DISSIMILARITY IN SUGAR CONTENT BETWEEN EARLY, MEDIUM, MID-LATE AND LATE MATURING SUGARCANE VARIETIES THROUGHOUT THE CRUSHING SEASON

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ABSTRACT

Understanding the dissimilarity in sugar content among different maturity sugarcane varieties throughout the crushing season is essential for sugar mills and farmers to make informed decisions regarding planting and harvesting schedules. The sugar content of sugarcane is a key determinant of its commercial value and it varies with the maturity stage of the crop. This study investigates the dissimilarity in sugar content among early, medium, mid-late, and late maturing sugarcane varieties during the crushing season 2021-2022 at Sugarcane Research Institute, AARI, Faisalabad, Pakistan. The findings reveal substantial variations in sugar content throughout the season among different maturity varieties. Early maturing varieties exhibited higher sugar content in the month of November at the beginning of the crushing season, providing sugar mills with an advantage for early crushing. However, as the season progressed, sugar content in early maturing varieties declined more rapidly in the month of March compared to other maturity categories. Medium and mid-late maturing varieties displayed a more consistent sugar content profile, with a gradual decline throughout the crushing season. Late maturing varieties demonstrated delayed maturity but maintained higher sugar content late into the season. These findings suggest that a strategic planting mix of different maturity varieties can optimize sugar production and extend the crushing season for maximum sugar recovery.

Keywords: Sugar Recovery, early, medium, late maturing sugarcane varieties

INTRODUCTION

Sugarcane (Saccharum officinarum L.) is one of the most economically significant crops globally, particularly in countries like Pakistan, where it serves as a key cash crop and a crucial source of revenue for both farmers and the sugar industry. Punjab, the most fertile province of Pakistan, plays a crucial role in the production of sugarcane. The Punjab region not only boasts an profusion of arable land but also possesses a diverse array of sugarcane varieties that differ in terms of their maturation periods, offering a unique opportunity to explore the dissimilarity in sugar content across these varieties throughout the crushing season. The sugarcane crushing season in Punjab Pakistan, typically spans from November to April, with variations in the maturation periods of different sugarcane varieties. These varieties can be broadly classified into early, medium, mid-late, and late maturing types based on the time required for them to reach optimal maturity for harvesting. This temporal diversity in maturation among sugarcane varieties raises questions about how sugar content fluctuates throughout the crushing season, impacting the overall efficiency and profitability of the sugar industry (Singh and Singh 2000, 2004; Hagos et al. 2014). Understanding these dissimilarities is essential for both farmers and sugar mill operators to make informed decisions regarding planting, harvesting, and processing. Longer sugar mills crushing periods and sugar recovery are dependent on a good balance of early and mid-late maturing sugarcane varieties (Singh et al., 2011). This study was carried out to evaluate sugarcane cultivars for sugar recovery to assist in guiding judgments on the appropriate balance of varieties for the region.

Methodology

Prior to the sugarcane crop being sown, a composite soil sample was taken from the field and its physicochemical characteristics were examined (Table 1). While phosphorus was measured using a spectrophotometer using sodium bicarbonate extraction and textural class using the hydrometer method (Olsen, et al., 1954; Bouyoucos, 1962), the pH of soil paste and electrical conductivity of the soil extract were determined using the method of (Mclean, 1982). The Ryan et al., (2001) method was used to assess the concentration of soil organic carbon (SOC). In contrast, potassium was measured using a PFP-7 Janway Flame photometer, and soil extraction was carried out using ammonium acetate (1 N of pH 7.0) (Rowell, 1994). Twelve different sugarcane varieties planted at Sugarcane Research Farm, Ayub Agricultural Research Institute Faisalabad (Table-2) representing early (Sr. No. 1 to 4), medium (Sr. No. 5 to 8), mid-late (Sr. No. 9 to 11), and late (Sr. No. 12) maturing types were selected for sugar recovery analysis. Sugarcane samples were collected at regular intervals throughout the crushing season, starting from the month of November 2020 to March 2021.For Cane Yield (t ha^{-1}) determination, 4×9.6m^2 plot sizes were harvested to get yield in tons per hectare. Furthermore, sugarcane juice quality parameters were also analyzed which were used to determine sugar yield and sugar recovery. The commercial cane sugar percentage (CCS %) was determined by utilizing the following equation:

CCS % =

$$\frac{3P}{2}(1 - F + \frac{5}{100} - \frac{B}{2}(1 - F + \frac{3}{100}$$

Where, F represents the fiber percentage of a cane sample and B represents the brix of sugarcane. (Chen and Chou 1993). The Sugar Recovery Percentage (SR %) was determined by utilizing the equation developed by Spancer and Meade (1963).

SR % = CCS % × 0.94

Where, CCS % represents the Commercial Cane Sugar Percentage and factor 0.94 represents the net titer. The sugar yield (t ha^{-1}) was determined by dividing the product of stripped can yield (t ha^{-1}) and sugar recovery percentage (SR %) by following the equation used by Majeed et al., (2022).

