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Growth and Yield of Sugarcane (*Saccharam officinarum*) as Influenced by Planting Materials and Plant Geometry

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Field experiments were conducted at Sugarcane Research Station, Melalathur, from 2010 to 2012, aiming to investigate the impact of plant geometry (5 x 2 ft single row, 5 x 1 ft double row) and various planting materials (single budded setts, double budded setts, and transplanting of sprouted seedlings). The results indicated that transplanting cane using chip bud seedlings exhibited significant establishment and vigor compared to direct planting of setts. In terms of planting geometry, the crop planted in a 5 x 1 ft double row configuration demonstrated a higher number of

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tillers and millable cane. However, when considering single cane weight, commercial cane sugar percentage, and benefit-cost ratio, the 5 x 2 ft planted crop outperformed, showcasing higher cane yield in comparison to other treatments.

Keywords: Sugarcane; planting geometry; chip bud seedling; benefit cost ratio.

1. INTRODUCTION

Sugarcane (*Saccharam officinarum*) is cultivated under varied conditions ranging from the tropics to the sub-tropics [1]. Sugarcane stands as a crucial commercial crop in India, significantly contributing to the agricultural landscape. The scale of its impact is immense, with 35 million farmers engaged in sugarcane cultivation, and an additional 50 million individuals relying on the employment opportunities generated by the 571 sugar factories and related industries throughout the country. In states such as Uttar Pradesh, Maharashtra, and Tamil Nadu, sugarcane emerges as a key player in bolstering the state economy. Over the last decade, sugarcane production in India has experienced fluctuations, ranging between 233 million tonnes and 355 million tonnes. This inconsistency is mirrored in the farm-level productivity, which has stagnated at a relatively low 40 t/ha. Several factors contribute to this suboptimal productivity, including inappropriate plant distribution, imbalanced nutrient management, and water stress, hence, lack of production technologies is considered as a major determinant [2].

Addressing these constraints becomes imperative not only for increasing productivity [3] also for sustaining and enhancing sugarcane production. One promising avenue is the adoption of an appropriate plant geometric configuration, specifically through wider row spacing. This approach offers practical solutions for farmers to simultaneously improve land, water, and labor productivity. By strategically adjusting the spatial arrangements the twin objectives of higher productivity and better use resource use efficiency can be achieved [4].

Wider row spacing not only addresses productivity concerns but also introduces additional benefits. For instance, the planting of sprouted seedlings after 30 days not only reduces the crop duration but also extends the crushing season for factories. This extension in the operational period of sugar factories contributes to increased employment opportunities over an extended timeframe. Moreover, it is anticipated to alleviate overall pressure on water resources, fostering sustainable agricultural practices and aiding in the recovery of ecosystems.

Recognizing the multifaceted impact of plant geometry and planting materials on sugarcane growth and yield, a comprehensive field experiment was undertaken. This study aimed to unravel the intricate relationships between these variables, providing valuable insights for farmers, policymakers, and industry stakeholders.

2. MATERIALS AND METHODS

A field experiment was conducted at Sugarcane Research Station, Melalathur, during the years 2010-2012, utilizing well-drained sandy loam soil with a pH of 7.8 and electrical conductivity (EC) of 0.2 ds/m. The soil analysis revealed low availability of nitrogen (N), medium levels of phosphorus (P), and adequate potassium (K) with values of 155, 13, and 245 kg/ha, respectively. The experimental design employed a Randomized Block Design with four replications. The selected test variety for the experiment was Co 86032, characterized as a midlate maturing variety. The experiment encompassed five treatments outlined as T_1: Conventional method of planting with 90 cm row spacing; T_2: Direct planting of single budded setts with 5 x 2 ft spacing in a single row; T_3: Direct planting of single budded setts with 5 x 1 ft spacing in a double row; T_4: Transplanting of chip budded seedlings with 5 x 2 ft spacing in a single row and T_5: Transplanting of chip budded seedlings with 5 x 1 ft spacing in a double row.

