ISSN 0973-8851

Research Highlights

2009-10

SUGARCANE BREEDING INSTITUTE
(Indian Council of Agricultural Research)
Coimbatore - 641 007. India

ISSN 0973-8851

Research Highlights

2009-10

SUGARCANE BREEDING INSTITUTE
(Indian Council of Agricultural Research)
Coimbatore - 641 007. India

Compilation & Editing
Dr. N. Vijayan Nair & Dr. D. Puthira Prathap

Suggested Citation
Sugarcane Breeding Institute, Research Highlights 2009-10, Coimbatore.

Publisher
Dr. N. Vijayan Nair
Director
Sugarcane Breeding Institute
Coimbatore - 641 007, India
Phone : 0422-2472621 Fax : 91 422 2472923
E-mail : sugaris@vsnl.com
Website : www.sugarcane-breeding.tn.nic.in

ISSN 0973-8851

Printer
Shri Garuda Graphics
Coimbatore - 641 002
Phone : 0422 - 2542555

Preface

I have great pleasure in presenting the Research Highlights of the Institute for the year 2009-10.

In the varietal front, the Institute made significant progress during the year by identifying four varieties for release viz., Co 0314 & Co 0218 for the Peninsular zone and Co 0124 & 0239 for the North Western Zone. These new varieties possess high yield, juice quality and resistance to red rot and are expected to fulfill the sugarcane varietal needs of these agro-climatic zones.

An exploration was organized in the Himalayan states of Uttarakhand and Himachal Pradesh for the collection of *Saccharum* germplasm. A total of 53 clones, some of them with cold tolerance, were collected from these two states from altitudes ranging from 215 - 2280 MSL. The *in vitro* germplasm conservation facility at Kannur Centre was strengthened and some of the clones not amenable for clonal maintenance are now being maintained *in vitro*. Interspecific and intergeneric hybrids were produced and characterized using molecular markers and some of them were back crossed to commercial varieties in an attempt to broaden and diversify the genetic base of the varieties.

Three new sugarcane specific drought responsive candidate genes were identified. Isolation and characterization of Resistance Gene Analogue sequences from sugarcane were carried out by designing primers on conserved domains of resistance gene sequences. The efficiency of the new ubiquitin promoters identified at the Institute in transforming sugarcane, rice, tobacco and Arabidopsis was validated. An improved method of plant tissue culture with beneficial bacteria for faster multiplication has been developed.

A comparison of the productivity and sustainability of organic sugarcane production systems with that of the conventional intensive production systems showed that there was an improvement in cane yield in the organic system in the third cycle over the conventional system. An improvement in the activity of the rhizosphere microflora in the organic plot indicated the sustainability of the organic production system. A study on the potential applications of remote sensing and digital imaging in sugarcane agriculture was conducted in Erode district of Tamil Nadu.

Yellow leaf disease is emerging as a major threat to sugarcane cultivation, particularly in tropical India. Detailed studies were conducted on the impact of yellow leaf disease (YLD) on sugarcane growth and yield under field conditions by comparing disease infected canes with asymptomatic canes in the diseased field and disease-free canes in healthy field. New fungicides were evaluated for their efficiency in managing red rot. Overnight soaking of sugarcane setts with 'Nativo' individually or in combination with 'Cabrio' or 'Thiophanate methyl' was found to protect the crop from soil borne inoculum of red rot.

The varieties and technologies developed by the Institute were popularized through various outreach programmes. In the Frontline demonstrations conducted in the farmers' fields, wide row planting was found to increase cane yield by 27% over the conventional system. The new variety Co 99004 was found to give better yield than the current variety Co 86032. A campaign on 'Use a laser leveler, save water' and a farmers' training programme at the Irrigation Management Training Institute, Tiruchirappalli were organized as part of the 'Farmers' Participatory Action Research Programme (FPARP)'. The institute organized the 41st Sugarcane R&D meeting of Tamil Nadu and Puducherry at Trichy and the 14th meeting of Sugarcane R&D workers of Northern Karnataka at Belgaum during the year. These meetings discussed the current problems in sugarcane agriculture in the respective states and the latest technologies available for improving productivity. A Kisan Mela was organized at the institute benefitting a large number of farmers from the southern states of the country. The institute pavilion bagged the Best Stall Award in the exhibition organized by the Tamil Nadu Agricultural University, Coimbatore during the state level Farmers' Day.

The major research achievements and activities of the institute for 2009-10 have been presented in this publication. I thank all the Scientists and staff of the Institute who had contributed to the research activities of the Institute during the year. The support and encouragement from Dr.S.Ayyappan, Secretary, DARE and Director General, ICAR, Dr.S.K.Datta, Deputy Director General (Crop Science) and Dr.K.C.Jain, Asst. Director General (CC), ICAR are duly acknowledged.

(N.VIJAYAN NAIR)
DIRECTOR

Research
Highlights
2009-10

Contents

Crop Improvement

NEW VARIETIES IDENTIFIED

Co 0218 - A promising midlate variety for Peninsular zone

The variety Co 0218 was evolved through hybridization and selection involving the high yielding parent Co 8353 with a high quality proven parent Co 86011. This midlate maturing clone identified as a 'Co' cane in 2002 was evaluated in AVT during 2007-2009 (two plant and one ratoon) at eleven centres of Peninsular zone.

Performance of Co 0218 in Peninsular Zone (in AICRP trials)

The overall mean (two plant and one ratoon crop) sugar yield was 15.30 t/ha in Co 0218 in comparison with Co 7219 (12.67 t/ha) and Co 86032 (14.69 t/ha). It registered 20.78% improvement over Co 7219 and 4.19 % over Co 86032. Its cane yield was 104.53 t/ha from three crops with an improvement of 12.37% over Co 7219. The advantage of the clone lies in its better juice quality, with a CCS of 14.58 % against 13.68 % in Co 7219 and 13.92 % in Co 86032; an improvement of 6.64 % and 4.75 % over the standards respectively. The clone had a high sucrose content of 20.63 % against 19.50 % in Co 7219 and 19.65 % in Co 86032 (improvement of 5.82 % and 5.00 % over the standards respectively). Co 0218 performed better at Coimbatore, Akola, Kolhapur, Navasari, Pravaranagar, Pune and Sankheshwar, thus exhibiting wide adaptability in the diverse climatic condition of Peninsular zone. Besides, this clone is also moderately resistant to red rot at Coimbatore, Navasari and Tiruvalla. It is also tolerant to drought and salinity. Co 0218 yields A1 quality jaggery and has 14.70 % fibre. It is a good ratooner with excellent field stand, with erect tall and thick canes and dark green foliage with moderate spines. The variety exhibited 20% flowering during mid November at Coimbatore conditions. Mean values for various yield and quality parameters are presented in the table.

Co 0218

1) Cane Yield (t/ha)	104.53
2) Number of millable canes (ha)	80840
3) Stalk length (cm)	246
4) Stalk diameter (cm)	2.76

5) Single cane weight (kg)	1.34
6) Sucrose % at 360 days	20.57
7) CCS %	14.61
8) Purity%	92.66
9) CCS (t/ha)	15.30
10) Extraction%	54.47
11) Fibre%	14.70
12) Jaggery Quality	A1
13) Pol % cane	15.41

Co 0314, an early maturing variety for Peninsular zone

The early maturing variety Co 0314 is a hybrid between Co 7201 and Co 86011. This clone performed well in the AICRP trials in Peninsular zone during 2006-2009. It is resistant to red rot and smut diseases. The field stand of this variety is good with early vigourous growth, dark green foliage and erect non lodging cane with no splits on rind. The variety gives A1 quality jaggery and is with good ratooning ability. It is suitable for cultivation in Tamil Nadu, interior parts of Andhra Pradesh, Maharashtra and Karnataka.

Comparison of Co 0314 with standards in AICRP trials (Mean of two plant and one ratoon crop)

Character	Co 0314	Co 85004	CoC 671
Cane yield (t/ha)	106.08	106.60	99.50
Sugar yield (t/ha)	14.35	13.96	13.48
Sucrose %	19.08	18.63	19.17

Co 0314

New varieties for Sub-tropical region

Co 0124 (Karan 5), a promising midlate variety for North West Zone

Co 0124 is a selection from progeny of Co 89003 GC. It has medium thick yellow green canes with concave-convex internodes, triangular-pointed buds, long lanceolate auricle and shallow bud groove. The clone is free from splits, leaf sheath hairiness, pith and bud cushion. The fibre content is about 12.65%. The jaggery is of A2 quality with light yellow colour. This clone is moderately resistant to the prevalent races of red rot pathogen by plug method of inoculation and had resistant reaction (R) by nodal method. This clone was evaluated under All India Coordinated Research Project in the North West zone. Its ranking in the zone was 3rd for cane yield, 2nd for sugar yield and 3rd for sucrose %. Its performance in AICRP(S) experiments (average of 2 plant and 1 ratoon crops at 7 locations) in the North West Zone is presented in the Table.

Co 0124

Co 0124 (Karan 5) in coordinated trials

Item	Co 0124 (Karan 5)	Co 1148	CoS 8436	CoS 767
Cane yield (t/ha)	75.71	74.62	67.47	70.08
% increase over checks		1.46	12.21	8.03
Sugar yield (t/ha)	9.68	9.01	8.44	8.59
% increase over checks		7.44	14.69	12.69
Sucrose %	18.22	17.49	18.06	17.60
% increase over checks		4.17	0.89	3.52

This variety would prove as a high quality midlate maturing clone under assured irrigation areas. This could be a suitable substitute for the presently cultivated variety CoS 8436.

