वार्शिक प्रतिवेदन
Annual Report 2025

भा.कृ.अनु.प - गन्ना प्रजनन संस्थान
कोयम्बत्तूर - 641 007

ICAR - SUGARCANE BREEDING INSTITUTE
Coimbatore - 641 007

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ICAR-Sugarcane Breeding Institute
Coimbatore - 641 007, Tamil Nadu, India
Tel. No. : 0422 - 2472621
E-mail : directorsbiicar@gmail.com
Website : http://sugarcane.icar.gov.in

For updates
http://caneinfo.icar.gov.in
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Editorial Committee
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Dr. P. Govindaraj
Director
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Preface

ICAR-Sugarcane Breeding Institute played a significant role in the production of sugarcane and sugar to sustain the needs of domestic consumption, ethanol and power production and export. The county had produced 476 million tonnes of sugarcane and 29.58 million of sugar including 3.4 million tonnes of sugar diverted for ethanol during the sugar year 2024-25. The varieties developed by the Institute occupied around 80% of the total sugarcane cropped area with the major contribution from Co 0238 and Co 0118 in subtropical region and Co 86032 in tropical region. The newly released varieties *viz.*, Co 11015 and Co 15023 were also occupying sizable areas. Sugarcane productivity was around 84 t/ha which is much higher than the world sugarcane productivity of 72 t/ha. Production of 3160 million liters of ethanol from sugarcane helped to reach the ambitious ethanol blending with petrol to 19.24%. Although sugar production scenario looks comfortable to meet the domestic consumption and diversion of sugar to ethanol production, challenges faced by both the sugarcane farmers and sugar mills are still more.

The states of Uttar Pradesh, Maharashtra and Karnataka continue to contribute more to the extend of around 75% of the total sugar production in the country; however, some states are facing major problems of shortage of cane followed by the underutilization of sugar mills. Andhra Pradesh is already out of sugar map and Tamil Nadu also witnessed 75% reduction in sugarcane area. The major challenges are labour shortage, high cost of cultivation, high labour cost, shortage of water and emergence of climate change induced new pests and diseases like pokkahboeng, crown mealy bug etc. It is high time to attract youth towards farming by making sugarcane production more profitable and less time demanding. The Institute is progressing well to address many of the issues through several technological interventions including development of climate smart varieties, mechanization of sugarcane cultivation and appropriate agro-technologies for yield enhancement and management of biotic and abiotic stresses. The technology landscape is also constantly changing and modern tools like Marker Assisted Breeding, Genomic Selection, Genome Editing, Artificial Intelligence and Machine Learning, Drone and Mechanization of major farm operations including planting and harvesting should be used. The Institute has successfully integrated both conventional and cutting edge technologies for the development of elite varieties and appropriate agro-technologies.

Co 18022 (Karan 18), a mid-late, high-yielding sucrose rich variety with resistance to Cf 13 red rot pathotype was released. In the Zonal Varietal Trial conducted in Peninsular, North West and East Coast Zones, Co 18003, Co 19012 and Co 09004, respectively were identified as the best clones by the Varietal Identification Committee. Four genetic stocks *viz.*, G1 14-161 (INGR 25104) for drought tolerance and red rot resistance, IND 99-847 (INGR 25105), IND 04-1372 (INGR 25106) for drought tolerance and GUK 14-48 (INGR 25037) for red flesh cane were registered with ICAR-NBPGR, New Delhi. Advanced Varietal Trials conducted at Coimbatore and Karnal identified 13 and five 'Co' canes, respectively. First time in the Institute, the variety Co 17018 was licensed to six sugar mills. The fluff supply program through National Hybridization Garden at Coimbatore made 456 biparental crosses and distributed 24.56 kg of fluff to 22 sugarcane breeding centres.

Under the Participatory Breeding Approach, a new initiative involving the industries, 10,600 seedlings from 33 biparental crosses were planted in the R&D farm of M/s. Bannari Amman Sugars, Satyamangalam. The energy cane SBIEC 14006 with high harvestable biomass yield of 284.27 t/ha was licensed to M/s. Radix Life Spaces Pvt. Ltd., Bengaluru. Sugarcane database was developed for 18 descriptors on 2000 clones.

Under SISMA funded project, Co 21003 was identified as the best clone across 10 factory locations and notification by SVRC is awaited. Quality breeder seed of 1263 and 1900 tonnes was produced at Coimbatore and Karnal, respectively. Additionally, 1.13 lakh and 50,000 tissue culture plants were produced at Coimbatore and Karnal, respectively and supplied to sugar mills, farmers and for breeder seed production. A total of 110 mother culture flasks were supplied to sugar mills for the production of tissue culture plantlets.

A total of 2,277 wild germplasm accessions including *Saccharum spontaneum* (1756), *Erianthus arundinaceus* (233), *Erianthus* spp. (178), allied Genera (62) and improved *Erianthus* for fibre (48) were conserved at ICAR-SBI, Coimbatore. The world collection of 3,380 sugarcane germplasm accessions were maintained at Kannur centre.

Four BC_3 clones involving *E. procerus* were identified as drought tolerant based on superior cane yield under stress. Hybrid progenies of *S. spontaneum* with different cytotypes and high sucrose varieties led to the identification of a superior clone SS 2021-304.

Pre-emergence application of Clomazone + Sulfentrazone @ 2.5 kg/ha followed by one inter-cultivation at 60 days recorded the highest cane yield (102.62 t/ha) and weed control efficiency of 86.5%. Co 18002 and Co 18003 were identified as drought tolerant, while Co 18002, Co 18003, Co 19008 and Co 19009 were identified as saline tolerant.

Application of a Bt-based biopesticide (Bt-62) against white grub using Bio Formulation Applicator (ICAR-SBI) in white grub endemic area showed 33% reduction. For the management of pokkahboeng, drone spraying of Propiconazole upto 0.2% was standardized.

The outreach programs included six sponsored training programs for cane growers / cane staff, 22 one-day training programs with 680 participants, 141 exposure visits benefitting 8294 students/academicians and 63 personalized advisories, two frontline demonstrations and a farmer-scientist interaction.

MTA was signed between ICAR-SBI and ICAR-CICR for two novel *cry8* genes discovered by ICAR-SBI towards the development of transgenic cotton for the management of cotton stem weevil. Registration certificates for Co 12029 (Karan 13), Co 18009 and Co 13035 (Karan 14) was obtained from PPV&FRA. Five copyright certificates were received. Licensed the following technologies *viz.*, SBIEC14006 - An energy cane with high biomass production, ICAR-SBI EPN Biopesticide formulation to two firms, *Cotesia flavipes* and *Telenomus dignus* mass multiplication technology against internode borer with release station and sugarcane variety Co 17018.

Thanks are due to all staff of the Institute for the successful conduct of research and developing commercially viable technologies for the benefit of farmers and millers. Great efforts taken by the editors Dr. T. Rajula Shanthy and team in compiling and editing the annual report and to bring it as an excellent publication is greatly appreciated. I acknowledge with thanks the constant guidance, support and encouragement received from Dr. M.L. Jat, Secretary, DARE and DG, ICAR, Dr. D.K. Yadava, DDG (Crop Science), Dr. Himanshu Pathak, previous Secretary, DARE and DG, ICAR, Dr T.R. Sharma, previous DDG (Crop Science) and Dr. Prasantha Dash, ADG (Commercial Crops).

P. Govindaraj
Director

2 THE ORGANIZATION

Background

ICAR-Sugarcane Breeding Institute (SBI), Coimbatore has been conducting research on various aspects of sugarcane agriculture and varietal improvement since its inception in 1912. The Institute has developed over 3260 'Co' selections, many of them becoming popular as commercial varieties in different parts of the country. 'Co' canes bred at ICAR-SBI along with the varieties identified from the crosses made at the institute by the State Sugarcane Research Stations occupy nearly 99% of the cane area in the country. Thus, the sugarcane varieties cultivated in the country today are directly or indirectly derived from this institute. 'Co' canes were successful as commercial varieties in over 30 countries at one time and are being extensively used as parents in breeding programmes even today. The Institute maintains one of the largest collections of sugarcane genetic resources in the world.

Location

The Institute is located 8 km from the Coimbatore railway station and 19 km from the Coimbatore airport. Geographically it is located at 77°E longitude and 11°N latitude at an altitude of 427 m above mean sea level.

Centres

The Institute has one Regional Centre at Karnal (Haryana) and two Research Centres at Kannur and Agali (Kerala).

Mandate

- To breed superior sugarcane varieties / genotypes having high sugar productivity as well as sustainability and to assist State sugarcane breeding programmes.
- To collect, maintain, evaluate, document and conserve sugarcane genetic resources.
- To conduct basic and strategic research on crop improvement, production and protection aspects of sugarcane cultivation.
- To effect technology transfer, consultancy and human resource development in the areas of sugarcane agricultural research.

Staff position

Table 1. Staff position as on 31.12.2025

Category	Sanctioned	Filled	Vacant
Director	1	1	-
Scientific	77	70	7
Technical	71	47	24
Administrative	43	20	23
Supporting	56	31	25
Total	248	169	79

Financial Statement

Table 2. Abstract of expenditure during 2025

Head	Amount in Lakhs (Rs.)
Government Grant	5801.37
Plan Schemes	23.70
Externally funded schemes	945.42
Contract Research Projects	13.12
Total	6783.60

Organizational set up

The research activities of the Institute are being carried out in three divisions and two sections at the main Institute and its Regional / Research Centres under the administrative control of the Director. The Prioritization, Monitoring and

Evaluation Unit (PME) supports the research management functions like prioritization, coordination, planning and review of research programs to ensure that the system functions with the requisite accountability in terms of efficiency and optimal utilization of resources. An administrative wing comprising Establishment, Audit and Accounts, Cash and Bills, and Stores effectively provides the required administrative support. The Estate section, besides maintenance of buildings, takes care of the vehicle management and security arrangements (Fig. 1).

Farm

The main Institute has a total area of 81.06 ha including farm, laboratory and office buildings. The farm area is 54.24 ha and is situated in four campuses *viz.*, Main (7.28 ha), ECC (28.50 ha), Additional land (17.20 ha) and VPT (2.00 ha). ICAR-SBI Regional Centre, Karnal has 21.94 ha, ICAR-SBI Research Centre, Kannur has 8.43 ha and ICAR-SBI Research Centre, Agali has 12 ha.

Library and documentation services

The library provides information support to the research and development activities of the Institute. It has a collection of 14,250 books including bound volumes of journals.

The PM-One India One Subscription (ONOS) was implemented for online access to international high impact scholarly research articles and Journal publications to scientists, students and researchers. Library has facilities *viz.*, internet terminals, scanning and digital access to holdings through KOHA software for the users. Academic research support is provided through access to dissertations, thesis, reports of other ICAR institutes and vital information on sugar industry activities through sugar industry publications. It has got ISBN and ISSN assigning facility for the publications of the institute.

The priced publications of the Institute were sold for an amount of Rs.34,720.

Weather data

Table 3. Weather data for January to December 2025

Month	Temperature °C		RH (%)		Wind velocity (km per hour)	Open pan evaporation (mm/day)	Rainfall (mm)	No. of rainy days
	Maximum	Minimum	Fore noon	After noon				
January	30.33	20.29	84.80	44.33	1.44	2.70	9	-
February	34.39	19.77	82.68	28.75	1.75	3.80	9	-
March	35.60	23.03	82.97	39.72	1.69	4.21	28.20	2
April	35.48	24.05	87.30	45.00	1.26	3.93	81.80	3
May	33.56	23.47	86.94	52.61	3.10	3.30	164.40	13
June	31.37	22.75	84.37	60.10	4.81	3.11	58.80	6
July	31.21	22.56	81.58	57.87	3.20	3.79	26.40	3
August	31.19	22.10	86.39	56.13	3.20	3.42	97.80	5
September	32.33	22.42	83.93	52.83	2.90	3.59	21.80	2
October	31.71	22.13	87.16	56.71	1.74	2.37	122.800	8
November	32.33	22.42	83.93	52.83	2.90	3.59	43.80	2
December	31.19	16.81	86.58	51.32	1.22	2.33	18.40	3
Mean/ Total	32.56	21.82	84.89	49.85	2.43	3.36	664.20	47

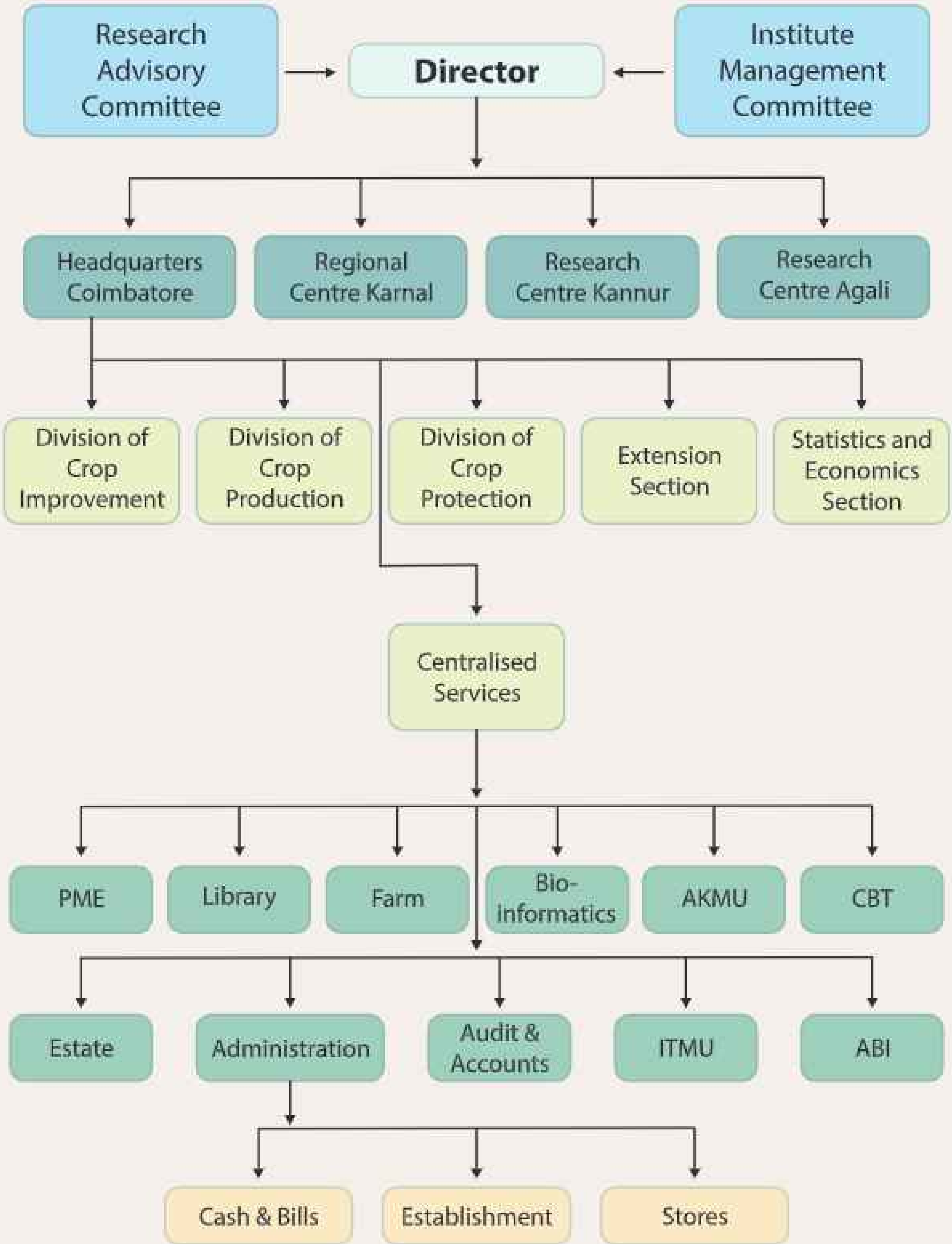


Fig. 1. Organizational structure of ICAR-SBI

3 कार्यकारी सारांश

को 18022 (करन 18) एक मध्यम–देर से पकने वाली तथा उच्च उपज देने वाली गन्ना किस्म है, जिसे उत्तर–पश्चिम क्षेत्र में खेती के लिए AICRP (गन्ना) की वैरायटी आइडेंटिफिकेशन कमेटी द्वारा रिलीज हेतु अनुमोदित किया गया है। यह किस्म द्वि–अभिभावक संकरण (CoS 8436 × Co 89003) से विकसित की गई है, जिसने AICRP परीक्षणों में अधिक गन्ना उपज तथा उच्च सुक्रोज प्रतिशत के लिए उत्कृष्ट प्रदर्शन प्रदर्शित किया है। यह किस्म लाल सड़न रोग के प्रति प्रतिरोधी है तथा लवणता के प्रति मध्यम सहनशीलता रखती है।

प्री–जोनल वैरायटल ट्रायल में 73 क्लोनों के मूल्यांकन के परिणामस्वरूप 13 उत्कृष्ट ''को'' गन्ने (Co 25001- Co 25013) तथा एक जेनेटिक स्टॉक CoGS 25014 की पहचान की गई, जिनमें अधिक गन्ना उपज, अधिक CCS उपज, उच्च सुक्रोज कंटेंट तथा लाल सड़न और स्मट रोगों के प्रति प्रतिरोध पाया गया। वर्ष 2025 श्रृंखला के इन 13 'Co' केनों में से 10 आशाजनक क्लोनों को आगे परीक्षण हेतु AICRP (गन्ना) के अंतर्गत पेनिन्सुलर जोन में अग्रेषित किया गया। एरोइंग प्लॉट में पुष्पन की तीव्रता 82.86: दर्ज की गई तथा उच्च उपज, बेहतर गुणवत्ता और लाल सड़न एवं स्मट रोगों के प्रति प्रतिरोध पर विशेष ध्यान देते हुए 'Co' तथा 'Co' संबद्ध किस्मों ISH, IGH, CYM क्लोनों और पंजीकृत जेनेटिक स्टॉक्स का उपयोग करके कुल 435 संकरण किए गए। इन संकरणों से प्राप्त 158 द्वि–अभिभावक संकरण, 26 पॉलीक्रॉस तथा 39 सामान्य संकलनों से प्राप्त लगभग 40,000 पौधों का ग्राउंड नर्सरी में मूल्यांकन किया गया। सहभागी प्रजनन दृष्टिकोण के अंतर्गत एक नई पहल के रूप में, 33 द्वि–अभिभावक संकरणों से प्राप्त 10,600 पौधों को बन्नारी अम्मन शुगर्स प्रा. लि., सत्यमंगलम के अनुसंधान एवं विकास फार्म में ग्राउंड नर्सरी में लगाया गया। द्वितीय क्लोनल परीक्षण से अच्छी फील्ड स्टैंड, उच्च उपज, बेहतर गुणवत्ता मापदंड तथा लाल सड़न और स्मट रोगों के प्रति प्रतिरोध को ध्यान में रखते हुए कुल 197 क्लोनों का चयन किया गया और इन्हें आगे PZVT (प्री–जोनल वैरायटल ट्रायल) गुणन के लिए अग्रेषित किया गया। PZVT (प्री–जोनल वैरायटल ट्रायल) में क्लोन Co 25003 (22.50%), Co 25005 (22.67%), Co 25009 (22.53%) तथा Co 25010 (22.11%) ने 12 माह पर 22.00% से अधिक जूस सुक्रोज दर्ज किया। Co 25005 ने कटाई के समय उच्च सुक्रोज प्रतिशत दर्ज करने के साथ–साथ प्लग एवं नोडल विधियों द्वारा परीक्षण में लाल सड़न के प्रति प्रतिरोधी प्रतिक्रिया प्रदर्शित की। इसके अतिरिक्त, एस. निजलिंगप्पा शुगर इंस्टीट्यूट, बेलगावी (कर्नाटक) में दो पौधा फसलों तथा एक रेटून फसल के दौरान 12 उत्कृष्ट क्लोनों के मूल्यांकन में Co 21003, 2020–127, 2020–121 तथा 2020–152 को CCS उपज और गन्ना उपज के लिए श्रेष्ठ पाया गया। इन क्लोनों ने स्थान–विशिष्ट संभावित किस्मों के रूप में अपनी क्षमता प्रदर्शित की।

उच्च कटाई योग्य जैव द्रव्यमान उपज (284.27 टन / हेक्टेयर) वाली एनर्जी केन SBIEC 14006 को M/s- Radix Life Spaces Pvt. Ltd. बेंगलुरु, कर्नाटक को लाइसेंस प्रदान किया गया। सूखा सहनशीलता के लिए सुदृढ़ मार्करों की पहचान हेतु 90 जीनोटाइपों के एक पैनल का प्रेरित सूखा परिस्थितियों में मूल्यांकन किया गया। इस अध्ययन में सूखा सहनशीलता से संबंधित विभिन्न लक्षणों जैसे कैनोपी तापमान, शूट बायोमास, रूट बायोमास, शूट लंबाई, सूखी शूट भार तथा सूखी जड़ भार के साथ मार्करदृलक्षण संबंध पाया गया, जिसमें 15–29% तक फेनोटाइपिक परिवर्तनशीलता दर्ज की गई। लाल सड़न के CF 06 आइसोलेट के विरुद्ध तीन वर्षों तक CCT के माध्यम से जीनोटाइपों को 22 प्रतिरोधी तथा 80 मध्यम प्रतिरोधी समूहों में वर्गीकृत किया गया। 2000 क्लोनों के लिए 18 वर्णनकर्ताओं पर आधारित एक गन्ना डेटाबेस विकसित किया गया, जिसमें वंशावली, उपज एवं गुणवत्ता मापदंड, जैविक तथा अजैविक तनावों के प्रति प्रतिक्रिया तथा पुष्पन संबंधी विशेषताओं की जानकारी शामिल है। एरोइंग प्लॉट में जंग (Rust) रोग की प्राकृतिक उपस्थिति के लिए 318 पैरेंटल क्लोनों की जांच की गई, जिनमें से 125 क्लोन (39.31%) जंग रोग से मुक्त पाए गए। इसके अतिरिक्त चार क्लोन कृ ।। 2024–05, KE 2024–01, RK 2023–83 तथा AA 2024–03 ने मानक किस्म Co 86032 की तुलना में अधिक एकल गन्ना भार , जूस वजन तथा पोलः जूस दर्ज किया और इन्हें एथेनॉल उद्योग / एकीकृत शुगर कॉम्प्लेक्स के लिए उपयुक्त पाया गया।

IVT (प्रारंभिक वैरायटल परीक्षण) में Co 21002 को CCS उपज तथा गन्ना उपज के लिए श्रेष्ठ पाया गया, जबकि तीन परीक्षण प्रविष्टियाँ Co 21003, Co 21007 और Co 21009 को सुक्रोज सामग्री के लिए सर्वश्रेष्ठ प्रदर्शन करने वाली प्रविष्टियों के रूप में पहचाना गया। AVT (उन्नत वैरायटल परीक्षण) की पहली पौधा फसल में Co 19009 और Co 19014 ने उच्च गन्ना उपज तथा CCS उपज के साथ आशाजनक प्रदर्शन किया। 12 माह पर जूस सुक्रोज के लिए पाँच प्रविष्टियों - Co 19009, Co 19014, CoT 19366, CoT 18366 और CoT 18369 - ने व्यावसायिक किस्म Co 86032 की तुलना में 5% से अधिक सुधार दर्ज किया। दो पौधा फसलों और एक रेटून फसल के आंकड़ों के विश्लेषण से पता चला कि Co 18003, Co 18002, CoVC 18061 और Co

18009 गन्ना उपज तथा चीनी उपज के लिए श्रेष्ठ पाए गए। इसके अतिरिक्त Co 18003, Co 18013, Co 18002, Co 18009, CoVSI 18121 और CoVC 18061 ने जूस सुक्रोज के मामले में Co 86032 से बेहतर प्रदर्शन किया।

PAU लुधियाना में आयोजित AICRP (S) कार्यशाला में स्वीकृत नौ 'ब्व' केन को सीड मल्टीप्लिकेशन सेंटर, पाडेगांव को उपलब्ध कराया गया। लक्षित प्री–ब्रीडिंग प्रयासों के अंतर्गत, जलवायु–स्मार्ट जेनेटिक स्टॉक्स के विकास के लिए किए गए संकरणों से प्राप्त 773.2 ग्राम फ्लफ आठ सहभागी केन्द्रों को प्रदान किया गया। नेशनल हाइब्रिडाइजेशन गार्डन में 470 क्लोनों में से 377 क्लोन में पुष्पन हुआ, जिससे 80.21% पुष्पन तीव्रता दर्ज की गई। इसके अतिरिक्त, नेशनल हाइब्रिडाइजेशन एवं फ्लफ सप्लाई प्रोग्राम के अंतर्गत किए गए 456 द्वि–अभिभावक संकरणों से प्राप्त 24.56 किलोग्राम फ्लफ देश के 22 केन्द्रों को वितरित किया गया। कुल 2,277 जंगली जर्मप्लाज्म अभिग्रहण का संरक्षण गन्ना प्रजनन संस्थान, कोयंबटूर में किया गया, जिनमें *Saccharum spontaneum* (1756), *Erianthus arundinaceus* (233), *Erianthus* spp. (178), सहयोगी जीनस (62) तथा रेशा (फाइबर) के लिए उन्नत *Erianthus* (48) शामिल हैं। इसके अतिरिक्त 47 उच्च ऊँचाई (high&altitude) वाले अभिग्रहण को ICAR & IARI क्षेत्रीय स्टेशन, वेलिंगटन में संरक्षित रखा गया।

इसके अलावा 1924 क्लोन, जिनमें 'Co* केन, विदेशी हाइब्रिड तथा अन्य पंजीकृत जेनेटिक स्टॉक्स शामिल हैं, को कोयंबटूर में संरक्षित रखा गया। नेशनल एक्टिव जर्मप्लाज्म रखरखाव के अंतर्गत 296 अधिसूचित एवं पंजीकृत जेनेटिक स्टॉक्स का संरक्षण किया गया तथा 26 नव अधिसूचित क्लोनों को सूचकांक (baMsDI) संख्या प्रदान की गई। कर्नाटक, आंध्र प्रदेश तथा तमिलनाडु से संकलित 49 *Saccharum spontaneum* क्लोनों में से IND 21–2106 और IND 21–2080 ने उत्कृष्ट वनस्पतिक वृद्धि प्रदर्शित की, जबकि IND 21–2103 में रूट–आई की अधिकतम संख्या दर्ज की गई, जो इसकी मजबूत रैटून क्षमता को दर्शाती है।

विभिन्न क्षेत्रों से संकलित *S. spontaneum* के 20 अभिग्रहणों में सोमैटिक गुणसूत्र संख्या का निर्धारण किया गया, जिसमें व्यापक साइटोटाइपिक विविधता (2n = 40–112) देखी गई। FISH (Fluorescence In Situ Hybridization) विश्लेषण से यह ज्ञात हुआ कि Û = 9 एक मध्यवर्ती विकासात्मक अवस्था का प्रतिनिधित्व करता है, जबकि पेनिन्सुलर क्षेत्र के क्लोनों में केवल Û=8 पाया गया। इससे यह संकेत मिलता है कि उप–हिमालयी क्षेत्र , भारत में *S. spontaneum* के विकासात्मक केंद्र के रूप में दिखाता है।

तीन जेनेटिक स्टॉक्स को ICAR & NBPGR नई दिल्ली में पंजीकृत किया गया। G1 14–161 (INGR 25104) एक अंतर–प्रजातीय संकर व्युत्पन्न (Co7201×Pathri (*S.barberi*) × Co 0209) है, जिसने टिलरिंग चरण में सूखा सहनशीलता तथा उष्णकटिबंधीय और उपोष्णकटिबंधीय लाल सड़न पैथोटाइप्स (CF 06 और CF 08) के प्रति प्रतिरोध प्रदर्शित किया। अन्य दो जंगली जर्मप्लाज्म अभिग्रहण *S. spontaneum* के हैं, अर्थात् IND 99–847 (INGR 25105) जो केरल से संकलित किया गया तथा IND 04–1372 (INGR 25106) जो मिजोरम से संकलित किया गया। इन्हें क्रमशः उच्च ज्यामितीय औसत उत्पादकता तथा उच्च सूखा सहनशीलता गुणांक के आधार पर सूखा सहनशील जेनेटिक स्टॉक्स के रूप में पंजीकृत किया गया। अजैविक तनावों के लिए ई. अरुंडिनेसियस जर्मप्लाज्म की स्क्रीनिंग ने लवणता सहिष्णुता, उच्च बायोमास, प्रोलाइन के उच्च संचय और 43 प्रमुख मात्रात्मक की पहचान के साथ तीन क्लोन (एसईएस 181, एसईएस 342, एसईएस 347) की पहचान की जीबीएस डेटा का इस्तेमाल करके ट्रेट न्यूक्लियोटाइड्स से सूखे को सहने की क्षमता से जुड़े अलग–अलग शारीरिक लक्षण और कैंडिडेट जीन का पता चला।

विशिष्ट गुणों वाले जेनेटिक स्टॉक्स के विकास के लिए 24 अंतर–प्रजातीय संकरण किए गए। CF 06 आइसोलेट के विरुद्ध लाल सड़न की स्क्रीनिंग में CCT विधि द्वारा 27 प्रतिरोधी तथा 51 मध्यम प्रतिरोधी क्लोन पहचाने गए, जबकि प्लग विधि से 4 प्रतिरोधी तथा 47 मध्यम प्रतिरोधी जीनोटाइप पाए गए। इसके अतिरिक्त 62 अंतर–प्रजातीय संकरों का सूखा परिस्थितियों में मूल्यांकन किया गया, जिनमें से पाँच क्लोन - TSGS 21–16, TSGS 21–39, TSGS 21–385, TSGS 22–365 और TSGS 23–5 – को गन्ना उपज तथा शारीरिक लक्षणों के लिए स्थिर प्रदर्शन करने वाले के रूप में पहचाना गया।

E. procerus को सम्मिलित करते हुए 577 BC_3 प्रोजेनी का बड़े पैमाने पर मूल्यांकन किया गया, जिसमें उपज एवं गुणवत्ता लक्षणों के आधार पर 134 श्रेष्ठ क्लोनों की पहचान की गई। जल–अभाव तनाव की स्थिति में BC_2 और BC_3 संकरों में उपज में कमी (41.31%) वाणिज्यिक चेक किस्मों (50.77%) की तुलना में कम पाई गई। BC_3 संकरों ने सूखा परिस्थितियों में गन्ने के व्यास में अपेक्षाकृत स्थिरता (5.70% कमी) तथा जूस शुद्धता में केवल 1.68: कमी बनाए रखी।चार BC_3 क्लोन – GU 22–70, GU 22–73, GU 22–93 और GU 22–110 – को तनाव की स्थिति में अधिक गन्ना उपज के आधार पर सूखा सहनशील के रूप में पहचाना गया। *E. procerus* से अंतःस्थापित (introgressed) क्लोनों में सूखा परिस्थितियों में टिलर रूपांतरण दक्षता अधिक पाई गई, जहाँ 13 क्लोनों ने मानक किस्म Co 06022 की तुलना में बेहतर प्रदर्शन किया।

Erianthus क्लोन (IND 04–1377 TC) और Co 86032 के बीच किए गए संकरणों से प्राप्त संकरों में गन्ने के रंग, ऊँचाई, मोटाई,

NMC (प्रति इकाई क्षेत्र गन्नों की संख्या) तथा HR ब्रिक्स में व्यापक फेनोटाइपिक विविधता देखी गई। 12 माह की आयु पर 23 संकरों में सुक्रोज सामग्री 14.16–19.0% दर्ज की गई, जबकि *Erianthus* सम्मिलित बैकक्रॉस संकर IK76–99× (Co 86032 × 04–774)–35में 17.53% सुक्रोज पाया गया। साइटोलॉजिकल और आणविक विश्लेषण से गुणसूत्र संख्या 2n = 85–144 पाई गई, जो 2n+n संचरण को दर्शाती है, तथा *Erianthus*–विशिष्ट मार्करों का उपयोग करके संकरता (hybridity) की पुष्टि की गई।

अलग–अलग साइटोटाइप और ज़्यादा सुक्रोज वाली किस्मों वाले एस. स्पॉटेनियम को शामिल करके क्रॉस से मिली हाइब्रिड संतानों से एक बेहतर क्लोन एसएस 2021–304 की पहचान हुई, जिसमें गन्ने की ज़्यादा पैदावार, ज़्यादा ब्रिक्स और बेहतर सिंगल गन्ने का वजन था। तीन क्लोन (आईएसएच 100, आईएसएच 28, सवाईऍम 14–298) में तीन रैटून फसलों में ज़्यादा औसत गन्ने की पैदावार, ज़्यादा औसत सुक्रोज कंटेंट और रेड रॉट टॉलरेंस पाया गया।

लंबे समय तक स्टोरेज के लिए गन्ने के जेनेटिक रिसोर्स के क्रायोप्रिजर्वेशन पर एनाटॉमिकल स्टडीज से पता चला कि कंट्रोल मेरिस्टम से निकली एक्सिलरी कलियों में बरकरार और एक्टिव मेरिस्टेमेटिक टिशू थे, जबकि एनकैप्सुलेशन–डिहाइड्रेशन और लिक्विड नाइट्रोजन के संपर्क में आने से पिघलने के बाद स्ट्रक्चरल डैमेज हुए। हाइब्रिड (बीसी, क्लोन जीआई 18–2) के जीआईएसएच एनालिसिस से पता चला कि 63.5% जीनोम में एस. ऑफिसिनारम, 21.5% में एस. स्पॉटेनियम,10.75% में पुनः संयोजक क्रोमोसोम, 1.8% में एरिएंथस,और लगभग 2.45% में अनजान जीनोमिक कंपोनेंट थे, जिससे एरिएंथस जीनोम के सफल इंट्रोग्रेशन की पुष्टि हुई।

को 06022 से एक सूखे पर असर डालने वाला साइटोक्रोम पी450 जीन (1.5 kb) सफलतापूर्वक क्लोन और सीक्वेंस किया गया। एक कंजर्वड ग्लाइकोसिलट्रांसफरेज जीन (1.5 kb) को अलग किया गया, क्लोन किया गया और गन्ने में क्रोमोसोम 2d पर इसकी मौजूदगी और तीन कंजर्वड मोटिफ (Glydks_transf_43) GlcAT&I और पीअलएन 02458) को वैलिडेट किया गया। जीडब्लूएएस किया गया था 100K एसएनपी ऐरे का इस्तेमाल करके 499 गन्ने के जीनोटाइप और पैदावार और क्वालिटी ट्रेट्स के लिए जरूरी मार्कर ट्रेट एसोसिएशन की पहचान की गई। केएएसपी एसे ने रेड रॉट रेजिस्टेंस से जुड़े एसएनपी को वैलिडेट किया, जो एसएनपी 98 मार्कर के लिए साफ बाइएलेलिक क्लस्टरिंग दिखा रहे थे। सीएफ 06 पैथोटाइप के खिलाफ फील्ड स्क्रीनिंग से 78 क्लोन में से 11 आर और 51 ऍमआर क्लोन की पहचान हुई। सप्रेशन सबट्रैक्टिव हाइब्रिड हाइब्रिडाइजेशन ने एएस–04–1687 और टीएसजीएस–20–24 में क्रमशः 452 और 625 सूखे–अपरेगुलेटेड ट्रांसक्रिप्ट की पहचान की, जो मुख्य रूप से एमएपीके, कैल्शियम और फॉस्फेटिडिलिनोसिटॉल सिग्नलिंग पाथवे से जुड़े थे। रूट एनाटॉमिकल एनालिसिस से पता चला कि क्लोन एएस–04–1687 में स्क्लेरेनकाइमा और स्टेल एरिया में बढ़ोतरी के साथ सूखे के अनुकूल लक्षण दिखे। सैलिनिटी स्ट्रेस के जवाब में TSGS 20–24 और को 94012 दोनों में स्ट्रेस से जुड़े जीन का काफी अपरेगुलेशन दिखा, और सैलिनिटी से प्रेरित एक एलआईऍम ट्रांसक्रिप्शन फैक्टर को सफलतापूर्वक क्लोन किया गया।

SWEET13c, SWEET4a तथा SWEET3a जीनों को लक्षित करते हुए CRISPR/Cas9 संपादित पौधों का पुनर्जनन किया गया और Cas9 के माध्यम से उनका सत्यापन किया गया। Sanger sequencing तथा ICE&CRISPR विश्लेषण द्वारा indel (insertion–deletion) उत्परिवर्तन की पहचान की गई, जिसमें, d SWEET13c–2 पौधे में 11% संपादन दक्षता पाई गई, जबकि Ng SWEET4–2 पौधों में 1–3% पदकमसे दर्ज किए गए। Synteny विश्लेषण से *S.spontaneum* के साथ मजबूत संरक्षण तथा ठंड तनाव के प्रति प्रतिक्रिया करने वाले PP2C जीनों के साथ सहसंबंध पाया गया, जिससे यह संकेत मिलता है कि ये जीन अजैविक तनाव के नियमन में महत्वपूर्ण भूमिका निभाते हैं। इसके अतिरिक्त, 46°C पर उच्च लैकेज गतिविधि प्रदर्शित करने वाले चार थर्मोफिलिक सूक्ष्मजीव आइसोलेट की पहचान की गई। प्रोटिओमिक विश्लेषण में 1,447 पेप्टाइड्स तथा 134 भिन्न रूप से अभिव्यक्त प्रोटीन (differentially expressed proteins) पाए गए, जिनमें लिग्निन अपघटन एंजाइम जैसे जाइलेनेज, हेमिसेल्युलेज तथा सेलुलेज शामिल हैं। *Aspergillus* sp. से प्राप्त लैकेज जीन (1.8 kb) को सफलतापूर्वक क्लोन किया गया, जिसका उद्देश्य बायोमास के डीलिग्नीफिकेशन की प्रक्रिया को सुदृढ़ करना है।

कोयंबटूर से किसान पार्टिसिपेटरी सीड प्रोग्राम (एफपीएसपी) के जरिए बीज पर AICRP के तहत, को–ऑपरेटिव और प्राइवेट चीनी मिलों को 1263.555 टन अच्छी क्वालिटी के ब्रीडर सीड केन (को 86032, को 11015, को 14012, को 18009) बांटे गए। इसके अलावा, 1.13 लाख टिशू कल्चर प्लांट (को 86032, को 11015, को 18009, को 14012, को 0238, को 0118, को 15023) बनाए गए और चीनी मिलों, किसानों और ब्रीडर सीड प्रोडक्शन के लिए सप्लाई किए गए। तमिलनाडु, पंजाब, कर्नाटक और उत्तर प्रदेश में मौजूद पांच टिशू कल्चर लैब को साठ वायरस फ्री मदर कल्चर फ्लास्क (को 86032, को 11015, को 0238, को 0118, को 15023) दिए गए। करनाल से 1900.52 टन ब्रीडर सीड (को 15023, को 16030, को 17018, को 0118) अलग–अलग स्टेकहोल्डर्स को डिलीवर किए गए। ऑन–फार्म और FPSP सीड प्रोडक्शन क्रमशः 207.531 टन और 1692.969 टन था। लगभग 50,000 टिशू कल्चर प्लांटलेट्स (को 0118, को 15023, को 17018) जेनरेट किए गए, और टिशू कल्चर प्लांटलेट्स की खेती के लिए 49 मदर फ्लास्क (को 0118), को

15023, को 17018) शुगर मिलों को बेचे गए। को 17018 वैरायटी के लिए सीड प्रोडक्शन और सेल लाइसेंस छह शुगर मिलों को दिया गया। करनाल सेंटर से कुल 27.14 लाख रुपये का रेवेन्यू जेनरेट हुआ। चार गन्ना किस्मों [VSI 08005 (VSI 12121), Phule Sugarcane 13007 (MS 14082), Phule & 11082 (CoM 11082) तथा Phule Sugarcane 15012 (MS 17082), पर DUS परीक्षण किया गया। इसके अतिरिक्त 27 DUS लक्षणों के आधार पर 246 संदर्भ किस्मों का पुनः–लक्षणन किया गया तथा 100 संदर्भ किस्मों का डिजिटलीकरण पूर्ण किया गया।

सीआरआईएसपीआर –क्रॉप नेटवर्क और उससे जुड़े जीनोम एडिटिंग इनिशिएटिव के तहत, पॉलीसिस्ट्रोनिक ऐंमएटएल–टारगेटिंग सीआरआईएसपीआर & Cas9 वेक्टर को सफलतापूर्वक बनाया और वैलिडेट किया गया। 300 से ज्यादा ट्रांसफॉर्मेंट की स्क्रीनिंग से मॉलिक्यूलर और सीक्वेंसिंग एनालिसिस के जरिए दो ऐंमएटएल –एडिटेड पौधों की पुष्टि हुई। एलीट गन्ने के जीनोटाइप में टिलरिंग और यील्ड बढ़ाने के लिए स्ट्रिगोलेक्टोन बायोसिंथेसिस जीन एमएएक्स 4–1 की जीनोम एडिटिंग की गई। हाइग्रोमाइसिन स्पेसिफिक प्राइमर का इस्तेमाल करके लगभग 250 पौधों में cas 9 कंस्ट्रक्ट की मौजूदगी की पुष्टि की गई। गामा किरणों का इस्तेमाल करके गन्ने के जीनोटाइप को 99004 के इन विट्रो म्यूटेजेनेसिस से अलग–अलग रूट सिस्टम आर्किटेक्चर (RSA) फेनोटाइप की पहचान हुई। तीन म्यूटेंट (एम72, एम736, एम748) फिजियोलॉजिकल परफॉर्मेंस के आधार पर सूखे को झेलने वाले पाए गए। वेक्टर pRGEB32 का इस्तेमाल करके एसडब्लूईईटी 13c, 4a और 3a जीन के लिए मल्टीप्लेक्स जीन कंस्ट्रक्ट बनाए गए। बायोफ्यूल एप्लीकेशन के लिए बायोमास कंपोजिशन को बदलने के लिए लिग्निन बायोसिंथेसिस पाथवे (सीएडी जीन) की टारगेटेड एडिटिंग की गई। गन्ने में डीएसटी, HPs, फ्लावरिंग जीन, टीबी1 और एचटीडी2 जीन को टारगेट करने वाले पॉलीसिस्ट्रोनिक कंस्ट्रक्ट बनाए गए।

'तमिलनाडु में चीनी की पैदावार बढ़ाने के लिए इंस्टीट्यूट–इंडस्ट्री मिलकर काम करने के तरीके से जगह के हिसाब से खास किस्मों का विकास (SISMA&TN) के तहत, दस चीनी फैक्ट्रियों में 20 अच्छे गन्ने के क्लोन का मूल्यांकन किया गया और दो अच्छे प्रदर्शन वाले क्लोन, यानी को 19009 और को 21003 की पहचान की गई, जिनमें गन्ने की पैदावार, चीनी की पैदावार और सुक्रोज की मात्रा बेहतर थी। इसमा के तहत सब–ट्रॉपिकल और ट्रॉपिकल गन्ना जोन में किए गए कई जगहों पर वैरायटी के मूल्यांकन ट्रायल में, दो एंट्री, यानी को 20016 और को 21012 ने सब–ट्रॉपिकल जोन की 16 चीनी मिलों में गन्ने की पैदावार, चीनी की पैदावार और खास क्वालिटी पैरामीटर में को 0238 से लगातार बेहतर प्रदर्शन कियङ्का गन्ने में सफेद ग्रब के खिलाफ ठज–बेस्ड बायोपेस्टीसाइड (Bt–62) का इस्तेमाल बायो फॉर्मूलेशन एप्लीकेटर (भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान) का इस्तेमाल करके सफेद ग्रब वाले इलाके में करने से सफेद ग्रब की आबादी में 33% की कमी देखी गई। मिनी ट्रैक्टर से मशीन से रोपाई

ट्रांसप्लांटर से पारंपरिक तरीकों के बराबर पैदावार मिल सकती है, साथ ही गन्ने की खेती में मेहनत (72.7%) और समय (50%) की भी काफी बचत होती है। अल्कली–प्रीट्रीटेड और एसिड/एंजाइम–डाइजेस्टेड गन्ने की खोई (को 11015 और को 86032) और एनर्जी केन बायोमास (एसबीआईईसी 14006 और एसबीआईईसी 18001) का इस्तेमाल करके शुरुआती फर्मेंटेशन स्टडीज से इथेनॉल प्रोडक्शन कन्फर्म हुआ। टेस्ट किए गए 15 यीस्ट आइसोलेट्स में से, सैकरोमाइसिस spp- (LV[a]su B) और सैकरोमाइसिस spp- (LV[a]su D) ने तुलना में ज्यादा इथेनॉल पैदावार दी। गन्ने की खोई (को 11015, को 86032) और एनर्जी केन बायोमास (एसबीआईईसी 14006, एसबीआईईसी 18001) पर ग्रोथ के लिए तेरह खाने लायक फंगल आइसोलेट्स का टेस्ट किया गया। सभी आइसोलेट्स में अच्छी कॉलोनाइजेशन दिखी, जिससे क्रूड प्रोटीन कंटेंट 0.44: से बढ़कर 8.75% हो गया, जिससे खाने लायक फंगस में गन्ने के बचे हुए हिस्सों को प्रोटीन से भरपूर करने और उनकी न्यूट्रिशनल वैल्यू को बेहतर बनाने की क्षमता का पता चला।

इंस्टीट्यूट में विकसित गन्ने पर आधारित खेती का सिस्टम (1 ha) जिसमें क्रॉपिंग सिस्टम (गन्ना उड़द), डेयरी, बकरी, मछली, पोल्ट्री और वर्मीकम्पोस्टिंग यूनिट शामिल हैं, ने डेयरी को सबसे ज्यादा फायदेमंद बताया है, जबकि क्रॉपिंग सिस्टम ने खेती की इनकम में सबसे बडा हिस्सा (46%) दिया, जिससे खेती के सिस्टम का कुल नेट प्रॉफिट ₹4.9 लाख/साल रहा। इंटरक्रॉप, ट्रैश मल्चिंग वाली नेचुरल खेती में गन्ने की पैदावार 66.9–94.7 t/ha दर्ज की गई, जो आम खेती (66.8–115.0 t/ha) से थोड़ी कम (5–7.5%) थी, लेकिन प्रोडक्शन कॉस्ट (12%) कम हुई। इस सिस्टम ने मिट्टी के ऑर्गेनिक कार्बन (0.54%), माइक्रोबियल कार्बन और न्यूट्रिएंट साइकिलिंग को बढ़ाया, जिससे एनवायरनमेंटल सेफ्टी और लंबे समय तक चलने वाली सस्टेनेबिलिटी पक्की हुई।

फील्ड स्टडी से पता चला कि गन्ने में ड्रिप इरिगेशन से सबसे ज्यादा गन्ने की पैदावार (152.1t/ha) और सीसीएस की पैदावार (20.9 t/ha) हुई, जबकि सिंचाई के लिए कम पानी (560 mm/ha) का इस्तेमाल हुआ, जो ट्रैश मल्चिंग और स्किप फरो तरीकों से बेहतर था। सिंचाई के तरीकों से जूस की क्वालिटी पर कोई असर नहीं पड़ा, लेकिन ड्रिप इरिगेशन ने किसानों के तरीकों और पेनिनसुलर जोन के दूसरे खास फसल सिस्टम की तुलना में पानी के इस्तेमाल की ज्यादा एफिशिएंसी और प्रोडक्टिविटी दिखाई।