In the single row planting, setts were placed on one side of the trench, while in the double row planting, setts were positioned on both sides of the trenches. In contrast, controls mimicked farmers' practices, employing an overlapping method for sett placement. The sugarcane received fertilization with 275:62.5:112.5 kg N, P_2O5, and K_2O/ha.

To assess germination and establishment, counts were recorded on the 30th day, with gap filling implemented in specific plots to achieve a uniform base population. Growth parameters, including tiller population, were documented on the 90th and 120th days post-planting. Additionally, cane length and girth were measured at 180, 260, and harvest stages. Yield parameters, such as the number of millable canes, CCS percentage, cane yield, and sugar yield, were recorded at harvest. Statistical analysis of the collected data followed the methodology suggested by Gomez and Gomez [5] and is presented in Table 1. This rigorous approach ensures a comprehensive understanding of the impact of various planting methods on sugarcane growth, development, and ultimate yield, providing valuable insights for optimizing cultivation practices.

3. RESULTS AND DISCUSSION

The experimental results revealed a significant impact of different planting material and planting geometries. Notable advantage for seedlings raised in portrays with chipbuds planted at wider spacing when compared to conventional planting materials in terms of crop establishment and growth. Transplanting of chip budded seedlings at 5 x 2 ft spacing in a single row (T_4) recorded higher crop establishment (91.7 %) fostering a robust plant population and vigorous growth, reflected in a commendable plant height of 4.62 m at harvest compared to other treatments. Wider row and plant spacing in transplanting of chip budded seedlings with 5 x 2 ft spacing improved air and sunlight penetration, promoting healthier cane growth.

Tiller numbers were notably higher in the 5 x 1 ft double row and conventional planting methods compared to the single row planting (5 x 2 ft), possibly due to the narrower plant-to-plant spacing (30 cm) in the former. However, despite the closer spacing, the double row planting tripled the population per unit area.

Transplanting of chip budded seedlings with 5 x 1 ft spacing in a double row (T_5) recorded higher tiller population (1,68,000/ha) and millable cane (1,23,000/ha) compared to other planting and spacing (Table 1). In general with respect to planting material, transplanting sprouted chipbud seedlings into the main field demonstrated superior performance over the use of traditional planting materials. The benefits included better establishment, increased growth, and the ability to maintain the required cane population in the main field. These findings align with those reported by Ramesh in [6] 1999. Favourable crop establishment methods will produce vigorous crop, the dominant plants generally emerge faster and since early growth is a geometric progression which ultimately had impact of yield [7]. The observed lower cane yield when using conventional seed materials (single and double budded setts) may be attributed to factors such as reduced germination rates and poor field-level establishment with diminished vigor. This conclusion is consistent with similar findings reported by Suriyavanshi et al. [8] in 2010.

