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SUSTAINABLE SUGARCANE INITIATIVE : BETTER OPTION FOR CANE PRODUCTION

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ABSTRACT
A new methodology has been developed for better cane production in order to maintain the productivity level and to stabilize India's rank in production on global market. This new technique is name as SSI. Under limited water supply, growth and productivity of some long duration crops like sugarcane was adversely affected. This chipping and chip planting method can curtail seed cost by 20000 to 25000 per ha that is direct benefit to the farmers. SSI improves the productivity of cane, efficiency of water use, land and labour. At same time it reduces the overall pressure on water resources, resulted in about 20 % higher yields. So, SSI is a better alternative to conventional sugarcane cultivation.

INTRODUCTION

Water is increasingly becoming a major limiting factor for agriculture, especially where irrigated crops and dry land agriculture were intermixed. Often in the same watershed, both irrigated crops such as rice and sugarcane exist with dry land crops such as sorghum and millets. In such circumstances, the impact of irrigated crops on dry land agriculture is significant, particularly in semi-arid regions, where irrigation is primarily based on ground water resources, leading to decline in ground water table and adversely reducing the productivity of crops. Further, the erratic trends in rainfall enormously raise the complexity in water issues. Thus, we need to explore every possible approach to reduce the water input to all crops, particularly those which excessively depend on scarce resources. Now a day's farmers are facing multiple problems in sugarcane cultivation. Water is one of the primary constraints in sugarcane cultivation which affects the productivity and profitability of sugarcane growers and millers. So, until or unless the farmers of India were not provided with better technology in cane production with limited use of water, the country will face difficulties to fulfill the growing sugar demand.

Generally sugarcane is vegetatively propagated in commercial cultivation. The stalk forms the basic seed material. The stalks are cut into small pieces that consist of two to three buds. When the stalk piece carries more than one bud the general phenomenon of apical dominance play its role. The terminal bud germinates rapidly and inhibits the development of lower buds. This results in lowering the average percentage of germination. H. Clement found that, on an average the longer the seed piece the lower-the germination. According to him, seed pieces with more than three buds are to waste the additional buds. According to Van Dillewijn, a small volume of tissue and a single root primordium adhering to the bud are enough to ensure germination in sugarcane although the resulting seedling appears thin. He also stated that, favourable conditions, cuttings with only one bud will also do well as seed material.

Sugarcane is an important commercial crop in India. There are about 35 millions of farmers growing sugarcane and another 50 millions depend on that 571 sugar factories those which generate employment every year. In Uttar Pradesh, Maharashtra and Tamil Nadu, sugarcane plays a major role in the state economy. Similarly, the productivity at the farm level is as low as 40 t/ha. The variability of rainfall due to climate change will worsen the problem further. Under such situation development of new technology which involve less input to produce more will be the viable option. This paper deals with:

Improving sugarcane productivity with the use of less input

Sugarcane in India is grown in two distinct agro-climatic regions – the Tropical (largely comprising Maharashtra, Karnataka, Gujarat and Tamil Nadu) and the Sub-tropical (Uttar Pradesh, Punjab, Haryana and Bihar). Among these states, Uttar Pradesh occupies half (2.25 m.ha) of the total area followed by Maharashtra (1.04 m.ha). Though UP dominates in production with 134 MT followed by Maharashtra with 79 MT, in terms of productivity, Tamil Nadu leads with 105 t/ha followed by Karnataka (88 t/ha) and Andhra Pradesh (82 t/ha).

Despite of its long duration and large area in India, sugarcane

yield is unimpressive, especially where the crop grows under irrigated condition. The average productivity of sugarcane is low in some regions i.e around 40 t/ha only. Not only the cane yield is low, also the sugar yield - typically less than 10% of cane weight - is also less than satisfactory given that yields of 14% of cane weight at the time of cutting (and sometimes much higher) are possible. The Australian sugar industry for instance is regularly typified by sugar yields of around 14%, while yields of up to 25 tonnes of sugar per hectare have been reported in Hawaii! Sugarcane cultivation and the sugar industry in India are facing serious challenges due to various internal and external factors.

The reasons for such low productivity are

The improved varieties released by research organizations perform well in the initial years but lose their vigour and decline in yield in due course.

Water availability is unpredictable. The concern is not only the quantity of water required, but also the lack of proper water management practices. Due to this, water is either wasted or sometimes not available at the right time.

Unpredictable climatic aberrations, improper cultivation practices, negligence in plant protection measures, imbalanced nutrient management and other practices like mono cropping often result in low productivity, fetching low price in the market.

Issues confronting sugarcane farmers and sugar industry

Low productivity and low incomes

High costs of cane cultivation

Depleting water tables

Shortage of labour

Low cane yields

Low rate of sugar recovery from the cane

Unpredictable climatic aberrations, improper cultivation practices, negligence in plant protection measures, imbalanced nutrient management and other practices like monocropping generally result in low productivity, fetching low price in the market.

The improved varieties released by research institutions have performed well in the initial years, but they lose their vigour and decline in yield in due course.