पारंपरिक और कम जुताई से कटाई के समय खरपतवार का सूखा वजन एक जैसा था। हाथ से निराई (7.11 g/m^2), पेंडीमेथालिन, इंटरक्रॉप, ट्रैश मल्चिंग, रेडी मिक्स (6.85 g/m^2),

और पेंडीमेथालिन, ट्रैश मल्चिंग, रेडी मिक्स (6.89 g/m^2) खरपतवार कम करने में सबसे असरदार थे। इंटीग्रेटेड वीड मैनेजमेंट तरीकों से ज़्यादा पैदावार मिली, जिसमें 113.9–116.8 जर्दें रिकॉर्ड किया गया। गन्ने के पौधे की फसल में खेत में नए हर्बिसाइड मॉलिक्यूल्स के नौ कॉम्बिनेशन का टेस्ट किया गया। हर्बिसाइड कॉम्बिनेशन में, क्लोमाजोन, सल्फेंट्राजोन का प्री–इमर्जेंस एप्लीकेशन / 2.5 kg/ha और उसके बाद 60 DAP पर एक इंटर–कल्टीवेशन से सबसे ज़्यादा गन्ने की पैदावार (102.62 t/ha), खरपतवार कंट्रोल एफिशिएंसी (86.5%) और कम खरपतवार इंडेक्स (3.28) दर्ज किया गया। पारंपरिक नैपसेक स्प्रेइंग, हाथ से खरपतवार हटाने और बिना ट्रीटमेंट वाले कंट्रोल के मुकाबले ड्रोन–कम्पैटिबल हर्बिसाइड स्प्रे वॉल्यूम पर फील्ड ट्रायल में, 25–50 L/ha स्प्रे वॉल्यूम के साथ 1.25 kg a-i-/ha पर प्री–इमर्जेंस एट्राजीन ने गन्ने के अंकुरण पर कोई असर नहीं डाला। 35 DAP पर 1.25 kg a.i./ha पर 25 L/ha स्प्रे वॉल्यूम के साथ एट्राजीन ने सबसे अच्छे नतीजे दिए, जिसमें खरपतवार की गिनती कम (38.7/m^2), खरपतवार का सूखा पदार्थ (9.7 g/m^2), और ज़्यादा खरपतवार कंट्रोल एफिशिएंसी (92.4%) थी।

गन्ने में हाइड्रोपोनिक और फील्ड इवैल्यूएशन से क्लोरोफिल डायनामिक्स, कैनोपी टेम्परेचर डिप्रेशन, मेटाबोलाइट्स और एंटीऑक्सीडेंट रिस्पॉन्स जैसे खास फिजियोलॉजिकल लक्षणों की पहचान न्यूट्रिएंट इस्तेमाल की एफिशिएंसी के भरोसेमंद इंडिकेटर के तौर पर हुई। नाइट्रोजन, फास्फोरस और पोटेशियम लेने और इस्तेमाल करने में जीनोटाइप काफी अलग थे, जिसमें को 86032, को 14012, को 14005 और AS 04–1875 जैसी लाइनों ने न्यूट्रिएंट सिस्टम में बेहतर परफॉर्मेंस दिखाई। एफिशिएंट जीनोटाइप ने न्यूट्रिएंट स्ट्रेस में ज़्यादा पत्ती एरिया, फोटोसिंथेटिक स्टेबिलिटी, कार्बोहाइड्रेट रिजर्व और मजबूत एंटीऑक्सीडेंट प्रोटेक्शन बनाए रखा। इन नतीजों से न्यूट्रिएंट–एफिशिएंट किस्मों का क्लासिफिकेशन मुमकिन हुआ ताकि बेहतर गन्ने की पैदावार और रेजिलिएंस के लिए जीनोटाइप चुनने और सटीक न्यूट्रिएंट मैनेजमेंट में मदद मिल सके। सैलिनिटी–टॉलरेंट गन्ने के क्लोन की तेजी से पहचान के लिए 9 और 12 dS m^{-1} EC पर हाइड्रोपोनिक स्क्रीनिंग को स्टैंडर्डाइज किया गया। टेस्ट किए गए क्लोन में, कोड 265 और को 86032 ने सॉल्टी को 97010 की तुलना में सैलिनिटी में बेहतर फिजियोलॉजिकल रेजिलिएंस दिखाया।

गन्ने में मॉर्फो–फिजियोलॉजिकल ट्रेट एनालिसिस से पता चला कि सीधी ऊपर की पत्तियों और प्लेनफाइल नीचे की पत्तियों वाले क्लोन ने सोलर रेडिएशन को अच्छे से हार्वेस्ट किया। गन्ने की पैदावार में पौधे की ऊंचाई, टोटल ड्राई मैटर, गन्ने की मात्रा, NMC और जर्मिनेशन % के साथ काफी पॉजिटिव कोरिलेशन दिखा, जबकि पत्ती के इंसर्शन एंगल का नेगेटिव कोरिलेशन था। क्लोन जैसे, को 85019, को 17004 और को 86032 ने बेहतर फोटोसिंथेटिक रेट और कुशल कार्बन मेटाबॉलिज्म दिखाया, जिसमें टीवीडी 2 पत्ती की पोजीशन ने सबसे ज़्यादा फोटोसिंथेटिक एक्टिविटी में योगदान दिया, जिससे बायोमास और पैदावार बढ़ाने में कैनोपी आर्किटेक्चर और नाइट्रोजन स्टेटस के महत्व पर जोर दिया गया।

हाइड्रोपोनिक सिस्टम के तहत होने वाले वॉटरलॉगिंग स्ट्रेस ने रेडॉक्स पोटेंशियल और ग्रोथ ट्रेट्स को कम कर दिया। को 62175 ने बेहतर दिखाया। को 86032 की तुलना में बेहतर पौधे की ऊंचाई और पत्तियों की संख्या के साथ टॉलरेंस। सूखे पर नए भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान फॉर्मूलेशन के असर पर स्टडी से पता चला कि फॉर्मूलेशन नंबर 3 को मेथिलोबैक्टीरियम spp. के साथ मिलाने पर, सिंचित और बिना सिंचित दोनों स्थितियों में पत्ती के पानी की स्थिति, वैक्स कंटेंट, प्रोलाइन जमाव, एंटीऑक्सीडेंट एक्टिविटी और टिलर्स की संख्या जैसे शारीरिक गुणों में सुधार हुआ। बिना सिंचित नमी के तनाव के तहत, इस ट्रीटमेंट ने को 86032 में मिल करने लायक गन्ने की संख्या में 63%, को 18009 में 48: और को 11015 में 30% की उल्लेखनीय वृद्धि की, जिससे सूखे के तनाव को कम करने और प्रोडक्टिविटी बढ़ाने में इसकी प्रभावशीलता पर प्रकाश डाला गया।

सात एवीटी 18 सीरीज क्लोन के सूखे के मूल्यांकन से पता चला कि, को 18002 और को 18003 में ज़्यादा टहनियों की आबादी और वृद्धि बनी रही, और उन्हें टॉलरेंट (T) रेट किया गया। को 18009, को 18013 और को 18024 को मॉडरेट टॉलरेंट (MT) रेटिंग दी गई।

खारेपन की दिक्कत में को 18 और को 19 सीरीज के क्लोन का मूल्यांकन करने पर पता चला कि को 18002, को 18003, और को 85019 ने कंट्रोल और खारेपन दोनों में गन्ने की ज़्यादा पैदावार बनाए रखी, जबकि को 18001 और को 97010 ने सिर्फ कंट्रोल हालात में ही अच्छा काम किया। को 19 सीरीज में, को 19008 और को 19009 ने दोनों माहौल में बेहतर मॉर्फो–फिजियोलॉजिकल गुण और पैदावार दिखाई। कुल मिलाकर, को 18002, को 18003, को 19008, और को 19009 टॉलरेंट थे और पेनिनसुलर जोन में, खासकर ट्रॉपिकल इंडिया के खारेपन वाले इलाकों में कमर्शियलाइजेशन के लिए विचार किए गए थे। नॉर्मलाइज्ड एलएआई और ग्रोइंग डिग्री डेज (GDD) के बीच नॉन–लीनियर रिश्तों को मॉडल करने के लिए एक पॉलीनोमियल रिग्रेशन का इस्तेमाल किया जाता है। 3rd ऑर्डर पॉलीनोमियल, 0.95 के r2 वैल्यू के साथ देखे गए डेटा को फिट करता है, जो बताता है कि 3rd ऑर्डर पॉलीनोमियल मॉडल गन्ने के क्लोन के लिए GDD पर आधारित नॉर्मलाइज्ड LAI का एक बेहतरीन प्रेडिक्टर है।

भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान क्षेत्रीय केंद्र, कन्नूर में दो मिट्टी की प्रोफाइल (निचली जमीन और ऊपरी जमीन) को लगातार पानी भरे रहने की स्थिति में पहचाना गया। निचली जमीन की मिट्टी की प्रोफाइल 160 cm से ज़्यादा गहराई

तक फैली हुई थी, जिसमें रेतीली ऊपरी मिट्टी थी जो धीरे–धीरे मिट्टी से भरपूर सबसरफेस में बदल गई। इस मिट्टी की परत ने पानी की सीधी आवाजाही को रोक दिया, जिससे पानी निकलने की खराब व्यवस्था हुई। गहराई के साथ बल्क डेंसिटी कम होती गई, जो सतह की परत में 1.56 mg/m^3 से लेकर गहरी परतों में 1.47 mg/m^3 तक थी, जबकि हाइड्रोलिक कंडक्टिविटी 2.5 cm/hr से कम रही। इसके उलट, ऊपर की जमीन की मिट्टी की गहराई 175 cm से ज्यादा थी और पूरी तरह रेतीली थी। यहाँ, गहराई के साथ बल्क डेंसिटी बढ़ी, जो नीचे 1.8 g/cm^3 से ज्यादा हो गई। हालाँकि रेतीली बनावट ने हाई हाइड्रोलिक कंडक्टिविटी दी, लेकिन कम गहरा ग्राउंडवाटर टेबल और लैंडस्केप की जगह की वजह से इस इलाके में लगातार पानी जमा रहा।

एफवाईएम और दैंचा दोनों को मिलाने से मिट्टी की कैल्केरियसनेस कम हुई, जिसमें एफवाईएम (2.5%) की तुलना में दैंचा में ज्यादा कमी (5.6%) दिखी, जो असरदार सुधार दिखाता है। फॉस्फोरस मैनेजमेंट ने गन्ने की पैदावार पर काफी असर डाला, जबकि ऑर्गेनिक बदलावों, फसल की बनावट और आपसी असर का कोई खास असर नहीं हुआ। सबसे ज्यादा गन्ने की पैदावार (152.25 t/ha) 50% SSP, यूरिया N जो बेसल पर 50% डीएपी के बराबर है, 90 डीएटी पर 50% डीएपी के ट्रीटमेंट के तहत दर्ज की गई। इस एक्सपेरिमेंट ने 150 t/ha का एसटीसीआर टारगेट सफलतापूर्वक हासिल कर लिया। गन्ने पर एआईसीआरपी के तहत, 14 नए गन्ने के जीनोटाइप को दो फर्टिलाइजर लेवल (100% और 125% आरडीएफ) के तहत जांचा गया, गन्ने की पैदावार पर फर्टिलाइजर लेवल का कोई खास असर नहीं था। इन जीनोटाइप में, को 18003 लगातार बेहतर रहा, जिसमें ज्यादा गन्ने की पैदावार, बेहतर सीसीएस पैदावार और स्थिर जूस क्वालिटी शामिल थी, जिससे यह स्टैंडर्ड चेक की तुलना में सबसे अच्छी एंट्री बन गई।

एस. रोबस्टम जीनोटाइप 51 NG 142, जो बैंगनी पत्तियां और लाल गूदे वाले तने देता है, उसकी बायोएक्टिविटी की जांच सॉल्वेंट एक्सट्रैक्शन और एंटीऑक्सीडेंट एसे के जरिए की गई। क्लोरोफॉर्म और डाइक्लोरोमीथेन एक्सट्रैक्ट में सबसे ज्यादा फ्लेवोनॉयड और फेनोलिक कंटेंट दिखे, जिसमें रेडिकल स्कैवेंजिंग एक्टिविटी 80% से ज्यादा थी, जिससे उनके मजबूत एंटीऑक्सीडेंट पोटेंशियल की पुष्टि हुई।

भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान द्वारा डेवलप की गई टेक्नोलॉजी के टेक्नोलॉजी डिस्क्लोजर, पेटेंट एप्लीकेशन और कमर्शियलाइजेशन से जुड़े अलग–अलग पहलुओं पर फैसले लेने के लिए एग्री–इनोवेट की ITMC और टेक्नो कमर्शियल मीटिंग की गईं। कॉटन स्टेम वीविल के मैनेजमेंट के लिए ट्रांसजेनिक कॉटन के डेवलपमेंट के लिए भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान क्षेत्रीय केंद्र द्वारा खोजे गए दो नए Cry8 जीन के लिए भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान और भारतीय कृषि अनुसंधान परिषद – केंद्रीय कपास अनुसंधान संस्थान के बीच एमटीए साइन किया गया। पीपीवी –एफआरए से को 12029 (करन 13), को 18009 और को 13035 (करन 14) के लिए रजिस्ट्रेशन सर्टिफिकेट मिले। पांच कॉपीराइट सर्टिफिकेट मिले। इन टेक्नोलॉजी का लाइसेंस दिया गया, जैसे एसबीआईईसी 14006 – ज्यादा बायोमास प्रोडक्शन वाला एक एनर्जी केन, दो फर्मों को भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान ईपीएन बायोपेस्टीसाइड फॉर्मूलेशन, कोटेसियाफ्लेवाइप्स और टेलीनोमसडिग्नस मास मल्टीप्लिकेशन टेक्नोलॉजी, इंटरनोड बोरर के खिलाफ रिलीज स्टेशन के साथ और गन्ने की किस्म को 17018। टेक्नोलॉजी ट्रांसफर और कमर्शियलाइजेशन में अच्छी प्रोग्रेस को दिखाते हुए दस एमओयू साइन किए गए।

सीसीटी तरीके के तहत, 3588 स्क्रीन किए गए क्लोन में से, 521 क्लोन (14.93%) लाल सड़न के इन्फेक्शन से मुक्त थे और उन्हें रेट किया गया और 754 क्लोन (21.61%) को MR कैटेगरी में रखा गया और बाकी क्लोन को S (39.2%) या डै (17.7%) रेट किया गया।) या HS (6.6%)। इसके अलावा, फील्ड टॉलरेंस के लिए टेस्ट किए गए छह पीजेडवीटी क्लोन में से एक रेसिस्टेंट क्लोन की पहचान की गई। गन्ने में रेड रॉट, स्मट और दूसरी बीमारियों के लिए आईवीटी और एवीटी क्लोन का मूल्यांकन किया गया और रेसिस्टेंट और टॉलरेंट क्लोन की पहचान की गई। क्वारंटाइन के तहत, नेशनल एक्टिव जर्मप्लाज्म में आठ जीनोटाइप और नेशनल हाइब्रिडाइजेशन गार्डन में चार जीनोटाइप को क्लियर किया गया।

एआईसीआरपी के तहत, 15 अलग–अलग किस्मों पर 10 रेड रॉट आइसोलेट्स का मूल्यांकन किया गया और पाया गया कि नए आइसोलेट्स स्टैंडर्ड पैथोटाइप की तुलना में ज्यादा खतरनाक थे। जीनोम एनालिसिस के लिए तीन नए सी. फाल्केटम पैथोटाइप को सीक्वेंस किया गया। छह जीन का इस्तेमाल करके सी. फाल्केटम के एमएलएसटी एनालिसिस से पता चला कि सीक्वेंस को टाइप स्ट्रेन के साथ ग्रुप किया गया था और सी. फाल्केटम पैथोटाइप सी. सबलाइनोला, सी. ग्रेमिनिकोला और सी. सेरेली से काफी मिलते–जुलते थे। सी. फल्केतम के जीनोम से इफेक्टर कोडिंग जीन का अनुमान लगाया गया और सी.फल्केतम इन्फेक्शन के दौरान ससेप्टिबल (CoC 671) और रेसिस्टेंट (को 93009) गन्ने की किस्मों में अलग–अलग एक्सप्रेस होने वाले इफेक्टर की पहचान ट्रांसक्रिप्टोम सीक्वेंसिंग के जरिए की गई।

गन्ने में रेड रॉट रेजिस्टेंस की शुरुआत जीनोम एडिटिंग से हुई, जिसमें कैंडिडेट जीन LOX3 जीन और CAX4 शामिल थे। इन दोनों टारगेट के जीन सीक्वेंस को कुशल टारगेट सीक्वेंस की पहचान के लिए स्क्रीन किया गया, पीएएम साइट्स की लोकेशन और इन दो टारगेट जीन के लिए सीआरआईएसपीओआरप्रोग्राम

का इस्तेमाल करके गाइड आरएनए डिजाइन किए गए। कंस्ट्रक्ट के साथ रेड रॉट ससेप्टिबल किस्मों (को 0238 और CoC 671) का ट्रांसफॉर्मेशन शुरू कर दिया गया है और कॉलोनी सिलेक्शन के अलग–अलग स्टेज में हैं। इंटरैक्टिंग होस्ट रिसेप्टर प्रोटीन की पहचान करने के लिए इन विट्रो पुल डाउन एसे के लिए रिकॉम्बिनेंट EPL1 का एक्सप्रेशन और प्यूरिफिकेशन किया गया है। गन्ने और पोक्काबोएंग (PB) से इन्फेक्टेड पौधों से फ्यूजेरियम की पांच स्पीशीज के बीच इंटरेक्शन से पता चला कि, सभी स्पीशीज विल्ट पैदा करने में शामिल नहीं थीं और विल्ट की गंभीरता फ्यूजेरियम स्पीशीज के साथ अलग–अलग होती है। PB के मैनेजमेंट के लिए, प्रोपिकोनाजोल का 0.2% तक ड्रोन स्प्रेइंग स्टैंडर्ड किया गया था। बायोलॉजिकल कंट्रोल के तहत, अलग–अलग गन्ना उगाने वाले इलाकों की राइजोस्फीयर मिट्टी से 158 बैक्टीरियल और 85 एक्टिनोबैक्टीरियल कल्चर अलग किए गए, विल्ट पैदा करने वाले एफ.सच्चारी और रेड रॉट पैदा करने वाले सी.फल्केतम के खिलाफ स्क्रीनिंग की गई और इन विवो कंडीशन में इवैल्यूएशन के लिए सबसे अच्छे चुने गए। को 86032 और को 0238 से अलग किए गए एंडोफाइटिक बैक्टीरिया को इन विट्रो में एंटीगोनिस्टिक पोटेंशियल, च्लच और एबायोटिक स्ट्रेस टॉलरेंस प्रॉपर्टीज के लिए स्क्रीन किया गया। को 86032 और को 0238 से अलग किए गए 379 बैक्टीरिया में से, 18 बैक्टीरिया ने बहुत मजबूत एंटीगोनिस्टिक पोटेंशियल दिखाया। अलग–अलग PGP प्रॉपर्टीज के लिए एंडोफाइटिक बैक्टीरिया की स्क्रीनिंग से Ng ज्यादा अमोनिया प्रोड्यूसर, तीन ज्यादा फॉस्फोरस सॉल्युबिलाइजर, 21 ज्यादा Zn सॉल्युबिलाइजर, 14 बहुत ज्यादा साइडरोफोर प्रोड्यूसर और 13 ज्यादा इंडोल एसिटिक एसिड प्रोड्यूसर की पहचान हुई। साथ ही, दो एंडोफाइटिक बैक्टीरिया ने इन विट्रो कंडीशन में बहुत ज़्यादा सूखा टॉलरेंस प्रॉपर्टी दिखाई।

इंटीग्रेटेड अप्रोच के तहत, केमिकल्स के साथ मैकेनाइज्ड सेट ट्रीटमेंटध्ट्रीटेड सेट से सेटलिंग प्लांटिंग और बायोएजेंट्स का मिट्टी में इस्तेमाल रेड रॉट, स्मट और विल्ट के खिलाफ काफी असरदार पाया गया। इसके अलावा, 55°C पर गर्म पानी के साथ सेट का डुअल ट्रीटमेंट, उसके बाद सेट ट्रीटमेंट डिवाइस में नर्सरी इनपुट और प्लांटिंग के समय बायोएजेंट्स का स्पॉट एप्लीकेशन ने नॉन फंगल बीमारियों जैसे जीएसडी और वाईएलडी के मामलों को काफी कम कर दिया। केले में भी बेहतर ग्रोथ और यील्ड एट्रीब्यूट्स के लिए इसी तरह के इंटीग्रेटेड अप्रोच को वैलिडेट किया गया है। इसके अलावा 55°C डिग्री सेल्सियस पर गर्म पानी के साथ दोहरा उपचार और उसके बाद 0.01: प्रोपिकोनाजोल ने को 97009 को नियंत्रण में 100: स्मट प्रकोप से पूरी तरह बचाया था। इसी तरह, रसायनोंध्जैव एजेंट के साथ गर्म पानी के साथ दोहरा उपचार अदरक के जीवाणु सड़न, कसावा में मोजेक और मिली बग, हल्दी में नेमाटोड और फसल विशिष्ट आईसीएआर संस्थानों में केले के खिलाफ सिद्ध हो चुका है। गन्ने के फंगल रोगों के प्रबंधन पर आउटरीच गतिविधियों से संकेत मिलता है कि, सेट ट्रीटमेंट डिवाइस (एसटीडी) की क्षमता को समझते हुए, तमिलनाडु सरकार ने एनएडीपी–आरकेवीवाई–डीआरपी आधारित परियोजनाओं के तहत, सहकारी, सार्वजनिक और निजी मिलों सहित सभी मिलों में 1 से 6 इकाइयों / चीनी मिल में स्वस्थ नर्सरी इकाइयां स्थापित करने के लिए उद्यमिता विकसित करने हेतु सब्सिडी पर 100 एसटीडी इकाइयों को मंजूरी दी इसके अलावा, NFSM के तहत, बिहार में हरि नगर, हसनपुर, सिदवालिया और नरकटियागंज जैसी चार चीनी

मिलों की अलग–अलग जगहों पर सेट ट्रीटमेंट डिवाइस का इस्तेमाल करके सिंगल बड सेट की मैकेनाइज्ड प्राइमिंग की भूमिका पर छोटे पैमाने पर ट्रेनिंग और डेमोंस्ट्रेशन के जरिए रेड रॉट मैनेजमेंट के लिए हेल्दी नर्सरी उगाने के टेक्निकल इनपुट को अपडेट किया गया।

नॉन–फंगल बीमारियों के लिए टिशू कल्चर पौधों की इंडेक्सिंग से पता चला कि भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान के 54 सैंपल में से, 96 और 44: सैंपल क्रमशः येलो लीफ वायरस और जीएसडी फाइटोप्लाज्मा से मुक्त थे। इसी तरह, ईआईडी पैरी, पुगुलुर, TN और वर्बेंट से 10 TC सैंपल बायो–एग्री एलएलपी, बागलकोट, कर्नाटक में 50% वायरस नहीं थे। गन्ने की पीली पत्ती के वायरस (एससीवाईएलवी) कोट प्रोटीन जीन एक्सप्रेशन, रिकॉम्बिनेंट प्रोटीन प्रोडक्शन और प्यूरिफिकेशन को प्रोकैरियोटिक और यूकेरियोटिक एक्सप्रेशन वेक्टर का इस्तेमाल करके स्टैंडर्डाइज किया गया। एससीवाईएलवी के खिलाफ पॉलीक्लोनल एंटीबॉडी डेवलप की गई और इसे डीएसी–ईएलआईएसए मेथड के तहत बहुत ज्यादा ससेप्टिबल सैंपल के साथ–साथ साफ तौर पर हेल्दी और टीसी सैंपल का इस्तेमाल करके स्टैंडर्डाइज किया गया। चार किस्मों में ट्रांसक्रिप्शनल प्रोफाइलिंग के जरिए फाइटोप्लाज्मा इन्फेक्शन पर होस्ट प्लांट में बदलाव से पता चला कि, हेल्दी पौधों की तुलना में फाइटोप्लाज्मा–इन्फेक्टेड पौधों में फाइटोहॉर्मोन बायोसिंथेसिस से जुड़े 80 से ज्यादा जीन, उसके बाद डिफेंस और फोटोसिंथेसिस जीन कम रेगुलेट किए गए थे। फाइटोप्लाज्मा डायग्नोसिस के लिए, रिकॉम्बिनेज पॉलीमरेज एम्प्लीफिकेशन प्राइमर डिजाइन और स्टैंडर्डाइज किए गए।

भारतीय कृषि अनुसंधान परिषद – केंद्रीय कपास अनुसंधान संस्थान क्षेत्रीय स्टेशन, कोयंबटूर के साथ मिलकर, कॉटन स्टेम वीविल, पेम्फेरुलुसाफिनिस के खिलाफ टॉक्सिन एक्सप्रेशन और उसके बाद बायोएसे स्टडीज के लिए दो नए cry 8 जीन को बैसिलस थुरिंजिएंसिस शटल वेक्टर में क्लोन किया गया। बतल8 जीन के सफल एक्सप्रेशन की पुष्टि हुई, और शुरुआती डाइट–इनकॉरपोरेशन बायोएसे में कंट्रोल की तुलना में टॉक्सिन–ट्रीटेड डाइट में 80–90: लार्वा मृत्यु दर दिखाई दी।

टेलीनोमस डिंगस के बड़े पैमाने पर प्रोडक्शन के लिए एक इम्प्रोवाइज्ड चिमनी और बॉक्स मेथड को स्टैंडर्डाइज किया

गया। बॉक्स मेथड में बैच में अंडे परजीवीकरण 55.6–100.0ः और चिमनी मेथड में 71.3–95.0% तक था।

ई. प्रोसेरस से मिले कुल 89 इंटरजेनेरिक गन्ने के हाइब्रिड को 'को' गन्ने के साथ क्रॉस करके बोरर कीटों के खिलाफ रेजिस्टेंस के लिए इवैल्यूएट किया गया। अर्ली शूट बोरर (ईएसबी) के लिए फील्ड स्क्रीनिंग में, नौ IGHs में सबसे कम ससेप्टिबिलिटी दिखी, और आर्टिफिशियल स्क्रीनिंग स्टडीज में जीयू 19–22, GU 19–55, और जीयू 19–72 को सबसे कम ससेप्टिबल पाया गया। इंटरनोड बोरर (INB) के खिलाफ स्क्रीनिंग में 12 जीनोटाइप को सबसे कम ससेप्टिबल, 24 को मॉडरेट ससेप्टिबल, और 54 को ससेप्टिबल के तौर पर क्लासिफाई किया गया। इंटरनोड बोरर इंसिडेंस और इंटरनोड मॉर्फोलॉजी पर इसके असर के आधार पर, चार जीनोटाइप (जीयू 19–4, जीयू 19–22, जीयू 19–24, और जीयू 19–55) को रेसिस्टेंट के तौर पर पहचाना गया।

ई. इ. अरुन्दिनासुस और एस. अस्पोंतंयूम से मिले पंद्रह आईजीएचएस को ईएसबी और आईएनबी के रेसिस्टेंस के लिए फील्ड–स्क्रीन किया गया। नतीजों से पता चला कि चार जीनोटाइप, यानी सीवाईएम 06–212, सीवाईएम 08–922, सीवाईएम 04–388, और सीवाईएम 07–971 ने ईएसबी के लिए पूरी तरह से रेजिस्टेंस दिखाया। बाद में गंभीर ईएसबी इन्फेक्शन के तहत आर्टिफिशियल स्क्रीनिंग से यह कन्फर्म हुआ कि जीनोटाइप सीवाईएम 08–922 ने 90% से ज्यादा पौधे को जिंदा रखा। आईएनबी इंसिडेंस और इंटरनोड मॉर्फोलॉजी पर इसके असर के आधार पर, तीन जीनोटाइप (सीवाईएम 06–924, सीवाईएम 07–981, और सीवाईएम 08–922) को रेजिस्टेंट के तौर पर पहचाना गया। टाइप I (एसबीआईईसी 11003, एसबीआईईसी 13010, एसबीआईईसी 11002 और एसबीआईईसी 14003) और टाइप II (एसबीआईईसी 14006, एसबीआईईसी 11004, एसबीआईईसी 11001 और एसबीआईईसी 14001) एनर्जी केन के ईएसबी और आईएनबी पर बायोलॉजिकल असर से पता चला कि टाइप प्प एनर्जी केन पर लार्वा और प्यूपा का सर्वाइवल काफी कम था। इसके अलावा, दोनों बोरर पेस्ट के लार्वा ने टाइप I की तुलना में टाइप II एनर्जी केन पर लार्वा डेवलपमेंट पीरियड ज्यादा लंबा दिखाया, जिससे पता चलता है कि टाइप II एनर्जी केन लार्वा ग्रोथ के लिए तुलना में कम सही हैं। डेवलपमेंट का लंबा समय बताता है कि टाइप II एनर्जी केन में एंटीबायोसिस से जुड़े गुण हैं, जो गन्ने के बोरर के खिलाफ बेहतर रेजिस्टेंस में मदद कर सकते हैं। को 86032 और सीवाईएम 08–922 के शुरुआती शूट बोरर से प्रभावित और बिना प्रभावित पौधों में तुलनात्मक जीन एक्सप्रेशन एनालिसिस से पता चला कि इंफेक्शन के शुरुआती फेज में, खासकर पत्ती के टिशू में, लिपोक्सीजिनेज (एलओएक्स) औ र ग्लूटाथियोन–ै –ट्रांसफरेज (जीएसटी) का एक मजबूत इंडक्शन होता है, जो शुरुआती डिफेंस रिस्पॉन्स में उनकी भूमिका को दिखाता है। बाद के स्टेज में, खासकर शूट टिशू में एलओएक्स एक्सप्रेशन बढ़ा हुआ रहा, जो बोरर इंफेक्शन के खिलाफ शुरुआती और लगातार डिफेंस में इसकी भूमिका का सुझाव देता है।

पारंपरिक गाजर डिस्क कंटैमिनेशन मेथड के विकल्प या सप्लीमेंट के तौर पर एक नया डाइट–इनकॉरपोरेशन बायोएसे मेथड डेवलप किया गया था। इस डाइट कंटैमिनेशन बायोएसे का इस्तेमाल करके, अलग–अलग मीडिया पर बनाए गए Bt–62 के स्पोर–क्रिस्टल मिक्सचर से पहले इंस्टार ग्रब में ज्यादा मृत्यु दर (30.0–80.0%) हुई, जिससे वज टॉक्सिसिटी का मूल्यांकन करने के मेथड की प्रभावशीलता और विश्वसनीयता का पता चलता है।

गन्ने के सीवी में क्राउन मिलीबग इंफेक्शन। को 86032 के कारण 10ः इंसिडेंस लेवल पर 9.1 जधं की पैदावार का नुकसान हुआ, जो ₹30,940/ha के आर्थिक नुकसान के बराबर है। फील्ड स्टडीज में लेप्टोमैस्टिक्ससिल्वे को मुख्य पैरासाइटॉइड के रूप में पहचाना गया, जिसमें पैरासाइटिज्म का लेवल 9.70 से 23. 77% तक था, जबकि प्रोमरिकडेअनफैसिएटिवेंट्रिस ने भी काफी योगदान दिया। लैब स्टडीज से पता चला कि एडवांस्ड निम्फल इंस्टार्स पर L- सिल्वे द्वारा ज्यादा पैरासाइटिज्म होता है, जबकि वर्जिन और मेटिंग वाली मादाओं द्वारा तुलनीय पैरासाइटिज्म होता है। जांचे गए कीटनाशकों में, थियामेथोक्साम L- सिल्वे की तुलना में ज्यादा सुरक्षित था, जबकि फील्ड ट्रायल्स के तहत क्राउन मिलीबग के खिलाफ कार्बोफ्यूरान सबसे असरदार था। एंटोमोपैथोजेनिक फंगस की स्क्रीनिंग से 15 मेटारिजियमएनिसोप्लिए और 5 ब्यूवेरियाबैसियाना आइसोलेट्स का पता चला जिनमें ज्यादा पैथोजेनिसिटी थी, जिससे 75–95ः मृत्यु दर हुई। फंगल डीएन अलग किए गए एंटोमोपैथोजेनिक फंगस (EPF) के बारकोड को छब्ठप् जेनबैंक में जमा किया गया ताकि स्पीशीज की पहचान कन्फर्म की जा सके। म्च्थ् आइसोलेट्स को अर्ली शूट बोरर (ESB), इंटरनोड बोरर (INB), और फॉल आर्मीवर्म के खिलाफ जांचा गया। कई

एम.एनिसोप्लिया और बी.बससियाना आइसोलेट्स में हाई पैथोजेनिसिटी दिखी, जिससे तीनों पेस्ट्स में 75–100ः मौत हुई, कुछ आइसोलेट्स ने एडवांस्ड या थर्ड–इंस्टार लार्वा में 100% मौत की वजह बनी। खास तौर पर, सात एम.एनिसोप्लिया आइसोलेट्स और एक बी.बससियाना आइसोलेट ने ब्रॉड–स्पेक्ट्रम असर दिखाया, जिससे ईएसबी, आईएनबी, और फॉल आर्मीवर्म के खिलाफ लगातार हाई मौत (80–100%) हुई। गन्ने की किस्मों की सिलिकॉन प्रोफाइलिंग में पत्ती के छिलके में सिलिकॉन की मात्रा में काफी अंतर दिखा, जिसमें को 06030, को 06022, और को 0238 में सबसे ज्यादा लेवल दर्ज किया गया और को 11015 और को 09004 में सबसे कम लेवल दर्ज किया गया। पत्ती के छिलके में सिलिकॉन की मात्रा ने ईएसबी और आईएनबी के होने के साथ एक बड़ा नेगेटिव संबंध दिखाया, जबकि छिलके में सिलिकॉन की मात्रा बोरर के होने से खास तौर पर जुड़ी नहीं थी।

पांच एस. अस्पोंतयूम जीनोटाइप में से, SES 519 में सबसे ज्यादा सिलिकॉन की मात्रा दर्ज की गई। सिलिकॉन से भरपूर SES 519 पत्ती पाउडर को आर्टिफिशियल डाइट में शामिल करने से, स्टैंडर्ड ज्वार–आधारित डाइट की तुलना में शुरुआती शूट बोरर और इंटरनोड बोरर की ग्रोथ, डेवलपमेंट और रिप्रोडक्टिव क्षमता में काफी कमी आई, जो बोरर बायोलॉजी पर सिलिकॉन के नुकसानदायक असर को दिखाता है। दो ठज क्रिस्टल टॉक्सिन जीन, cry 81 और cry 9Eb, जो क्रमशः सफेद ग्रब और आईएनबी के खिलाफ असरदार हैं, उन्हें देसी बैसिलस थुरिंजिएंसिस स्ट्रेन से अलग किया गया और गन्ने में एक्सप्रेशन के लिए कोडॉन–ऑप्टिमाइज किया गया। जीन कंस्ट्रक्ट को पोर्टेरिसिया यूबिक्विटिन प्रमोटर के कंट्रोल में एक GRP सिग्नल पेप्टाइड को शामिल करते हुए pCAMBI I1305.1 वेक्टर का इस्तेमाल करके डेवलप किया गया था। cry9Eb कंस्ट्रक्ट में एक वैक्यूलर टारगेटिंग सीक्वेंस शामिल किया गया था, जबकि cry8Sa1 कंस्ट्रक्ट में यह नहीं था। कंस्ट्रक्ट को पहले E-कोलाई में बदला गया, फिर एग्रोबैक्टीरियम ट्यूमेफेशियंस स्ट्रेन एलबीए4404 में मोबिलाइज किया गया और कॉलोनी पीसीआर और सेंगर सीक्वेंसिंग से कन्फर्म किया गया।

तीन स्टैंडर्ड सहित सत्रह एवीटी I प्लांट ट्रायल एंट्री को ESB इंसिडेंस के लिए स्क्रीन किया गया और सभी सबसे कम ससेप्टिबल (LS) थे और INB के लिए, सभी 17 एंट्री एचएस थीं। एवीटी II प्लांट ट्रायल में, आईएनबी इंसिडेंस के लिए स्क्रीन की गई 14 एंट्री में से, 10 एंट्री (कोएन18071, कोएन 18072, को 18001, को 18002, को 18003, को 18009, को 18013, को 18012, को 18013, कोवीसी 18061) एमएस थीं। जांची गई 14 एवीटी रैटून ट्रायल एंट्री में से, चार, नौ, और एक एंट्री को आईएनबी के लिए क्रमशः एच एस, एमएस और एलएस के रूप में कैटेगरी में रखा गया था।

एक फर्मेंटर में बनाया गया Bt–62 स्ट्रेन, हाथ से चलने वाले एप्लीकेटर का इस्तेमाल करके, रूट जोन के पास 1.0×10^{14} CFU /ha की डोज पर लगाया गया था। ट्रीटेड प्लॉट में व्हाइट ग्रब इंसिडेंस में 53.01% की कमी देखी गई, जबकि कंट्रोल प्लॉट में केवल 6.52% की कमी देखी गई। क्राउन मिलीबग की वजह से पैदावार में 7.1 टन/हेक्टेयर का नुकसान हुआ, जब गन्ने की वैरायटी को 11015 में इसका इंसिडेंस लेवल 10% तक पहुंच गया। CMB के इंफेस्टेशन से जूस कंटेंट में काफी कमी आई, जो हेल्दी गन्नों की तुलना में इंफेस्टेड गन्नों में पांच गुना कम था। पांच इंफेस्टेड गन्नों से औसत जूस कंटेंट 579 उस था, जबकि उसी वैरायटी के हेल्दी गन्नों में 3,225 उस था। इसके अलावा, CMB इंफेस्टेड गन्नों में ब्रिक्स वैल्यू और जूस प्योरिटी परसेंटेज थोड़ा कम (1.0–1.2%) था।

बढ़े हुए को₂ कंसंट्रेशन (450, 550, और 750 ppm) के संपर्क में आने से आईएनबी की ग्रोथ और डेवलपमेंट पर बुरा असर नहीं पड़ा। को₂ लेवल बढ़ने के साथ लार्वा ड्यूरेशन कम हो गया, जबकि नेचुरल होस्ट और आर्टिफिशियल डाइट दोनों में प्यूपा और एडल्ट स्टेज पर कोई असर नहीं पड़ा। इस स्पीशीज ने ज्यादा को₂ कंडीशन में अपना लाइफ साइकिल सक्सेसफुली पूरा किया, और अर्ली शूट बोरर ने 550 और 750 ppm पर 50 दिनों के अंदर अपना पूरा लाइफ साइकिल पूरा कर लिया।

पांच मोनोक्सेनिक एंटोमोपैथोजेनिक नेमाटोड (EPN) आइसोलेट्स को चार ट्रीटमेंट के साथ यीस्ट एक्सट्रैक्ट–बेस्ड मीडिया का इस्तेमाल करके इन विट्रो मास प्रोडक्शन के लिए इवैल्यूएट किया गया। सभी आइसोलेट्स सक्सेसफुली मल्टीप्लाई हुएय हालांकि, स्पीशीज के बीच यील्ड में काफी अंतर देखा गया। इन्फेक्टिव जुवेनाइल्स का प्रोडक्शन 400 से 1,20,000 प्रै तक था, जिसमें स्टीनर्नमेसुरखेटेन्से (SBIP3) ने 1,20,000 IJs/ml मीडिया की सबसे ज्यादा यील्ड रिकॉर्ड की।

इपीएन आइसोलेट्स में एनवायरनमेंटल स्ट्रेस के प्रति टॉलरेंस में काफी इंटरस्पेसिफिक वेरिएबिलिटी देखी गई। डेसिकेशन टॉलरेंस 72–100% तक था, जिसमें स्टीनर्नमेग्लेसेरी ने सबसे ज्यादा टॉलरेंस दिखाया, जबकि हेटेरोरहैबडाइटिस spp. कम टॉलरेंट थे। एस. ग्लेसेरी और एस. सियामकाई ने ज्यादा तापमान (40°C) को भी बेहतर तरीके से झेला। यूवी टॉलरेंस में बहुत अंतर थाय सभी स्टीनरनेमा आइसोलेट्स में यूवी एक्सपोजर के बाद भी जहरीलापन बना रहा, जबकि एक एच. इंडिका आइसोलेट में कम टॉलरेंस दिखा। भारतीय कृषि अनुसंधान परिषद – गन्ना प्रजनन संस्थान इपीएन बायोपेस्टीसाइड बनाने की टेक्नोलॉजी को दो बायोपेस्टीसाइड कंपनियों को कमर्शियलाइज किया गया है।

पांच आइसोलेट्स एच. इंडिका एसबीआईटीएनडी78, एच. बैक्टीरियोफोरा एसबीआईपी5, स्टीनरनेमासुरखेटेन्स एसबीआईपी 3, एस. थर्मोफिलम एसबीआईएच1, और एस. सियामकाई एसबीआईटीएनटी1 का बड़े पैमाने पर प्रोडक्शन किया गया, टैल्क में बनाया गया, और एआईएनपीएसएपी सेंटर्स को सप्लाई किया गया। लेबोरेटर ल बायोएसे में पहले इनस्टार व्हाइट ग्रब की 25–100% मौत देखी गई, जबकि गन्ने के सीवी.. को 11015 के साथ पॉट ट्रायल में एच. इंडिका एसबीआईटीएनडी78 से 8% मौत देखी गई। तमिलनाडु में एक फील्ड ट्रायल में दिखाया गया कि H-इंडिका एसबीआईटीएनडी78 ने व्हाइट ग्रब की आबादी को 78% तक कम किया, जो इमिडाक्लोप्रिड ट्रीटमेंट के बराबर है।

H. indica (SBITND78) की कीट–रोगजनक कवकों *M. anisopliae* और *B. bassiana* के साथ अनुकूलता का मूल्यांकन *Galleria mellonella* के लार्वा तथा प्रथम अवस्थीय व्हाइट ग्रब (*H. serrata*) के विरुद्ध किया गया। यद्यपि सभी उपचारों से मृत्यु हुई, लेकिन केवल EPN के प्रयोग से

G. mellonella के लार्वा 2 दिनों के भीतर मर गए, जबकि केवल EPF के प्रयोग से 8 दिनों में 100: मृत्यु प्राप्त हुई। EPN–EPF के संयुक्त प्रयोग से व्यक्तिगत उपचारों की तुलना में विरुलेंस (रोगजनक क्षमता) में कमी तथा समूह उत्पादन में कमी देखी गई, क्योंकि EPN से संक्रमित होस्ट में कवक की वृद्धि अवरुद्ध हो गई। इन परिणामों से यह संकेत मिलता है कि परीक्षण की गई परिस्थितियों में मूल्यांकित EPN और EPF के बीच अनुकूलता नहीं पाई गई।

गन्ने के नेमाटोड की पहचान के लिए एक सीएनएन मॉडल को मोबाइल–कम्पैटिबल फॉर्मेट (TensorFlow Lite/ONNX) में बदला गया और ।दकतवपक ́जनकपव के जरिए एक Android ऐप में इंटीग्रेट किया गया। ऐप यूजर्स को कैमरा या गैलरी से इमेज इनपुट करने, उन्हें लोकली प्रोसेस करने और प्रेडिक्शन दिखाने की सुविधा देता है। एपीके–बेस्ड ऐप 10× मैग्निफिकेशन पर 92% एक्यूरेसी के साथ नेमाटोड इमेज की सही पहचान करता है।

भारतीय कृषि अनुसंधान परिषद दृगन्ना प्रजनन संस्थान, क्षेत्रीय केंद्र, कन्नूर से GUK 14–48 (INGR25037), जो *S. robustum* का एक दुर्लभ अंतःप्रजातीय संकर है तथा लाल गूदे, उच्च गन्ना उपज और फिनॉलिक्स, एंटीऑक्सीडेंट तथा एन्थोसायनिन की अधिक मात्रा से युक्त है, को एनबीपीजीआर में आनुवंशिक भंडार (Genetic Stock) के रूप में पंजीकृत किया गया। क्लोन GUK 17–301, जिसकी वंशावली में बाँस जैसी संरचना और जलभराव सहनशीलता पाई जाती है, को गन्ना उपज और गुणवत्ता के लिए उत्कृष्ट प्रदर्शन के आधार पर 'ब्व' दर्जा प्रदान किया गया तथा इसे Co 24015 नाम दिया गया।

दुनिया भर में 3,380 गन्ने के जर्मप्लाज्म एक्सेसियन का कलेक्शन, जिसमें अलग–अलग सैकरम स्पीशीज, एलाइड जेनेरा और रिलेटेड जेनेरा शामिल हैं, को असरदार तरीके से कंजर्व, कैरेक्टराइज और इस्तेमाल किया गया। गन्ने के जर्मप्लाज्म की पूरी मॉनिटरिंग से पता चला कि अलग–अलग इंटेंसिटी पर बड़ी बीमारियाँ और कीड़े–मकौड़े फैल रहे हैं, साथ ही असरदार बायोलॉजिकल कंट्रोल के तरीके, खासकर एपिरिकेनियामेलानोल्यूका की सफल स्थापना, कीड़ों की आबादी को कम लेवल पर बनाए रखना और क्वारंटाइन सेफ्टी पक्का करना शामिल है। इन विट्रो कंजर्वेशन और क्रायोप्रिजर्वेशन प्रोटोकॉल ने लंबे समय तक जर्मप्लाज्म बचाने में मदद की, जबकि SSR मार्कर का इस्तेमाल करके मॉलिक्यूलर कैरेक्टराइजेशन ने जेनेटिक डायवर्सिटी की समझ को बढ़ाया। फूलों के विकास, बीज के मैच्योर होने और जर्मिनेशन डायनामिक्स पर स्टडीज से असली बीज वायबिलिटी और प्लांटिंग वैल्यू को बेहतर बनाने के लिए कीमती जानकारी मिली, जिससे जर्मप्लाज्म मैनेजमेंट और गन्ना सुधार प्रोग्राम को मिलकर मजबूती मिली। A PhysioIndexR पैकेज को क्लासिकल और नए स्ट्रेस टॉलरेंस इंडेक्स, फिजियोलॉजिकल ट्रेट्स और कम्पोजिट मेट्रिक्स की गणना के लिए एक यूनिफाइड एनालिटिकल फ्रेमवर्क के तौर पर डेवलप किया गया था, जिससे मल्टी–स्ट्रेस माहौल में कुशल जीनोटाइप इवैल्यूएशन, रैंकिंग और प्रायोरिटी तय करना मुमकिन हो सके। फिजियोलॉजी–बेस्ड ट्रेट एस्टिमेशन और एडवांस्ड कम्पोजिट स्कोरिंग तरीकों के साथ क्वांटिटेटिव स्ट्रेस इंडेक्स को इंटीग्रेट करके, यह टूल फसल ब्रीडिंग और फिजियोलॉजी में डेटा–ड्रिवन फैसले लेने की क्षमता को मजबूत करता है, जिससे क्लाइमेट–रेसिलिएंट जीनोटाइप की पहचान करने और सस्टेनेबल एग्रीकल्चरल प्रोडक्शन को आगे बढ़ाने में मदद मिलती है।

आउटरीच प्रोग्राम में गन्ना उगाने वालों / गन्ना स्टाफ के लिए 6 स्पॉन्सर्ड ट्रेनिंग प्रोग्राम, 680 पार्टिसिपेंट्स के साथ 22 एक–दिन के ट्रेनिंग प्रोग्राम, 8294 स्टूडेंट्स/एकेडेमिशियंस को फायदा पहुंचाने वाले 141 एक्सपोजर विजिट और 180 गन्ना किसानों को फायदा पहुंचाने वाले 63 पर्सनलाइज्ड एडवाइजरी शामिल थे। को 11015 और को 14012 किस्मों पर दो फ्रंटलाइन प्रदर्शन पूरे किए गए। 28 फरवरी 2025 को विभिन्न स्कूलों और कॉलेजों के 1000 से अधिक छात्रों की भागीदारी के साथ राष्ट्रीय विज्ञान दिवस मनाया गया। कोयंबटूर और इरोड जिलों में चार कृषि–आधारित प्रदर्शनियों में स्टॉल लगाकर भाग लिया। 'समृद्धि के लिए गन्ना खेती' पर आकाशवाणी पर फार्म स्कूल के प्रतिभागियों के लिए एक किसान–वैज्ञानिक बातचीत का आयोजन किया गया। डीडी किसान, नई दिल्ली ने संस्थान के इनपुट्स के साथ 'किसानों को उन्नत गन्ने की किस्मों से लाभ' (हिंदी में) एक कार्यक्रम तैयार किया था। सोशल मीडिया की कथित उपयोगिता पर गन्ना विकास कर्मियों के बीच एक सर्वेक्षण से पता चला कि बहुमत इस कथन से सहमत था मोबाइल ऐप केन एडवाइजर 2.0 के लिए कंटेंट फाइनल हो गया है और इंग्लिश वर्जन के लिए एपीके फॉर्मेट मिल गया है।

4 EXECUTIVE SUMMARY

Co 18022 (Karan 18), a mid-late and high-yielding variety has been approved for release in the Variety Identification Committee of AICRP(S) for cultivation under North West Zone. This variety was developed from the bi-parental cross (CoS 8436 x Co 89003) exhibiting superior performance in AICRP trials for high cane yield and sucrose %. It is resistant to red rot disease and moderately tolerant to salinity.

