

# **How to produce healthy seed material and improve planting for increasing the productivity of sugarcane in Punjab state**

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## **Introduction**

Sugarcane cultivation and the development of a sugar production industry run in parallel to the growth of human civilisation and are as old as agriculture. In addition to being the third most important cash crop in India, sugarcane ranks third in the list of most-cultivated crops, coming after paddy and wheat. India is one of the largest sugarcane producers in the world, producing around 300 million tons of cane per annum. The production of sugar is the second largest agro-processing industry in the country, after cotton and textiles. India has more than 566 sugar mills.

About 4 million sugarcane farmers and a large number of agricultural labourers are involved in sugarcane cultivation and ancillary activities, constituting 7.5% of the rural labor force. In addition, the industry provides employment to 500,000 skilled and semi-skilled workers in rural areas. The sugar industry thus is a focal point for socio-economic development in rural areas, mobilizing rural resources, generating employment and higher incomes, and supporting the development of transport and communication facilities.

## **The Sugar Cane Sector in Punjab**

The state of Punjab has sub-tropical weather conditions with severe cold during the period December-January and scorching heat during May-June. Thus, the climate of Punjab is suitable for optimum growth of sugarcane crop only during the period July-October, after which time there is a drop in temperature which induces sugar accumulation and ripening.

During the growing season, the climatic conditions for sugarcane cultivation in Punjab are almost as conducive as in tropical areas. Sugar production provides an alternative to the widely adopted wheat-paddy cropping system. Development of improved varieties and new crop production methods plus improved plant protection and cane processing technologies have played a vital role in promoting sugarcane cultivation and expansion of the sugar industry.

During 1965-66, there were 5 sugar mills in Punjab state with crushing capacity of 4,950 tonnes of cane daily (TCD). At present, 23 sugar mills are working, of which 16 are in the cooperative sector and 7 in the private sector. Seven sugar mills in the cooperative sector are closed since 1995-96 due to a shortage of sugarcane. The total crushing capacity of the 23 sugar mills is 57,016 TCD. For

successful maximum running of these mills, 2.30 lakh ha area is required, but at present only 90,000 ha of area is under sugarcane.

The total area under sugarcane declined in 2009-10 to 63,000 ha, from 81,000 ha the year before, with an average productivity of 59.89 tonnes per hectare. The total cane crushed by the mills during 2009-10 was 175,000 tonnes compared to 250,000 tonnes the year before.

The recovery rate from Punjab's sugarcane is about 9.5%, compared to 12-13% in southern India, which is a cause of concern for mill owners. This is a major reason for the mills' lower output. The productivity of the sugar sector in Punjab is not currently very encouraging owing to various factors, e.g.:

- Farmers are sourcing poor quality seed cane from other farmers, which results in low cane production
- Rising costs of cultivation are a discouragement for innovation
- Increasing labour shortages
- Improper cultivation practices, like the usage of poor quality setts
- High sett rate per hectare
- Inappropriate water and nutrient management measures
- Unbalanced use of fertilizer

To increase output and profitability in the sector, there is need to increase on-farm production and productivity of cane and to increase the recovery rate of sugar in mills. Also, there is need to improve the efficiency and to reduce the costs of cultivation by adopting the latest technologies; to have rapid multiplication of disease-free seed of new, improved varieties of sugarcane; and to safeguard the interests of cane growers and the sugar industry by saving cane that could be used for seed purposes.

The expected area under sugarcane will be 94,000 ha during the crushing year 2010-11. Out of this, around 55,000 ha are under newly planted crop, and the rest is under ratoon crop, regrown from previous planting. For the planted crop, farmers have used about 550,000 tonnes of seed worth about US\$ 40 million (Rs. 165 crore@ Rs. 300/- per quintal). To produce 550,000 tonnes of cane seed for planting, about 9,166 ha area is required. From the above, one can see that farmers are currently using a huge quantity of seed which could be saved by alternative techniques which economise on planting material.

