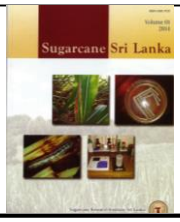
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RESEARCH

Analysis of Maturity Pattern across Major Planting Seasons of Newly Released Sugarcane Varieties at Udawalawe, Sri Lanka

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ABSTRACT

The optimal harvest age of sugarcane varieties is critical for maximizing sugar yield, influenced by various factors such as environmental conditions, varietal characteristics, and management practices. This study aimed to determine the optimum harvest age for newly introduced sugarcane varieties of the 2003 series in Udawalawe, Sri Lanka. Field experiments were conducted at the Sugarcane Research Institute (SRI), utilizing well-drained Reddish Brown Earths (RBE) soil in the DL1a Agro Ecological Region. Planting was carried out in Yala and Maha seasons of 2020, with subsequent crop management aligned with SRI recommendations. Cane sampling and juice quality analysis were conducted monthly interval from 9 - 14 months. Results revealed diverse patterns of maturity among varieties, influenced by prevailed weather parameters during sampling period. Varieties exhibited differential responses based on planting season with some showing similar maturity patterns to the standard variety SL 96 128, while others demonstrated unique trends. Notably, SL 03 983 displayed significantly higher Pol % from 10-12 months and sugar content was declined after 12 months when planted in both Yala and Maha seasons. Therefore SL 03 983 could be considered as early matured variety compared to standard variety. Also The SL 03 336, SL 03 1025 and SL 03 1077 recorded maximum T/B ratio at 12-13 months and those varieties could be considered as mid mature varieties as similar to Standard variety. This assessment provides valuable insights for optimizing planting schedules and harvesting operations to achieve maximum cane and sugar yield in areas where similar weather pattern Sri Lanka's sugarcane industry.

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INTRODUCTION

Sugarcane is the most important sugar crop in Sri Lanka that produces sugar and ethanol. There are 25,000 ha of sugarcane belong to four sugar companies with the capacity of 8000 Tons of Cane per Day (TCD) by 2022 [1]. In general most of the sugarcane varieties released by the Sugarcane Research Institute (SRI) matures at 12 months age. However, crop maturity age can be change based on the variety and the prevailing environmental conditions. When sugarcane is harvesting, varietal differences in growth and maturity rates have to be considered [2]. In addition, management practices, environmental conditions, and pest and disease conditions also influence the optimal harvest age of sugarcane [2]. The climate parameters such as temperature, solar radiation, relative humidity and total rainfall variables that account for a major variation in harvest age among sugarcane growing countries [3].

Sugarcane varieties differ in their ability to mature at different stages. Based on the optimum harvesting sugarcane varieties can be classified as early maturing (10- 12 months), medium maturing (12 months) or late maturing (14-16 months) [4]. Early maturing varieties have relatively high sucrose content in early season while late maturing varieties reach to high sugar content at late stage [4]. The optimum harvesting age is also vary depend on the countries i.e. 10-14 months in Brazil, 12-18 months in India, 13-19 months in Jamaica, 15 months in Queensland (Australia) 16 months in Mauritius and, 20 - 24 months in Hawaii [5].

Early maturing varieties are important during early-season milling operations to sustain the cane supply for milling [6]. When explained scientifically, considering only the age of sugarcane is not a reliable guide to determine the sugarcane maturity [7]. Also, the optimum harvest age of new sugarcane varieties has to be considered within the new variety introduction program since varieties differ in their agronomic characteristics and pattern of maturity and knowledge on pattern of maturity of a variety is a prerequisite to decide harvesting age to get maximum yield [6]. Therefore, the information generated from this study is useful to schedule planting program and organize harvesting operations to get highest cane and sugar yield. Therefore, the study was carried out to determine the optimum harvest age against the planting season for the 2003 series newly introduced sugarcane varieties.