Evaluation of 73 clones in the Pre-Zonal Varietal Trial resulted in the identification of 13 elite 'Co' canes (Co 25001-Co 25013) and one genetic stock CoGS 25014 with superior cane yield, CCS yield, sucrose content and resistance to red rot and smut. Out of the 13 'Co' canes of 2025 series, 10 promising clones were advanced to AICRP (Sugarcane) testing in Peninsular Zone.

Flowering intensity in the arrowing plot was 82.86% and 435 crosses were made utilizing 'Co' and 'Co' allied varieties, ISH, IGH, CYM clones and registered genetic stocks with emphasis on high yield, high quality, resistance to red rot and smut diseases. A total of 40,000 seedlings from 158 biparental crosses, 26 polycrosses and 39 general collections were evaluated in ground nursery. As a new initiative in participatory breeding approach, 10600 seedlings from 33 biparental crosses were planted in ground nursery at the Research and Development farm of Bannari Amman Sugars Pvt. Ltd, Satyamangalam. A total of 197 clones combining good field stand, yield, quality parameters and resistance to red rot and smut from second clonal trial were promoted to PZVT multiplication. In PZVT, the clones Co 25003 (22.50%), Co 25005 (22.67%), Co 25009 (22.53%) and Co 25010 (22.11%) recorded more than 22.00% sucrose at 12 months. Co 25005 exhibited resistant reaction (R) to red rot by plug and nodal methods besides recording high sucrose % at harvest. Evaluation of 12 elite clones at S. Nijalingappa Sugar Institute, Belagavi (Karnataka) over two plant crops and one ratoon identified Co 21003, 2020-127, 2020-121 and 2020-152 as superior for CCS yield and cane yield, demonstrating their potential as location specific promising varieties.

The energy cane SBIEC 14006 with high harvestable biomass yield of 284.27 t/ha was licensed to M/s. Radix Life Spaces Pvt. Ltd, Bengaluru, Karnataka. A panel of 90 genotypes was evaluated under imposed drought conditions to identify robust markers for drought tolerance. Marker Trait Association was observed for different traits associated with drought tolerance. The genotypes were grouped into 22 R and 80 MR through CCT for three years against red rot CF 06 isolate. Sugarcane database was developed for 18 descriptors on 2000 clones which include information on pedigree, yield and quality parameters, response to biotic and abiotic stresses and flowering attributes. Four clones AA 2024-05, KE 2024-01, RK 2023-83 and AA 2024-03 recorded higher single cane weight, juice weight and pol% juice than the standard Co 86032 and were found suitable for ethanol industry/integrated sugar complex.

In IVT, Co 21002 for CCS yield and cane yield and three test entries, (Co 21003, Co 21007, Co 21009) were identified as best performers for sucrose content. In the first plant crop of AVT, Co 19009 and Co 19014 were promising with high cane and CCS yield. For sucrose % at 12 months, five entries (Co 19009, Co 19014, CoT 19366, CoT 18366, CoT 18369) recorded more than 5% improvement over the commercial variety Co 86032. Analysis of two plant and one ratoon data revealed that Co 18003, Co 18002, CoVC 18061 and Co 18009 were found superior for cane yield and sugar yield. Co 18003, Co 18013, Co 18002, Co 18009, CoVSI 18121 and CoVC 18061 were superior to Co 86032 for sucrose.

Nine 'Co' canes which were accepted at the AICRP(S) workshop held at PAU, Ludhiana were supplied to seed multiplication centre, Padegaon. As a part of targeted prebreeding efforts, eight participating centres received 773.2 g of fluff from the crosses made for the development of climate smart genetic stocks. In the National Hybridization Garden, 377 of the 470 clones flowered with a flowering intensity of 80.21%. Twenty two centres received 24.56 kg of fluff from 456 biparental crosses made from the National Hybridization and Fluff Supply Program.

A total of 2,277 wild germplasm accessions which included *Saccharum spontaneum* (1756), *Erianthus arundinaceus* (233), *Erianthus* spp. (178), allied Genera (62) and improved *Erianthus* for fibre (48) were conserved at ICAR-SBI, Coimbatore and 47 high-altitude accessions were maintained at ICAR-IARI RS, Wellington. Additionally, 1924 clones which include 'Co' canes, foreign hybrids and other registered genetic stocks were maintained at Coimbatore. National Active Germplasm maintenance comprised 296 notified and registered genetic stocks, and 26 newly notified clones were assigned index numbers. Among the 49 *S. spontaneum* clones collected from Karnataka, Andhra Pradesh and Tamil Nadu, the accessions IND 21-2106 and IND 21-2080 exhibited superior vegetative vigor, while IND 21-2103 recorded maximum root-eye number indicating strong ratoonability.

Somatic chromosome numbers were determined in 20 accessions of *S. spontaneum* collected from different regions and wide cytotypic variation (2n=40-112) was observed. FISH analysis revealed that x=9 represents an intermediate evolutionary stage and Peninsular clones showed only x=8, indicating the sub-Himalayan region as the evolutionary center of *S. spontaneum* in India.

Three genetic stocks were registered with ICAR-NBPGR, New Delhi. G1 14-161 (INGR 25104) is an interspecific hybrid derivative [(Co 7201 x Pathri (*S. barberi*) x Co 0209], exhibited tillering phase drought tolerance and resistance to tropical and subtropical red rot pathotypes (CF 06 and CF 08). Other two wild germplasm accessions of *S. spontaneum viz.*, IND 99-847 (INGR 25105) collected from Kerala and IND 04-1372 (INGR 25106) collected from Mizoram were registered as drought tolerant genetic stocks with high geometric mean productivity and high drought tolerance coefficient respectively.

Screening of *E. arundinaceus* germplasm for abiotic stresses identified three clones (SES 181, SES 342, SES 347) with salinity tolerance, high biomass, high accumulation of proline and identification of 43 key Quantitative Trait Nucleotides using GBS data revealed various physiological traits and candidate genes associated with drought tolerance.

Twenty four interspecific crosses were made to develop trait specific genetic stocks, and red rot screening against CF 06 identified 27 R and 51 MR clones by CCT, while the plug method detected 4 R and 47 MR genotypes. Sixty two interspecific hybrids were evaluated under drought conditions, and five clones (TSGS 21-16, 21-39, 21-385, 22-365, 23-5) were identified as stable performers for cane yield and physiological traits.

Large scale evaluation of 577 BC_3 progenies involving *E. procerus* identified 134 superior clones based on yield and quality traits. Under water deficit stress, BC_2 and BC_3 hybrids showed lower yield reduction (41.31%) than commercial checks (50.77%). Four BC_3 clones (GU 22-70, GU 22-73, GU 22-93, GU 22-110) were identified as drought tolerant based on superior cane yield under stress.

Hybrids from crosses between *Erianthus* clone (IND 04-1377 TC) and Co 86032 exhibited wide phenotypic variation in cane colour, height, thickness, NMC and HR brix. Twenty three hybrids at 12 months recorded sucrose content of 14.16-19.0%, and the *Erianthus* involved backcross hybrid [IK 76-99×(Co 86032x04-774)-35] had 17.53% sucrose. Cytological and molecular analyses revealed chromosome numbers of 2n=85-144, exhibiting 2n+n transmission and hybridity was confirmed using *Erianthus* specific markers.

Hybrid progenies derived from crosses involving *S. spontaneum* with different cytotypes and high sucrose varieties led to the identification of a superior clone SS 2021-304 with high cane yield and high Brix, and superior single cane weight. Three clones (ISH 100, ISH 28, CYM 14-298) had high mean cane yield, high mean sucrose content and red rot tolerance across three ratoon crops.

GISH analyses of the hybrid (BC_4 clone GI 18-2) indicated 63.5% genome of *S. officinarum*, 21.5% of *S. spontaneum*, 10.75% of recombinant chromosomes, 1.8% of *Erianthus*, and roughly 2.45% of unidentified genomic components thereby confirming successful introgression of *Erianthus* genome.

A drought-responsive Cytochrome P450 gene (1.5 kb) from Co 06022 was successfully cloned and sequenced. A conserved glycosyltransferase gene (1.5 kb) was isolated, cloned and validated its presence on chromosome 2B and containing three conserved motifs (Glyco_transf_43, GlcAT-I, and PLN02458) in sugarcane. GWAS was conducted in 499 sugarcane genotypes using 100K SNP array and identified significant marker trait associations for yield and quality traits. KASP assay validated red rot resistance associated SNPs showing clear biallelic clustering for SNP 98 marker. Field screening against CF 06 pathotype identified 11 R and 51 MR clones from 78 clones.

Suppression subtractive hybridization identified 452 and 625 drought-upregulated transcripts in AS-04-1687 and TSGS-20-24, respectively which were primarily associated with MAPK, calcium and phosphatidylinositol signaling pathways. Root anatomical analysis indicated that the clone AS-04-1687 exhibited drought adaptive traits with increase in sclerenchyma and stele area. In response to salinity stress, both TSGS 20-24 and Co 94012 showed significant up regulation of stress related genes, and a LIM transcription factor induced by salinity was successfully cloned.

CRISPR/Cas9 edited plants targeting SWEET13c, SWEET4a, and SWEET3a were regenerated and validated through Cas9. Sanger sequencing and ICE-CRISPR analysis identified indel mutations, with one SWEET13c-2 plant exhibiting an editing efficiency of 11%, while six SWEET4a-2 plants displayed 1–3% indels. Synteny analysis revealed a strong conservation with *S. spontaneum* and a correlation with cold stress responsive PP2C genes thereby supporting their involvement in the regulation of abiotic stress. Four thermophilic microbial isolates exhibiting high laccase activity at 46°C were identified, and proteomic analysis revealed 1,447 peptides with 134 differentially expressed proteins, including lignin degrading enzymes such as xylanases, hemicellulases, and cellulases. A full-length laccase gene (1.8 kb) from *Aspergillus* sp. was successfully cloned for the purpose of biomass delignification.

Under the AICRP on seed through the farmers participatory seed program (FPSP) from Coimbatore, 1263.555 tons of breeder seed canes (Co 86032, Co 11015, Co 14012, Co 18009) were distributed to both co-operative and private sugar factories. Additionally, 1.13 lakh tissue culture plants (Co 86032, Co 11015, Co 18009, Co 14012, Co 0238, Co 0118, Co 15023) were supplied to sugar mills, farmers and for breeder seed production. Sixty virus free mother culture flasks (Co 86032, Co 11015, Co 0238, Co 0118, Co 15023) were provided to five tissue culture laboratories located in Tamil Nadu, Punjab, Karnataka and Uttar Pradesh. From Karnal, 1900.52 tons of breeder seed (Co 15023, Co 16030, Co 17018, Co 0118) was delivered to various stakeholders. The on-farm and FPSP seed production was 207.531 tons and 1692.989 tons, respectively. Approximately 50,000 tissue culture plantlets (Co 0118, Co 15023, Co

17018) were generated, and 49 mother flasks (Co 0118, Co 15023, Co 17018) were sold to sugar mills, for the cutivation of tissue culture plantlets. The seed production and sale license for the variety Co 17018 was granted to six sugar mills. A total revenue of Rs 27.14 lakhs was generated from the Karnal centre.

DUS tests in four varieties [VSI 08005 (VSI 12121), Phule Sugarcane 13007 (MS 14082), Phule-11082 (CoM 11082) and Phule Sugarcane 15012 (MS 17082)] was conducted. The re-characterization of 246 Reference Varieties for (RV) 27 DUS characters and digitalisation of 100 RVs was done.

Under CRISPR-Crop Network and allied genome editing initiatives, polycistronic MATL-targeting CRISPR-Cas9 vectors were successfully constructed and validated. Screening of over 300 transformants confirmed two MATL-edited plants through molecular and sequencing analyses. Genome editing of the strigolactone biosynthesis gene *MAX4-1* was accomplished to enhance tillering and yield in elite sugarcane genotypes. About 250 plants were confirmed for the presence of the cas9 construct using the hygromycin specific primers. *In vitro* mutagenesis of sugarcane genotype Co 99004 using gamma rays led to the identification of different root system architecture (RSA) phenotypes. Three mutants (M72, M36, M48) were found to be drought tolerant based on physiological performance. Using the vector pRGEB32 multiplexed gene constructs were developed for SWEET 13c, 4a and 3a genes. Targeted editing of the lignin biosynthesis pathway (CAD gene) was undertaken to modify biomass composition for biofuel applications. Polycistronic construct targeting DST, HPs, flowering gene, *TB1* and *HTD2* genes were developed in sugarcane.

Under Development of location specific varieties through Institute–Industry collaborative approach for enhanced sugar productivity in Tamil Nadu, 20 promising sugarcane clones were evaluated across 10 sugar factories and identified two high-performing clones (Co 19009, Co 21003) with superior cane yield, sugar yield and sucrose content.

In multi-location varietal evaluation trials conducted across sub-tropical and tropical sugarcane zones under ISMA, two entries *viz.*, Co 20016 and Co 21012 consistently outperformed the check Co 0238 in cane yield, sugar yield and key quality parameters across 16 sugar mills in the sub-tropical zone.

Application of a Bt-based biopesticide (Bt-62) against white grub in sugarcane using Bio Formulation Applicator (ICAR-SBI) in white grub endemic area showed 33% reduction in white grub population. Mechanical transplanting using mini tractor-operated transplanters can achieve yield comparable to conventional methods, while offering substantial labour (72.7%) and time (50%) savings in sugarcane cultivation.

Preliminary fermentation studies using alkali-pretreated and acid/enzyme-digested sugarcane bagasse (Co 11015, Co 86032) and energy cane biomass (SBIEC 14006, SBIEC 18001) confirmed ethanol production. Among the 15 yeast isolates tested, *Saccharomyces* spp. (strain B) and *Saccharomyces* spp. (strain D) produced comparatively high ethanol yields. Thirteen edible fungal isolates were tested for growth on sugarcane bagasse (Co 11015, Co 86032) and energy cane biomass (SBIEC 14006, SBIEC 18001). All the isolates showed good colonization, which boosted crude protein content from 0.44% to 8.75% demonstrating the potential of edible fungi to enrich sugarcane residues with protein, improving their nutritional value.

Sugarcane-based farming system (1 ha) comprising cropping system (sugarcane + blackgram), dairy, goats, fish, poultry and vermicomposting units in the institute has indicated dairy as the most profitable, while cropping system contributed the largest share (46%) of farm income, with overall net profit of the farming system as ₹4.9 lakh/year. Natural farming with intercrop + trash mulching recorded cane yields of 66.9-94.7 t/ha, slightly lower (5-7.5%) than conventional farming (66.8-115.0 t/ha), but recorded reduced production costs (12%). The system enhanced soil organic carbon (0.54%), microbial carbon and nutrient cycling, ensuring environmental safety and long-term sustainability.

Drip irrigation in sugarcane achieved the highest cane yield (152.1 t/ha) and CCS yield (20.9 t/ha) while using less irrigation water (560 mm/ha), outperforming trash mulching and skip furrow methods. Juice quality remained unaffected by irrigation practices, but drip irrigation clearly demonstrated higher water-use efficiency and productivity compared to farmers' practice.

Conventional and reduced tillage produced similar weed dry weight at harvest. Hand weeding (7.11 g/m^2), Pendimethalin + intercrop + trash mulching + ready mix (6.85 g/m^2), and Pendimethalin + trash mulching + ready mix (6.89 g/m^2) were the most effective in reducing weeds. High yields were achieved with integrated weed management practices, recording 113.9-116.8 t/ha. Nine combination of new herbicide molecules were tested in sugarcane plant crop under field condition. Among herbicide combinations, pre-emergence application of Clomazone + Sulfentrazone @2.5 kg/ha followed by one inter-cultivation at 60 DAP recorded the highest cane yield (102.62 t/ha), weed control efficiency (86.5%) and lower weed index (3.28). Field trial on drone-compatible herbicide spray volumes against conventional knapsack spraying, hand weeding, and untreated control revealed that, pre-emergence Atrazine at 1.25 kg a.i./ha with 25-50 L/ha spray volume did not affect sugarcane germination. Atrazine at 1.25 kg a.i./ha with 25 L/ha spray volume achieved the best results, with lower weed count (38.7/m^2), weed dry matter (9.7 g/m^2), and higher weed control efficiency (92.4%) at 35 DAP.

Hydroponic and field evaluations in sugarcane identified key physiological traits such as chlorophyll dynamics, canopy temperature depression, metabolites and antioxidant responses as reliable indicators of nutrient use efficiency. Genotypes differed markedly in nitrogen, phosphorus, and potassium uptake and utilization, with lines such as Co 86032, Co 14012, Co 14005 and AS 04-1875 showing superior performance across nutrient regimes. Efficient genotypes maintained high leaf area, photosynthetic stability, carbohydrate reserves, and stronger antioxidative protection under nutrient stress. These findings enable classification of nutrient-efficient cultivars to support genotype selection and precision nutrient management for improved cane yield and resilience. Hydroponic screening at 9 and 12 dS m^{-1} EC was standardized for rapid identification of salinity-tolerant sugarcane clones. Among the tested clones, CoM 265 and Co 86032 exhibited better physiological resilience under salinity compared to the susceptible Co 97010.

Morpho-physiological trait analysis in sugarcane revealed that clones with erect top leaves and planophile bottom leaves efficiently harvested solar radiation. Cane yield showed significant positive correlation with plant height, total dry matter, cane volume, NMC and germination %, while leaf angle of insertion had a negative correlation. Clones *viz.*, Co 85019, Co 17004 and Co 86032 demonstrated superior photosynthetic rates and efficient carbon metabolism, with TVD+2 leaf position contributing maximum photosynthetic activity, underscoring the importance of canopy architecture and nitrogen status in enhancing biomass and yield.

Waterlogging stress, induced under hydroponic system reduced redox potential and growth traits. Co 62175 showed superior tolerance with better plant height and leaf number than Co 86032.

Study on the effect of new ICAR-SBI formulation on drought showed that the formulation No. 3 combined with *Methylobacterium* spp., improved physiological traits such as leaf water status, wax content, proline accumulation, antioxidant activity, and tiller numbers under both irrigated and unirrigated conditions. Under unirrigated moisture stress, this treatment significantly increased millable cane numbers by 63% in Co 86032, 48% in Co 18009, and 30% in Co 11015, highlighting its efficacy in mitigating drought stress and enhancing productivity.

Drought evaluation of seven AVT 18 series clones revealed that, Co 18002 and Co 18003 maintained high shoot populations and growth, and were rated tolerant (T). Co 18009, Co 18013 and Co 18024 were rated moderately tolerant (MT).

Evaluation of Co 18 and Co 19 series clones under salinity stress revealed that Co 18002, Co 18003 and Co 85019 maintained high cane yield under both control and salinity, while Co 18001 and Co 97010 performed well only under control conditions. Among the Co 19 series, Co 19008 and Co 19009 exhibited superior morpho-physiological traits and yield under both environments. Overall, Co 18002, Co 18003, Co 19008 and Co 19009 were tolerant and considered for commercialization in the Peninsular Zone, especially saline-prone areas of tropical India.

A polynomial regression is used to model non-linear relationships between normalized LAI and Growing Degree Days (GDD). The 3rd order polynomial fits the observed data with an r^2 value of 0.95 indicating that the 3rd order polynomial model is an excellent predictor of normalized LAI based on GDD for the sugarcane clones.

Two soil profiles (low-land and up-land) at ICAR-SBI, RC, Kannur were characterized under persistent waterlogging conditions. The low-land soil profile extended beyond 160 cm in depth, with a sandy topsoil that gradually transitioned into a clay-rich subsurface. This clay layer restricted vertical water movement, resulting in poor drainage. The bulk density decreased with depth, ranging from 1.56 mg/m^3 in the surface layer to 1.47 mg/m^3 in deeper layers, while hydraulic conductivity remained low at less than 2.5 cm/hr. In contrast, the upland soil profile exceeded 175 cm in depth and was sandy throughout. Here, the bulk density increased with depth, reaching more than 1.8 g/cm^3 at the bottom. Although the sandy texture provided high hydraulic conductivity, the shallow groundwater table and landscape position led to persistent waterlogging in this area.

Soil calcareousness was reduced by both FYM and daincha incorporation, with daincha showing higher reduction (5.6%) compared to FYM (2.5%), indicating effective amelioration. Phosphorus management significantly influenced cane yield, while organic amendments, crop geometry, and interactions had no significant effect. The highest cane yield (152.25 t/ha) was recorded under the treatment of 50% SSP + Urea N equivalent to 50% DAP at basal + 50% DAP at 90 DAT. The experiment successfully achieved the STCR target of 150 t/ha.

Under AICRP on sugarcane, 14 new sugarcane genotypes were evaluated under two fertilizer levels (100% and 125% RDF), there was no significant effect of fertilizer level in cane yield. Among the genotypes, Co 18003 consistently excelled, combining high cane yield, superior CCS yield and stable juice quality, making it the most promising entry compared to standard checks.

S. robustum genotype 51 NG 142, producing purple leaves and red-fleshed stems, was evaluated for bioactivity through solvent extraction and antioxidant assays. Chloroform and dichloromethane extracts showed the highest flavonoid and phenolic contents, with radical scavenging activities exceeding 80%, confirming their strong antioxidant potential.

ITMC and techno commercial meetings of Agri-innovate were conducted to take decisions on different aspects pertaining to technology disclosures, patent applications and commercialization of technologies developed by ICAR-SBI. MTA was signed between ICAR-SBI and ICAR-CICR for two novel *cry8* genes discovered by

ICAR-SBI towards the development of transgenic cotton for the management of cotton stem weevil. Registration certificates for Co 12029 (Karan 13), Co 18009 and Co 13035 (Karan 14) was obtained from PPV&FRA. Five copyright certificates were received. Licensed the following technologies *viz.*, SBIEC14006 - An energy cane with high biomass production, ICAR-SBI EPN Biopesticide formulation to two firms, *Cotesia flavipes* and *Telenomus dignus* mass multiplication technology against internode borer with release station and sugarcane variety Co 17018. Ten MoUs were signed underscoring strong progress in technology transfer and commercialization.

Under CCT method, among 3588 screened clones, 521clones (14.93%) were free from red rot infection and rated as R and 754 clones (21.61%) were categorized as MR and the remaining clones were rated as S (39.2%) or MS (17.7%) or HS (6.6%). Besides, identified one resistant clone among six PZVT clones tested for field tolerance. IVT and AVT clones were evaluated for red rot, smut and other diseases in sugarcane and resistant and tolerant clones were identified. Under quarantine, eight genotypes in National Active Germplasm and four genotypes in National Hybridization Garden were cleared.

Under AICRP, 10 red rot isolates were evaluated on 15 differential varieties and the new isolates were more virulent than standard pathotypes. Three designated *C. falcatum* pathotypes were sequenced for genome analysis. MLST analysis of *C. falcatum* using six genes indicated that the sequences were grouped with the type strain and *C. falcatum* pathotypes were closely related to *C. sublineola*, *C. graminicola* and *C. cereale*. Effectors coding genes were predicted from the genome of *C. falcatum* and differentially expressed effectors in susceptible (CoC 671) and resistant (Co 93009) sugarcane cultivars were identified through transcriptome sequencing.

Red rot resistance in sugarcane was initiated by genome editing involving candidate genes (LOX3 gene, CAX4). Gene sequences of these two targets were screened for identification of efficient target sequences, location of PAM sites and guide RNAs were designed using CRISPOR program for these two target genes. Transformation of red rot susceptible cultivars (Co 0238 and CoC 671) with the construct has been initiated and the calli are in different stages of selection. Expression and purification of recombinant EPL1 for *in vitro* pull down assay has been undertaken to identify the interacting host receptor proteins.

Interaction between sugarcane and five species of *Fusarium* from pokkahboeng (PB) infected plants indicated that, all the species were not involved in inducing wilt and the severity of wilt varies with the *Fusarium* species. For the management of PB, drone spraying of Propiconazole up to 0.2% was standardized. Under biological control, 158 bacterial and 85 actinobacterial cultures were isolated from the rhizosphere soils of different sugarcane growing regions, screened against *F. sacchari* causing wilt and *C. falcatum* causing red rot and selected best ones for evaluation under *in vivo* conditions. Endophytic bacteria isolated from Co 86032 and Co 0238 were screened *in vitro* for antagonistic potential, PGP and abiotic stress tolerance properties. Among 379 bacteria isolated from Co 86032 and Co 0238, 18 bacteria exhibited very strong antagonistic potential. Screening endophytic bacteria for various PGP properties identified six high ammonia producers, three high phosphorous solubilizers, 21 high Zn solubilizers, 14 very high siderophore producers and 13 high Indole acetic acid producers. Also, two endophytic bacteria exhibited very high drought tolerance property under *in vitro* conditions.

Under integrated approach, efficacy of mechanized sett treatment with chemicals/ settling planting from treated setts and soil application of bioagents were found to be significantly effective against red rot, smut and wilt. Further, dual treatment of setts with hot water at 55°C followed by nursery inputs in Sett Treatment Device (STD) and spot application of bioagents at the time of planting had significantly reduced non fungal diseases *viz.*, GSD and YLD incidence. Similar integrated approach has been validated in banana for enhanced growth promotion and yield attributes. Also dual treatment with hot water at 54°C followed by Propiconazole at 0.01% had completely protected Co 97009 from 100% smut incidence in control. Similarly, dual treatment with hot water followed by chemicals/ bioagents had been proved against bacterial rot of ginger, mosaic and mealy bug in cassava, nematodes in turmeric and banana in crop specific ICAR institutes. Outreach activities on the management of sugarcane fungal diseases indicated that, realizing the potential of Sett Treatment Device (STD), Tamil Nadu Government under NADP-RKVY-DRP based projects, approved 100 STD units on subsidy for developing entrepreneurship to establish healthy nursery units in all the mills including co-operative, public and private mills @ 1 to 6 units / sugar mill. Out of 100 sanctioned units, training was given to 60 entrepreneurs, from which about 506 participants were benefitted with respect to healthy settling production. In addition, under NFSM, updating the technical inputs for raising healthy nursery for red rot management was done through small scale training and demonstrations on the role of mechanized priming of single bud setts using Sett Treatment Device (STD) in various locations of four sugar mills *viz.*, Hari Nagar, Hasanpur, Sidwalia and Narkatiaganj in Bihar.

Indexing of tissue culture (TC) plants for non-fungal diseases revealed that, out of 54 samples from ICAR-SBI, 96 and 44% samples were free from yellow leaf virus and GSD phytoplasma, respectively. Similarly, 10 TC samples from EID parry, Pugulur, TN and Verdant Bio-Agri LLP, Bagalkot, Karnataka showed 50% free from viruses. Sugarcane yellow leaf virus (SCYLV) coat protein gene expression, recombinant protein production and purification were standardized using prokaryotic and eukaryotic expression vectors. Polyclonal antibody was developed against the SCYLV and was standardized under DAC-ELISA method using the highly susceptible samples as well as from the apparently healthy and TC samples. Host plant changes upon phytoplasma infection through transcriptional profiling in four cultivars showed that, more than 80 genes related to phytohormone biosynthesis followed by defense and photosynthesis genes were down regulated in phytoplasma-infected plants compared to healthy plants. For phytoplasma diagnosis, recombinase polymerase amplification primers were designed and standardized.

Two novel *cry8* genes were cloned into a *Bacillus thuringiensis* shuttle vector for toxin expression and subsequent bioassay studies against the cotton stem weevil, *Pempherulus affinis*, in collaboration with ICAR–CICR Regional Station, Coimbatore. Successful expression of the *cry8* genes was confirmed, and preliminary diet-incorporation bioassays showed 80-90% larval mortality in toxin-treated diets compared to the control.

An improvised chimney and box method was standardized for large-scale production of *Telenomus dignus*. Egg parasitization across batches ranged from 55.6–100.0% in the box method and 71.3-95.0% in the chimney method.

A total of 89 intergeneric sugarcane hybrids derived from *E. procerus* crossed with 'Co' canes were evaluated for resistance against borer pests. Under field screening for early shoot borer (ESB), nine IGHs showed least susceptibility, and artificial screening studies further identified GU 19-22, GU 19-55 and GU 19-72 as least susceptible. Screening against internode borer (INB) classified 12 genotypes as least susceptible 24 as moderately susceptible and 54 as susceptible. Based on INB incidence and its impact on internode morphology, four genotypes (GU 19-4, GU 19-22, GU 19-24, GU 19-55) were identified as resistant.

Fifteen IGHs derived from *E. arundinaceus* with *S. spontaneum* were field-screened for resistance to ESB and INB. The results revealed that four genotypes *viz*., CYM 06-212, CYM 08-922, CYM 04-388, and CYM 07-971 showed complete resistance to ESB. Subsequent artificial screening under severe ESB infestation confirmed that genotype CYM 08-922 exhibited more than 90% plant survival. Based on INB incidence and its effect on internode morphology, three genotypes (CYM 06-924, CYM 07-981 and CYM 08-922) were identified as resistant.

The biological effects of Type I (SBIEC 11003, SBIEC 13010, SBIEC 11002, SBIEC 14003) and Type II (SBIEC 14006, SBIEC 11004, SBIEC 11001 and SBIEC 14001) energy canes to ESB and INB revealed significantly lower larval and pupal survival on Type II energy canes. Besides, larvae of both borer pests exhibited a prolonged larval developmental period on Type II energy canes than on Type I, indicating that Type II energy canes are comparatively less suitable for larval growth. The extended developmental duration suggests the presence of antibiosis related traits in Type II energy canes, which may contribute to enhanced resistance against sugarcane borers.

Comparative gene expression analysis in early shoot borer-infested and uninfested plants of Co 86032 and CYM 08-922 revealed a strong induction of lipoxygenase (LOX) and glutathione-S-transferase (GST) during the early phase of infestation, particularly in leaf tissues, indicating their role in early defense responses. LOX expression remained elevated at later stages, especially in shoot tissues, suggesting its role in both early and sustained defense against borer infestation.

A novel diet-incorporation bioassay method was developed as an alternative or supplement to the conventional carrot disc contamination method. Using this diet contamination bioassay, the spore-crystal mixture of Bt-62 produced on different media caused high mortality (30.0-80.0%) in first-instar grubs, demonstrating the effectiveness and reliability of the method for evaluating Bt toxicity.

Crown mealybug infestation in Co 86032 resulted in yield loss of 9.1 t/ha at a 10% incidence level, corresponding to an economic loss of ₹30,940/ha. Field studies identified *Leptomastix sylvae* as the predominant parasitoid, with parasitism levels ranging from 9.70 to 23.77%, while *Promuscidea un fasciativentris* also contributed significantly. Laboratory studies showed high parasitism by *L. sylvae* on advanced nymphal instars, with comparable parasitism by virgin and mated females. Among insecticides evaluated, Thiamethoxam was relatively safer to *L. sylvae*, whereas Carbofuran was the most effective against crown mealybug under field trials. Screening of entomopathogenic fungi revealed 15 *Metarhizium anisopliae* and 5 *Beauveria bassiana* isolates with high pathogenicity, causing 75–95% mortality.

Fungal DNA barcodes of the isolated entomopathogenic fungi (EPF) were deposited in the NCBI GenBank to confirm species identity. The EPF isolates were evaluated against ESB, INB and fall armyworm. Several *M. anisopliae* and *B. bassiana* isolates exhibited high pathogenicity, causing 75–100% mortality in all three pests, with some isolates inducing 100% mortality in advanced or third-instar larvae. Notably, seven *M. anisopliae* isolates and one *B. bassiana* isolate demonstrated broad-spectrum efficacy, causing consistently high mortality (80–100%) against ESB, INB and fall armyworm.

Silicon profiling of sugarcane varieties showed significant difference in leaf sheath silicon content, with Co 06030, Co 06022 and Co 0238 registered the highest levels and Co 11015 and Co 09004 exhibited the lowest. Leaf sheath silicon content showed a significant negative correlation with the incidence of ESB and INB, whereas silicon content in the rind was not significantly associated with borer incidence.

Among five *S. spontaneum* genotypes, SES 519 recorded the highest silicon content. Incorporation of silicon-rich SES 519 leaf powder into an artificial diet significantly reduced the growth, development and reproductive potential of ESB and INB compared to a standard sorghum-based diet, indicating a detrimental effect of silicon on borer biology.

Two Bt crystal toxin genes, cry8Sa1 and cry9Eb, effective against white grub and INB, respectively, were isolated from indigenous *Bacillus thuringiensis* strains and codon-optimized for expression in sugarcane. Gene constructs were developed using the pCAMBIA1305.1 vector incorporating a GRP signal peptide under the control of the *Porterisia* ubiquitin promoter. A vacuolar targeting sequence was included in the cry9Eb construct, whereas it was absent in the cry8Sa1 construct. The constructs were first transformed into *E. coli*, then mobilized into *Agrobacterium tumefaciens* strain LBA4404 and confirmed by colony PCR and Sanger sequencing.

The Bt-62 strain, produced in a fermentor, was applied near the root zone at a dose of 1.0×10^{14} CFU/ha, using a manually operated applicator. The treated plot showed 53.01% reduction in white grub incidence, compared to only 6.52% reduction in the control plot.

Yield loss due to crown mealybug was estimated at 7.1 tonnes/ha when the incidence level reached 10% in the sugarcane variety Co 11015. CMB infestation caused a substantial reduction in juice content which was five folds lower in infested canes compared to healthy ones. The mean juice content from five infested canes was 579 ml, whereas it was 3,225 ml in the healthy canes in the same variety. In addition, Brix value and juice purity percentage were marginally lower (1.0-1.2%) in the CMB infested canes.

Exposure to elevated CO_2 concentrations (450, 550, 750 ppm) did not adversely affect the growth and development of INB. Larval duration decreased with increasing CO_2 levels, while pupal and adult stages remained unaffected in both natural hosts and artificial diets. The species successfully completed its life cycle under elevated CO_2 conditions, and ESB completed its entire life cycle within 50 days at 550 and 750 ppm.

Five monoxenic entomopathogenic nematode (EPN) isolates were evaluated for *in vitro* mass production using yeast extract–based media with four treatments. All the isolates multiplied successfully; however, significant variation in yield was observed among species. The production of infective juveniles ranged from 400 to 1,20,000 IJs, with *Steinernema surkhetense* (SBIP3) recording the highest yield of 1,20,000 IJs/ml of media.

Significant interspecific variability was observed among EPN isolates in tolerance to environmental stresses. Desiccation tolerance ranged from 72-100%, with *Steinernema glaseri* showing the highest tolerance, while *Heterorhabditis* spp. were less tolerant. *S. glaseri* and *S. siamkayai* also exhibited better tolerance to high temperature (40°C). UV tolerance varied widely; all *Steinernema* isolates retained virulence after UV exposure, whereas one *H. indica* isolate showed less tolerance. The ICAR-SBI EPN biopesticide formulation technology has been commercialized to two biopesticide companies.

Five isolates *H. indica* SBITND78, *H. bacteriophora* SBIP5, *Steinernema surkhetense* SBIP3, *S. thermophillum* SBIH1, and *S. siamkayai* SBITNT1 were mass-produced, formulated in talc and supplied to AINPSAP centres. Laboratory bioassays showed 25–100% mortality of first-instar white grubs, while pot trials with sugarcane cv. Co 11015 showed 8% mortality by *H. indica* SBITND78. A field trial in Tamil Nadu demonstrated that *H. indica* SBITND78 reduced white grub populations by 78%, comparable to Imidacloprid treatment.

The compatibility of *H. indica* (SBITND78) with the EPF fungi *M. anisopliae* and *B. bassiana* was evaluated against *G. mellonella* larvae and first-instar white grubs (*H. serrata*). Although all the treatments caused mortality, EPN alone caused mortality of within two days, where as EPF alone achieved 100% mortality by eight days. Combined EPN–EPF applications resulting in reduced virulence and lower mass production compared with individual treatments, with fungal growth being inhibited in EPN-infected hosts. These results indicate a lack of compatibility between the evaluated EPN and EPF under tested conditions.

A CNN model for sugarcane nematode identification was converted to a mobile-compatible format (Tensor Flow Lite/ONNX) and integrated into an Android app via Android Studio. The app allows users to input images through the camera or gallery, processes them locally, and displays predictions. The APK-based app accurately identifies nematode images at 10x magnification with 92% accuracy.

From ICAR-SBI RC, Kannur, GUK 14-48 (INGR 25037), a rare interspecific hybrid of *S. robustum* characterized by red flesh, superior cane yield and high levels of phenolics, antioxidants and anthocyanins was registered as a genetic stock with NBPGR. Clone, GUK 17-301 with bamboo and waterlogging resistance in its lineage was assigned 'Co' status (Co 24015) based on its superior performance for cane yield and quality.

The world collection of 3,380 sugarcane germplasm accessions of *Saccharum* species and allied genera was effectively conserved, characterized and utilized. Comprehensive monitoring of sugarcane germplasm revealed the occurrence of major diseases and insect pests at varying intensities, with effective biological control measures, particularly the successful establishment of *Epiricania melanoleuca*, maintaining pest populations at low levels and ensuring quarantine safety. *In vitro* conservation and cryopreservation protocols supported long-term germplasm preservation, while molecular characterization using SSR markers enhanced understanding of genetic diversity. Studies on floral development, seed maturation and germination dynamics provided insights to improve true seed viability and planting value, collectively strengthening germplasm management and sugarcane improvement program.

A PhysioIndexR package was developed as a unified analytical framework for computing classical and novel stress tolerance indices, physiological traits and composite metrics, enabling efficient genotype evaluation, ranking and prioritization under multi-stress environments. By integrating quantitative stress indices with physiology-based trait estimation and advanced composite scoring methods, the tool strengthens data-driven decision-making in crop breeding and physiology, thereby supporting the identification of climate-resilient genotypes and advancing sustainable agricultural production.

The outreach programs included six sponsored training programs for cane growers / cane staff, 22 one-day training programs with 680 participants, 141 exposure visits for 8294 students/ academicians and 63 personalized advisories benefitting 180 sugarcane farmers. Two frontline demonstrations were completed on the varieties Co 11015 and Co 14012. National Science Day was celebrated on 28 February 2025 with the participation of over 1000 students of various schools and colleges. Participated in four agri-based exhibitions in Coimbatore and Erode districts by putting up a stall. A farmer-scientist interaction was organized for the participants of Farm School on AIR on 'Sugarcane farming for prosperity'. DD Kisan, New Delhi had produced a program 'Farmers reap benefits from improved sugarcane varieties' (in Hindi) with inputs from the Institute.

A survey among the cane development personnel on perceived usefulness of social media revealed that a majority had agreed with the statement 'Using social media makes it easier to distribute information to stakeholders in sugarcane agriculture'. Survey based studies were conducted in nine districts in Tamil Nadu to get feedback about the performance of micropropagation in sugarcane. Contents for the mobile app Cane Adviser 2.0 were finalized and have received the apk format for English version.

5. RESEARCH ACHIEVEMENTS

5.1 Division of Crop Improvement

Breeding superior sugarcane varieties of different maturity with improved cane yield, quality and resistance to biotic and abiotic stresses

Breeding sugarcane varieties for tropical region

'Co' canes identified

Thirteen elite clones were identified from the pre-zonal varietal trial conducted during 2024-25 and assigned 'Co' numbers (Co 25001 to Co 25013) and one clone *viz.,* CoGS 25014 was identified as genetic stock for high CCS yield, high cane yield and sucrose %. The performance of these elite clones in comparison with the standards is presented in Table 4.

'Co' canes selected for AICRP(S) trials

Out of 13 'Co' canes of 25 series, 10 'Co' canes (Co 25003, Co 25004, Co 25005, Co 25007, Co 25008, Co 25009, Co 25010, Co 25011, Co 25012, Co 25013) were selected for testing in Zonal Varietal Trial in Peninsular zone.

Hybridization (2025)

Out of 350 clones planted in arrowing plot, 290 flowered with flowering intensity of 82.86%. A total of 435 crosses were effected which included 285 biparental crosses involving tropical and tropical clones, 100 crosses between tropical and subtropical clones and 30 crosses involving ISH, IGH, CYM clones, genetic stocks and 20 polycrosses utilising high yielding, high quality, red rot and smut resistant parents.

(S. Alarmelu, A.J. Prabakaran, A. Anna Durai, R. Karuppaiyan, K. Elayaraja, Adhini S. Pazhany and H.K. Mahadeva Swamy)

Ground Nursery (2025)

Forty thousand seedlings from 158 biparental crosses, 26 polycrosses, one self and 39 general collections were evaluated. The biparental crosses ISH 100 x Co 11015, CoVC 14062 x CoC 671, Co 11015 x CoVC 14061, Co 8371 x Co 12009, CoC 671 x CoVC 14061, Co 8353 x Co 11015, Co 11015 x Co 13007, Co 21010 x Co 775 and Co 21008 x Co 11015 exhibited good field stand, cane thickness and clones with HR brix above 23.0%.

(S. Alarmelu, A.J. Prabakaran, A. Anna Durai, R. Karuppaiyan, C. Appunu, K. Elayaraja, Adhini S. Pazhany, H.K. Mahadeva Swamy and K. Gopalareddy)

Seedling raising for ground nursery (2025-26)

As a new initiative in participatory breeding approach in collaboration with sugar industry, 10600 seedlings from 33 biparental crosses were planted in ground nursery at the Research and Development farm of Bannari Amman Sugars Ltd, Satyamangalam. Also, 23500 seedlings from 183 biparental crosses, 22 polycrosses and 28 general collections were planted for evaluation in ground nursery.

(R.M. Shanthi, S. Karthigeyan, K. Mohanraj, S. Sheelamary, R.T. Maruthi, T. Lakshmi Pathy, R. Gobu and K. Praveen)

First Clonal Trial - Ratoon (2025)

Out of 3060 clones selected from ground nursery and evaluated for NMC, cane thickness, cane height and HR Brix at 240 days in ratoon crop, 100 clones had HR brix of >19.0%. The crosses, Co 17003 x Co 97015, CoVC 14061 x Co 11015, Co 13014 x Co 11015, Co 13014 x Co 97015 and

Table 4. Performance of 'Co' selections at Coimbatore

'Co' Number	Parentage	CCS yield (t/ha)	Cane yield (t/ha)	Sucrose (%)		Red rot	
				300 DAP	360 DAP	Plug	Nodal
Co 25001	Co 10026 x Co 11015	18.58	118.68	21.72*	21.70	R	R
Co 25002	Co V 89101 x ISH 266	17.261	24.79	21.44	20.77	R	R
Co 25003	Co 86032 x CoC 8001	20.64*	126.70	22.30*	22.50*	MR	R
Co 25004	CoVC 14062 x Co 11015	20.03	125.76	20.73	21.69	MR	-
Co 25005	Co 99008 x CoPant 97222	20.91*	129.76	22.32	22.67*	R	R
Co 25006	Co 86032 x Co 94005	19.20	128.26	20.85	20.32	MR	R
Co 25007	Co 86032 x Co 92008	20.92*	138.37*	20.05	21.08	R	R
Co 25008	Co 99006 x Co 0209	19.73	128.18	20.68	21.38	MR	R
Co 25009	Co 86032 x CoC 8001	20.40	124.44	21.35	22.53*	MR	-
Co 25010	CoM 12085 GC	21.92*	132.67	20.60	22.11*	MR	R
Co 25011	PZVT 2017-187 x Co 94008	19.77	124.48	20.08	21.30	R	R
Co 25012	Co 8347 x Co 12014	20.49*	135.38	20.82	20.15	R	R
Co 25013	Co 99008 x CoPant 97222	22.67*	152.74*	19.87	21.98*	R	R
Genetic stock							
CoGS 25014	Co 86032 GC	21.71*	138.68*	20.51	21.58	S	S
Standards							
Co 09004		18.10	116.18	22.87	21.90		
Co 11015		20.81	121.98	23.29	23.47		
Co 86032		17.74	121.04	20.39	20.62		
CoC 671		16.10	99.27	23.58	22.45		
CD		2.84	16.80	1.28	1.33		
CV		9.72	8.90	2.97	3.03		

Co 12009 x Co 8371 were the best with mean HR brix % of 19.21, 19.52, 18.58, 18.84 and 18.38 respectively. The crosses Co 86032 x 83V297 and Co 11015 x Co 0212 were identified as promising biparental combinations with high number of selectable progenies for good ratoonability.

(S. Alarmelu, A.J. Prabakaran, A. Anna Durai, R. Karuppaiyan, C. Appunu, K. Elayaraja and H.K. Mahadeva Swamy)

First Clonal Trial (2025-26)

Out of 2856 clones screened, the crosses Co 8371 x Co 19009, Co 21009 x Co 19009, Agali 2018-24 x Co 19009 and Co 19008 x CoVC 14061 gave more selections with high HR brix (≥ 21.0%) (Fig. 2). Progenies derived from the biparental crosses with Co 19009 as male parent recorded high H.R Brix (%) values at 240 days.

(R.M. Shanthi, S. Karthigeyan, K. Mohanraj, S. Sheelamary, R.T. Maruthi and T. Lakshmi Pathy)

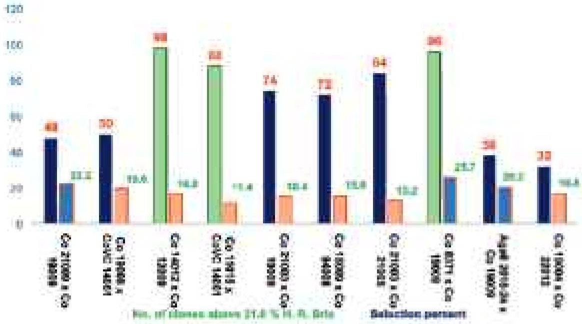


Fig. 2. Promising biparental combinations with high selection percent

Second Clonal Trial- Trial I

Out of 330 clones evaluated, 70 clones recorded > 19.0% sucrose at 10 months compared to 18.40% in the best standard Co 86032 and 34 clones recorded more than 22.0% sucrose, high proportion of recombinants combined high juice sucrose along with red rot resistance (CCT). Clones with Co 11015, CoTl 14111, Co 86032, PZVT 2018-47 and CoC 671 as one of the parents recorded high early sucrose accumulation and contributed for more than 41.0% of selections. Based on overall performance, 123 clones with good field stand, yield, quality and red rot resistance were selected for further evaluation in PZVT.

