



Performance of High Yielding Promising Sugarcane Variety VSI-12121 for Sangareddy District, Telangana, India

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Authors' contributions

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

Article Information

DOI: <https://doi.org/10.9734/ijpss/2026/v38i25961>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://pr.sdiarticle5.com/review-history/152121>

Original Research Article

Received: 05/12/2025

Accepted: 31/01/2026

Published: 04/02/2026

Abstract

An Farm Trial (OFT) was conducted during the late rabi seasons of 2022–23 and 2023–24 in farmers' fields of Sangareddy district, Telangana, with the objective of evaluating the performance of a promising sugarcane variety VSI-12121 in comparison with the widely cultivated popular variety Co 86032. The study was undertaken in view of the need for varietal diversification and enhancement of sugarcane productivity under real farm conditions. The trial was implemented at

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five representative locations under assured irrigated conditions, strictly following the recommended package of practices to ensure uniform crop management across locations and seasons. Observations were recorded on important yield-attributing characters, including number of productive tillers, internode length, stem girth, and individual cane weight, in addition to cane yield and economic parameters. The results clearly indicated the superior performance of VSI-12121 over the check variety Co 86032 across all locations and during both years of experimentation. VSI-12121 recorded a higher average number of productive tillers (12 per plant), longer internode length (15.96 cm), greater stem girth (11.4 cm), and higher individual cane weight (1.55 kg) compared to Co 86032. These improved yield attributes played a decisive role in enhancing the overall cane yield of the variety. The average cane yield of VSI-12121 was 144.55 t ha⁻¹ during 2022–23 and 138.61 t ha⁻¹ during 2023–24, registering yield advantages of 24.27% and 22.31%, respectively, over the popular variety Co 86032. The consistent yield superiority of VSI-12121 across seasons highlights its better adaptability and stable performance under farmers' field conditions. Minor variations in yield between years may be attributed to seasonal climatic fluctuations and location-specific soil conditions. Economic analysis further substantiated the superiority of VSI-12121, which recorded higher net returns of Rs. 2,75,932 ha⁻¹ and Rs. 2,72,358 ha⁻¹ and a higher benefit–cost ratio of 3.57 and 3.35 during 2022–23 and 2023–24, respectively. The enhanced profitability was mainly due to higher cane yield with only a marginal increase in cost of cultivation. Overall, the study conclusively demonstrated that VSI-12121 is a high-yielding, economically viable, and farmer-friendly sugarcane variety, making it highly suitable for cultivation in Sangareddy district of Telangana and similar agro-climatic regions.

Keywords: Sugarcane; on farm trial; VSI-12121; yield attributes; economics.

1. Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the most important commercial and industrial crops in India, contributing significantly to the national economy through the production of sugar, jaggery, kandsari, and ethanol mentioned by Singh & Singh (2020). The crop plays a vital role in sustaining rural livelihoods by providing employment to millions of farmers, agricultural laborers, and workers engaged in sugar industries. India is among the leading sugarcane-producing countries of the world; however, productivity levels across regions vary widely due to differences in agro-climatic conditions, soil fertility, crop management practices, and varietal choice. Enhancing sugarcane productivity remains a major challenge, particularly in the context of increasing production costs, climatic variability, and declining natural resources (Rajaya et al., 2022; Heliyanto et al., 2020).

The productivity of sugarcane is largely influenced by the genetic potential of the variety, agronomic management practices, and prevailing agro-climatic conditions (Guhan et al., 2024). Among these factors, varietal potential plays a decisive role, as improved varieties possess higher yield potential, better adaptability, and enhanced tolerance to biotic and abiotic stresses. Adoption of improved sugarcane

varieties is considered one of the most effective and economically viable strategies for increasing cane yield and profitability without substantially increasing the cost of cultivation. Continuous varietal improvement and replacement of obsolete varieties are therefore essential for sustaining productivity and profitability in sugarcane-based farming systems (Wu et al., 2024; Que et al., 2024; Khan et al., 2018).

Several studies have highlighted the significance of high-yielding sugarcane varieties in improving cane productivity and economic returns. Singh et al. (2018) reported that varietal improvement has been a major contributor to yield enhancement in sugarcane, accounting for a substantial portion of productivity gains achieved over the years. Similarly, a previous study emphasized that improved sugarcane varieties exhibit superior yield performance and profitability when evaluated across different agro-climatic regions. These studies underline the importance of evaluating newly developed varieties under diverse field conditions before recommending them for large-scale cultivation.

