

Sustainable Sugarcane Initiative, SSI

An opportunity to improve the quality and productivity of sugarcane while reducing the impact on natural resources

SSI Seminar Paper by AgSri

Introduction

Sugarcane is an important commercial crop of India next only to cotton and it is one crop that spreads across both in the tropics and the subtropics. Sugarcane area hovers around 5 million ha every year with a cane production of 350 million tonnes or thereabout, ranking second in the world after Brazil. The sugar industry is expanding over the years tremendously. In 1950 there were only 138 sugar mills which grew to 571 by 2005. The number has crossed to more than 600 as per the current figures. Out of these 600 and odd sugar factories, around 55 % are in the co-operative sector, 35 % in the private sector and 10 % in the public sector. However not all these sugar factories are functioning. According to a Government report, there are 162 sugar mills, which can be considered as sick and are not functioning due to various reasons (Press Trust of India / New Delhi, November 23, 2010) indicating the kind of crisis the industry is facing. Of these 162 sick mills, 139 are in the cooperative sector while the rest 23 are in the private sector. The main reasons for sickness of these sugar mills, as adduced by the Government, are non-availability of adequate raw material, poor recovery from sugarcane, lack of modernisation, high cost of working capital, control of molasses, lack of professional management and over-staffing. Besides, high state advised prices of sugarcane by some states are responsible for sickness of some sugar mills. The sugar industry's contribution, to the Indian economy is presently enormous with its total turnover of over Rs. 55,000 crores per year. The annual economic contribution of the sugar industry to the national exchequer through taxes amounts to more than Rs. 2800 crores annually.

The present day cultivated sugarcane (*Saccharum* spp. hybrid) constitutes man-made hybrid derivatives involving *Saccharum officinarum*, the original sugarcane and *S. spontaneum*, the wild species, that has given biotic and abiotic stress resistance and seed fertility that is essential for breeding. Apart from this, there had also been incorporation of a few gene complexes from the now defunct cultivated species *S. barberi* (North Indian cane) and *S. sinense* (Chinese cane). These two species are considered to have arisen through natural hybridisation between *Saccharum officinarum* and *S. spontaneum*, leading us to the conclusion that sugarcane is essentially derived from *Saccharum officinarum* and *S. spontaneum*. The first commercially successful first generation inter-specific hybrid (*S. officinarum* x *S. spontaneum*) in the world, Co 205 was developed and released for cultivation in subtropical India by Sugarcane Breeding Institute (then known as Imperial Sugarcane Breeding Station), Coimbatore, the world leader in sugarcane breeding.

This was followed by Co 213, Co 214, Co 281, Co 285, Co 290, Co 312, Co 1148 etc., which completely revolutionised the sugar industry in the northern belt. The recently released subtropical varieties such as Co 0118 and Co 0238 are gaining popularity now. Among the varieties developed by the Institute for tropical India, Co 419, Co 453, Co 740, Co 997, Co 62175, Co 6304 etc. became extremely popular across the southern, western, central and the coastal states in the earlier years. The variety Co 86032 notified for release in the year 2000 now occupies more than 90 % of the area in Tamil Nadu and around 55 % in the entire tropical belt. With the launching of fluff supply programme during the mid seventies as a parallel channel of breeding with

emphasis on location specific varietal development, a number of varieties like Viswamitra, Krishna, Co 86V96, CoJn 86141 and CoM 0265 have become popular in one or more states of the tropical belt. Similarly in subtropical belt, varieties from this stream, like CoS 767, CoS 8432, CoS 8436, CoS 88230, CoSe 92423, CoSe 95422, CoH 119, CoJ 85 and CoP 9301 are being cultivated.

In many of the sugarcane growing countries of the world, Co canes became extremely popular in the earlier years. There a number of varieties like Co 419, Co 421, Co 517, Co 945 (number one variety in Kenya occupying 25% area), Co 997, Co 6806 (number one variety in Sudan), Co 7219 and CoC 671 which are still being grown especially in the African countries. There is a great clamour for Coimbatore canes in the African countries especially in the context of supply of varieties from Sugarcane Breeding Institute being discontinued for the past 3-4 decades as a policy decision by Government of India and the inability of these countries to get good varieties from other sources like Australia, Mauritius, Brazil or South Africa.

