in the preparation of these financial statements as the Institute will continue to receive ongoing support from the Government and the Stakeholders in the Sugar Industry, which will enable the Institute to meet its funding requirements for operations and to meet its obligations as and when they fall due. The Institute receives funds from the Government, Fiji Sugar Corporation, and Growers through Fiji Sugar Corporation.

Further, the Institute incurred negative cash flows from operations of $474,917 during the year ended 31 December 2019 and positive working capital of $1,463,530 after reclassification of certain related party receivables to non-current assets.

Accordingly, these financial statements have been prepared on going concern basis and do not include any adjustments relating to the recoverability and classification of recorded asset amounts or to the amounts and classification of labilities that may be necessary should the necessary should the Institute be unable to continue as a going concern.

1.3 Summary of significant accounting policies

(a) Foreign currency translation

The Institute's financial statements are presented in Fijian dollar, which is also the Institute's functional currency.

Transactions in foreign currencies are initially recorded by the Institute at the functional currency rates prevailing the date of transaction.

Monetary assets and liabilities denominated in foreign currencies are retranslated at the functional currency of exchange ruling at the reporting date.

Non-monetary items that are measured in terms of historical cost in a foreign currency are translated using the currency rates as at the dates of the initial transactions. Non-monetary items measured at fair value in a foreign currency are translated using the exchange rates at the date when the fair value is measured.

(b) Revenue recognition

Revenue is recognized to the extend that it is probable that the economic benefit will flow to the entity and the revenue can be reliably measured in accordance with realisation principle, regardless of when the payment is being made. Revenue is measured at the fair value of the consideration received, excluding discounts, rebates, and consumption tax. The following specific criteria must also be met before revenue is recognised:

Contributions and grants

Grants are recognised in the statement of financial position initially as deferred income when there is reasonable assurance that it will be received and that the Institute will comply with the conditions associated with the grant.

1.3 Summary of significant accounting policies (continued)

(b) Revenue recognition (continued)

It is the recognised in the profit or loss as grant income on a systematic basis as the Institute recognises expenses be achieving the relevant conditions of the grant. Grants that relate to the acquisition of an asset are recognised in profit or loss as the asset is depreciated or amortised. The Institute chooses to present grant income on a gross method that is, recognising entire grant income and than offsetting against expense.

Other income

Outsource income and other revenue from operating activities are recognised in profit or loss on an accrual basis.

(c) Income tax

The Institute is exempt from income tax by virtue of Part 7(2) of the Income Tax (Exempt Income) Regulations 2016.

(d) Financing income

Finance income comprises interest received on the term deposits held. Interest income is recognised as it accrues in profit or loss.

(e) Property, plant and equipment

(i) Recognition and measurement

Items of property, plant and equipment is stated at cost, net of accumulated depreciation and/or accumulated impairment losses, if any.

Cost includes expenditure that is directly attributable to the acquisition of the asset. When parts of an item of property, plant and equipment have different useful lives, they are accounted for as separate items (major components) of property, plant and equipment.

Any gain or loss on disposal of an item of property, plant and equipment is determined by comparing the proceeds from disposal with carrying amount of the property, plant and equipment, and is recognised net within other income/ other operating expenses in profit or loss.

(ii) Subsequent costs

The cost of replacing part of an item of property, plant and equipment is recognised in the carrying amount of the item if it is probable that the future economic benefit embodied within the part will flow to the Institute an its cost can be measured reliably. The cost of the day-to-day servicing of property, plant and equipment are recognised in profit or loss as incurred.

(iii) Depreciation

Depreciation is calculated to write off the costs of the items of property, plant and equipment less their estimated residual values using the straight-line method over their estimated useful lives, and is recognised in profit and loss. The estimated useful lives of property, plant and equipment for current and comparative periods as follows:

The depreciation rates for the current and comparative year is as follows:

Asset	Rate
▸ Fixtures and fittings	10 years
▸ Plant and equipment	6.67-10 years
▸ Motor vehicles	6.67 years
▸ Land and building	80 years
▸ Computers	5 years

Depreciation methods, useful lives and residual values are reassessed at reporting date and adjusted if appropriate.

1.3 Summary of significant accounting policies (continued)

(f) Intangible assets

(i) Recognition and measurement

Intangible assets that are acquired by the Institute have a finite useful life and are measured at cost less accumulated amortisation and impairment losses.