Cane yield in sugarcane is a complex trait governed by several yield-attributing characters such as number of productive tillers, internode length, stem girth, and individual cane weight (Patra, 2023). The number of productive tillers determines the population of millable canes per

unit area, which directly influences final yield. Internode length and stem girth contribute to cane length and thickness, while individual cane weight reflects the cumulative effect of these morphological traits. An earlier study reported that varieties possessing superior expression of these yield attributes consistently produce higher cane yield and better economic returns. Therefore, assessment of yield-attributing characters is crucial for understanding the yield potential of sugarcane varieties.

On Farm Trials (OFTs), promoted by the Indian Council of Agricultural Research, serve as an important extension tool for evaluating and validating agricultural technologies under real farm conditions. Unlike research station experiments, OFTs are conducted in farmers' fields, thereby capturing the variability in soil, climate, and management practices. These trials help in assessing the performance, adaptability, and acceptability of improved varieties and technologies, while simultaneously facilitating their dissemination among farmers. A recent finding emphasized that OFTs play a critical role in bridging the gap between research and field-level adoption by generating location-specific recommendations based on farmers' feedback and performance under actual cultivation conditions.

In Telangana, sugarcane is cultivated extensively under irrigated conditions, and the variety Co 86032 has dominated cultivation for several years due to its wide adaptability and stable performance. However, continuous cultivation of a single variety over a long period poses several risks, including yield stagnation, increased susceptibility to pests and diseases, and reduced resilience to changing climatic conditions. Varietal diversification is therefore essential to minimize production risks and sustain sugarcane productivity in the region. Introduction and evaluation of new promising varieties can help overcome these limitations and provide farmers with better alternatives.

VSI-12121 is a recently developed sugarcane variety reported to possess high yield potential and desirable agronomic traits. However, its performance under farmers' field conditions in Telangana, particularly in Sangareddy district, has not been adequately documented. Evaluation of this variety through on farm trials is necessary to assess its adaptability, yield performance, and economic viability in comparison with the existing popular variety.

Hence, the present investigation was undertaken to assess the performance of sugarcane variety VSI-12121 under farmers' field conditions of Sangareddy district, Telangana, with the objective of identifying a suitable high-yielding and economically viable variety for enhancing sugarcane productivity and farmers' income in the region.

2. Materials and Methods

The on-Farm Trial (OFT) was conducted during the late rabi seasons of 2022–23 and 2023–24 in farmers' fields located at Mamidigi, Siddapurthanda, Bidekanna, and Rejinthal villages of Sangareddy district, Telangana. The district is geographically situated between 17.70°–17.80° N latitude and 77.55°–77.70° E longitude and is characterized by a semi-arid tropical climate. The region receives the majority of its annual rainfall during the southwest monsoon, while sugarcane cultivation is predominantly supported through bore well irrigation, particularly during the rabi season. The soils of the experimental fields ranged from sandy loam to clay loam in texture, which are commonly used for sugarcane cultivation in the district.

Two sugarcane varieties were evaluated in the study, namely Co 86032, which represents the prevailing farmers' practice and serves as the check variety, and VSI-12121, a promising high-yielding variety selected for demonstration. The trial was conducted at five farmer locations, with each variety planted in a plot size of 0.4 ha at each location. Planting was carried out during the second fortnight of March in both seasons under assured irrigated conditions to ensure uniform crop establishment. Well-emerged single-bud seedlings of uniform size and vigor were used for planting to minimize variability arising from planting material.

All agronomic operations were carried out in accordance with the recommended package of practices of Professor Jayashankar Telangana State Agricultural University (PJTSAU) and were followed uniformly across locations and seasons. These practices included recommended spacing, nutrient management, irrigation scheduling, weed control, and plant protection measures. Timely irrigation was provided through bore wells to meet crop water requirements, particularly during critical growth stages such as tillering and grand growth phases. Adequate plant protection measures were adopted to minimize pest and

disease incidence and to ensure normal crop growth.

Observations were recorded on important yield-attributing characters, including number of productive tillers per plant, internode length (cm), stem girth (cm), and individual cane weight (kg). These observations were taken from randomly selected representative plants at harvest. Cane yield was recorded on a plot basis at harvest and expressed in tonnes per hectare ($t\ ha^{-1}$). The mean values of observations recorded at different locations were used for analysis and interpretation.