Co 0239 (Karan 6), a high quality early maturing variety for North Western Zone

Co 0239, selected from Co 93016 GC, has medium thick yellow green canes with cylindrical internodes, oval buds, lanceolate auricle, bud cushion and shallow bud groove. The clone is free from splits and pith. The fibre content is about 12.79%. The jaggery is of A1 quality with light yellow colour. This clone is MR to the prevalent races of red rot pathogen by plug method of inoculation and showed resistant reaction by nodal method of inoculation. Co 0239 was evaluated under All India Coordinated Research Project in the North West Zone. It ranked 1st in the zone for CCS yield, 2nd for cane yield and 4th for sucrose % in juice. Its performance in AICRP(S) experiments (average of 2 plant and 1 ratoon crops at 7 locations) in the North West Zone is presented.

Co 0239 (Karan 6) in coordinated trials

Item	Co 0239 (Karan 6)	CoJ 64	CoPant 84211
Cane yield (t/ha)	79.23	67.59	66.84
% increase over checks		17.22	18.54
Sugar yield (t/ha)	10.37	8.59	8.28
% increase over checks		20.72	25.24
Sucrose %	18.58	17.90	17.65
% increase over checks		3.80	5.27

Co 0239

This variety would prove as a high quality early maturing clone under assured irrigation, water stress and water logging areas. This could be a suitable substitute for CoJ 64.

VARIETIES IN PIPELINE

Co 0403 and Co 0409 perform well in Advanced Varietal Trials at Coimbatore

Co 0403, an early maturing variety

In the Advanced varietal Trials (Early) 2008-2010 in Peninsular zone conducted at Coimbatore, five test entries Co 0403, CoM 0326, CoN 03131, CoSnk 03632 and CoSnk 03754 were tested with three standards viz. CoC 671, Co 85004 and Co 94008 in two plant crop trials and one ratoon trial. Mean data of three trials indicated that Co 0403 was the best in the trial with a combination of high cane yield (116.41 t/ha) and CCS yield (15.81 t/ha). The sucrose % juice at 300 days was 19.67. This clone showed an improvement of 29.49% in cane yield and 23.01 % for CCS yield over the standard CoC 671. However for juice quality parameters, there was a marginal drop of 2.53 % for sucrose content compared to the high sugared standard variety CoC 671. Co 0403 was better than the

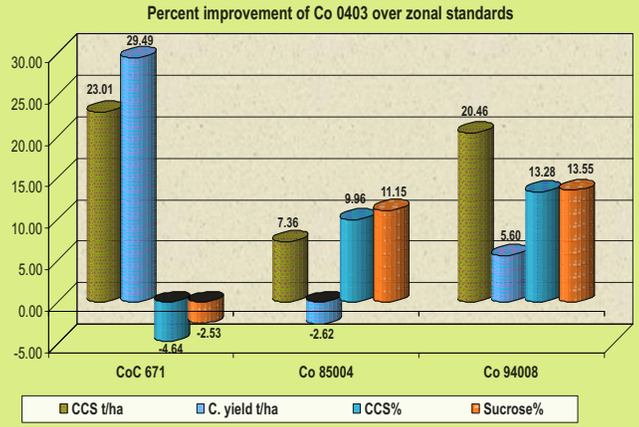
standard Co 94008 for cane yield, sugar yield and sucrose % juice, while in comparison with the standard Co 85004, this entry was clearly better with 11.2 % improvement in juice sucrose but with a marginal reduction in cane yield.

This clone was derived from the cross Co 8371 x Co 86011. More number of millable canes, impressive stand and resistance to stresses like red rot, smut, drought and salinity are the added advantages of this clone over the standard CoC 671 noted for its high susceptibility for red rot and poor ratooning potential.

Co 0403

Mean performance of entries in AVT (Early) in two plant and one ratoon crop at Coimbatore (2008-2010)

Sl. No.	Entries	CCS yield (t/ha)	Cane yield (t/ha)	300 days	
				CCS %	Sucrose %
1	Co 0403	15.81	116.41	13.55	19.67
2	CoM 0326	11.90	91.85	12.91	18.75
3	CoN 03131	11.25	94.82	11.87	17.02
4	CoSnk 03632	12.69	127.20	9.95	14.75
5	CoSnk 03754	10.49	89.74	11.79	17.21
	Standards				
1	CoC 671	12.85	89.90	14.21	20.18
2	Co 85004	14.72	119.54	12.32	17.70
3	Co 94008	13.12	110.24	11.96	17.32



Co 0409, a midlate variety

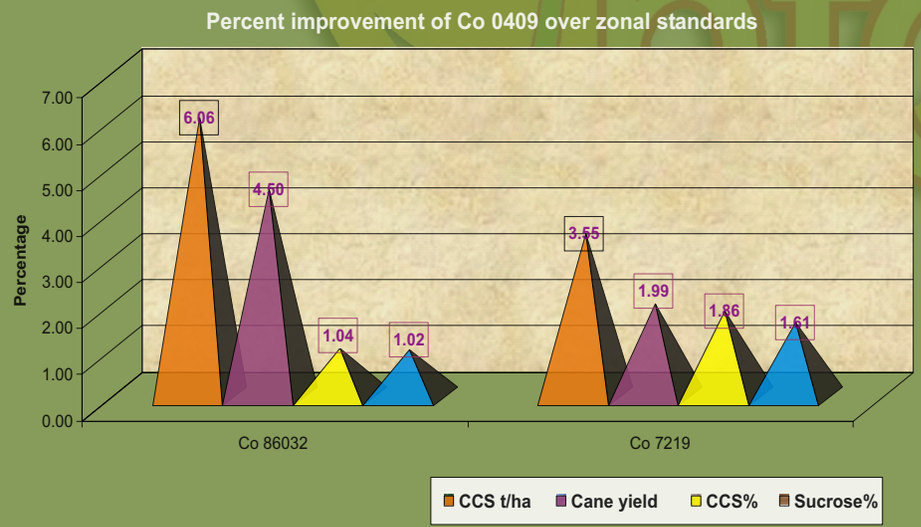
In Advance Varietal Trial (Midlate) six test entries Co 0409, Co 0415, Co 0416, CoM 0316. MS 0301 and CoSnk 08322 were evaluated in two plant and one ratoon crops along with two standards viz. Co 86032 and Co 7219 during 2008-10. The variety Co 0409 was the best in the trial combining high CCS yield (16.30 t/ha), cane yield (113.78 t/ha), CCS% (13.47) and sucrose % juice (19.31%). Co 0409 is a rare combination of high yield and juice sucrose and was better than both the standards with an improvement of 6.06 % for CCS yield, 4.60% for cane yield 1.04 % for CCS% and 1.02 % for sucrose.

Co 0409

In addition to its better agronomic performance, this clone is resistant to red rot disease. The canes are dark purple with green canopy and flowering intensity is about 20%.

Mean performance of entries in AVT (Midlate) in two plant and one ratoon crops at Coimbatore (2008-2010)

Sl. No.	Varieties	CCS yield (t/ha)	Cane yield (t/ha)	CCS %	Sucrose %
1	Co 0409	16.30	113.76	13.47	19.31
2	Co 0415	14.20	102.42	13.12	18.90
3	Co 0416	13.94	101.41	12.93	18.61
4	CoM 0316	11.49	80.49	13.57	19.45
5	MS 0301	15.21	111.15	12.89	18.48
6	CoSnk 08322	15.07	112.28	12.60	18.12
	Standards				
1	Co 86032	15.37	108.86	13.34	19.12
2	Co 7219	15.74	111.54	13.23	19.01



GENETIC RESOURCES

Exploration in Himalayas for wild sugarcane germplasm

An exploration was organised in the Himalayan states of Himachal Pradesh and Uttarakhand from August 23rd to 12th September 2009 for the collection wild germplasm from altitude range of 215 – 2280 msl. Out of a total of 12 districts in Himachal Pradesh, nine districts were surveyed and 28 collections of *Saccharum spontaneum, Erianthus fulvus and Miscanthus* species made from 9 districts. In Uttarakhand, out of a total of 13 districts, 11 districts were surveyed and 25 clones *(S.spontaneum, Miscanthus)* collected from 10 districts. In both the states, the habitat distribution of *S.spontaneum* was river banks/beds, hill slopes and fallows. It occurred along the major rivers of Sutlej, Beas, Ganges and Yamuna. These were medium tall and flowering. In general, the variability in height was limited to short, medium and medium tall types. Very tall and tall types found in North east was absent here. Kesardeshi (1950 msl) near Almora (Uttarakhand) is the highest elevation from where *S.spontaneum* was collected. Near Almora, the shortest clone (IND09-1542) measuring 30 cm was collected. *Erianthus fulvus* and *Miscanthus* were found only above 2000 M elevation.

Miscanthus on forest edge at Jalori pass (2320 MSL, Himachal Pradesh)

S.spontaneum
IND09-1517
on sandy & rocky river bed of Beas (1472 MSL, Himachal Pradesh)

Germplasm conservation

The sugarcane germplasm comprising 3368 accessions were clonally maintained at the Kannur centre. 24 clones were maintained in vitro. 1232 accessions belonging to *Saccharum spontaneum, Erianthus* and allied genera were maintained at Coimbatore.

In vitro germplasm conservation

Germplasm - a field view

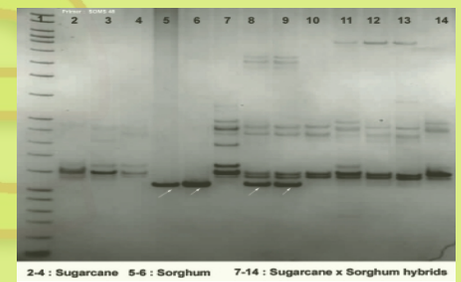
Registration of germplasm

Co 0120 (IC 565020) was registered as sugarcane germplasm with NBPGR, New Delhi and its' registration number is INGR09130. It is novel and distinct based on – i) high juice quality early in the season (at 240 days), and ii) early maturity.