MATERIALS AND METHODS

The experiment was conducted in research farm at SRI. The area where field experiments were conducted belongs to DL1a Agro Ecological Region [8]. The soil in the area is predominantly well-drained Reddish Brown Earths (RBE) (Alfisol to Ustalf) with a sandy clay-loam texture [9]. The experimental area receives 1,300 mm average annual rainfall with 75 % expectancy and about two-thirds of the annual rainfall is received during September to February (Maha season).

There is a small peak of rainfall during March to May. The ambient air temperature are high and range from 28°C to 32°C [10]. Planting material of 2003 series superior varieties selected from replicated yield trials were multiplied at the SRI research farm in 2019. Before establishing of multiplication plots each variety was subjected to hot water treatment to prevent possible transmission of sett-borne diseases. After the multiplication of seedcane, each variety was planted in plots with 6 m 5 rows and 3 replicates with Randomized Complete Block Design (RCBD) in two-major seasons (Yala and Maha) at the research farm Uda Walawe. The SL 96 128 variety was used as standard variety for comparison. The details of the newly released varieties and dates of planting are presented in Table 1.

The first set of variety (M1) was planted in June 2020 (Yala Planting) and same experiments (M2) was established in October 2020 (Maha planting). Crop management activities including weeding, fertilizer application and irrigation were done in line with SRI recommendations. Cane sampling

Table 1. Description of selected 2003 series varieties

Trial No/Code	Date of Planting	Name of the Varieties
M1	03/06/2020	SL 03 336, SL 03 983, 03 1025, SL 03 1077, SL 96 128 (Std)
M2	20/10/2020	SL 03 336, SL 03 983, 03 1025, SL 03 1077, SL 96 128(Std)

* Std: - Standard Verity

was started from 9 months age and, brix % of sugarcane stem top and bottom, and analysis of juice quality parameters (Brix %, Pol %, Fibre %, Purity% and Pure Obtainable Cane Sugar = POCS %) were conducted during 2021. Maturity data collection was continued in monthly intervals up to 14 months.

RESULTS AND DISCUSSION

The sugarcane maturation is defined by physiologists as a senescent stage, between the fast growth and the final death of the plant [11]. The soil water content, nitrogen and potassium in the soil and temperature are major factors in affecting the degree of the maturation of the sugarcane [12]. Different varieties showed a different pattern of maturity because, soil water content, temperature, and humidity are changed at the ripening stage based on the planting time of the year. At the full maturity of the sugarcane crop T/B ratio of brix % equal to 1 and purity % should be greater than 85 % [13]. Generally sugar content of the cane is affected by the weather condition of 1-2 weeks period before cane samples are collected. The behavior of each variety compared to standard variety SL 96 128 are presented and discussed separately as follows.

Weather condition during the sampling period

Cane sample analysis started in August 2020 and continued up to January 2022. Since sugarcane juice quality is affected by prevailing weather conditions [12], Variations of the weekly rainfall, is presented in the following graphs (Figure 1). When consider the rainfall throughout the year it is clear that during the October-December and March-May received comparatively high rainfall than the other months of the year (Figure: 1). The rainfall received 1-2 weeks before is a key parameter that affect the sugar content in cane

Behavior of sugar content in cane

Planting time: June 2020 (Yala Season)

The figure 2-5 shows the variation of POCS % of new sugarcane varieties (Maturity curve) with age against standard SL 96 128, when the crop is planted in June 2020 (Yala season). It is clear that the SL 03 983 recorded a similar pattern to standard variety, SL 96 128 (Figure: 5). However SL 03 983 recorded significantly high POCS % from 09-12 months age compared to the standard variety (Table: 2). The SL 03 983 recorded >0.85 T/B ratio from 10-11 months (Figure: 6) and POCS % was reduced after 11 months (Figure: 5). Therefore SL 03 983 expressed some early mature characters and, there is a possibility to harvest this variety at 10-11 months age.

All varieties show decreasing trend of POCS % with age because during April, May and June, there was Yala season rainfall (Figure: 1) and rainfall increases soil moisture and reduced the sugar content in mature cane [14]. Also, the POCS % of SL 03 336, SL 03 1025 and SL 03 1077 were not significantly different compared to standard variety (Table: 2). Based on the T/B ratio curves SL 03 336, SL 03 1025 and SL 03 1077 matured for harvesting at 12-14 months age (Figure: 6).