Present scenario of cane and sugar

Sugarcane is a versatile crop and is one of the most efficient converters of solar energy into dry matter. In spite of this inherent nature of sugarcane to have high productivity levels, the sugar industry quite often faces major problems. Cycles of surplus and shortage are not uncommon. Many a times the industry faces heavy losses. For instance, during the last crushing season ending October, 2010, around 300 small and mid-size sugar factories, representing 40 per cent of India's 24.2 million tonnes of sugar output, faced a financial crisis due to losses in cane crushing (August 15, 2011, Business Standard). According to this report, the situation is likely to worsen in the ensuing season.

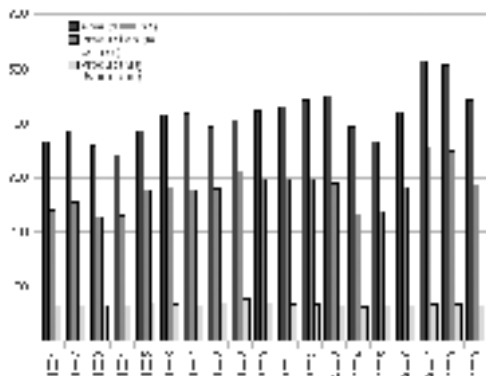
Sugar production this year is estimated officially at 26-26.5 million tonnes, up from 24.2-24.5 in 2009-10. In 2010-11, sugarcane was planted in 4.98 million hectares across the country. Area under sugarcane in the new crop year that starts in October 2011 is expected to increase by around 8 -10 per cent because of good price to growers and relatively favourable weather conditions. These developments are bound to have an impact on sugar economy of the Nation. The loss for the first eight months during the current crushing season, as estimated by ISMA, is Rs 3,200 crores, at an average of Rs 400 crores per month. Apart from other necessary interventions like policy initiatives and financial support that are needed, it is imperative to increase the productivity levels of sugarcane if the industry is to come out of the red.

In this context it is pertinent to have a look at the trend in cane area, production and productivity in India during the past two decades (Fig. 1).

It is quite evident that the production is very closely related to the extent of area planted ($r = 0.91$ and $R^2 = 0.83$). The productivity level, on the other hand, shows that there had not been much of an improvement over the past 20 years, the average hovering around 67 tonnes/ha, with a high of 76.5 during 1999 and a low of 59.4 during 2004. It is to be noted that in spite of significant advances in crop husbandry during these two decades, the cane productivity has remained stagnant. Given the biotic and abiotic stress factors, continuous degradation of soils, varietal deterioration, erratic rain fall and a plethora of other factors, s

a serious challenge for the researchers and most of the research efforts undertaken are geared towards solving these problems, seriously limiting initiatives to increase productivity levels.

Fig.1 Sugarcane area, Production and Productivity in India during the past two decades



Needless to say, ways and means have to be found out to change the situation for the better. There can be many solutions, scientific and otherwise, that can improve the productivity levels of sugarcane and turn the fortunes of both the farmers and the industry. 'Sustainable Sugarcane Initiative' (SSI) is one method that has caught the imagination of all the stake holders, especially the farmers, because of its proven ability to increase the productivity at reduced inputs. SSI addresses the most important aspect of the sugar industry, the supply and the quality of raw material.