The normal practice in many parts of the world is to use sugarcane produced for commercial purposes also for seed purposes. Characteristics for good seed qualities are seldom taken into consideration. Many growers do not consider seed quality, and many of those who do, select the seed cane only at the sett cutting and planting stage. This is not enough. If a grower wants to

be sure of getting good, disease-free seed cane, he should raise the seed crop separately. This crop should be kept completely free from pests and diseases by constant field scouting through the whole season. Moreover, seed quality is not just a matter of being free from pests and diseases. Seed has to have high water content and good nutritional status.

Neglect in raising a good seed crop is one of the major defects in sugarcane cultivation all over the world. Deriving sugarcane seed from the commercial crop has been responsible for rapid multiplication of a large number of diseases like red rot, wilt, smut, ratoon stunting, and grassy shoot. These adversely affect the cane yield and quality. Raising healthy and vigorous sugarcane crops for seed purposes is essential and recommended.

The Sustainable Sugarcane Initiative (SSI) being supported by the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and the Worldwide Fund for Nature (WWF) is one such approach that offers some solutions to these mounting problems through a set of principles and practices that 'produce more with less,' getting more output with reduced inputs.

### **Sustainable Sugarcane Intensification (SSI)**

The management practices proposed in this approach could help farmers by reducing their costs of cultivation while enhancing their crop productivity in a sustainable manner. We would like to bring to everyone's attention to the groundbreaking insights for sugarcane cultivation with farm-based approaches that pursue a strategy for getting 'more with less' in agriculture. Such approaches are also showing good results with wheat, ragi (finger millet) and others crops, applying the concepts and principles of the System of Rice Intensification (SRI).

This breakthrough method we anticipate will bring a sea change in the way that sugarcane cultivation is done in India and the world over. It will increase the profitability for the farmers significantly while reducing inputs – water, fertilizer, seed material – thereby improving the productivity of water, land, labour, and capital expenditure. The sugarcane industry will also benefit from huge profits deriving from better sugarcane quality and recovery.

This method of better management practices in sugarcane cultivation involves use of **less seeds** and **less water**, and reduced by optimizing utilization of fertilizers and land. It can achieve more yields and profits for farmers and millers alike. SSI is an alternative to the conventional seed, water and space-intensive sugarcane cultivation that is presently practiced by millions of farmers across the country.

The constituent elements of SSI are:

1. Raising young cane plants in a nursery using small chips taken from the cane, each with a single bud, and growing them out individually in cups. This allows the cane itself to be used for sugar extraction, rather than being put into the soil to sprout as is the practice now.
2. Transplanting these seedlings while still young (25-35 days old) once they have emerged and stabilized.
3. Maintaining wide spacing between plants (4 x 2 feet) in the main field when doing the transplanting.
4. Providing sufficient moisture to the crop, but avoiding inundation of water.
5. Encouraging soil health and fertility by adding organic material to the soil for nutrient enhancement, plant protection, and other inter-cultural practices.
6. Practicing intercropping with other crops, such as onion, garlic and lady fingers, for more effective utilization of land, which also enhances the health and fertility of the soil.

The Punjab Department of Agriculture initially nominated 4 farmers for SSI training in January 2009. This was organized by ICRISAT at Pattanchur, Hyderabad, under the ATMA program. After this training, DOA organized demonstrations in the field by these trained farmers in District Gurdaspur, under the auspices of ATMA. One demonstration was also organized in the field of the State Minister of Agriculture, Hon. Sucha Singh Langah. The sugarcane used were varieties CoJ85 and CoJ89.

### **Practices Used**

**Nursery:** For growing seedling materials, various materials and tools are needed, like a bud chipper, plastic trays, coco-pith and sawdust as planting material, vermicompost and/or bio-gas plant slurry or farmyard manure (FYM), polythene sheets, and trash cans and watering cans (rose cans). For the nursery, an area of 100 square meters (4 marla) is used for one hectare of field. This is covered with a shading net to provide shade to the young plants and to create more favorable conditions for growth, like a warm and wind-free environment. Five quintals (just half a ton) of healthy, disease-free, 7-9 month old canes were required for establishing one acre of field.