Production and characterization of intergeneric hybrids of sugarcane

Twenty seven progenies obtained from sugarcane *x* Sorghum hybrids were characterized morphologically. The progenies resembled the sugarcane parent largely. The progenies were also characterized using Sorghum specific markers, confirming their hybridity.

Variability for cane characteristics in *Saccharum x Sorghum* hybrids



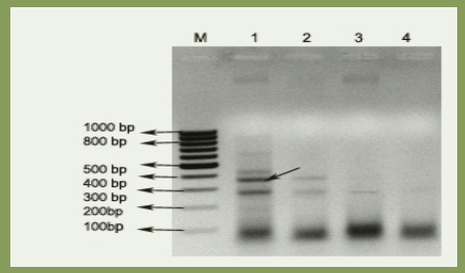
Sorghum specific SSR markers amplified in two hybrid progenies from *Saccharum x Sorghum* crosses
Lane 1: Marker; Lanes 2-4 Sugarcane *(Saccharum officinarum);*
Lanes: 5-6 Sorghum
Lanes 7-14 : progenies from Sugarcane *x* Sorghum crosses. Progenies 8 & 9 show Sorghum specific markers

BIOTECHNOLOGY

Identification of new candidate genes for drought:

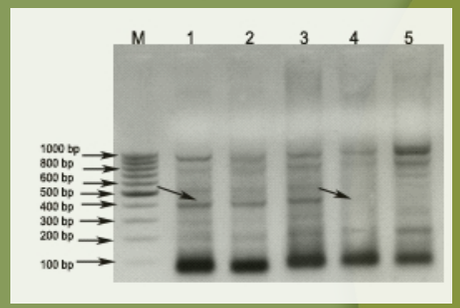
Three new sugarcane specific drought responsive candidate genes viz. $DREB_{360}$, $LEA_{385}CALMOD_{400}$ were identified based on their presence in drought tolerant parent and progeny and absence in drought susceptible parent and progeny through RTPCR.

DREB 360 gene profile



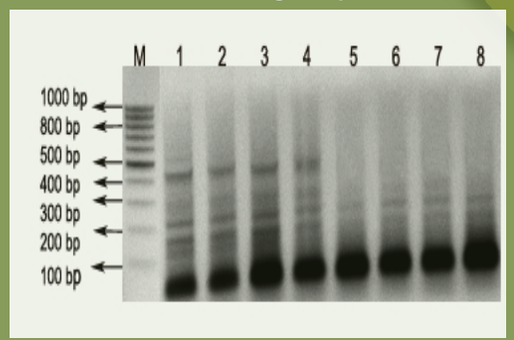
M-100bpDNA ladder
1 - Drought tolerant parent (Co 740)
2 - Drought tolerant progeny
3 - Drought susceptible parent (Co 775)
4 - Drought susceptible progeny

LEA 385 gene profile



M: 100bp DNA Ladder
1- Drought tolerant parent (Co 740)
2-3 Drought toleraant progenies
4 - Drought susceptible parent Co 775
M - Marker

CALMOD 400 gene profile



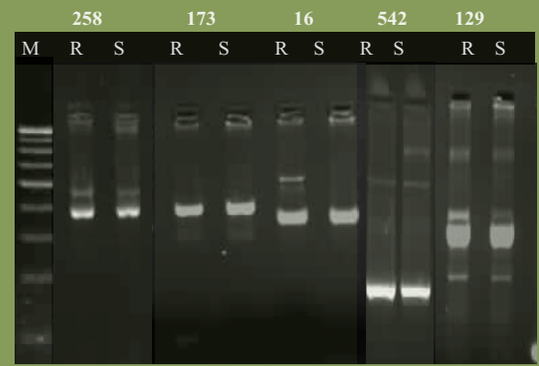
M-100 bp DNA ladder
1- Drought tolerant parent (Co 740)
2-4 Drought susceptible parent (Co 775)
6.-8 Drought susceptible progeny

Genus and species specific markers for identification of hybrids.

Species and genus-specific micro satellite markers were developed and used in the identification of inter-specific and inter-generic hybrids. Fifty markers specific to *S.officinarum* , 94 markers specific to *S.robustum* and 625 *Erianthus* – specific markers were developed. Five *Erianthus* X *Saccharum* progenies were screened using primers that generated specific profiles with respect to the two parents. Only one progeny (PIO 01-0022) X PIEP 970004) showed the presence of both *Saccharum* and *Erianthus* specific markers, thus confirming its hybridity. A progeny from *Saccharum* X *Sclerostachya* cross was screened and it showed presence of markers specific to both the parents, proving its hybridity. The presence of markers specific to *S.officinarum* and *S.robustum* confirmed the hybridity of a progeny from a cross involving these two species.

Resistance Gene Analogues (RGAs) in sugarcane

Isolation and characterization of resistance gene analogue sequences from sugarcane was done by designing primers on conserved domains of resistance gene sequences. Twenty nine primers were designed and were used to amplify genomic sequences of two varieties Bo 91 and CoC 671, that are resistant and susceptible to red rot. The sequences were compared for homologies with the available information in the NCBI databank. Strong homology to disease resistance proteins like RPM1 of rice, disease resistance sequences of *Zea mays, Sorghum bicolor, Glycine max* etc., containing various classes of disease resistance domains. Twenty two percent of the RGAs had NBS-LRR domains, 22% had NB-ARC domains, 14% had protein kinases, 13% had S/T kinases, 5% had serine proteases, 2% had receptor kinases and 1% were retrotransposans. Eight percent of the sequences showed homologies with resistant proteins whereas 6% of the sequences were hypothetical proteins. Prediction of functional elements in the sequences revealed the presence of promoters in RGA-019S, 183S, 231R, 231S, 267R, 267S, 275R, 275S, 125R and the presence of PolyA signals in the products amplified by the primer RGA-275. Twenty RGAs were predicted to have internal exonic regions. About 5 primers viz., RGA-016, RGA-129, RGA-258, RGA-542 and RGA-173 had been used to amplify both the genomic DNA and cDNA of BO 91 and CoC 671. cDNA sequences showed more degree of homology compared to genomic DNA which may be attributed to the removal of intronic sequences. About 54 RGA sequences have been submitted at GSS database in NCBI genbank.

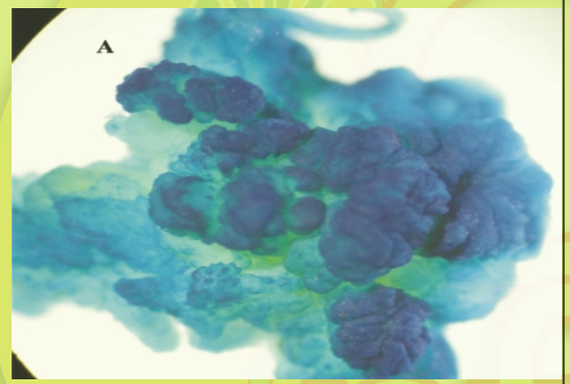


M - 100 bp MARKER R – Bo 91
S – CoC 671

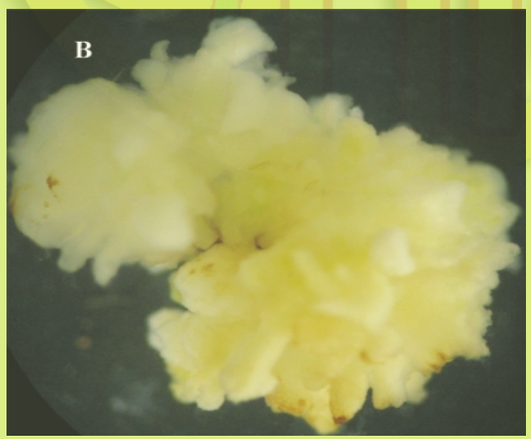
RT-PCR using primers amplifying conserved regions of resistant genes

Identification and cloning of sugarcane specific promoters

Out of three 5' upstream sequences of the three different ubiquitin genes isolated, two were cloned in pCAMBIA vector in place of the CaMV35s promoter so as to get a gene regulatory region - *gus* fusion. Constructs with regulatory region I were used for transforming sugarcane, rice, tobacco and Arabidopsis through *Agrobacterium* / biolistics with appropriate controls for validation studies.



The expression of GUS gene driven by the regulatory sequence 1 in transgenic rice callus



Untransformed control rice callus.

Transient expression of GUS gene driven by the regulatory sequence 1 in sugarcane.

This regulatory region could drive the *gus* gene expression in rice and sugarcane tissues but not in tobacco and *Arabidopsis,* indicating monocot specific nature of regulatory sequence. With a view to understand the role of different domains of 5' upstream region in gene expression, six deletions of this region were cloned in pCAMBIA vector for transformation studies.

Sugarcane Micropropagation – use of microbes for faster and better sugarcane micropropagation

An improved method of plant tissue culture with beneficial bacteria for faster multiplication has been identified. These beneficial bacteria are capable of producing wide range of amino acids, phytohormones and vitamins supporting and enhancing growth of plants under tissue culture. No harmful effect on tissue cultured plants has been observed.

The benefits included the faster rate of *in vitro* multiplication and more shoots produced with less ingredients. Substantial reduction in the media ingredients such as mineral salts and phytohormones was found. Micropropagation through this method reduces the cost of production by 20% through reduced media ingredients and higher shoot yield.

