AgSri
crops • water • people

Natural Resource Management Center
NRMC, Kolkata
NABARD

SSI | Sustainable Sugarcane Initiative






Producing 'MORE WITH LESS'

2012

This publication is conceived and written by the AgSri team:
Dr. Biksham Gujja, Founder and Chairperson, AgSri; Dr. Vinod Goud, Chief Technical Officer, AgSri; Dr. US Natarajan (former scientist, Sugarcane Breeding Institute, Coimbatore); TVVV Rao, Suhasini Ramayanam and Sraban Dalai.

Thanks to NABARD for funding the printing of this publication.

Acknowledgments

This publication has been compiled with inputs and from the experiences of thousands of SSI farmers from different states of India. We take this opportunity to sincerely thank each and every SSI farmer for their hard work and for sharing their experiences. Our special thanks to Dr. Norman Uphoff, Dr. Hapase, Shri. Ashish Ganapule and Dr. N Loganadhan for all their support. Thanks to Triveni Engineering and Industries Ltd., for providing AgSri the resources and access to work with farmers in their fields. This manual is in continuation of the earlier work by some of the AgSri team at WWF-ICRISAT.

Editors: Manisha Agarwal and Anuradha S Echanbadi
Design: Akshakala and Grey Pixels
Photographs: AgSri field team - Uttar Pradesh, Odisha, Maharashtra and Andhra Pradesh

For copies, contact:

AgSri

#24, Road No.76, Jubilee Hills,
Hyderabad-500033,
Andhra Pradesh, India.
e-mail: info@agsri.com
Website: www.agsri.com

Note: The information in the manual has been produced based on our experiences in the field with the support of progressive SSI sugarcane farmers, experts and industry and after extensive research and verification by the AgSri team. However, the results in the field are subjective to local soil, geographical, climatic and other conditions. Our research is ongoing and we would like to hear from you. Please share your comments, feedback and/or additional information to the address or email above.

SSI | Sustainable Sugarcane Initiative

Producing 'MORE WITH LESS'

Contents

Preface

Sugarcane is an important crop in India, being cultivated by 45 million farmers. About 50 million people depend on this crop, including the employment generated by around 570 sugar factories and other related industries. Sugar is used in many products and its use is growing. The sugarcane crop is also contributing to our ever-increasing thirst for energy, becoming a substitute for oil. It is a crop with a future.

But, sugarcane cultivation in India is in crisis. During the last 10 years, sugarcane production has been fluctuating widely, between 233 and 355 million tonnes. At the same time, productivity at the farm level has been stagnant over the last two decades, at around 65–70 tonnes/ha. With low yields, high input costs, lack of labour availability, water scarcity, climate-induced uncertainties, pest and diseases, and so many other factors, the sugarcane farmers are indeed in a bad state. Those who are producing the raw material for sugar production are bitter. They are shifting to other crops.

India, with the second largest area under sugarcane cultivation in the world, around 5 million ha (4.98 in during the year 2010-11), is in big trouble. This will have global implications. We can go on describing and decrying the problems. But solution, to attain cheaper, better and sustainable cane production, will have to be tested, demonstrated and promoted. It is time for all those who are associated with sugarcane, sugar production and industries using sugar to unite to take proactive actions.

The Sustainable Sugarcane Initiative (SSI) is a step in that direction of addressing the fundamental problems of sugarcane cultivation. SSI provides practical options to farmers for improving the productivity of their land, water and labour, all at the same time. SSI by reducing the overall pressure on water resources contributes to the preservation and recovery of ecosystems. This in turn will contribute to reducing the human footprint on Planet Earth. SSI is a set of practices based on principles for producing 'More with Less' in agriculture. This is a farm-based method and farmers have the option to use the cane variety of their choice. The inspiration for putting this package together comes from the successful approach of SRI - System of Rice Intensification.

This book is a step-wise manual in the development of SSI, first published in 2009 as part of the WWF-ICRISAT Project. The practices mentioned in the manual did exist, but only here and there in a small way. Most of these practices were innovated and improvised by innovative farmers and scientists. Our contribution was to put all of them together after extensive consultation with farmers. The earlier version of this manual received wide attention from many stakeholders and several demonstration sites were established by industry and farmers.

As mentioned in the first edition, this second edition was an expected extension of SSI knowledge, based on extensive field trials and further consultations. Approaches like SSI should evolve over time. The greater the field experience gained, the more will these manuals have to be revised and revisited. The staff who worked with the earlier Project (WWF-ICRISAT) are now part of AgSri, working towards building public-private partnerships for promoting SRI and SSI. This manual has incorporated many field-level experiences since 2009 and several aspects of each of the practices in it have been

modified according to empirical results. We are releasing this revised manual into the public domain so that others too can contribute and further modify it, through their own experiences. AgSri is just one actor among many and we invite other producers, organizations and companies to further improve this knowledge system for the benefit of farmers and millers.

It is important to mention here that knowledge systems like SSI and SRI, which are farmer-based, can have historical precedents in our agriculture. This has been seen for rice production methods. Indian farmers a century ago were trying several methods to improve the production, as a close relative to what is now known as SRI. The system of cultivation in its present name and form is reported to have originated from Madagascar (http://sri.ciifad.cornell.edu/index.html).

However, it has been documented that the main principles of SRI - single seedlings, wide spacing, maintaining soil moist but not flooded, inter-cultivation, etc., were not only practiced by some Indian farmers at the start of the 20th century, but were also documented and promoted through local publications. After knowing about SRI, historical research has brought these publications out from archives (http://www.agsri.com/images/newsletter/sri/SRI%20issue%206%20(17-05-09).pdf). Modern science can further refine, authenticate, standardize and improvise in order to make these insights more useful to our farmers.

Recently I visited Ramkola in UP, where SSI had been introduced in 2010 as part of a Triveni-AgSri partnership. The first year's results were a little disappointing due to various reasons, particularly water-logging. Some farmers were totally opposed to establishing their crop through seedling raising and transplanting, one of the main principles of SSI. Some even removed transplanted seedlings from the fields. Staff were ridiculed and accused of causing losses to farmers. It was not a pleasant experience. But this is not an uncommon reaction as we found the same reactions from many farmers in the initial days of SRI. Those who were willing to try out the new methods encountered mockery and even hostility. Like the SRI farmers then, however, there have been some sugarcane farmers who decided to go ahead with an SSI field and the results for the first year were not bad, although not necessarily good either. The ratoon crop though in the second year was extremely good. The same farmers who previously removed the crop are now convinced and want to adopt SSI.

The SSI farmers around Ramkola are near Kushinagar, the famous Buddhist site. This ancient site is completely surrounded by rice and sugarcane fields. The Mahaparinirvana Temple has the famous reclining Buddha statue (6.1 m) resting on the right side. Here, Lord Buddha delivered his last teachings, in the year 531 BC. This statue, setup almost 1,500 years ago, had its days of glory in long past history, but disappeared with time, until the British archaeologist Carlleyle excavated it in 1876 and put all the pieces together. This magnificent statue is a painful reconstruction of all those pieces. Like our culture, much of the ancient knowledge of our agriculture too has been shattered into pieces with the onslaught of time and modernity. We need to collect these pieces of wisdom, putting them in their proper place and re-constructing the knowledge systems that we once had for farming.

This reconstruction of farm-based knowledge has to be done, with balance and proven results, now. Methods like SRI and SSI are a few specific efforts in putting farm-based agricultural practices back on the scientific and practical agendas and giving such knowledge shape and identity. Looking to the past does not serve an end; it should fit and serve the present and future. The recent successes of SRI and SSI are a clear indication that the modern problems of water crisis, soil degradation, stagnant yields, high input costs in agriculture, loss of varieties, etc., can to some extent be addressed with our existing knowledge systems or with adaptations that synthesize old and new knowledge. It looks like we once had a better way of managing water and crops, for the benefit of people. We need to put these knowledges in current perspective and market them properly to meet the rising challenges in the farming sector. SSI is one more attempt after SRI but surely, not the last. These agro ecological principles are being extended to wheat, ragi, mustard and other crops, with encouraging results.

This manual in English is to inform decision-makers – industry, government agencies, extension organizations, investors and manufacturers of agricultural implements - to look at the potential of SSI and to take steps to upscale it. The earlier version of the SSI manual published by the WWF-ICRISAT Project has been translated into Telugu, Tamil, Hindi, Odiya, Kannada and Marathi. Similarly, we are expecting the stakeholders to produce this manual also into the local languages. AgSri can work with sponsors to produce it with some local modifications. We are looking forward to establishing partnerships not only in disseminating this manual but establishing demonstration projects.

This manual gives immense scope and opportunities to design and redesign the appropriate farm machines required for SSI. The development of tools and machines will further help in scaling up. Drip irrigation companies might look into the opportunity that SSI provides for expanding their businesses and also for saving water. Companies which are doing business with sugar now should become actively involved in promoting sustainable methods like SSI for their – as well as others' – benefit. Farmers are most inclined to believe only what they see. No matter what training manuals say, no matter how nicely the information has been put together, it will not convince the farmers unless they have some personal exposure or acquaintance. There is no substitute for practicing new methods or technologies on the ground, demonstrating them and taking all the critique/feedback from the farmers.

This is what AgSri is doing. Working with farmers, working with them not only to demonstrate the improvised yields and profitability, but also to show its sustainability year after year. AgSri is working with the farmers as customers, who demand quality, proof and durability. AgSri is learning and improvising its work with the farmers, for its business. Improving quality is the most important aspect of serving customers. That is why this SSI manual is that one step towards improving the quality of services to farmers, all the while incorporating experiences from the ground.

Finally, we are sure about one thing, in the coming years, sugarcane farmers will be reducing their seed material, they will be planting wide and practicing intercropping and using less water – the essential principles and practices of SSI. SSI is not a conventional package of practices but a new way of thinking as well as cultivating. We can all work together towards this process.

Biksham Gujja
Founder and Chairperson
AgSri

Message

The Indian sugar industry anchors 45 million sugarcane growers, cultivating over 42 lakh hectares in India. After rice, sugarcane employs the highest number of labourers, of which 60 percent are women workers. Sugar production for 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. The area under sugarcane in the new crop year that starts in October 2011 is expected to increase by around 8-10 percent because of good price being offered for growers and relatively favorable weather.

Sugarcane cultivation and the sugar industry in India are facing serious social, economic and environmental challenges. The increasing costs of cultivation and poor yields are making sugarcane cultivation economically unviable for farmers. Environmental issues like declining water table and degradation of soil pose other major threats to cane farmers and ecosystems. The productivity at the farm level has been stagnant at around 65–70 tonnes/ha over the last two decades. Unless we come up with a creative solution for our farmers, the crisis of water availability will keep intensifying and there will be a severe strain on our water sources.

The Sustainable Sugarcane Initiative (SSI) is a method of better management practices that involves use of less seeds, less water and optimum utilization of fertilizers and land to achieve more yield and profit for farmers and millers alike. It is an alternative to the conventional seed, water and space-intensive sugarcane cultivation. Sustainable Sugarcane Initiative (SSI) has already helped over 5,000 farmers across India to improve their water productivity by 40 percent, profits by 30 percent, while reducing their ecological footprint. Several sugar mills and industries have begun to show great interest in this new and innovative method of sugarcane cultivation and are planning/proposing to form into larger partnerships and networks with the proactive support of governments, banks, research institutions and civil society organizations.

The Natural Resource Management Center (NRMC), in its pursuit of increasing household incomes of small farmers, is keen to promote sustainable approaches for sugarcane cultivation involving both the industry and farmers. The challenges ahead call for capacity-building of farmers, service providers and research organizations on SSI. I am sure this manual on SSI will go a long way in bridging the knowledge gap of various stakeholders.