Increase in the emission of methane and nitrogenous gases into the environment under the existing cultivation practices.

The major principles that govern SSI can be stated as below

Raising nursery using single budded chips

Transplanting young seedlings (25-35 days old)

Maintaining wide spacing (5X2 feet) in the main field

Providing sufficient moisture through water saving efficient irrigation technologies *viz*., skip

furrow, alternate furrow and subsurface drip irrigation

Practicing intercropping with effective utilization of land

MATERIALS AND METHODS

Bud selection: Healthy canes of 7 to 9 months old which have good internode length (7 to 8 inches) and girth. Observe and avoid canes with disease infestation like fungus growth, spots etc. Remove buds from the selected canes using an implement called Bud Chipper. The Bud Chipper comprises a handle and a cutting blade fixed on a wooden plank. Keep the cane on the plank and adjust it in such a way that a single bud is placed exactly below the cutting blade. When the handle is pressed, single bud chip comes off the cane. Large number of buds (about 150/hr) can easily be chipped off in this way in a short period of time. Next, the chipped buds have to be treated with organic or chemical solutions.

Age of the cane	No. of potential buds per cane	No of canes required
7-9 months	10-Aug	700

Bud treatment: Bud treatment helps in 90 percent germination and subsequent health.

Chemical treatment	Organic treatment
Malathion – 40 ml	Trichoderma or Pseudomonas – 1 kg
Carbendazim – 10 g	Cow urine – 3 to 4 liters

Source: SSI - A training manual. ICRISAT-WWF Project, 2009

Raising nursery using single budded chips

In the conventional method, 2-3 budded sugarcane setts are used for planting. In SSI, single budded chips, carefully removed from healthy canes are used for raising nursery. The selected buds are placed in trays filled with coco-pith (coconut coir waste) to raise the seedlings. Place the buds flat or in a slightly slanting position in the cones of a tray. Do not press or push it hard. Ensure that the bud side faces up. By raising nursery, high percentage of germination can be achieved within a week depending on the agro climatic conditions. It involves:

Stacking

After filling all the trays, place them one above the other and finally keep an empty tray upside down at the top. About 100 trays (4 sets, each consisting of 25 trays) are to be placed together and wrapped tightly with polythene sheets. Place small weights on the bundles and keep it for 5 to 8 days in the same position to create high temperature and humidity.

Pre sprouting

Under proper conditions (especially, warm temperature) within 3 – 5 days, white roots (primodia) will come out and shoots will also appear in next 2 to 3 days. Either on the 5th or 8th day (based on the climatic conditions), all the trays with sprouted buds are to be removed from the polythene sheet and kept side by side in beds on the ground to facilitate watering and other nursery management practices.

Grading

During six leaf stage (about 20 days old seedling), grading of the plants has to be done. Stop giving water for a day to loosen the coco-pith in the trays, this enables easy lifting up of the young seedlings.

Main field preparation

Tillage operations can be carried out using harrows or rotavator. The operations are to be repeated to make the soil bed free from clods, weeds and crop residues. Then field should be deep ploughed using a tractor. Deep ploughing of 10 to 12 inches is essential to facilitate better aeration of soil and infiltration of water into the soil. If the field is uneven, leveling has to be done using a tractor operated leveler.

Transplanting young seedlings at wider pacing

It is important to note here that this one month growth of seedlings achieved under SSI method cannot be achieved even after two months in conventional method.

The young seedlings raised in the nursery are transplanted to the main field at the age of 25 – 35 days.

zigzag method of planting can be followed.

follow a north–south direction of planting.

Planting should be done in such a way that the upper level of coco-pith around the plant roots should be in line with ground level.

Plant-to-plant distance of 2 ft

In the SSI method of sugarcane cultivation, wide spacing of 5X2 feet maintained in the main field leads to 45,000 to 55,000 millable canes because of more tillering. So, wider spacing in SSI cultivation not only reduces the seed usage from 16,000 three budded setts to 4,000 to 5,000 single buds, but most importantly it also supports easy air and sunlight penetration in the crop canopy for better and healthy cane growth.

Irrigation management

Optimum application of water through drip irrigation should be followed. So, by giving only required quantity of water about 40% of water is saved. With SSI, about 5 irrigations can be saved as the germination period (up to 35 days) is spent in the nursery. Irrigation is normally applied once in 10 days during the tillering period (36-100 days), once in 7 days during the grand growth period (101-270 days) and once in 15 days during the maturity period (from 271 days till harvest).

Organic cultivation

SSI is also a organic method of cultivation as mostly organic inputs are used for it. Farmers should incorporate more organic manures, bio-fertilizers and follow biocontrol measures. This adoption of organic methods can be tried by framers for long term benefits.

Overall benefits

In conventional method, cost of setts occupies the major part of cost of cultivation

By practicing SSI, seed cost can be reduced up to 75%

Reduction in the plant mortality rate

Increases in the length and weight of each cane

No of tillers increased, So yield also increased.