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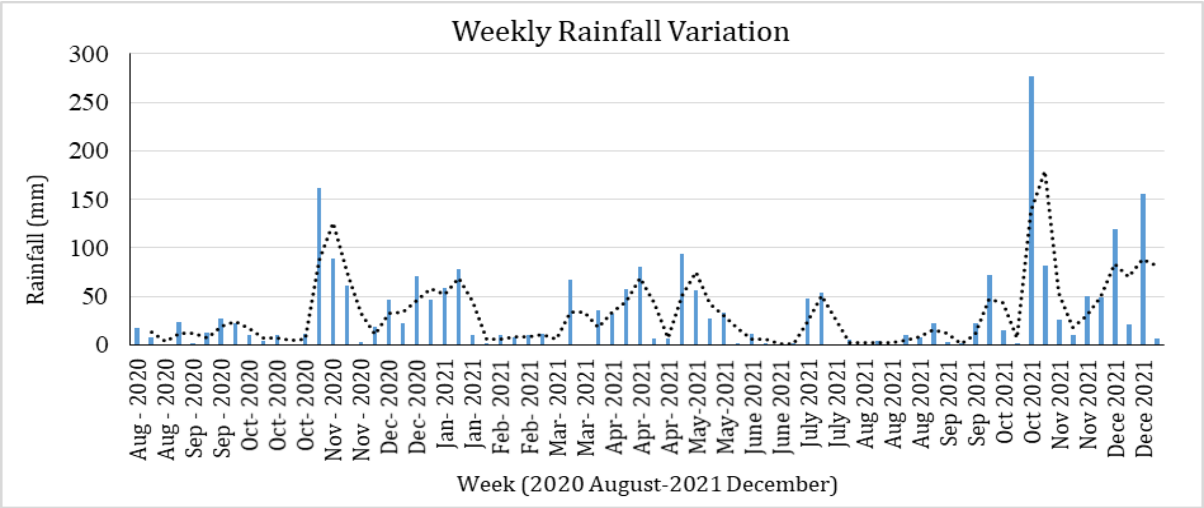


Figure 01: Variation of rainfall with time

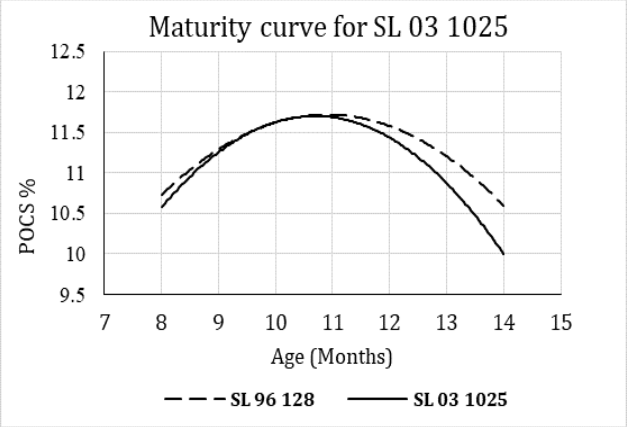


Figure 02: Variation of POCS % with age for SL 03 1025 (Yala Planting)

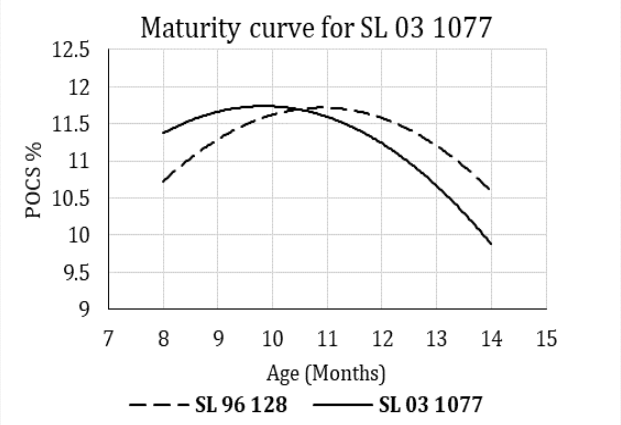


Figure 03: Variation of POCS % with age for SL 03 1077 (Yala Planting)