S.K. Mitra
Chairman
NABARD

Foreword

The emergence of SSI in India is part – and an important part – of a larger movement within agriculture that is reshaping the thinking and practices for producing food and fiber in ways that will be more appropriate to the challenges of the 21st Century with its particular constraints and opportunities.

The Green Revolution which boosted production of cereal grains in the latter third of the 20th Century was a great success in many if not all ways. Introduction of improved varieties better able to benefit from external inputs of water, fertilizer and other agrochemicals – along with higher energy and capital inputs for mechanization and irrigation – made it possible for India to achieve a degree of agricultural self-sufficiency thought impossible five decades ago.

However, there are many negative consequences of such intensive agriculture for environment, society, health, etc. that have been extensively documented.

The concepts and practices associated with the System of Rice Intensification (SRI) are now redressing some of the limitations of the Green Revolution while improving the productivity of land, water and labour all at the same time. These methods have begun spreading to other crops.

The Sustainable Sugarcane Initiative is one such development which is inspired by SRI experience.

These methods with various names such SRI, SSI, SWI, STI, SCI, etc., have shown good results in improving the productivity of rice, sugarcane, wheat, ragi, teff and many other crops, even brinjal!

We are seeing that changes in the way that plants, soil, water and nutrients are managed can bring about more productive and hardy crops (phenotypes) from almost any given variety (genotype).

Farmers in India and around the world face immense challenges as we proceed in this century. It is pretty certain that *petro-based products*, whether synthetic fertilizers or agrochemical protectants, will be more costly in the next 50 years than in the previous five decades.

While we may be uncertain about the extent, distribution and timing of *climate change*, we are pretty sure that climatic conditions will become less rather than more favorable for agriculture, particularly with respect to rainfall, so water-saving becomes more necessary.

These two trends alone make it imperative that we revise our agricultural thinking and practices to take better advantage of the genetic potentials that already exist in plants and of the biological potentials that exist in soil systems, with their complex food webs and interactive nutrient cycling.

Much more remains to be known in scientific terms about the mechanisms, rates, limits, etc., of these interactions and about their implications for productivity and sustainability. But already there is a solid scientific basis in crop and soil science, particularly in soil biology and ecology as well as in epigenetics, to account for the phenomenal increases in output being achieved with SRI-derived methods.

I greatly appreciate and applaud the initiative that AgSri has taken on SSI and the support that NABARD has given to this innovative enterprise. Indian farmers and policy-makers – and especially consumers – should be very grateful for their efforts and entrepreneurship.

The rest of the world will be watching the performance of SSI for improving sugarcane production in India. If Indian farmers can quickly and capably utilize these new opportunities, refining and adapting them in the process, there should be a worldwide impact.

In addition to food security improvement, possibly the energy needs of India and other countries will also be served if the natural potentials of the sugarcane plant can be more fully and efficiently harnessed. SSI should thus benefit whole countries and their economies, as well as many millions of farmers and consumers and the environment.

Norman Uphoff
Senior Advisor
SRI International Network and Resource Center (SRI-Rice)
Cornell International Institute for Food, Agriculture
and Development (CIIFAD)

Introduction

Sugarcane is an important commercial multipurpose crop that provides sugar and a myriad of by-products/co-products with ecological sustainability, given that it is also a renewable, natural agricultural resource. Sugarcane juice is used for making white sugar, brown sugar (Khandsari), Jaggery (Gur) and ethanol. The main by-products after the juice extraction are bagasse and molasses.

The cultivation of sugarcane dates back to the Vedic period. The most ancient reference to sugarcane is in Athervaveda which is 4,000 years old and the word 'sugar' is derived from the Sanskrit word *Sarkara*. In the 1400s–1500s in India, cows belonging to the Sultan of Mandu were fed with sugarcane to make their milk sweet for use in puddings.

Different species of sugarcane likely originated in different locations with *Saccharum barberi* originating in India and *S.edule and S. officinarum* coming from New Guinea. India was the first to begin with the production of sugar following the process of pressing sugarcane to extract juice and boiling it to get crystals. The first sugar mill in India was established in Bengal on the banks of River Hoogly in the year 1784. By 1994-1995, India had about 408 mills in operation with an average crushing capacity of 2452 tonnes (t) per day and a crushing duration of 161 days. By March 2005, the total number of sugar factories in India was around 571.

At present, while the raw sugar prices are progressively escalating, sugarcane cultivation and sugar industry are being pushed into fresh new crises. In countries like India, it is the small landholding farmers who cultivate crops predominantly and any changes in the market or technology or policy that come along will affect them, directly or indirectly.

India contributes about 12 percent of world sugar production and has annual sugar production capacity of 23 million tonnes, with a total investment of $11 billion, which is no longer limited to sugar but also includes the co-generated power and ethanol sector as well.

Issues confronting sugarcane farmers and sugar industry

- Low productivity and low incomes are serious concerns that growers are grappling with owing to various set of factors.
- The costs of cane cultivation have risen alarmingly for seed/planting material, manures and fertilizers, irrigation, cultural practices and harvesting.
- Cultivation methods - the seed rate is 2.5 to 4 tonnes/acre; in some states, it is double this quantity, due to close planting (2.5 ft) adopted by farmers.
- Despite high seed rate, close planting can only support a population of 25,000 canes per acre (due to high mortality while competing for sunlight and nutrients) with lesser number of tillers (8-10 per plant) and few millable canes (3-4 per clump). The average weight of canes is 0.75 kilogram, which under good circumstances ends up yielding about 25 to 30 tonnes/acre.
- Depleting water tables. The concern is not only the quantity of water, but an absence of proper water management practices, leading to wastage of water resources.
- In irrigated areas, water is consumed in large quantities (1,500-3,000 litres/kg of cane produced, as estimated by FAO). The flooding method of irrigation is wasteful, causing huge strain on local ground water resources.
- Shortage of labour as the traditional practices have high labour requirement.
- Unpredictable climatic aberrations, improper cultivation practices, negligence in plant protection measures, imbalanced nutrient management and other practices like mono-cropping generally result in low productivity, fetching low price in the market.
- Decline in cultivation coupled with market uncertainty is making the operation of sugar mills unproductive, thus affecting the cycle of production and having indirect adverse effects on the livelihoods of farmers and labourers.
- 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.

On the one hand, there is the opportunity in terms of growing demand for sugar and other by-products of sugarcane and on the other hand, there is the decline in production and productivity due to various reasons. The average productivity of sugarcane is low with certain regions reporting yields as low as 40 t/ha only. Not only is the cane yield low; the sugar yield is typically less than 10 percent of cane weight, which is less than satisfactory given that yields of 14 percent of cane weight at the time of cutting (and sometimes even higher) are possible. There are large losses between cutting in the field and processing in mills.

The rising cost of farm chemicals, along with the increasing social and environmental costs of water use by the agricultural sector and the

During the Release of the First Edition of the SSI Manual, May 2009: From (L to R) Dr. S. P. Wani, Principal Scientist, ICRISAT; Shri. Prabhakar Reddy, President, Farmers Federation of AP; Dr. Biksham Gujja, Team Leader, ICRISAT-WWF Project, Dr. William Dar, Director General, ICRISAT; Shri. Sucha Singh, Hon'ble Agriculture Minister, Punjab; Dr. Dave Hoisington, Deputy Director General-Research, ICRISAT; Dr. Vithal Rajan, Board of Directors, KCP Sugars; Shri. P. K. Singh, General Manager-Cane, Triveni Engineering and Industries Ltd.

A truly green agricultural revolution is now needed ...

Food security must now be attained through green technology, so as to reduce the use of chemical inputs (fertilizers and pesticides) and to make more efficient use of energy, water and natural resources, as well as through significant improvement of storage facilities and marketing to reduce waste.

An extensive menu of already-available green technologies and sustainable practices in agriculture, which have been successfully adopted with large productivity gains in developing-country contexts, can be deployed to lead the radical transformation towards sustainable food security, including technologies and practices such as low-tillage farming, crop rotation and inter-planting, water harvesting and recycling, water-efficient cropping, agroforestry and integrated pest management.

The main policy focus on the supply side should be promotion and development of sustainable agriculture, with an emphasis on small farm holders in developing countries, since it is in this area that most gains in terms of both productivity increases and rural poverty reduction can be achieved.

United Nations
New York, 2011

World Economic and Social Survey 2011
The Great Green Technological Transformation

pollution accruing from modern, input-intensive production practices, have begun to raise serious questions in the minds of policy makers, planners and farmers alike about the long-term viability of the sector. Any problem affecting the sugar sector is a widespread problem, affecting a significant number of stakeholders and ecosystems. The desirability of a widely replicable solution is therefore equally obvious. The challenges are already being addressed in the rice sector, with the System of Rice Intensification, popularly known as SRI. SRI is an integrated approach that greatly reduces irrigation water requirements while producing a range of benefits including higher yields, better-quality rice, less chaff and resistance to lodging. Addressing the challenges in sugarcane production is of utmost importance keeping in view the health of the industry as well as the currently declining household incomes of cane growers.

The 'More with Less' approach is a package of simple agriculture innovations applied for sugarcane farming using less inputs – water, seed and fertilizers – inspired by SRI experience. The approach is called Sustainable Sugarcane Initiative (SSI) – a "More with Less" methodology for increasing the productivity of sugarcane cultivation by changing the management of plants, soil, water and nutrients. SSI has helped over 5,000 farmers so far in India to improve their water productivity by 40 percent, their profits by 30 percent, while reducing their ecological impact. SSI leads to healthier soil and plants supported by greater root growth and the nurturing of soil microbial abundance and diversity. In addition, it has been found in farmers' experience that using drip irrigation leads to a great saving of water, by as much as 80 percent. As such, SSI is becoming a focus for the industry, governments, as well as financial institutions for its scaling up.

This manual is a culmination of efforts of research institutes, farmer groups, industry and AgSri in understanding and communicating the processes and approaches that significantly improve yields, reduce inputs and use less irrigation. Research and demonstrations are being taken up over five states in India. The practices prescribed in this manual need to be adapted based on local agro-climatic conditions. It is hoped that the manual will be useful for both farmers and sugar industries to adopt and adapt SSI practices in order to improve cane productivity and incomes while reducing the costs of production.

Bud chip method – Landmarks

Using bud chips, instead of setts, as a material suitable for planting, has a long and interesting history dating back to the early 50s. The events evolved from initial academic curiosity to the present-day SSI, where a great commercial potentiality is being realised due to the synergistic effects of several sugarcane technologies, especially transplanting of seedlings raised from bud chips and wider row spacing. The long journey that has been made, passed through several stages and the observations made and objectives envisaged at different points of time are as follow:

- Possibility of growing the crop from buds, tiny tissue cut from canes, instead of using whole lengths of cane (setts).
- Control of sett-borne infections by eliminating the internode portion while drenching with fungicides to allow full permeability.
- Saving large amount of seed cane.
- Commercial viability of raising seedlings (from bud chips) and transplanting into the main field by using cups or plastic trays.
- Nursery period of just one month, allowing a breathing spell for main field preparation where wet conditions prevail and preclude sett planting in the right season.
- Use of bud chips for effective utilisation of precious seed cane in germplasm material.
- Easy transport of selections and test varieties across the country in varietal development programmes.
- A holistic approach of 'More with Less' (inspired by the success of System of Rice Intensification - SRI) with bud chip seedlings and wider row spacing forming the bedrock, culminating in 'Sustainable Sugarcane Initiative - SSI', a better way of growing sugarcane.

The following are important events in the long journey:

1952 Van Dillewijn, the noted sugarcane physiologist, found that a small volume of tissue and a single root primordium adhering to the bud are enough to ensure germination in sugarcane. He noticed that under favourable growing conditions, a cutting with only one bud did well as seed material.