Shoots in standard medium

Shoots in modified medium with beneficial bacteria

Crop Production

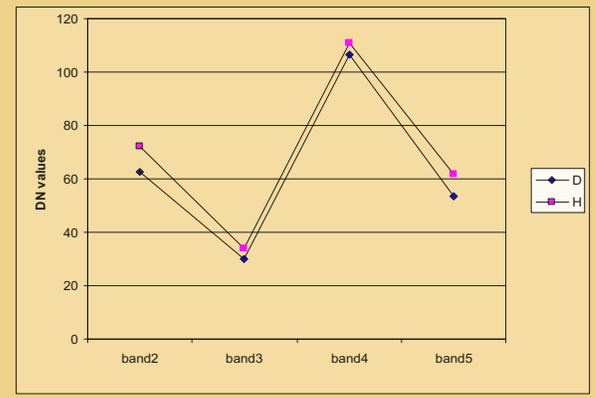
Sustainability of organic and conventional sugarcane production systems

The project was initiated with the objective of comparing the productivity and sustainability of organic sugarcane production systems with that of conventional intensive production systems over a period of 10 years. It consists of three cycles, with each cycle consisting of a plant crop followed by a ratoon crop and then followed by a rotational crop of cotton. In the plant crop of third cycle, a significant yield improvement was observed over the conventional system and also improvement in the activity of the rhizosphere micro flora , indicating the sustainability of the organic production system.

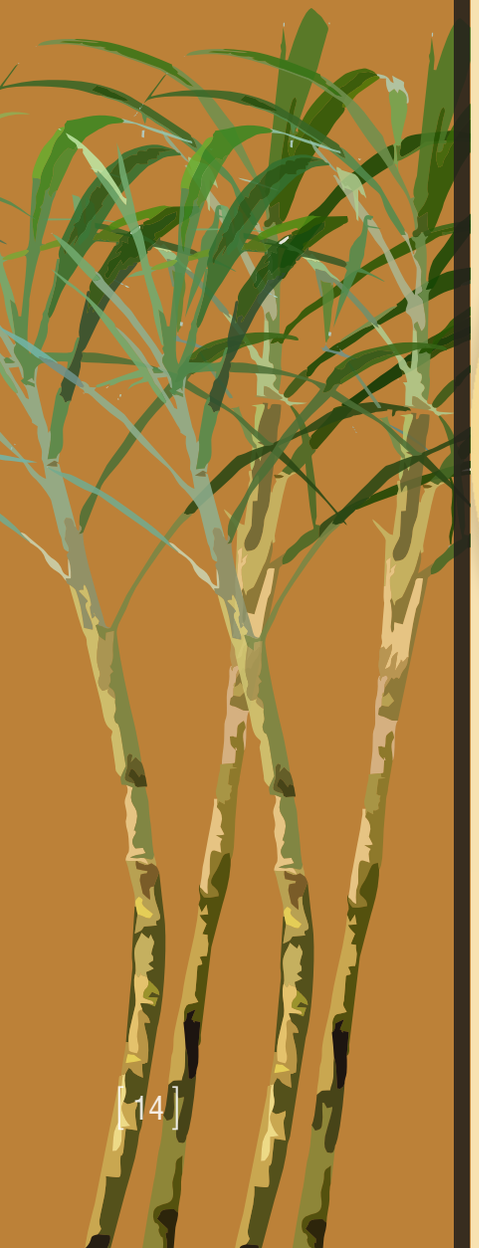
- A plant crop cane yield of 124 t/ha was recorded in the organic plot, whereas an yield of 108 t/ha was recorded in the conventional plot. A stalk population of 1.72 and 1.64 lakhs per ha was recorded in the organic and conventional systems respectively. The mean CCS% at 10 months of planting was 11.58% in organic plot and 11.65% in the conventional system whereas it was 12.94% in the organic and 12.47% in the conventional plots at 12th month.
- At 120 and 240 days after planting higher bacterial (>3.3 x 10^7 cfu/g of soil), fungal (>3.3 x 10^4 cfu/g of soil) and actinomycetes (>3.3 x 10^5 cfu/g of soil) population was observed in the organic plots than in the conventional plots. Higher rhizosphere dehydrogenase activity was noticed in organic plots (1.68 µg triphenyl tetrazolium formazone (TTF)/g/hour) than in the conventional plot (1.19 µg TTF/g/hour).
- Mean nematode population in the organic and conventional farming was 1550 and 1320/ 100cc of soil respectively. Reduction of plant parasitic nematode population was observed in organic farming. Organic farming favoured the free living nematode population than conventional farming system.

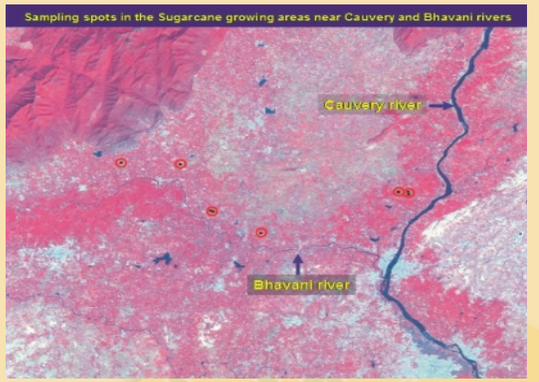
Remote Sensing and Precision Farming

A study on the potential application of remote sensing and digital imaging in sugarcane agriculture was conducted in the Sakthi Sugars Ltd., cane growing area. The sugarcane growing areas in Erode district (Sakthi Sugars Ltd., area) were surveyed during December 2009. Sugarcane fields with YLD and YLD free area were demarcated in the digital satellite imagery IRS P6 date of Pass December 30, 2008 Path 100 and Row 65 number obtained from NRSC, Hyderabad. The Digital



DN values of Healthy and YLD infected sugarcane field in different spectral bands (D- YLD affected sugarcane Field and H - Healthy free from YLD Field; (Band 2 [Green] - 0.52 to 0.59 microns, Band 3 [Red]- 0.62 to 0.68 microns, Band 4 [NIR] - 0.76 to 0.86 microns and Band 5 [NIR]- 1.55 - 1.70 microns)



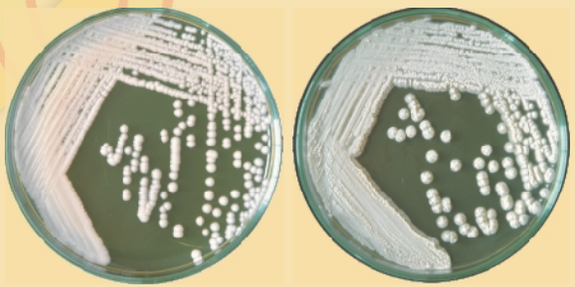


FCC of digital satellite imagery IRS P6 date of Pass December 30, 2008 Path 100 and Row 65 of the study area along with ground truth sample location

Number(DN) values were extracted using the customized programme developed in C# Visual Studio 2008 in the dot net platform. The DN value in the YLD affected field was lower than the YLD free area in all the 4 bands data. The DN values for the 4 bands were analyzed using the bootstrap confidence intervals. The difference in DN values were compared using the difference of mean (d_{AVE}). The difference of mean (d_{AVE}) is one of the measures of difference used in unpaired data, where no dependence is assumed between the two groups of data. A confidence interval for d_{AVE} provides quantitative information, which also includes a statistical test (by looking whether it contains zero) but is not restricted to it. The healthy sugarcane field gave significantly higher DN values than that of YLD affected fields. The DN values in the healthy sugarcane field is higher by 7.5 DN value with 95 % BCa confidence interval (1, 30 DN values) when compared to YLD affected fields. Hence, it is possible to develop subpixel classification model to the highest classification accuracies to demarcate the YLD affected sugarcane fields.

Microorganisms for ethanol production from sugarcane biomass

Samples like decaying fruits, vegetables, toddy samples and lignocellulose feeding insects & their frass material were collected to isolate yeast. The samples were subjected to enrichment in glucose & xylose broth and about 50 isolates capable of growing on xylose medium were obtained. These isolates were subjected to presumptive yeast conformation tests viz., osmotolerance, growth at different pH & temperatures, tolerance to 1% acetic acid, colony characteristics, microscopic examination, sporulation and carbon utilization. Totally 35 isolates were tentatively identified as yeast. The qualitative ethanol producing ability of the yeast cultures utilizing glucose, sucrose and xylose were carried out. Presence of ethanol in the culture was analyzed using gas chromatograph. Four cultures were identified as ethanol producers



SBI-Y-09 SBI-Y-29

Yeast isolates capable of ethanol production from glycose and xylose

from glucose, sucrose and xylose.

Improving sprouting in winter initiated ratoon

Sprouting in winter initiated ratoon is a major problem in the sub-tropics. Experiments were conducted at the Karnal centre to improve sprouting in winter initiated ratoons. Application of fresh sulphitation press mud @ 20 t/ha, combined application of potash @ 60 kg/ha+ $ZnS0_4$ @ 25kg/ha or $ZnSO_4$ @ 25 kg/ha+ SPMC @ 10 t/ha at ratooning recorded the significantly higher number of sprouts at 45 days, shoots at 75 days, better yield attributes than other treatments and gave significantly higher cane yield of 71.0, 66.7 and 78.1% than control. The Sugar yield varied from 4.16 to 7.90 t/ha, being maximum with application of fresh sulphitation press mud @ 10 t/ha + ZnSO4 @ 25 kg/ha, immediate after harvest of plant crop.

Tolerance to salinity

Pot culture studies on salinity conducted at Karnal confirmed that sugarcane variety Co 0238 was tolerant to salinity and accumulates less Na in the leaves. Salinization and desalinization studies have indicated that salinity effects are partly ionic and partly that of water stress which also depends upon the relative salt resistance of the clone. Salinity primarily affects rates of photosynthesis by affecting stomatal conductance. Other clones which possess tolerance to saline condition were Co 05011 and Co 0239.