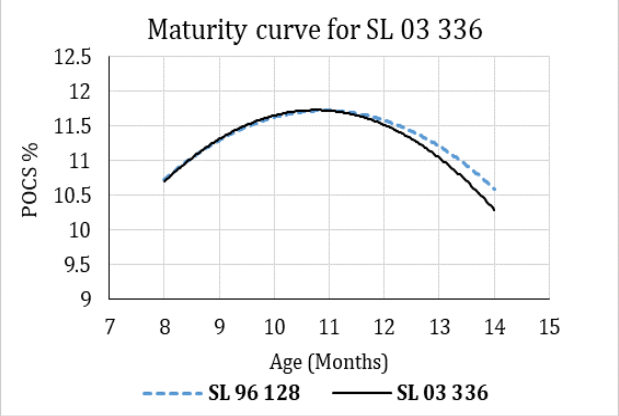


Figure 04: Variation of POCS % with age for SL 03 336 (Yala Planting)

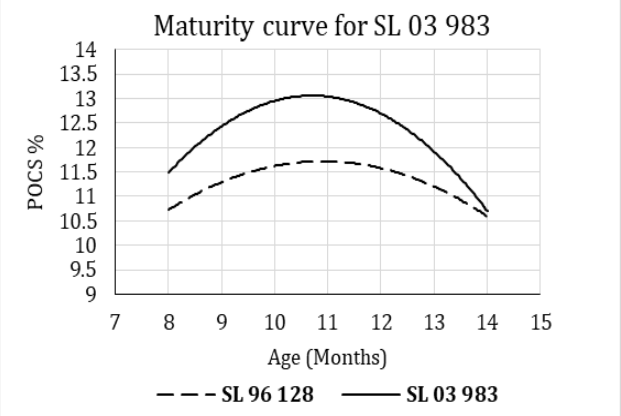


Figure 05: Variation of POCS % with age for SL 03 983 (Yala Planting)

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Table 2. POCS % variation with crop age (Yala planted crop)

Variety	POCS % ± SD						
	Age (Months)						
	8	9	10	11	12.5	13	14
SL 03 336	10.8 ± 0.3	11.1 ±0.4	11.6±0.7	12.1±0.4	10.7± 0.4	11.3±0.8	10.3±0.7
SL 03 983	11.5 ± 0.5	12.2*±1.0	13.4*±0.4	12.8*±0.5	11.8± 0.5	12.4*±1.1	10.6±0.6
SL 03 1025	10.3 ± 0.4	13.5*±0.1	12.4±0.7	11.8±0.4	10.6± 1.0	10.3±1.0	10.6±0.5
SL 03 1077	11.2 ± 0.4	11.9± 0.5	11.6±0.2	11.5±0.4	11.1± 1.0	10.3±0.5	10.0±0.7
SL 96 128	10.5 ± 0.4	11.3±0.3	12.2±0.2	11.6±0.4	11.5±0.3	10.3±0.5	11.1±0.5