(ii) Amortisation

Intangible assets are amortised on a straight-line basis in profit or loss over their estimated useful lives, from the date that they are available for use.

The estimated useful life for the current and comparative years is as follows:

- Software 5 years

(g) Financial instruments

(i) Non- derivative financial asset

The Institute generally recognises loans and receivable on the date that they are originated. All other financial assets (including assets designed as at fair value through profit or loss) are recognised initially on the trade date, which is the date that the Institute becomes a third party to the contractual provisions of the instrument.

The Institute derecognises a financial asset when the contractual rights to the cash flows from the asset expire, or it transfers the rights to receive the contractual cash flows on the financial asset in a transaction in which substantially all the risks and rewards of the ownership of the financial asset are transferred. Any interest in the transferred financial asset that is created or retained by the Institute is recognised as a separate asset or liability.

Financial assets and liabilities are offset and the net amount presented in the statement of financial position when and only when the Institute has a legal right to offset the amounts and intends either to offset the amounts and settle on a net basis or to realise the asset and settle the liability simultaneously.

The Institute classifies non- derivative financial assets into the following categories: financial assets at fair value through profit or loss, held to maturity financial assets and loans receivable.

Receivables

Receivables are stated at cost less allowances for doubtful debts. The collectability of debt is assessed at balance date and specific allowance is made for any impairment. Bad debts are written off in the period they are identified. Receivables comprise receivables from related party, staff advances and deposits.

Cash and cash equivalents

Cash and short-term deposits in the statement of financial position comprise cash at bank and cash on hand. For the purpose of statement of cash flows, cash and cash equivalents consist of cash and short-term deposits as defined above, net of outstanding bank overdrafts.

(ii) Non- derivative financial liability

Financial liabilities are recognised initially on the trade date at which the Institute becomes a party to the contractual provisions of the instrument.

The Institute derecognises a financial liability when its contractual obligations are discharged or cancelled or expire.

(ii) Non- derivative financial liability

The Institute classifies non-derivative financial liabilities into the other financial liabilities category. Such financial liabilities are recognised initially at fair value plus any directly attributable transaction costs. Subsequent to initial recognition, these financial liabilities are measured at amortised cost using the effective interest method.

Other financial liabilities comprise of payable and other accruals.

1.3 Summary of significant accounting policies (continued)

(h) Impairment

The carrying amount of assets are renewed at each balance date , to determine whether there is an indication of impairment. If any such indication exists, the assets recoverable amounts are estimated at each balance date. An impairment loss is recognised when ever the carrying amount of an asset or its cash generating amount exceeds its recoverable amount. All impairment losses are recognised in profit or

An impairment loss is reversed if more has been charged in the estimates used to determine the recoverable amount and is reversed only to the extent that the asset's carrying amount that would have been determined, net of depreciation or amortisation, if no impairment loss has been recognised.

(i) Employee benefits

(i) Superannuation

Obligations for contributions to a defined contribution plan are recognised as an expense in profit or loss when they are due.

(ii) Employee entitlements

Liability for annual leave is recognised and measured as the amount unpaid at reporting date at current pay rates in respect of employee services up to that date.

(ii) Short-term benefits

Short-term employee benefit obligations are measured on an undiscounted basis and are expensed in profit or loss as the related service provided.

A liability is recognised for the amount to be paid under short-term benefit if the Institute has a present or constructive obligation to pay this amount as a result of past services provided by the employee and the obligations can be measured reliably.

(j) Receivable from related parties

The amounts receivable from related parties are recognised when there is a contractual receivable or a right to receive.

(k) Employee benefits

Liabilities for wages and salaries expected to be settled within 12 months of the reporting date are recognised in other payables on the statement of financial position.

(l) Deferred income

The Institute's deferred income comprises of cash received or receivable from the stakeholders and donor agencies. Each grant received or receivable has its specific conditions that the Institute needs to comply with. The related grant being credited to deferred income as the liability and released to profit or loss over the expected useful economic life.

(m) Unexpended project funds

Unutilised donor monies at year end used for cash grant which is received for utilization in more than one financial period is treated as unexpended project funds.

(n) Leases

Leases are classified as operating leases. Rental payable under operating leases are charged to the income statement on a straight-line basis over the term of the relevant lease.

(o) Value Added Tax (VAT)

The Institute complies with VAT under the Second Schedule of the VAT Decree 1991.

(p) Comparative figures

When necessary, comparative figures have been adjusted to conform to changes in current presentation year.

