

## **Improvement of Fruit Quality Characters of Pineapple Hybrids**

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### **INTRODUCTION**

Pineapple (*Ananas comosus* var. *comosus*) is the third most important tropical fruit crop after banana and citrus in terms of worldwide production. Mauritius (Queen group) and Kew (Cayenne group) are the major pineapple varieties grown in Sri Lanka. The Kew variety is not much popular as a fresh fruit due to its sourness but has some desirable characters such as barrel shape, broad and shallow eyes, and spineless leaves. In contrast, the Mauritius variety has high demand as a fresh fruit due to its sweetness character but possesses some undesirable characters such as conical shape fruit and spiny leaves. Chan (1986) indicated that Queen and Cayenne can be hybridized easily to generate superior hybrids having good fruit quality characters as well as other physical qualities required to be used it as a fresh fruit and for the canning industry. In fact, it was observed that Mauritius and Kew are well suited for hybridization to develop improved cultivars because each has strong features that complement the weaker traits of the other. Mauritius has golden color flesh, high brix value, less acidity and less juice content which complement to Kew's pale yellow color flesh, low brix value, high acidity and high juice content. Hence, in the year 1995 at the Regional Agricultural Research and Development Center, Makandura, hybridization program for pineapple improvement was initiated to develop hybrid varieties with high sugar and low acidity along with good physical characteristics such as spineless leaves and barrel shape fruits (Fernando and Somadasa, 1997). There were few pineapple hybrids developed by the past researchers and among them, two good hybrid lines are H3 and H4. The main characters of these two hybrids were cylindrical shape fruit, broad eyes, dark yellow flesh and spineless leaves (spines only at tip also considered). However, both these

**\*\* Short Communication**

hybrids show low sweetness index, which is an undesirable character. Sweetness index or sugar-acid ratio is the measure that contributes to the unique flavor of pineapples and the recommended level is considered to be in the range of 20-40 as reported by Soler (1992). Sugar-acid ratio or sweetness index of both hybrid pineapple (H3 and H4) were lower than 20. Hence, the present study was carried out with the objective of improving the fruit quality characters of these two hybrids through a backcross program with Mauritius type to increase sugar-acid ratio.

### **MATERIALS AND METHODS**

The study was carried out at Regional Agriculture Research and Development Center, Makandura, starting from *Maha* 2013/14 to *Yala* 2016. Hybrid 3 (H3) and Hybrid 4 (H4) were back crossed with Mauritius. Consequently, H3 x Mauritius back cross produced 14 offspring and H4 x Mauritius back cross produced 21 offspring and their fruits were subjected to the analysis. The pineapple fruits were first manually peeled. About 100g of the edible portion of the fruit (taken from top, middle and bottom part of the fruit and mixed together) was extracted and then filtered. The filtrate was then used to determine physicochemical properties (pH, Brix value or Total Soluble Solids and Titratable Acidity). Brix value (Total Soluble Solids) was measured by using a hand refractometer with a range from 0-32 Brix. The pH of the extracts was measured using a pH meter. Titratable acidity was determined by performing a manual titration to a colour change point. The predominant naturally occurring acid in pineapple is citric acid and its acid factor -  $6.4 \times 10^{-3}$  was used to calculate titratable acidity in this study (OECD, 2009). All determinations were done in triplicate. Sugar-acid ratio (sweetness index) was derived as a ratio of Total Soluble Solids content (Brix) to titratable acidity (%). Fruit quality data were statistically analyzed by an analysis of variance (ANOVA) and means separation by Duncan's Multiple Range Tests at  $P=0.05$ .

### **RESULTS AND DISCUSSION**

The physicochemical characteristics of fruits produced by plants derived from H3x Mauritius and H4x Mauritius backcrosses are summarized in Table 1 and Table 2 respectively.