SSI – Genesis

SSI is a continuum of SRI (System of Rice Intensification) that was promoted by WWF-ICRISAT project. The System of Rice Intensification is a methodology developed by Fr. Henri de Laulanié in the 1980's in Madagascar. It was a bottom up approach of farm practices and by 1994 the philosophy was scientifically validated. The recent research also found that in 1905 the farmers in Tamilnadu have developed similar practice which used less seeds, less water, wide spacing and intercultivation ([http://sri-india.110mb.com/newsletter/SRI%20issue%206%20\(17-05-.09\).pdf](http://sri-india.110mb.com/newsletter/SRI%20issue%206%20(17-05-.09).pdf)). The farmers published a detailed manual calling it gaja planting. So Indian farmers have tried many things in improving the productivity much before. SRI has been a phenomenal success in improving rice productivity through out the world following the promotion of this philosophy by 'Africare' in the African Sahel, 'Oxfam America' in Southeast Asia and the 'Worldwide Fund for Nature (WWF)' in India. Both SRI and SSI are methodologies that depart from conventional cultivation. Sustainable Sugarcane Initiative is nothing but building on experiences and putting together of various dimensions that include farm based innovations. Also, SSI as a concept, gives enough room for further improvement of the component practices, that is, the methodology is capable of evolving.

The most important aspect of SSI methodology is the practice of transplanting bud chip raised seedlings, instead of the normal sett planting. This component itself has evolved over a period of around 60 years. The noted Sugarcane Physiologist, van Dillewijn was the first to suggest in 1952 that a small volume of tissue and a single root primordium adhering to the bud are enough to ensure germination in sugarcane. After a long gap of 22 years, the idea was picked up by research workers at Andhra Pradesh. In order to reduce sett borne infection of red rot, Narasimha Rao and Satyanarayana working at Anakapally Sugarcane Research Station, reported in 1977 that drenching of three budded setts in fungicide solution before planting did not control diseases owing to ineffective permeation of the solution whereas in bud chip the permeation was complete and there was disease control in the seedling raised crop.

The year 1977 marked real use of bud chips for commercial planting and saw the designing of bud chipping machine at Andhra Sugars. Ramaiah, Narasimha Rao and Prasad carried out a detailed experiment at Andhra Sugars, Tanuku with three varieties (Co 419, Co 975 and Co 997) under bud chip and normal methods of cultivation. Their analysis brought out the usefulness of the method in saving the seed cane enormously. Later, Narasimha Rao, in the same year, working as Advisor to Andhra Sugars, in a report published in 'The Hindu' told that commercial planting could be practiced with bud chip raised seedlings and the resultant crop with high and synchronous tillering with heavier canes led to higher yields and better recovery. The method was tried in 400 acres in Andhra Sugars. Gokhale, also in 1977, reported that the bud chip method was a new technology that saved enormous amount of seed cane for planting.

Fascinated by the work done by Andhra Sugars, Tanuku in fabricating the bud chip machine, during the year 1978, Balasundaram, then working as Head of Kannur Station (vested with the responsibility of maintaining and utilising the world repository of sugarcane germplasm) of Sugarcane Breeding Institute, explored the possibility of using the machine for seed cane saving in the precious germplasm material. Yet another significant development during 1981 was the technique of Spaced TransPlanting (STP) of Indian Institute of Sugarcane Research (IISR),

Lucknow in subtropical region where quite a lot of seed cane is unnecessarily being used for planting.

At Mayiladuthurai in Tamil Nadu, Nagendran and Sekar, working then at NPKRR Cooperative Sugar Mills reported in an article published in 'The Hindu' during 1988 that 'bud chip seedlings transplanting technique' as most suitable for adoption in the wet lands of Cauvery delta. The very good foundation laid earlier at Tanuku Sugars, encouraged Narendranath to go in for 500 acres of sugarcane with bud chip raised seedlings. He emphasised that it was three times more cost-effective than the way sugarcane is normally planted. In his ISSCT presentation during 1992, he reported that for seven weeks there was a saving in management costs on 99 acres, since one acre nursery was sufficient to produce seedlings for planting 100 acres.

At Sugarcane Breeding Institute, Prasad and Sreenivasan during 1996, reported use of the bud chip method as a low cost technology for exchange of cane seed material. This facilitated easy carrying and transport of Co canes as bud chips in carton boxes across the country for the regular varietal development programme. During 2007, Jeypore Sugars, Chagallu, Andhra Pradesh used of single bud sets for raising seedlings in trays was started with the aim of saving one month time in preparing the main field which is normally wet during December - January. The factory started with 40,000 seedlings during 2007-08 and went on to produce 4 lakhs in 2008-09, 27 lakhs in 2009-10 and 50 lakhs in 2010-11.

