

# Advanced seed multiplication and planting techniques for sustainable sugarcane

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*Sugarcane is an important industrial crop for sugar and ethanol production, but its conventional propagation through three-bud setts is bulky, costly, and prone to disease transmission. Advanced seed multiplication methods such as tissue culture, bud chip, cane node, and spaced transplanting address these challenges by reducing seed requirement, ensuring disease-free planting material, and enhancing rapid varietal replacement. Combined with improved planting techniques like trench, FIRB, and ring pit method, these innovations increase productivity, resource efficiency, mechanization, and sustainability in sugarcane cultivation.*

**Keywords:** Bud Chip, Seed multiplication, Sugarcane, Tissue culture

**SUGARCANE** (*Saccharum officinarum x spontaneum* L.) is a versatile crop primarily used for sugar production. Furthermore, its role has extended to being a vital raw material for ethanol generation. Traditionally, sugarcane is propagated through three bud setts in a conventional system. Nonetheless, this approach presents intricate challenges in seed production, along with the cumbersome processes of transportation, exchange, and replacement. These difficulties arise from the reliance on vegetative propagation and the substantial quantities of planting material required. One of the major expenses in sugarcane production is the seed cane, which is required in substantial quantities. In the conventional propagation system through sett cutting, the seed multiplication ratio is about 1:10, meaning 1 hectare of seed crop yields enough seed cane to cover 10 hectares. A good seed cane should be healthy, free from pests and diseases, with high moisture content and rich reserves of invert sugars and soluble nitrogen compounds. Choosing seed cane with these qualities is essential for ensuring strong germination and high productivity in sugarcane.

For replacing old, deteriorated, or de-notified varieties with improved ones, a well-structured seed production chain is required. Since new varieties demand quick dissemination, rapid multiplication methods such as bud chip, cane node, and tissue culture techniques are commonly employed to accelerate their replacement. To fully harness the potential of newly evolved sugarcane varieties, it is essential to deploy them in suitable niches.

Early maturing varieties like CoLk 14201, CoLk 16202, CoLk 15466, CoLk 15201, Co 15023 and CoS 13235 are gaining popularity among farmers and may replace red rot susceptible varieties. The introduction of new seed multiplication methods can reduce the bulkiness of seeds and make transportation easier. Using genetically pure and disease-free seed cane alone is expected to improve stalk yield by 10–15%. Quality seeds are essential for realizing the full benefits of other inputs such as manures, fertilizers, water, land, and labour. The cost of seed cane and the quantity of seed material required for planting account for approximately 20% of the total cultivation cost. By using bud chip settlings along with improved production technology for nursery management, transplanting methods and timing, plant spacing, weed control, nutrient requirements, irrigation scheduling, and optimum time for cane harvesting, farmers can achieve a good cane yield of 100 t/ha. Adopting the bud chip method of sugarcane cultivation can save nearly 80% of the stalk material used for planting, which can be utilized for other purposes like consumption. The budchip technology has shown promising results, providing higher cane yield compared to the conventional method of planting with three-bud setts. The bud chip technology resulted in a 13.86% higher cane yield over the conventional method. The cane-node method is an innovative approach designed for the priming of sugarcane seed material, along with its systematic packaging, transport, certification, and placement in the field. This technique ensures rapid

germination and contributes to higher cane yields. In this method, a small stem section containing a single bud, the root band, and about an inch of internode on either side is used as the planting material.

The adoption of innovative seed multiplication methods, coupled with the integration of refined production technologies for improved new sugarcane varieties can significantly enhance seed production and seed yield. Such advancements stand to significantly enhance the overall productivity and sustainability of sugarcane cultivation.

#### Major problems in conventional sugarcane seed production system

- **Low seed multiplication rate:** Conventional sugarcane seed production relies on the vegetative propagation of sugarcane through stem cuttings, resulting in a relatively slow multiplication rate. New methods that can accelerate seed multiplication could significantly increase the availability of planting material and lead to the more rapid establishment of new sugarcane crops.
- **Disease transmission:** Conventional seed multiplication methods may contribute to the spread of diseases, as pathogens can be transmitted through infected planting material. Developing new techniques that ensure disease-free planting material is crucial in maintaining healthy sugarcane crops and preventing widespread disease outbreaks.
- **Space and labour-intensive:** Conventional sugarcane seed production often requires large areas of land and significant labour inputs for planting, maintenance, and harvesting of the crop. Novel approaches that utilize alternative growth substrates, automated systems, or tissue culture techniques could help reduce space and labour requirements while increasing efficiency.
- **Inefficient use of resources:** Current seed multiplication systems might be inefficient in terms of water and nutrient use. New methods that optimize resource utilization and minimize waste could lead to more sustainable and environmentally friendly sugarcane production.
- **Lengthy production cycle:** Traditional seed multiplication techniques often have long production cycles before the sugarcane is ready for commercial planting. Shortening the multiplication cycle through innovative methods could help meet the increasing demand for sugarcane and accelerate the release of new improved varieties.
- **Limited access to quality planting material:** In some regions, farmers may face challenges in accessing high-quality sugarcane planting material due to limited availability. Introducing new seed multiplication techniques that can be easily adopted at the farm level could enhance accessibility and affordability for small-scale farmers.