1974 In order to reduce sett-borne infection of red rot, Narasimha Rao and Satyanarayana, working at the Anakapally Sugarcane Research Station, attempted to use the buds alone for planting, eliminating the internode portion of sugarcane. Drenching three-budded setts in fungicide solution before planting did not control the disease, owing to ineffective permeation of the solution, whereas in bud chips the permeation was complete and there was disease control.

1977 This year marked the real use of bud chips for commercial planting and saw the designing of a bud chipping machine at Andhra Sugars. During 1976, Ramaiah, Narasimha Rao and Prasad had carried out a detailed experiment at Andhra Sugars, Tanuku, with three varieties (Co419, Co975 and Co997) under bud chip and normal methods of cultivation. The results were published in the year 1977. Their analysis brought out the usefulness of the method with enormous saving of seed cane. The authors did not observe any decline in yield and quality of cane, however also no increase in yield. The absence of a productivity increase, contrary to what is being witnessed now, could be attributed perhaps to the lack of wider spacing adopted, which is essential for realising the full potential of the bud chip method. Subsequently, Narasimha Rao working as an advisor to Andhra Sugars, in a report published in The Hindu dated 29th July, 1977, reported that commercial planting could be practiced with bud chip-raised seedlings and the resultant crop with high and synchronous tillering and heavier canes would lead to higher yields and better recovery. The method was being tried in 400 acres in Andhra Sugars, he added. Gokhale, in a publication presented at the sixth convention of Sugarcane Technologists Association of India, reported that the bud chip method as a new technology saved enormous amount of seedcane for planting.

1978 Fascinated by the work done by Andhra Sugars, Tanuku, in fabricating the bud chip machine, Balasundaram, retired director of the Sugarcane Breeding Institute and then working as head of the Kannur Station of the Institute (which was vested with responsibility for maintaining and utilising this world repository of sugarcane germplasm), explored the possibility of using the machine for seed-cane saving for conserving precious germplasm material. He obtained the machine from Andhra Sugars, replaced the curved edge of the knife with a straight one and effectively used it for cutting single buds for planting *Saccharum officinarum* germplasm.

1981 Yet another significant development was the technique of Spaced Transplanting (STP) of the Indian Institute of Sugarcane Research (IISR), Lucknow, under subtropical conditions where quite a lot of seed cane was unnecessarily being used for planting. In this technique, developed by Srivastava, Narasimhan and Shukla, a single-bud nursery is raised and seedlings (settlings) are transplanted in the field with wider spacing within the row to facilitate the availability of abundant solar radiation and soil aeration that enhances high levels of tillering.

1988 At Mayiladuthurai in Tamil Nadu, Nagendran (presently Special Director of Thiru Arooran Sugar Mills Ltd., Chennai) and Sekar, both working then at NPKRR Cooperative Sugar Mills, reported in an article published in The Hindu that 'bud chip seedlings technique' was most suitable for adoption in the wetlands of Cauvery delta. They added that farmers need not sacrifice their *thaladi* crop for the sake of growing sugarcane by adopting this method of seedling raising.

1992 The very good foundation laid earlier at Tanuku Sugars encouraged Narendranath to go in for 500 acres of sugarcane with bud chip raised seedlings. Presenting his work at XXI. ISSCT Congress in Bangkok, he emphasized that it was three times more cost-effective than the way sugarcane is normally planted. He added that for seven weeks, there was a saving in management costs on 99 acres, since a one-acre nursery was sufficient to produce seedlings for planting 100 acres.

1996 At the Sugarcane Breeding Institute (SBI), Prasad and Sreenivasan used the bud chip method as a low-cost technology for exchange of cane seed material. Bud chips stored even up to 13 days could give good survival rates when raised in poly bags. This facilitated carrying and easy transport of canes as bud chips in carton boxes across the country in the regular varietal development programme.

2009 This year marked the watershed in the history of bud chip method. Inspired by the success of 'System of Rice Intensification (SRI)' under the WWF-ICRISAT Project, Biksham Gujja and his team extended the concept of SRI and its principles to sugarcane and the 'Sustainable Sugarcane Initiative (SSI)' was thus born. The methodology developed by them encompassed the following:

- Raising a bud chip nursery in cavity trays in place of raised beds.
- Growing the seedlings under a shade net for better survival and growth.
- Planting seedlings with an age of 30 days or less.
- Planting the seedlings under wider spacing (4 ft or more between rows and 2 ft within row); allowing for copious exposure to sunlight results in high and synchronous tillering and good plant growth.
- Emphasising water-saving methods, including drip irrigation.
- Encouraging greater use of organic inputs for better soil fertility and structure.
- Advocating intercrops to suppress weeds as well as to provide intermittent income to farmers.

This 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, Karnataka, Maharashtra, Punjab, Uttar Pradesh and Odisha under the WWF-ICRISAT Project. The method has proved its efficacy beyond any doubt and large numbers of farmers have started adopting SSI while a large number of sugar factories are evincing interest in promoting this methodology given the better quality of cane as well as more supply. All said and done, there is a need for concerted research to understand the phenomenon better and to fine-tune the methodology further, so that it can be adopted by more and more farmers and by the industry as a whole.

Step-wise guide to SSI practices

Sustainable Sugarcane Initiative (SSI) is a method of sugarcane production that involves the use of less seeds, less water and appropriate utilization of fertilizers and land to achieve more yields. Being adopted enthusiastically by farmers, SSI is fast becoming a better alternative to the conventional methods of sugarcane cultivation that are seed, water and space-intensive.

The principles that govern SSI are:

- Raising a nursery using single-budded chips from canes.
- Transplanting young seedlings (25-35 days old).
- Maintaining wide spacing (5 to 9 X 2 ft) in the main field.
- Providing sufficient moisture and avoiding flooding of fields.
- Encouraging organic methods of providing nutrients, plant protection and other intercultural practices.
- Practicing intercropping for effective utilization of land and maintaining ground cover.

SSI is an alternate to conventional seed, water and space-intensive sugarcane cultivation.

The benefits vary depending on how farmers put these principles into practice, either individually or in combination. When all these principles are followed in combination, they work in a synergistic way to save inputs and achieve higher yields per unit area. Hence, it is important to understand each one of them well.

1. Raising nursery using single-budded chips

Single-budded chips, carefully removed from healthy canes, are used for raising the nursery. Only 50-75 kg of bud chips are used for a hectare of crop and the remaining canes could be sent for crushing. To raise the seedlings, the selected buds are placed individually in the cones of plastic or biodegradable germination trays along with the coco-pith (coconut coir waste). Through this method, a high percentage of germination can be achieved within a week, based on the agro-climatic conditions. This method for seedling growing is found to be the best among all the methods in terms of seed saving and proper cane growth.

ip methodology is found he best among all the ds in terms of seed and proper cane growth.

are to select only y buds while chipping eatment.

e-infested, damaged, nd sprouted buds should avoided.

can be cut into two for easy chipping s.

1.1 Selection of canes

The following procedure has to be adopted for the selection of healthy buds:

- Select healthy canes that are 7 to 9 months old. The inter node length should be about 15 cm and girth about 10-15 cm.
- Inspect the canes and avoid any with disease infestation like fungus growth, spots, etc.
- Care should be taken while removing the dry leaves from the cane. It is preferable to remove the leaves by hand as using knives would damage the buds.
- Cut the required quantity of cane. About 700 canes are needed (irrespective of variety) to get 6,300 buds (after discarding the damaged buds). This is sufficient for 1 acre plantation of seedlings with 5 X 2 ft spacing even after deducting the wastage due to mortality in nursery and main field.
- Approximately 8-10 buds can be removed from each cane.

1.2 Chipping of buds

Bud chipping is done with the help of a machine called a Bud Chipper (as shown in the picture below). The Bud Chipper comprises a handle and a cutting blade fixed on a wooden plank.

- Hold the cane on the plank and adjust it in such a way that a portion of the single bud is placed exactly below the cutting blade. When the handle is pressed, a single bud chip comes off from the cane.
- About 500 buds can be chipped off in this way by two labourers in an hour.

Care should be taken to cut the chip in such a way that the healthy bud is at the centre of the chip

Table 1. Requirement of canes per acre

Age of the cane	7-9 months
No. of potential buds per cane	8-10
No. of canes required	700

1.3 Treatment of bud chips

It is important to treat the bud chips with various organic or chemical solutions before planting to avoid infestation. Approximately 100 bud chips weigh 1 kg. Bud chips can be filled in a 5 kg bag for treatment. This needs to be repeated 10-12 times in a day with the same solution to cover 6,300 buds. The bud treatment can be done in the following manner:

- Take a tub or drum (of 50 litres capacity), preferably made of aluminium or plastic.
- Pour 20 liters of water in the tub and dissolve the chemical or organic components as recommended in Table 2.
- Put the bud chips in a porous plastic/gunny bag or bamboo basket and immerse the bag/basket in the prepared solution for 20 minutes.

Table 2. Treatment solution for bud chips for 1 acre (6300 buds)

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

Bud treatment helps in 90 percent germination and subsequent health.

1.4 Nursery

An appropriate site, an assured water source, materials like plastic trays, coco-pith/saw dust, sieved Farm Yard Manure (FYM), gunny bags, polythene sheets and rose watering cans are necessary for setting up the nursery. The nursery area needs to be covered with a shade net (see Annexure) to provide shade to the young plants and to create favourable conditions like warmth and wind-free environment. The soil inside the net is drenched with Chlorpyriphos 50 EC (5ml/l) to control termites and care should be taken to avoid any weed growth. There are two methods by which farmers can raise seedlings in the nursery – Stacking of trays and pre-sprouting method.

For a 1-acre plot using 5X2 ft spacing, 120 trays (each with 50 cones, to accommodate 6,000 pre-sprouted buds) and 180 kg coco-pith are sufficient to raise the 5,000 seedlings needed (considering the mortalities in nursery).

The number of seedlings required will vary according to the spacing (considering the mortality in the main field) (refer to Table 3).

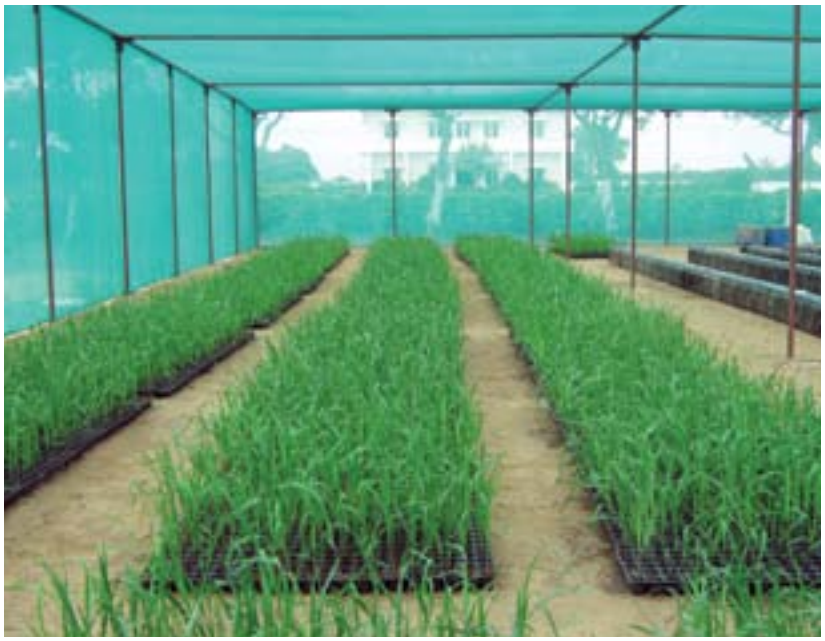


Table 3. Number of seedlings required per acre depending on the spacing (including 15 percent mortality)

Spacing	Number of seedlings
4 X 2	6,250
5 X 2	5,000
6 X 2	4,200
7 X 2	3,600
8 X 2	3,200

Take care to select healthy buds while:
a. Chipping,
b. Treatment,
c. Selecting from pre-sprouted lot and
d. Placing in trays.

t use the gunny bags that have sed for packing sugar. This ad to fungus infestation in the y.