Out of this, only the buds are taken. They are separated from the cane with the help of a specially-designed machine that is called **bud chipper**. (Figure 1) Damaged, split and sprouted buds were discarded when chipping. The weight of chipped buds is about 85 kg (<5% of the cane weight). The rest of the canes can be sold to sugarcane juice venders. The chipped buds were treated with chemical solution to prevent any disease infestation in the resulting plants and were filled into gunny bags. A plastic sheet was spread in a corner of the shaded net shed, and sugarcane trash/rice straw was spread evenly on it.



Figure 1: Bud chipper implement for cutting out buds from sugar cane

Some water was sprinkled over the material. Chemical-treated gunny bags were laid flat, side by side, on the trash, and the buds were spread inside the bags evenly using hands. One more layer of trash was spread above the moist gunny bags, and water was sprinkled over it. The entire packs were covered with a polythene sheet. The buds were kept in this position for 5-6 days for pre-sprouting. After the 6<sup>th</sup> or 7<sup>th</sup> day, the gunny bags were opened and the well-sprouted bud chips were transferred to be put into in the trays.

The cavities of plastic trays were half-filled with a mixture of sawdust, coco-pith and vermin-compost. Then they were fully filled with more mixture after placing well-sprouted buds in cavities, one per hole, without pushing firmly downward. After filling, all the trays were spread inside the net shed, and a plastic sheet was placed over them for 2 days by tightly covering for avoiding entry of water, air or sunlight into the trays. Based on the moisture content of coco-pith, watering to the trays (seedlings) was done in the evenings for the next 25 days, using rose cans.

After appearance of two leaves, the application of water was increased gradually, depending on the moisture level in trays. About 30-35 days after sowing of the nursery, transplanting was done at spacing of 4 ft x 2 ft. Fertilizer was used as

per recommendation. Irrigation water was applied in furrows rather than by inundating the whole field. This resulted in saving of a huge quantity of water

**Crop Protection:** In the field, attack of stalk rot was noticed in the case of CoJ85 variety, which was controlled by rogueing (removal) of the affected plants. CoJ89 variety was not affected. No other insect or disease was reported during the whole life cycle of the crop. By this method, healthy, thick, disease-free canes were produced which were used for seed purposes as neighboring farmers were very interested in getting this disease-free sugarcane crop for themselves.

**Results:** With variety CoJ85, 357 quintals per acre of seed was produced, and 325 quintals in the case of variety CoJ89. During the 2009-10 crop year, 5 farmers cultivated sugarcane with this new method. Where there was lack of shading net or unavailability of cocopith, the nursery failed, or cane growth was poor. The growth of nursery was very good when it was sown under a shading net. The number of millable canes was more, 10-25 per plant, in the case of SSI as compared to conventional method, 5-13 canes per plant.

**Economic Considerations:** In sugarcane cultivation, seed is the main input cost, amounting to Rs. 25,000-30,000 per ha. The cost of seed can be greatly reduced by producing seed in a special seed nursery as described above. For this, farmers can be motivated by a subsidy on shading net, cocopith, vermicompost units, and plastic trays, so that farmers can easily adopt this technique because they are usually hesitant to purchase new inputs.

If farmers can be motivated to produce their seed by SSI methods, the costs of production can be reduced and a disease-free crop can be produced which results in higher productivity of sugarcane in Punjab state. See Table 1 below for a comparison of the two methods:

Table 1: Calculations and comparisons for sugarcane crop establishment

No.	Particular	Conventional practice	SSI Practice	Saving (%)
1	Current rate of seed/ha (kg)	8,700-10,000	165-200	95
2	Cost of seed/ha (Rs.)	26,000-30,000	13750	53
3	Seed requirement for state (tons)	564,220	84,633	85
4	Seed cost for state (Rs. crores)	169.26	25.38	85
5	Area for seed requirement (ha)	9,466	1,410	85

Notes for this table are given at end of this report

A summary comparison between conventional and SSI methods of cultivation is provided in Table 2 on the next page.