Crop Protection

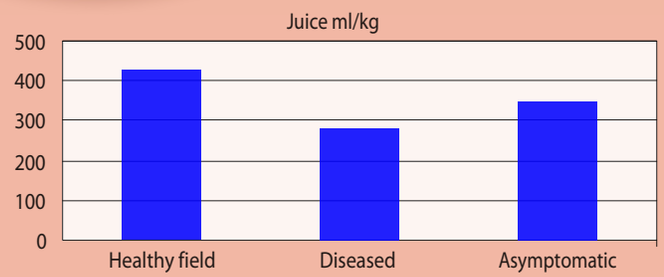
Pathology

Impact of Yellow Leaf Disease on sugarcane

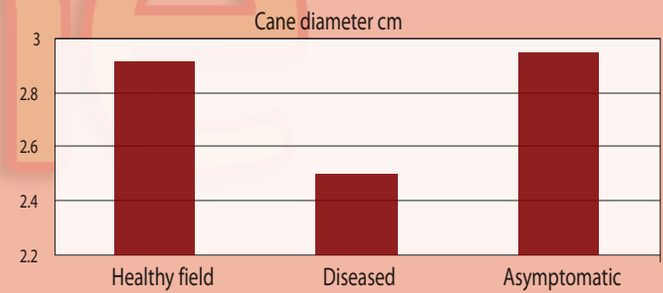
Yellow leaf disease (YLD) is emerging as a major threat to sugarcane cultivation in the country.

Detailed studies were conducted on the impact of yellow leaf disease (YLD) on sugarcane growth and yield under field conditions by comparing disease infected canes with asymptomatic canes in the diseased field and disease-free canes in healthy field. Reduction in cane weight of diseased canes was 37.23% compared to asymptomatic plants in diseased field and it was 15.69% as compared to disease-free canes. Reduction in cane diameter in the diseased canes was 15.25 % as compared to asymptomatic canes and 14.09% as compared to the disease-free canes. Also for number of internodes, asymptomatic and diseased canes showed significant difference between them. Average juice yields of 429.6, 347.0 and 279.5 ml/kg were recorded in disease-free, asymptomatic and diseased canes, respectively at 12th month. Juice analysis revealed that there is comparative reduction in % brix, % sucrose and CCS % and significant reduction in purity of diseased field canes as compared to healthy field canes. Cane productivity in the sugar mill area also showed a steady decline and reached to the lowest of 77.5 t/ha in 2009 from 95 t/ha recorded during 2000. Similarly sugar recovery in the mill showed a declining trend over the years. Data on sugar percent in cane of the mill also steadily declined from 12.31 in 2000 to 11.11 in 2009. Overall, the mill performance data revealed that there is a gradual but steady decline in sugarcane productivity in the mill area, sugar percent in cane and sugar recovery due to YLD. This situation needs immediate attention to manage the disease by implementing healthy seed nursery programmes in the region.

Impact of yellow leaf infection on cane juice yield

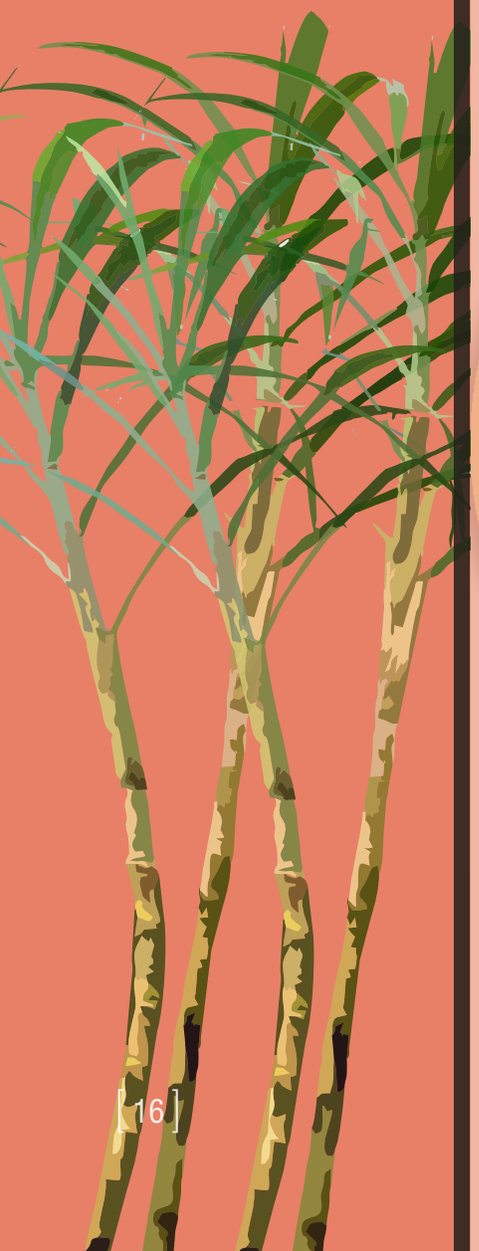


Impact of yellow leaf infection on cane growth



YLD management

- Performance of tissue culture derived plants under endemic locations showed that they have a better crop stand even after two generations and remained free from the disease. Similarly the selection nursery concept suggested to the factory i.e. selecting disease-free clumps from the field to raise nursery crop was found to be effective to have disease free nurseries and such fields had a uniform crop stand and remained free from YLD. In addition to the previous approach, this strategy is also found to be a useful strategy to manage the disease.



Severe expression of YLD in plant crop of Co 86032 in Tamil Nadu

Red rot and its management

Identifying proteins involved in red rot resistance through proteomics

Two - dimensional gel electrophoresis (2-DGE) was employed to identify proteome profiles from the stalk tissues of resistant and susceptible sugarcane varieties after pathogen inoculation. From the proteome profiles, specific proteins involved in red rot resistance in sugarcane were identified. Proteins from the stalk tissues of two cvs. Co 93009 (resistant to red rot) and CoC 671 (susceptible to red rot) were extracted 12 h after pathogen inoculation and the proteome profiles were analyzed by 2-DGE. The number of protein spots was found to be higher (335 ± 7) in the resistant cultivar after 12 h of pathogen challenge. The inoculated susceptible cultivar had the lowest number of protein spots (280± 3). More than 250 protein spots that were detected in stalk tissues by proteomic analysis showed reproducible abundance within the replications. Approximately 50 protein spots were additionally induced in the resistant cultivar upon pathogen inoculation, whereas ~ 24 proteins have got down-regulated in the susceptible cultivar. Our studies on the proteome-level changes that occur during *C. falcatum* – sugarcane interaction using 2-DGE, are the first attempt to standardize proteome analysis and to identify specific proteins involved in red rot resistance in sugarcane. About 125 up/down regulated proteins were characterized by peptide mass finger printing. Some of the identified proteins were putative callose synthase, R2R3-MYB transcription factor MYB6, p-coumarate 3-hydroxylase, PrLTP1 and PISTILLATA-like protein. Further validation of differential expression of the identified proteins by real time-PCR is in progress.

Red rot management

Uptake/ infiltration of fungicide in sugarcane setts by vacuum infiltration was found to be equal to overnight soaking in different tissues like buds, rind, cut ends and internal tissue.

Under field conditions overnight soaking of setts with 'Nativo' individually or in combination with 'Cabrio' or 'Thiophanate methyl' was found to protect the crop from debris borne inoculum of red rot and such treatments improved plant survival and millable canes.

Among the SAR inducers used, BTH recorded the lowest red rot incidence (0.4%) upon challenge using *Colletotrichum falcatum* grain inoculum, followed by Cf-elicitor (2.3%) and GABA (2.9%).

Variability in red rot pathogen

Differential host pathogen interaction studies involving 14 differentials showed that the red rot pathotypes CF02, CF03 and CF09 are more virulent than the pathotypes CF08, CF01 and CF11 in North West zone.

Among the four new isolates collected from Tamil Nadu, the isolates from CoSi 6 and Co 91017 were found to be more virulent.

The following varieties Co 1148, Co 7805, Co 86032, Co 94003, Co 94008, Co 99006, Co 0238, CoSi 95071 and CoV 92102 exhibited a clear differential interaction against red rot isolates from tropical region.

New pathogen isolates were collected from Tamil Nadu, Haryana, AP and Bihar. Diversity work was initiated with 49 isolates of *C. falcatum* with two sets of â-tubulin primers. Nucleotide variations among the isolates showed that variable region 1 of â-tubulin gene (~545bp) has more nucleotide variations than variable region 2 of â-tubulin gene (~480bp) and actin gene.

Molecular diagnosis of red rot and smut

Comparison of molecular diagnostics with tissue bioassay indicated that PCR - based diagnostics was found to be highly accurate to detect red rot in cane tissues.

A protocol to isolate RNA and DNA from soil and PCR/RT-PCR based techniques were standardized to diagnose the presence of red rot and other fungal pathogens of sugarcane in the rhizospheric and non-rhizospheric soil.

Primers were designed based on bE mating type gene of the smut pathogen and they specifically amplified the target gene (~454 bp) in asymptomatic plants with a latent infection of the smut pathogen. This PCR-based diagnostic technique is being revalidated over a large number of genotypes and PCR conditions will be optimized for repeatable results

Molecular basis of red rot resistance

Subtractive hybridization was standardized to clone specifically induced transcripts in incompatible interaction between sugarcane and *C. falcatum* by using RNA isolated from resistant and susceptible varieties as tester and driver, respectively.