Outside India, at least there are two known cases of seedling raising for sugarcane cultivation. Thomas, in 1984, reported planting of three months old seedlings at the rate of 14285 per ha with a spacing of 1.4 m x 0.5 m in South Africa. In 1995, Tianco in Philippines, used 40 days old seedlings raised in polybags and found that yields were 11 % higher, millable canes were 17 % lower but individual canes were 34 % heavier as compared to normal method of cultivation.

The year 2009 marked watershed in the history of bud chip method. Inspired by the success of 'System of Rice Intensification' under WWF-ICRISAT project, Biksham Gujja and his Team extended the concept to sugarcane and the 'Sustainable Sugarcane Initiative' was thus born (WWF-ICRISAT, 2009). The first detailed manual on SSI with clear concepts was released to public in May 2009. Though bud chip was known, but the work at WWF-ICRISAT project and the manual have put it as a package and contextualised it taking the experience of SRI. Bud chip method is one of the six principles of the SSI package. Other five principles and practices are wide spacing, intercropping, reduction of water use and reduction of chemical inputs. The combination effect of these six practices will give optimum results. However farmers depending on their time, capacity and resources will adapt these practices. It is knowledge intensive and it is process which will evolve depending upon the agro-climatic, socio-economic conditions. The method was taken up on a fairly large scale in several states and training on the methodology was given to farmers from the states of Tamil Nadu, Andhra Pradesh, Maharashtra, Punjab and Orissa under the WWF-ICRISAT project.

The WWF-ICRISAT project on SSI envisaged combining useful components of sugarcane cultivation in a synergistic way. Drip irrigation and wide row spacing were two elements that started gaining ground during the late 90's. These two methods gave the farmers the practical options of using water judiciously and raising an intercrop as an additional and a quicker source of income. There was also the realisation that continued use of inorganic inputs has wrought havoc on soil health. Putting together these various dimensions along with raising seedlings through bud chip, the SSI was conceptualised and implemented during 2009 and 2010. This generated massive interest among the farmers and they started practicing the methodology with great enthusiasm. As the adage goes 'seeing is believing' both the farmers and the industry realised the great potential of this methodology and by 2011, SSI has become nationally accepted. Although it is not a finished product, the results there for every one to see and as already mentioned it is capable of evolving and getting fine tuned.

Saving in seed cane and water

Apart from higher productivity, SSI results in enormous seed cane saving and in water productivity. With the current seed rate of 5 - 8 tonnes per ha depending upon the inter row spacing, the saving could be as high as 4 tonnes at the minimum for every ha of cane planted. With around 5 million ha being planted every year in India, there is the possibility of saving 20 million tonnes of cane that could go for crushing, benefiting both the farmers and the industry - working out to around 4000 crores of rupees every year.

According to the website <http://www.waterfootprint.org/>, the water footprint (water requirement to produce certain quantity of product) for sugarcane is 175 lit per kg of cane or 1500 lit per kg of sugar (at 11% recovery), as compared to 3400 lit for rice and 1300 lit for wheat to produce one kg of grain. The estimate for sugarcane should have been based on furrow irrigation and normal spacing. With drip irrigation and wide row spacing, the water requirement for sugarcane cultivation is expected to be much lower. Water saving according to Jain irrigation website () is to the tune of 40 to 70 %. In addition, nursery raising would substantially reduce the water intake of young crop that would otherwise stand in the field for around 30 days, requiring at least five irrigations. Although SSI with drip irrigation system as a component brings down the water requirement, there is need to generate authentic information on the quantity of water saved through drip irrigation and seedling raising.