1.4.1 Stacking of trays

In this method, the trays are filled with bud chips and stacked to create warmth. The following steps are to be taken for this:

- Keep the well-decomposed coco-pith ready near the trays. Fill half of each cone in the tray with coco-pith.
- Place the buds in a slightly slanting position in half-filled cavities of trays. Do not press or push them hard. Ensure that the bud side faces up.
- Then cover the bud chips in the trays completely with coco-pith.
- After filling all the trays, place them one above the other and finally, place an empty tray upside down on the top of the stack. This way, about 100 trays arranged in 4 sets (each set consisting of 25 trays) are to be placed together and wrapped tightly with polythene sheets. Place small weights on the bundles and keep them closed for 5 to 8 days in the same position, to create high temperature and good humidity.
- Care should be taken to avoid water, air or sunlight entering into the trays by tightly covering them with polythene sheets and keeping the bundles inside the shade net. Create artificial warmth by placing electric bulbs if the climate is somewhat cold. This is the most crucial phase of the nursery management. Under proper conditions (especially warm temperature), white roots (primodia) will come out within 3-5 days and shoots will also appear in the next 2 to 3 days.
- All the trays with sprouted buds are to be removed from the polythene sheet on or between 5th and 8th day (based on the sprouting under climatic conditions) and are then kept side by side on the polythene sheets spread on the ground to facilitate watering and other nursery management practices.

1.4.2 Pre-sprouting

In this method, the bud chips are allowed to sprout and then transferred to trays. This method is preferred during cold seasons.

- Spread 5mX10m polythene sheets in the corner of the shade net shed.
- Above those sheets, spread one layer of wet empty gunny bags to cover the entire surface.
- Above this layer, spread the gunny bags loaded with treated bud chips. The bags should be kept in a flat position and patted well in order to make the bud chips spread out all over within the bag uniformly.
- Above these bags, spread one more layer of wet gunny bags. Cover the gunny bags with a plastic sheet similar to the one spread at the bottom. All these gunny bags should be drenched in fungicide solution for 15 minutes before use.
- Keep this set-up intact and air tight for a week. Take care not to allow any water, air or light to enter inside the set-up.
- After 7 days, open the pack and observe for pre-sprouting of bud chips. Buds would show white roots (primordia) and tiny sprouts. The bud chips which display good signs of sprouting are transferred for filling in the trays.

- The remaining poorly and partially-germinated bud chips can be retained in the gunny bag packs. These bud chips can be periodically observed for sprouting (once in 3 days) and transferred to trays accordingly.
- The sprouted buds are transferred to the trays as shown in Section 1.4.1. trays are kept side by side on the ground. Cover these tray beds entirely with plastic sheets. This set-up has to be kept for another two days.
- After two days, observe the growth of the seedlings. In normal conditions, they would attain a height of about 2 inches. At this stage, polythene sheets can be removed and watering can be initiated.

1.4.3 Watering

- Based on the moisture content of the coco-pith, watering the trays (seedlings) has to be continued in the evenings for the next 15 days using rose watering cans. Shoots will start growing strong and leaves will start sprouting. After the appearance of two leaves, application of water can be increased gradually depending on the moisture level in the trays.

1.4.4 Grading

- During the 3-4 leaf stage (about 20-25 day-old seedlings), grading of the plants has to be done. Stop giving water for a day to loosen the coco-pith in the trays as this will enable easy removal of the young seedlings from the trays.
- Plants of similar age (and height) can be removed and placed in one tray. This way, grading of the plants according to their height is achieved and damaged or dead plants can be removed.

A group of 10 labourers can be made in-charge of one unit, assigning them with tasks such as the removal of cane leaves (2), chipping of buds (4) and other works (4).*

**Carrying canes to the chipping yard, collecting and treating them, taking them for pre-sprouting. Once the entire chipping process is over, all the 10 labourers can be involved in tray-filling, covering with sheets, watering, grading, etc.*

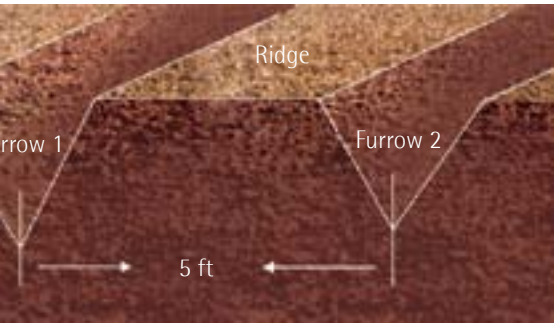
If the coco-pith in the cone is dry, water can be applied. If it is sticky, application of water should be delayed.

Planting in the main field

Deep ploughing of 10 to 12 inches is essential to facilitate better aeration of soil and infiltration of water into the soil.

Organic manure can be added before the last ploughing.

Furrows and ridges help in proper application of manure and optimum utilization of irrigated water.



2.1 Main field preparation

Main land preparation for sugarcane starts with clearing the preceding crop residues. Stubbles are to be collected and removed from the field. All other minor residues can be incorporated into the soil by a rotavator.

2.1.1 Tillage

- 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.
- After the tillage operation, the field should be deep-ploughed using a tractor.
- If the field is uneven, leveling should be done, preferably using a tractor-operated leveler. While leveling, a gentle slope can be maintained to facilitate easy movement of the irrigation water.

2.1.2 Application of organic manure

The SSI method encourages application of organic manure as much as possible as this enhances the macro and micro nutrient availability in the soil in an eco-friendly way. It helps in appropriate utilization of some of the chemical fertilizers and protects the soil from degradation and other hazardous effects.

- Apply organic manure like FYM/compost/well-decomposed press mud (about 8-10 tonnes/acre).
- Quantity of organic manure could be adjusted in such a way to supply 112 kg N/acre through one or more sources depending on their N content.
- Trichoderma, PSB, Azotobacter, Pseudomonas and decomposing cultures (4-5 kg in 500 kg of FYM/acre) can be mixed with the organic manures and applied in furrows. This will control soil pathogens and improve the soil fertility to realize higher yields.

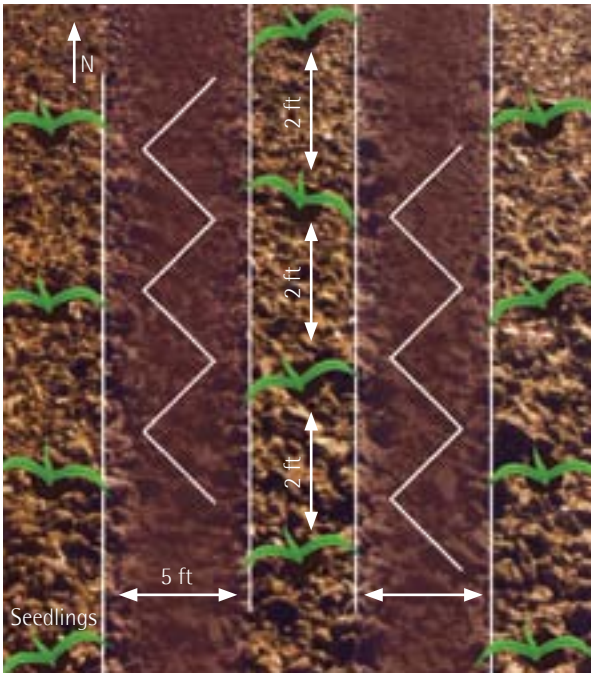
2.1.3 Making furrows and ridges

- Make furrows with a distance of 5 ft in between furrows.
- Run a sub-soiler attached to the ridger/plough through the furrow to loosen the soil. This will support proper incorporation of the manure, deep plantation and prevention of lodging.

2.2 Transplanting of the seedlings in furrows

The ideal age for transplanting young seedlings from the nursery to the main field is 25 to 35 days, as they will establish and grow better, with minimum loss due to transplantation shock. The following steps are to be taken while transplanting:

- After proper grading, stop giving water one day before transplanting. This will loosen the coco-pith in cavities and help in easy removal of the seedlings for transplantation.
- The zigzag method of planting can be followed to utilize more space and achieve maximum tillers (as shown in the picture).
- Plant-to-plant distance of 2 ft has to be maintained for easy sunlight penetration and profuse tillering.
- For better access to sunlight, follow a north–south direction of planting. However, the slope of the field should also be taken into consideration.
- It is better to put the seedlings in equally-distanced small holes (2 ft distance) made by pressing a hole with a wooden pole into the side of the furrow. Applying a recommended quantity of basal fertilizer mixed with organic manures (FYM/compost/well-decomposed press mud) adjacent to the holes before planting would help in boosting the growth of the seedlings.
- Seedlings are to be planted in the moistened soil in the furrows with a gentle thrust. Forced thrusting of the seedlings too deep may result in poor tillering.
- Do not place the seedlings in the middle of furrows, this will hinder the root growth.
- To moisten the soil, irrigate the field one or two days before transplanting. Similarly, irrigation is to be done immediately after planting. Water will fill any air gaps around the plant if soil compaction is not proper.



It is important to irrigate the field with a minimum quantity of water instead of flooding.

While planting care should be taken to avoid air gaps.

If the seedlings are pressed deep into the soil, this would drastically affect the seedling emergence and further tillering. So, great care should be taken during this activity.

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.

Maintaining wider spacing

In the conventional method, the distance between two rows is maintained at 1.5 to 2.5 ft and 16,000 three-budded setts (48,000 buds) are directly planted in the soil to achieve a normal population of 44,000 canes per acre. But unfortunately, only 25,000 millable canes are achieved at harvesting. With the SSI method of sugarcane cultivation, wide spacing of 5X2 ft between plants in the main field gives 45,000 to 55,000 millable canes because of more tillering. This wider spacing in SSI cultivation reduces the seed usage to mere 4000 to 5000 bud chips grown seedlings, compared to 48000 buds in three budded setts, 32000 buds in the two-budded setts and 16000 buds in one-budded setts in conventional cultivation. Most importantly, it also supports easy air and sunlight penetration in the crop canopy for better and healthier cane growth.

It is already mentioned in the manual that the furrows should be made with 5 ft between rows. Initially, farmers may prefer not to go beyond 3-4 ft distance, but after seeing the benefits of the 5 ft spacing, they gradually switch to wider spacing.

In the case of farmers going for multi-cropping with different rows of intercrops, furrows can be made at a distance of 6-8 ft and the in-between beds can be used to raise multiple intercrops, generating supplemental income.

- In places where there are chances of lodging due to heavy winds, a paired-row system of planting can be followed. In case of paired rows, distances of 2.5 ft between rows and 5 ft between two such paired rows are maintained. The plants in paired rows can be tied to each other in order to avoid lodging.
- A plant-to-plant distance is maintained at 2 ft within rows. Wider spacing helps in easy penetration of sunlight and air which helps in healthy growth of seedlings and controls pests and pathogens to some extent. Maintaining at least 5 ft distance between rows will become obligatory in the future, considering the spacing requirements needed for introducing mechanical harvesters in the fields.

Tillering in SSI

Tillering (the production of side shoots) is an inherent trait of grass species. There is a definite pattern of tillering in sugarcane. SSI methodology facilitates better tiller emergence and survival impacting on yields due to more number of millable canes eventually. Tillers arise from the buds of the bottom-most six internodes, which are highly compressed and not visible to the naked eye when the plants are young. Under normal conditions, tillers do not arise from the internodes above these six.

Corresponding to these six internodes, there are six leaf sheaths (Fig. 1). The first five are devoid of leaf blades (1 to 5 in the figure) and the sixth one has a rudimentary leaf blade (6 in the figure). The leaf sheaths removed from the seedling are shown in Fig. 2. The bottom-most leaf sheath is extremely short and the leaf sheaths upwards become progressively longer. The structure is invariably the same, whatever the number of seedlings examined and this can be taken as a thumb rule. Tillers do not arise from the internodes above the bottom six unless the shoot apex has broken, as can be seen in Fig. 3.