Sugar Yield (t ha^{-1}) =

$$\frac{\text{Stripped Cane Yield}\,(t\ ha^{-1}) \times \text{Sugar Recovery}\,(\%)}{100}$$

RESULTS AND DISCUSSION

The results of present experiment indicated that sugar content in all four types of sugarcane varieties exhibited temporal variation throughout the crushing season (Table-2). Early Maturing (Table-2) sugarcane varieties (Sr. No. 1 to 4) displayed the higher sugar recovery% during the early growth stages but experienced a decline in sugar recovery in the month of March (Singh and Singh 2000). The comparison (Table 3) showed that CPF-251 ranked 1st position in case of average sugar content (12.90%) but 12th position regarding sugarcane yield (90.55 t/ha). But the opposite trend was observed in case of striped cane and sugar yield (Singh and Singh 2004).

The data showed that highest cane (140.65 t/ha) and sugar yield (16.37 t/ha) was noted in CPF-252 and it ranked 1st as compared to other varieties (table-3). Early maturing varieties while initially having high sugar content may not be the best choice for late-season harvesting in the month of march due to its rapid decline in sugar content as it over matures (Hagos *et al.,* 2014).

Medium (Table-2) maturing varieties (Sr. No. 5 to 8), with its steady increase in sugar content during mid to late stages, could be an optimal choice for mid-season harvesting. On the other hand, mid late (Sr. No. 9 to 11) and late (Sr. No. 12) maturing sugarcane varieties (Table-2) which exhibit higher sugar recovery during mid-late and late season, respectively, may be more suitable for late-season harvesting to maximize sugar yield (Singh etal., 2011; Hagos *et al.,* 2014). The dissimilarity in sugar content observed between the early, medium, mid-late, and late maturing sugarcane varieties highlights the importance of selecting appropriate varieties for specific harvesting windows. Farmers and sugar mills should consider the temporal dynamics of sugar content when planning harvesting schedules.

Table-1 Physiochemical Properties of Experimental Soil

Characteristics	Units	Value
Sand	%	47.54
Silt	%	21.18
Clay	%	31.28
Textural class		Sandy clay loam
pH_s	---	7.90
EC_e	$dS\ m^{-1}$	1.13
Organic matter	%	0.71
Total nitrogen	%	0.021
Available phosphorus	$mg\ kg^{-1}$	8.55
Extractable potassium	$mg\ kg^{-1}$	126

Table-2 Variation in sugar recovery (%) observed between the early, medium, mid-late, and late maturing sugarcane varieties throughout the crushing season

Sr. No.	Varieties	November	December	January	February	March	Average Sugar Rec. (%)
	Early Maturing						
1	CP–77-400	12.10	12.25	12.91	13.15	12.75	12.63
2	CPF – 237	12.15	12.35	12.78	12.82	12.25	12.47
3	CPF – 250	12.20	12.65	13.45	13.10	12.45	12.77
4	CPF – 251	12.45	12.80	13.50	13.18	12.55	12.90
	Medium Maturing						
5	CPF – 246	11.10	11.90	13.20	13.35	12.15	12.34
6	CPF – 247	11.25	12.10	12.80	12.55	12.08	12.16
7	CPF – 248	11.15	11.80	12.89	13.10	12.85	12.36
8	CPF – 253	11.30	11.78	12.85	13.10	12.92	12.39
	Mid-late Maturing						
9	HSF – 240	10.15	10.90	12.00	12.30	13.15	11.70
10	SPF – 234	10.35	11.55	11.80	12.10	12.98	11.76
11	CPF – 249	10.85	11.55	12.12	12.60	12.85	11.99
	Late Maturing						
12	CPF – 252	9.90	10.70	11.85	12.55	13.20	11.64

Table-3 Ranking of different sugarcane varieties on the basis of sugar recovery, cane and sugar yield

Sr. No.	Variety Name	Average Sugar Recovery (%)	Ranking	Sugarcane Yield (t/ha)	Ranking	Sugar Yield (t/ha)	Ranking
1	CP – 77-400	12.63	3	120.35	3	15.20	3
2	CPF – 237	12.47	4	110.1	8	13.73	6
3	CPF – 250	12.77	2	120.2	5	15.35	2
4	CPF – 251	12.90	1	90.55	12	11.68	12
5	CPF – 246	12.34	7	100.45	10	12.40	10
6	CPF – 247	12.16	8	110.4	7	13.42	7
7	CPF – 248	12.36	6	100.75	9	12.45	9
8	CPF – 253	12.39	5	120.25	4	14.90	4
9	HSF – 240	11.70	11	100.35	11	11.74	11
10	SPF – 234	11.76	10	120.65	2	14.18	5
11	CPF – 249	11.99	9	110.85	6	13.30	8
12	CPF – 252	11.64	12	140.65	1	16.37	1

CONCLUSION

For longer crushing times and higher sugar recovery, the right ratio of early to mid-late and late maturing sugarcane varieties is crucial. Understanding these temporal variations is crucial for optimizing harvesting schedules and ensuring efficient sugar production in the sugarcane industry. Farmers and sugar mill operators should select varieties that align with their desired harvesting windows to maximize sugar yield and economic returns. It's important to note that the sugar content variations observed in this study can also be influenced by environmental factors, soil conditions, and agronomic practices. Therefore, further research is needed to assess how these factors interact with varietal differences.

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