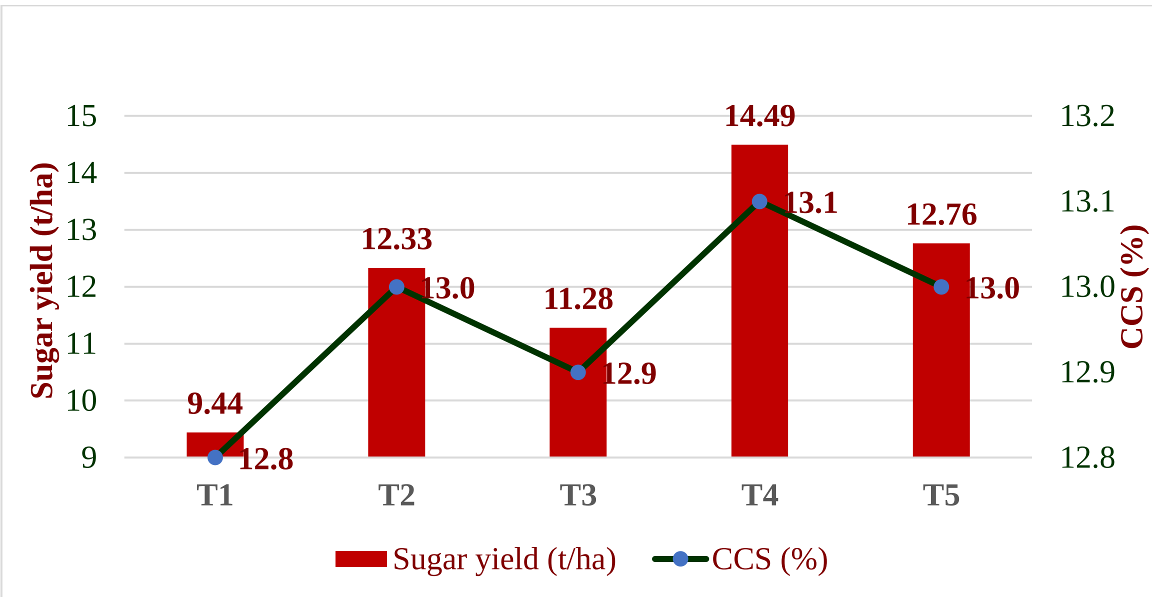

Fig. 1. Effect of plant geometry with different planting materials on quality parameters of sugarcane

Table 1. Effect of plant geometry with different planting materials on growth, yield parameters and economics of sugarcane

Treatments	Germination/ Establishment (%)	Plant height (m) at harvest	Tillers population 1000'/ha	Millable cane 000'/ha
T_1	58.3	3.58	126.37	91.57
T_2	71.3	4.26	106.35	76.96
T_3	65.3	4.15	136.87	97.96
T_4	91.7	4.62	121.59	88.15
T_5	85.7	4.53	168.14	123.00
S.Ed	5.60	0.33	9.54	7.01
CD (P=0.05)	12.35	0.75	21.0	15.45

T_1: Conventional method of planting with 90 cm row spacing
T_2: Direct planting of single budded setts with 5 x 2 ft spacing in a single row
T_3: Direct planting of single budded setts with 5 x 1 ft spacing in a double row
T_4: Transplanting of chip budded seedlings with 5 x 2 ft spacing in a single row
T_5: Transplanting of chip budded seedlings with 5 x 1 ft spacing in a double row

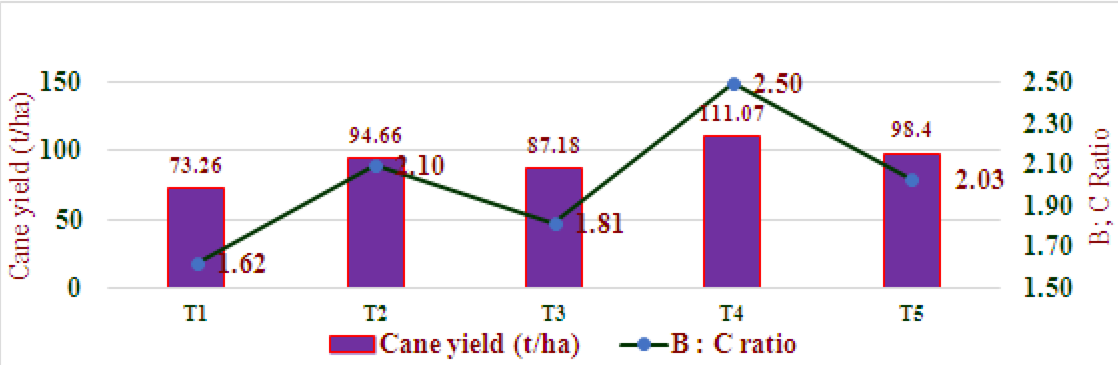

Fig. 2. Effect of plant geometry with different planting materials on cane yield and economics of sugarcane

In terms of cane yield, the transplanted 5 x 2 ft single row crop (T_4) exhibited superior performance, recording higher cane yield (111.07 t/ha). The treatment also demonstrates superior sugar-related metrics, boasting a high CCS of 13.05%, leading to a substantial sugar yield of 14.49 t/ha (Fig. 1). This outcome can be attributed to the more effective utilization of available nutrients in the soil, ultimately resulting in increased cane weight and sugar yield. Notably, these findings align with previous studies by Nagendra and Palanisamy [9] and Singh et al. [10].