Table 2. Comparison between conventional and SSI methods of cultivation

Particulars	Conventional method	SSI method
Seeds/sets	20,000 sets with 3 buds each	13,750 plants from single buds
Weight of cane needed	87-100 qtl/ha	1.50-2.0 qtl/ha
Nursery preparation	No	Yes
Measures to maintain uniformity in plants	No grading	Grading is done during nursery
Fertilizer	Urea DAP MOP	130 kg As per soil test report No
		225 kg 50 kg 20 kg
Planting	Sets in furrow	Plants in furrow
Spacing	1.5 x2.5 ft (25 per 100m <sup>2</sup> )	4x2ft (12.5 per 100m <sup>2</sup> )
Water requirement	More (flooding irrigation)	Less (furrow system)
Mortality among plants	High	Low
No. of tillers per plant	5-10 (125-250 per 100m <sup>2</sup> )	10-25 (125-312 per 100m <sup>2</sup> )
No. of millable canes	4-5	10-15
Accessibility to air and sunlight	Low	High
Scope for intercrop	Less	More

**Benefits observed by farmers:**

- Less seed is required (a 95% reduction)
- Better germination percentage of seed material
- Reduced plant mortality rate in the main field
- Easier transport of the young seedlings for a longer distance
- Intercultural operations can be carried out easily with a power weeder due to wider spacing
- More accessibility for the plants to air and sunlight, which results in stronger root systems and more millable cane
- Reduction in lodging due to earthing up and better root growth
- Increase in length and weight of individual canes (1.5-2.5 kg each)
- Higher number of millable canes (137,500 to 150,000 canes per hectare)
- Optimum land utilization by intercropping
- Suitable for rapid multiplication of seed

**Constraints:** Farmers have also identified some difficulties that they encounter when using SSI methods at this stage of its development:



- Unavailability of cocopith and plastic trays at local level; there is no local supply network in place to meet the demand for such materials.
- SSI needs more attention as farmers should not just plant and ignore their crop; the increased attention pays off in higher yield, but farmers need to adjust their expectations and practices accordingly.
- Psychology and mind set: the idea of reducing inputs and getting more output is quite counter-intuitive, so there are mental adjustments that need to be made.

### Summary Data

Total area under sugarcane cultivation:	90,000 ha
Area under ratoon crop:	33,578 ha
Area under planted crop:	56,422 ha

**Intercropping:** For optimum utilization of land, some crops like wheat, onion, garlic, tomato and lady finger are planted with the autumn sugarcane crop in between the rows of sugarcane. In the spring or summer planted crop, moong bean, mash and tomato are sown. This practice will give extra benefits to farmers. Figure 2 shows an intercropped SSI field.



Figure 2: Five crops planted simultaneously with sugarcane in SSI method of sugarcane cultivation



### Notes for Table 1:

1. Although about 1.50 tons of seed cane are needed per ha initially with SSI, only about 150 kg of this is only used, in the form of bud chips. The remaining canes can be sold for crushing. Hence, the seed rate mentioned here is 165-200 kg per acre, with the saving of more than 95%.
2. Cost of seed can be calculated by comparing normal seed cost per ha vs. cost of seedlings required per ha in SSI. In this case, about 13750 seedlings are needed per ha, allowing for 15% mortality in SSI during nursery and main field. So, a farmer needs to invest only Rs. 13750 per ha (@Rp.1 per seedling) compared to about Rs. 28,000 per ha in normal method (10 tons @ Rs. 2,800 per ton on average). This saves about 56% of the cost. This is based on following 4x2 feet spacing. The percentage of saving may be reduced in case of going for closer spacing.
3. The seed requirement for the state is calculated based on the assumption that initially 1.5 tons of seed cane are needed per ha, hence, 84,633 tons (56,422 ha x 1.5 t). However, as mentioned earlier, about 95% of the canes will go back to the factory for crushing, and this benefits the state by increasing the net tonnage crushed per season.
4. The above-mentioned explanation applies to the seed cost saving for Punjab state also.
5. Same as above