The full length cDNA (815bp) corresponding to the complete ORF of the sugarcane class IV chitinase was directly cloned into the pMAL-C4X protein expression vector. The recombinant plasmid was then transformed into the *E. coli* strain K12 and the chitinase protein was expressed as an MBP-chitinase fusion protein. The presence of chitinase in the recombinant protein was confirmed by Factor Xa cleavage, which cleaved the fusion protein into two fragments ~ 42.0 kDa and ~26 kDa corresponding to MBP and chitinase, respectively.

Gene specific forward and reverse primers were designed for fatty acid desaturase (FAD) and leucine rich protein (LRR) transcripts identified in DD-RT-PCR for their full length amplification through 5'-3'RACE. An amplicon of ~800bp was obtained for FAD.

Optimized the amplification of the following transcription factors WRKY, MYB, TLP, NAC and BZIP from sugarcane using 42 sets of primers to study their role in pathogen recognition and signalling.

Production of antiserum to recombinant virus coat protein

cDNA fragment coding for the partial ORF of the sugarcane streak mosaic virus (SCSMV) coat protein gene (~850bp) was cloned into the *EcoRI* site of the protein expression vector pMAL-C4X. The recombinant plasmid was then transformed and the SCSMV-CP was expressed as an MBP-SCSMV-CP fusion protein.

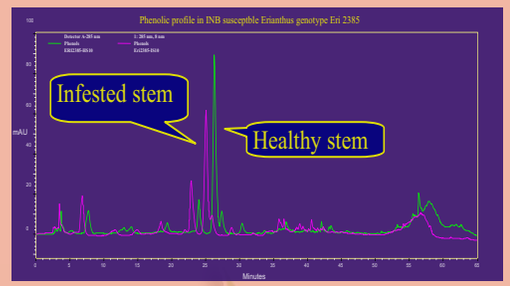
Virus indexing of sugarcane seedlings

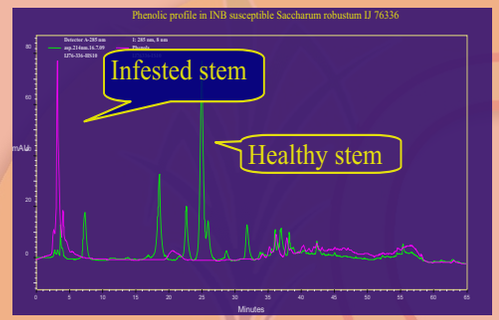
A total of 117 numbers of sugarcane tissue culture samples (*in vitro* stock cultures) were received from two tissue culture production facilities viz., EID Parry, Pugalur and Rajshree sugars, Varadarajnagar to index them for the viruses under Accredited Virus Testing of tissue culture seedlings. These plantlets were screened for the presence of sugarcane yellow leaf virus (SCYLV), sugarcane streak mosaic virus (SCSMV) and grassy shoot phytoplasma (GSD) by RT-PCR/PCR techniques using the standard operating protocols approved by DBT. Out of 117 samples screened for SCYLV, 111 samples were found infected with varying degrees of virus titre. Among the 110 samples analyzed for GSD, 20 samples were found to be infected and the remaining 90 samples were confirmed to be free from GSD infection. Test reports on virus indexing were prepared and sent to the tissue culture production labs.

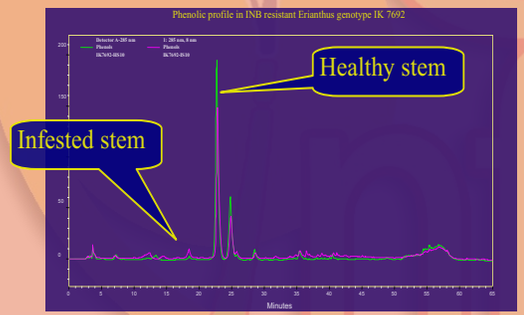
Entomology

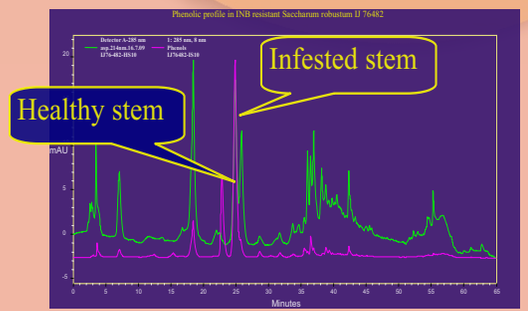
Plant phenolic acids and genotypic reaction to internode borer

Attempts were made to discern if the genotypic reaction to the sugarcane internode borer, *Chilo sacchariphagus indicus* could be reflected in terms of their phenolic acid contents. HPLC analysis of plant tissues (leaf and stem) were undertaken in select genotypes of *Erianthus spp.* and *Saccharum* spp rated as being resistant and susceptible to the internode borer. The









chromatograms revealed the presence of gallic acid, vannilic acid, ferrulic acid, cinnamic acid, flavone, syringic acid, phloroglucinol, caffeic acid, catechin, catechol, orcinol and coumarin in the healthy and borer infested plants in varying quantities that was distinct between the resistant and susceptible types.The chromatograms were found to include several other phenolic compounds also which are yet to be identified.

Induction of plant stress akin to pest damage and its influence on plant phenolics

Specific host plant signaling compounds viz. methyl jasmonate is known to be produced in response to biotic stresses and implicated in induced resistance. A condition of plant stress akin to pest damage was artificially induced by spraying methyl jasmonate at 100 ppm on four months old sugarcane plants. Alcohol extracts of leaves and stem from neighboring healthy sugarcane plants were taken at 1, 2, 3, 24 and 48 h intervals and subjected to HPLC analysis for phenolic acid

induction, if any, after the spray. In leaf tissues, catechol recorded a sudden spurt (67.74 ppm) one hour after treatment which came down to zero in the subsequent 24 h. However, the quantity remained a low 3.18 ppm compared to considerable increase in control (53.36 ppm) in the subsequent time interval (48h). After 24 h, no change was observed in the levels of caffeic acid, coumarin, cinnamic acid, catechol, gallic acid and vanillic acid. After 48 h, caffeic acid and catechol showed a decline. However, other phenolic substances such as coumarin, syringic acid, cinnamic acid, flavone, ferulic acid, catechin, phloroglucinol and orcinol showed increase in their levels. In stem, as in the case of leaf tissue, catechol showed a sudden spurt (6.22 ppm against 0.35 ppm in control) at 1h compared to all other phenolics. The quantity of this compound came down to zero in the subsequent 3h (as against 2h in leaf tissues); the level was maintained at 24 and 48 h intervals.

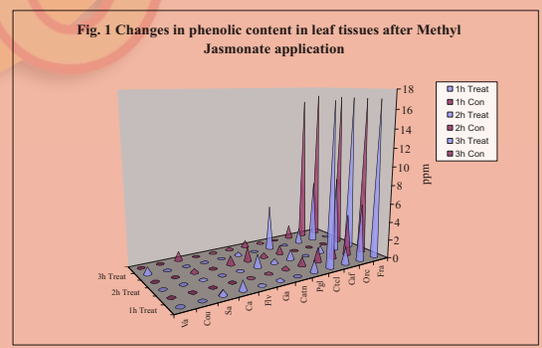


Fig. 1 Changes in phenolic content in leaf tissues after Methyl Jasmonate application

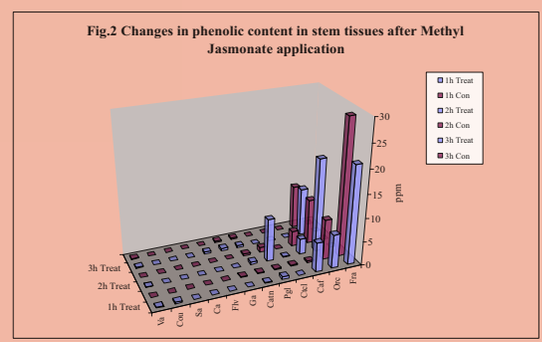
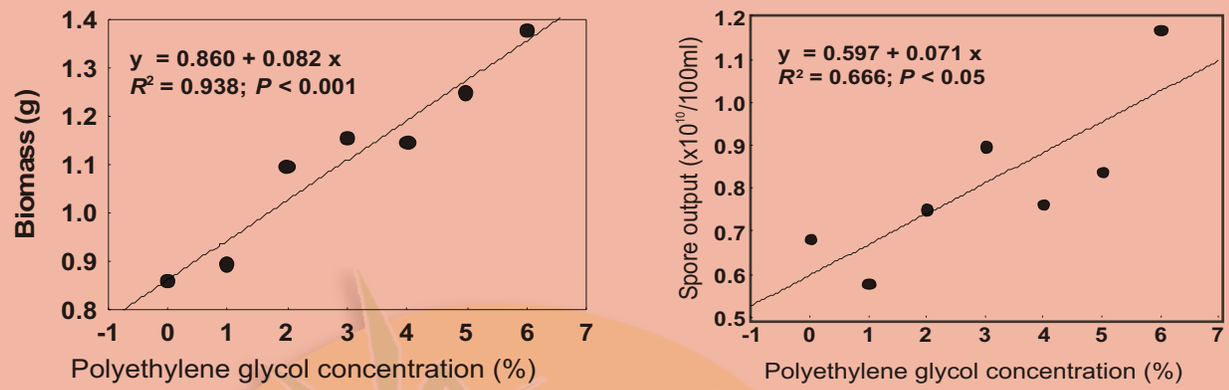


Fig.2 Changes in phenolic content in stem tissues after Methyl Jasmonate application

Changes in phenolic conent in leaf tissues after methyl jasmonate application



Growth parameters of *Metarhizium anisopliae* as influenced by Polyethylene glycol concentration

Effect of select media supplements on entomopathogenic fungi

In studies on modification of molasses-based media with supplements, polyethylene glycol (PEG) at 1-6% positively affected the biomass and spore output of *Metarhizium anisopliae* and *Beauveria bassiana* in a dosage-dependent manner. $CaCl_2$ at 0.0-3.0% also positively influenced the biomass of both fungi. Radial growth showed higher response in *B. bassiana* at medium concentrations whereas in *M. anisopliae,* there was a general negative trend. Spore production of both fungi was significantly higher in supplemented media than control with optimal response at the medium concentration. The supplement chitin at 0.1-0.6% significantly decreased biomass and radial growth of *B. bassiana* whereas it had a significant positive effect on the two parameters of *M. anisopliae*. The supplement negatively affected spore output of *B. bassiana* but not that of *M. anisopliae*. Lactic acid at 0.5-3.0% had a positive effect on biomass of both fungi. The supplement mildly affected the radial growth of *B. bassiana* but significantly reduced that of *M. anisopliae*. Lactic acid indistinctly affected spore output of both fungi.