The portion representing the six compressed internodes and their buds (not visible to the naked eye), from where tillers appear later, are shown in Fig. 4. All the six leaf sheaths (that have been removed) that covered the buds arise more or less at the same place (within one cm space), so all the six internodes are highly compressed within this narrow distance.

The compressed internodes would become visible by around 45 days as shown in Fig. 5. Leaf sheaths and sett roots have been removed to provide clarity in this figure and shoot roots can be seen emerging from these compressed internodes. It may be noted that sprouting has not started yet. It can also be seen that the normal internodes above this portion are longer and do not give out shoot roots, indicating that the buds from these will not sprout and give out tillers.

Tillers start emerging from around 60 days, as seen in Fig. 6. One tiller has already emerged and three others have started emerging.

Under ideal conditions, the above pattern of tiller emergence from the mother shoot could be repeated for every tiller that has formed. Thus, if there are four primary tillers from the mother shoot and each one of them gives four secondary tillers, the plant would have 21 tillers [i.e., 1 + 4 + (4x4)]. Under SSI methodology, around 20 tillers or more per plant are quite possible, provided that (a) the soil is fertile and loose, (b) spacing between plants is adequate to trap enough solar radiation and (c) if there is no shading due to intercrops or other factors.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

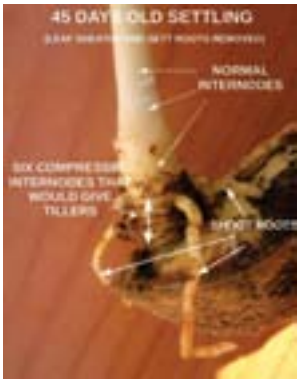


Fig. 5

Fig. 6

Providing sufficient moisture and avoiding flooding of fields

requirement for ane is usually an average akh litres/acre for a full including rainfall keep alternating between and hectares). However, conventional method of rrigation, 80 lakh litres/ f water is applied by on alone.

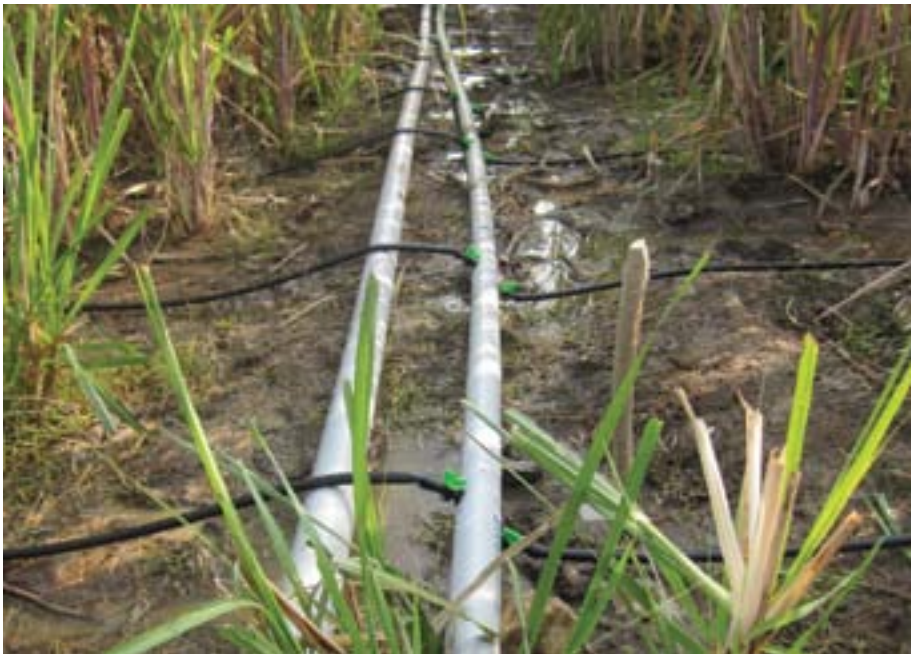
In SSI, water management is another crucial issue. It is emphasized that plants be provided with sufficient moisture, rather than inundating the field with water. Flooded condition during the crop formation stage will actually hinder the growth of the plant. By giving only the required quantity of water, about 40 percent of water can be saved with more rather than less yield. Measures like raising of nursery, following furrow/alternate furrow irrigation and optimum application of water through drip irrigation are recommended. It is always better to provide plants with sufficient quantity of water on time rather than continuously flooding the field with enormous amounts of water.

y and alternate furrow on can be followed to save up to 50 percent.

- In the conventional flooding method, more water is always applied than the crop's biological demand which affects the crop's growth.
- After transplantation, the best frequency of the irrigation will differ depending on the soil type, age of the crop, rainfall and moisture availability. For sandy soils, the frequency will be more and for clay soil it will be less.
- 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).
- Furrow irrigation helps in proper application and saving of water. Alternate furrow irrigation means irrigating the furrows with odd numbers initially, followed by irrigating the furrows with even numbers after 7 to 15 days, as per the moisture content of the soil and the age of the crop. This will ensure saving of water up to 50 percent.

drip system, irrigation ncy improves by up to 90 t and water is saved up to percent. Consumption of city is also reduced.

- Drip irrigation can be practiced more effectively in SSI due to wider spacing and the planting of single seedlings.



SSI, about 5 irrigations e saved as the germination (up to 35 days) is spent nursery.

Encouraging organic methods of nutrient, plant protection and intercultural practices

The SSI method discourages high application of chemical fertilizers and use of pesticides and weedicides. Farmers should incorporate more organic manures and bio-fertilizers and follow bio-control measures as much as possible for best results.

A sudden switch over to organic cultivation is not advisable in most soils as populations of soil organisms that have been unbalanced or inhibited by large inorganic nutrient supplies need some time to build up. Instead, a gradual reduction of inorganic inputs and adoption of organic methods can be tried by farmers for long-term benefits.

Organic inputs will over time improve the structure and functioning of soil systems as the abundance and diversity of soil organisms improves.

Fertilizer application

Like any other crop, nutrient management in sugarcane cultivation is essential for good crop growth.

- Soil testing is a prerequisite to know the nutrient status and for enriching the soil accordingly. If there is no such facility, then NPK can be applied at the rate of 112 kg N, 25 kg P and 48 kg K per acre, respectively, through inorganic or organic methods.
- Inorganic fertilizers like Urea, Di-Ammonium Phosphate (DAP), Muriate of Potash (MoP) and Ammonium Sulphate can be applied to achieve the above-mentioned nutrient requirement where supplies of organic nutrients and material are insufficient.
- As per the specific requirement of the soil, based on the lab test results, appropriate fertilizers can be identified and their doses can be calculated and applied in split doses as basal, first, second and further top dressings.
- It is observed that by practicing appropriate cultivation practices like wider spacing, spot application, earthing up and mulching, the required quantity of NPK can be supplied to the plants by applying appropriate or less quantity of these fertilizers.
- The most appropriate method of applying fertilizers is by mixing them with organic manures, neem cake, etc. and spot applying them through furrows at the root zone (2-3 inches away from roots). This will enable gradual release of nutrients supported by microbial activities.
- Applied fertilizers should be covered immediately with soil to avoid losses like volatilization. It is better to irrigate the furrows once the applied fertilizer is covered well with the soil.

It may be essential to apply micronutrients like iron, zinc, manganese, copper, molybdenum and boron if evaluations show that there are certain deficiencies in the soil.

It is generally not good to apply fertilizers beyond 120 days, as this might reduce the juice quality.

- It is best to apply the fertilizers through drip irrigation (fertigation), which increases the fertilizer use efficiency of the crop and saves much of the input cost to the farmer.
- The recommended quantity of fertilizers can be applied in split doses (basal, 30, 60, 90 and 120 days after planting) for the efficient utilization by plants. Table 4 can be referred to for this purpose. However, the dosage should be decided based on the soil fertility status of the particular field, which is properly analyzed by soil testing.
- Further, by applying organic manures at the time of field preparation or by raising and incorporation of green manures or *Navdhanya* into the soil, sufficient quantity of nutrients can be supplied for plant growth. In addition, application of bio-fertilizers like azospirillum and phosphobacteria, 2 kg each on 45th and 75th day after planting, by mixing it with FYM (200 kg/acre) or periodic application of *Amruthpani* along with irrigation would also improve the crop growth. The manures should be applied in the sides of furrows and incorporated into the soil while earthing up.

Table 4. Fertilizer dosage recommended for field application (per acre)*

Dosage	Days after planting	Fertilizers and their quantity (kg)			
		DAP	MoP	Urea	Amm. Sulphate
Basal Dose	0	35	20		
Top dressing - 1st	30	20		25	
Top dressing -2nd	60		30	75	
Top dressing -3rd	90		30	100	
Top dressing - Final	120				50
Total		55	80	200	50

*Although the general recommendation is 112:25:48 kg NPK per acre, farmers need to follow the dosages as per the recommendations based on soil testing results.

eral options are available for organic methods of plementing soil nutrients with low cost. *Navdhanya* is a nbination of 9 fairly fast-growing crops that are grown incorporated into the soil to enrich the soil's nutrient ply as given below (for an acre):

le 5. *Navdhanya* nbinations

ops	Quantity (kg)
nhemp	2
incha	2
ngelly	0.2
ck gram	1
een gram	1
w pea	1
riander	0.5
nugreek	0.5
arl millet	0.5

These grains can be broadcast in the inter-space bed, one week after the sugarcane planting. After 45 days, they can be incorporated into the soil in situ. This practice can be followed two times in a season for enriching the soil with various needed nutrients. Based on availability, one or two of the crops listed here can be replaced with local ones.

Amruthpani is a solution of the following ingredients (for an acre), used for boosting crop growth:

Table 6. *Amruthpani* combinations

Ingredients	Quantity
Cow dung	20 kg
Jaggery	1 kg
Chickpea flour	1 kg
Gingelly oil	200 ml
Cow urine	5 l
Bio-fertilizers or oil cakes	5 kg
Local soil	0.5 kg

The above-mentioned products can be dissolved in 100 litres water in a drum. The drum can be kept in a shaded place for 5 days. The ingredients should be thoroughly mixed at periodical intervals. They can be applied through irrigation water 4-5 times in a season.

Weed management

A weed-free environment is absolutely essential for efficient intake of nutrients. This can be achieved by:

- Deep ploughing and removal of perennial weeds.
- Hand weeding and mechanical weeding 130, 60 and 90 days after planting are better for long-term benefits. Other appropriate measures to control the weeds should be practiced to minimize the production loss.

Mulching

Trash mulching is important in sugarcane cultivation as it helps in checking the weeds and providing needed moisture.

- Sugarcane trash can be applied 21.5 t/acre within 3 days of planting. Similarly, after detrashing the removed leaves can be applied in the inter spaces as mulch.
- These trash supplies can be cut and incorporated into the soil with the help of a power tiller. Wider spacing between rows allows easy execution of this practice, even in the ratoon stages.

Mulching is the best practice to control weeds.

Mulching will help develop earthworms, which in turn will improve the soil's aeration and its infiltration of water.

Earthing up

Earthing up means application of soil at the root zone to strengthen the crop stand.

Normally, two earthing up procedures – partial, small and full, or heavy – are followed during a crop period.

- Partial earthing up is done on the 75th day after planting, essentially to disturb the roots a bit and hence to trigger more tillers in the initial stage of the crop. In this case, a little soil from the side root zone is lifted up and spread across the row using a spade.
- Full earthing up is done on the 120th day after planting. In this operation, soil from the ridge is thrown on both the sides of the plant towards furrows and these furrows will become ridges and vice versa. The newly-formed furrows will be later used for irrigation. This heavy earthing up helps in controlling further production of tillers and provides sufficient anchorage to the crop against lodging.