(S. Alarmelu, A.J. Prabakaran, A. Anna Durai, R. Karuppaiyan, C. Appunu, K. Elayaraja, Adhini S. Pazhany, H.K. Mahadeva Swamy and K. Gopalareddy)

Second Clonal Trial- Trial II

Out of 348 promising clones evaluated, 57 clones recorded more than 21.0% sucrose at 330 days. The clone 2023-014 developed from the cross Co 8371 x Co 11015 recorded a maximum sucrose of 22.60%. The clone 2023-504 from the cross Co 0209 x Co 8347 recorded the maximum single cane weight of 2.80 kg and 3.60 cm cane diameter. The clone 2023-114 identified from the cross Co 11015 x Co 94008 recorded a maximum cane height of 340 cm. Screening of clones for red rot by CCT method indicated that 17.82% of the clones were exhibiting resistance to red rot and 32 clones combined both high juice quality and red rot resistance. The crosses with maximum selection are Co 11015 x CoVC 14061, Co 11015 x Co 94008, Co11015 x 85 R 186, Co11015 x Co 94005, Co 13014 x Co 94008, CoLk 8102 x Co 12014 and Co 8371 x Co 11015. Based on overall performance, 74 clones were selected and promoted to PZVT multiplication.

(R.M. Shanthi, S. Karthigeyan, K. Mohanraj, S. Sheelamary and T. Lakshmi Pathy)

Pre-Zonal Varietal Trial (Coimbatore)

Performance of 'Co' canes identified during 2024-25 at Coimbatore

Out of 73 clones evaluated along with four standards (Co 86032, Co 09004, Co 11015, CoC 671), based on cane yield, CCS yield, sucrose %, reactions to red rot and smut and field stand, 13 elite clones were selected and assigned 'Co' number (Co 25001 to Co 25013). Among the 'Co' canes, Co 25013 recorded significantly higher CCS yield (22.67 t/ha), followed by Co 25010 (21.92 t/ha) as against the standard Co 86032 (17.74 t/ha). The top five 'Co' canes with high cane yield are Co 25013 (152.74 t/ha), Co 25007 (138.37 t/ha), Co 25012 (135.38 t/ha), Co 25010 (132.67 t/ha) and Co 25005 (129.76 t/ha) compared to standard variety Co 86032 (121.04 t/ha). Five 'Co' canes recorded significantly higher sucrose % than the standard Co 86032 (20.62%) at harvest. The clone CoGS 25014 recorded significantly higher CCS yield (21.71 t/ha), cane yield (138.68 t/ha) and sucrose % of 21.58 at harvest which was identified as genetic stock.

(K. Elayaraja and R.T. Maruthi)

Pre-Zonal Varietal Trial (2025 series) multiplication

Two hundred and six clones of PZVT 2025 series and 22 clones of PZVT 2024 series were multiplied for conducting Pre Zonal varietal trial in 2026-27. About 22.0 % clones exhibited resistance to red rot by CCT method. Fifty clones recorded HR brix % above 21 at 10 months.

(S. Alarmelu and T. Lakshmipathy)

Arrowing plot

A total of 350 clones including recently identified 'Co' canes, parents of proven and zonal crosses, genetic stocks registered with NBPGR, cytoplasmically diverse (CYM, CD) clones were maintained in the arrowing plot for effecting crosses in 2025 hybridization program.

(H.K. Mahadeva Swamy, K. Gopalareddy and K. Elayaraja)

Screening for diseases

Red rot: From 79 PZVT clones screened under field condition by plug method with CF 06 pathotype, six clones were R, 36 were MR, 22 were moderately susceptible (MS), five were susceptible (S) and three were highly susceptible (HS) to red rot. In nodal method, out of 65 clones screened in field with CF 06 pathotype, 48 were R and 17 were S.

(V. Jayakumar and R. Selvakumar)

Smut: Out of 73 clones evaluated for smut resistance under field condition, 10 were R, 8 were MR, 12 were MS, 14 were S and 29 were HS.

(A. Ramesh Sundar and R. Ramesh)

Botanical characterization and DNA finger printing of elite selections and varieties

Botanical description of 2023 series 'Co' canes were completed. The molecular fingerprints of the 'Co' canes of 2024 series (Fig. 3) and VSI 21121, VSI 18008, TC 2513, Co 86032, CoC 671, Co 2000-08 and CoH 20261 were developed.

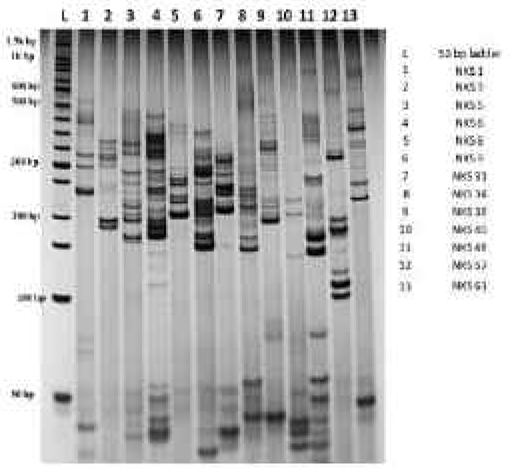


Fig. 3. Molecular profile of Co 24002

(H.K. Mahadeva Swamy and S. Alarmelu)

Identification and testing of short duration sugarcane clones

Hybridization and Ground nursery: To improve the short duration clones *viz.,* Co 11015, Agl 2018-24, SDC 2020-12, PZVT 2022-133 and SDC 2019-15 (either thin cane or showing yellowing syndrome), six crosses were made with thick cane parents or YLD free parents. A total of 265 seedlings derived from the cross Co 11015 x CoM 20082 and 23 seedlings of the cross Co 86032 x Co 11015 were evaluated. Twenty-three seedling progenies with HR Brix % >23.0 were selected. Crosses involving Co 11015 as one of the parents had given high proportion of selectable progenies with high brix %.

Clonal evaluation: In the first clonal trial, 80 clones derived from the crosses between short duration parents were evaluated. The clones selected from crosses involving Co 11015 and Agl 2018-24 either as female or male parent exhibited high brix values.

(R. Karuppaiyan and V. Krishnapriya)

Evaluation of elite clones for identifying promising location specific sugarcane varieties

Karnataka: Twelve entries along with two standards were evaluated at SNSI Belagavi (Table 5). Based on two plant and one ratoon crops, Co 21003 (21.39, 145.76), 2020-127 (20.74, 137.85), 2020-121 (20.65, 143.08) and 2020-152 (19.65, 135.87) were found superior to Co 86032 (17.04, 121.98) with respect to CCS yield (t/ha) and cane yield (t/ha, respectively.

(H.K. Mahadeva Swamy and K. Mohanraj)

Table 5. Performance of PZVT clones at SNSI, Belagavi, Karnataka

Clone	CCS (t/ha)	Cane yield (t/ha)	CCS (%)	Sucrose (%) (12m)
Co 21003	21.39	145.76	14.70	20.75
2020-76	11.39	81.69	13.89	19.76
2020-49	12.08	83.32	14.51	20.60
2020-152	19.65	135.87	14.44	20.41
2020-28	15.49	112.85	13.75	19.51
2020-23	13.80	98.73	13.99	19.82
2020-127	20.74	137.85	15.05	21.34
2020-121	20.65	143.08	15.14	20.66
2020-67	14.75	97.17	15.16	21.49
2020-147	15.86	106.50	14.92	21.18
2020-15	14.72	100.93	14.59	20.69
2020-11	715.61	106.17	14.73	20.95
Standards				
Co 86032	17.04	121.98	13.97	19.67
CoC 671	117.63	115.51	15.29	21.55

Breeding special varieties for high biomass and total sugars for cogeneration, ethanol and forage production

Cogeneration and ethanol production: Sixty-five energy cane clones and SBIEC 14006 were evaluated (36 genetic stocks and 29 experimental hybrids). Among 29 energy cane experimental hybrids, the highest cane height was recorded in SBIEC 11007 (370 cm) and the highest cane weight in SBIEC 13002 (1.32 kg). For quality traits, highest Brix % and Pol % was found in SBIEC 14003 (17.74 and 14.88) respectively. SBIEC 14006 recorded single cane weight of 1.38 kg, cane height of 395 cm and cane diameter of 2.38 cm and 39 internodes at 12th month. This clone recorded very high harvestable biomass yield of 284.27 t/ha. Brix and Pol were 10.51% and 7.24% respectively. Licensing of Energy Cane variety SBIEC 14006 was granted to M/s. Radix Life Spaces Pvt Ltd, Bengaluru, Karnataka during June 2025.

(P. Govindaraj, K. Elayaraja and M.R. Meena)

Identification of superior sugarcane varieties suitable for different agro-eco climatic regions of Tamil Nadu (ART/MLTs in collaboration with TNAU)

Multi-location Trial–I plant (2024-25): Co 11015 was the best standard for CCS yield (19.70 t/ha) and Co 86032 was the best for cane yield (130.43 t/ha). Among the test entries, Co 17009 (18.10 t/ha CCS yield and 130.67 t/ha cane yield) was superior to Co 86032. None of the test entries was superior to Co 11015 for sucrose content (21.75%) and CCS percent (15.26%). However, Co 18001 (20.05% sucrose, 14.16% CCS), Co 17009 (19.72% sucrose, 13.85% CCS) and C 17043 (19.20% sucrose, 13.27% CCS) recorded higher quality parameters than Co 86032 (19.06% sucrose, 13.36% CCS).

Adaptive Research Trial–I plant (2024-25): Two test entries (C 16338 and Co 17001) along with five standards were evaluated at three locations *viz.*, Sathyamangalam, Appakudal and Odapalley. Among the standards, CoG 7 recorded the highest cane yield of 152.89 t/ha at Appakudal followed by Co 86032 (138.03 t/ha). The highest sugar yield was recorded by Co 18009 (16.9 t/ha), followed by Co 86032 (18.8 t/ha) and Co 11015 (16.8 t/ha). Among the test entries, Co 17001 (16.3 t/ha) was found to be on par with Co 86032 for sugar yield (16.8 t/ha). At Bannariamman Sugars, Sathyamangalam, the standard Co 86032 recorded the highest cane yield (154.57 t/ha) and sugar yield (24.07 t/ha). Among the test entries, C 16338 with 19.94 t/ha of CCS yield and 144.83 t/ha of cane yield was found better. At Ponni Sugars, Erode, Co 86032 recorded the highest cane yield (185.12 t/ha) and sugar yield (22.49 t/ha). None of the test entries outperformed Co 86032 at this location, however C 16338 was found to be on par with the standard Co 86032 for sugar yield.

Multi-location Trial–II plant (2025-26): The second plant trial was planted with seven test entries

Table 6. Marker trait associations for drought tolerance in sugarcane

Trait	Marker	P value	Phenotypic variance
Canopy temperature	NKS31_202	1.27E-07	29.299
	NKS5_2931.33	E-05	20.991
	NKS31_245	9.99E-05	17.142
Dry root weight	SNAC	4.90E-06	22.838
	NKS31_268	4.76E-05	18.573
	NKS38_195	3.05E-04	14.956
Dry shoot weight	DREB1A	2.96E-07	27.845
	NKS31_202	2.51E-05	19.796
	NKS31_245	7.64E-05	17.662
	NKS40_105	1.10E-04	16.962
Fresh root weight	SNAC1	2.52E-062	4.05
	NKS9_397	3.79E-05	19.009
Fresh shoot weight	DREB1A	3.57E-07	27.518
	NKS61_252	2.84E-04	15.096
Root volume	NKS40_438	1.17E-04	16.835
RWC	NKS6_182	1.02E-04	17.099
	NKS5_293	2.29E-04	15.52
Shoot length	NKS5_293	2.03E-05	20.198
	NKS6_182	5.32E-05	18.358
	NKS5_312	9.02E-05	17.34
	SNAC1	1.02E-04	17.096
	NKS38_396	1.35E-04	16.551
Leaf biomass	NKS48_332	1.37E-04	22.005
Internode number	NKS5_502	6.05E-04	18.208
Tilleess per ha	NKS48_248	9.22E-04	17.107

C 17017, C 17043, C 17122, Co 17009, Co 18001, G 15060 and Si 15003 along with six standards viz., Co 86032, Co 11015, CoC 13339, CoG 7, and CoV 09356.

Exchange and multiplication of materials: Co 18002 and Co 19014 were supplied to the Sugarcane Research Stations at Cuddalore and Sirugamani of Tamil Nadu Agricultural University, Coimbatore. Five entries *viz.*, C 22002, C 22014, C 22133, C 22229 and C 22283 were received from Cuddalore and multiplied for testing under MLT during 2026-27.

(A. Anna Durai, K. Elayaraja, Adhini S. Pazhany and T. Lakshmi Pathy)

Marker–assisted selection in sugarcane for drought tolerance and red rot resistance

A panel of 90 genotypes were evaluated under imposed drought conditions to identify markers for drought tolerance. Variation was found for shoot biomass, root biomass, shoot length, dry shoot weight and dry root weight. MTSs (Marker Trait Association) was observed for canopy temperature (NKS31_202, NKS5_293), dry root weight (SNAC, NKS31_268), dry shoot weight (DREB1A, NKS31_202, NKS31_245), root volume (NKS40_438), RWC (NKS6_182) and shoot length (NKS5_293, NKS6_182) with phenotypic variation of 15-29%. For red rot resistance the panel developed was tested using CF 06 isolate through CCT for three years and 22 were R, 80 were MR, 37 were MS, 51 were S and 14 were HS (Table 6).

(H.K. Mahadeva Swamy, K. Mohanraj, K. Gopalareddy, P. Malathi and R. Manimekalai)

Selection and evaluation of multipurpose sugarcane clones with high ethanol and bagasse yields for integrated sugar complexes

A field trial was laid to identify suitable varieties for ethanol industry/integrated sugar complex with 14 test clones and two standards (Co 86032, CoM 0265) with an average single cane weight of 2.0 kg, showing MS/MR/R reactions to red rot and possessing moderate sucrose content. At 10 months, four clones (AA 2024-05, KE 2024-01, RK 2023-83, AA 2024-03) recorded higher single cane weight, juice weight and pol% than the standards (Table 7).

(R. Karuppaiyan, C. Palaniswami, M. Alagupalamuthirsolai and Adhini S. Pazhany)

Development of database management systems (DBMS) for improving breeding efficiency

Sugarcane database has been developed for 18 descriptors on 2000 clones using MySQL 10.10.2

Table 7. Performance of selected clones for cane and juice traits at 300 days

Clone	SCW (kg) 10m	Juice Wt/Stalk (kg) 10m	Juice Extraction (%) 10m	Pol (%) 8m	Pol (%) 10m
AA 2024-05	1.87	0.98	53.38	18.03	21.25
KE 2024-01	1.72	0.93	61.13	14.14	18.83
RK 2023-83	2.57	1.34	58.23	15.76	19.81
AA 2024-03	1.84	0.98	53.98	16.40	19.32
Standards					
CoM 0265	2.19	1.18	58.92	14.78	18.18
Co 86032	1.61	0.86	52.98	16.24	18.26
CD	NS	NS	4.83	1.59	2.2
CV	13.42	18.35	3.85	4.85	5.52

Fig. 4. Snapshot of updated sugarcane parental database

server, Frontend: HTML, CSS, BOOTSTRAP and JAVASCRIPT; Backend: PHP 7.4 (Fig. 4). The information includes pedigree data, yield and quality parameters, response to biotic and abiotic stresses, and flowering attributes. A model sugarcane parental database was developed with different menu options, and the database has to be tested for technical glitches. The database serves as a common platform allowing breeders to simultaneously access details of parental clones and determine the best cross combinations for multi-trait improvement.

(R.T. Maruthi, Vinayaka, A. Anna Durai, K. Mohanraj and M. Prateepa, ICAR-NBAIR, Bengaluru)

Molecular profiling of sugarcane gene pool for brown rust and identification of novel genomic regions for rust in Bru 1 gene null background

In the arrowing plot (2024-25) out of 318 parental clones screened for natural incidence of rust, 125 were free from rust (39.31%) while 28 had traces, 128 were S and 37 (11%) were HS (Fig. 5). From the

Fig. 5. Rust incidence in arrowing plot

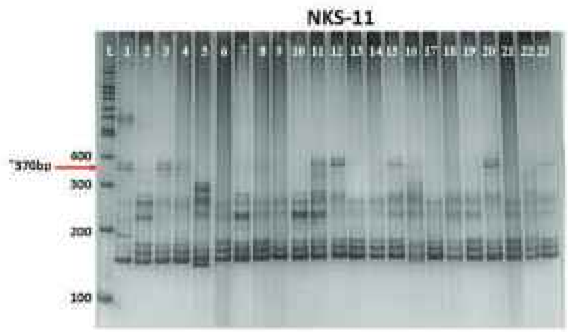
18 crosses made in the previous year, 1500 seedlings were generated. The candidates for crossing were selected based on the genotyping of rust-free clones which are devoid of *Bru1*.

(K. Gopalareddy, H.K. Mahadeva Swamy and R. Selvakumar)

Genetic analysis and reference set development in sugarcane for smut resistance

Twenty-three biparental crosses were done involving smut tolerant sugarcane genotypes (Co 6806, Co 775, Co 22018, Co 22010, Co 94008, CoH 13, ISH 176) during 2024 and 2500 seedlings are planted for evaluation in ground nursery.

Biochemical and molecular analysis: Out of 52 sugarcane genotypes evaluated under both normal and inoculated conditions for smut resistance, six genotypes (BO 91, ISH 176, CoSe 92423, CoS 8436, Co 6304, Co 19008) were HS. Leaf samples were collected at different stages for biochemical analysis (phenols, salicylic acid content and lignin) and variation between 15 R (Co 6806, Co 10004, Co 22010, Co 85002, Co 22009, Co 21003) and 37 S clones was observed for phenols and salicylic acid content with an increase in trend in resistant clones. DNA from the 52 clones were screened with reported molecular markers for smut resistance. NKS 11 primer was found to



L- Ladder	5.Co Se 92423	10.Co 23018	15.Co 22009	20.Co 10003
1.Co 6806 - R	6.Co 21002	11.Co 22010	16.Co 22004	21.Co 15023
2.Co 6304 - S	7.Co 21005	12.Co 85002	17.Co 22003	22.Co 86032
3.Co 10004	8.Co 21003	13.Co 93009	18.CoT 8201	23.Co 23002
4.Co 8347	9.Co 86011	4.Co 23019	19.Co 15002	

Fig. 6. NKS 11 primer to differentiate between smut resistant and susceptible clones

differentiate between smut resistant and susceptible clones (Fig. 6).

(Kona Praveen, R. Gopi, A. Anna Durai, H.K. Mahadeva Swamy, S. Sheelarnary and G.S. Suresha)

Enhancement of sugarcane germplasm and development of pre-breeding material

Maintenance at Coimbatore and Wellington: A total of 2277 accessions were maintained at Coimbatore, which included *S. spontaneum* (1756), *Erianthus arundinaceus* (233), *Erianthus* spp. (178), allied Genera (62) and improved *Erianthus* for fibre (48). Forty-seven accessions collected from Arunachal Pradesh are being maintained at ICAR-IARI Regional Station, Wellington (Fig. 7).

Fig. 7. Germplasm accessions in ICAR-SBI wild sugarcane germplasm repository

(S. Karthigeyan, Adhini S. Pazhany, S. Sheelamary and M. Sivaswamy ICAR-IARI Regional Station, Wellington)

Maintenance of commercial hybrids and genetic stocks: In 2025, a total of 1960 clones including 'Co' canes, foreign hybrids and other genetic stocks were planted for maintenance of commercial hybrids and genetic stocks.

(K. Gopalareddy, S. Sheelarnary and T. Lakshmi Pathy)

Categories of clones	No. of clones	Categories of clones	No. of clones
'Co' canes	1316	IGH	37
'Co' allied	16	IA	13
Foreign hybrids	52	GU	1
ISH	283	CYM	94
PL	58	IND	6
CD	84	**Total**	**1960**

National active germplasm maintenance: The seed materials received from different centres were submitted to quarantine. In all, 296 notified and registered genetic stocks were maintained and 26 clones (Co 18022, CoP 17437, CoP 02182, CoS 17235, CoS 14235, CoS 18231, CoS 18232, CoPb 18211, CoPb 18213, CoPb 18214, CoPb 17215, CoLk 16202, Co Lk 16470, CoSnk 08101, CoSnk 20102, CoSnk 20103, MS 14082, MS 17082, 2015 A 311, 2017 A 553, G1 14-161, IND 99-847, IND 04-1372, Co 19017, Co 19009, Co 21003) were assigned index numbers.

(C. Jayabose and S. Alarmelu)

Characterisation, evaluation and cataloguing: Quantitative and qualitative traits were recorded in 49 *S. spontaneum* clones collected from Karnataka, Andhra Pradesh and Tamil Nadu and significant genetic variation was observed for all the 12 morphophysiological traits studied. IND 21-2106 and IND 21-2080 showed superior vegetative vigor. IND 21-2103 exhibited the maximum root-eye indicating strong ratoonability. Several genotypes showed region-specific trait expression highlighting the influence of genotype x environment interactions. HR brix % showed a negative association with biomass-related traits indicating genotypic trade-offs between vegetative growth and sugar content. Multivariate analyses grouped the genotypes into five distinct clusters comprising genetically diverse and complementary parental clones suitable for sugarcane prebreeding.

(C. Jayabose, S. Karthigeyan and Adhini S. Pazhany)

Cytological studies in *Saccharum* and allied genera

S. spontaneum: Somatic chromosome number was determined in 20 accessions of *S. spontaneum* with different places of origin. These clones are IND 01-1157(2n=112), IND 03-1219(2n=64), IND 03-1266(2n=48), IND 11-1674(2n=80), IND 11-1690(2n=64), IND 15-1705(2n=72), IND 16-1804(2n= 54), IND 16-1749(2n= 54), IND 16-1761(2n=64), IND 16-1770(2n=72), IND 16-1786(2n=52), IND 16-1792(2n=54), IND 16-1813(2n=40), IND 16-1826(2n=54), IND 17-185(2n=40), IND 18-1994(2n=96), IND 19-2028(2n=80), IND 21- 2102 (2n=64), IND 21-2056(2n=64), IND 21-2061(2n=64) (Fig. 8).

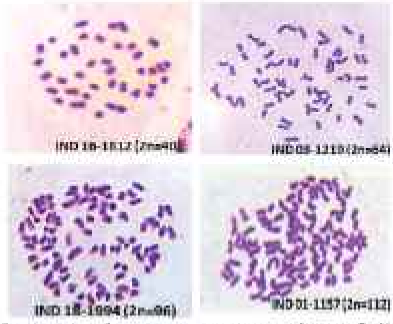


Fig. 8. Somatic chromosome number of different clones of *S. spontaneum*

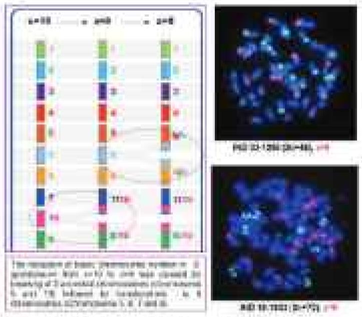


Fig. 9. Oligo-FISH analysis of different cytotypes of *S. spontaneum* with specific probes of chromosome 9 (green) and chromosome 10 (red)

Florescent *in situ* hybridization (FISH) study was conducted with recently designed chromosome specific oligo probes to establish the knowledge regarding the genetic diversity and evolutionary relationship of different cytotypes. Oligo nucleotide probe specific to chromosome number 9 and 10 were labeled with different fluorochromes (Alexa 546, Alexa 633, Alexa 488) (Fig. 9). FISH results revealed that the cytotypes with 2n=48, 64, 80, 88, 96, 112 showed a basic chromosome number x =8, cytotypes 2n= 40 with x=10, cytotype 2n=54 with x=9, cytotype 2n=72(tropical) with x=8 and cytotype 2n=72 (Sub tropical) with x=9. Three types of basic chromosome numbers were observed in the studied clones. Clones with x=10 and x=9 were much less than those with x=8. x=9 can be considered as an intermediate revolutionary step between x=10 and x=8. The reduction of basic chromosome number in *S. spontaneum* from x=10 to x=8 was caused by breaking of 2 ancestral chromosomes (chromosome 9 and 10) followed by translocations to 4 chromosomes (Chromosome 5, 6, 7 and 8). *S. spontaneum* accessions used in the study represented ten states of India. Clones from sub-Himalayan foot hills (Gangetic plains) showed x=10, 9 and 8 whereas the clones from peninsular region showed only x=8. This revealed that Sub-Himalayan foot hills correspond to the region of evolution of *S. spontaneum* in India.

(V.P. Sobhakumari)

Floral biological and cytological characterization of *Erianthus*

Flowering was observed in 60 sugarcane clones, of which five rare flowering clones - IND 18-1945, IND 18-1942, IND 99-907, IND 01-1110 and IND 03-1223 flowered. Detailed floral biological observations were recorded for 23 clones. The number of days from floral symptom appearance to panicle emergence varied from 9.0 days (EA Thornless and SES 342) to 16.0 days (Mythan-B), with a mean duration of 11.1 days. Anther dehiscence occurred within four days of tip emergence in EA Thornless, IND 01-1110, IND 18-1943 and IND 18-1942, whereas the longest duration to anther dehiscence was recorded in ERI 2384 (15 days after tip emergence). The duration required for complete panicle opening ranged from 11.0 days (IND 01-1110) to 23.0 days (ERI

2384) with a mean of 15.5 days. Anthesis in SES 288, US 3-1, and IND 18-1943 occurred between 6.30 and 7.30 p.m., while EA Pugalur exhibited anthesis between 3.30 and 4.00 p.m. In Mindana, anthesis was observed between 4.30 and 5.00 p.m. Meiotic analysis conducted in eight clones revealed a predominance of bivalent formation with only minor abnormalities (Fig. 10). Additionally, eight clones from the IND 2019 collection were characterised, and digital descriptor states for 15 clones were incorporated into the DELTA software. Exotic clones were further analysed using Intkey options, resulting in the generation of automated descriptions.

Fig. 10. Meiosis of IND 04-1107, *Ea.thornless, Ea.sarkander*

(A. Suganya)

Evaluation of sugarcane germplasm for biotic and abiotic stresses at Coimbatore

Saccharum spontaneum: Forty-two *S. spontaneum* accessions were evaluated in four environments for their drought tolerance potential along with two checks. DC (Drought coefficient) and GMP (Geometric mean productivity) were estimated for dry and fresh biomass in each environment. IND 04-1372 recorded the highest DC, while the highest GMP was recorded by the accession IND 99-847. Membership function value for drought (MFVD) was computed across traits and indices, where IND 04-1372 had highest value followed by IND 99-847. These two clones were registered as genetic stocks for drought tolerance with ICAR-NBPGR, New Delhi. Besides these two clones, IND 99-848 and IND 08-1500 were also found to be superior to best check Ponape1 based on pooled MFVD values. In 2024, a new set of 44 accessions along with two checks were evaluated in RCBD for their moisture stress tolerance, and morpho-physiological traits were recorded at various stages of stress and revival. At harvest, accession IND 85-522 recorded highest biomass per clump followed by IND 84-431, IND 84-464 and all these were superior to best check Ponape1.

Erianthus arundinaceus: Both salinity and drought screening of *E. arundinaceus* clones were carried out under pot and field conditions. From the *E. arundinaceus* clones evaluated for drought stress tolerance in field conditions, ten clones were selected and evaluated for salinity stress tolerance in pot culture. *Erianthus* clones exhibited a wide range of physiological and biochemical responses to salinity with some clones *viz.,* SES 181, SES 342 and SES 347 showing high levels of tolerance mechanism against salt stress in terms of higher stability of photosynthetic pigments, high biomass, higher accumulation of proline and lower lipid peroxidation. Further, GBS data generated from the 96 *Erianthus* drought association panel has identified 1,044 high quality Quantitative Trait Nucleotides (QTNs). GWAS conducted using a comprehensive drought panel identified 43 QTNs, associated with various physiological traits with phenotypic variation (PVE) in the range of 0.26% to 59.35% for both control and drought. Candidate genes (Target of Rapamycin 2 (TOR2), Trans-Membrane Kinase 1 (TMK1), potassium transporter auxin response factor, FAD-binding PCMH-type domain-containing protein, Nitrate Transporter 1/Peptide Transporter Family (NRT1/PTR) involved in drought perception and signalling were successfully identified in the QTN region. This study identified IND 99-892, IND 10-1591, IND 03-1260, SES 288, SES 293 as drought tolerant *Erianthus* clones and the QTNs linked to drought tolerance for further validation and utilization in the sugarcane breeding program.

(T. Lakshmi Pathy, H.K. Mahadeva Swamy, R. Valarmathi, R. Arun Kumar and R. Gobu)

Anatomical characterization of *Saccharum* complex and core collections

Internode micromorphological studies in the clones of *E. arundinaceus* indicated the occurrence of short cells as only solitary cork cells, rarely in two to three. Cork cells shape was either rectangular or square, pointed cork cells were also observed in all clones. Silica cells were rarely observed in IND 10-1591. Long cells were wavy in all the clones except in SES 288 it was slightly sinuous. Its frequency ranged from 51.65 (SES 288) to 69.50% (IK 76-99). The short cells were at low frequency of 31.5% in IK 76-99 and in other clones, it was high ranging from 40.8% to 48.3%. Papillae observed in the cork cells was at a high frequency of 83.05% in SES 288 while it was less with 16.6% in *E. a. sarkander*.

Internode anatomical studies in *Narenga* and *Sclerostachya* revealed smaller vascular bundles at lower frequency. Narenga had 3-4 layers of hypodermis. The rind vascular bundle sheaths of *Sclerostachya* were interconnected and the cortical bundles distantly arranged (Fig. 11).

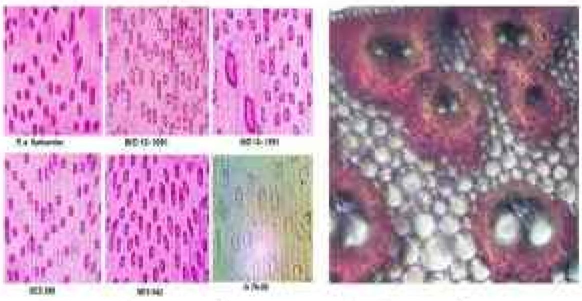


Fig. 11. Internode anatomy in *E. arundinaceus*

(A. Suganya)

Developing trait specific genetic stocks with biotic and abiotic stress tolerance, quality and yield traits in sugarcane through pre-breeding

Identifying multi-trait genetic stocks (MTGS) with improved *Saccharum* genetic base

Fifteen clones were evaluated under drought in two locations (Coimbatore and Agali). The stress was induced by withholding the irrigation from 60 DAP onwards till 150 DAP. The clones were evaluated for cane yield traits and juice quality at 11th month in both the locations. In both locations, the mean maximum reduction for cane height was 28.12% and 31.21% followed by single cane weight with 36.24% and 41.23% reduction, respectively. The juice sucrose ranged from 17.72% in the clone multi trait genetic stock (MTGS) 14-15 to 20.98% in the clone MTGS 14-48. The mean juice sucrose % was 2.34% and 6.56% less under drought at Coimbatore and Agali, respectively. There was significant difference between both the treatments for total dry matter. The mean extraction was 48.82% whereas it was 44.56% in drought. The clone MTGS 14-48 recorded the highest extraction % of 44.56. Only few drought tolerant clones recorded better SPAD values of more than 40. There was a significant decline in tillers, leaf weight, sheath weight, stem weight, total dry matter, number of green leaves, leaf area index, internode number and plant height. Three clones had significantly better total dry matter in comparison with other drought tolerant clones and standards (Co 85019, Co 10026 and Co 86032) indicating their drought tolerance potential. After early stress, increase in tiller number and retention of green leaves was observed in five clones. Nine drought tolerant clones combining yield, quality and red rot resistance were forwarded for further evaluation in clonal trial II.

Based on cane yield recorded in four environments (two seasons x two locations), five clones namely MTGS 14-38, MTGS 14-31, MTGS 14-33, MTGS 14-21 and MTGS 14-48 exhibited drought adaptive traits and combined resistance to red rot (CCT). Six clones were identified as highly drought tolerant and can be utilized in the development of climate resilient varieties. The increase in leaf area index was observed in these clones which were caused by the increase of shoot fresh weight which may be due to its more tolerance to drought stress. The clone G1 14-161 exhibiting tillering phase drought tolerance and red rot resistance under tropical and sub-tropical conditions was registered with NBPGR, New Delhi (INGR 25104).

(S. Alarmelu, S. Sheelamary, R. Arunkumar and Adhini S. Pazhany)

Developing trait specific genetic stocks for biotic and abiotic stress tolerance utilizing novel *Saccharum* germplasm

Development of new interspecific hybrids: Twenty-four crosses were effected using newly developed ISH clones as female parents and Co 775, Co 16018, Co 22012, Co 19014, CoVC 14061, Co 21006, Co 94008 and CoT 8201 as male parents during 2024 and 1995 seedlings from 26 second generation backcrosses and 15 first generation back crosses were transplanted in ground nursery.

Screening for red rot: Out of 201 clones developed using different accessions of *Sacc arum* spp. screened for CF 06 isolate of red rot pathogen by controlled condition testing method, 27 test entries were R while 51 were MR to red rot pathogen. Screening of 70 clones for red rot resistance by plug method of inoculation with pathotype indicated that 4 and 47 genotypes showed R and MR reaction, respectively.

Screening for drought and salinity tolerance: Sixty-two inter-specific hybrids were evaluated for their response to drought condition. Cane length among the cane yield contributing characters and LAI among the physiological traits (Fig. 12), showed positive correlation with cane yield under less irrigated condition. TSGS (Trait Specific Genetic Stock) 21-16, TSGS 21-39, TSGS 21-385, TSGS 22-365 and TSGS 23-5 showed stable performance for cane yield and physiological traits in both irrigated and drought conditions.

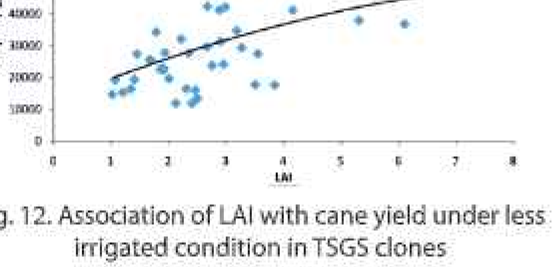


Fig. 12. Association of LAI with cane yield under less irrigated condition in TSGS clones

(A. Anna Durai, A.J. Prabakaran, H.K. Mahadeva Swamy, R.T. Maruthi, K. Mohanraj, Kona Praveen, R. Selvakumar, V. Jayakumar, M. Nisha and R. Arun Kumar)

Developing trait specific genetic stocks with *Erianthus* genetic base

Screening of BC_3 progenies involving Erianthus procerus: Out of 577 BC_3 progenies derived from 28 BC_3 crosses involving *E. procerus* evaluated for NMC, cane diameter and HR Brix at the 11 months, 219 clones recorded HR Brix values above 20.0%, 189 clones recorded more than 10 millable canes and 88 clones exhibited cane diameter greater than 3.0 cm. Based on the combined performance of these traits, 134 clones were selected. Of these, 98 clones were advanced to clonal trial, while 36 clones were planted in a drought screening trial to assess their drought tolerance potential.

Evaluation of BC_2 and BC_3 progenies for water deficit stress: Twelve BC_2 and 22 BC_3 progenies involving *E. procerus* were evaluated under water deficit stress in a split-plot design. At 10 months, cane yield was significantly reduced under drought stress, with a mean reduction of 41.31% in the backcross hybrids, compared to a 50.77% reduction observed in commercial varieties. The mean sucrose content of BC_3 hybrids under drought was 16.94%, and ranging from 14.51% (GU 22-190) to 19.49% (GU 22-150), with an average reduction of 13.91% under stress conditions. Cane diameter and juice purity were the least affected traits, showing reductions of 5.70% and 1.68%, respectively. Based on superior cane yield performance under drought stress, four BC_2 clones GU 22-70, GU 22-73, GU 22-93, and GU 22-110 were identified as drought-tolerant.

Evaluation of 11 BC_2 and 36 BC_3 hybrids involving *E. procerus* under drought condition for tillers at 90, 120, and 180 DAP and number of shoots at 240 DAP. *E. procerus*-introgressed clones exhibited a stronger ability to maintain higher tiller conversion efficiency (TCE) under drought stress compared to commercial checks. Thirteen clones recorded higher TCE than the check variety Co 06022. The superior tiller conversion efficiency of these clones under water-limited condition indicates a strong capacity to convert early tillers into established shoots, a key determinant of final cane population and yield under drought stress.

(K. Mohanraj, A. Suganya, H.K. Mahadevaswamy, V. Jayakumar and R. Gopi)

Improvement of elite interspecific hybrids derived from different cytotypes of *S. spontaneum* through nobilisation with typical clones of *S. officinarum* (2n=80)

Hybridization and evaluation of ground nursery and elite hybrids: Fifty biparental crosses were effected using *in vitro* reinvigorated plants of IND 04-1377 and IJ 76-314 and typical clones of *S. officinarum* (Laukona, Aweola 68, Unkown 3, Keong, Vespertina, IJ 76-314)/ Co canes/ elite hybrids/ genetic stocks at Coimbatore and Agali.

In 104 seedlings from 12 crosses involving TC plants and elite hybrids evaluated in ground nursery at 12 months, HR brix ranged from 16.20 to 20.60% with a mean of 17.40%. Mean NMC /seedling was 12.0 with a range of 9.0–18.0 plants. Cane height varied from 2.0–3.4m with a mean of 2.45m. Mean cane thickness was 2.3 cm and it ranged from 1.7–3.4 cm. The hybrids derived from IND 04-1337 TC x Co 86032 had shown high variation for cane color (white-reddish purple), cane thickness (1.2- 2.3 cm), cane height (130- 250 cm) and NMC (1.0-28.0). HR brix ranged from 14.40- 20.40% with a mean of 16.20%.

At 12 months, 23 hybrids had sucrose % 14.16-19.0 while in the checks it was 19.60 (Co 86032) and 20.20 (Co 11015). The *Erianthus* involved backcross hybrid [IK 76-99 x (Co 86032 x 04-774)-35] had sucrose of 17.53% at 12 month (Table 8).

Cytological studies in 30 hybrids indicated 2n= 85-144. Two hybrids from the GC of IJ 76-314 - TC-3 exhibited 2n+n transmission (Fig. 13). Twenty-eight seedlings from three crosses involving TC plants of IND 03-1377, IJ 76-314 and the genetic

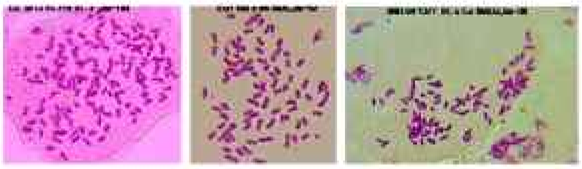


Fig. 13. 2n+n transmission in the interspecific hybrids

Table 8. Mean sucrose per cent of individual hybrids

Cytotype 2n	Hybrid / Cross	Sucrose (%)
80	BC Co 86249 x BC 06-391-444	19.18
40	[MS 6847 x BC 04-2065] X Co 8811-23	17.16
80	ISH 100 x BC 06-391-504	17.82
40, 56	ISH 100 x [(Co 98008 x AS 04-1901) + AS 04-1687] -1	16.19
80	BC Co 86249 x BC 06-391-442	16.35
40, 56	ISH 100 x (Co 98008 x AS 04-1901) + AS 04-1687]-2	16.85
40, 56	(Co 98008 x AS 04-1901) x AS 04-1687	18.13
80 EA	17-1- IK 76-99 x BC 774-35	17.53
	Co 11015	20.20
	Co 86032	19.60

stock AS 04-1687 were analyzed for molecular polymorphism with 12 SSR primers. The total fragments generated ranged from 129 - 163 / cross. Polymorphism ranged from 49.61- 75.60%. The hybrids of IND 04-1377 x Co 0233 exhibited 49.6% polymorphism while the plants derived from general collections of IJ 76-314 TC-3 had shown 50.70 percentage of polymorphism. Hybridity of *Erianthus* involved back cross hybrids were confirmed with 25 SSR markers. A total of 237 fragments have been generated, of which 61 *Erianthus*-specific markers have been identified in the hybrids.

(A. Suganya, A. Selvi, R.T. Maruthi and K. Elayaraja)

Targeted pre-breeding with different cytotypes of *Saccharum spontaneum* L. characterized for abiotic stress tolerance

Phenotypic and agronomic evaluation of F1 sugarcane hybrids: To broaden the genetic base of sugarcane, 60 parental crosses were generated using *S. spontaneum* cytotypes as female parents and high-sucrose commercial cultivars as male parents, producing 313 F_1 clones. After two cycles of clonal evaluation (each 3m row length), the progenies were assessed for key agronomic and quality traits (Fig. 14). The clone SS 2021-304 (IND 03-1224 × Co 11015) recorded the highest cane yield of 72.9 kg/row, HR Brix 20% and SCW 1.35 kg combining high biomass and sucrose content. SS 2021-306 showed the highest HR Brix (21%) and SS 2021-378, SS 2021-395, and SS 2021-427 achieved yields above 64 kg/row. The clone SS 2020-305 had the maximum NMC (111/row). High HR Brix % were also recorded in SS 2021-506 (20%) and SS 2021-491 (19.6%). Clones such as SS 2021-445 and SS 2021-373 exhibited SCW > 1.2 kg, while SS 2020-338 recorded the longest internode (18.67 cm). HR brix ranged from 6-21% across the F_1 population.

a. SS 2020-338 (Long Internode) b. SS 2021-306 (High HR Brix%) c. SS 2021 - 304 (High cane yield)

Fig 14. Superior clones identified for different traits

Cluster analysis: The circular heatmap combined with hierarchical clustering clearly differentiates the F1 hybrids into three major clusters based on their phenotypic profiles (Fig. 15). Distinct colour patterns across the heatmap indicated considerable variation among traits with each cluster showing characteristic trait expression. This visualization highlights strong phenotypic diversity within the population and effectively groups genotypes with similar performance patterns. The cluster I comprised 80 clones while cluster III had 58 clones. The predominance of clones in Cluster II with 194 clones highlights the significant genetic variability introduced through *S. spontaneum*, offering opportunities for targeted breeding and trait-specific improvement. Based

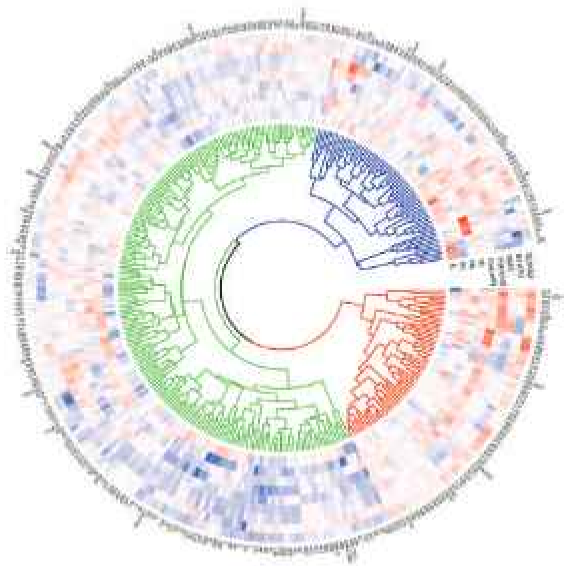


Fig. 15. Circular heatmap combined with hierarchical clustering of F1 hybrids

on overall performance, 30 elite clones have been advanced for multi-location trials at ICAR-SBI, Coimbatore and ICAR-SBIRC, Agali to validate stability across environments.

Cytogenetic evaluation of F1 hybrids: Somatic chromosome number of 32 F_1 hybrids from *S. spontaneum* x Co canes (developed in 2020) determined through root tip mitosis ranged from 2n=80-90 showed n+n transmission (Fig. 16). All the clones were confirmed for its hybridity. Twenty F1 clones from the hybridization done in 2021 showed somatic chromosome number (2n) ranging from 2n=80-92 (n+n transmission). Hybridity of these clones were confirmed.

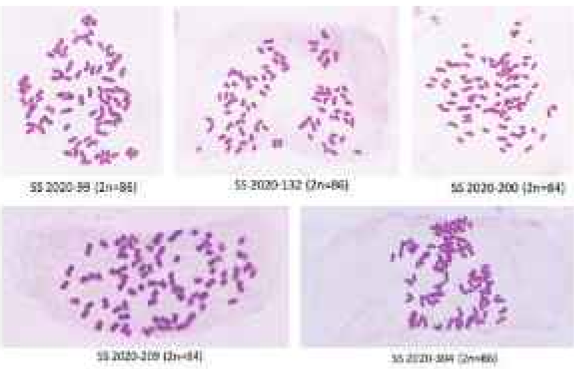


Fig. 16. Confirmation of F_1s for hybridity

(S. Sheelamary, S. Karthigeyan and V.P. Sobhakumari)

Identification of multi-ratooning potential of selected interspecific and intergeneric hybrids of *Saccharum* spp.

Forty-two diverse interspecific and intergeneric hybrid clones along with standards were assessed for the tillering, cane yield and quality traits. Their performance compared in third ratoon crop indicated that, *S. spontaneum* derived hybrids recorded the maximum number of stalk with 162.70 ('000/ha) followed by CYM/IGH clones 141.49 ('000/ha) and *S. barberi/sinense* hybrids (134.04 '000/ha) in comparison to commercial clone Co 86032 (78.52 '000/ha). The conversion of tillers into stalk number was estimated at harvest and observed that *S. robustum* clones had the highest conversion of 82.73 % followed by PIO/PIR clones (81.46%) and *S. officinarum* clones (78.80%) in comparison to standard Co 86032 with 72.69%. Cane yield (t/ha) at harvest was maximum in CYM/IGH involved hybrids followed by *S. robustum* hybrids and *S. spontaneum* hybrids in comparison with the standard Co 86032. The improved germplasm clones, PIO/PIR hybrids showed the maximum sucrose % (19.26%) at harvest followed by *S. robustum* clones (19.17%) and *S. officinarum* hybrid clones (19.05%) in comparison with Co 86032 (19.10%). Among the different clones, ISH 526 (20.67%) was identified with high sucrose % followed by ISH 131 (20.48%), ISH 530 (20.44%) and ISH 100 (20.07%). Overall, the ratoon performance indicated that three hybrids *viz.*, ISH 100, ISH 28 and CYM 14-298 with high cane yield, high sucrose % and field tolerance to red rot were identified with multiratooning potential for utilizing in commercial breeding programmes.