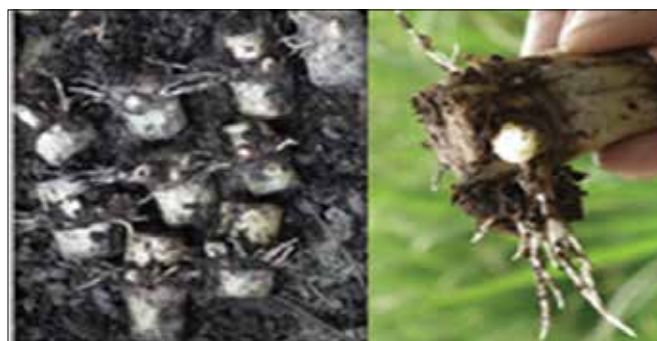
Adopting new seed multiplication methods can address the major gaps in conventional sugarcane seed production, leading to more efficient, disease-resistant, and climate-resilient sugarcane crops.



Bud chip technology

#### Advance seed multiplication methods

- **Tissue culture (micropropagation):** Tissue culture produces plantlets from meristematic tissues or nodal segments under aseptic laboratory conditions. To lower costs for smallholder supply chains, many programmes use tissue culture to produce foundation material that is then multiplied using field-level methods (single-bud planting, nurseries). Its advantages are: 1) Produces pathogen-free plantlets (meristem-tip cultures eliminate systemic viruses and many bacteria/fungi), 2) Extremely high multiplication rates (one explant can yield thousands of plantlets within months), 3) Enables purification of elite clones and rapid propagation of newly released varieties.
- **Bud chip technology:** Bud chip technology (also called Single-bud propagation) plants one bud per unit instead of traditional 2–3 bud sets. Bud chips are cut from healthy, disease-free cane through bud chip cutter, treated (fungicide/insecticide), and planted in sterile media in trays or polybags. After 6–8 weeks, once shoots and roots develop seedlings are hardened and transplanted. Its advantages are: 1) Reduces seed requirement by up to 60–80% compared with conventional sets, 2) Promotes rapid expansion of a nucleus area of high-quality planting material, 3) Works well with nursery-based raising (polybag/tray systems) and transplanting.
- **Cane node technology:** In this technique, a cane node containing a healthy bud is selected and placed in a slurry made from decomposed farmyard manure (FYM) maintained at about 60% moisture. The



Cane node technology



Seedlings ready for STP

nodes are incubated in this medium for 4–5 days inside a container, during which the buds begin to sprout. Once sprouting occurs, the germinated buds are carefully transported to the field and planted in furrows. This approach promotes rapid and uniform bud sprouting, ensures convenient handling and transport of planting material, and reduces the bulkiness of seed cane. Using the cane-node method, only about 1–2 tonnes of seed material are required to plant one hectare, making it far more efficient than conventional seed cane usage.

- **Space transplanting technique (STP):** Spaced transplanting in sugarcane involves raising seedlings from single-bud setts or bud chips in a nursery for 25–35 days and then transplanting them into the main field at wider spacing (90×90 cm or 120×60 cm). This method saves seed material (1–1.5 tonnes vs. 6–8 tonnes in conventional planting), ensures uniform crop stand, promotes better tillering, facilitates intercropping and mechanization, and reduces pest/disease incidence. Though it requires initial nursery management and careful transplanting, it enhances productivity and efficiency.