2. Revenue and expenses	2019 $	2018 $
2.1 Contributions and grants		
Contribution from the Fiji Government	713,161	594,366
European Union	522,979	1,674,139
Fiji Sugar Corporation (FSC)	713,161	594,366
Sugar Cane Growers	713,161	594,366
	2,662,462	3,457,237
2.2 Other income	$	$
Gain on sale of fixed assets	21,208	29,809
Outsource income	65,743	107,322
Others	2,162	280
	89,113	137,411
2.3 Cost of operations	$	$
Advertising	4,626	1,511
Amortisation	5,272	496
Bank charges	3,413	5,451
Consultancy fees	26,731	21,015
Depreciation	459,502	389,023
Electricity	49,641	47,568
EU cost	102,405	1,316,042
Communication expenses	37,449	26,188
Material costs	78,584	37,484
Motor vehicle running expenses	124,809	107,194
Repairs and maintenances	138,984	108,607
Subcontract expenses	264,392	203,295
Wages and salaries	457,191	360,995
	1,752,999	2,624,869
2.4 Administrative expenses	$	$
Audit fees	9,000	9,500
Audit fees - EU Project	33,079	35,060
Accommodation and meals	6,360	8,534
Annual leave expense	9,532	13,449
Board allowance	34,508	14,959
Cleaning and landscaping	3,478	10,444
Office security	109,333	52,465
Office supplies	11,288	21,774
Director's fees	62,464	78,935
Fiji National Provident Fund contributions	122,665	105,028
Freight	24,218	56,942
Fringe benefit tax	13,547	6,531
General expenses	42,330	13,011
ICT consumables	12,627	-

2. Revenue and expenses (continued)	2019	2018
2.4 Administrative expenses (continued)	**$**	**$**
Insurance	53,955	46,443
Legal fees	1,742	183
Land rent	7,817	12,419
Medical expense	6,394	6,086
Media and publication	9,656	17,753
Other expenses	-	10,603
Postage	1,153	623
Repair and maintenance	6,081	39,867
Rent expense	35,385	16,372
Staff expenses	17,381	12,736
Stationery	5,642	5,155
Training and Productivity Authority of Fiji	11,854	8,773
Travel	17,846	7,026
Utilities	8,078	9,587
Wages and salaries	685,787	541,492
	1,363,200	1,161,750

2.5 Personnel expenses	**$**	**$**
Fiji National Provident Fund (FNPF) contributions	122,665	105,028
Training and Productivity Authority of Fiji	11,854	8,773
Key management compensation - short term benefit	98,980	99,326
Wages and salaries	1,043,998	803,161
	1,277,497	1,016,288

2.6 Finance income	**$**	**$**
Interest received	8,148	17,739

3. Cash and cash equivalents	$	$
Cash at bank	421,041	1,339,889
Cash on hand	500	52
Cash and cash equivalents in the cash flow statements	421,541	1,339,941

Cash and cash equivalents consist of cash on hand and balances with banks. Cash and cash equivalents included in the statement of cash flows comprise of the following statement of financial positions amounts:

	$	$
Cash at bank and on hand	421,541	1,339,941
	421,541	1,339,941

4. Receivables	$	$
Trade receivable	20,322	14,046
Staff advance	378	1,327
Deposits	4,506	4,506
VAT receivable	140,116	178,222
Interest receivable	6,609	6,609
Prepayments	5,500	-
Withholding tax receivable	16,921	-
	194,352	204,710

5. Property, plant and equipment

Cost	Land and Buildings	Fixtures and Fittings	Plant and Equipment	Motor Vehicles	Computers	Work in progress	Total
As at 1 January 2018	2,856,987	140,120	2,229,633	1,320,661	364,857	-	6,912,258
Additions	-	22,199	703,545	317,459	63,040	1,234,915	2,341,158
Disposals	-	-	-	(53,633)	-	-	(53,633)
At 31 December 2018	2,856,987	162,319	2,933,178	1,584,487	427,897	1,234,915	9,199,783
Additions	152,674	18,459	18,308	229,742	19,147	-	438,330
Transfers	1,234,915	-	-	-	-	(1,234,915)	-
Disposals	-	-	-	(96,569)	-	-	(96,569)
At 31 December 2019	4,244,576	180,778	2,951,486	1,717,660	447,044	-	9,541,544
Accumulated depreciation							
As at 1 January 2018	196,042	51,982	1,187,088	1,142,462	307,566	-	2,885,140
Depreciation charge for the	31,875	13,706	236,003	76,768	30,671	-	389,023
Disposals	-	-	-	(53,633)	-	-	(53,633)
At 31 December 2018	227,917	65,688	1,423,091	1,165,597	338,237	-	3,220,530
Depreciation charge for the	32,296	15,630	270,121	108,060	33,394	-	459,501
Disposals	-	-	-	(96,569)	-	-	(96,569)
At 31 December 2019	260,213	81,318	1,693,212	1,177,088	371,631	-	3,583,462
Net book value							
At 31 December 2019	3,984,363	99,460	1,258,274	540,572	75,413	-	5,958,082
At 31 December 2018	2,629,070	96,631	1,510,087	418,890	89,660	1,234,915	5,979,253