(K. Elayaraja and R. Gomathi)

Cryopreservation of sugarcane genetic resources for long term storage and future utilization

Anatomy of cryopreserved cells: Histological examination of meristem-derived axillary buds (MDAB) revealed progressive structural alterations following encapsulation–dehydration and liquid nitrogen (LN) exposure compared to control. In control MDABs, a well-organized and uninterrupted single-layered epidermis, 2–3 layered parenchymatous hypodermis, and distinct vascular bundles with intact xylem elements were observed, along with an active side-shoot apical meristem showing viable apical dome and leaf primordia. In contrast, LN-treated MDABs exhibited time-dependent cellular damage following thawing, beginning with rupture of the epidermis, shrinkage of hypodermal parenchyma, and variation or collapse of vascular bundles. Shortly after LN exposure and thawing, some tissues retained meristematic activity; however, with increasing post-thaw culture duration,

a. Figure on the left (L.S.) shows the side-shoot apical meristem of control (Dm). b. C.S. of MDAB which is treated in LN for 7 days and 14 days after thawed 14 days after post-thaw culture, the MDAB C.S. c. C.S. of MDAB which is treated in LN for 21 days and 14 days after thawed Red arrows show the browning of cells

Fig. 17. Co 11015 – Histological study of meristem derived axillary buds

progressive degeneration became evident, including reduced cellular size, disrupted cortical organization, browning of epidermal and hypodermal cells, and complete disorganization of vascular bundles. Longitudinal sections further revealed a gradual loss of meristematic activity, marked by browning of the apical dome and disruption of leaf primordia. Prolonged LN exposure and extended post-thaw culture resulted in severe tissue necrosis, membrane damage, and extensive cellular collapse, indicating cumulative cryo-induced injury and loss of structural integrity in MDABs (Fig. 17). Seeds, pollen and axillary meristem could be stored to a maximum of 614, 392 and 585 days under cryopreservation, respectively.

(C. Jayabose, R. Valarmathi and D. Neelamathi)

Development of core collection of wild sugarcane (*S. spontaneum* L.)

Morphological and molecular characterization: A total of 1756 accessions of *S. spontaneum* representing a wide range of geographical and genetic diversity have been catalogued. A core collection of 162 accessions has been developed, representing the phenotypic diversity present in the larger set using Corehunter R package. Molecular characterization was completed for IND-81 to IND-21 series using markers.

(S. Sheelamary, S. Karthigeyan, C. Jayabose, T. Lakshmi Pathy and M. Nisha)

Population improvement and development of sugarcane genetic stocks for high sugar accumulation potential for sub-tropical India

Sixteen bi-parental crosses involving high sucrose parents were effected in addition to six selfs and 15 general collections made during 2024 flowering season. Crosses involving the clones, CP 62-23, CP 94-1430, S.O Hybrid, IG 91-100, PIO 00-581, PIO 98-295 and PIO-00-547 with commercial varieties were attempted at Agali in 2024. The fluff from the crosses involving *S. officinarum*/PIO clones from previous seasons gave comparatively less germination. The crosses from NHG, Coimbatore (2023 season) involving the high sugar genotype LG 14564 exhibited good germination. These crosses gave a high proportion of stools with HR Brix values >20%.

(A. Anna Durai, R.T. Maruthi; M. Swapna, Sanjeev Kumar ICAR-ISRI, Lucknow)

Molecular cytogenetic and agronomic characterization of introgressed lines of *Erianthus* x *Saccharum*

GISH analysis was done in the following BC_2 and BC_3 clones of *Erianthus procerus* x *S. officinarum*. GU 19-237 (17E), GU 19-169 (10E), GU 19-254 (14E), GU 19-27 (9E), GU 19-288 (8E), GU 19-506 (10E) and GU 22-110 (8E) (Fig. 18). In BC_2 clones 8-10 *Erianthus* clones observed during GISH analysis. One BC_2 clone and one BC_3 clones showed 2n+n chromosome segregation (GU19-237 and GU22-110 respectively). Somatic chromosome number of these clones determined through root tip mitosis in BC_2 clones ranged from 2n=88-134 whereas for BC_3 clones the range was 2n=94-108.

Data on agronomical characters of five BC_2 clones and two BC_3 clones was collected in control and drought condition at 10 months along with the standard, Co 86032. The presence of *Erianthus* genome has been confirmed in all these clones through GISH. BC_2 and BC_3 clones performed better than standard variety Co 86032 under control condition. Back cross progenies showed better cane height, diameter and single cane weight than Co 86032 in drought condition whereas for brix%, none of the clones was better. The single cane weight ranged from 1.18 kg (GU 19-506) to 1.74 kg (GU 19-169) in control. Out of seven clones subjected to GISH study, three BC_2 clones were resistant to red rot for CF 06 inoculum.

Double hybridization was performed in the GISH slide of a BC_4 clone of *E. arundinaceus* x *S. spontaneum* namely GI 18-2 (2n=109) (Fig. 19). During the first hybridization, GISH has been done with labelled probe of *Erianthus*. Two chromosomes of *Erianthus* were observed in this clone. GISH was performed with the same slide with differentially labelled genomic DNA from *S. officinarum* and *S. spontaneum* to identify the specific origin of the chromosomes. It was found that 63.5% of the genome of this hybrid was composed of *S. officinarum*, 21.5% of *S. spontaneum*, 10.75% recombinant chromosomes, 1.8% *Erianthus* chromosomes and around 2.45% of the genome was having unknown component.

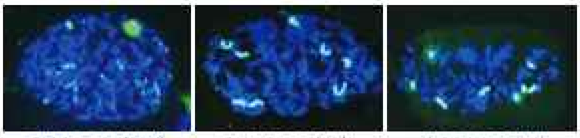


Fig. 18. GISH analysis of BC_2 and BC_3 clones of *Erianthus procerus* x *S. officinarum*

Fig. 19. Double hybridization in BC_4 clone of *E. arundinaceus* (GI 18-2)

(V.P. Sobhakumari and K. Mohanraj)

Sugarcane genomics and molecular markers

Isolation and characterization of genes associated with high Water Use Efficiency (WUE) in sugarcane cultivars

Twelve genes that are directly involved in WUE of plants *viz.*, two genes (ERECTA, EPF1) that control stomatal density, six genes (OST1, KAT1 GORK, HAB1, ABI1, HT1) on stomatal movements, three genes (CER1, SHN1, NCED1) involved in cuticular wax thickness and one gene (MYB96) that control water uptake in plants were studied. The above genes and the translated protein sequences were retrieved from *Arabidopsis*, *Sorghum* and rice and blasted against the polyploid genome sequences of sugarcane R570. Genome wide analysis of 13 EPF/EPFL-ERECTA/TMM/SERK in three *Saccharum sp* (*S. officinarum* LA-Purple, *Saccharum* hybrid cultivar R570, *S. spontaneum* Npx and one

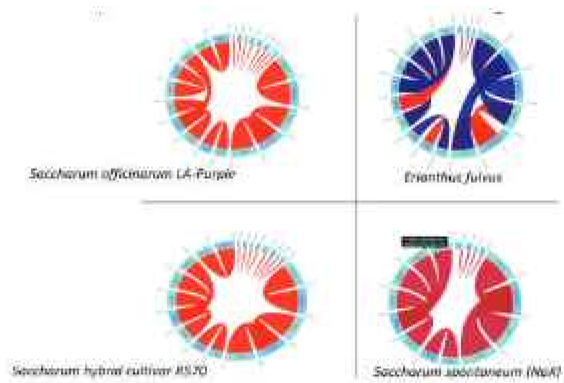


Fig. 20. Protein homology of *Arabidopsis* EPF/EPFL, ERECTA, TMM and SERK family members with *Saccharum* and *Erianthus genomes* - Distribution of SERK homologs of four sugarcane species

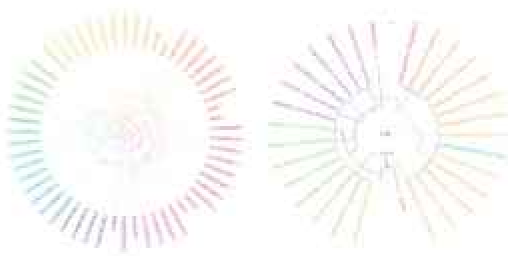


Fig. 21. Phylogenetic tree (MEGA) for *Arabidopsis* SERK proteins with *S. spontaneum* (Left) and *E. fulvus* (Right)

Erianthus sp (*E. fulvus*) was carried out to understand their evolution (Fig. 20). The phylogenetic tree for SERK proteins with *Erianthus* (Fig. 21) demonstrates that *Erianthus* possesses SERK-like proteins that are evolutionarily conserved with *Arabidopsis* SERKs. The distribution across multiple SERK subclades suggests that *Erianthus* has a diverse RLK gene family, possibly due to gene duplication events and adaptation to its environment. The *Erianthus* proteins (Eru) are distributed across these clades, confirming they are homologs (orthologs/ paralogs) of SERKs. This implies that *Erianthus* shares conserved signalling pathways with *Arabidopsis*, but also shows evidence of gene family expansion and functional diversification.

(K. Deva Kumar, P.T. Prathima and M. Alagupalamuthirsolai)

Identification of functionally relevant SSRs and SNPs from drought and oxidative stress responsive transcriptomes of sugarcane and functional validation of key genes for stress tolerance

Cloning and sequencing of drought candidate Cytochrome P450: The drought tolerant sample of Co 06022 was used for cloning the conserved regions of Cytochrome P450 gene. Partial gene sequences retrieved from the transcriptome data was used for primer designing. Amplification of the cDNA using gene specific primers resulted in an amplicon size of 1.5kb, was cloned and sequenced. The isolated sequence was found to be unique with respect to domain distribution and domain position in the protein sequences when compared with *Sorghum* and *Zea mays* and other *Saccharum* cultivars.

Plant transformation vector construction with Cytochrome P450: Integrity of cloned plasmid pJET1.2 carrying the cytochrome P450 insert (~4.3 kb) was checked. Restriction digestion using BamHI and XbaI enzymes, validated the absence of internal restriction sites, ensuring suitability for cloning. The digested and eluted product was ligated into a binary vector and transformed into *E. coli* DH5α host cells. Screening of the transformants by colony PCR with gene-specific primers, yielded positive amplicons (~500 bp) from several colonies. Plasmid PCR also confirmed the presence of the cytochrome insert in all selected transformants. Leaf samples have been inoculated for callus induction for further transformation with the developed constructs.

Isolating conserved region of glycosyl transferase drought candidate gene in sugarcane: Leaf samples of 3-month-old plants of the drought-tolerant sugarcane clone Co 06022 subjected to 10 days of drought was used for isolating the gene. The conserved domain of the glycosyltransferase gene was identified, forward 5'-ATGGCGGGG CTTCACTTCTTGCT-3' and reverse 5'- TTACTGCC GTCTGCCGAGCA-3' primers targeting the specific gene were designed and used for the amplification of the gene. The amplified PCR product of 1.5kb obtained was cloned in pJET1.2 cloning vector and sequenced. The sequence analysis confirmed the presence of glycosyltransferase gene (Fig. 22). The cloned sequence queried against the Sugarcane Genome

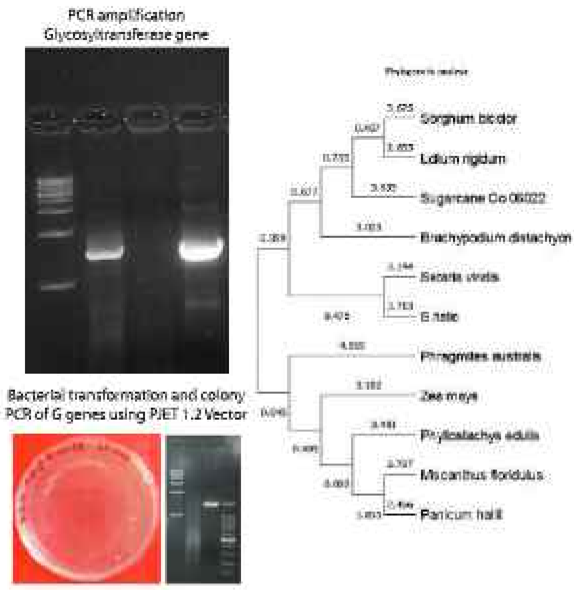


Fig. 22. Cloning and characterization of the drought candidate glycosyltransferase gene

Hub, resulted in a positive match with a sugarcane glycosyltransferase gene located on chromosome 2B (Chr2B). Three conserved motifs Glyco_transf_43, GlcAT-I, and PLN02458 were identified in the glycosyltransferase gene of Co 06022.

(A. Selvi, R. Manimekalai, P.T. Prathima, K. Lakshmi and K. Devakumar)

Development of affordable genomic selection tools for sucrose content and red rot and genomic prediction models for yield in sugarcane

Genome-wide association study (GWAS) was performed using 499 sugarcane genotypes from four biparental and diverse populations using the Axiom Sugarcane 100K SNP array. Broad-sense heritability ranged from moderate to high across sucrose traits, and BLUPs were estimated for GWAS. Heritability was measured for yield and juice quality traits. GLM and MLM models in TASSEL identified several significant marker-trait associations (Fig. 23). Notably, markers on chromosomes homologous to *Sorghum* chromosomes 1, 3, and 6 were consistently associated with cane yield, brix and NMC.

Candidate genes near significant SNPs included those involved in sucrose metabolism and stress

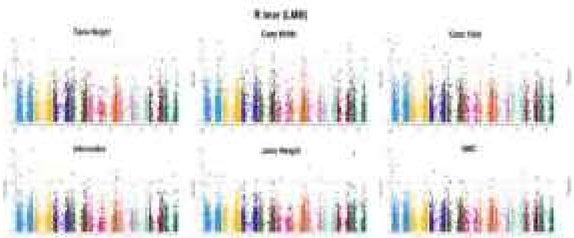


Fig. 23. Significant QTLs identified for yield traits in sugarcane

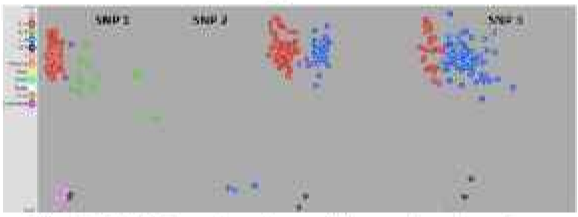


Fig. 24. KASP marker-based clustering showing biallelic clustering for SNP 1

responses. KASP assay was done for the significant SNPs identified for red rot resistance (Fig. 24) showing bialleic type of clustering for SNP 98 marker.

Screening for red rot resistance: Among the 78 clones along with two susceptible checks screened for red rot resistance under field condition by plug method of inoculation with CF 06 pathotype, 11 were R, 51 were MR, 13 were MS, two were S and one was HS to red rot.

(R. Manimekalai, V. Jayakumar, K. Mohanraj, M.R. Meena, P.T. Prathima and H.K. Mahadeva Swamy)

Deep sequencing of suppression subtractive libraries for prospecting differentially expressed genes/Transcription factors from the sugarcane hybrids exposed to drought and salinity stress

Drought experiment: Suppression subtractive hybridisation was used to identify upregulated transcripts during water deficit conditions in AS-04-1687 and TS-GS 20-24. A total of 452 and 625 differentially expressed fragments were identified in AS-04-1967 and TSGS 20-24, respectively after subtraction. Most of the transcripts upregulated during drought stress were involved in signal transduction pathways such as MAPK signalling pathway, calcium signalling pathway, cAMP signalling pathway and phosphatidylinositol pathway, suggesting the possibility of activation of drought-responsive genes. Few transcripts were involved in metabolic pathways to maintain the energy balance and protection of cellular components by the synthesis of osmo-protectants and defense-related compounds.

Anatomical studies of drought exposed genotypes: Compilation of root anatomical data revealed that the transverse section of root was slightly round/ round- oval in drought tolerant AS 04-1687, while it was round shaped in drought sensitive clone Co 775 (Fig. 25). Structural differences include higher root hair frequency, curvy root hairs, number of

Fig. 25. Root anatomy and its changes in AS 04-1687 and Co 775 under drought conditions

sclerenchyma layers, and reduced cortical profile with higher stele area. The aerenchyma of AS 04-1687 was narrower while it was wider in Co 775 in which most of the cortical profile disintegrated under drought condition. Anatomical modifications showed cell wall lignification around the metaxylem and reduction in metaxylem diameter elements.

Salinity experiment: Seven genotypes were grown in microplot under normal and saline environmental conditions (saline water treatment with an EC of 8dS/m). Total RNA was isolated form these seven genotypes (14 samples including control and treatment), converted into cDNA and used as template for expression analysis. TS-GS 20-24 and Co 94012 showed strong upregulation of stress-related genes, indicating that they were adequately responding to salinity. Based on the results of the expression analysis, isolated and cloned a salinity stress induced transcription factor LIM (Lin11, Isl1, and Mec3) (Fig. 26).

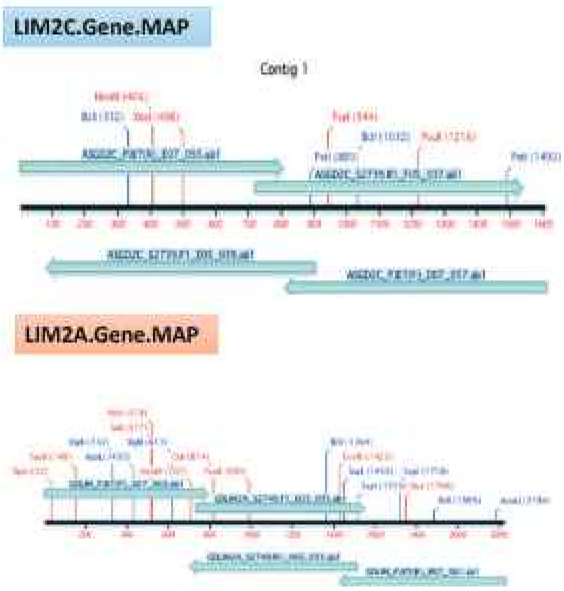


Fig. 26. Cloning and characterization of LIM transcription factor from sugarcane interspecific hybrids

(K. Lakshmi, A. Selvi, R. Gomathi, A. Suganya, K. Deva Kumar, S. Sheelamary and Pooja)

Genome wide identification, characterization and comparative genome analyses of SWEET genes regulating sucrose accumulation in sugarcane

Screening for the edited plants: CRISPR/Cas9-edited sugarcane plants targeting SWEET13c, SWEET4a, and SWEET3a were successfully regenerated. Genomic DNA was isolated from all the hardened plants, and PCR screening using Cas9 and hygromycin-specific primers confirmed the presence of both transgene components through clear amplification bands (Fig. 27). Further validation of editing events was performed on selected Cas9- and Hygromycin-positive plants. Twenty-two SWEET13c-2 plants and 17 SWEET4a-2 plants were amplified using target gene-specific primers and subjected to Sanger sequencing. ICE-CRISPR analysis, (Inference of CRISPR Edits analysis tool) was used to analyse CRISPR editing results from Sanger sequencing data (Fig. 28). It calculates editing efficiency by determining the frequency and types of insertions and deletions (indels) in a sample. This analysis revealed that one SWEET13c-2 plant showed 11% indel frequency, while six

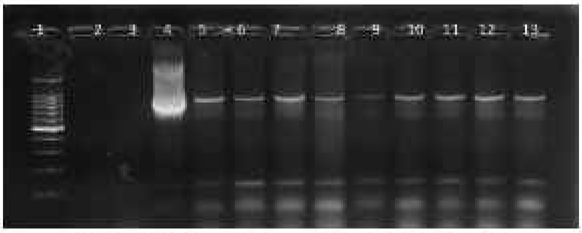


Fig. 27. PCR positive lines for Cas 9 gene; Lanes: 100 bp ladder; No template control; untransformed Control; Positive Control; Samples 5-13

Fig. 28. ICE-CRISPR analysis of an edited SWEET gene sequence

SWEET4a-2 plants showed indel frequencies ranging from 1–3%, indicating low-level but detectable editing events in the regenerated plants.

(P.T. Prathima, A. Selvi, R. Manimekalai, K. Lakshmi and K. Thamilarasi)

Metabolic engineering of sugarcane for enhanced accumulation of low-calorie

Characterization of D-Allulose epimerase enzyme: D-Allulose epimerase gene (ALSE 1 & 2) was cloned from bacterial sources and heterologous expression of the protein was performed in BL21DE3 Plyss host cells. The isolated protein was checked for enzymatic activity and purified. The solubilized fractions of *E. coli* BL21 (DE3) harboring pET28a + DAEase were pooled and purified to homogeneity under denaturing conditions by Immobilized Metal Affinity Chromatography. The bound enzyme was eluted by a gradient of imidazole. The eluted enzyme checked by SDS-PAGE with a 15% precast polyacrylamide gel to determine the purity of the protein. The purified protein was checked for enzymatic conversion of fructose and glucose into allulose, using standards and sugarcane juice as substrates (Fig. 29).

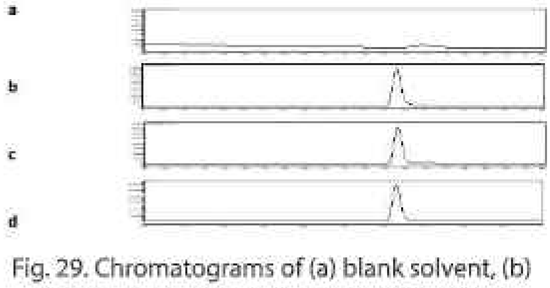


Fig. 29. Chromatograms of (a) blank solvent, (b) standard in water (c) ALSE 1 and (d) ALSE 2

(P.T. Prathima, K. Lakshmi, A. Selvi, R. Manimekalai and V. Krishnapriya)

Development of database and algorithm for designing gRNAs for sugarcane

A total of 500 PP2C genes were identified, distributed across all 10 chromosomes and their sub-genomes. Phylogenetic analysis classified these genes into 13 subfamilies. The results showed similarity to *S. spontaneum*, where the largest subfamily is F with 37 members, the largest subfamily in the sugarcane hybrid cultivar was also F, with 74 members, followed by subfamily A with 69 members. The exon and motif distribution were found to be highly conserved within the same subfamily. Tandem duplication was prominent, with 107 genes identified as paralogs, indicating their role in gene expansion. The chromosomal distribution of SoffiXPP2C genes was partially biased, as approximately 50% of the genes were located on chromosomes 1, 2, and 3, along with their respective sub-genomes. Synteny analysis revealed a strong conservation of the protein phosphatase domain between modern hybrid and wild sugarcane (*S. spontaneum*) (Fig. 30). Additionally, the synteny association of SoffiXPP2C genes with two potential cold stress-responsive genes, SsPP2C27 and SsPP2C64,

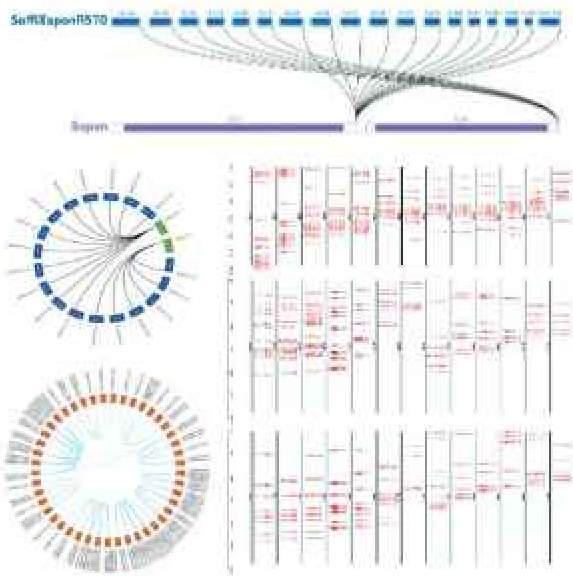


Fig. 30. Comparative analysis of genome wide Protein Phosphatase 2c (pp2c) gene in cultivated sugarcane and distant relatives

suggests a possible role of SoffiXPP2C genes in abiotic stress regulation.

(R. Manimekalai, A. Selvi, K. Lakshmi, P.T. Prathima, K. Nithya, Shweta Kumari, K. Deva Kumar and K. Thamilarasi)

Identification and functional characterization of GRAS transcription factor family of genes and their role in various abiotic stress responses in sugarcane

To characterize the GRAS superfamily, sorghum GRAS genes were BLASTed against the sugarcane monoploid genome, identifying 86 *Saccharum* hybrid (ShGRAS) genes (83 from the genome and 3 from contigs). All genes contained the conserved LHR1, VHIID, LHRII, PFYRE, and SAW domains. Based on protein domains, they were classified into 10 subfamilies; 46 belonged to the LISCL subfamily, while only one gene each represented the SCR, HAM, SCL4/7, and DLT subfamilies. Phylogenetic analysis grouped the sequences into 13 clades, consistent with subfamily classification. Of the 86 ShGRAS genes, 81 showed similarity to sorghum GRAS, 31 to *Arabidopsis* GRAS, and 50 to rice GRAS.

(K. Deva Kumar, K. Lakshmi and M. Alagupalamuthirsolai)

A proteomic approach for identification and characterization of new ligninolytic enzymes for improved sugarcane bagasse delignification

Thermophilic microbes were isolated from a sugarcane compost pit and screened for ligninolytic activity as determined by laccase activity assay. Among the microbes screened four isolates (S1, S3, S8 and S10) which had maximum laccase enzyme production at 46°C were identified. Proteomics analysis was conducted for these isolates as two groups and 1447 peptides were identified. The key proteins identified were extracellular xylanases 26.3 and 27 kDa (xyl I); 7.7 and 17.7 kDa (xyl II), hemicellulases, and pectinases. Few cellulases, glucan endo-1,3-β-glucosidase were observed from the isolate S1. These enzymes were associated with several pathways related to the degradation of lignin. Among them, starch and sucrose metabolism, pentose phosphate pathway, glutathione metabolism, and the ortho-cleavage pathway of aromatic rings which were closely related to lignin degradation were identified. Additionally, the full-length laccase gene (1.8 kb) from *Aspergillus* sp. which can be utilized for biomass modification was cloned.

(K. Lakshmi and P.T. Prathima)

Unravelling the molecular mechanism of sugarcane for hypoxia caused by waterlogging

Waterlogging-susceptible clone Co 86032 and waterlogging-tolerant clones Co 62175, BO 91 and Co 8371 were grown under pot conditions. Waterlogging stress was imposed on potted plants at six months for a period of four weeks. The tolerant clone Co 62175 showed a significant increase in shoot and root length, number of aerial root and length of the aerial roots under waterlogged conditions compared to the susceptible variety Co 86032.

Cloning of genes: Primers were designed for cloning the putative waterlogging tolerant genes *viz.*, pyruvate decarboxylase (*pd*), lactate dehydrogenase (*ld*), 1-aminocyclopropane-1-carboxylic acid synthase (*accs*), 1-aminocyclopropane-1-carboxylic acid oxidase (*acco*), ethylene responsive transcription factor (*erf*), aldehyde dehydrogenase (*aldd*), alcohol dehydrogenase (*alcd*) and G-box binding factor (*gbf*) from the already available transcriptome data of sugarcane varieties. Among the genes targeted for cloning, the complete CDS of *erf* (1081 bp) from the waterlogging-tolerant variety Co 8371 and *acco* (1075 bp) from Co 11015 were successfully obtained. Partial CDS sequences were obtained for *pd* (523 bp) and *ld* (784 bp) from Co 86032 and Co 11015 and *alcd* (725 bp) from Co 8371.

Synteny analysis: Synteny analysis of sugarcane hybrid R-570, *Saccharum officinarum* and other cereals such as rice, wheat, barley, maize and sorghum was carried out to identify the heterologous genes tolerant to waterlogging. Total number of all the genes obtained in the analysis was 7,74,371, collinear genes obtained was 5,32,355 (68.75%). Fifteen waterlogging genes reported from other cereals, mainly belonging to *erf-vii* subfamily were used to find the heterologous genes in the assembly. 273 genes were found to match with the selected waterlogging tolerant genes of cereals. These genes formed 13 syntenic network and it comprises 104 genes from sugarcane hybrid R570.

(K. Thamilarasi, A. Selvi, R. Manimekalai, P.T. Prathima and R. Gomathi)

Harnessing comparative genomics and bioinformatics tools for abiotic stress tolerance in sugarcane

Sixty-seven drought-tolerant genes from major crops including *Arabidopsis*, rice, wheat, maize, sorghum, soybean, and *Brassica napus* were collected and a BLAST analysis against the genomes of sugarcane cultivar R570 and its wild progenitor *S. spontaneum* (AP85-441) have been performed. The analysis identified 56 potential ortholog genes in R570 and 49 in *S. spontaneum*. Orthologous and drought-tolerance genes formed common phylogenetic clusters, suggesting strong sequence conservation. Whole-genome synteny analysis between R570 and *S. spontaneum* revealed strong genomic collinearity. A large proportion of genes showed collinear relationships, with comparable numbers of tandem duplications in both genomes. Synteny-based analysis identified numerous drought-related orthologs forming conserved synteny pairs and networks in both species. Conserved domain analysis of identified ortholog gene revealed the presence of several drought-associated domains, including AP2, bZIP, WRKY, PP2C, GRAS, and NAM superfamilies, indicating their potential role in stress response regulation. Gene Ontology (GO) enrichment highlighted their involvement in critical abiotic stress responses, including response to water deprivation, abscisic acid, salicylic acid, jasmonic acid, and heat, as well as positive regulation of stress signaling pathways. Overall, these findings demonstrate the conservation and genomic organization of drought-responsive orthologs in sugarcane and its wild relative, providing valuable insights for functional genomics and marker-assisted breeding for enhanced drought tolerance.

(Shweta Kumari, R. Manimekalai, A. Selvi, K. Lakshmi and Vinayaka)

Gene discovery and genetic transformation in sugarcane

Deciphering the molecular mechanism regulating tillering in sugarcane through functional genomics approach

Quantitative analysis of the tiller node tissues from a high (Co 86032) and low tillering genotype (Co 99004) identified 2,867 significantly differentially abundant proteins. Significant enrichment of pathways involved in photosynthesis, carbohydrate metabolism, C-type lectin receptor signaling and linoleic acid metabolism with a significantly higher abundance of proteins was observed in Co 86032. A comparative transcriptome analyses of the tiller node tissues from Co 86032 and Co 99004 at 20, 30 and 40 days after planting identified ~44000 significant DEGs. At $\log_2$ differential expression between high and low tillering genotypes about 23000 to 24000 DEGs were identified. From both the data genes/proteins specifically involved in sugar transport, nitrogen metabolism, cell wall organization, cytokinin signaling, and kinases had significantly higher abundance while genes/proteins for strigolactone, auxin, abscisic acid, and gibberellic acid, involved in the negative regulation of tillering, showed significant lower abundance in tiller nodes of Co 86032 compared to Co 99004. Gene expression validation of selected candidate proteins (*ShMAX4*, *ShMAX3*, *ShTB1*, *ShSWEET1A* and *auxin efflux carrier protein*) was found to be consistent with the differential protein abundance quantified among the high and tillering sugarcane genotypes. Further from the transcriptome of the tiller node gene regulatory network analyses has identified hub genes regulating tillering in sugarcane.

(R. Valarmathi, C. Appunu and K. Mohanraj)

Development of white grub resistant transgenics in sugarcane

In order to develop transgenic sugarcane against white grub *Holotrichia serrata*, a novel crystal toxin gene cry8Sa1 was codon optimized for expression in sugarcane. Codon optimized cry8Sa1 gene was synthesized with appropriate restriction enzymes in both ends of gene for cloning in a binary vector pCAMBIA1305. Transformation vector was constructed and the resultant recombinant vector was used for genetic transformation of sugarcane variety Co 86032. Putative transformants are in different stages of selection and few of them are in regeneration stage.

(C. Appunu, B. Singaravelu, G.S. Suresha and P. Mahesh)

Multi-disciplinary projects Standardization of true seed production technique through developing homozygous parental lines and apomixes Inbreeding

Forty selfs were effected among the progeny of various selfing generations in 2024 flowering season. Majority of selfs were made among seventh and eighth generation selfs of Co 1148 (S_8) and S_4 generation clones of Co 775. Additionally, 12 crosses were made among selfed generations of Co 1148 and Co 775 for the evaluation of hybrids involving the inbreds. Approximately 500 advanced generation selfs were selected from the ground nursery and planted in the clonal stage for further evaluation. DNA was extracted from 46 advanced generation (S_7) inbreds of 1148-13-11-2-252-170-36 and fingerprinted with 12 STMS primer pairs. A total of 202 alleles were amplified. The selfs 1148-13-11-2-252-170-36-448 and 1148-13-11-2-252-170-36-458 had amplified least alleles and could be utilised for further selfing. S_7 progenies exhibited least number of classes for internode shape, sheath hairiness while higher variation was observed for internode colour and dewlap color.

(A. Anna Durai, T. Lakshmi Pathy and M. Nisha)

Evaluation of hybrids

Tropical (Coimbatore): Out of 1087 hybrid seedling progenies from 13 combinations of intermated inbreds evaluated for 13 cane yield and juice quality traits, Co 1148-S_8 x Co 1148-S_7 (S_8xS_7) recorded the least variability. Among the traits under observation, cane diameter (CV=3.12) had the least variability followed by HR brix, cane height, single cane weight. NMC per clump recorded the maximum variability in this population. Greenish yellow with grey tinge is the predominant stalk color group comprising 72.50% progenies while 27.50% progenies were characterized by yellow green colored stalk.

(R.M. Shanthi and S. Alarmelu)

All India Coordinated Research Project (Sugarcane)

Peninsular Zone

Advanced varietal Trial (Mean of two plant and ratoon trials-2023-25): Eleven entries were evaluated under AVT I plant during 2023-24 and II plant and ratoon during 2024-25 along with three standards (Table 9). Analysis of two plant and one ratoon data revealed that Co 18003 (21.03 t/ha), Co 18002 (20.99 t/ha), CoVC 18061 (20.95t/ha) and Co 18009 (20.20 t/ha) were found superior to the best standard Co 09004 (17.90 t/ha) for sugar yield. For cane yield also, CoVC 18061 (149.85 t/ha) Co 18002 (144.53 t/ha) and Co 18003 (141.97 t/ha) and Co 18009 (140.35 t/ha) were superior to the best standard Co 86032 (116.92 t/ha). None of the

Table 9. Pooled analysis of two plant and one ratoon trials (2023-2025)

Clone	CCS yield (t/ha)	Cane yield (t/ha)	CCS (%) (12m)	Sucrose (%) (12m)
Co 18001	15.77	115.07	13.62	19.48
Co 18002	20.99	144.53	14.54	20.71
Co 18003	21.03	141.97	14.84	21.16
Co 18009	20.20	140.35	14.39	20.58
Co 18012	15.24	110.65	13.79	19.82
Co 18013	17.67	120.45	14.58	20.87
Co 18024	13.14	98.06	13.43	19.32
CoVC 18061	20.95	149.85	14.01	20.06
CoN 18071	12.78	95.95	13.34	19.09
CoN 18072	16.80	128.74	13.00	18.61
CoVSI 18121	16.53	116.80	14.11	20.16
Standards				
Co 86032	16.22	116.92	13.88	19.84
CoC 671	16.70	109.19	15.33	21.88
Co 09004	17.90	116.66	15.35	21.89

test entries was superior to the best standard Co 09004 for juice quality (21.89% sucrose and 15.35% CCS). However, Co 18003 (21.16%), Co 18013 (20.87%), Co 18002 (20.71%), Co 18009 (20.58%), CoVSI 18121 (20.16%) and CoVC 18061 (20.06%) were superior to Co 86032 (19.84%) for juice sucrose at harvest.

AVT – II Plant (2024-25)

Among 11 test entries, Co 18003 recorded highest CCS yield of 21.48 t/ha followed by CoVC 18061 (21.02 t/ha), Co 18002 (19.77 t/ha) and Co 18009 (18.46 t/ha) which were 27.10%, 24.38%, 16.98% and 9.23% improvement respectively over the best standard CoC 671 (16.90 t/ha). For cane yield CoVC 18061 was the best entry with 155.3 t/ha against the best standard Co 86032 (111.6 t/ha). Other entries recording higher cane yield were Co 18003 (149.4 t/ha), Co 18002 (142. 1 t/ha) and Co 18009 (131.1 t/ha). Juice analysis at 12 months indicated that Co 18003 (20.47%) had the highest sucrose content among the test entries while the best standard CoC 671 recorded 21.79% sucrose. At 10 months, CoC 671 recorded the highest sucrose content (20.16%.) and none of the test entries was found superior to CoC 671. The test entries Co 18003 (19.69%), Co 18013 (19.46%), Co 18002 (19.01%) and Co 18012 (18.79%) were superior to Co 86032 (18.74%) at 300 days for juice sucrose content.

(K. Mohanraj and S. Sheelamary)

AVT-Ratoon (2024-25)

A total of 11 entries along with three standards were evaluated for their ratoon performance. Co 18002 recorded the highest CCS yield of 21.03 t/ha which was 17.03% improvement over the best standard Co 09004 (17.97 t/ha). Other entries superior to the best standard for CCS yield were CoVC 18061 (20.66 t/ha), Co 18003 (20.31 t/ha) and Co 18009 (20.00 t/ha). CoVC 18061 recorded the highest cane yield (138.54 t/ha) which was 19.76% improvement over the best standard Co 09004 (115.68 t/ha). This was closely followed by Co 18002 (137.56 t/ha) and Co 18009 (135.26 t/ha) and Co 18003 (131.32 t/ha) which were18.91%, 16.92% and 13.52% improvement, respectively over the best standard Co 09004. Among the standards, CoC 671 was the best recording high juice sucrose values of 22.57% and CCS of 15.90% while the mid-late standard Co 86032 recorded 20.17% sucrose and CCS of 14.23% at 11 months. Co 18013 was the best clone in this trial recording the highest juice sucrose value of 21.95% at 11 months with an improvement of 8.27% over the mid-late standard Co 86032.

(C. Appunu and R.T. Maruthi

AVT-I Plant (2024-25)

Among the fourteen test entries evaluated, Co 19009 recorded the highest CCS yield of 20.49 t/ha with 27.35% improvement over the best standards Co 09004 (16.09 t/ha) and CoC 671 (16.09 t/ha). Similarly, Co 19014 (18.38 t/ha) and CoT 18368 (18.21 t/ha) registered 14.23% and 13.18% improvement, respectively over the best standards. For cane yield, Co 19009 (144.29 t/ha) showed 22.55 % superiority over the best standard Co 86032 (117.74 t/ha) followed by CoT 18368 (141.74 t/ha) and Co 19014 (124.62 t/ha) showing 20.38% and 5.84% improved yield respectively over the best standard. For juice sucrose at 12 months, CoC 671 (21.78%) was the best standard and none of the test entries was superior to the standard. However, five entries *viz.*, Co 19009, (20.38%), Co 19014 (20.54%), CoT 19366 (19.88%), CoT 18366 (20.27%) and CoT 18369 (21.00%) recorded more than 5% improvement over the commercial variety Co 86032 (18.82%). At 10 months, none of the test entries was found superior to both the early standards Co 09004 (20.00 %) and CoC 671 (19.82%). Only one entry, Co 19014 (18.81%) registered more than 5% improvement over Co 86032 (17.88%) at 300 days.

(S. Alarmelu and R. Gobu)

IVT (2024-25)

Sixteen test entries were evaluated along with three standards. Co 21002 (18.41 t/ha) was the only entry showing 10% improvement over the commercial variety Co 86032 (16.54 t/ha) for CCS yield and numerically superior performance over the best standard Co 09004 (18.31 t/ha). Co 21002 (141.37 t/ha), Co 21004 (126.99 t/ha), CoM 21082 (126.87 t/ha), CoN 21072 (125.23 t/ha) and Co 21003 (122.51 t/ha) recorded higher cane yield over the best standard Co 09004 (121.63 t/ha). At 12^{th} month juice sucrose, none of the test entries was superior to the best standard CoC 671 (23.72%). Three test entries *viz.*, Co 21003 (22.31%), Co 21007 (22.46%) and Co 21009 (22.99%) were superior to Co 86032 (21.21%) registering more than five per cent improvement. At 300 days, CoC 671 was the best standard with 20.03% sucrose followed by Co 09004 with 19.92%. Two entries *viz.*, Co 21006 (19.08%) and Co 21009 (18.86%) were on par with Co 86032 (18.86%) for sucrose% at 10 months of crop age.

(Adhini S. Pazhany, H. K. Mahadevaswamy and V. Sreenivasa)

Exchange of seed materials 2024-25

Nine entries (Co 24001, Co 24002, Co 24003, Co 24004, Co 24005, Co 24009, Co 24010, Co 24011, Co 24012) that were accepted in the AICRP(S) workshop held at Punjab Agricultural University, Ludhiana in October 2024 were supplied to Padegaon centre. Twenty five Co canes of 23 series were multiplied and supplied to Mandya, Powarkheda, Pugalur, Rudrur, Sameerwadi, Sirugamani and Thiruvalla. Apart from these, 17 zonal entries of '22 series and 21 new entries of '24 series have been multiplied.

(R. Karuppaiyan and K. Elayaraja)

Targeted pre-breeding for development of climate smart genetic stocks utilizing untapped genetic resources in *Saccharum* complex

Twenty-six crosses for red rot resistance and 18 crosses for drought tolerance were effected. The fluff of 26 crosses effected for red rot resistance was sent to six centres *viz.*, Coimbatore, Cuddalore, Pune, Karnal, Pusa and Shahjahanpur. Similarly, fluff of 18 crosses effected for drought tolerance was sent to five participating centres *viz.*, Coimbatore, Mandya, Pune, Karnal and Lucknow. Altogether, 773.2 gram of fluff was sent to the eight centres including Coimbatore.

(P. Govindaraj, R.M. Shanthi, S. Alarmelu, A. Anna Durai, K. Mohanraj, R. Karuppaiyan, M. Nisha, H. K. Mahadevaswamy and R.T. Maruthi)

Fluff Supply / National Hybridization Programme

Fluff supply 2024: Fluff weighing 24.56 kg was supplied to the 22 fluff receiving centres along with germination potential. The centres in North West Zone received the maximum quantity of fluff (8.60 kg) followed by Peninsular zone (7.4 kg). The four centres in North Central and North East zone received (5.02 kg while four other centres in East Coast Zone received 3.5 kg of fluff of biparental crosses, general collections and polycrosses (Table 10).

National Hybridization Programme 2025: Four hundred and seventy parental clones were planted in NHG 2025-26 including five new introductions from Seorahi (CoSe 11453), Shahjahanpur (CoS 18231 and CoS 18232) and Anakapalle (2015 A 311 and 2017 A 553). Two poly-cross nurseries of 11 females and eight males for subtropical region and 13 females and eight males for tropical region were planted and maintained. Out of 470 parents, 377 flowered with flowering intensity of 80.21%. Four hundred and fifty-six crosses were effected for 21 centres.

(A. *Anna Durai and Adhini S. Pazhany)*

AICRP on Seed (Crops)-Sugarcane

Breeder seed production

A total of 1263.555 tons of quality breeder seed canes were produced and supplied to co-operative and private sugar factories [Co 86032 (804.495 tons), Co 11015 (121.955 tons), Co 14012 (83.65 tons) and Co 18009 (253.455 tons)] during February-August 2025. A field day was conducted in Sevur and Pasur village in Tiruppur district for the varieties Co 86032, Co 11015, Co 14012 and Co 18009 on 14 February 2025. A seed day programme was organized under AICRP on Seed (Crops) at ECC Farm involving the seed production farmers and scientists of the institute on 12 March 2025.

For the year 2025-26, tissue culture plants of Co 86032 (7500), Co 11015 (1450), Co 14012 (1500) and Co 18009 (1800) were planted in the Institute farm during October to December 2024 (Fig. 31). The materials were harvested during May-July 2025 and 2,00,260 settlings were produced and supplied to 10 farmers and planting has been completed in 32 acres.

Fig. 31. Seed Day (12 March 2025)

To produce the basic seed material for quality seed production for the next year (2026-27), tissue culture plants of the varieties Co 86032 (10,600), Co 11015 (2000), Co 14012 (1750), Co 18009 (2000) were planted during October-November 2025 in the Institute farm.

(A.J. Prabakaran, S. Karthigeyan, K. Mohanraj, A. Anna Durai, B. Singaravelu, R.Selvakumar and R. Gobu)

Production and supply of tissue culture plants

A total of 1.13 lakhs tissue culture plants were produced via apical meristem culture from the varieties *viz.,* Co 86032 Co 11015, Co 18009, Co 14012 Co 0238, Co 0118 and Co 15023 and provided to sugar mills, farmers and breeder seed

Table 10. Number of crosses effected and quantity of fluff supplied during 2024 flowering season

Centre	Biparental cross		General Collections		Polycrosses		Total quantity of fluff (g)
	No.	Fluff weight (g)	No.	Fluff weight (g)	No.	Fluff weight (g)	
Peninsular Zone							
Mandya	21	554.34	20	453.55	5	38.95	1046.84
Navsari	20	601.72	25	470.52	5	38.93	1111.17
Padegaon	19	620.15	15	282.99	5	38.43	941.57
Powarkheda	15	372.84	15	266.11	5	32.94	671.89
Pune	23	721.34	17	381.22	5	46.12	1148.68
Rudrur	18	440.68	20	426.26	5	36.7	903.64
Sankeshwar	20	532.9	20	335.08	5	44.43	912.41
Thiruvalla	15	350.3	15	304.35	5	48.37	703.02
Total	151	4194.27	147	2920.08	12*	324.87	7439.22
East Coast Zone							
Anakapalle	16	293.5	20	413.41	5	58.7	765.61
Cuddalore	29	854.94	15	268.73	5	45.2	1168.87
Perumalapalle	-	-	20	333.71	13	256.55	590.26
Vuyyuru	20	471.45	20	459.02	5	45.26	975.73
Total	65	1619.89	75	1474.87	12*	405.71	3500.47
North West Zone							
Gurdaspur	28	817.06	20	469.83	5	50.39	1337.28
Kapurthala	24	658.76	25	449.92	4	42.33	1151.01
Lucknow	38	986.16	59	1245.12		-	2231.28
Pantnagar	13	445.12	20	368.21	5	35.54	848.87
Shahjahanpur	35	1123.05	31	734.46	2	11.17	1868.68
Uchani	21	653.27	27	462.23	5	47.20	1162.7
Total	159	4683.42	182	3729.77	13*	186.63	8599.82
North Central and North East Zone							
Buralikson	16	450.39	20	398.313	5	50.645	899.348
Motipur	17	559.33	20	629.87	3	27.22	1216.42
Pusa	34	990.59	25	515.63	3	17.67	1523.89
Seorahi	28	820.82	27	537.26	4	24.31	1382.39
Total	95	2821.13	92	2081.073	9*	119.845	5022.048
Grand total	***470***	***13318.71***	***345***	***10205.79***	***25****	***1037.06***	***24561.56***

** Excluding duplicates*

production. Sixty virus free mother culture flasks of varieties Co 86032, Co 11015, Co 0238, Co 0118 and Co 15023 were given to five tissue culture laboratories of Tamil Nadu, Punjab, Karnataka and Uttar Pradesh. Varieties Co 86032 and Co 09004 were rejuvenated via meristem tip culture and disease-free tissue culture seedlings were planted in breeding trial at ECC farm. A four-days training on Sugarcane micropropagation was imparted to an Assistant Professor (Plant Breeding) from S. Nijalingappa Sugar Institute, Belagavi, Karnataka. Total revenue of Rs. 13.96 lakhs was generated through sale of tissue culture plants and mother culture flasks.