An economic analysis was carried out to assess the profitability of the evaluated varieties. The cost of cultivation was calculated based on actual field expenses incurred for inputs and operations during the respective seasons. Gross returns were computed by multiplying cane yield with the prevailing market price of sugarcane, while net returns were calculated by deducting the cost of cultivation from the gross returns. The benefit-cost (B:C) ratio was worked out to compare the economic feasibility of the two varieties. The data generated through the On-Farm Trial were analyzed using simple averages and percentage increase over the check variety to assess the performance of VSI-12121 under farmers' field conditions.

3. Results and Discussion

3.1 Yield Attributing Parameters

Yield-attributing characters are crucial determinants of cane yield in sugarcane, as they directly influence the population of millable canes and individual cane weight. The performance of the promising sugarcane variety VSI-12121 with respect to yield-attributing parameters in comparison with the popular variety Co 86032 is presented in Table 1. Across all locations, VSI-12121 consistently recorded superior values for all the observed yield attributes, clearly demonstrating its higher genetic potential under farmers' field conditions. Minor variations in yield between years may be attributed to seasonal climatic fluctuations and location-specific soil conditions

The average number of productive tillers per plant was significantly higher in VSI-12121 (12 tillers) compared to Co 86032 (7 tillers). Productive tillers directly contribute to the number of millable canes per unit area, and hence, varieties with higher tillering ability

generally produce higher cane yield. The higher tiller production in VSI-12121 may be attributed to its better early vigor and efficient utilization of available soil moisture and nutrients. Similar improvements in tiller production with improved sugarcane varieties were also reported by Singh et al. (2018), who emphasized the role of varietal improvement in enhancing cane population.

Internode length showed a marked variation between the two varieties. VSI-12121 recorded a higher average internode length (15.96 cm) compared to Co 86032 (11.04 cm), Table 1. Longer internodes contribute to increased cane length and biomass accumulation, which ultimately results in higher individual cane weight. In addition, stem girth was significantly higher in VSI-12121 (11.40 cm) than in Co 86032 (9.84 cm). Increased stem girth is an important morphological trait that enhances cane weight and juice content, comparing the averages.

Consequently, the individual cane weight of VSI-12121 (1.55 kg) was substantially higher than that of Co 86032 (1.14 Kg), Table 1. The combined effect of higher tiller number, longer internodes, and thicker stems resulted in superior expression of yield attributes in VSI-12121. These findings are in agreement with earlier study, who reported that sugarcane varieties possessing better yield-attributing characters invariably record higher cane yield and economic returns. The consistent superiority of VSI-12121 across all the locations *via.*, Mamidigi, Siddapurthanda, Bidekanna, and Rejinthall villages of Sangareddy district, Telangana. indicates its adaptability and stability under varying field conditions.

3.2 Cane Yield

The cane yield performance of the two sugarcane varieties during 2022–23 and 2023–24 is presented in Table 2. VSI-12121 recorded significantly higher cane yield than Co 86032 across all locations and during both years of experimentation, indicating its consistent and stable performance under farmers' field conditions.

During the 2022–23 season, the average cane yield of VSI-12121 was $144.55\ t\ ha^{-1}$, whereas Co 86032 recorded an average yield of $116.28\ t\ ha^{-1}$. This resulted in a yield advantage of 24.27% over the check variety. Similarly, during the 2023–24 season, VSI-12121 recorded an average yield of $138.61\ t\ ha^{-1}$, compared to

113.33 t ha⁻¹ in Co 86032, registering a yield advantage of 22.31%. The yield increases of VSI-12121 across locations ranged from 21.07% to 28.18%, highlighting its superior yield potential.

The higher cane yield recorded by VSI-12121 can be directly attributed to its superior yield-attributing characters such as higher productive tillers, longer internodes, greater stem girth, and higher individual cane weight. These traits collectively enhanced the number of millable canes and biomass production per unit area. Minor variations in yield across locations and years may be attributed to differences in soil fertility, irrigation availability, and micro-climatic conditions prevailing at individual farmer fields (Castro et al., 2019).

The consistent yield superiority of VSI-12121 across seasons indicates its better adaptability and resilience under the agro-climatic conditions of Sangareddy district. These findings corroborate the results of recent findings, who reported significant yield advantages of newly

introduced sugarcane varieties over existing popular varieties when evaluated under on-farm conditions. The results clearly demonstrate the importance of varietal replacement in sustaining and enhancing sugarcane productivity.