6. Intangible assets	Software	Total
Cost	$	$
As at 1 January 2018	2,480	2,480
Additions	-	-
Disposals	-	-
At 31 December 2018	2,480	2,480
Additions	26,361	26,361
Disposals	-	-
At 31 December 2019	28,841	28,841
Accumulated depreciation		
As at 1 January 2018	27	27
Amortisation	496	496
At 31 December 2018	523	523
Amortisation	5,272	5,272
At 31 December 2019	5,795	5,795
Net book value		
At 31 December 2019	23,046	23,046
At 31 December 2018	1,957	1,957

7. Trade and other payables	2019 $	2018 $
Trade creditors	13,377	42,010
Payables and accruals	76,436	72,965
	89,813	114,975

8. Deferred income

The Institute's deferred income comprises cash received or receivable from the stakeholders and donor agencies. Each grant income received or receivable has its specific conditions that the Institute needs to comply with. The movement in deferred income is as follows:

	$	$
Balance at the beginning of the year	12,458,893	11,144,379
Funds received or receivable during the period	2,778,811	5,101,854
Utilised during the period	(3,117,021)	(3,787,340)
Balance at 31 December	12,120,683	12,458,893
This is comprised as follows:	$	$
Fiji Government	39,031	67,732
Fiji Sugar Corporation (FSC)	7,020,857	6,399,043
Sugar Cane Growers	2,700,000	2,700,000
European Union grant	2,202,291	2,834,061
Estate income	160,895	248,515
Insurance income	-	1,759
Other income	(2,391)	207,783
Total	12,120,683	12,458,893

8. **Deferred income (continued)**

	2019	2018
Disclosed as:	$	$
Current	421,541	525,789
Non-current	11,699,142	11,933,104
Total	12,120,683	12,458,893

9. **Employee benefits**	$	$
Balance at 1 January	32,165	18,716
Provision created / utilised during the year	9,532	13,449
Balance at 31 December	41,697	32,165

10. **Related parties**

Related parties of the Institute include key stakeholders in the Fiji Sugar Industry, namely, the Government of Fiji, Fiji Sugar Corporation, South Pacific Fertilizers Limited, Sugar Cane Growers Fund and Sugar Cane Growers Council.

Transactions with these parties and outstanding balances at year end are disclosed below:

(a) Board members

The names of the Directors at any time during the financial year as follows:

- Professor Rajesh Chandra - Chairman (Expired - February 2020)
- Mr Prakash Chand - Chairman (Effective - March 2020)
- Dr Sanjay Anand
- Mr Graham Clark
- Ms Reshmi Kumari
- Professor Ravendra Naidu
- Mr Ashween Nischal Ram
- Mr Raj Sharma

(b) **Amounts receivable from related parties**	$	$
Fiji Sugar Corporation - grant income	6,999,999	6,424,999
- other income	20,858	20,858
Sugar Cane Growers	2,700,000	2,700,000
Allowance for uncollectability - Sugar Cane Growers	(1,800,000)	(1,800,000)
	7,920,857	7,345,857

Disclosed as:	$	$
Current	1,400,688	1,123,853
Non-current	6,520,169	6,222,004
Total	7,920,857	7,345,857

10. Related parties (continued)

(b) Amounts receivable from related parties (continued)

Reconciliation of Allowance for Uncollectability	2019 $	2018 $
Balance at the beginning of the year	1,800,000	1,800,000
Provision created during the year	-	-
Balance at the end of the year	1,800,000	1,800,000

Receivables from related parties are interest free and receivables as and when required.