**Table 1. Physicochemical properties of pffspring obtained from H3x Mauritius backcross**

<b>Plant No.</b>	<b>pH value</b>	<b>Total Soluble Solids (Brix)</b>	<b>Titratable Acidity (%)</b>	<b>Sweetness Index (TSS/Acid ratio)</b>
1	3.56 <sup>f</sup>	11.0 <sup>g</sup>	0.61 <sup>g</sup>	18.03 <sup>g</sup>
2	3.65 <sup>e</sup>	10.3 <sup>h</sup>	0.66 <sup>e</sup>	15.60 <sup>h</sup>
3	3.65 <sup>e</sup>	17.0 <sup>b</sup>	0.68 <sup>d</sup>	25.00 <sup>b</sup>
4	2.49 <sup>h</sup>	11.0 <sup>g</sup>	0.58 <sup>h</sup>	18.96 <sup>e</sup>
5	3.83 <sup>b</sup>	13.0 <sup>e</sup>	0.72 <sup>b</sup>	18.05 <sup>g</sup>
6	3.91 <sup>a</sup>	16.2 <sup>c</sup>	0.70 <sup>c</sup>	23.14 <sup>c</sup>
7	3.49 <sup>g</sup>	11.0 <sup>g</sup>	0.59 <sup>g</sup>	18.64 <sup>e</sup>
8	3.55 <sup>f</sup>	12.8 <sup>f</sup>	0.66 <sup>e</sup>	19.39 <sup>e</sup>
9	3.72 <sup>d</sup>	14.0 <sup>d</sup>	0.72 <sup>b</sup>	19.44 <sup>e</sup>
10	3.71 <sup>d</sup>	10.0 <sup>i</sup>	0.65 <sup>f</sup>	15.38 <sup>h</sup>
11	3.80 <sup>b</sup>	11.0 <sup>g</sup>	0.72 <sup>b</sup>	15.49 <sup>h</sup>
12	3.79 <sup>c</sup>	13.2 <sup>e</sup>	0.70 <sup>c</sup>	18.85 <sup>e</sup>
13	3.88 <sup>a</sup>	18.4 <sup>a</sup>	0.69 <sup>c</sup>	26.66 <sup>a</sup>
14	3.91 <sup>a</sup>	14.0 <sup>d</sup>	0.74 <sup>a</sup>	18.91 <sup>e</sup>
H3	3.70 <sup>d</sup>	13.1 <sup>e</sup>	0.71 <sup>c</sup>	18.45 <sup>f</sup>
Mauritius	3.90 <sup>a</sup>	16.1 <sup>c</sup>	0.75 <sup>a</sup>	21.14 <sup>d</sup>
CV %	0.5292	0.77	0.0297	2.86

Within a column, the means followed by same letter are not significantly different at p=0.05.

**Table 2. Physicochemical properties of offspring obtained from H4x Mauritius backcross**

Plant No.	pH value	Titratable Acidity (%)	Total Soluble Solids (Brix)	Sweetness Index (TSS/Acid ratio)
1	3.68 <sup>e</sup>	0.63 <sup>f</sup>	17.3 <sup>d</sup>	27.48 <sup>d</sup>
2	3.96 <sup>c</sup>	0.65 <sup>e</sup>	12.8 <sup>k</sup>	19.69 <sup>h</sup>
3	3.96 <sup>c</sup>	0.60 <sup>g</sup>	10.0 <sup>n</sup>	16.60 <sup>m</sup>
4	3.58 <sup>e</sup>	0.71 <sup>b</sup>	14.0 <sup>i</sup>	19.70 <sup>h</sup>
5	3.63 <sup>e</sup>	0.69 <sup>c</sup>	16.8 <sup>e</sup>	24.34 <sup>f</sup>
6	3.64 <sup>e</sup>	0.72 <sup>b</sup>	12.0 <sup>l</sup>	16.60 <sup>m</sup>
7	4.00 <sup>c</sup>	0.63 <sup>f</sup>	17.3 <sup>d</sup>	27.46 <sup>d</sup>
8	4.04 <sup>c</sup>	0.59 <sup>j</sup>	19.0 <sup>b</sup>	32.20 <sup>b</sup>
9	3.50 <sup>g</sup>	0.76 <sup>b</sup>	14.0 <sup>i</sup>	18.60 <sup>k</sup>
10	4.00 <sup>c</sup>	0.72 <sup>b</sup>	13.5 <sup>j</sup>	18.24 <sup>j</sup>
11	4.98 <sup>a</sup>	0.58 <sup>i</sup>	11.0 <sup>m</sup>	18.96 <sup>i</sup>
12	3.93 <sup>c</sup>	0.61 <sup>f</sup>	24.0 <sup>a</sup>	39.34 <sup>a</sup>
13	3.70 <sup>e</sup>	0.70 <sup>b</sup>	18.9 <sup>b</sup>	27.00 <sup>e</sup>
14	3.59 <sup>e</sup>	0.77 <sup>b</sup>	14.8 <sup>g</sup>	19.20 <sup>h</sup>
15	4.19 <sup>b</sup>	0.59 <sup>h</sup>	17.5 <sup>d</sup>	26.27 <sup>c</sup>
16	3.28 <sup>h</sup>	0.81 <sup>a</sup>	14.4 <sup>h</sup>	17.70 <sup>l</sup>
17	3.94 <sup>c</sup>	0.65 <sup>e</sup>	18.3 <sup>c</sup>	28.15 <sup>d</sup>
18	4.00 <sup>c</sup>	0.72 <sup>b</sup>	12.0 <sup>l</sup>	16.60 <sup>m</sup>
19	3.51 <sup>f</sup>	0.67 <sup>d</sup>	13.0 <sup>k</sup>	19.40 <sup>h</sup>
20	3.54 <sup>f</sup>	0.71 <sup>b</sup>	14.0 <sup>i</sup>	19.70 <sup>h</sup>
21	2.83 <sup>i</sup>	0.90 <sup>a</sup>	13.0 <sup>k</sup>	14.40 <sup>o</sup>
H4	3.20 <sup>h</sup>	0.80 <sup>a</sup>	12.2 <sup>l</sup>	15.25 <sup>n</sup>
Mauritius	3.90 <sup>d</sup>	0.75 <sup>b</sup>	16.1 <sup>f</sup>	21.14 <sup>g</sup>
CV%	2.1	10.57	1.2	2.04