POCS % values marked with the * is significant compared to standard variety

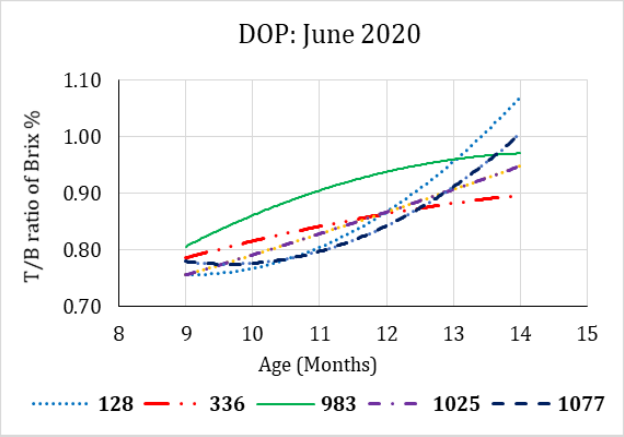


Figure 06: Variation of Top/Bottom ratio of brix %

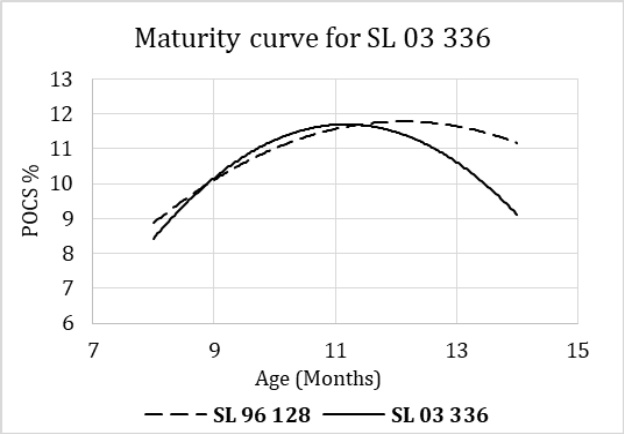


Figure 07: Variation of POCS % with age for SL 03 336 (Maha Planting)

Planting time: October 2020 (Maha Season)

The figure 7-10 shows the variation of POCS % of new sugarcane varieties (Maturity curve) with age against standard SL 96 128, when the crop is planted in October 2020 (Maha season). All tested varieties were recorded with a similar pattern of POCS % variation to the standard, SL 96 128 since POCS% were not statistically significant (Table: 3). The POCS % of all the varieties gradually increases from 9-12 months age and recorded maximum at 11-12 month period and then gradually reducing. (Figure: 7-10).

For Maha season planted crop, rainfall was increased after 12 months (Figure: 1) and this may also causes to reduce the sugar content in mature cane [14]. Based on the both POCS % and T/B ratio curves optimum harvesting age of these new varieties could be considered as 12 months when planted in Maha season.

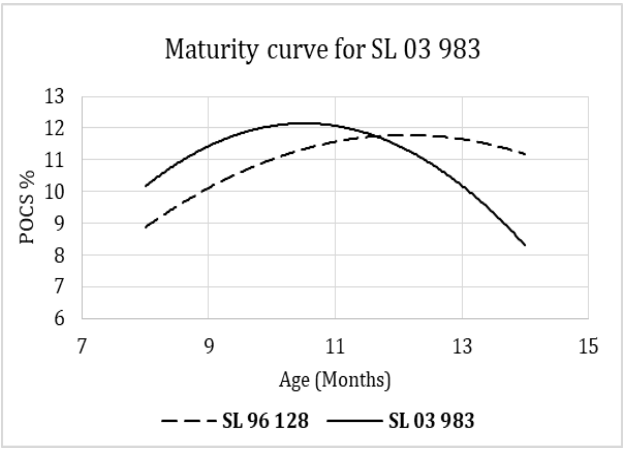


Figure 08: Variation of POCS % with age for SL 03 336 (Maha Planting)

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Table 3. POCS % variation with crop age (Maha planted crop)

Variety	POCS % ± SD					
	Age (Months)					
	8	9.25	11	12.25	13.25	14
SL 03 336	8.5 ± 0.3	10.43 ± 0.2	11.50 ± 0.3	11.64 ± 0.4	10.28 ± 0.4	9.04 ± 0.5
SL 03 983	10.5 ± 0.4	10.89 ± 0.3	12.60 ± 0.3	11.49 ± 0.2	9.15 ± 0.5	8.52 ± 0.6
SL 03 1025	10.5 ± 0.5	10.69 ± 0.3	11.90 ± 0.2	10.81 ± 0.4	8.77 ± 0.6	9.08 ± 0.8
SL 03 1077	10 ± 0.4	10.25 ± 0.5	11.10 ± 0.3	10.95 ± 0.3	11.64 ± 0.5	10.64 ± 0.7
SL 96 128	9.1 ± 0.6	9.87 ± 0.5	12.00 ± 0.4	11.50 ± 0.4	11.88 ± 0.6	11.00 ± 0.8