Virus indexing of in vitro *leaf samples: In vitro* cultures of varieties *viz.,* Co 86032, Co 18009 and Co 11015 developed from apical meristem culture were indexed for SCYLV, SCMV, SCSMV and GSD phytoplasma at pathology laboratory through RT-PCR and nearly 70% of the samples were found to be virus free.

(D. Neelamathi, R. Valarmathi, C. Jayabose and K. Nithya)

EXTERNALLY FUNDED PROJECTS

Identification, characterisation and verification of new sugarcane varieties for DUS testing at Coimbatore (PPV&FRA)

During 2024-25 crop season, 250 tropical RV's (Reference Varieties) of sugarcane were planted. Fifty-six example varieties representing 27 DUS traits were raised in the 2025-26 crop season. DUS tests were conducted in four varieties *viz.,* VSI 08005 (VSI 12121), Phule Sugarcane 13007 (MS 14082), Phule-11082 (CoM 11082) and Phule Sugarcane 15012 (MS 17082). First year DUS testing of two new varieties (NV's) - VSI 08005 (VSI 12121) along with closely resembling Reference Varieties (Co 8347, Co 94008, Co 62175) and Phule Sugarcane 13007 (MS 14082) along with closely resembling RV's (CoC 773, 93 V 297, CoM 0265) and zonal standards Co 86032 and CoC 671 was conducted. The candidate variety VSI 08005 (VSI 12121) (NV) was distinct from the RV's (Co 94008 and Co 62175) for DUS traits *viz.*, hairiness, shape of inner auricle, colour not exposed to sun and it was distinct from RV Co 8347 for internode shape, rind surface appearance and waxiness. The candidate variety Phule Sugarcane 13007 (MS 14082) (NV) was distinct from the RV's (CoC 773 and 93 V 297) for DUS traits *viz.*, hairiness, inner auricle, colour of dewlap, leaf sheath curvature, and it was distinct from the RV CoM 0265 for growth crack, waxiness, bud shape and bud tip in relation to growth ring. Second year DUS testing of two new varieties (NVs), indicated that Phule-11082 (CoM 11082) was different from the closely resembling RVs and was (Co 8347, Co 8371, CoA 89081 and Co 7805) for DUS traits *viz.*, plant growth habit, hairiness, shape of ligule, inner auricle, leaf blade curvature, adherence of leaf sheath, internode colour exposed to sun and prominence of growth ring and MS 17082 was distinct from the RVs (Co 8347, Co 8371, Co 853 and Co 6304) for DUS traits *viz.*, plant growth habit, hairiness, shape of ligule, inner auricle, internode colour (exposed to sun), internode shape, rind surface appearance, waxiness, bud groove and bud tip in relation to growth ring. The re-characterization of 246 RV's for 27 DUS traits was completed and images of 100 reference varieties were digitalized.

(S. Alarmelu and C. Jayabose)

CRISPR–Crop Network–Targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing (NASF)

Construction of PTG-Based CRISPR-Cas9 vectors for multiplex editing of matl gene

Screening of Cas-SgRNA transformed plants for edits in matl gene: Three constructs were developed for the matrilineal gene. Polycistronic multi-plex vector development was optimized in sugarcane *viz.,* MATL- tRNA –pRGEB32 I, (Polycistronic-3 gRNA), MATL- tRNA –pR-Pcambia II (Polycistronic-3 gRNA MATL- BK U6-pRGEB32 (Monocistronic- 2 gRNA). The gRNAs that showed high cleavage efficiency in the *in vitro* cleavage assay were used. 3X PTG-based CRISPR-Cas9 vectors were constructed. Overlap Extension PCR was used to amplify and fuse the tRNA-gRNA cassette with Golden Gate Assembly. *E. coli* cells (DH5 alpha) were transformed with the PTG fragment and the pRGEB32 vector, and colony PCR was performed using PTG fragment-specific primers to select the positive colonies transformed with the PTG fragment and pRGEB32. Colonies with amplicons of 600 bp were obtained and confirmed by Sanger sequencing. The recombinant plasmid was purified and transferred into *Agrobacterium tumefaciens* EHA105 strain. The putative transformed plants were hardened in pots. DNA isolated from more than 300 transformed plants were screened using CAS 9 primers. The Cas positive plants were screened with sequencing with mutation primers and capillary electrophoresis and two edited plants were identified (Fig. 32).

Fig. 32. The indels frequencies in the matl gene by CRISPR-Cas editing

(R. Manimekalai, V.P. Sobhakumari, C. Appunu, M. Ravi, IISER, Trivandrum)

Improving tillering and yield in sugarcane through creating novel alleles of strigolactone biosynthesis gene MAX4-1 using CRISPR / CAS9

Strigolactones (SL) are produced through the CAROTENOID CLEAVAGE DIOXYGENASE (CCD) pathway sequentially regulated by MAX2, MAX3 and MAX4 (More Axillary Branching) genes. Synthesis of strigolactone (SL) starts with the all trans β-carotene, which is converted to 9-cis-β-carotene by the activity of Dwarf 27 (D27), MAX3 then converts it into 9 cis β–apo 10'-carotenal, MAX4 converts 9 cis β–apo 10'-carotenal to strigolactone precursor called carlactone. The coregulation of MAX3, MAX4 and a receptor (MAX2) resulted in producing the branch-inhibiting strigolactone hormone. Strigolactone interacts with auxin and inhibits side branching and thus a strong negative regulator for tillering. Knock out lines of MAX4 gene was created through CRISPR/Cas9 mediated genome editing to improve tillering and yield in sugarcane. *ShMAX4-1* SgRNA was designed using CRISPR-PLANT platform. MAXsgRNA with appropriate adaptors was cloned at *Bsa* I restriction site under OsU3 promoter in the plant transformation vector pRGEB31 harboring hygromycin resistant gene as the selectable marker. The construct was mobilized into *E. coli* and putative plasmid was confirmed for the presence of 20bp protospacer sequence using PCR and Sanger sequencing. The putative positive plasmid DNA harbouring *ShMAX4-1* SgRNA was used for transformation into a selected sugarcane genotype (Co 99004) having high sugar content and high quality, but exhibits shy tillering. Putative positive Cas9-*ShMAX 4-1-gRNA* construct was transformed using particle bombardment into 45 days old callus developed from the sugarcane genotype Co 99004. Fifty to sixty percent white friable calli was successfully obtained after six rounds of selection in hygromycin selection medium and were successfully regenerated into shoots. Ten putative transgenic events were generated from the transformation. About 250 plants were confirmed for the presence of the cas9 construct using the hygromycin specific primers. The PCR positive plants were further selected and the gRNA target region (450bp) is amplified and screened for the presence of mutation.

(R. Valarmathi, C. Appunu and K. Mohanraj)

Deciphering the genetic basis of root-system architecture for developing climate resilient sugarcane

The phenotypic response of a commercial sugarcane genotype Co 99004 in root development and RSA to gamma ray induced *in vitro* mutagenesis was studied. Mutant populations of sugarcane genotype Co 99004 were developed through gamma ray induced mutagenesis. The phenotypic variants of Co 99004 in V1 generation could be categorized into five distinct phenotypically scorable classes, which exhibited genetic, metabolomic and phenotypic variation in RSA. About 17 RSA traits were quantified from scanned root images and analysed to identify traits linked to improved root development, shoot biomass and drought adaptation. Seventeen RSA traits were measured, and five key traits with high phenotypic variability—simple stem diameter (SSD), projected root area (RA), root system width (WMA), rooting depth (SKD), and skeleton width (SKW). The mutants with superior root system were screened for drought under control and field condition. Based on the physiological performance under drought and integrated ranking placed identified three mutants (M72, M36 and M48) as drought tolerant compared to that of the wild type control.

(R. Valarmathi, C. Appunu, Ashish Kumar Srivastava, BARC)

Identification and characterization of SWEET genes associated with sugar content and disease susceptibility in sugarcane

The qRT-PCR data from 6^{th} to 12^{th} month of planting for 10 contrasting pairs of high and low sugar genotypes was analyzed. Developmental regulation of SWEET genes expression in different stages of crop growth and tissue specificity was established. Multiplexed gene constructs were developed for SWEET 13c, 4a and 3a genes with tRNA-spacer for sugarcane transformation using the vector pRGEB32.

(P.T. Prathima)

Targeted genome editing in sugarcane: CRISPR/Cas9-mediated lignin modification towards lignocellulosic biofuel production

CRISPR/Cas9 Off-Target effect induces albinism via Phytoene Desaturase (PDS) gene disruption in sugarcane

Synthesis of CRISPR–Cas9 construct/s for precise sugarcane genome editing: Two guide RNA sequences targeting the *CAD* gene were designed to modify the syringyl/guaiacyl ratio in lignin biosynthesis. The OsU3 promoter was used for Cas9 expression, ensuring strong, constitutive activity. To enhance transcript stability and prevent transcriptional interference, a Pol III terminator was employed, and the gRNA and Cas9 cassettes were arranged in a head-to-head orientation. This design minimized RNA polymerase read-through and improved editing efficiency by maintaining proper expression of both components in the CRISPR construct. Agrobacterium-mediated transformation of *Erianthus* was achieved. Totally 76 plants were generated.

During shoot regeneration, approximately 90% of the transformed plants developed white, albino shoots. Sequence analysis revealed unintended partial homology between the designed CAD gRNA, upstream of the PAM sequence and the coding sequence of the *Phytoene Desaturase* (*PDS*) gene (at 609-616 bp), a key gene involved in carotenoid biosynthesis. Real-time PCR analysis of albino plants showed markedly reduced *PDS* expression, further confirmed by PCR amplification (Fig. 33). Chlorophyll a & b, total carotenoid estimation also revealed significantly lower levels in albino plants, validating the off-target disruption of the *PDS* gene by the CAD-specific gRNA. These findings highlight the importance of precise gRNA design to minimize off-target effects and emphasize the need to redesign a highly specific gRNA for targeted editing of the *CAD* gene in sugarcane.

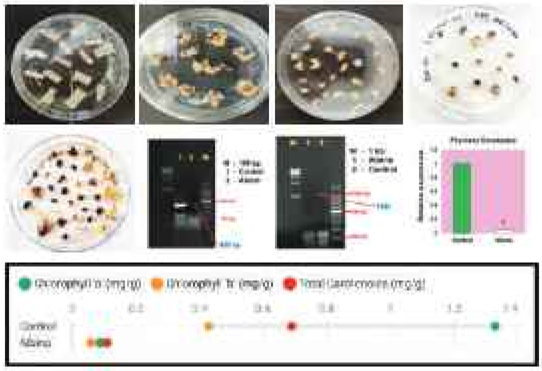


Fig. 33 a. Explant inoculation; b, Callus initiation; c, Callus induction; d & e, Emergence of white shoots; f, PCR amplification of 25S rRNA; g, PCR amplification of PDS gene; h, Bar graph depicting the expression of PDS gene in control and albino plants and i, Dot plot depicting chlorophyll 'a', 'b' and total carotenoid content in both control and albino plants.

(K. Lakshmi)

Development of genome consortium databank from plants and microbial population emerging from India

Strategies were formulated to automate the process for annotating plant genome data originating from India utilizing the Linux operating system, C programming language, and R software. Currently, development of a pipeline is underway to automate the retrieval of all plant genome and cyanobacteria sequences submitted from India.

(P.T. Prathima)

Genome editing in sugarcane to improve yield, quality, biotic stress tolerance and biomass modification for biofuel production (ICAR-EFC)

Creating targeted mutation in sugarcane for improving water deficit tolerance

One polycistronic construct with three gRNAs each for DST and HPs gene was developed under the pRGEB32 binary vector for improving drought tolerance. Proper cloning and alignment of gRNAs in the vector was confirmed through sequencing. Genetic transformation was carried out with embryogenic calli of Co 86032. Four batches of particle bombardment were performed and generated 96 putative edits of Co 86032 and all these edits are under hardening stage.

(C. Appunu)

Improving tillering in sugarcane through CRISPR/Cas9-mediated gene editing of strigolactone biosynthesis gene Teosinte branched (Tb1)

Functional genomics on sugarcane tillering has identified candidate genes inhibiting tillering. From the preliminary data two candidates Teosinte Branched 1(*TB1*) and High Tillering Dwarf 2 (*HTD2*) involved in strigolactone signalling in sugarcane has been identified to create knock out mutation to downregulate the gene function. Multiple guide RNAs targeting first exon of the candidate genes were designed using CRISPOR platform. For the binary genome editing vector construction, the polycistronic tRNA-SgRNA were synthesised and cloned into pRGEB32 vector under OsU6 promoter and transformed into *E.coli* system. The presence of polycistronic tRNA-SgRNA insert in *E.Coli* was confirmed by PCR and sanger sequencing and the construct of mobilised into *Agrobacterium*. Putative positive plasmids harbouring the guide RNA sequences were transformed to Co 99004 callus using *Agrobacterium* mediated transformation. Callus was initiated from the variety Co 99004 and transformed with pRGEB32 vector harbouring *ShHTD2* and *ShTB1* guide RNAs. Putative positive calli harbouring *ShHTD2/Cas9* construct was successfully regenerated after six rounds of selection and the calli harbouring *ShTB1/Cas9* construct is under first round of selection.

(R. Valarmathi, C. Appunu and K. Mohanraj)

PUBLIC–PRIVATE PARTNERSHIP PROJECTS

Enhancing sugar productivity in Tamil Nadu through Institute-Industry Approach (SISMA-TN funded-SWEET BLOOM 2.0)

Seed cane supply: Twenty promising sugarcane clones (Co 21002, Co 21006, Co 22004, Co 22009, Co 22010, Co 22015, Co 22016, Co 23002, Co 23006, Co 23007, Co 23008, Co 23009, Co 23010, Co 23013, Co 23015, Co 23016, C 16338, C 22020, C 22054, G 2008-019) were multiplied and supplied to sugar factories during July-August 2024 for further multiplication at respective factory locations.

Performance of varieties: Seventeen genotypes were evaluated along with Co 86032 and local standards (II plant and ratoon crop) during 2024-25. Data of two plant and one ratoon crops were analyzed and genotypes which were better for cane yield and quality than Co 86032 were identified as suitable for particular location (Table 11). Co 19008, Co 19009, Co 20011, Co 21003 and Co 21004 performed better than Co 86032 for cane yield and sugar yield at harvest. Clones, Co 21007 (20.59%), Co 20009 (20.18%), Co 20010 (20.03%), Co 15017 (19.69%), Co 20011 (19.38%), Co 19009 (19.23%), Co 20005 (19.16%), Co 21003 (19.07%) and Co 21004 (19.00%) recorded higher sucrose than Co 86032 (18.79%).

The clone Co 21003 ranked first in seven locations. The best clone Co 19009 recorded 16.07%, 19.30% and 2.62% improvement over Co 86032, respectively for cane yield, sugar yield and sucrose content across Tamil Nadu. Another clone Co 21003 recorded 10.64%, 12.77% and 1.46% improvement over the standard Co 86032 for cane yield, sugar yield and sucrose content, respectively.

New planting (2025-26): First plant crop was laid out in a replicated trial with 20 clones along with standard Co 86032 in eleven sugar factory locations for evaluation. Thiru Arooran Sugar Mills Ltd, Thirumandankudi planted the evaluation trial in 2025.

Workshop organised: One day workshop was conducted on 'Application of cutting-edge technologies in sugarcane improvement and production' at ICAR-SBI, Coimbatore on 18 June 2025.

(P. Govindaraj, C. Appunu, R.M. Shanthi, S. Alarmelu, S. Karthigeyan, A. Anna Durai, R. Karuppaiyan, K. Mohanraj, Maruthi R.T, K. Elayaraja, S. Sheelamary, K. Gopalareddy, H.K. Mahadeva Swamy, R. Gobu, Adhini S. Pazhany, Kona Praveen, T. Lakshmi Pathy, D. Neelamathi, C. Jayabose, R. Valarmathi, B. Singaravelu, P. Malathi, R. Selvakumar, T. Ramasubramanian, M. Punithavalli and P. Mahesh)

Project Members from TNAU, Coimbatore:
(D. Sassikumar & Satheeshkumar, SRS Cuddalore, V. Anbanandan, SRS Sirugamani, N.A. Saravanan, SRS Melalathur)

Identification of suitable location specific sugarcane varieties for commercial cultivation under different agro-climatic situations in India (ISMA)

Sub-Tropical Zone (16 sugar mills): Nine clones along with two checks Co 0238 and Co 0118 were evaluated for cane and juice quality traits at 12 months. Six entries *viz.*, Co 16030, Co 17018, Co 19017, Co 20016, Co 20017 and Co 21012 recorded higher cane yield than the check Co 0238 (140.8 t/ha). The entry Co 20016 recorded the highest mean cane yield of 174.10 t/ha followed by Co 16030 (170.70 t/ha). Co 20016 recorded a sugar yield of 23.40 t/ha compared to the check Co 0238 (18.53 t/ha). Highest sucrose was recorded in the entry Co 21012 (19.30%) followed by Co 20016 (19.14%) compared to the check Co 0238 (18.95%). The entry Co 20016 recorded higher Pol% cane of 14.41% compared to Co 0238 (14.36%). Based on one year study (12 months data) at 16 sugar mills across sub-tropical India, the entries Co 20016 and Co 21012 were found to be promising for all the

Table 11. Location specific genotypes combining yield and quality

Sugar factory	Genotypes
Bannari Amman Sugars, Sathyamangalam	Co 15017, Co 19009, Co 20010, Co 20011, Co 21003, Co 21004
Bannari Amman Sugars, Tirukovilur	Co 19009, Co 21003
Dhanalakshmi Srinivasan Sugars	Co 20010, Co 21003
EID Parry (India), Nellikuppam	Co 19009
Kothari Sugars, Kattur	Co 19002, Co 19008, Co 19009, Co 20010, Co 20011, Co 21003, Co 21004
Kothari Sugars, Sathamangalam	Co 19009, Co 20009, Co 20010, Co 21003
Ponni Sugars, Erode	Co 19009
Rajshree Sugars, Mundiampakkam	Co 19009, Co 20011, Co 21003
Sakthi Sugars, Appakudal	Co 19009, Co 21003
Sakthi Sugars, Sivaganga	Co 15017, Co 19009, Co 20010, Co 20011, Co 21003

agronomic traits and, sugar yield compared to the check variety Co 0238. The first plant crop was ratooned to assess ratoon potential.

Plant crop trial: The varietal evaluation work in subtropical zone is continued with 17 more new entries and trials were planted during second fortnight of Februay 2025.

Tropical Zone (9 sugar mills): Trials with 22 entries (Co 16006, Co 17001, Co 18009, Co 17005, Co 18003, Co 19003, Co 19004, Co 19005, Co 19009, Co 19014, Co 20003, Co 20005, Co 20009, Co 21003, Co 21004, Co 21009, Co 22005, Co 22012, Co 22015, Co 22018, Co 22019, Co 24015) were planted in RBD design with three replications in six sugar mills; multiplication is being carried out in three Athani sugar units. The entries Co 18009, Co 24015, Co 22018, Co 22019, and Co 21003 showed better field stand.

Training: One day training program was organized for 15 staff of nine sugar mills in tropical zone (Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh) at ICAR-SBI, Coimbatore on 9 January 2025. Hands on training was provided on juice analysis in experimental trials and demonstration of sett treatment device (Fig. 34 and 35).

Fig. 34. One day training program for the staff of tropical mills (9 January 2025)

Fig. 35. Monitoring of experimental trials at Dhampur Bio organics Ltd., Uttar Pradesh

(P. Govindaraj, K. Mohanraj, H.K. Mahadeva Swamy, R.M. Shanthi, S. Alarmelu, A. Anna Durai, S. Karthigeyan, R. Karuppaiyan, C. Appunu, R.T. Maruthi, S. Sheelamary, K. Elayaraja, Adhini S. Pazhany, K. Gopalareddy, R. Gobu, Kona Praveen, T. Lakshmi Pathy, D. Neelamathi, A. Ramesh Sundar, Ravinder Kumar, M.R. Meena, M.L. Chhabra and M. Nisha; R. Viswanathan, Sanjeev Kumar, A.K. Mall, Aalok Shiv and Indu (ICAR-IISR, Lucknow)

5.2 Division of Crop Production

5.2.1 Agronomy, Microbiology, Farm Machinery, and Power

Development of cropping systems and improved agronomic practices to enhance sugarcane productivity

Development and promotion of tools and machinery for sugarcane mechanization

Evaluation of Bio Formulation Applicator using new formulations against white grubs under field condition: A field experiment was conducted to evaluate the Bio Formulation Applicator (earlier known as the EPN applicator) for the application of a Bt-based biopesticide (Bt-62) against white grub in sugarcane (8^{th} month) in white grub endemic area at Sathyamangalam. For pre-treatment assessment, a trench in the root zone (1m length) was excavated to a depth of 0.3 m and a width of 0.3m at ten randomly selected spots, and the number of white grubs was recorded. The Bt formulation was applied at a dosage of 1×10^{10} CFU m^{-2} using the Bio Formulation Applicator by uniformly dispensing the diluted fermenter product into the root zone. Ten untreated spots were maintained as control. Post-treatment observations indicated a 33% reduction in white grub population in the treated spots, whereas no reduction was observed in the control, demonstrating the effectiveness of the Bio Formulation Applicator for targeted delivery of Bt formulations under field conditions.

(T. Arumuganathan, C. Palaniswami, C. Sankaranarayanan, P. Mahesh, T. Senthil Kumar and Syed Imran (ICAR-CIAE, RC)

Inter-Institutional Collaborative Research Project on testing and evaluation of IISR sugarcane machineries under tropical condition

Demonstration of tractor-operated sugarcane cutter planter: A large scale demonstration of tractor operated sugarcane cutter planter was conducted in farmers' field at Tirukoilur, Kallakurichi district. Over 100 farmers from Villupuram and Kallakurichi districts and 50 cane staff from M/s. Bannari Amman Sugars (BAS) Limited, Tirukoilur, senior officers and sugarcane farmers participated in the demonstration (Fig. 36). Mechanised sugarcane planting was done in more than 100 acres of area under BAS, Tirukoilur using the tractor-operated sugarcane cutter planter.

Fig. 36. Field demonstration of two row sugarcane sett cutter planter

(A.K. Singh – ICAR-IISR, Lucknow, T. Arumuganathan, S. Anusha, ICAR-SBI and T. Senthil Kumar -ICAR-CIAE, Coimbatore)

Development and promotion of mini tractor operated sugarcane planters for small-farm mechanization

Field testing and performance evaluation of mini tractor operated sugarcane settling transplanter: Field trial was conducted to evaluate different sugarcane settling transplanting methods and spacings with seven planting treatments: mini tractor-operated single-row transplanter, ICAR-SBI–CIAE tractor-operated two-row transplanter, and manual transplanting, each at 45 and 60 cm plant-to-plant spacing, along with farmers' practice (sett planting) as control. Settling establishment exceeded 90% across all treatments, indicating high transplanting efficiency. Cane yield did not differ significantly among transplanting methods or spacing. Yields under the mini tractor-operated transplanter ranged from 112.6 to 113.0 t/ha, comparable to the tractor-operated two-row transplanter (115.8–116.9 t/ha) and manual transplanting (120.7–122.1 t/ha). The results demonstrate that mechanical transplanting using mini tractor-operated transplanters can achieve yield comparable to conventional methods, while offering substantial labour (72.7%) and time (50%) savings in sugarcane cultivation (Fig. 37).

Fig. 37. Mini tractor-operated sugarcane settling transplanter and field view

(T. Arumuganathan, T. Senthilkumar - ICAR-CIAE and S. Anusha)

Exploring novel microorganisms for sugarcane biomass based 2G ethanol

Microbial isolates were obtained from insect gut samples as well as from culture collections and commercial sources to isolate and characterize novel microbes capable of degrading lignocellulosic sugarcane biomass for biofuel applications. Several isolates demonstrated the ability to grow on cellulose, xylan, lignin, xylose, glucose, and alkali-digested sugarcane bagasse, indicating their potential for biomass deconstruction and conversion. Preliminary fermentation studies using alkali-pre-treated and acid/enzyme-digested sugarcane bagasse (Co 11015 and Co 86032) and energy cane biomass (SBIEC 14006 and SBIEC 18001) confirmed ethanol production. Among the 15 yeast isolates tested, *Saccharomyces* spp. (strain B) and *Saccharomyces* spp. (strain D) produced comparatively high ethanol yields. However, overall ethanol recovery was low, indicating the need for further process optimization.

A total of 13 edible fungal isolates - *Ganoderma lucidum*, *Pleurotus eryngii* (001 and 002), *Hericium erinaceus* (lion's mane pink and white), *Hypsizygus ulmarius* (elm), *Flammulina filiformis*, *Agaricus bisporus*, *Pleurotus djamor*, *Pleurotus ostreatus*, *Pleurotus florida*, and *Calocybe indica* (Milky white and APK 2) were evaluated for growth on sugarcane bagasse (Co 11015 and Co 86032) and energycane biomass (SBIEC 14006 and SBIEC 18001). All the isolates exhibited good growth on these substrates. Fungal colonization significantly enhanced the crude protein content of biomass ranging from 0.44 to 8.75%, demonstrating the feasibility of protein enrichment of sugarcane residues using edible fungi.

Cellulase and xylanase production by *Trichoderma* spp. isolates (SBT T1, T68, TNAU 1, T64, T30, T12, Trash 1, T19, T53, TK19, T2, T11, ICAR 3, TK13, T7, T67, T6, T66, T69, Tricho 2, TNAU 3, and TNAU 2) was assessed using sugarcane bagasse (Co 11015 and Co 86032) and energycane biomass (SBIEC 14006 and SBIEC 18001) as substrates. Isolate T30 recorded the highest cellulase activity on sugarcane bagasse, while TK9, ICAR 3, and T7 showed superior activity on SBIEC 14006 biomass, and ICAR 3, T11, and T19 on SBIEC 18001 biomass. For xylanase production, most of the isolates exhibited comparable enzyme activity across substrates.

(K. Hari, G.S. Suresha, B. Singaravelu and P. Govindaraj)

Doubling income of small farms through sugarcane-based farming system (SBFS)

Integrated sugarcane-based farming system model (1 hectare) comprising sugarcane + blackgram intercropping system (0.8 ha), dairy (0.04 ha), goat unit (0.04 ha), fish culture (0.04 ha), vermicomposting (0.06 ha), and fodder production (0.02 ha) was developed at the institute. The livestock component included three lactating cows with three calves, Salem Black goats (13 does + 1 buck), country chicken (15), ducks (12), and fish culture with rohu, catla, and mrigal. Dairy animals produced 20-25 l of milk per day. Sugarcane + blackgram intercropping was cultivated under drip irrigation. Economic analysis revealed that, dairy unit was the most profitable enterprise, generating a gross return of ₹2,82,790 and a net return of ₹1,07,087 per year. The cropping system contributed 46% of total farm income, followed by dairy (33%) and goat farming (8.9%). Overall, the integrated farming system recorded a gross return of ₹8,09,704 and net return of ₹4,19,696 per year (Fig. 38). The system effectively recycled farm resources: 3.8 tons of green cane tops and pulse haulms were used as cattle fodder, while 8.24 tons of dairy manure and 2.3 tons of goat manure were recycled back to the fields. Vermicomposting utilized 8.5 tons of dry trash and 2.0 tons of cowdung, yielding 4.12 tons of vermicompost.

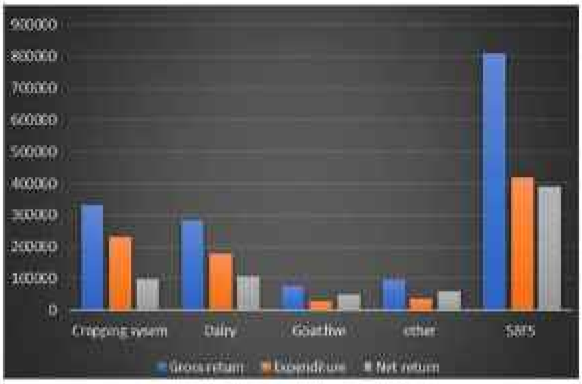


Fig. 38. Economics (Rs./ha/unit) of the SBFS

(P. Geetha, T. Rajula Shanthy, C. Palaniswamy, R. Gobi and M. Thirunavukarasu, TNAU)

Natural farming for sustainable use and management of natural resources to improve productivity in sugarcane based cropping system

A field experiment on conventional and natural farming practices was conducted to test verify the feasibility of natural farming in sugarcane. Among the various natural farming practices, higher number of millable canes (NMC) ('000) and cane yield were recorded in Natural Farming (NF) without trash mulching (69.3 and 99.5 t/ha) and NF +intercrop + trash mulching (66.9 and 94.7 t/ha) than conventional farming (66.8 and 115.0 t/ha). Though 5 - 7.5% reduction in yield was observed in natural farming compared to conventional farming, there is a saving (12%) in cost of production, in addition to environmental safety and improved soil ecosystem services *viz.* organic carbon, soil microbial carbon and nutrient cycling (making nutrients available for plant growth), soil formation, and habitat provision for a vast array of organisms.

(P. Geetha, K. Hari, M. Alagupalamuthirsolai and T. Subramani)

Enhancement of sugarcane productivity and profitability through tillage and weed management practices in tropical India

Conventional and reduced tillage resulted in comparable weed dry weight at harvest. Among the various weed management practices, hand-weeding at 30, 60, 90, and 120 DAP (7.11 g/m^2), and pre-emergence pendimethalin at 1.0 kg a.i./ha + intercropping with black gram followed by trash mulching followed by application of metribuzin +2,4-D + pyrazosulfuron ethyl (ready mix) @ 3 kg/ha after final earthing up (6.85 g/m^2) and pre-emergence pendimethalin @ 1.0 kg a.i./ha + trash mulching followed by application of metribuzin +2,4-D + pyrazosulfuron ethyl @ 3 kg/ha after final earthing up (6.89 g/m^2) resulted in significantly less weed dry weight at harvest. Sugarcane yield in the reduced tillage plot (92.9 t/ha) was on par with conventional tillage (87.3 t/ha). However, pre-emergence pendimethalin @ 1.0 kg a.i./ha + intercropping with black gram followed by trash mulching followed by application of metribuzin +2,4-D + pyrazosulfuron ethyl (ready mix) @ 3 kg/ha after final earthing up recorded higher cane yield (116.8 t ha^{-1}), which was on par with pre-emergence pendimethalin @ 1.0 kg a.i. ha^{-1} + trash mulching followed by application of metribuzin +2,4-D + pyrazosulfuron ethyl @ 3 kg/ha after final earthing up (113.9 t/ha) and hand weeding at 30, 60, 90 and 120 DAP (116.5 t/ha).

(S. Anusha, K. Kannan, K. Hari and V. Krishnapriya)

Optimisation of herbicide application in sugarcane using drones

The study aims to evaluate the efficacy of different spray volumes and herbicide doses under drone-compatible application conditions, in comparison with conventional knapsack spraying, hand weeding, and an untreated control. Among the different combination of treatments, pre-emergence application of atrazine 1.25 kg a.i./ha with 25 L/ha and 50L/ha spray volume did not affect sugarcane germination. Pre-emergence application of atrazine 1.25 kg a.i./ha with 25 L/ha spray volume recorded lower weed count (38.7 No./m^2), weed dry matter (9.7 g/m^2) and higher weed control efficiency (92.4%) at 35 days after planting.

(S. Anusha, T. Arumuganathan, K. Kannan, T. Ramasubramanian and P. Geetha)

5.2.2 Plant Physiology

Enhancing the physiological efficiency of sugarcane

Deciphering the physiological basis of nutrient use efficiency in sugarcane

Based on the morpho-physiological responses of Co 86032 to varying levels of major nutrients, hydroponic nutrient supplementation for genotypic evaluation under controlled conditions was optimized, defining deficiency, critical threshold, and sufficiency levels. Physiological markers such as chlorophyll content, chlorophyll *a* fluorescence, canopy temperature depression, leaf metabolites, lipid peroxidation, and antioxidant enzyme activity were significantly correlated with biomass accumulation and partitioning.

In the plant crop, total biomass was the highest in control plots, followed by minus P, minus N, and minus K treatments. Nitrogen uptake was the highest in minus P, followed by control and lowest in minus K. Phosphorus uptake was highest in minus N, followed by control and lowest in minus P. Potassium uptake was the highest in control, followed by minus N and lowest in minus K. Reciprocal internal efficiency (RIE) for N was the lowest under minus K, while RIE for P and K was lowest under minus P, showing differential genotypic responses.

Among 'Co' canes, Co 86032, Co 14005 and Co 14012 recorded high cane yield across treatments in the plant crop, whereas Co 18009 and Co 15010 performed better in the first ratoon. Among inter-specific hybrids, AS 04-1875 consistently exhibited high biomass and yield in both plant and ratoon crops.

Based on pooled plant and ratoon performance, genotypes were classified for nutrient efficiency. Nutrient efficient genotypes were able to either take up the inherent nutrients from the soil, or convert the limited nutrients to cane yield owing to efficient uptake or utilisation. Inefficient genotypes were poor performers under nutrient limitation, nevertheless, maybe responsive to fertilizer addition.

- N-efficient genotypes included Co 06022 and Co 15017 (uptake), Co 14012 (utilization), and Co 86032, Co 18009, Co 14005, CYM 08- 922, Co 15010, AS 04-924, AS 04-1875, and AS 04-939 (uptake and utilization), whereas Co 09004, Co 10026, Co 0238, Co 11015, Co 97010, and GUK 06-402 were N-inefficient.
- P-efficient genotypes comprised Co 15009 and AS 06-391-503 (uptake), Co 14012, AS 04-1875, and CYM 08-922 (utilization), and Co 86032, Co 18009, Co 14005, Co 15010, AS 04-924, AS 04-1875, and AS 04-939 (uptake and utilization), while Co 10026, Co 0238, Co 11015, Co 15017, and Co 97010 were P inefficient.
- K-efficient genotypes included Co 14005, Co 06022, and AS 06-391-503 (uptake),

Co 15010 and AS 04-1875 (utilization), and Co 86032, Co 14012, CYM 08-922, AS 04-924, and AS 04-939 (uptake and utilization), whereas Co 09004, Co 10026, Co 0238, Co 11015, Co 97010, and GUK 06-402 were K-inefficient.

Efficient genotypes exhibited higher leaf area than inefficient genotypes under minus N and minus P conditions. Reduction in chlorophyll *a* concentration was greater in efficient genotypes, while high chlorophyll *a/b* ratio under minus P indicated preferential degradation of chlorophyll *b*, helping maintain photosynthetic efficiency. Total chlorophyll declined by about 50% under minus N. Carotenoid and anthocyanin concentrations were high in efficient genotypes under nutrient stress, providing antioxidative protection and aiding nutrient remobilization.

Efficient genotypes also maintained high leaf sugar and starch contents, while phenol concentration was high in inefficient genotypes. Protein concentration did not differ significantly among genotypes but declined by ~50% under minus N. Free amino acids decreased under nutrient stress. Antioxidant enzyme activities (catalase, peroxidase, and superoxide dismutase) and lipid peroxidation increased under nutrient deficiency, with a more pronounced response in inefficient genotypes, indicating greater oxidative stress and membrane damage.

(V. Krishnapriya, R. Arun Kumar, S. Anusha and M. Alagupalamuthirsolai)

Plant architectural traits for developing ideotype concept in sugarcane for tropical conditions

The leaf angle of insertion revealed that the clones with both erect leaves at the top and the planophile leaves at the bottom layer have an advantage in efficiently harvesting the solar radiation for effective use of photosynthesis. The mid-point vertical height of the top visible dewlap leaf (TVD-1) had a positive correlation with cane yield in Co canes. Among the studied traits, the

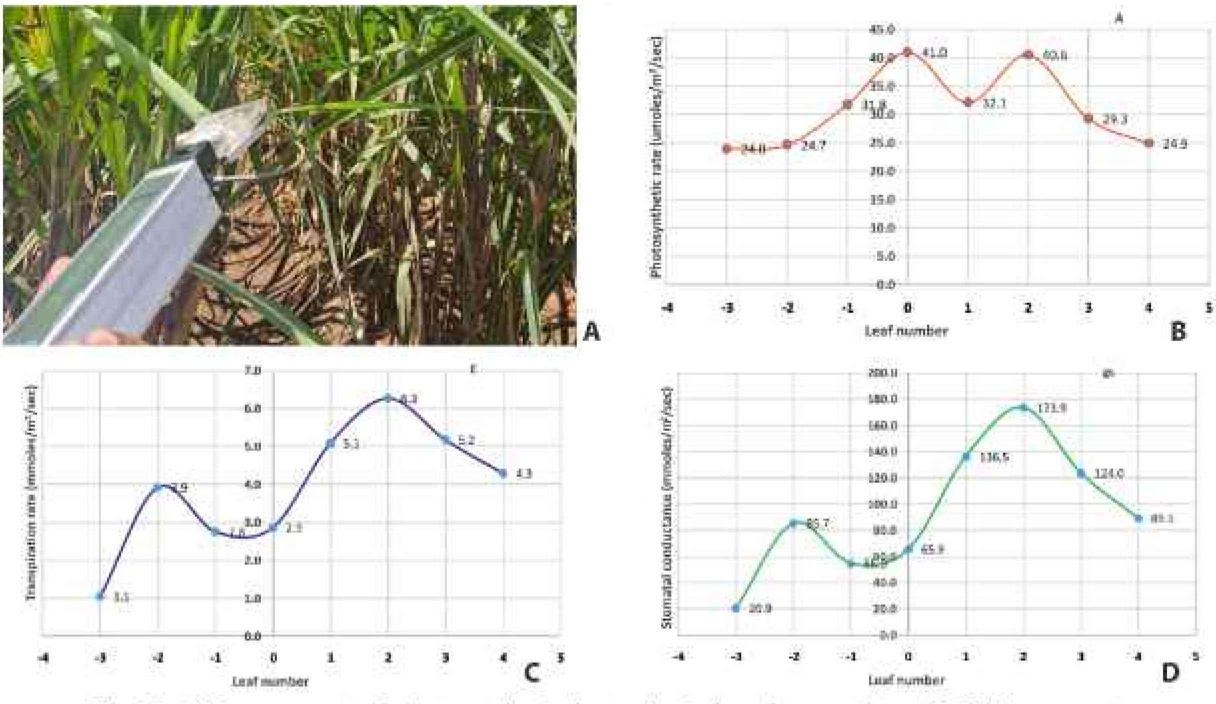


Fig. 39. A. Measurement of photosynthesis data using Infrared gas analyzer (IRGA) instrument across different leaf position in Co 86032 sugarcane variety B. Photosynthetic rate C. Transpiration rate and D. Stomatal conductance variability at TVD leaf level in Co 86032

plant height, total dry matter, cane volume, NMC, and germination % showed significant positive correlation with cane yield in Co canes and germplasm clones. Leaf angle of insertion showed a negative correlation, revealing that the more erect leaves led to underutilization of photosynthetically active radiation. The calculated cane volume was found to have a significant positive correlation with cane yield, and the clones with better harvest index had greater cane volume.

Growth analysis revealed that the leaf growth rate, sheath growth rate had significantly positive correlation with cane growth rate and crop growth rate. Significant variations in chlorophyll 'a' and 'b' content, RWC, SPAD, and harvest index were also observed. The sugarcane clones viz, Co 85019, Co 17004 and few more clones were recorded with a better photosynthetic rate of more than 25µmol m^{-2} s^{-1} compared to other Co canes, and this signifies the efficient carbon metabolism, growth, and biomass in the identified clones. In a photosynthetic assessment conducted across the leaf positions (from TVD -4 to TVD +4) of a single Co 86032 plant, the TVD +2 leaf exhibited the highest photosynthetic rate (A) (40.6 µmol m^{-2} s^{-1}), transpiration rate (E) (6.3 mmol m^{-2} s^{-1}), and stomatal conductance (gs) (173.9 mmol m^{-2} s^{-1}), likely attributable to greater light interception at this leaf position (Fig. 39). The traits evaluated at different growth stages showed that certain key traits had a significant association with either biomass or cane yield. The top visible dew lap leaf number seven (TVD-7) had significantly better correlation with whole plant leaf area signifying more light utilization and growth. A stronger correlation was observed between the SPAD index and both plant height and leaf number, highlighting the pivotal role of nitrogen in plant growth at early crop growth stage.

(R. Arun Kumar, S. Alarmelu, K. Mohanraj, V. Krishnapriya, S. Anusha, T. Arumuganathan and M. Alagupalamuthirsolai)

Development of hydroponic screening methodologies for sugarcane varietal evaluation in response to abiotic stress under controlled condition

Electrical conductivity (EC) of 9 and 12 dS m^{-1} salinity can be used for rapid screening of salinity-tolerant sugarcane clones, respectively, under hydroponic conditions. At the formative phase, sugarcane clones *viz.*, Co 86032, CoM 0265 and Co 97010, initially planted in polybags, were transferred to hydroponic pot culture conditions, where Hoagland solution was used for nutrient supply and crop maintenance. Initially, the nutrient solution was supplied at half strength, and the concentration was gradually increased as the crop growth progressed. The clones were subjected to salinity stress by treating hydroponically grown plants to 9 and 12 dS m^{-1} salt (mixture of salts) stress which has led to salt stress gradually after 21 days of treatment, and the morphological & physiological responses *viz.*, leaf tip drying, lower leaves drying, SPAD index, chlorophyll a, b and total chlorophyll content, carotenoid content, proline, nitrate reductase, photosynthetic rate, transpiration rate and stomatal conductance were recorded. Salt stress has induced a significant decline in all the studied parameters except proline (Fig. 40). The trait of tolerance of high internal Na^+, Cl^- was assessed indirectly, by measuring chlorophyll content through its retention capacity at stress. Significant reduction in plant height and leaf number was observed under salinity stress conditions at formative phase. The clones CoM0265 and Co 86032 showed better physiology and salinity tolerance compared to the susceptible type Co 97010. Also, in a separate experiment, the screening for waterlogging tolerance was standardized. Two sugarcane clones, *viz.*, Co 86032 and Co 62175 were grown in ambient and waterlogged conditions by blocking of drainage holes in the pots, which led to waterlogging (WL) stress, and it has also led significant decline in oxidation reduction potential (redox potential) of

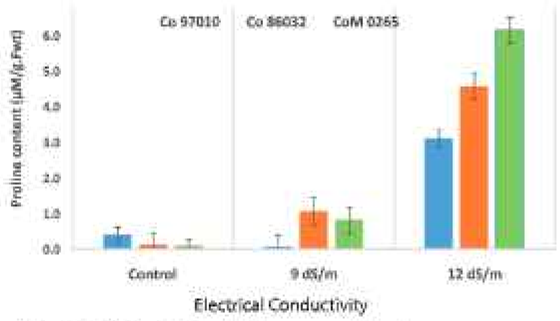


Fig. 40. Effect of salinity on proline in sugarcane clones grown under hydroponic condition

water by 3 weeks of treatment. The stored Hoagland solution was filled into the tank for the WL stress. Significant differences in the physiological parameters were observed, and the Co 62175 showed better water logging tolerance with better plant height, leaf number compared to Co 86032 at formative phase.

(R. Arun Kumar V. Krishnapriya, K. Hari and M. Alagupalamuthirsolai)

Development of spray formulation to mitigate water deficit stress in sugarcane

A confirmation field trial was carried out to evaluate the efficacy of selected foliar spray formulations using three sugarcane varieties, Co 86032, Co 18009, and Co 11015. The study also assessed the combined effect of *Methylobacterium* spp. with the selected formulation under both unirrigated (90–170 DAP) and irrigated conditions. Moisture stress adversely affected morphological traits and physiological activity under unirrigated conditions. However, selected formulations significantly enhanced specific leaf weight, epicuticular wax content, proline accumulation, relative leaf water content, membrane stability, photosynthetic pigments, phenolics, soluble proteins and antioxidant enzyme activities (SOD, CAT, POX) across all tested varieties during the formative phase. These improvements contributed to better leaf water status and higher tiller numbers at the grand growth stage. Under unirrigated conditions, formulation No. 3 combined with *Methylobacterium* spp. significantly increased the number of shoots by 63%, 48%, and 30% in Co 86032, Co 18009, and Co 11015, respectively, at 8 months after planting.

(M. Alagupalamuthirsolai, R. Gomathi, R. Arunkumar and V. Krishnapriya)

Physiological parameters / Screening of AVT clones for drought tolerance

Seven AVT 18 series clones along with two tolerant standards (Co 99004 and Co 86032) were evaluated for drought using standard protocols. Available soil moisture at 30, 60 and 90 days after stress was 17, 28 and 41% of soil moisture depletion over control, respectively. Significant decline in shoot population (14.6%) and plant height (30.2%) was observed under drought stress compared to the control; further drought treatment recorded 3.4% higher canopy temperature compared to the control treatment. Among the clones, Co 18002 and Co 18003 recorded higher shoot populations and growth parameters under drought than other clones.

Rating for drought tolerance: Based on cane yield and sugar yield, Co 18002 and Co 18003 was rated as tolerant (T), while Co 18009, Co 18013 and Co 18024 were rated as moderately tolerant (MT), and Co 18001 and Co 18012 were rated as susceptible (S) to drought stress.

(R. Gomathi, R. Arun Kumar and V. Krishnapriya)

Physiological parameters/Screening of AVT clones for salinity tolerance

Test clones (Co canes) of 19 series (7 Nos) and 18 series (7 Nos), along with Co 11015, Co 14012, Co 86032, Co 85019 (tolerant), and Co 97010 (susceptible) were planted in the microplot during 2024-25. The salt mixtures, *viz.*, NaCl: $CaCl_2$: Na_2SO_4 were prepared, and salinized water was irrigated at recommended intervals. Among the sugarcane clones, Co 18002, Co 18003, Co 19008, Co 19009 and Co 85019 recorded better cane yield under both control and salinity stress. Based on the

Fig. 41. Sugarcane clone (Co 18002) under control (unrolled leaves) and saline (rolled leaves) conditions

present study the clones, Co 18002, Co 18003, Co 19008 and Co 19009 are rated as tolerant (T) (Fig.41).

(R. Arun Kumar, V. Krishnapriya and M. Alagupalamuthirsolai)

5.2.3 Soil Science and Agricultural Chemistry

Natural resource management for enhancing productivity and sustainable sugarcane production

Development of simulation model for sugarcane production system

Leaf area index (LAI) of 20 sugarcane clones were recorded periodically. The maximum LAI observed was 3.75. A polynomial regression is used to model non-linear relationships between normalized LAI and Growing Degree Days(GDD). The 3[rd] order polynomial fits the observed data

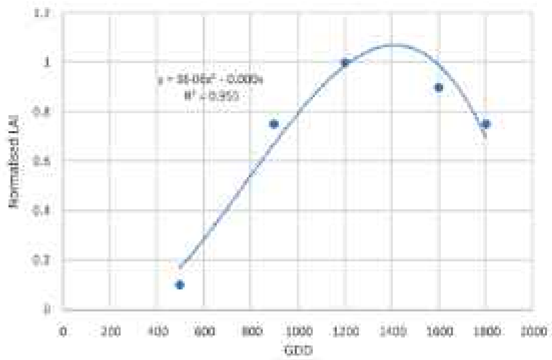


Fig. 42. Polynomial regression model - normalised LAI and Growing Degree Days(GDD)

with an r^2 value of 0.95 indicating that the 3[rd] order polynomial model is an excellent predictor of normalized LAI based on GDD for the sugarcane clones (Fig. 42). This relationship can be valuable for:

- *Predicting sugarcane growth stages*: Farmers and researchers can use GDD to anticipate certain LAI thresholds, which can be critical for timing irrigation, fertilization, and pest control.
- *Optimizing management practices*: Understanding the LAI progression in relation to GDD can help in making informed decisions about crop management, potentially leading to improved yield and resource efficiency.
- *Modeling sugarcane production*: The developed polynomial model can be incorporated into larger crop simulation models to forecast sugarcane biomass accumulation and yield based on weather data.