Within a column, the means followed by same letter are not significantly different at  $p=0.05$ .

According to the results, pH values of offspring of H3 x Mauritius backcross and H4 x Mauritius backcross varied from pH 2.49 - 3.91 and pH 2.83 - 4.98 respectively (Table 1 and Table 2). Titrable acidity is a measure of the total acid concentration of the sample and organic acids present in foods affect the colour, flavor, microbial stability and quality maintenance (Sadler and Murphy, 2010). Titrable acidity of offspring of H3 x Mauritius cross and H4 x Mauritius cross were varied from 0.58% - 0.74% and 0.58% - 0.90% respectively (Table 1 and Table 2). Total Soluble Solid (Brix) is one of

the important qualitative parameters of the pineapple fruit and it also increase the taste and also help to develop palatable flavors (Singleton and Gortner, 1965; Rahman *et al.*, 1979). The Total Soluble Solids (Brix) values of offspring of H3 x Mauritius cross and H4 x Mauritius cross were ranged from 10.0-18.4 and 10.0-24.0 respectively (Table 1 and Table 2). The Sugar-Acid ratio (Sweetness Index) values of offspring of H3 x Mauritius and H4 x Mauritius crosses were ranged from 15.38 to 26.66 to 14.40 39.34 respectively (Table 1 and Table 2). It was observed that three offspring derived from H3 x Mauritius backcross (plant number 3, 6, 13) and eight offspring derived from H4 x Mauritius backcross (Plant number 1, 5, 7, 8, 12, 13, 15, 17) produced fruits with significantly higher Sugar-Acid ratio (Sweetness Index) values than the both parents.

### CONCLUSION

The result revealed that three offspring derived from H3 x Mauritius backcross (plant number 3, 6, 13) and eight offspring derived from H4 x Mauritius backcross (Plant number 1, 5, 7, 8, 12, 13, 15, 17) produced fruits with higher Sugar-Acid ratio (Sweetness Index) values than their parents and these values were higher than the recommended value of 20.

Based on the backcross results, it can be expected that pineapple fruit quality and other characters can be further improved by carrying out the following breeding work: (i) selected backcrossed offspring from both backcrosses can be used to develop new varieties with more sweet fruit types along with other suitable plant characters through selection and evaluation criteria for few generations (ii) selected backcrossed offspring from both backcrosses can be subjected to few more backcrosses with Mauritius parent to increase the sweetness of the fruit and selecting for other fruit characters and plant characters essential for fresh fruit and the canning industry.

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