* SD: Standard deviation

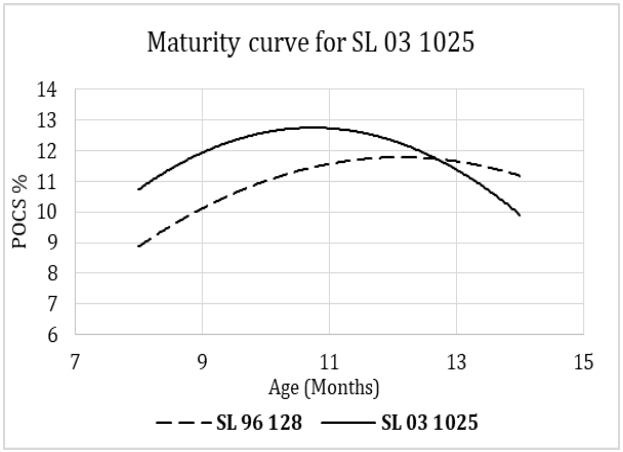


Figure 09: Variation of POCS % with age for SL 03 1025 (Maha Planting)

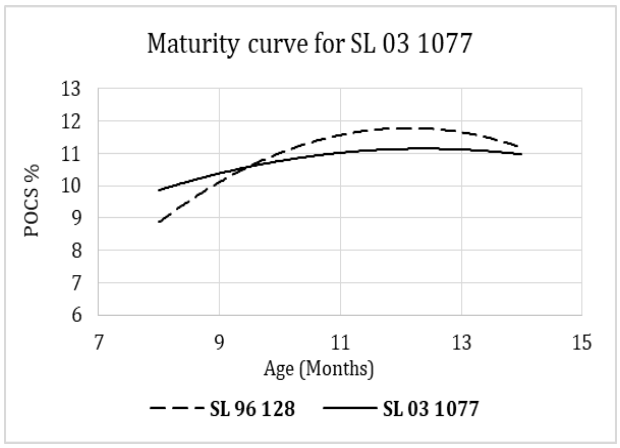


Figure 10: Variation of POCS % with age for SL 03 1077 (Maha Planting)

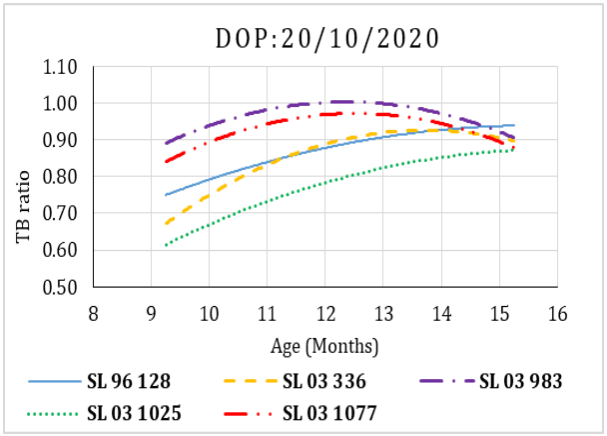


Figure 11: Variation of T/B ratio with age (Maha Planting)

CONCLUSIONS

This research generates information on the dynamics of sugarcane maturity and sugar production based on planting time of newly introduced sugarcane varieties in Sri Lanka. Through particular field experiments and thorough analysis, we have described the diverse patterns of maturity exhibited by different varieties, emphasizing the critical role of weather conditions. Our findings highlight the variations of the sugar content against the planting season for scheduling harvesting operations to maximize cane and sugar yield. Ultimately, the knowledge generated from this study contributes to the advancement of sugar production technology by optimizing yield and quality in sugarcane cultivation.

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CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

FUTURE DIRECTIONS

However, the pattern of sugar accumulation in cane stem basically depends on number of factors including the prevailing weather conditions. Therefore long term data collection and analysis in this domain have to be done for a precise maturity pattern identification for different growing areas since climate conditions are different in major sugarcane growing areas in Sri Lanka.

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