(C. Palaniswami, A. Vennila, V. Kasthuri Thilagam, K. Hari, R. Gomathi, R. Karuppaiyan, A. Anna Durai, K. Mohanraj, P. Geetha, S. Anusha, G.S. Suresha, R. Arun Kumar, V. Krishnapriya, R. Valarmathi, T. Arumuganathan and C. Jayabose)

Diagnosis of nutrient deficiencies and diseases, characterisation of canopy and estimation of biomass in sugarcane using drone based optical images

Multispectral images were captured using a drone during June 2024 and January 2025 (Fig. 43). The drone-acquired optical images were stitched to generate an orthomap, and the required datasets were prepared for deriving vegetation indices. The optical sensor data were processed to compute the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Red Edge Index (NDRE) for the treatment plots. Correlation analysis revealed that the blue and red spectral bands, along with the normalized red, showed a

Fig. 43. Multispectral image captured using a drone

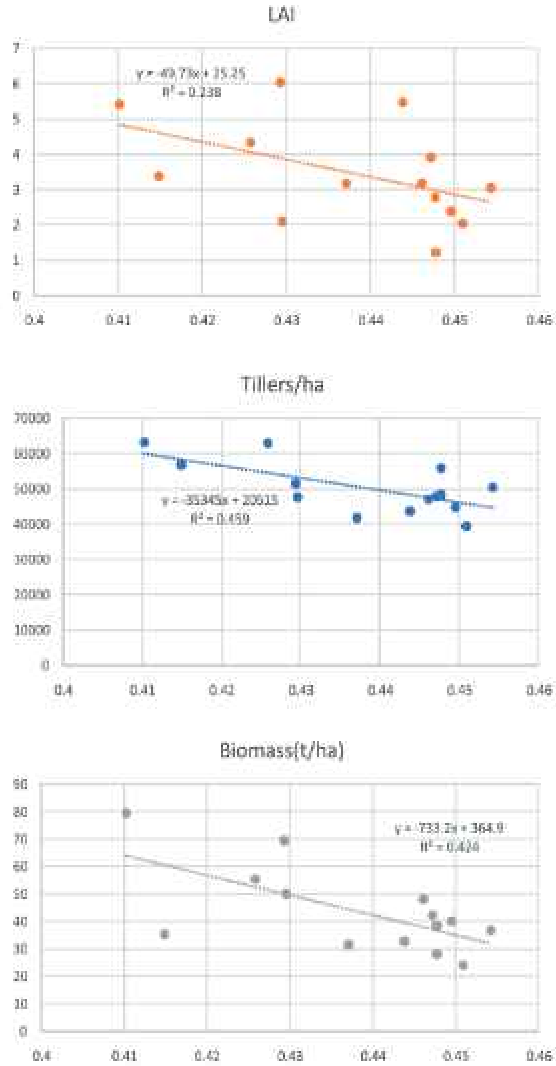


Fig. 44. Correlation of normalized red with biomass, leaf area index (LAI), and the number of tillers

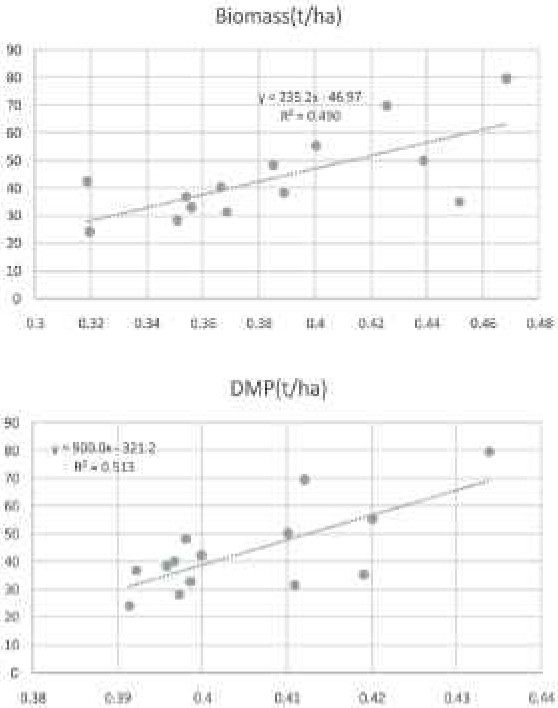


Fig. 45. Correlation of NDVI and Normalised green with biomass

significant negative correlation with biomass, leaf area index (LAI), and the number of tillers (Fig. 44 & Fig. 45). NDVI and normalised green exhibited a significant positive correlation with biomass and number of tillers.

(C. Palaniswami, A. Vennila, V. Kasthuri Thilagam, T. Arumuganathan, A. Anna Durai, K. Mohanraj, K. Kannan, R. Arun Kumar, R. Raja (ICAR-CICR, Coimbatore)

Evaluation of hydraulic characteristics of waterlogged soil under sugarcane cultivation for deriving suitable management strategies

Two waterlogging soil profiles were characterized in the research farm of ICAR-SBI, RC, Kannur. One profile was excavated at low-land farm and another at up-land farm. Both the lands are subjected to waterlogging for more than three months annually and the soil remains in saturated condition for most of the year. The ground water table in this area is also very shallow ($\leqslant$ 2 m below the surface).

Characteristics of low-land soil profile: The depth of the lowland soil profile exceeds 160m. The soil has more sand in the top soil and it decreased progressively with depth. The subsurface soil contains high proportion of clay, which restricts vertical water movement and contributes to poor drainage.

The bulk density of soil reduced with soil depth from 1.56 in the top layer to 1.47 Mg m^{-3}. The soil in the upper two top layers was red in colour, whereas below these layers soil colour was brown. The hydraulic conductivity was low in all the layers and less than 2.5 cm hr^{-1} (Table 12).

Characteristics of up-land soil profile: The depth of the upland soil profile is more than 175 cm. The bulk density increased with the depth and was morethan1.8 g/cm^3 at the bottom. The proportion of sand was high throughout the soil profile. Soil colour of this profile varied with all the layers indicating the filled soils in this area. The characteristics of the upland soil profile is described below in Table 13.

Although the upland soil profile contains a significant amount of sand and exhibits high hydraulic conductivity, shallow groundwater table

Table 12. Lowland soil profile and their characteristics

Soil profile of low land	Depth (cm)	Characteristics	Bulk density (Mg m^{-3})	Hyd. Cond. (cm hr^{-1})
	0-35	Wavy boundary, sandy clay, dark brown colour, strong grade angular blocky structure; few very fine pores, thin patchy clay cutans; non calcareous, many fine roots	1.56	1.25
	35-64	Clear wavy boundary, clay loam, yellowish brown colour, strong angular blocky type structure; thin patchy clay cutans; non calcareous, few very fine pores; few fine roots	1.58	1.17
	64-90	Gradual and wavy boundary, clay loam, yellowish brown colour, patchy clay cutans, no roots; Non calcareous, few very fine pores	1.54	1.36
	90-115	Gradual and wavy boundary, clay loam, Greyish brown colour, crumb structure; noncutans; Non calcareous, few very fine pores; No roots	1.50	1.56
	115-160	Gradual and wavy boundary, clay, Greyish brown colour, granular structure, No cutans, non calcareous, No roots.	1.47	1.32

Table 13. Upland soil profile and their characteristics

Soil profile of upland	Depth (cm)	Characteristics	Bulk density (Mg m^{-3})	Hyd. Cond. (cm hr^{-1})
	0-28	Clear smooth boundary, mottling absent; Granular structure; cutans absent; micro pores; few fine roots, coarse fragments; No calcareousness	1.38	7.78
	28-46	Clear wavy boundary, mottling absent; thin patchy cutans; many Micro size pores; Granular structure, Few fine roots, No calcareousness	1.75	7.36
	46-75	Clear wavy boundary, mottling absent; cutans absent; many Micro size pores; Few fine roots, No calcareousness	1.82	9.73
	75-100	Clear wavy boundary, mottling absent; cutans absent; many Micro size pores; no roots, No calcareousness	1.86	8.76
	100-175	Acidic parent material	1.24	5.84

and landscape position of the field result in persistent water logging.

Nutrient dynamics under waterlogging condition: Surface soil collected from a sugarcane field was incubated under laboratory waterlogged conditions for 13 weeks. Soil pH, electrical conductivity (EC), and redox potential (Eh) were monitored at 3-day intervals during the first eight weeks. The initial soil redox potential was 299 mV (day 0) and declined progressively upon waterlogging. By the end of 13 weeks, Eh decreased to −74 mV, indicating a strongly reduced soil environment (oxygen depleted condition). This decline in Eh under waterlogged conditions is primarily attributed to oxygen depletion, followed by the utilization of Fe^{3+} and Mn^{4+} as alternative electron acceptors, resulting in reduced soil conditions.

The initial soil pH averaged 7.06 and showed a temporary increase during the early stages of

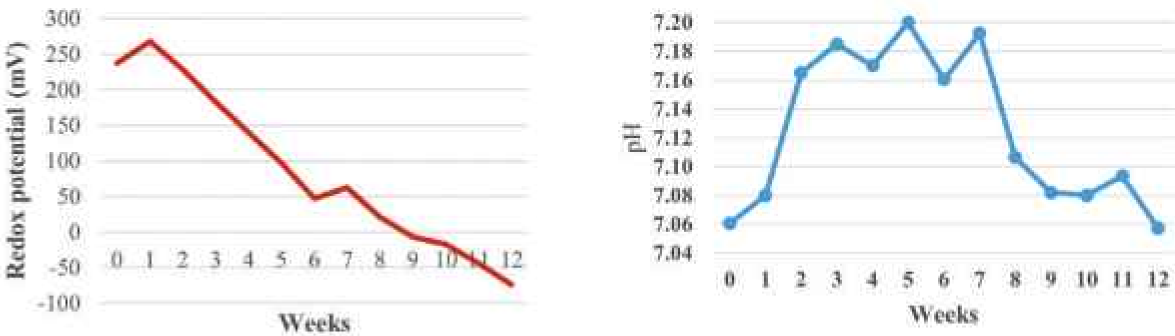


Fig. 46. Temporal change of soil redox potential and pH in waterlogging condition

waterlogging. After approximately 20 days, soil pH gradually declined and stabilized close to its initial value (Fig. 46).

(V. Kasthuri Thilagam, A. Vennila, C. Palaniswami and M. Nisha)

Optimisation of phosphorus nutrition, organic amendments and crop geometry for improving sugarcane productivity in calcareous soil

Soil characteristics were analyzed before the beginning of the experiment, and after imposing the FYM and Daincha treatments. The initial free calcium carbonate content in soil was 3.48 and 3.62% at 0-15 and 15-30 cm depth, and a reduction in calcium carbonate content in soil was observed with both FYM and Daincha incorporation when compared to the initial. Daincha showed higher reduction (5.6%) of soil calcareousness than the FYM treatment (2.5%), showing amelioration. The Single bud settlings of sugarcane variety Co 11015 were transplanted as per the crop geometry treatments. In the plant crop, P treatment showed a significant difference in cane yield, while the organic amendments, crop geometry and the interactions did not show any significant difference. Among the P treatments, the highest cane yield (152.25 t/ha) was recorded with the application of 50% SSP+ Urea N equivalent to 50% DAP at Basal and 50% DAP at 90 days after transplanting. Juice quality did not vary significantly among the factors or their interactions. The mean juice brix, sucrose, purity, and CCS was 22.18, 21.16, 95.39 and 15.16%, respectively. Sugar yield did not vary significantly among the factors or their interactions and the mean sugar yield was 22.77 t/ha. Overall, the actual cane yield obtained from the experiment plot (2916 m^2 area) was 43.62 tons accounting for 149.59 t/ha. Hence, this experiment achieved the STCR target of 150 t/ha.

(A. Vennila, V. Kasthuri Thilagam and C. Palaniswami)

Nutrient uptake and nutrient use efficiency

Seven clones of AVT along with three standards (Co 09004, Co 86032 and CoC 671) were evaluated for nutrient content in trash and cane separately. Nutrient use efficiency of the genotypes was evaluated based on the RUE. Among the genotypes tested Co 18003 was found effective in terms of kg of nutrient required for producing one ton of cane. The genotype Co 18003 requires 1.30 kg of N, 0.21 kg of P and 1.23 kg of K for producing one ton of sugarcane which was comparatively lesser than the standards tested and identified as the most efficient genotypein utilizing the nutrients for sugarcane production.

(V. Kasthuri Thilagam)

Multi-disciplinary Projects

Value addition and Product diversification in sugarcane

The process for production of wine from sugarcane juice was optimized by using six new yeast strains *Saccharomyces cerevisiae* (Fig. 47). Sugarcane juice with 20° Brix and the treatments inoculated with the yeast strains B and D had produced the best quality wine and yielded the highest alcohol of 13% as compared to rest of the treatments tested.

(G.S. Suresha, K. Hari and P. Murali)

Functional analysis of bioactive compounds from stem extracts of red-fleshed *Saccharum robustum* genotypes for therapeutic applications and their product development

Wild sugarcane genotype 51 NG 142 known to produce purple leaves and red fleshed *Saccharum robustum* stem extracts were characterized for its bioactivity by employing multiple solvent extraction followed by evaluation of bioactive compounds for antioxidant activity. Among the extracts from purple leaves, those extracted with chloroform and diethyl ether showed the highest

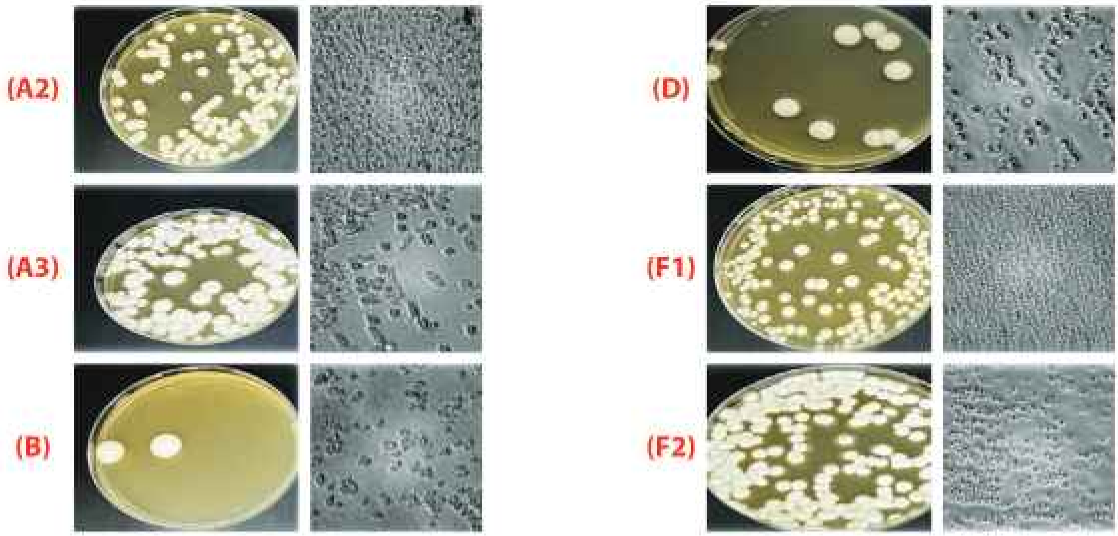


Fig. 47. New yeast strains *Saccharomyces cerevisiae* used for standardization of wine production from sugarcane juice

flavonoid concentration of 1141.67 µg/100 g fresh weight and DPPH free radical scavenging activity of 86.59% when compared to rest of the solvent extracts. Characterization of red fleshed *Saccharum robustum* stem extracts revealed that chloroform extracts had the highest flavonoid content of 5236.5 µg/100g fresh weight when compared to rest of the solvent extracts. Phenolic content was the highest in dichloromethane extracts (95.2 µg/g fresh weight). Antioxidant assays, including DPPH and ABTS methods, confirmed the potent radical scavenging activity with chloroform and dichloromethane extracts showing inhibition rates above 80%.

(G.S. Suresha, K. Hari, M. Nisha and R.T. Maruthi)

Sub-cellular targeting of invertase inhibitory proteins: A novel approach to enhance sucrose yield in sugarcane

The Southern blotting analysis of invertase Inhibitor over expressed sugarcane transgenic events was carried using DIG labelled transgene specific probe to know the transgene copy number. Integration of transgene in the transgenic events varied from 2 - 6 copies in which the events P2+VT-3, P2+VT-16, P2+VT-18, P2+VT-25 and P2+VT-39 showed two copy number; the events P2+VT-9, P2+VT-40, P2-VT-2, P2-VT-5 and P2-VT-14 with three; the event P1+VT-3 showed four copies; events P1+VT-3 and P1+VT-12 with five copies and the event P1-VT-2 exhibited six copies in the genome. These results have clearly validated the presence of transgene in the PCR positive transgenic events. Although more than one copy number exists, it would not affect the performance of transgenic events due to vegetatively propagated nature of sugarcane.

(G.S. Suresha)

All India Coordinated Research Project (Sugarcane)

Agronomic performance of elite sugarcane genotypes

Fourteen new sugarcane genotypes were assessed along with three standard varieties under two fertilizer levels: F1 (100% RDF) and F2 (125% RDF). In general, 125% RDF showed slightly higher values for millable canes, single cane weight, and cane yield across genotypes.

Co 18003 (137.8 t/ha), Co 18002 (129.3 t/ha), CoVC 18061 and Co 18009 (125.2 t/ha) significantly outperformed all checks at both fertilizer levels. NMC ('000/ha) were highest in Co 18002 (100.23) and Co 18003 (99.30). Single cane weight was higher (>1.4 kg) in Co 18009 and Co 18012. The interaction effect indicated that Co 18003 and Co 18009 recorded marginal yield increases at F2; however, the differences were statistically non-significant, indicating limited fertilizer responsiveness. In contrast, Co 18013 and Co 18024 showed minimal variation, indicating stable performance under standard fertilizer levels.

Juice-quality traits (Sucrose %, CCS %, and CCS yield) were not influenced by fertilizer level, whereas genotype effects were significant for all three traits. The genotype Co 18003 recorded a mean sucrose of 20.24%, which was statistically at par with the standard checks Co 09004 (20.85%) and CoC 671 (21.05%). For CCS%, Co 18003 (14.12%) was comparable to Co 09004 (14.53%) but slightly lower than CoC 671 (14.80%) Importantly, Co 18003 achieved the highest CCS yield (19.47 t/ha), significantly surpassing the checks CoC 671 (14.67 t/ha), Co 09004 (13.96 t/ha), and Co 86032 (13.53 t/ha). Overall, Co 18003 combines high juice quality with superior recoverable sugar and emerges as the most promising entry.

Evaluation of new herbicide molecules for weed management in sugarcane plant crop: Nine combination of new herbicide molecules were tested in sugarcane plant crop under field condition. All the herbicide treatments recorded significantly higher yield than the weedy check (control). Among the herbicide treatments, pre-emergence application of Clomazone + Sulfentrazone @ 2.5 kg/ha followed by one inter-cultivation at 60 DAP recorded the highest cane yield (102.62 t/ha), weed control efficiency (86.5%) and lower weed index (3.28) and on par with other treatments except treatments pre emergence application of Atrazine 80% WP @ 2.5 kg/ha followed by one inter-cultivation at 60 days after planting (partial earthing up) and post emergence application of 2,4 D Na salt @ 2.5 kg/ha at 2-4 leaf stage of weeds followed by earthing up at 120 DAP. Juice quality was not significantly influenced by the different weed management practices. Multiple treatments improved CCS yield over the control, aligning with their yield response. Among herbicides, the highest net return and B:C ratio was obtained with pre-emergence application of Clomazone + Sulfentrazone @2.5 kg/ha followed by one inter-cultivation at 60 DAP, and post-emergence application of 2-4 D sodium salt + Metribuzine + Pyrazosulfuron ethyl @3 kg/ha at 2-4 leaf stage of weeds, followed by earthing up at 120 DAP.

Evaluation of liquid nano urea for its efficacy in enhancing N use efficiency: Leaf greenness (SPAD), single-cane weight and sucrose % were not significantly affected, indicating quality *per se* was stable across schedules. Differences appeared in cane yield and CCS yield. The RDN applied as 50% basal and rest through three nano-urea sprays at 30, 60 and 90 DAP recorded the highest cane yield (93.9 t/ha) and CCS yield (12.61 t/ha), both at par with the conventional check (87.85 t/ha; 12.21 t/ha). The RDN applied as 50% basal and rest through two sprays (45 & 90 DAP) and the RDN applied as 50% basal and rest through three sprays (45, 90 & 135 DAP) were also statistically at par with the check for cane yield (86.6 and 82.2 t/ha, respectively) and CCS (11.79 and 11.43 t/ha). Half of RDN applied as 50% basal and the rest through nano foliar spray and 75% of RDN applied as 50% basal and the rest through nano foliar spray at various intervals reduced the cane and CCS yield.

(K. Kannan, P. Geetha and S. Anusha)

Externally Funded Projects

Intellectual Property Management and Technology Transfer/ Commercialization – Institute Technology Management Unit (ITMU) (National Agricultural Innovation Fund Scheme (NAIF) - Component I, IP & TM, ICAR)

ITMC and techno commercial meetings of Agri-innovate were conducted to take decisions on different aspects pertaining to technology disclosures, patent applications and commercialization of technologies developed by ICAR-SBI. MTA was signed between ICAR-SBI and ICAR-CICR for two novel Cry8 genes discovered by ICAR-SBI towards the development of transgenic cotton for the management of cotton stem weevil. Registration certificates for Co 12029 (Karan 13), Co 18009 and Co 13035 (Karan 14) was obtained from PPV&FRA. Copyright applications were submitted for 14 publications of which five certificates were received. Licensed the following technologies *viz.,* SBIEC14006 - An energycane with high biomass production, ICAR-SBI EPN Biopesticide formulation to two firms, *Cotesia flavipes* and *Telenomus dignus* mass multiplication technology against internode borer with release station and sugarcane variety Co 17018 were licenced and totally 10 MoUs were signed.

(K. Hari, V. Krishnapriya and Kona Praveen)

Networking project on Improving water use efficiency and economizing water use in sugarcane cultivation in sub-tropical India (ISMA)

To develop water saving agro-techniques for sugarcane in subtropical and tropical India and to assess the irrigation water requirement of the most prominent crops / cropping systems with sugarcane, a field study was conducted with different methods of irrigation in tropical India (ICAR-SBI, Coimbatore). Cane yield was significantly high in drip irrigation (152.10 t/ha) followed by trash mulching (136.4 t/ha) and skip furrow irrigation (118.0 t/ha). The irrigation water applied was comparatively less (560.0 mm/ha) in drip irrigation system followed by trash mulching (773.8 mm/ha) and skip furrow (820.6 mm/ha), respectively when compared to farmers practice (908.4 mm/ha) and prominent cropping system (1380.2 mm/ha).

(P. Geetha and S. Anusha)

Agricultural Drone Project funded by ICAR-Agricultural Technology Application Research Institute, Hyderabad under Sub Mission on Agricultural Mechanization: Drone Technology Demonstration

Demonstration of sprayer drone technology: A total of 257 field demonstrations of agricultural sprayer drones were conducted covering 200 ha in sugarcane farmers' in Ariyalur, Tiruchirappalli Kallakurichi, Tiruvannamalai and Erode districts (Fig. 48). Micro-nutrient mixtures and plant protection chemicals were applied using drones. The drone operated at 2 m above the crop canopy, could spray 10–13 L per 0.5 acre in 10 minutes. The major advantages observed in drone spraying included time saving, rapid coverage, reduced labour requirement, minimal chemical exposure, water saving, and uniform spray coverage. However, limitations observed were spray drift, unsuitability in fields with coconut border/ intercrops or overhead power lines, requirement of skilled/licensed pilots and difficulty in using powder formulations. Key measures suggested for accelerating adoption include large-scale demonstrations, sensitization of farmers and stakeholders (sugar factory personnel, agricultural officers), training and engagement of rural/ unemployed youth, financial support to offset high initial investment, and standardization of SOPs for different crops and chemical application levels.

Fig. 48. Field demonstration of sprayer drone technology

(T. Arumuganathan and K. Kannan)

5.3 Crop Protection

5.3.1 Plant Pathology

Host resistance, interactomics, pathogen variability, diagnosis and disease management in sugarcane

Screening of sugarcane progenies and germplasm for red rot resistance

Screening for red rot under controlled condition testing: A total of 3588 breeding clones from various trials *viz.*, parental clones from NHG and germplasm, clones from drought and waterlogging tolerance screening, ISH derivatives, clones from IGH, DUS and PZVT (2025 series), cytotypes of *S. spontaneum*, genetic stocks, inbreeding, genomic selection and various clonal trials were screened in CCT chamber. Among the screened clones, 521 clones (14.93%) were free from red rot infection, rated as resistant (R) and 754 clones (21.61%) were categorized as moderately resistant (MR). About 1367 clones (39.18%) were rated as susceptible (S); 616 clones (17.66%) as moderately susceptible (MS) and 231 clones (6.62%) were rated as highly susceptible (HS).

(R. Selvakumar, A. Ramesh Sundar, P. Malathi, V. Jayakumar, R. Ramesh, R. Gopi and A. Jeevalatha)

Field tolerance to red rot

Six PZVT clones of 2023 series along with two standards were planted in field both under pathogen inoculated (CF06 soil borne inoculum) and healthy conditions to test their field tolerance. Under pathogen inoculated condition, the clones PZVT 2023-20 and PZVT 2023-156 showed reduction in germination, when compared to healthy condition, indicating germination loss due to red rot disease. Monitoring red rot incidence throughout the crop season recorded 73.8% incidence in susceptible check CoC 671 and no incidence in Co 86032, while the clones PZVT 2023-33 and PZVT 2023-217 showed least incidences *i.e.*, 4.1% and 1.3%, respectively and the clone PZVT 2023-51 showed no incidence of red rot, indicating field tolerance comparable to Co 86032.

(V. Jayakumar and R. Selvakumar)

Sugarcane quarantine [NHG & NAG]

Four clones (CoS 15233, CoN 13072, CoN 13073, CoN 15071) were handed over to NHG and eight clones (CoS 19231, CoS 19235, CoA 12323, CoN 18071, PDN 15006 / MS 16081, Co 18022 and CoVSI 16121) were handed over to NAG after due quarantine.

(R. Selvakumar and A. Ramesh Sundar)

Virus Indexing

Sixty four samples including 54 samples of Co 86032 from tissue culture lab of the Institute were processed for virus indexing. RT-PCR was followed for all the viruses using coat protein primers and nested PCR was followed for the SCGS phytoplasma. Test results showed that 96%, 80%, 94% and 44% (24/54) of TC materials were free from SCYLV, SCMV, SCSMV and SCGS phytoplasma, respectively. Two TC samples of Co 86032 received from EID parry, Pugalur for YLD and GSD diagnosis were found positive. Out of nine samples of CoM 0265 and Co 86032 received from Verdant Bio- Agri LLP, Bagalkot, Karnataka, seven samples for SCYLV, three samples for SCMV and four samples for SCSMV were found to be free.

(K. Nithya and P. Malathi)

Smart delivery of agro-inputs using Sett Treatment Device for biotic and abiotic stress management in sugarcane and other vegetatively propagated crops

Sugarcane: Efficacy of mechanized priming of planting material with physical, chemical and biological agents has been validated with six ICAR

Institutes for pest and disease management in vegetatively propagated crops. Single bud setts of CoV 92101 having combined infection of YLD and GSD were subjected to dual treatment with hot water at 55°C followed by nursery inputs *viz.*, fungicide, insecticide and nutrients to have an integrated approach to eradicate fungal and non-fungal pathogens and planted directly in the main field. While planting, spot application of bioformulation with *Trichoderma* over the setts was done. Combination of dual sett treatment and spot application of bioformulation significantly reduced the expression of GSD incidence (<1%) as against 100% in infected control, while, intensity of YLD has been reduced to 1-2 grade as against 4-5 grade in untreated CoV 92101 (Fig. 49) along with improvement in growth and yield attributes. Similarly, subjecting setts of Co 97009 having smut infection for double treatment in hot water

Control Plot   Treated Plot

Fig. 49. Efficacy of dual treatment with hot water followed by nursery inputs and soil application of bioformulations on non-fungal diseases *viz.*, GSD and YLD in CoV 92101

Heavy inoculum from nearby Co 96007 and Co 97009

Co 97009 setts treated with hot water at 54°C followed by Propicanazole   Treated   Inoculum source

Fig. 50. Efficacy of dual treatment with hot water and fungicide on sett borne infection of smut incidence in Co 97009 with heavy inoculum from nearby field

at 54°C followed by propiconazole had no incidence of smut as against 100% infection in untreated plot till harvest (Fig. 50).

Besides, integrated disease management strategy has been demonstrated in National Hybridization Garden (NHG - 440 clones), by treating two budded setts in Sett Treatment Device (STD) with chemicals and soil application of *Trichoderma* enriched FYM. Monitoring the crop indicated that there was no incidence of pokkahboeng and mealy bug throughout the crop. However, permanent wilting in some of the clones need rejuvenation. Mechanized priming technology has also been adopted for other field trials for nursery and direct planting.

Other crops: In banana, treating corms in hot water followed by chemicals (fungicide, insecticide and nutrients) and planting in soil mixed with bioformulation had significantly improved the growth and yield attributes. It indicates that, the best treatment could be employed for integrated management of pests and diseases in banana (NRCB). In IISR, efficacy of hot water treatment for nematode eradication in turmeric and bacterial rot in ginger along with improvement on germination and vigour has been proved. Besides, efficacy of fungicides and bioagents on *Fusarium* management has been validated in ornamental crops by IIHR. Following the confirmation on reduction in mosaic and mealybug incidence by subjecting the tapioca planting material to hot water followed by agro-inputs containing insecticide, CTCRI had installed Hot water Treatment facility for further standardization. In ISRI, Lucknow, mechanized priming based healthy nursery programme has been initiated through KVKs.

(P. Malathi, A. Ramesh Sundar, R. Selvakumar, V. Jayakumar, K. Nithya, A. Vennila, T. Ramasubramanian, T. Rajula Shanthy, R. Gomathi, R. Viswanathan (ISRI); Ravindra Naik (CIAE); S.S. Veena (CTCRI); R. Thangavelu (NRCB) and Priti Sonavane (IIHR))

Sugarcane phytoplasma diseases: diagnosis, understanding the molecular mechanism of plant host phytoplasma interactions

Host plant changes upon phytoplasma infection through transcriptional profiling was carried out in four varieties (Co 16006, CoV 92101, Co 86032, CoC 671). Leaf samples were collected from healthy and GSD infected clumps of the four varieties. High – quality RNA samples with RIN value >6.0 were used for the construction of cDNA libraries and were sequenced on HiSeq 4000 (Illumina, USA) to generate paired end reads (2X 150bp) of about 5-10GB quality reads/ library. De novo transcriptome assembly of sugarcane RNA-seq data generated a total of 160079 transcript contigs, with an average transcript length of 679.64 bp and number of expressed genes 143274. The sequence length of the shortest contig at 50% of the total assembly length *i.e.*, N50 was 650bp and GC content was 51.5%. The total assembled transcriptome size was approximately 108795999 bp, representing a comprehensive coverage of expressed genes across healthy and phytoplasma-infected samples.

In the healthy Vs diseased comparisons, the upregulated transcript varied from 2523 to 795 and downregulated transcript varied from 2862 to 665, of which 1637 to 291 transcript were unique from upregulated and 1290 to 54 transcripts were unique for downregulated, while two and seven transcripts were common within upregulated and downregulated transcript. In the diseased vs diseased comparisons, the upregulated transcript varied from 536 to 54 and downregulated transcript varied from 207 to 48, of which 681 to 26 transcripts were unique from upregulated and 203 to 48 transcripts were unique for downregulated, while no common transcript within upregulated and downregulated were found. Heat map analysis of DEGs related to defence, phytohormone biosynthesis and photosynthesis showed that more than 80 genes related to phytohormone biosynthesis followed by defence and photosynthesis genes were downregulated in phytoplasma-infected plants compared to healthy plants in all six different combinations.

(K. Nithya, R. Manimekalai, M. Punithavalli and V. Krishnapriya)

Structural and functional characterization of endophytic bacterial microbiome of sugarcane

Functional characterization of endophytic bacteria

Assessing antagonistic potential: The endophytic bacteria isolated from two varieties *viz.*, Co 86032 and Co 0238 were screened *in vitro* for their antagonistic potential against red rot and wilt pathogens by dual culture technique. Among 240 bacteria isolated from Co 86032, 11 bacterial strains *viz.*, SEC 8, SER 64, SER 66, SER 67, SEL 92, SEL 155 SEL 170, SER 131, SER 146, SER 149 and SER 153 showed very strong antagonistic potential (>75% mycelial growth inhibition) against *C. falcatum*, while 11 bacteria have strong

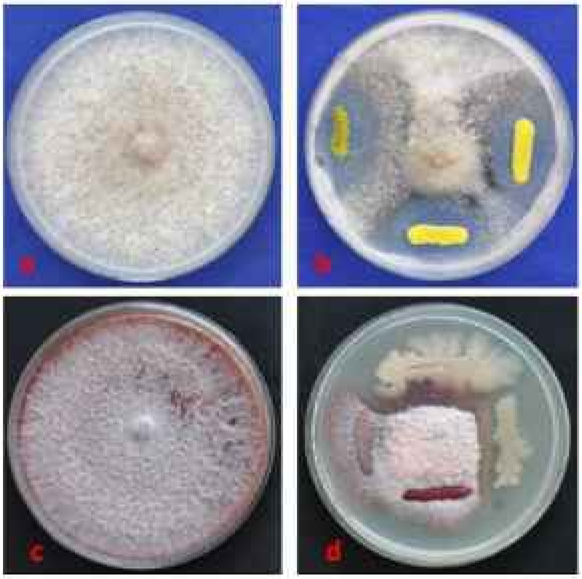


Fig. 51. *In vitro* antagonistic properties of endophytic bacteria against *C. falcatum* and *F. sacchari*. *a. C. falcatum control; b. C. falcatum mycelial growth inhibition by endophytic bacteria. c. F. sacchari control; d. F. sacchari mycelial* growth inhibition by endophytic bacteria

antagonistic potential against *F. sacchari*. Among 139 bacteria isolated from Co 0238, seven bacterial strains *viz.*, SEL 92, SEL 155, SEL 170, SER 131, SER 146, SER 149 and SER 153 showed very strong antagonistic potential against *C. falcatum*, while four bacterial strains *viz.*, SEL 170, SEC 129, SER 146 and SER 153 showed very strong antagonistic potential against screening against *F. sacchari* (Fig. 51).

Assessing Plant Growth Promoting (PGP) properties: A total of 104 endophytic bacteria were screened for various PGP properties and among them six (SEC 4, SEC 29, SEC 38, SEC 45, SEC 50, SEC 57) were identified as high ammonia producers (+++ qualitative grade), three bacteria (SEC 34, SEC 45 and SEC 50) were high phosphorous solubilizers, 21 were high Zn solubilizers, 14 were very high siderophore producers and 13 bacteria produced high Indole acetic acid (IAA >200µg/ml). The endophytic bacteria exhibiting clear zones as indication of P and Zn solubilisation are presented in Fig. 52.

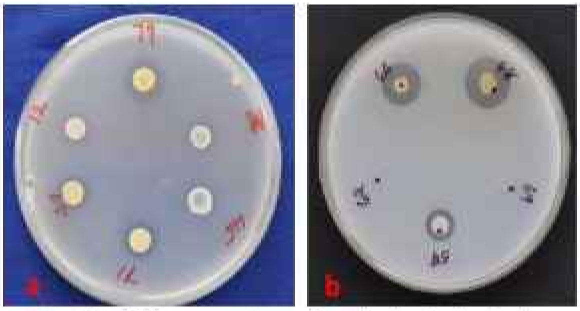


Fig. 52. PGP properties of endophytic bacteria a. *P solubilization*; b. *Zn solubilization*

Assessing abiotic stress tolerance properties: A total of 127 endophytic bacteria were screened for salt stress through *in vitro* qualitative assay and 114 bacteria were screened for tolerance to drought by assessing bacterial growth in PEG amended media. Thirty bacteria possessed tolerance up to 15% of NaCl in media, while two bacteria *viz.*, SEC 81 and SER 118 exhibited very high drought tolerance by exhibiting growth (>0.4 OD value) even in 30% PEG amended media.

(V. Jayakumar, R. Gopi, P.T. Prathima and K. Hari)

Characterisation of *Fusarium* species associated with sugarcane *Pokkahboeng* (PB) and their management

Wilt: Five species of *Fusarium* (*F. sacchari, F.verticillioides, F. andiyazhi, F. hygamai, F. proliferatum*) were inoculated on eight varieties (Co 86002, CoT 8201, MS 901, Co 86010, ISH 100, Co 98010, Co 94012, Co 93009) individually to observe the wilt symptom development 60 days after inoculation in the field. All the species did not involve in inducing wilt and the severity of wilt varies with the *Fusarium* species (Fig. 53).

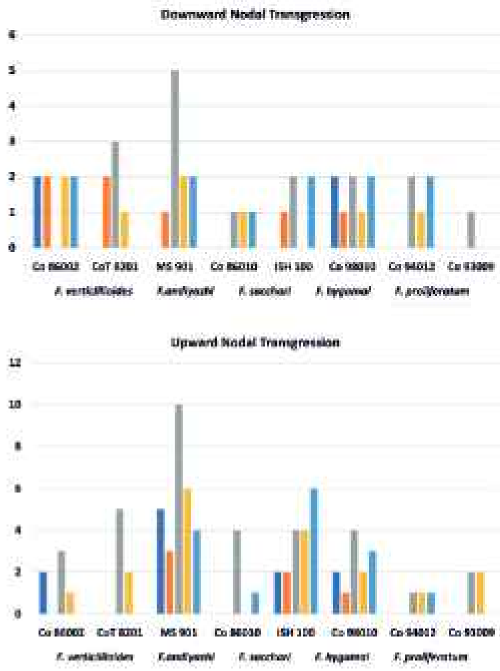


Fig. 53. Nodal transgression of *Fusarium* species on sugarcane

Pokkahboeng (PB): More than 100 samples from PB affected plants were collected and associated *Fusarium* spp. were isolated and maintained for further studies. Sixteen varieties were monitored for PB and mild incidence was noticed in most of the varieties. However, the varieties were sprayed with propiconazole @ 0.5 ml per litre of water using drone and newly developing leaves after spraying were free from PB symptoms. The phytotoxicity effect of propiconazole at various concentrations was tested through drone spraying and none of the tested varieties showed any phytotoxicity upto 2.0 ml per litre of water.

Nodal malformation was noticed in a clone at PB infected nodes. The affected portion with buds were planted in the field and the same malformed nodal symptom was noticed in six months crop after PB infection. It shows that the infection carried over from planting material. However, the entry was healthy and free from any wilt indicating the mechanism of wilt and PB are not the same, which needs further confirmation (Fig. 54).

Fig. 54. Observation of nodal malformation on planting of PB affected clone in the field

Physio-biochemical observations *viz.*, SPAD value, chlorophyll a, b, carotenoid contents, peroxidase, canopy temperature, relative abundance of auxin, photosynthetic rate, transpiration rate, stomatal conductance, were recorded in the *pokkahboeng* infected and healthy plants of Co 86032 and Co 18009. The PB affected crop showed significant reduction in chlorophyll a, chlorophyll b, total chlorophyll, carotenoid contents, and auxin content in the leaf. Analysing 10 years of weather data recorded at SBI indicated that, PB appeared in May when RH reaches high (87%) after dry summer in April and maximum temperature comes down (35°C) (Fig. 55).

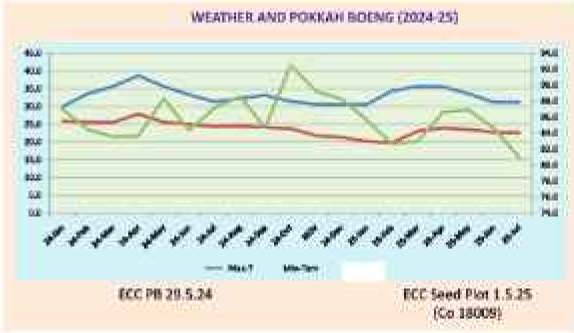


Fig. 55. Weather parameters and PB expression in the field during 2024- 2025 crop season

(R. Selvakumar, V. Jayakumar, R. Gopi, R. Arun Kumar and M.L. Chhabra)

Deciphering the mechanism of gain of virulence in *Colletotrichum falcatum* vis-à-vis breakdown of red rot resistance in sugarcane

Genome sequencing of C. falcatum: Three designated *C. falcatum* pathotypes were sequenced by both long read and short read platforms. Initial analysis of data indicated that the genome size is about 50Mb. GC content of the genome ranged from 50.49 to 50.81. About 12,000 genes are predicted from the assembled contigs using BLASTX programme. The top BLASTX hit of each gene was studied and the organism's name was extracted.

Multi Locus Sequence Typing (MLST) of C. falcatum: MLST analysis of 13 *C. falcatum* pathotypes using six genes was carried out. All sequences were submitted to NCBI GenBank, and accession numbers were obtained. The phylogenetic tree of six genes (*act, cal, chs 1, his3, ITS, tub 2*) showed that the sequences of all 13 pathotypes were grouped with the type culture CBS147945. Sequences of all other species were formed into separate clusters based on their closeness. *C. falcatum* pathotypes are closely related to *C. sublineola, C. graminicola* and *C. cereale*.

Interaction between C. falcatum *pathotypes and sugarcane host differentials*: Detached leaf assay in

20 sugarcane differentials with 13 *C. falcatum* pathotypes revealed that the sporulating pathotypes caused more lesion length compared to non-sporulating pathotypes. Further, field inoculation of 22 sugarcane differentials with 13 *C. falcatum* pathotypes by standard plug method showed that, each differential had showed varying level of disease reaction towards the tested pathotypes.

(R. Ramesh, A. Ramesh Sundar and A. Jeevalatha)

Exploration of rhizosphere microbes for the management of red rot (*Colletotrichum falcatum*), wilt (*Fusarium sacchari*) in sugarcane

A total of 41 rhizosphere soil samples were collected from different sugarcane growing areas of Tamil Nadu, Kerala, Uttar Pradesh, Bihar, Maharashtra, Haryana, Andhra Pradesh, Telangana and Madhya Pradesh, from which, 158 bacterial cultures and 85 actinobacterial cultures were isolated. In the dual culture study, 14 rhizosphere bacterial cultures recorded more than 50% inhibition of F. *sacchari* with highest inhibition rate of 80% and 71.25% was observed in T2 and T4, respectively both collected from the Triveni sugar mill, also N3 (78.60%) and N6 (76.20%) both from Narkatiaganz. Among the actinobacterial isolates tested against wilt pathogen, two isolates Na4 and Ba1 from Narkatiaganz and Bundhi recorded 53.75% and 62.50% inhibition, respectively. In the antagonistic activity against the *C. falcatum*, 32 bacterial isolates recorded more than 50% inhibition. Among the *Actinobacteria* tested against the red rot pathogen, 21 isolates recorded more than 50% inhibition and the highest inhibition rate of 66.25% was observed in isolate Kna4 (Fig. 56).

Fig. 56. *In vitro* effect of Kn28 (*Rhizobacteria*) and Kna4 (*Actinobacteria*) on *Colletotrichum falcatum*

(R. Gopi, V. Jayakumar, M.L. Chhabra, T. Ramasubramanian and G.S. Suresha)

Genome-wide analysis of effector coding genes in *Colletotrichum falcatum* and identification of their counterparts in sugarcane

The protein sequences of *C. falcatum* were used as input in SignalP 6.0 software to identify proteins with signal peptide. Deep TMHMM 1.0, a deep learning protein language model-based algorithm and Pred-GPI web server were used to exclude proteins with transmembrane domain and ER retention signal. Further the short-listed proteins were used as input in Effector P3.0, a machine learning model to predict effectors. About 302 proteins were found to be effector proteins with high cysteine residues and ≤ 300 amino acids length which were either cytoplasmic or apoplastic in nature. DeepLoc 2.1 was used to know the localization nature of the predicted effectors.

Identification of crucial effectors involved during *C. falcatum* infection in sugarcane was initiated with the transcriptome data of susceptible and resistance cultivars inoculated with *C. falcatum*. The high-quality reads were mapped against the reference (GCA_ 030867235.1_Colfa1 _genomic.fna) *C. falcatum* genome using the Hisat2 genome assembler. Differentially

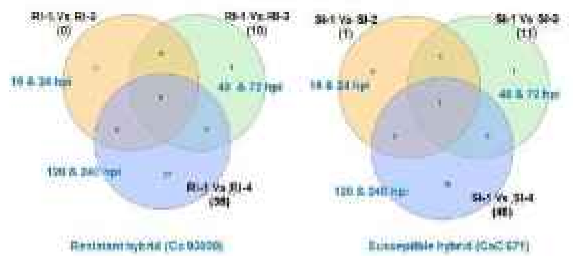


Fig. 57. Unique and common differentially expressed effectors during *C. falcatum* infection in sugarcane

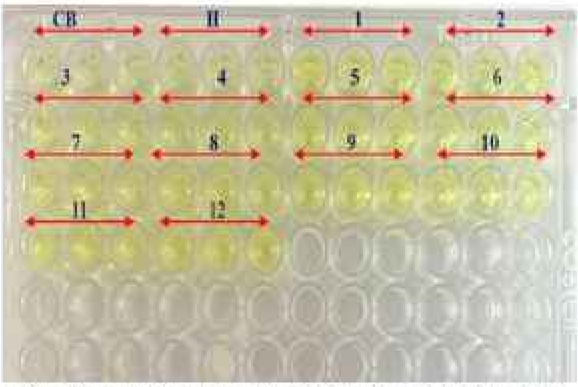
expressed *C. falcatum* genes with P-adj value <= 0.05 and log2 fold change, +2 for up and -2 for down regulated was found using the DESeq2 package of R. Venn diagram was drawn to identify common and unique differentially expressed effectors at different time points of inoculation in resistant (Co 93009) and susceptible (CoC 671) sugarcane cultivars (Fig. 57).

(A. Jeevalatha, R. Ramesh, A. Ramesh Sundar, G.S. Suresha and P.T. Prathima)

Externally Funded Projects

ICAR-CRP on Development and application of diagnostics to viruses and phytoplasmas infecting sugarcane

Sugarcane yellow leaf virus (SCYLV) coat protein gene expression, recombinant protein production and purification was standardized using prokaryotic and eukaryotic expression vectors. The concentration of the purified protein was 0.75mg/mL which was sent for the Polyclonal antisera production for immunological diagnosis work. Polyclonal antibody (pAb) was standardized from 1: 500 to 1: 10000 using the purified protein as well as the crude protein of the symptomatic (Co 10031) and apparently healthy (Co 62399) samples by DAC- ELISA method. Host plant crude protein extraction was standardized using 1M phosphate and carbonate buffers. Primary antibody showed intense yellow color development and three to four times higher OD value @1: 500 and 1: 1000 with 1:10000 secondary antibody concentrations when compared to apparently healthy and buffer control (Fig. 58). Along with the field samples, TC-0 samples from Co 11015 and Co 86032 were also tested. Nearly, 40 YLD samples showing HS grade were tested with the newly developed DAC- ELISA method which showed OD in the range of 0.392 to 0.690. Further validation on DAC- ELISA with more number of samples and species clones and DAS-ELISA development is in progress for precise immunological diagnostics.