Efficacy of *Steinernema glaseri* against *Holotrichia serrata*

The efficacy of EPN *Steinernema glaseri* in effecting whitegrub mortality was assayed under pot culture conditions. At a dosage of 10^3 juveniles / grub, the mortality obtained was 25%. Further studies are in progress.

Steinernema glaseri infection on white grubs

Outreach

SUGARCANE RESEARCH AND DEVELOPMENT MEETINGS

41st meeting of Sugarcane Research & Development Workers of Tamil Nadu and Puducherry

Director, SBI delivering the theme address

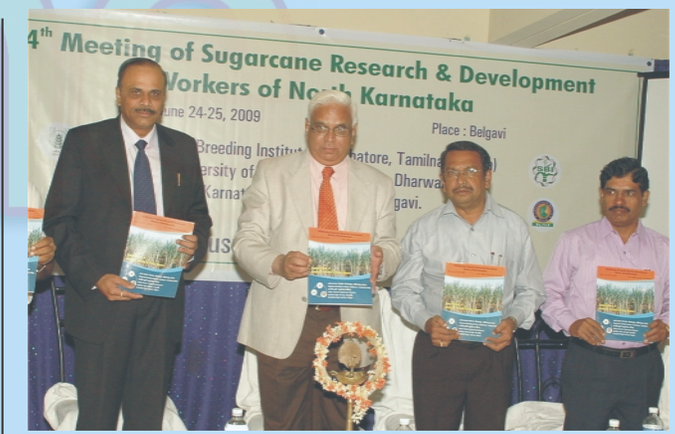
The 41st meeting of Sugarcane Research and Development Workers of Tamil Nadu & Puducherry was held at Hotel Breeze Residency, Tiruchirappalli during October 8-9, 2009. The major topics for discussion were 'Mechanization of sugarcane farming' and 'Micro-irrigation for sugarcane'

The meeting was hosted by E.I.D Parry (India) Ltd. Dr.P.Murugesa Boopathi, Vice-Chancellor of Tamil Nadu Agricultural University Dr.P.Murugesaboopathi, Vice-Chancellor of Tamil Nadu Agricultural University released "Compendium of Research Articles & Status Papers" and delivered the Inaugural address. Dr.N.Vijayan Nair , Director , Sugarcane Breeding Institute delivered the theme address. The Presidential address during the inaugural session of the meeting was delivered by busy Shri K.Ravindran, Sr.Vice President (Operations), E.I.D Parry (I) ltd., Thiru T.Soundaiah IAS, Collector, Tiruchy district , delivered the Special address.

About 350 delegates comprising scientists from Sugarcane Breeding Institute, Coimbatore and Tamil Nadu Agricultural University, Coimbatore, Development Department personnel from various sugar factories, officers from the Department of Agriculture, Directorate of Sugar and other Cane Development organizations in Tamil Nadu & Puducherry participated in the meeting.

14th meeting of Sugarcane Research & Development Workers of Northern Karnataka

The 14th meeting of Sugarcane Research and Development Workers of Northern Karnataka was held at Belgaum during June 24-25, 2009. Mechanization in sugarcane farming was the major topic of discussion besides four technical sessions and a general session. The meeting was hosted by GMR Industries Ltd., Bangalore. Dr.J.H.Kulkarni, Vice-Chancellor of University of Agricultural Sciences (Dharwad), released the "Compendium of Research Articles & Status Papers" and delivered the Inaugural address. Dr.N.Vijayan Nair,



Release of the Compendium at the R&D meet

Director , Sugarcane Breeding Institute delivered the theme address. The Presidential address during the inaugural session of the meeting was delivered Mr.R.Ramakrishnan, Managing Director of GMR Industries Ltd.,. Shri.M.Prabhu, Director of Karnataka Sugar Institute, Belgaum and Dr.K.G.Parameshwarappa, Assoc. Director of Research, UAS-D delivered the Special addresses.

About 150 delegates comprising scientists from Sugarcane Breeding Institute, Coimbatore and University

of Agricultural Sciences (Dharwad), Karnataka Sugar Institute, JDAs of Belgaum and Bagalkot, Development personnel from Agricultural department, sugar factories of Northern Karnataka and other Cane Development organizations in the region participated in the meeting.

Kisan mela 2009

A Kisan mela was organized during 16-18 Septemberat Coimbatore to showcase the recent production technologies. The mela was inaugurated by Dr.C.Swaminathan, Vice-Chancellor, Bharathiar University. Various research institutions, banking and insurance

Field visit

firms, fertilizer and pesticide firms, farm equipment manufacturers and other service providers had put up 32 stalls in the mela. Interactive seminars were arranged on topics such as promising sugarcane varieties, advances in sugarcane agronomy and current trends in integrated disease and pest management. Video films on sugarcane technologies were screened. Dr.Swapan Kumar Datta, Deputy Director General (Crop Sciences) of the Indian Council of Agricultural Research was the Guest of honour during the valedictory session of the mela. Over 1200 farmers from all over the country had participated in the mela.

DDG, ICAR (Centre) inspecting Kisan mela stalls

Frontline demonstrations

The results of the Frontline demonstrations conducted in the farmers' fields of Bannari amman Sugars Ltd area revealed that the technology wide row planting in sugarcane effected the maximum increase of about 27 % followed by Paired row planting, bio-fertilizer application and Co 99004 variety.

Foundation day

The Foundation day of SBI was celebrated on 24 October 2009. Dr. P. Murugesa Boopathi, Vice-Chancellor , Tamil Nadu Agricultural University delivered the Foundation day lecture. Retired scientists of SBI were honoured by the Scientists' Club of SBI.

FARMERS' PARTICIPATORY ACTION RESEARCH PROGRAMME (FPARP)

"Use a laser leveler, save water" campaign

As part of the Farmers' Participatory Action Research Project (FPARP) a campaign, "Use a laser leveler, save water" was conducted at Athipalayam village, Coimbatore district on 6.3.2010 to commemorate the World Water Day. A demonstration of 'laser leveller' was conducted in an FPARP farmer's field, followed by an interactive session. Over 60 persons including cane growers, cane development personnel and scientists took part in the event.

Laser leveller demonstration at Athipalayam

Study tour

FPARP partiicipants at Sugarcane Research Station, Sirugamani

A Study tour was organized as part of FPARP and the participants were exposed to various water management practices being adopted by progressive farmers of Tamil Nadu. A visit to Sugarcane Research Station (TNAU), Sirugamani was also organized through FPARP on 7.1.2010.

Training

As sensitizing the cane growers was one of the objectives of the Project, FPARP participants from all the three zones (four districts) underwent a Training programme on *"Water management for sustainable sugarcane production"* at Irrigation Management Training Institute, Tiruchirappalli on 6.1.2010.

FPARP participants at the Irrigation Management Training Institute, Tiruchirappalli

Miscellaneous

Ph.Ds awarded

The following candidates obtained Ph.D degree from Bharathiyar University, Coimbatore

Mr. S. Arvinth, was awarded Ph. D. based on the dissertation entitled 'Genetic engineering of sugarcane cultivars with genes coding for Cry1Ab and Aprotinin for shoot borer resistance' for which the studies were conducted under the guidance of Dr. M.N. Premachandran, Head, Division of Crop Improvement. Transgenics in sugarcane with *Aprotinin* and *cry1Ab* genes were developed through particle bombardment and *Agrobacterium* mediated transformation and the transgene integration and expression analyses were carried out using molecular tools. The effectiveness of *cry1Ab* gene was evaluated against the shoot borer. The pyramiding of the aprotinin and *cry1Ab* gene in the same plant was also done and the transmission of the transgenes to the progeny was confirmed.

Ms. D. Leena Lavanya's research work entitled, 'Molecular characterization of high sugared genotypes of sugarcane (*Saccharum* spp.)' under the guidance of Dr.G.Hemaprabha) fetched her the PhD degree. The study addressed the genetic base of high sucrose breeding pool of sugarcane using molecular tools. The use of 30 sugarcane specific STMS primers on 82 high sucrose genotypes of the breeding pool proved the existence of moderate diversity to enhance sucrose content through breeding. Development and screening the mapping population for high sucrose content and validation on a set high and low sucrose commercial canes (Co canes) showed that the STMS marker $NKSCSSR45_{180}$ was linked to high sucrose content and might prove beneficial in MAS for sucrose content.

Smt. B.Sajitha's PhD dissertation entitled 'Drought response and osmoregulation in sugarcane : A physiological and biochemical approach towards drought tolerance' under the guidance of Dr.S.Venkataramana found that drought treatment caused reduction in sugarcane plant height while tolerant types transpired less and showed relatively higher photosynthetic rates. An average reduction of 47% in cane yield and 26.02% in juice sucrose was evident under drought and fairly less yield and quality reduction in Co 97008, Co 95014 and Co 87023 suggested the varietal tolerance at cellular level.