**Table 1.** Seed multiplication through advanced seed multiplication method

Planting techniques	Conventional Method	STP (Space transplanting)	Bud chip	Cane node technology
Seed requirement (q/ha)	60–70	20	8–10	8–10
Seed multiplication ratio	1:10	1.40	1:60	1:60
Initial Investment: 4–5 lakhs				
Profit: 10–15 lakhs per season (80 paise to 1 ₹ investment for per plantlet and 4–5 ₹/plantlet gain)				
<ul style="list-style-type: none"> <li>• Sugarcane conventional cultivation: 1.5 lakh profit</li> <li>• Seed production: 3–4 lakh</li> </ul>				

### Planting techniques

The method of planting should be designed to promote extensive root growth and penetration into the soil profile, allowing the crop to make optimal use of available nutrients and moisture for better productivity. To reduce labour intensity in field operations particularly

harvesting and intercultural practices, wider row spacing is advised. In the sub-tropical zone, row spacing of 120 cm or 30:150 cm is recommended to enable mechanized harvesting while sustaining high cane yields. In tropical regions, a spacing range of 120–150 cm proves more suitable, as it supports mechanization and ensures good yield levels.

- **Flat planting:** It is the most common and traditional method of planting, mainly practiced in areas with adequate irrigation. In this technique, well-prepared and leveled fields are used, and furrows are opened about 8–10 cm deep. Healthy cane setts of two or three buds are placed horizontally in the furrows, end to end, and then covered with soil. Row spacing is generally 75 cm. This method is simple, requires less labour, and ensures quick and uniform germination.
- **Trench method:** The trench method of planting is recommended to achieve higher yields in both plant and ratoon sugarcane crops. This system helps prevent lodging and performs well even in light soils. The ICAR-ISRI, Lucknow has developed a mechanized version of trench planting with the key features: 1) Trenches are prepared 30 cm wide and 25–30 cm deep, 2) A spacing of 120 cm (90 cm + 30 cm) is maintained from center to center between two trenches, 3) A trench planter is used for mechanized sowing of sugarcane setts in a paired-row pattern.
- **Furrow irrigated reduced bed planting:** At IISR, an innovative Furrow Irrigated Raised Bed (FIRB) system has been developed to minimize cane yield reduction under late planting conditions. In this approach, 2–3 rows of wheat are sown on raised beds during October–November, while sugarcane is planted in the furrows at its optimum season of February–March. The recommended bed configuration is 50-30-50 cm. This method ensures that sugarcane receives sufficient time for tillering and grand growth, while both crops benefit from timely planting and an improved rhizosphere environment. As a result, the yields of wheat as well as sugarcane are enhanced.
- **Ring pit planting (No-tiller technology):** In this method, sugarcane tillering is minimized while encouraging the vigorous growth of mother shoots, resulting in a higher number of millable canes with greater length and weight. This approach, commonly referred to as “No-Tiller Technology”,



FIRB method of planting



Ring pit method of planting

involves digging pits of 75–90 cm in diameter and about 30 cm deep using a mechanized pit digger.

Depending on spacing, nearly 9000 pits/ha (at 105 cm spacing) or 6900 pits/ha (at 120 cm spacing) are created, with the excavated soil placed around the rim of each pit. For planting, 20 treated 2-bud or 3-bud setts are arranged radially inside each pit, resembling the spokes of a wheel. To promote healthy establishment, *Trichoderma* (20 kg/ha) mixed with 200 kg FYM or press mud is applied over the setts, along with the recommended dose of manures, fertilizers, and crop protection chemicals. During intercultural operations, the dug-out soil is gradually refilled into the pits up to a depth of 5–7 cm. This technique significantly improves resource efficiency enhancing cane yield by 1.5–2 times, increasing water use efficiency by 30–40%, and improving nutrient use efficiency by 30–35%.

**Table 2.** Planting techniques and their characteristics

Planting Techniques	Characteristics
Flat Planting	75 cm wide bed and shallow furrow of 8–10 cm deep
Trench planting	Trenches are prepared with a width of 30 cm and a depth of 25–30 cm A 120 cm spacing is maintained from center to center between trenches (configured as 90 cm:30 cm) Sugarcane setts are planted mechanically in a paired-row pattern using a trench planter
Ring pit planting	Pits of 75–90 cm in diameter and 30 cm deep are created using a mechanized pit digger. About 9,000 pits/ha (105 cm spacing) or 6,900 pits/ha (120 cm spacing) are prepared, maintaining center-to-center distances. The excavated soil is placed around the edges of each pit, and fifteen treated 2-bud setts are arranged inside each pit in a radial pattern, similar to the spokes of a wheel.
Furrow Irrigated Raised Bed (FIRB) technique	Wheat is sown in 2–3 rows on raised beds during October–November, while sugarcane is planted later in the furrows at its ideal planting time (February–March). The raised bed system follows a 50–30–50 cm configuration.

**SUMMARY**

Adopting innovative seed multiplication and planting techniques ensures efficient resource use, rapid varietal replacement, and higher yields. These advancements lower costs, save seed material, enable mechanization, and support sustainable, profitable sugarcane cultivation.

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