Water requirement reduced as germination period was maintained in Nursery.

It is easy to transport the young seedlings for longer distance

Intercultural operations can be carried out easily due to wider spacing.

RESULTS AND DISCUSSION

The Sustainable Sugarcane Initiative (SSI) is yet another practical approach for sugarcane production which is based on the principles of 'more with less'. Previous experiments indicated that planting sugarcane with 2 bud setts found superior in increasing number of millable canes, yield as compared to 3 and single bud setts (patel and patel, 2014) but this bud chip planting is the latest technique of sugarcane planting, wherein the bud along with a portion of the nodal region is chipped off and planted in pro-tray with FYM, soil and sand. The biometric parameters *viz*., diameter of the cane, cane height, single cane weight, juice content and yield of the mechanically planted sugarcane settlings were on par with the manually planted sugarcane settlings. The juice quality of sugarcane from mechanically planted settling in terms of brix, CCS, sucrose and purity was at par with sugarcane from manual planting of settlings at the time of harvest. Cost, economic analysis of planting with mechanical planter showed 40 and 85 %, saving in cost and labour, respectively over manual bud chip settling planting. (Naik *et al.,* 2010)

Van Dillewijn (1952) the sugarcane physiologist found that, a small volume of tissue and a single root primordium adhering to the bud were enough to ensure germination in sugarcane. Ramaiah *et al*. (1977) carried out a detailed experiment with three varieties (Co 419, Co 975 and Co 997) under bud chip and normal methods of cultivation. The analysis brought out the usefulness of the method in saving the seed cane enormously.

Technologies such as situation-specific cultivars, newer planting techniques, heat therapy or meristem culture derived quality seed material, site-specific and cultivar- specific nutrient management, drip irrigation, fertigation, integrated weed management, abiotic and biotic stress management, *etc*. have the potential to increase yields substantially (Sundara *et al.,* 2011). The evaluation trials conducted on the principle components revealed the optimum size and age of the bud chips (4–10 months old) and suitable media combination

Particulars	Conventional method	SSI method
Seeds/Setts	48,000 buds (16,000 three budded setts/acre)	5000-6300 buds (5000-6300 single budded chips/acre)
Nursery preparation	No	Yes
Measures to maintain uniformity among plants	No Grading	Grading is done during nursery
Planting	Direct planting of setts in the main field	Transplanting of 25-35 days old young seedlings raised in a nursery
Spacing	1.5 to 2.5 ft between rows	4-5 ft between rows
Water requirement	More (flooding of field)	Less (furrow or drip irrigation method)
Mortality rate among plants	High	Low
No. of tillers per plant	Less (10-15)	More (20-25)
No. of millable canes achieved per clump	5-Apr	10-Sep
Accessibility to air and sunlight	Low	High
Scope for intercrop	less	More

(cocopith/sawdust) for raising better seedlings. Gokhale (1977) reported the bud chip method as a new technology that saved enormous amount of seed cane for planting. Nagendran (1988) reported 'bud chip seedlings transplanting technique' as most suitable for adoption in the wet lands of Cauvery delta. Narendranath (1992) emphasized that the bud chip raised seedlings were three times more cost-effective than the way sugarcane was normally planted. Prasad and Sreenivasan (1996) used the bud chip method as a technology for easy transport of cane seed material.

Loganandhan *et al*. (2013) revealed that SSI field trials resulted in about 20 % higher yields. The state governments are showing interest in covering larger areas under SSI. SSI method can revamp the sugarcane sector by its merits like ensuring of quality seed materials, increase in yield and income generating opportunities.

According to Rajula and Ramanjaneyulu (2014), reasons for adoption of SSI technology include reduced seed rate, possibility of intercropping, reduced cost of cultivation and increase in cane yield. The other positive factors as perceived by the farmers are synchronized tillers, more number of millable canes, good root establishment, ease of intercultural operations and possibility of multi ratooning. The study helps to get a better understanding of the performance of sustainable sugarcane initiative in farmer's fields appraised in terms of their own reference and farmers' observations of this unique technology in South India.

Gill and Kaur (2015) reported that to overcome the problem of higher seed rate per unit area an idea of single bud chip planting was floated in form of an experiment in which seed rate is reduced by hundred times with ensured equal or higher yield levels with respect to conventional planting. This chipping and chip planting method can curtail seed cost by '20000 to '25000 per ha that is direct benefit to the farmers. Better germination was obtained with single bud chips than with the conventional three-bud setts in an experiment conducted by Iqbal *et al*. (2002).

Healthy sugarcane production in SSI method is hindered by incidence of sett rot which causes 90% loss of seedlings. Bud chip treatment with pseudomonas fluoroscens @ 10g/l + trichoderma viride @ 4g/l + mixing of P,fluoroscens @ 1kg/ 250kg of coco peat and bud chip treatment with P. fluoroscens @ 10g/l followed by 0.1% thiophanatemethyl treatment were found to be highly effective with better germination percentage (Shanmugam *et al*., 2016).

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