Economic viability is evident with the highest B:C ratio of 2.50 (Fig. 2). The inclusion of sprouted chip-budded seedlings after 30 days proves advantageous, reducing the crop duration by a month and its maintenance cost. Further, transplanting of chip budded seedlings with 5 x 2 ft spacing in a single row (T_4) requires less number of chip bud seedlings as compared to other planting method and spacing, hence, it incurred low expenditure and eventually the same treatment recorded higher cane yield which reflected in higher B : C ratio.

4. CONCLUSION

This study aimed to investigate the impact various procedures for planting sugar cane such us single budded setts, double budded setts, and transplanting of sprouted seedlings. The results showed that wider row and transplanting of chip budded seedlings with 5 x 2 ft spacing not only reduce seed material costs but also support improved air and sunlight penetration,promoting healthier cane growth. These insights provide valuable guidance for optimizing agricultural practices, emphasizing treatment transplanting of chip budded seedlings with 5 x 2 ft spacing as a comprehensive and economically sound choice for enhancing sugarcane production and economic returns."

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jayakumar J, Harisudan C, Shanmugapriya S, Ganapathy V, Ravichandran P, Veeramani S Thiruvarassan. An evaluation of biocontrol agents against sugarcane lesion nematode. Pratylenchus zeae. Journal of Advanced Zoology. 2023;44(6):1357-1362.
2. Harisudan C, Nisha Sapre. Evaluation of crop establishment methods and foliar nutrition for enhancing productivity of rice fallow/follow sesame (*Sesamum indicum* L.). J. Oilseeds Res. 2019;36(2):89-92.
3. Harisudan C, Veeramani P, Jayakumar J, Karunakaran V, Sivagamy K, Ravichandran V, Kathirvelan P, Thiruvarassan S, Baskaran R and Subrahmaniyan K. Nutrient Management Strategies for Groundnut-blackgram Cropping Sequences. Int. J. Environ. Clim. Change. 2023; 13(12):859-863.
4. Harisudan C, Subrahmaniyan K. Evaluation of irrigation levels and plant geometry for drip irrigation in groundnut (*Arachis hypogaea* L.). J. Oilseeds Res. 2020;37(4):267-271.
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A wiley interssciences publications. John Wiley and Sons, New York; 1984.
6. Ramesh P. Growth yield and water requirement of Sugarcane (*Saccharum officinarum*) as influenced by planting geometry with different planting materials. Cooperative Sugars. 1999;31: 315-317.
7. Harisudan C, Vincent S, K Subrahmaniyan. Modifying root and canopy architecture for effective resource use efficiency and yield maximization in sesame (*Sesamum indicum* L.). Extended Summaries: 5th International Agronomy Congress on Agri Innovations to Combat Food and Nutritional Challenges Held during 23 to 27 November, 2021 at Professor Jayashankar Telagana State Agricultural University, Hyderabad. 2021; 164-165.
8. Suryavanshi VP, Pagar PA, Baig MIA, Khandekar BS. Comparison of different planting material with plant geometry in sugarcane variety Co-94012. International Journal of Agricultural Sciences. 2010 January to June; 6(1):172-174.
9. Nagendra KR, Palanisamy P. Spaced row planting improves sugarcane yield. Kissan World. 1997;24(3):11-13.
10. Singh NP, Verma RDN, Singh RG, Singh SB. Effect of plant geometry and nitrogen level on yield and juice quality of sugarcane. Sugar tech. 2000;2:1-2.

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