

Growth and yield of Sugarcane (*Saccharum officinarum*) as influenced by planting geometry with different planting materials

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

Key words : Sugarcane, Planting geometry, Gross income, benefit cost ratio

1. INTRODUCTION

Sugarcane (*Saccharum 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 T₁: Conventional method of planting with 90 cm row spacing; T₂: Direct planting of single budded setts with 5 x 2 ft spacing in a single row; T₃: Direct planting of single budded setts with 5 x 1 ft spacing in a double row; T₄: Transplanting of chip budded seedlings with 5 x 2 ft spacing in a single row and T₅: 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, P₂O₅, and K₂O/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. RESULT AND DISCUSSION

Planting material

The experiment results unveiled a notable advantage for seedlings raised in portraits with chipbuds when compared to conventional planting materials in terms of crop establishment and growth. Transplanting these 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.

In contrast to the conventional method involving single and double budded setts, the chipbud seedlings exhibited higher tiller numbers per clumb, a greater number of total millable canes, and increased cane weight. The planting of sprouted seedlings yielded an impressive cane output of 111 t/ha, surpassing the results obtained from single and double budded setts. This can be attributed to factors such as the higher conversion rate of millable canes, greater single cane weight, and elevated commercial cane sugar content associated with the transplantation of

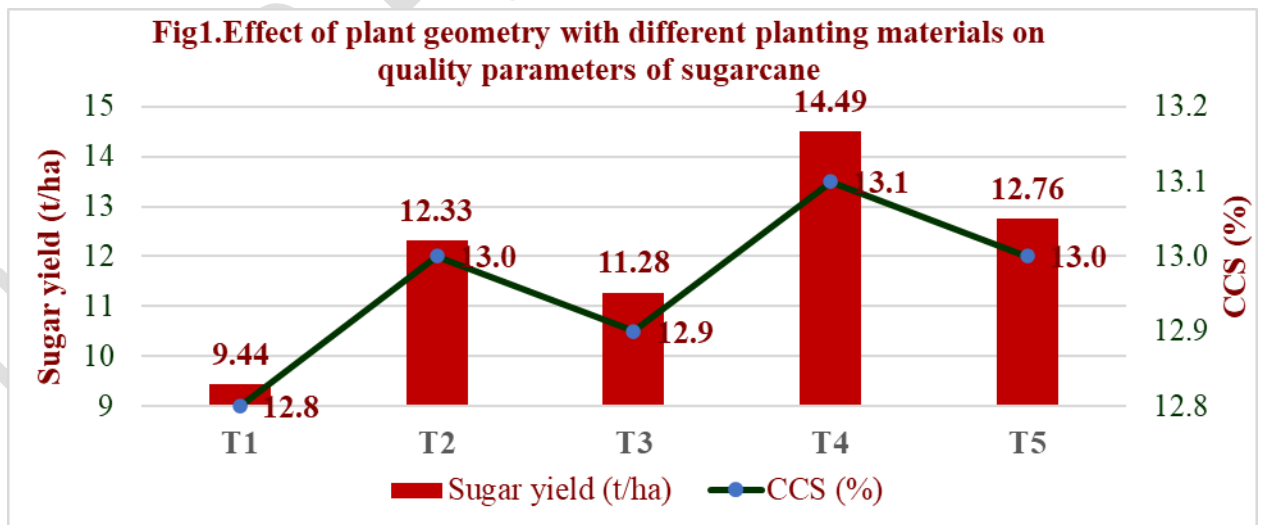
seedlings. These findings align with those reported by Ramesh in [6] 1999. The observed lower cane yield when using conventional seed materials (single and double budded setts) may be attributed to factors such as reduced germination rates and poor field-level establishment with diminished vigor. This conclusion is consistent with similar findings reported by Suriyavanshi *et al.* [7] in 2010.

Planting geometry

The experimental results revealed a significant impact of different planting geometries, including conventional, 5 x 2 ft single row, and 5 x 1 ft double row configurations, on tiller count and millable canes (Table 1). 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.

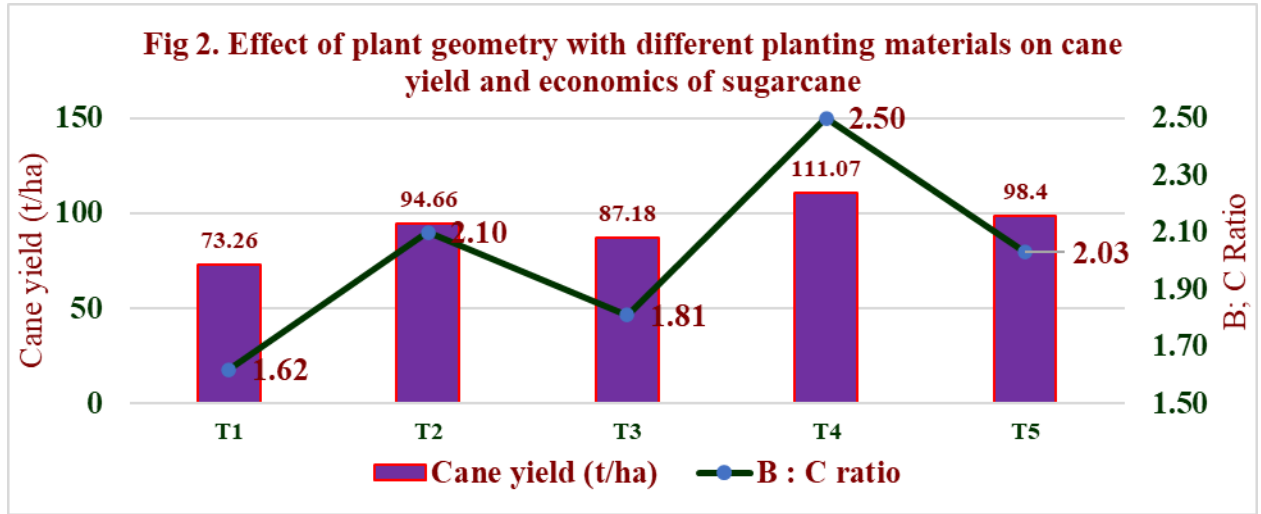
Table 1. Effect of plant geometry with different planting materials on growth, yield parameters and economics of sugarcane

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



In terms of cane yield, the transplanted 5 x 2 ft single row crop exhibited superior performance, recording higher cane yield (111.07 t/ha), CCS % (13.05%), and sugar yield (14.49 t/ha), along with a higher B:C ratio (1:2.50). 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 [8] and Singh et al. [9].



4. CONCLUSION

The treatments exhibit varying impacts on key parameters, revealing Treatment T4 as the most promising for optimizing sugarcane production. Transplanting of chip budded seedlings with 5 x 2 ft stands out with exceptional germination rates at 91.7%, fostering a robust plant population and vigorous growth, reflected in a commendable plant height of 4.62 m at harvest. Additionally, Transplanting of chip budded seedlings with 5 x 2 ft spacing excels in tiller population, millable cane density, and cane yield, surpassing other treatments with values of 121.59 tillers 1000³/ha, 88.15 millable canes 000³/ha, and an impressive 111.07 t/ha, respectively. 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. Economic viability is evident with the highest B:C ratio of 2.50. Furthermore, the inclusion of sprouted chip-budded seedlings after 30 days proves advantageous, reducing the crop duration by a month. Wider row and plant spacing in 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.

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