Earthing up around the base of sugarcane plants helps in:

1. *Triggering new tillers*
2. *Providing better aeration*
3. *Covering of applied fertilizers*
4. *Better root development*
5. *Arresting the growth of water shoots*
6. *Sufficient anchorage*
7. *Preventing lodging*

shing helps in:
an cultivation
y movement of air into the
p canopy
duction in pests
y intercultural operations
tached leaves can be
d in mulching or compost
paration

Detrashing

Detrashing means removal of excess and unproductive leaves from the plants. Sugarcane produces a large number of leaves. A normal stalk, on an average, bears 30-35 leaves under good growing conditions. But, for effective photosynthesis, only the top 8-10 leaves are sufficient. Most of the bottom leaves would not participate in the process and eventually dry. But they would compete for the nutrients which otherwise could be used for stalk growth.

It is important to remove the lower dry and green leaves during the 5th and 7th month and apply them as mulch in the interspaces. This would avoid accumulation of pests and pathogens under leaves. But if the leaves remains green and healthy, not senescing, they would not be accumulating pests and pathogens .

Propping

Propping means giving support to the canes to avoid lodging. Normally, this is done by tying the canes one another with leaves. Leaves are the factories that produce sugar (starch) and the stem is the godown that stores them. Especially, middle-level green leaves contribute a lot in sugar production and thus the practice of propping by using those leaves to tie canes together should be avoided.

- Propping can be done in the 7th month, either by tying the canes in each row, or by bringing the canes of two rows together and tying them (in case of a paired-row system).
- It is advisable to use the dry bottom leaves for propping and to avoid young green leaves in the middle.
- Trees like Casuarina, Sesbania grandiflora, etc., can be raised across the wind-blowing directions to act as wind breakers and to avoid lodging of sugarcane.

Plant Protection

Like every crop, sugarcane should be protected from pests and diseases. Following are some of the major pests and diseases and their control measures.

Pests:

Early Shoot Borer (ESB)

Chilo infuscatellus; F: Crambidae; O: Lepidoptera

Symptoms:

Dead heart in a 1-3 month-old crop, which can be easily pulled out. The rotten portion of the straw coloured dead heart emits an offensive odour. A number of bore holes can be seen at the base of the shoot just above the ground level.

Management:

Plant seedlings during December-January to escape the incidence, with trash mulching of 10–15 cm thickness at 3 days after planting. Do earthing up on the 30th day and ensure adequate moisture. Remove and destroy dead hearts. Apply Baveria basiana @ 5kg/acre along with FYM.

Other options include: Release of 50 fertilized Tachinid parasite Sturmiopsis inferens/acre when the crop is at the age of 45-60 days. Soil application of Carbofuran 3G (33 kg/ha) and Monocrotophos 36 SL (1 litre) or Endosulfan 35 EC (1 litre) or Chloropyriphos 20 EC (2 litres) per hectare and Corezin spray (150 ml/acre) before 90 days.

Internode Borer (INB)

Chilo sacchariphagus indicus; F: Crambidae; O: Lepidoptera

Symptoms:

Internodes are constricted and shortened with a number of boreholes and fresh excreta in the nodal region. Affected tissues are reddened.

Management:

Collect and destroy the eggs periodically. Detrash at 150 and 210 days after planting. Avoid use of excessive nitrogen fertilizers. Use Egg parasitoid Trichogramma chilonis @ 10 cards/acre at 20 meters distance from 4th month onwards at 15 days intervals. Pheromone traps @10/acre at 20 meters distance) in the 5 months old crop. Male moths can be trapped and killed.

Top Shoot Borer (TSB)

Scirpophaga excerptalis;
F: Pyralidae; O: Lepidoptera

Symptoms:

In grown-up canes, a dead heart which is reddish brown in colour is seen. Parallel rows of shoot holes are seen in the emerging leaves and red tunnels in the midribs of leaves; bunchy tip/top due to the growth of side shoots from sprouted top buds. Larva bore into the unfolded leaves (into the midrib) and mine their way to the base.

Management:

Collect and destroy the egg masses. Release of parasite, Isotima javensis Rohn against 3rd or 4th broods of the pest. Apply of Furadon @ 30 Kg/acre either in the last week of June or first week of July.

Termites

Odontotermes obesus: F: Termitidae; O: Isoptera

Symptoms:

Poor establishment of seedlings (after transplanting) and bud chips of seedlings hollow inside and may be filled with soil. Characteristic semi-circular feeding marks on the margin of the leaves in the standing crop. Entire shoot dries up and can be pulled out. Cane collapses if disturbed; rind is filled with mud.

Management:

Locate and destroy the termite colony. Destroy the affected seedlings. Soil treatment: Lindane 1.6 D @ 50 kg/ha. Fumigation with Aluminium phosphide @ 2 tablets/meter diameter mounds. Apply 2.5 litres of Chloropyriphos with irrigation or drenching both sides of the plant rows with 5 litres of Chloropyriphos (20 EC). Confidore (@350 ml/acre) is also effective.

White Grub

Holotrichia consanguinea;
F: Melolonthidae; O: Coleoptera

Symptoms:

Leaves become yellowish and wilt. Crowns dry up. Affected canes come off easily when pulled. Pest causes extensive damage to roots. Fleshy C-shaped grubs, which are whitish yellow in colour, are found close to the base of the clump.

Management:

Set up a light trap to attract and destroy the adults during the early rains. Provide adequate irrigation. Crop rotation in endemic areas. Collect and destroy the adult beetles on trees like Azadirachta indica (neem), Ailanthus excelsa and Acacia sps. Apply Lindane 1.6 D @ 50 kg/ha near the root zone.

Pyrilla

Pyrilla perpusilla,
F: Lophopidae, O: Hemiptera

Symptoms:

Yellow leaves, covered with black sooty mould; top leaves get dried up and lateral buds germinate.

Management:

Avoid excessive use of nitrogenous fertilizers. Set up a light trap and detrash at 150 and 210th days of planting. Apply Malathion 50 EC (2 litres) or Endosulfan 35 EC (2 litres/ha).

Mealy bug

Saccharicoccus sacchari,
F: Pseudococcidae,
O: Hemiptera

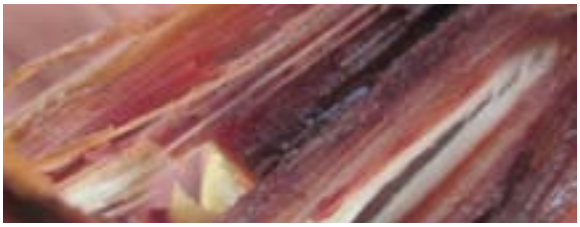
Symptoms:

Pinkish oval insects beneath the leaf sheath on the nodes, with whitish mealy coating; main cane stunted; also it attack roots. Sooty mould develops on the plant.

Management:

Detrash at 150 and 210 days of planting. Drain excess water. Apply Methylparathion 50 EC (@ 1 litre/ha) or Malathion 50 EC (1 litre/ha).

Diseases



Red Rot

Colletotrichum falcatum

Symptoms:

Discolouration of young leaves. The margins and tips of the leaves wither and the leaves droop. As the disease advances, the entire stem rots and central tissue becomes pithy. The internodes shrink and the cane splits open; large cavities may be found in the center. Leaves show symptoms in the form of dark red lesions in the midrib, which elongate, turning blood red with dark margins. A sour alcoholic smell emanates from the tissues.

Management:

Select planting material from healthy cane and collect seed from only disease-free area. Bud chips are treated by dipping in 0.1 percent Carbendazim for 15 minutes. In the standing crop if one of the stools becomes infected, the canes are to be collected and destroyed by burning. Follow crop rotation.

Whip Smut

Ustilago scitaminae Syd.

Symptoms:

Affected plants produce a whip-like structure, several feet in length and curved in on itself. It comes out from the central spindle at the apex. In its earlier stages, the smut-like powder on this whip-like outgrowth is covered by a white, silvery, thin membrane, which soon ruptures and flakes off, exposing a dense black powdery dust.

Management:

Remove smutted canes in thick-cloth of gunny bags and destroy them. Discourage the practice of ratooning of that crop. Avoid chipping buds from smutted canes and use seed cane from healthy fields. Treat seed with Carbendazim @ 2g/litre of water in the nursery.

Grassy Shoot Disease (GSD)

Mycoplasma like Organism (MLO)

Symptoms:

A number of thin tillers will emerge from the base of the infected cane. These tillers have pale yellow or completely chlorotic and white leaves. Cane formation does not take place in such tillers.

Management:

Use only healthy seed cane for chipping of buds. Pull out diseased cane and destroy them. Bud treatment with hot water (50 degree centigrade) will kill the pathogens and prevent its spreading.

Pokka Boeing

Fusarium moniliforme

Symptoms:

Chlorotic condition at the base of the young leaves, accompanied with distortion, wrinkling, twisting and shortening of young leaves.

Management:

Using of resistant variety. Treat the buds with 0.1 percent Bavistin.

Wilt

Cephalosporium Sacchari

Symptoms:

Affected plants appear wilted and conspicuously stunted. The crown leaves turn yellow, lose turgor and eventually wither.

Management:

The fungi gain entry mainly through injuries or holes made by borer insects. Disease spreads through infected planting material. So, it can be managed using healthy buds for nursery, by crop rotation and by optimization of soil moisture. Controlling root borers may considerably prevent wilting.

Intercropping for effective utilization of land

SSI supports intercropping within sugarcane stands with crops like wheat, potato, cow pea, french beans, chick pea, water melon, brinjal, etc., as there is wide spacing between the rows. In addition to more effective utilization of land, this practice will reduce the weed growth up to certain level and give extra income to farmers. Depending on location-specific factors, different intercrops may be tried.

- It is advisable to select nitrogen-fixing legume crops as intercrops, as they fix atmospheric N and improve the nutrient status of the soil upon incorporation after harvest.
- Intercrops also act as live mulch and preserve moisture and reduce the pest attack by being alternate hosts in some cases. Green manures raised as intercrop improve the soil fertility on incorporation.

Intercrops control weeds to a major extent in the initial stage and provide extra income to farmers.

Harvesting

Harvesting is the most important stage in cane cultivation, as it requires appropriate timing and methods to perform this activity.

- Farmers' harvesting of sugarcane is practiced in collaboration with the industry, in most cases, to suit factory schedules. Sucrose content in the plants will reach the most desirable level in the 10th month of the one-year crop duration and canes will be ready for harvest within the next two months.

Sucrose content in the plants will reach the desirable level (above 16 percent) at the 10th month of a one-year crop.

- While harvesting, care should be taken to cut the canes from the base, preferably 5 cm below the ground using axe or similar kind of implements. Improper harvest using sickles would result in the high-sucrose-containing bottom part of the plant being left in the field itself, resulting in reduced cane harvest and less sugar yield. Harvesting using an axe is also preferable as there is no need of stubble shaving in the case of ratooning.

Unless there was a severe disease attack on the previous crop, trash burning should be avoided after the harvest. Otherwise, burning of trash will destroy the beneficial microbial population rich in the top layer of fertile soil.

Ratoon management

For successful ratooning, plant crops should be harvested when the weather conditions are conducive for stubble sprouting, neither too cold nor too hot.

After the harvest of mature crop, buds, on the left over underground stubbles germinate again and give rise to another crop. This crop is called "ratoon crop". It is the most commonly followed and important practice in sugarcane cultivation. In this manner several ratoons can be taken from a single plant crop with proper nutrition and irrigation as well as pest and disease management. As compared with plant crop, the cost of ratoon cultivation is 30-40 percent less since the costs of land preparation, seed canes, planting, etc., are avoided in ratoon crop. If well managed, the ratoon can give better yields with better juice quality and sugar recovery in comparison to the plant crop.