3.3 Economics

Economic feasibility is a critical factor influencing farmers' adoption of new varieties. The economic analysis of the sugarcane varieties is presented in Table 3. VSI-12121 recorded higher, gross cost, gross returns, net returns, and benefit–cost (B:C) ratio compared to Co 86032 during both years of the study, clearly establishing its economic superiority.

During 2022–23, VSI-12121 recorded a net return of Rs. 2,75,932 ha⁻¹ with a B:C ratio of 3.57, whereas Co 86032 recorded a net return of Rs. 2,03,192 ha⁻¹ with a B:C ratio of 2.93. Similarly, during 2023–24, VSI-12121 recorded higher net returns (Rs. 2,72,358 ha⁻¹) and a higher B:C ratio (3.35) compared to Co 86032 (Rs. 2,03,274 ha⁻¹ and 2.78, respectively).

Table 1. Yield attributing parameters of promising sugarcane varieties (cumulative average of two years 2022-2023 and 2023-2024)

Location	Variety	No. of productive tillers/plant	Internode length (cm)	Stem girth (cm)	Individual cane weight (kg)
Loc 1	Co 86032	8	11.4	10.1	1.29
Loc1	VSI-12121	14	18.1	12.1	1.71
Loc 2	Co 86032	6	11.6	9.6	1.17
Loc 2	VSI-12121	11	14.6	11.4	1.46
Loc 3	Co 86032	7	10.9	10.0	1.09
Loc 3	VSI-12121	12	15.2	11.0	1.57
Loc 4	Co 86032	7	10.5	9.8	1.07
Loc 4	VSI-12121	11	16.3	11.2	1.52
Loc 5	Co 86032	7	10.8	9.7	1.12
Loc 5	VSI-12121	12	15.6	11.3	1.53
Average	Co 86032	7	11.04	9.84	1.14
Average	VSI-12121	12	15.96	11.40	1.55

Table 2. Yield of promising sugarcane varieties during 2022–23 and 2023–24 in different locations

Location	2022–23 Co 86032 (t ha ⁻¹)	2022–23 VSI-12121 (t ha ⁻¹)	Yield increase (%)	2023–24 Co 86032 (t ha ⁻¹)	2023–24 VSI-12121 (t ha ⁻¹)	Yield increase (%)
Loc 1	120.62	154.62	28.18	118.94	145.10	21.99
Loc 2	112.50	138.30	22.93	111.14	136.25	22.59
Loc 3	114.87	141.60	23.26	113.85	137.84	21.07
Loc 4	117.95	144.50	22.50	109.62	135.72	23.80
Loc 5	115.48	143.75	24.48	113.12	138.16	22.13
Average	116.28	144.55	24.27	113.33	138.61	22.31

Table 3. Economic parameters of sugarcane varieties

Year	Variety	Gross cost (Rs ha ⁻¹)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	B:C ratio
2022–23	Co 86032	1,04,950	3,08,142	2,03,192	2.93
2022–23	VSI-12121	1,07,125	3,83,057	2,75,932	3.57
2023–24	Co 86032	1,14,050	3,17,324	2,03,274	2.78
2023–24	VSI-12121	1,15,750	3,88,108	2,72,358	3.35

Although the cost of cultivation of VSI-12121 was marginally higher than that of Co 86032, the substantially higher cane yield resulted in increased gross and net returns. The higher profitability of VSI-12121 makes it more attractive to farmers and enhances its potential for large-scale adoption. These findings are in line with the observations of Singh et al., (2019), who reported that high-yielding sugarcane varieties provide better economic returns even with slightly higher input costs.

Overall, the economic analysis clearly indicates that adoption of VSI-12121 can significantly improve farm income and profitability, thereby contributing to the economic sustainability of sugarcane cultivation in Sangareddy district.

4. Conclusion

The on-Farm Trials conducted during 2022–23 and 2023–24 confirmed the superior performance of sugarcane variety VSI-12121 over Co 86032 under the agro-climatic conditions of Sangareddy district, Telangana. VSI-12121 recorded higher yield-attributing characters, resulting in significantly higher cane yield and improved economic returns with a superior benefit–cost ratio. The consistent yield advantage and profitability of VSI-12121 indicate its suitability for cultivation under assured irrigated conditions. Hence, the variety can be recommended for large-scale adoption to enhance sugarcane productivity and farmers' income in the region. Further studies on ratoon performance, juice quality parameters, and long-term adaptability across diverse agro-ecological zones are suggested.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

Competing Interests

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<https://pr.sdiarticle5.com/review-history/152121>