Tillering potential

The increase in productivity that results in SSI is mainly because of robust root system and vigorous growth of the plant. The special feature of the system is that the plant has enormous potential for tillering which has to be tapped properly. Tillering in sugarcane comes from the bottom most six internodes which are highly compressed. The buds from these six internodes in the mother shoot are capable of giving six primary tillers and again these primary tillers in turn are capable of giving six secondary tillers each ($1 + 6 + 6 \times 6 = 43$), theoretically speaking. If tertiary tillers are also produced the number could be enormous. But in practice, even if four tillers are produced from the mother shoot and if they give again four tillers each, then the total tillers emerging would be 21 (i.e. $1+4+ 4 \times 4$). It is extremely important to harness the full potential of tillering in SSI.

As mentioned earlier, SSI is not a finished product. It is evolving. In order to upscale and further modify through experience the stakeholders need to do the following.

- a) more demonstrations at different agro-climatic zones
- b) training and knowledge dissemination particularly in the regional languages
- c) developing required tools and update
- d) research on varietal response to the SSI.

The national level dialogue which is being organized in Coimbatore from 24-25th August will facilitate a discussion and start a process for evolving national road map for up-scaling the SSI. AgSri in partnership with NABARD and SBI is organizing a national level seminar to facilitate the dialogue which hopefully helps in evolving a road map for taking up SSI at national level with specific targets.

The Seminar

The National Seminar being conducted at Tamil Nadu Agriculture University on 24th and 25th of August, 2011 will go a long way in refining SSI and taking it forward to greater heights through dialogue among various stake holders. The Seminar is sponsored by National Resource Management Centre (NRMC) of NABARD and co-hosted by Sugarcane Breeding Institute, Coimbatore and AgSri, Hyderabad. The overall goal of the Seminar is "to improve the cane productivity in India by promoting SSI".

About 100 participants from major sugarcane producing states are attending the Seminar. The

delegates include individual farmers, non-governmental and community based organisations (NGOs/CBOs), Sugar factories, research and extension agencies, Govt. organisations and NABARD officials. The Seminar Schedule is based on themes that consist of - understanding principles and practices of SSI, identifying issues and constraints to adopt it in different agro-climatic conditions, research and extension, policy requirements, institution building, technical manpower requirements and convergence of Industry, farmers and academic Institutions and so on.

The Seminar is expected to deliberate on

1. Establishing more SSI demonstration sites in all sugarcane growing states. Based on the results setting up specific targets for each state/ mill in promoting SSI.
2. Training and knowledge sharing and dissemination particularly in regional languages.
3. Required tools, machines in order to help in up-scaling SSI.
4. Research on varietal response to the SSI.
5. Networking in creating multidisciplinary and multidimensional approach to SSI.
6. Policy framework to mobilise required human and financial resources to up-scaling SSI including a mechanism to certify the sugarcane production.

Conclusion

Sustainable Sugarcane Initiative is a good opportunity to improve the quality and productivity of Sugarcane cultivation. At the same time India can address the most important issues such water crisis, ecological foot print of agriculture. For long time the field based approaches which improve productivity have been neglected. SRI which is a major success story in rice production has inspired in putting SSI together. The components of SSI are nothing new, but the methodology is a serious effort in conceptualising the already available farm practices and putting them into practice in a synergistic way. The seedling raising methodology has a long history and many people have contributed to its evolution, culminating in the WWF-ICRISAT project named as SSI that encompassed not only seedling raising but also wide row spacing, water saving, intercropping and organic inputs. Saving of seed cane and water through SSI could be enormous. Tillering potential in SSI is quite impressive and its full potential is yet to be harnessed. SSI has proven its merits, but there are a number of areas where further research is needed to put SSI on a still larger perspective. The present dialogue is expected to set the tone for carrying forward this path breaking methodology.

The national seminar is great opportunity for all stakeholders to provide their inputs in improving SSI. The seminar may want to come out with specific targets for improving the sugarcane production through SSI. This paper is meant to help the discussions at the seminar to evolve a required institutional and financial frame work to meet the targets for next five years. There are also efforts at international level in bringing up standards for producing sugarcane. SSI is the first step towards standardisation of sugarcane cultivation focusing improving productivity while reducing the agriculture foot print on planet earth.