Plant crops should be harvested when the weather conditions are conducive for stubble sprouting. Harvest first ratoon crop preferably in February. Low temperatures will adversely affect sprouting of buds if harvested in December to January and may result in poor ratoon crop. Avoid ratooning of pest and disease infected plant crops.

Avoid ratooning of pest-affected and disease-infected plant crops.

Following better management practices are recommended within a week after harvesting the plant crop to maintain good ratoon crop and achieve higher yields with reduced costs of cultivation.

8.1 Stubble shaving

- The stubbles just above the ground level should be cut using a very sharp blade.
- This helps the healthy underground buds to sprout and establish a deeper root system.
- The deeper root system thus obtained facilitates optimum utilization of the nutrients and moisture available in the lower soil layers and provides good support for the growth of the ratoon crop.

8.2. Off-barring

- It is an operation wherein the ridges are broken or cut on either side using a plough.
- This will remove older roots and loosen the soil to develop better root system and thereby contributing towards better absorption of nutrients and water.

8.3. Basal dose of fertilizer

- 50 kg DAP, 40 kg Potash, 140 kg Urea and 10 kg Zinc Sulphate mixed with 500 kg compost per acre be applied soon after stubble shaving and off barring and covered with soil or by placement method.

8.4. Trash mulching

- Dried leaves of first ratoon are to be spread on the ground between the rows.
- Light irrigation should be given in order to provide moisture for better root and shoot sprouting.

8.5. Spray for protection and boost the growth

- Prepare a solution with Chloropyriphos (400 ml), Carbendazim (400 gm), Urea (4 kg) and Biozyme (400 ml) in 200 litres of water to cover one acre.
- Spray it on shaved stubbles to prevent pests and disease attack and boost growth of stumps and tillers.

8.6. Gap filling

- If there are no cane clumps for a distance of more than 60 cm or so, it can be considered as a gap.
- Uproot clumps with excess sprouting, cut into quarters, dip them in chemical solution (Chloropyriphos @ 2 ml and Carbendazim @ 20 gm in one litre of water) and plant in the gaps. Then newly planted settlings are watered soon after.
- Gap filling can also be done using the seedlings raised in the nursery.

Besides the above mentioned practices, all the other crop management practices like irrigation, weeding, subsequent doses of fertilizers, earthing up, detrashing and propping should be continued as done for plant crops. Ratoon crops mature one month prior to the plant crops. In the conventional method of sugarcane cultivation, ratoon crops are maintained for only a maximum of two seasons but farmers practicing SSI methods would be able to achieve 5 to 6 ratoon crops.

Ratoon crop needs more nitrogenous fertilizers compared to plant crop (double the quantity).

Ratoon crop matures earlier than the plant crop.

Varieties

Any variety that is normally cultivated in an area will be suitable for SSI also. However, care should be taken while chipping the buds in a variety with larger buds, since the buds in such varieties are more prone to damage. The most important aspect in SSI is an increase in tillering. There are genetic differences for tillering propensity between sugarcane varieties. For example, CoC 671, a very high sugar-content variety, has thicker canes compared to Co 86032, but it has lesser tillers. In SSI, since wide spacing is adopted, the differences between varieties for tillering ability appear to narrow down considerably.

The major varieties that are under cultivation in different states where sugarcane occupies a significant acreage are given below and any variety suitable for the region can be used for SSI.

Varieties used in different States of India

Tropical conditions

Maharashtra	:	Co 86032 and CoM 0265
Tamil Nadu	:	Co 86032 and Co 99004
Karnataka	:	Co 86032 and CoC 671
Andhra Pradesh	:	Viswamitra, Krishna, 83 V 15, Co 86032, 86 V 96, Co 7805 and Co 8368
Gujarat	:	Co 86032, Co 86249, Co 86002 and Co 95006
Madhya Pradesh	:	Co 86032, CoC 671 and CoJn 86141
Odisha	:	Co 86032 and CoM 0265

Subtropical conditions

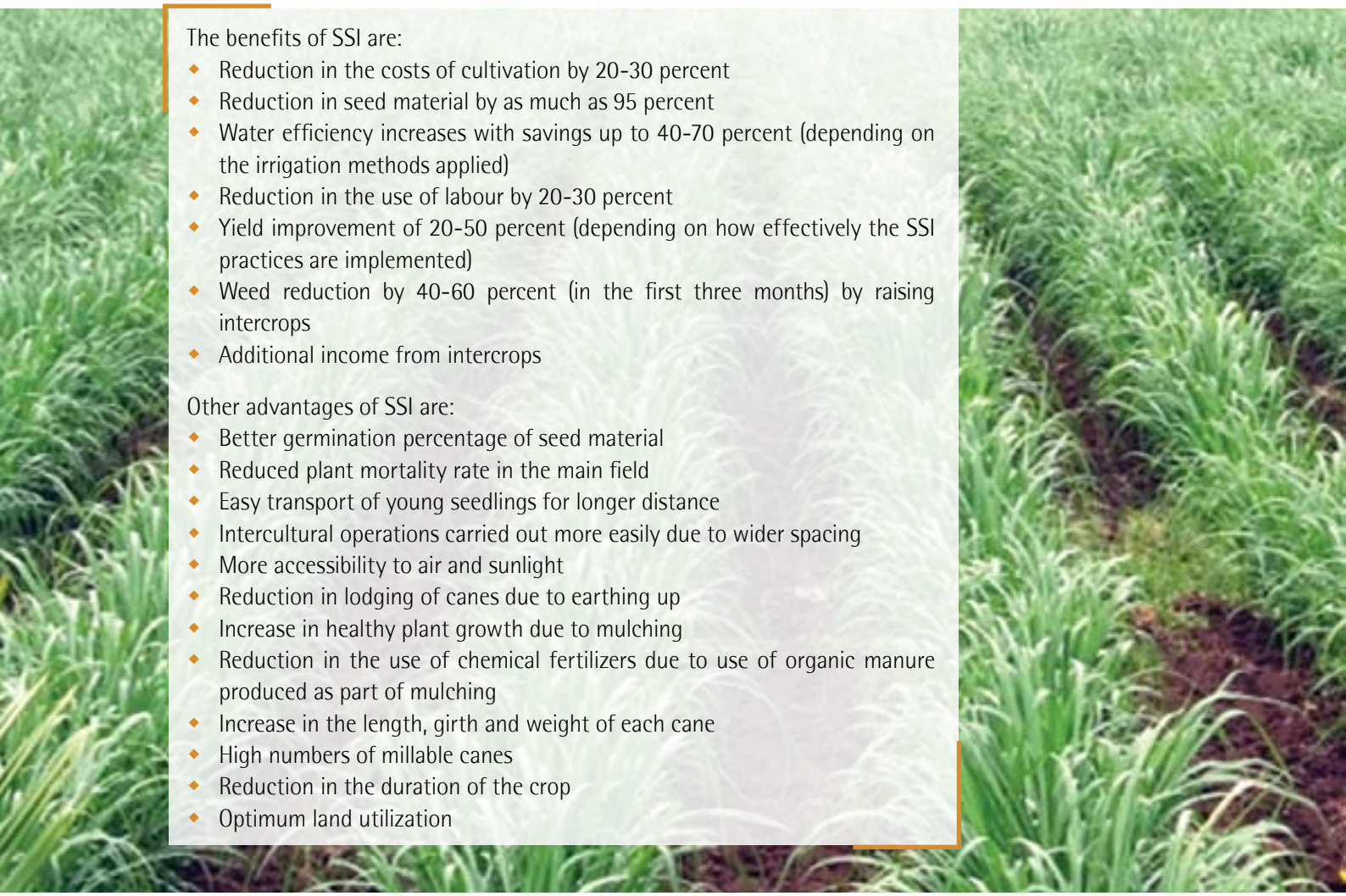
Uttar Pradesh	:	Co 0238, CoS 8436, CoS 8432 and CoS 88230
Haryana	:	CoH 119, CoS 8436 and Co 89003
Bihar	:	Bo 91, CoSe 95422, CoSe 92423 and CoP 9301
Punjab	:	CoS 8436, CoJ 83, CoJ 85 and CoJ 89

Summary

Sustainable Sugarcane Initiative (SSI) is a method composed of better management practices that involves use of less seeds, less water and optimizing utilization of fertilizers and land to achieve more yields and greater profits for farmers and millers alike. It is an alternative to the conventional seed, water and space-intensive sugarcane cultivation.

When all the principles and practices of SSI are followed, they would work synergistically to improve the cane quality and productivity and reduce the inputs to achieve higher yields and extra income from intercropping.

When planting as per the SSI methodology, in addition to increasing the tillering ability of the variety, the practices also increase the individual weight of the canes with enhanced height and girth. Early planting of the seedling enables the plant to develop a stronger root system (shoot root) and synchronous and healthy tillers because of abundant sunlight available and efficient use of water and nutrients. There is quicker growth, subsequently increasing the productivity. Moreover, intercropping during the cane cultivation cycle yields 20 percent additional profits on investment.



The benefits of SSI are:

- Reduction in the costs of cultivation by 20-30 percent
- Reduction in seed material by as much as 95 percent
- Water efficiency increases with savings up to 40-70 percent (depending on the irrigation methods applied)
- Reduction in the use of labour by 20-30 percent
- Yield improvement of 20-50 percent (depending on how effectively the SSI practices are implemented)
- Weed reduction by 40-60 percent (in the first three months) by raising intercrops
- Additional income from intercrops

Other advantages of SSI are:

- Better germination percentage of seed material
- Reduced plant mortality rate in the main field
- Easy transport of young seedlings for longer distance
- Intercultural operations carried out more easily due to wider spacing
- More accessibility to air and sunlight
- Reduction in lodging of canes due to earthing up
- Increase in healthy plant growth due to mulching
- Reduction in the use of chemical fertilizers due to use of organic manure produced as part of mulching
- Increase in the length, girth and weight of each cane
- High numbers of millable canes
- Reduction in the duration of the crop
- Optimum land utilization

ize of Shade net shed required for nursery (1 acre)

Total number of trays needed for nursery (1 acre):

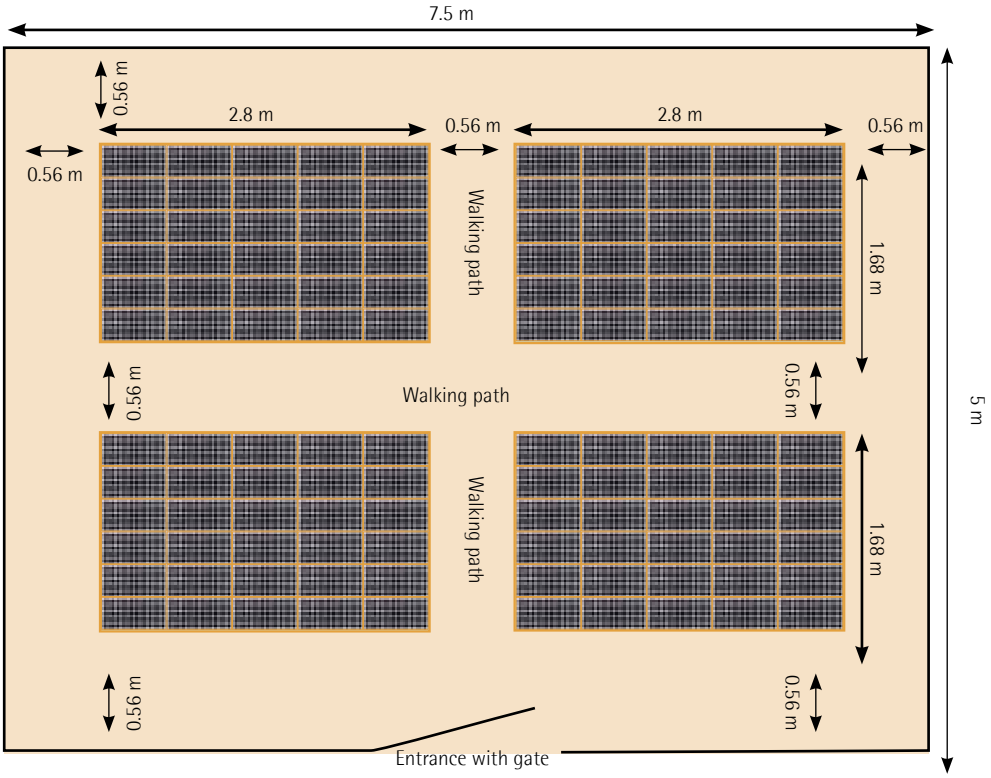
Spacing	Number of trays
4x2 ft spacing	145
5x2 ft spacing	120