(c) Amounts payable to related parties	$	$
Fiji Sugar Corporation	2,265,685	2,265,685

(d) Outstanding debts owed from Fiji Sugar Corporation Limited

Net receivable from Fiji Sugar Corporation Limited ("FSC") amounts to $4,734,314 as at 31 December 2019. On 26 February 2019, a Deed of payment was signed between the Institute and FSC. FSC agreed and acknowledged that it owed a sum amounting to $4,009,314 as at 31 October 2018 to the Institute which was FSC's contribution towards SRIF's operations as per Section 11(2) of the Sugar Research Institute Act 2005.

The amount stipulated in the agreement is $4,009,314 which is the amount as at 31 October 2018. The net receivable amount as at 31 December 2019 is $4,734,314 and is reconciled as follows:

	$
Balance at 31 December 2018	4,159,314
Contributions during the year	900,000
Payments made in 2019	(325,000)
Balance at 31 December 2019	4,734,314

The payment terms were agreed as follow:

(i) The amount of $250,000 will be paid by FSC in 2019, with 2 equal instalments of $125,000 each payable on 30 August and 31 December respectively;

(ii) The remaining balance of $3,759,314 will be payable by FSC over the next 4 years (2020-2023) in 8 equal instalments of $469,914 payable on 30 August and 31 December each year;

(iii) the repayments will be at zero interest rate.

(e) Transactions with related parties	$	$
Deferred income		
Grant income - Fiji Sugar Corporation	298,165	681,193
Grant income - Fiji Government	716,287	825,688
Grant income - Sugar Cane Growers	825,688	825,688
Estate income- Fiji Sugar Corporation	269,679	292,633
	2,109,819	2,625,202

10. Related parties (continued)

(f) Key management personnel

Key management personnel include the Chief Executive Officer and Finance Administration Manager of the Institute.

Transactions with the key management personnel are no favourable than those available, or which might be reasonably be expected to be available, on similar transactions to third parties on an arm's length.

Key management compensation is disclosed under Note 2.5.

11. Commitments and contingencies

(i) Contingent liability - $nil (2018:$nil)
(ii) Capital expenditure commitments - $nil (2018:$nil)
(iii) Finance lease commitments - $nil (2018:$nil)
(iv) Operating lease commitments - $nil (2018:$nil)

12. Subsequent events

Subsequent to end of the financial year, the COVID-19 outbreak was declared a pandemic by the World Health Organization in March 2020. We have not seen a significant impact on our business to date. The outbreak and the response of Governments in dealing with the pandemic is interfering with general activity levels within the community, the economy and the operations of our business. The scale and duration of these developments remain uncertain as at the date of this report however they will have an impact on our earnings, cash flow and financial condition.

It is not possible to estimate the impact of the outbreak's near-term and longer effects or Governments' varying efforts to combat the outbreak and support businesses. This being the case, we do not consider it practicable to provide a quantitative or qualitative estimate of the potential impact of this outbreak on the Company at this time.

The financial statements have been prepared based upon conditions existing at 31 December 2019 and considering those events occurring subsequent to that date, that provide evidence of conditions that existed at the end of the reporting period. As the outbreak of COVID-19 occurred after 31 December 2019, its impact is considered an event that is indicative of conditions that arose after the reporting period and accordingly, no adjustments have been made to financial statements as at 31 December 2019 for the impacts of COVID-19.

Apart from the exception above, no other matters or circumstances have arisen since the end of the financial year which significantly affected or may significantly affect the operations of the Company, the results of those operations, or the state of affairs of the Company in future financial years.

13. Segment Information

Industry segment

The Institute operates predominantly in the sugar industry.

Geographical segment

The Institute operates predominantly in Fiji and is therefore one geographical area for reporting purposes.

14. Principal business activity

The functions of the Institute are outlined under the Sugar Research Institute of Fiji Act No 14 of 2005, which includes promoting by means of research and investigation, the technical advancement, efficiency and productivity of the sugar industry, and to provide its functions, powers, administration and finance and for

Number of employees

As at balance date, the Institute employed a total of 82 employees (2018: 69).

P. O. Box 3560, Lautoka | Ph: +679 8921839 & +679 8921840 | Email: info@srif.org.fj
Website: www.srif.net.fj | Rarawai (Ba) Office: +679 8907343
Wairuku (Rakiraki) Office: +679 8907344 | Batinikama (Labasa) Office: +679 8907345