Smt.R. Shanmugavadivu worked under Dr.P.N.Gururaja Rao, for her PhD work on 'Studies on photoperiodic control of flowering in sugarcane'. She carried out studies with a view to inducing flowering artificially in controlled photoperiod facilities by photoperiod treatment and synchronize flowering time with that of late flowering clones.

Training:

Seventy three students were imparted one month training programme on Crop Improvement, Crop Protection and Crop Production divisions.

Twenty seven students under took their MSc project work at the institute in Bio-technology and related areas.

An International Training Course on "Breeding of Sugarcane for Sugar-Industrial Complex" was organized at the Institute from 12th to 26th October, 2009.

A winter school on Application of molecular tools for crop improvement was conducted during Dec. 2-22, 2009.

Conducted a two day training programme on 'Sugarcane agriculture for jaggery production' for 15 jaggery farmers from Marayoor, Idukki district during 4-5 February 2010.

Conducted Exposure training for 18 students of Cane Inspector course from Sakthi Institute of Technology, Sakthinagar on 6 February 2010.

Training abroad:

Dr. V.P. Sobhakumari SS, was deputed for training in the area of Allele Mining under Dr Luca Comai, Prof. of Plant Biology,UC Davis Genome Centre and Section of Plant Biology, Univ. of California, Davis, USA from 22 March to 19 June 2010 approved under HRD Programme of NAIP .

Exhibition

Participated in the exhibition organized at Tamil Nadu Agricultural University, Coimbatore during the state level Farmers' Day conducted during 9-10 June 2010.

A one-day book exhibition was organized on 10.2.2010 (Wednesday). Publishers displayed Foreign / Indian books related to Science / Agriculture / Sugarcane.

Recognition / Awards :

The institute pavilion bagged the Best Stall Award in the exhibition organized at Tamil Nadu Agricultural University, Coimbatore during the state level Farmers' Day

Dr. N. Vijayan Nair, Director has been nominated as ICAR representative on the Board of Management in Kerala Agricultural University, Thrissur w.e.f. July 24, 2009 for three years or until further orders.

Dr. N. Vijayan Nair, Director has been nominated as Member of Scientific Advisory Committee in PPV & FRA for a tenure of 3 years from 22.1. 2010

Dr. N. Vijayan Nair, Director has been nominated as Member of Germplasm Advisory Committee of Crop Group of Commercial Crops Viz., Cotton, Sugarcane, Tobacco, Jute & Allied Fibres w.e.f. 13.4.2010

Education

The Institute has been recognized by the Bharathidasan University, Trichy to conduct Ph.D. programme in biotechnology

FROM THE RESEARCH HIGHLIGHTS OF 1918-19

The influence of spacing on total yield of sugar

"..we may therefore conclude that , with good cultivation, the yield of sugar, influenced as it is by so many factors, has not intimate relation to the spacing of the plants, and that this may accordingly vary within moderately wide limits without disadvantage. These limits have to be determined in each place and with each variety separately.."

Excerpts from Barber, C.A. Studies in Indian Sugarcanes No.4: Tillering or underground branching, Memoirs of the Dept. of Agriculture in India, Vol.X, No.2, June 1919.

PUBLICATIONS FOR SALE

BOOKS

S.No.	Details of the book	Year	* Price in Rs.
1.	Handbook on Sugarcane disease and their Management *By. R. Viswanathan and P. Padmanaban Paperback, 78p.*	2008	120.00
2.	Sugarcane Production Manual *Eds. K.C.Alexander and S. Arulraj, Paperback, 129P*	1995	40.00
3.	Sugarcane Varietal Improvement : Proceedings of the International symposium on sugarcane Varietal Improvement - Present Status and Future thrusts at SBI During Sept. 3-7.1987 *By. K. Mohan Naidu, T.V. Sreenivasan and M.N. Premachandran, HB, 364p*	1989	310.00
4.	Sugarcane Varieties in India (1979 - 86) : Morphological *Description and Agricultural characteristics* *By P. Sankaranarayanan and B. Natrajan, Hard & Spiral bound, 239P*	1987	145.00
5.	Sugarcane entomology In India *Eds. H. David S. Eswaramoorthy and R. Jayanthi, Hardbound, 564P*	1986	138.00
6.	Catalogue on Sugarcane Genetic Resources - I *(Saccharum spontaneum / By P. Kandasami et al.*	1983	75.00

CDs

S.No.	Topics	Language	* Price in Rs.
1.	Interactive multimedia on sugarcane production	English	500.00
2.	Expert system package on sugarcane pest management	English	500.00
3.	Achievement of TAR / IVLP at SBI	English, Tamil, Telugu, Kannada & Hindi	100.00
4.	Sugarcane varieties	- do -	100.00
5.	Ratoon Management	- do -	100.00
6.	Integrated nutrient management	- do -	100.00
7.	Wider row spacing	- do -	100.00
8.	Integrated disease management	- do -	100.00
9.	Integrated pest management	- do -	100.00
10.	About Sugarcane Breeding Institute	- do -	100.00
11.	Biofertilizers	- do -	100.00
12.	Organic recycling	- do -	100.00
13.	Cane of Prosperity (SBI - A profile) / 2008	- do -	200.00

Copies can be obtained

By Cash : from Library (Books) and Extension (CDs)

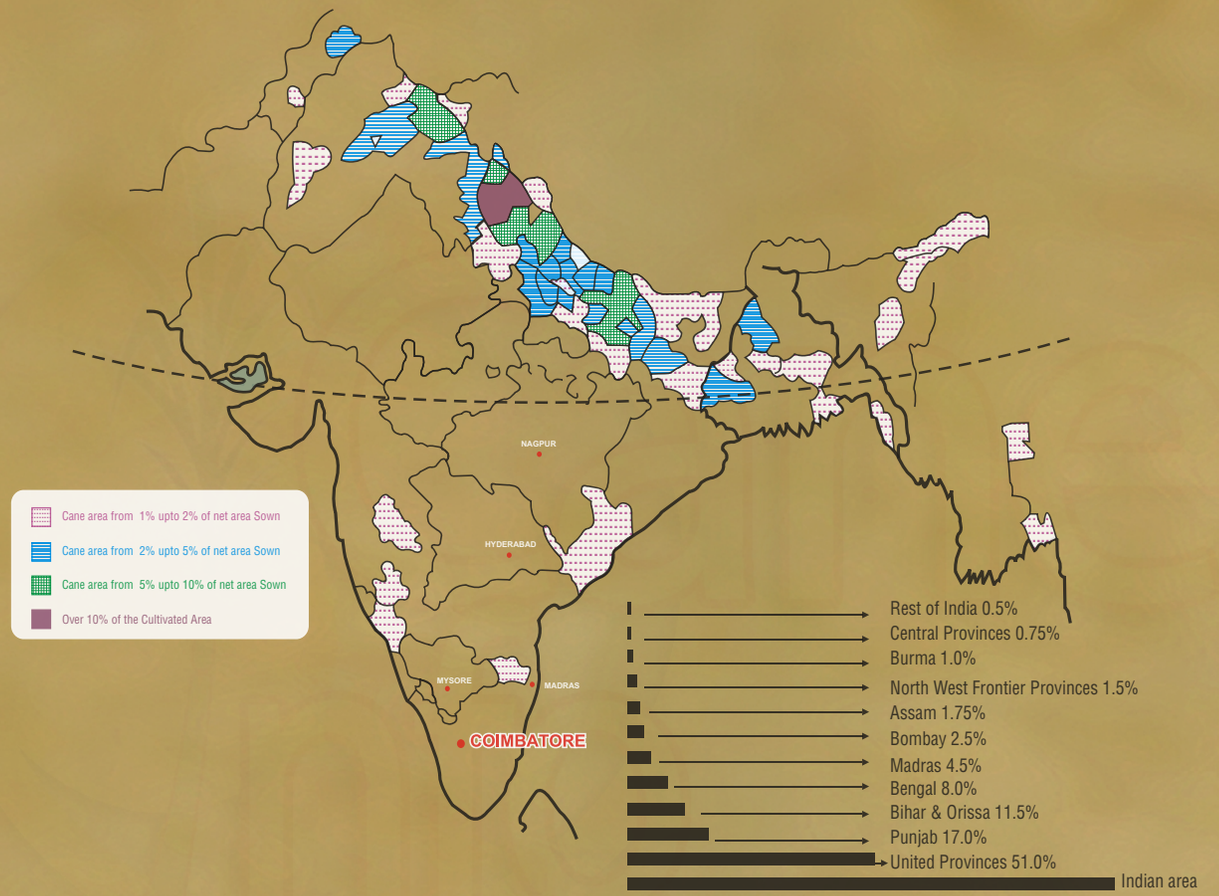
By Post : from the Director, SBI by sending a demand draft for the cost of the book (s) / CD(s) drawn in favour of "Director ,Sugarcane Breeding Institute" on any nationalized bank in Coimbatore

Contact : Ph : 0422 - 2472621 Extn : 209 - Email : sbilibrary@gmail.com

* Price is inclusive of packing and forwarding charges

DISTRIBUTION OF SUGARCANE AREA IN INDIA (1935)

(Bulk of Indian Sugarcane area in sub tropics)



COIMBATORE (IN TROPICAL INDIA) HAS SUCCESSFULLY BRED IMPROVED SEEDLINGS FOR THE MAIN SUGARCANE TRACTS OF SUB-TROPICAL NORTH INDIA.

Source : Agriculture & Livestock in India, Vol V, Part IV, July 1935