Size of shade net shed: length 7.5 m, width 5 m, height 3 m at the centre and 2.5 m in the sides. This set-up will accommodate up to 120 trays (of 50 cavities each) as shown in the picture. Depending on the space available, area to be covered and spacing to be followed, the size of the shed can be extended and seedling beds can be increased accordingly. During the rainy season, a plastic sheet can be placed at the top of the shed to avoid heavy downpour on the trays.

f a tray (50 cones)

0.56 m

Size of shade net shed required for nursery (1 acre)



The necessary materials can be obtained from concerned manufacturers or from horticulture and forest nursery equipment suppliers locally.

l "internets" way to Cuba

Dr. Rena S. Perez

z graduated from Cornell University with a B.S. degree in agriculture and in entomology. She has lived and in Cuba with her Cuban husband 959. She worked in the Institute of Science in Havana, 1964-70 while a PhD in poultry science. For the years, she worked in pig production llowing that until her formal ent in 2000, she worked in animal ion in the Ministry of Sugar. When ned about SRI in that year, she began ing the new methodology through ar cooperatives with which she had sly worked. For the past decade, she ved as volunteer coordinator of SRI s in Cuba and is now trying to get tainable Sugarcane Initiative (SSI) ced and evaluated in Cuba.

everal months ago, I received from Dr. Norman Uphoff of Cornell University, an email message with an accompanying file labeled with the letters SSI. I thought it a mistake that he had meant to write SRI, not SSI, certainly an easily made keyboard mistake. The email explained how a friend in India, Dr. Biksham Gujja, an ecologist and formerly a senior advisor with the Worldwide Fund for Nature in Switzerland, was working with something called 'the Sustainable Sugarcane Initiative' (SSI).

Dr. Norman Uphoff and Dr. Rena Perez with a rice farmer Mr. Roman Armelo

Dr. Gujja had given leadership for SRI dissemination in India from 2004 on after sponsoring three years of scientific evaluation of SRI by leading research institutions in India. After some SRI farmers started extrapolating and adapting the new ideas to improve the production of sugarcane, he launched SSI with support from WWF and an international agricultural research center based in Hyderabad, India (the International Crop Research Institute for the Semi-Arid Topics, ICRISAT).

I read the email immediately, being struck by the report that a first on-farm trial in India had increased the farmer's cane yield from 35 to 110 t/ha. Then I hurriedly opened the file to find a training manual on Sustainable Sugarcane Initiative.

Having worked with 156 sugar mills in the cane sector (advising on animal production, as an animal nutritionist) for 17 of the 52 years that I have lived in Cuba, I couldn't believe my eyes. Cuba, which at one time had

Location map

Two months old SSI fields

produced almost 10 percent of the world's production of sucrose from sugarcane, between 7 and 8 million tonnes) is at present barely able to reach 1 million tonnes, from harvesting a national sugarcane crop that averages only 37 t/ha. It broke my heart.

I was reminded of a 1986 visit to the "La Romana" sugar mill in the Dominican Republic where I saw the incredible results from pig-fattening based on free-choice sugar cane juice and a restricted daily amount of soybean meal. From this visit, I worked with the CPA "Camillo Cienfuegos" in Bahia Honda, Cuba, to set up a similar system there.

In 2000 when Dr. Uphoff provided us with information on the methodology on SRI (now known as SICA in Cuba and elsewhere in Latin America), this same cane coop, with 16 ha dedicated to rice to feed its workers, tried out the new methods and these quickly caught on, almost doubling the CPA's yield. I will never forget that they had to double the size of their concrete rice drying area because of the yield increase with SRI.

The day after I received the file related to SSI, I forwarded it to this same coop. However, no one ever acknowledged receipt. It's the way things often happen in Cuba. That was more than three months ago.

Last week, I was scheduled to give a talk on rice on SRI in a research center at Los Palacios, in Pinar del Rio. When I arrived and didn't see many cars, so I thought: maybe I made a mistake, wrong place? Wrong day? It was the latter, so in order to sort of self-vindicate I drove across the Sierra de los Organos (mountains) to Bahia Honda on the north coast with the objective of visiting the "Camilo Cienfuegos" cane coop, to leave them a copy of the SSI document that I had on my flash stick (Since they hadn't acknowledged having received the file, quite possibly too large for the island's digital setup, I assumed they never had received it.)

When I entered the coop head office, I asked if they had ever received the file on SSI which I sent. Blanco, the Chief Economist answered: "But the first plants have been in the ground already for two months. Let's go see them!"

SSI Nursery

Mr. Jose Antonio Espinosa and Dr. Norman out at the rice field

Rena Perez
Havana 11/11

Ta Nadu to take up sustainable su cane initiative on 10,000 ha

Successful agricultural practices should be documented

ON INCREASING YIELD: S.K. Misra (centre), Executive Director, Development, releasing a book at a seminar on 'Sustainable Sugarcane Breeding Institute and Agfri at Tamil Nadu Agricultural Wednesday. Chairperson of Agfri, Hyderabad, Bikshum Gujja (left) are in the picture. — PHOTO: M. PERIASAMY

initiative to boost sugarca ne yield

PRODUCTIVITY:P. Subbian (second right), Registrar, Tamil Agricultural University, releasing a book on Sustainable garcane Initiative at the university in Coimbatore on

ORE: The System of Rice Intensification (SRI) greatly reduces quirement and ensures higher yield, less chaff and better

Sweet Revolution, 2009! SSI gives birth to Neo-Agriculture

May 27, 2009

Revised 29 May 2009 at 0949 Manila time

SWEET LOVE C12H22O11. Sweet lovers C7H5NO3S. Quite simply, I like my sugar sweet, not artificially saccharine. I like it harvested from the field rather than from the lab; I like it cultured on soil rather than cultured on Petri dishes or whatever. I want to be in the US, the home of the brave and the land of the free, but I don't want to be sugar-free.

I'm in the Philippines; I am a farmer's son; I am part of the island – I prefer the natural to the man-made. Today, I want to talk nicely about sweetness. Grown by mild-mannered chemists in immaculate facilities, C7H5NO3S. Saccharin is sweet; grown by tough-talking farmers on uneven farms

My costs came down by Rs. 3000/- in SSI. I got a harvest of 21 tonnes and gained 3 times greater profit of Rs. 26930/-, all this from just 0.37 acre of land.

Sanjib Sahu
Farmer, Tripura Village,
Nayagarh District, Odisha

Sustainable Sugarcane Initiative (SSI) can save water and at the same time increase productivity, if implemented seriously.

Shri. Sharad Pawar
Hon'ble Agriculture Minister,
Government of India

I congratulate Dr. Biksham Gujja and his associates... for adapting the water conservation principles inherent in the System of Rice Intensification to sugarcane.

Prof. M.S. Swaminathan
Chairman,
M.S. Swaminathan Research Foundation

The Hindu, Date 06-May-2009

Ray of hope for cane farmers

Special Correspondent

ICRISAT and WWF partner to bring out Sustainable Sugarcane Initiative manual

HYDERABAD: At a time when sugarcane farmers and industry are going through a crisis because of high demand for water, rising cost of cultivation and low yields and productivity, a new technology of Sustainable Sugarcane Initiative (SSI) is being offered as a solution.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and World Wide Fund for Nature (WWF) have partnered together to explore options for 'Improving water productivity in agriculture'. After their success with paddy, they extended successful methods and practices for achieving 'more with less' through SSI to sugarcane.

The ICRISAT –WWF project also brought out SSI manual which was released by ICRISAT Director General

the productivity of water, land and labour. Dr. Biksham said agriculture methodology should radically change for increasing productivity with less water and other inputs. Demonstration sugarcane farms had been set up in Uttar Pradesh, Punjab, Orissa, Karnataka and Tamil Nadu and in Andhra Pradesh, it is already being practiced by some progressive farmers.

Dr. Dar said SSI was the solution when world was impacted by climate change and water was becoming a scarce resource. Punjab Agriculture Minister Sucha Singh said the new method solved the prob-

Business Line

up of publications

Home Page » Sugar

Agri-Biz & Commodities » Cultivation

New method to grow sugarcane with less water

sification system

yields by at least 20 per cent and reduce water consumption by 20 per cent.

e industry can take to drip method for cultivating the water- and also get higher yields.

e from the SRI (System of Rice Intensification) cultivation, ressive farmers as it consumed less water and yielded more, sugarcane industry.

yields by at least 20 per cent and reduce water consumption y 20 per cent.

Research Institute for the Semi-Arid Tropics (icrisat) and ined hands to develop SSI, or Sustainable Sugarcane

sing the method in different climatic zones of the country. We Pradesh, Andhra Pradesh, Karnataka and Orissa to test the ader for the Icrisat-WWF project, told *Business Line*.

small portion of cane (bud) as seed, resulting in significant

ercropping between the rows, generating additional income.

e crop, the productivity levels hover around 40 tonnes a ne other countries.

Dr Gujja was quite hopeful about the success of the method. "Keeping in mind the water crisis and growing demand for sugar, I expect that this method would replace the existing farming methods in the next five years," he said.

Touching New Heights:
Farmer Chandrapal Singh with his SSI crop
(Uttar Pradesh, India)

AgSri

AgSri, a social entrepreneur, is focused on developing and expanding the potential of agriculture sector to ensure improved productivity, more income for farmers, quality raw materials for industries and surpluses produced for domestic consumption and export. AgSri (www.agsri.com) is innovating, packaging, implementing and scaling up farm-based technologies that are inherently farmer-friendly and ecologically-sustainable "More with Less" approaches such as System of Rice Intensification (SRI), Sustainable Sugarcane Initiative (SSI) and System of Wheat Intensification (SWI) which have successfully demonstrated their potential to increase yields per acre by at least 10 percent and often much more, is less expensive to farmers and uses less seed, water and fertilizers. At the same time, some of AgSri's other activities include supporting government agencies in increasing food security through training and demonstration and through work with the industry as well, increasing their profits through quality yields, earning carbon credits and getting seed certification. AgSri's crop and water management technologies positively impact soil fertility and address issues concerning water crisis and climate change without any extra investments. AgSri partners include farmers, cooperatives, industry, multilateral institutions, government agencies and civil society organizations. AgSri aims to improve the productivity of agriculture and water sector.

Natural Resource Management Center (NRMC), NABARD

The National Bank for Agriculture and Rural Development (NABARD) has set up a full-fledged Natural Resource Management Centre (NRMC) at Kolkata. Natural resources in the context of agriculture and rural development mainly comprised of land, water, forest, energy, biological and climate resources needed to sustain and improve quality of life. NABARD extends this definition to include the entire value chain, beginning with awareness generation, capacity building, technology and information inputs, developing physical structures for management and utilization of natural resources for sustainable livelihood generation (http://www.nabard.org/nrmc/nrmchome.asp).

AgSri

#24, Road No.76, Jubilee Hills,
Hyderabad-500033,
Andhra Pradesh, India.
e-mail: info@agsri.com
Website: www.agsri.com

Natural Resource Management Center
NRMC, Kolkata
NABARD

www.agsri.com