CB- Carbonate buffer; H- Healthy (Co 62399); 1- CoS 96260; 2- LG 06810; 3- BO 128; 4- CoPant 18211; 5- CoPant 12226; 6- CoV 94101; 7- CoP 15437; 8- CoS 03261; 9- CoA 13321; 10- CoS 97261; 11- CoLK 9412; 12- CoH 76

Fig. 58. DAC- ELISA reactions of YLD samples from different varieties

(K. Nithya, R. Selvakumar and D. Neelamathi)

Mechanized priming of planting material and technology popularization for revival of sugarcane productivity in Tamil Nadu (RKVY)

Sugarcane nursery units were established in 10 sugar mills of Tamil Nadu by providing Sett Treatment Device (STD) units. Training and demonstrations to the factory staff and entrepreneurs on mechanized means of treatment of single bud setts with the combination of fungicide, insecticide and nutrients for healthy nursery programme were conducted. All the selected sugar mills started supplying settlings from setts treated with various agro-inputs. Based on the demand of farmers, Tamil Nadu Government under NADP-RKVY-DRP based projects, approved 100 units on subsidy for developing entrepreneurship in all the mills including co-operative, public and private mills @ 1 to 6 units/sugar mill. Out of 100 sanctioned units, training was given to 60 entrepreneurs coming under 11 co-operative sugar mills and 2 public sugar mills (Fig. 59a). During the 13 training and demonstrations conducted for the entrepreneurs, 506 participants were benefitted with respect to healthy settling production. Two five-days training program on 'Recent technologies for improving productivity in sugarcane' was conducted during 8-12 and 22-26 September 2025 for cane staff of 12

Fig. 59a. Training cum demonstrations for entrepreneurs of Tamil Nadu

Fig. 59b. Participants of training programme

cooperative and two public sugar mills with 26 and 21 participants, respectively (Fig. 59 b).

Apart from healthy settling production, model farms established with Settling Transplanting Technology (STT) demonstrated the significant improvement in yield with recent varieties *viz.*, Co 18009, Co 14012 and Co 11015 at the Institute and with Co 86032 in factory areas.

(P. Malathi, A. Ramesh Sundar, T. Rajula Shanthy, A. Vennila, T. Ramasubramanian, R. Selvakumar, R. Gopi and Ravindra Naik (CIAE-RS, CBE))

Decoding the molecular events of PAMP-triggered immunity (PTI) by unlocking the interactome of the PAMP-CfEPL1 of *Colletotrichum falcatum* during interaction with sugarcane (DST-SERB)

The project is envisaged to identify interacting partners of the PAMP-CfEPL1 of *C. falcatum* in sugarcane using CoC 671 and Co 86032 (red rot susceptible and tolerant cultivars, respectively). *Cf*EPL1 gene was cloned in pCAMBIA1302 vector (Fig. 60a) backbone under 35S promoter upstream to the GFP coding sequence and 6xHis tag for transient expression of *Cf*EPL1 proteins in sugarcane protoplasts, which are analysed microscopically for GFP fluorescence indicating expression of fusion protein (Fig. 60b). Results indicated successful expression of EPL1 gene fused with Green Fluorescent protein (GFP) in sugarcane protoplasts. Expression and purification of recombinant EPL1 for *in vitro* pull down assay was undertaken to identify the interacting host receptor proteins. The studies to co-purify interacting proteins from the sugarcane leaf total protein extract using purified *Cf*EPL1 as a bait is under progress.

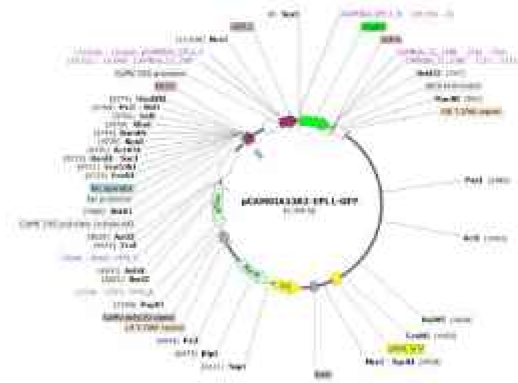


Fig. 60a. Vector map of pCAMBIA:EPL1::GFP

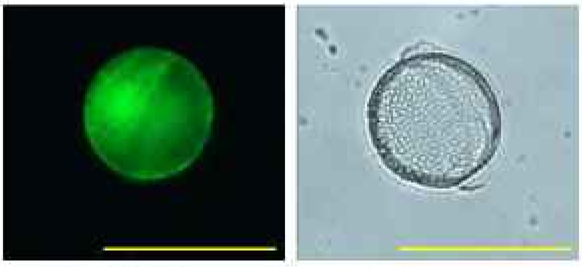


Fig. 60b. Microscopic analysis of sugarcane protoplasts for GFP fluorescence (Scale bar = 50 μm)

(A. Ramesh Sundar, V. Jayakumar, G.S. Suresha and P. Malathi)

Development of onsite field diagnostics to sugarcane grassy shoot *disease* Candid at us phytoplasm as acchari by RPA-LFD method to ensure healthy seed chain and sustain sugar production (DST-SERB)

Three sets of Recombinase polymerase amplification (RPA) primers were designed from the highly conserved region of *Candidatus phytoplasma sacchari* (SCGS phytoplasma) sequences submitted in NCBI, Genbank. All primer sets were standardized through gradient PCR with temperature of 45°C- 52°C, of which, the primer set 1 (RPA_FP1 and RPA_RP1) had shown intense amplification of 210 bp from the tested cvs. Co 86032, CoV 92101 and CoC 671. The same primer sets were tried for standardization under isothermal condition using the Twist Dx kit, which resulted in the expected amplification of 210bp at 30-37°C in different samples tested *viz.*, CoVC 17016, PZVT 2021-92, Co 86032, PI 16131, MS 17082, CoC 671, CoT 18368 and Co 0238.

(K. Nithya (ICAR-SBI), R. Viswanathan (ICAR-ISRI, Lucknow) and Susheel Kumar Sharma (ICAR-IARI, New Delhi))

Deciphering susceptibility ("S") genes for engineering red rot resistance in sugarcane through genome editing under All India Network Program (AINP) on biotech crops

Red rot resistance in sugarcane by genome editing of LOX3 gene

Red rot resistant (Co 93009) and susceptible (CoC 671) sugarcane varieties were inoculated with *C. falcatum* CF6. Samples were collected at different time points of post-inoculation. RNA-sequencing was performed and DEGs were analysed using the DESeq2. The possible association of LOX3 gene with susceptibility of sugarcane cultivar CoC 671 to red rot pathogen was confirmed using qPCR assay. The complete lipoxygenase gene sequence was screened for PAM site and two gRNAs from exon 1 and one gRNA from exon 2 region were identified using CRISPOR programme (Fig. 61). Secondary structure of gRNA scaffold was predicted using RNAfold web server. Polycistronic CRISPR construct with three gRNAs was developed in vector pRGEB32. The construct was mobilized into *Agrobacterium* strain LBA4404 through triparental mating and transformation was confirmed using the back-transformation into *E. coli*. *Agrobacterium* mediated transformation of embryogenic calli of red rot susceptible cultivars CoC 671 and Co 0238 were performed and the calli are in different stages of selection.

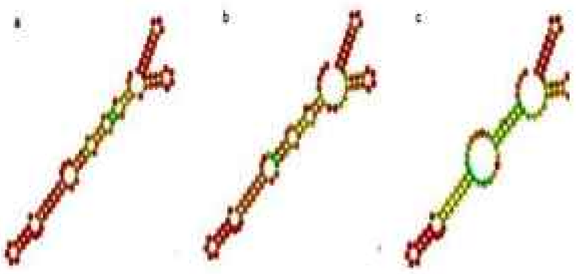


Fig. 61. Secondary structure of gRNA scaf old predicted using RNAfold web server a) gRNA1 and b) gRNA2, c) gRNA3

(A. Ramesh Sundar, R. Ramesh and A. Jeevalatha)

ICAR-genome editing project

Genome editing for red rot resistance in sugarcane

CAX4 was selected as a candidate gene to enhance resistance in sugarcane through CRISPR-Cas editing. CAX4 gene was amplified, cloned and sequenced from sugarcane cultivars/ clones *viz.*, CoC 671, Co 0238, Co 93009 and Baragua. Then, the CAX4 gene sequence was screened for efficient target sequences and location of PAM sites and off-target minimized gRNAs were

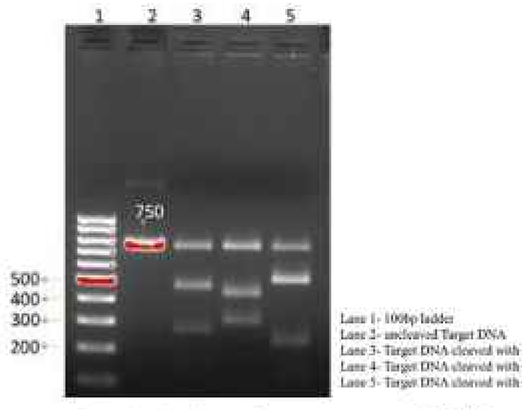


Fig. 62. *In vitro* cleavage assay of gRNAs targeting CAX4 gene

identified. Three guide RNAs from the exon region of CAX4 gene were designed using CRISPOR programme. The efficiency of sgRNAs to cleave the target DNA was confirmed using *in vitro* cleavage assay. CRISPR construct was developed in vector pRGEB32 with three guide RNAs and mobilized into *Agrobacterium* (LBA4404) through triparental mating. Transformation was confirmed using back-transformation into *E. coli* and PCR confirmation of hygromycin resistance gene, the Cas9 gene, and the Vir gene (Fig. 62). Transformation of red rot susceptible cultivars (Co 0238 and CoC 671) with the construct has been initiated and the calli are in different stages of selection.

(A. Ramesh Sundar, R. Ramesh and A. Jeevalatha)

Dissemination of technology on mechanized priming of planting material for sustainable sugarcane agriculture (NFSM)

Updating the technical inputs for raising healthy nursery was done through small scale training and demonstrations on the role of mechanized priming of planting materials using Sett Treatment Device (STD) in various locations of four sugar mills *viz.*, Hari Nagar, Hasanpur, Sidwalia and Narkatiaganj in Bihar. Also demonstrated the technology with STD, using different inputs *viz.*, thiophanate methyl alone or combination with Azoxystrobin and Tebuconazole/ Difenconazole @ 0.2 ml, Thiamethoxam 30FS/ Fipronil 5SC/ Imidacloprid (0.2 ml), commercial formulation of Ferrous sulphate (0.5 g), Zinc sulphate (0.5 g) and urea (0.5 g) per litre of water for the healthy nursery programme and to create awareness among cane officials and farmers about benefit of sett treatment on plant growth, pest and disease management in the main field (Fig. 63).

Besides, integrated red rot management strategy covering healthy seed/ nursery programme by mechanized sett treatment with effective fungicides, secondary application of fungicides by drenching/ sprays and application of bioformulations in the soil were advocated benefitting about 275 members including cane officials, entrepreneurs and farmers.

(P. Malathi, R. Gopi and M.L. Chhabra)

AICRP-Pathology

Identification of pathotypes / races of red rot pathogen

Ten red rot isolates *viz.*, *Cf*C24 -1 (Kucchipalayam), *Cf*C 24 -2 (Athiyur), *Cf*C 24 -3 (Soorapattu), *Cf* 11015 -1 (Villupuram), *Cf* 11015 -2 (Villupuram), *Cf*86032 (Vengathur), *Cf*PI 1110 (Sanimedu), *Cf*PI 1110 (Kanai), *Cf*V92012 (Alagramam) and *Cf*PI 1110 (Maragadhapuram) collected from various sugarcane cane growing districts were evaluated along with CF06 and CF12 against 15 differentials *viz.*, *Baragua, Khakai*, BO 91, Co 419, Co 997, Co 1148, Co 62399, Co 7717, Co 86002, Co 86032, Co 0238, CoC 671, CoJ 64, CoS 767 and CoS 8436. Of the tested isolates, *Cf*86032 (Vengathur), *Cf*PI110 (Kanai) and *Cf*PI110 (Sanimedu) was highly virulent on many of the differential varieties. The

Fig. 63. Training and demonstrations in sugar mills in Bihar

isolates *viz., Cf*11015 -1 (Villupuram), *Cf*V92012 (Alagramam) and *CfC* 24 -1(Kucchipalayam) expressed virulent reaction than CF12. The isolates from Co 11015 were moderately virulent on many varieties resulting in intermediate reactions on 4 varieties. Among the standard pathotypes, CF12 was more virulent than CF06.

(R. Selvakumar and R. Ramesh)

Survey of sugarcane diseases naturally occurring in the area on important sugarcane varieties

Field visits were carried out in farmer's field under command area of SNJ Sugars Ltd, Pennadam and Vellore district during December 2025. Spraying of propiconazole was recommended in PB affected Co 18009 field in Komavidanthal village in Virudhachalam, Cuddalore district. In another field grown with PI110 variety affected with YLD in Pennadam village of Cuddalore, the farmer was advised to go for recommended variety for that area.

(A. Ramesh Sundar, P. Malathi, R. Selvakumar, V. Jayakumar, R. Ramesh, R. Gopi, A. Jeevalatha and K. Nithya)

Evaluation of IVT/Zonal varieties for resistance to red rot, smut, YLD, brown rust and pokkahboeng

Red rot: Thirty-six clones including17 IVT, 5 AVT-I and 14 AVT-II were screened under field condition for red rot resistance against two pathotypes *viz.,* CF06 and CF12 by both plug and nodal methods. Among the IVT clones screened against CF06 pathotype, five clones *viz.,* Co 22005, Co 22007, Co 22009, Co 22010 and Co 22018 were rated as R and eight clones as MR by plug method, whereas 11 showed R reaction and five exhibited S reaction by nodal method of inoculation. Screening against CF12 pathotype by plug method identified four clones *viz.,* Co 22005, Co 22007, Co 22010 and Co 22018 as R, eight clones as MR, two as MS and two as S, while screening by nodal method showed that 10 were R and five were S to red rot disease. Among five AVT-I entries screened against CF06 & CF12 pathotypes one entry *viz.,* Co 20011 exhibited R reaction, while two were MR and two were MS by plug method, whereas three were R and two were S by nodal method of inoculation. In AVI-II screening by plug method two entries *viz.,* Co 19008 and CoT 18369 showed R reaction and the remaining 12 entries showed MR reaction by plug method, whereas in nodal method 13 entries exhibited R reaction and one entry showed S reaction. Screening against CF12 pathotype revealed four AVT-II entries as R and 10 entries as MR by plug method, while by nodal method 12 clones were identified as R and two as S.

(V. Jayakumar, R. Ramesh and A. Ramesh Sundar)

Smut: Among 17 IVT clones screened under field conditions, five clones *viz.,* Co 22012, CoSnk 22101, CoSnk 22103, CoSnk 22106 and CoSnk 22107 were R, three clones were MR, five clones were MS, twoeach were S and HS. Among five AVT-I clones, one entry (CoSnk 20103) was R one each was MR and MS and 2 clones were HS. Among 14 AVT-II clones, two clones (CoM 19081, CoT 19367) were rated as R, two clones as MR, one clone as MS, five clones as S and four clones as HS.

(R. Ramesh, R. Gopi and A. Ramesh Sundar)

Rust: IVT, AVT and ZVT trials were monitored for presence of rust and pokkahboeng at 15 days intervals. In PZVT, brown rust was observed in 2024-4, 11, 27, 36, 67, 77, 98, 105, 111, 158, 188, 189, 203, 208, 225, 251, 255 and 262. In AVT-I, rust was not noticed in any of the entries while, in AVT-II plant trials, the entries Co 19005 and CoT 18369 showed rust symptoms.

(R. Selvakumar and R. Gopi)

Pokkahboeng: In PZVT, pokkahboeng was noticed in 2024-22, 111, 123, 178, 184, 189, 196, 197, 227 and 231. In AVT-I, PB was observed in Co 20003 and

CoSnK 20103, while in VT-II plant trials, CoT 18368 alone showed PB symptoms under natural conditions.

(R. Selvakumar and A. Jeevalatha)

YLD: In IVT, out of 20 entries, eight were identified as R *viz.*,Co 22007, Co 22009, CoN 22071, CoSnk 22101, CoSnk 22106, CoSnk 22107 and the standards Co 86032 and Co 09004, six entries were S, five entries were MS and one had shown HS (Co 11015). In AVT I plant, out of eight entries, four entries were R *viz.*,Co 20003, CoM 20082, CoSnk 20103 and the standard Co 09004; three were S and the standard Co 11015 had shown HS. Of 17 entries in AVT II plant, 10 entries were R *viz.*, Co 19002, Co 19005, Co 19014, CoM 19081, CoR 19143, CoT 18366, CoT 18369, CoT 19366, and the standardsCo 86032, Co 09004; two were MS and the remaining five were identified as susceptible to YLD.

(K. Nithya and P. Malathi)

Efficient delivery of fungicides and other agro-inputs to manage major fungal diseases in sugarcane

Demonstration of mechanized delivery of plant protection chemicals or agro inputs using Sett Treatment Device for effective disease management and increased settling vigour: As earlier studies confirmed the efficacy of mechanized sett treatment on improved germination, settling vigour and yield along with reduction in incidence of fungal diseases, present investigation was carried out on efficacy of settling planting raised from treated single bud setts on the incidence of fungal diseases in the main field during 2024-25. For which, three field experiments were laid out with common set of treatments for single bud setts followed by raising settlings and planting 25 days old settlings in the main field. The treatments include T1–Mechanized sett treatment with Azoxystrobin-23SC – 0.5ml/ lit; T2–Mechanized sett treatment with Propiconazole 25Ec – 0.2ml/ lit (smut & wilt) or Thiophanate methyl 75WP – 0.5g/ lit (red rot); T3–Mechanized sett treatment with Azoxystrobin- 0.2ml + Propiconazole – 0.1ml/ lit (smut & wilt) or Thiophanate methyl 75WP – 0.3g/ lit (red rot); T4–Infected control and T5–Healthy control. Infected canes of Co 96007 for smut; Co 86032 for wilt were used as source of inoculum in setts. Grain based red rot inoculum was placed before planting the settlings of susceptible variety CoC 671. Observations till maturity indicated that, there was no disease incidence in red rot and wilt trial irrespective of treatments and control, which indicates efficacy of settling planting against diseases. While in smut trial, treating setts with Propiconazole or its combination with Azoxystrobin were found to be effective in reducing smut incidence. However, in all the trials, significant difference in yield attributes among treatments were observed.

(P. Malathi)

Management of YLD through meristem culture

Meristem culture derived tissue culture materials of Co 11015 and Co 86032 were maintained under field condition along with the infected control or diseased material and with the apparently healthy of the same variety. The TC seedlings of both the varieties had not shown any YLD whereas the diseased material had shown YLD with a severity grade of HS.

(K. Nithya, P. Malathi and D. Neelamathi)

AICRP on Biological Control

Pathology

Efficacy of bioagents for fungal disease management with improved plant growth attributes

Sett treatment and soil application of bioagents will be sufficient to take care of crop health under normal situation in sugarcane. However, with heavy inoculum pressure or in endemic situation,

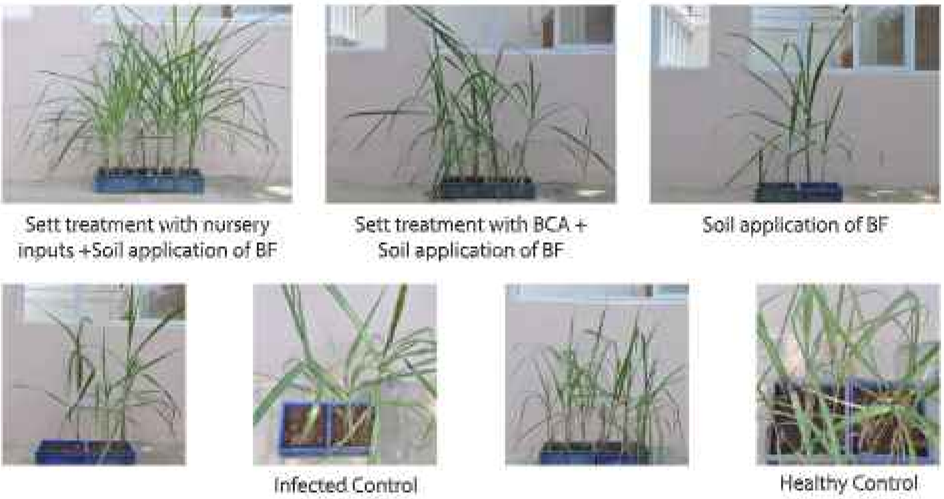


Fig. 64. Validation of integrated management strategy with nursery inputs and bioagents

treating setts with bioagents is not found to be effective to eradicate the primary inoculum. In contrast, treating setts with chemicals could protect the crop for short period and unable to protect the entire crop duration. Hence, an integrated approach involving sett treatment with nursery inputs and soil application of bioagents to manage pest and diseases and improve plant growth parameters (Fig. 64).

(P. Malathi)

5.3.2 Entomology

Studies on sugarcane pests and their management

Isolation of novel Bt isolates from biodiversity hot spots and functional validation of indigenous crystal toxin genes against sugarcane insect pests

Soil samples were collected from 85 locations in Assam for the isolation of novel *Bacillus thuringiensis* (Bt) isolates. In total, 420 soil samples(1g each) were collected from Assam,along with GPS details of each site. Similarly, 185 samples (1g each) were collected from 37 locations in Agati and Kavaratti Islands of Lakshadweep for Bt isolation. From the 320 soils samples collected from Assam,11 Bt isolates were successfully isolated.

Two novel *cry8 genes* from Bt 41 isolates isolated earlier, were cloned into a Bt shuttle vector for toxin expression and for conducting bioassay studies against the cotton stem weevil, *Pempherulus affinis,* in collaboration with ICAR-CICR Regional station, Coimbatore. The novel cry8 gene was well expressed in the shuttle vector, and preliminary bioassay studies revealed 80 to 90% mortality of the stem weevil larvae-fed on a toxin-contaminated diet, compared to control larvae fed on a diet without toxin.

(B. Singaravelu, C. Appunu, G.S. Suresha, C. Sankaranaryanan, K. Deva Kumar, P. Mahesh, T. Ramasubramanian and E.K. Saneera)

Prospects for conjunctive use of *Telenomus dignus* and *Cotesia flavipes* against internode borer (INB)

Mass multiplication technology of Cotesia flavipes *and* Telenomus dignus*:* Laboratory mass multiplication methods have been developed for the parasitoids using both target and alternative hosts. An improvised method has been standardized to scale-up the production of *Telenomus dignus* using the chimney and box method. In the box method, 55.6 -100.0%

parasitization was observed in eggs across different batches, whereas in the chimney method, parasitization ranaged from 71.3 to 95.0%.

Evaluation of Field Release Station (FRS) against Telenomus dignus: FRS was evaluated for the egg parasitoid *Telenomus dignus* in laboratory validation tests, in which ready-to-emerge *Telenomus* parasitoid eggs were placed in the device (Fig. 65). In four different tests, the percent egress was found to be considerably high, ranging from 75.00-100.0%.

Fig. 65. Field release station

Dispersal ability of Cotesia flavipes: The dispersal ability of the parasitoid *Cotesia flavipes* was studied in sugarcane ecosystem in five spots within an approximately 1 ha field. Parasitism levels varied from 5.0% to 15.0%. In these spots, the parasitized larvae showed an aggregated distribution, within a range of 20 to 50 m.

Field evaluation of parasitoids against INB: Field efficacy of *T. dignus* and *C. flavipes* was established in augmentative trials and enhanced post-release parasitism rates against INB (Table 14).

(P. Mahesh, B. Mahendran, R. Maruthadurai and E.K. Saneera)

Early detection of mechanism of resistance operating in sugarcane intergeneric hybrids against shoot borer, *Chilo infuscatellus* (Snellen) and internode borer, *Chilo sacchariphagus indicus* (Kapur) (Lepidoptera: Crambidae)

Evaluation of intergeneric sugarcane hybrids evolved from E. procerus *with 'Co' canes against borers:* A total of 89 intergeneric sugarcane hybrids (IGHs) developed from *E. procerus* × commercial sugarcane hybrids ('Co' canes) were evaluated under field conditions. Among these, GU 19-4, GU 19-7, GU 19-27, GU 19-28, GU 19-60, GU 19-61, GU 19-72, GU 19-78, and GU 19-85 exhibited a least susceptible (LS) reaction to early shoot borer (ESB), *Chilo infuscatellus*. Of the 89 IGHs, 25 were further subjected to artificial screening against ESB, wherein GU 19-22, GU 19-55, and GU 19-72 also showed least susceptibility.

Similarly, field screening of 89 IGHs derived from *Erianthus spp.* × 'Co' canes for resistance to INB revealed 12 LS, 24 MS and 54 S genotypes, respectively. Despite INB infestation, no significant reduction in internode length and girth was observed in ten clones. Considering both INB incidence and its effect on internode morphology,

Table 14. Augmentative evaluation of *Telenomus* sp. and *Cotesia flavipes* against INB

Treatment	Pre-treatment INB		Post-treatment INB				Post-treatment INB			
	Incidence	Intensity	30 days		% increase		60 days		% increase	
			Incidence	Intensity	Incidence	Intensity	Incidence	Inten	Incidence	Intensity
Release plot	7.9	6.1	9.3	3.7	18.1	-39.3	10.7	2.4	36.2	-60.2
Control plot	9.6	7.6	14.3	4.5	48.6	-40.3	14.5	3.0	50.5	-60.2

four genotypes GU 19-4, GU 19-22, GU 19-24, and GU 19-55 were identified as resistant to INB.

Evaluation of intergeneric sugarcane hybrids derived from Erianthus arundinaceus *with* Saccharum spontaneum *against borer pests:* Out of 15 IGHs developed from *E. arundinaceus* × *S. spontaneum* field-screened to assess their response against ESB and INB. Four genotypes (CYM 06-212, CYM 08-922, CYM 04-388, and CYM 07-971) exhibited complete resistance to ESB under field conditions. Further laboratory screening studies revealed that CYM 08-922 exhibited over 90% plant survival even under severe ESB infestation, indicating a high degree of inherent resistance. With respect to INB, evaluation based on borer incidence and its consequent effect on internode morphology identified three genotypes CYM 06-924, CYM 07-981, and CYM 08-922 as resistant.

Biological effects of energy canes against ESB and INB: Biological effects of Type I (SBIEC 11003, SBIEC 13010, SBIEC 11002 and SBIEC 14003) and Type II (SBIEC 14006, SBIEC 11004, SBIEC 11001 and SBIEC 14001) energy canes were studied against ESB and INB. The Type I-fed *C. infuscatellus* and *C. sacchariphagus indicus* larval survival rates were significantly high, resulting in > 41% and > 46% survival, respectively. However, it was lower with > 26% and > 36% survival in *E. arundinaceus*. Similar trend was observed for pupal survival rates of both *C. infuscatellus* and *C. sacchariphagus indicus* between the two types of energy canes. *Chilo infuscatellus* and *C. sacchariphagus indicus* larval

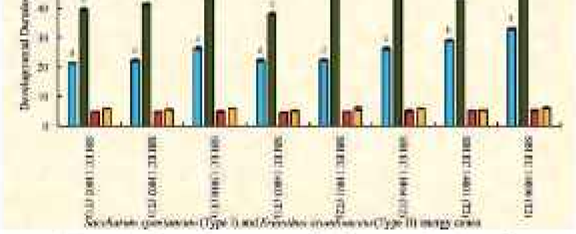


Fig. 66. Developmental characteristics of *C. infuscatellus* and *C. sacchariphagus* indicus on Type I and Type II energy canes

developmental duration differed significantly among Type I and Type II energy canes, ranging from 22 to 34 days and 39 to 52 days, respectively (Fig.66). Both borer larvae exhibited prolonged larval development on Type II energy canes than on Type I, indicating that Type II energy canes are comparatively less suitable for larval growth. The extended developmental duration suggests the presence of antibiosis- or tolerance-related traits in Type II energy canes, which may contribute to enhanced resistance against sugarcane borers.

Comparative gene expression analysis between shoot borer–infested and uninfested plants: Samples from Co 86032 and CYM 08-922 were collected at 24 h and two weeks after ESB infestation to study early and late host responses and total RNA were isolated from leaf and shoot tissues. cDNA was synthesized and gene-specific primers (Lipoxygenase (LOX) and glutathione-S-transferase (GST) were used for expression analysis, with 25S rRNA as the internal control. Generally, both LOX and GST activities were strongly induced during the early phase of infestation, particularly in leaves, highlighting their role in early defense responses. LOX activity remained elevated at later stages, with a more pronounced response in shoots, indicating its involvement in both early and sustained defense against insect infestation. In contrast, although GST activity also remained elevated at later stages, its levels were comparatively higher in control tissues than in infested ones, suggesting that GST plays a prominent role mainly during the early phase of defense following insect attack.

(M. Punithavalli and K. Mohanraj)

Use of endophytic *Metarhizium anisopliae* and *Beauveria bassiana* in sugarcane pest management

The strains of *B.bassiana*, *M. anisopliae*, *M.flavoviride*, *M. pinghaense*, *Paecilomyces lilacinus*, *Verticillium lecani*, *Aschersonia placenta*, *Hirsutella citriformis* and *Isaria fumosorosea* were preserved as cultures by four methods and as cadavers. The cultures stored in sealed agar plates and slants had significantly higher viability than the glycerol-stored and frozen cultures. Microscopic examination of spores, vegetative growth and sporulation on both solid and liquid media confirmed the maintenance of cultural and morphological fidelity. Virulence bioassays conducted against *Galleria*, ESB, and INB revealed no loss of pathogenicity. Further, 193 new entomopathogenic fungi (EPF) isolates were added to the repository for their potential role in sugarcane pest management. Protocols for cost-effective *in situ* mass multiplication of EPF to facilitate spatial and temporal establishment and spread in the field were also standardized.

(N. Geetha, T. Ramasubramanian and P. Shanmugam, TNAU)

Standardization of diet-based bioassay for white grub

Three types of diet combinations were evaluated for rearing of *Holotrichia serrata*. On diet 1, the mean survival period from egg laying to adult emergence ranged from 7.0 to 180 days, whereas on diet 2 it extended from 7.0 to 273. The shortest survival period was recorded on diet 3, ranging from 14.0 to158.0 days. On diet 1, the developmental duration of the egg, larval, and pupal stages ranged from 10–14, 114–178, and 14–21 days, respectively.

In diet 2, the larval period ranged from 118 to 168 days, while the pupal period lasted 14-21 days. Overall growth ratio was the highest in diet 2 and was significantly different from that observed in diet 1 and 3. A novel diet-incorporation bioassay method was developed as an alternative or supplement to the conventional carrot disc contamination method. Using this diet contamination bioassay, the spore-crystal mixture of Bt-62 produced on different media resulted in higher mortality (30.0-80.0%) in first-instar grubs.

(P. Mahesh and B. Singaravelu)

Bio-ecology of crown mealy bug and its management in association with *Pokkahboeng* in sugarcane

Crop loss due to crown mealybug infestation was studiedin the plant crop of Co 86032 during the 2024-25 cropping season. The reduction in cane yield at a 10% incidence level of the mealy bug was estimated as 9.1 t/ha, corresponding to a monetary loss of ₹30,940/ha, based on the Fair and Remunerative Price (FRP) of ₹3,400 per tonne fixed by the Government of India for the sugar year 2024-25. Field-level parasitization on the mealybug was also monitored from April to December, 2024 during which *Leptomastix sylvae* emerged as the dominant parasitoid. The extent of parasitism by *L. sylvae* ranged from 4.39 to 10.30% out of a total parasitism of 9.70-23.77%. The activity of *Promuscidea unfasciativentris* was also observed to be high with 3.65-13.46% of mummified mealybugs. Laboratory studies revealed a preference of *L. sylvae* for later nymphal instars, with mean parasitism of 33.16% on advanced instars compared to 22.00% when all instars were exposed. Further, it was also observed that the mean per cent parasitism was 32.92% when virgin female was allowed to parasitize the mealybug. This is on par with the mean per cent parasitism of 33.16% when both the sexes were allowed to mate and parasitize the population. Toxicity assays of insecticides to the parasitoid, *L. sylvae* indicated that thiamethoxam was relatively less toxic to *L. sylvae*, while field efficacy trials identified carbofuran as the most effective insecticide against *P. saccharifolii*. Besides, 63 EPFs, 35 *Metarhizum anisopliae* and 28 *Beauveria bassiana* isolates were screened for their pathogenicity against the mealybug, *P. saccharifolii*. Out of these, 15 *M. anisopliae* and 5 *B. bassiana* isolates exhibited high pathogenicity, causing 75-95% mortality.

(T. Ramasubramanian, R. Selvakumar and B. Singaravelu)

Isolation, characterization and utilization of entomopathogenic fungi for pest management in sugarcane

Isolation of entomopathogenic fungi from soil, their cultural and molecular characterization, and evaluation against major sugarcane pests were undertaken from 334 soil samples collected from Tamil Nadu (180), Assam (84), Himachal Pradesh (28), Kerala (26), Karnataka (14) and Madhya Pradesh (2). A total of 111 EPF isolates were obtained out of which 65 were identified as *Beauveria bassiana*, and the remaining 46 were *Metarhizium* spp. The isolated EPF were characterized by both cultural and molecular approaches; After 21 days of inoculation, radial growth ranged from 6.3 to 8.4 cm in *M. anisopliae* isolates and from 6.7 to 8.4 cm in *B. bassiana* isolates characterized by cultural methods. In *M. anisopliae*, the lowest and highest radial growth was recorded for SBI_TNTRY5_Ma and SBI_HPSLN9_Ma isolates, respectively. Similarly, in *B. bassiana*, the lowest and highest radial growth were recorded in the isolates SBI_TNOTY2_Bba and SBI_TNKDI_Bba, respectively. The spore count ranged from 7×10^6 to 1×10^9 spores mL^{-1} in *B. bassiana* isolates and from 7×10^8 to 1.1×10^{11} spores mL^{-1} in *M. anisopliae* isolates.

The fungal DNA barcodes generated in this study to confirm the identity of the isolated EPF were deposited in the NCBI GenBank. In addition to isolation and characterization, the EPF isolates were evaluated for their efficacy against ESB, INB and fall armyworm. A total of 17 *M. anisopliae* and four *B. bassiana* isolates were found to be highly pathogenic, causing 75–100% mortality of ESB. The *B. bassiana* and *M. anisopliae* isolates, namely SBI_HPSLN1_Ma, SBI_HPSLN2_Ma, SBI_HPSLN3_Ma, SBI_TNPLR_Ma, SBI_MPIDR2_Ma and SBI_TNTRY1_Bba were found to be highly virulent against ESB, causing 100% mortality in advanced instars. A total of 20 *M. anisopliae* and three *B. bassiana* isolates were found to be highly virulent, causing 75-100% mortality of the INB. Among these, SBI_HPSLN2_Ma, SBI_TNAKL_Ma, SBI_TNMRI_Ma, SBI_MPIDR2_Ma, SBI_TNTMI_Mp and SBI_TNTRY1_Bba were observed to be highly pathogenic, resulting in 100% mortality of advanced instars of INB. Further, 12 *M. anisopliae* and 13 *B. bassiana* isolates were found to be highly pathogenic to fall armyworm, causing 75-100% mortality. Among these, nine EPF isolates exhibited high virulence, resulting in 100% mortality of third-instar larvae. Of the EPF isolates tested against lepidopterans, seven *M. anisopliae* and one *B. bassiana* isolates were identified as broad-spectrum in nature, causing 80-100% mortality across all three species included in the study.

(T. Ramasubramanian, P. Malathi and B. Singaravelu)

Relationship between silicon content in *Saccharum* and *Erianthus* species with resistance to sugarcane borers

Quantification of silicon (Si) in popular sugarcane varieties and their relationship with ESB and INB incidence: Silicon profiling at the preferred feeding sites of sugarcane borers *Chilo infuscatellus* and *Chilo sacchariphagus indicus* in popular sugarcane varieties (Co 11015, Co 0212, Co 86032, Co 0238, Co 09004, Co 06030, and Co 06022) revealed that Co 06030 had the highest silicon concentration in the leaf sheath, followed by Co 06022 and Co 0238, whereas Co 11015 and Co 09004 showed the lowest silicon contents. Correlation analysis between silicon content in the rind and leaf sheath with ESB and INB incidence indicated a negative association between leaf sheath silicon content and the incidence of both borers. In contrast, rind silicon content showed no significant correlation with borer incidence.

Biological effects of silicon (Si) in S. spontaneum *on the biology of borer pests:* Silicon content was quantified in five *S. spontaneum* genotypes (TOBARCO, SES 519, IK 76 238, I 544, and SES 569), wherein, SES 519 exhibited the highest silicon concentration. To assess the influence of silicon on borer biology, leaf powder from SES 519 was incorporated into an artificial diet and evaluated against ESB and INB. The results were compared with those obtained from a standard sorghum leaf–based diet. Incorporation of silicon-rich SES 519 leaf powder significantly impaired the growth and development of both ESB and INB, as evidenced by reduced larval and pupal weights, prolonged larval duration, decreased fecundity and shortened adult longevity (Fig. 67). Furthermore, silicon deposits from different genotypes were visualized using high-resolution microscopy for detailed characterization studies.

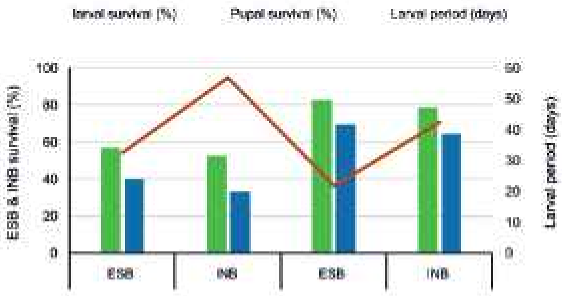


Fig. 67. Effect of silicon rich *S. spontaneum* (SES 519) on the biology of ESB and INB

(M. Punithavalli, A. Vennila and C. Jayabose)

Development of transgenics for resistance against sugarcane internode borer *Chilo sacchariphagus indicus*

Two crystal toxin genes, *cry8Sa1* and *cry9Eb*, isolated and identified from indigenous *Bacillus thuringiensis* (Bt) isolates were found to be effective against white grub (*Holotrichia serrata*) and INB, respectively, and both were codon-optimized for expression in sugarcane. Gene constructs for each toxin gene were developed using the pCAMBIA1305.1 vector, incorporating a GRP signal peptide and a vacuolar targeting sequence under the control of *Porterisia* ubiquitin promoter to achieve targeted expression in sugarcane stem and root tissues. Two gene constructs for two toxin genes *viz., cry9Eb* with vacuolar targeting sequence and *cry8Sa1* without vacuolar targeting sequence was developed and transformed into *Escherichia coli*. Recombinant plasmids were then mobilized to *Agrobacterium* strain LBA4404. Recombinant clones were confirmed by colony PCR and Sanger sequencing. Simultaneously, shoot meristem of sugarcane variety Co86032 was used as explant for callus initiation. Several batches of embryonic calli were developed and employed for co-cultivation with recombinant *Agrobacterium* harboring cry8Sa1 and *cry9Eb* genes. The co-cultivated calli are currently under hygromycin selection.

(B. Singaravelu, C. Appunu, G.S. Suresha and P. Mahesh)

Modelling climate change impacts on internode borer and stalk borer of sugarcane and its larval parasitoid

Impact of bioclimatic variables on the distribution of INB: Nineteen bioclimatic variables were downloaded from the WorldClim v2.1 database at a spatial resolution of 2.5 arc-min (~4.6 km). Occurrence records of INB were collected from AICRP on sugarcane entomology reports, published literature and field surveys, and the corresponding geographic coordinates were determined using Google Earth. Bioclimatic data for the baseline period (1970–2000) and future periods (2030 and 2050) were used to estimate present and future habitat suitability.

Impact of climate change on the biology of Cotesia flavipes*:* The impact of increasing temperature on the biological attributes of *C. flavipes* was studied under controlled laboratory conditions. Parasitised larvae of the internode borer (INB) were reared at 28°C in a BOD incubator. Fresh sugarcane shoots were provided to the parasitised larvae on alternate days. Key biological parameters, including larval duration, cocoon period, sex ratio, and adult longevity, were recorded. The larval and cocoon periods ranged from 10–12 days and 5–7 days, respectively. Adult survival varied between 2 and 4 days.

(R. Maruthadurai, T. Ramasubramanian, P. Mahesh and K. Srinivas, ISRI, Lucknow)

All India Coordinated Research Project (Sugarcane Entomology)

Evaluation of zonal varieties/genotypes for their reaction against major insect pests

AVT I plant trial: Seventeen entries, including three standards were screened for ESB incidence and all were LS. For INB, all the 17 entries were HS. INB incidence ranged between 24.0% (CoT 18368) to 81.3% (Co 19014), while the percent intensity varied from 1.23% (CoT 18368) to 5.56% (Co19005).

AVT II plant trial: All 14 entries evaluated for INB were categorized as moderately susceptible (MS), including CoN18071, CoN18072, Co 18001, Co 18002, Co 18003, Co 18009, Co 18013, Co 18012, Co 18013, and CoVC 18061 were MS. INB incidence ranged between 24.0 to 53.3%, while the percent intensity ranged between 1.07% (CoVSI 18121) and 5.01% (Co 18024).

AVT ratoon trial: Among the 14 entries evaluated, four, nine, and one entries were categorized as HS, MS and LS respectively, to INB. Incidence of INB ranged between 20.0 (Co18002) to 57.3% (CoC 671), whereas the percent intensity varied between 1.31% (Co 18009) and 3.79% (Co 09004).

(B. Singaravelu, T. Ramasubramanian, M. Punithavalli and P. Mahesh)

Survey and surveillance of sugarcane insect pests

Surveys on the incidence of crown mealybug (CMB) and other major pests, including INB were conducted during July-August 2025 in the command areas of Ponni Sugars, Erode, and Perambalur Sugars, Eraiyur. Pest incidence was assessed in 11 fields in four villages in Ponni Sugars areas. The sugarcane varieties Co 86032, Co 11015 and PI 1110 occupied approximately 67, 19, and 9% of the registered cane area, respectively, in the command area of the factory. In the Odappalli Division, crop health was generally poor in the visited fields due to shallow soil depth, water scarcity, and high pest incidence. INB incidence was high in nearly all the surveyed fields. Bud sprouting and aerial roots were very common in those fields due to do severe incidence of INB. CMB incidence was also recorded to be high in this Division, irrespective of the major varieties grown *viz.*, Co 86032, Co 11015 and PI 1110. Only one surveyed field showed white grub infestation, limited to the border rows, where the grubs were collected from the root zone of the clumps and destroyed. The crop was good and free from the incidence of insect pests in the Cauvery River basin area (Kokkarayanpettai Division), where the soil depth was found to be good with adequate source of irrigation. Another survey was conducted in August, 2025 in famers' fields in Perambalur District. Sugarcane fields in Pudhukudisai and Nallarikkai villages were visited, where CoV 09356 was the predominant variety, along with Co 86032 in some fields. The fields were infested with CMB, INB and leaf mite, however, the level of incidence of these pests was low, remaining below 10%.

(B. Singaravelu, T. Ramasubramanian, M. Punithavalli and P. Mahesh)

Monitoring of insect pests and bioagents in sugarcane agro-ecosystem

Monitoring of pests were conducted at fortnightly interval in a monitoring plot planted with the variety Co 86032. ESB activity was recorded from April to June, with an average incidence of 12.69%. INB activity commenced in July and continued until February, with peak incidences observed during October and November at 19.5 and 20.5%, respectively. Crown mealy bug activity was observed during August and September, with mean incidences ranging from 3.7 to 4.1%. In addition to the previously recorded parasitoids, *viz., Leptomastix sylvae*, *Aenasius hayati* and *Promucidea unfasciativentris*, two more parasitoids *viz., Prochiloneurus pulchellus* and *Eotopus beneficus* were found parasitising mealybug. The larval parasitoid *Cotesia flavipes*, associated with

INB, was active from August to February, with parasitisation ranging from 1.30 to 10.34%.

(B. Singaravelu, T. Ramasubramanian, M. Punithavalli and P. Mahesh)

Integrated approach to manage white grubs in sugarcane

A field experiment was conducted to evaluate the Bio-Formulation Applicator (formerly known as the EPN applicator) for the application of a *Bacillus thuringiensis* (Bt) formulation against white grubs in sugarcane crop. The Bt-62 strain, multiplied on standard T3 medium in a fermentor, was evaluated in a white grub endemic area at Thalavady village under the command area of M/s Bannari Amman Sugars, Sathyamangalam. Two plots of 200 sq.m each, with a 7-month-old sugarcane crop were demarcated in a highly grub-infested farmers field. Pre-treatment assessment of white grub population was carried out by excavating soil up to 1 m length in the root zone at randomly selected locations within each plot and counting the number of grubs. The Bt-62 formulation was applied in one plot, while the other plot was maintained as an untreated control. The fermentor product (20 L)was diluted with 40 L of water, and the Bt-62 formulation was applied near the root zone using a manually operated bio-formulation applicator at a dosage equivalent to 1.0×10^{14} CFU ha-1. Post-treatment assessment of white grub incidence was conducted after 30 days. The treated plot recorded a 53.01% reduction in white grub incidence, compared to only 6.52% reduction in the untreated control plot.

(P. Mahesh, B. Singaravelu and T. Ramasubramanian)

Assessment of yield losses caused by crown mealybug (CMB) of sugarcane under changing climate scenario

Yield loss due to crown mealy bug (CMB) was estimated at 7.1 tonnes/ha when the incidence level reached 10% in the sugarcane variety Co 11015. CMB infestation caused a substantial reduction in juice content which was five folds lower in infested canes compared to healthy ones. The mean juice content from five infested canes was 579 ml, whereas 3,225 ml in the healthy canes in the same variety. In addition, Brix value and juice purity percentage were marginally lower (1.0-1.2%) in the CMB infested canes.

(T. Ramasubramanian, B. Singaravelu, M. Punithavalli and P. Mahesh)

All India Coordinated Research Project on Biological Control

Pest surveillance carried out in the areas of Maduranthakam, Cheyyar, Thiruttani, Vellore and Tirupattur Co-operative Sugar Mills of Tamil Nadu in January indicated that post monsoon, sugarcane crops in these areas exhibited heavy infestation of INB, resulting in yield losses. The incidence of sucking pests was low, and parasitoid activity was also minimal. In February, pest monitoring was extended to the command areas of seven additional sugar factories in Tamil Nadu. Borer pests were commonly observed, with occasional flare up of whitefly and woolly aphid. In districts such as Namakkal, Perambalur, Kallakurichi and Viluppuram, crops had suffered severe damage during the previous season due to CMB-associated pokkaboeng disease, rendering the ratoon crops vulnerable during the summer months. CMB activity and associated biocontrol agents were monitored at the Institute. In addition, protocols for economical *in situ* mass multiplication of EPF for effective spatial and temporal establishment and field-level spread were standardized.

Two field experiments were carried out at Vengur Division, Bannari Amman Sugars, Thirukovilur, Tamil Nadu. In the experiment on field evaluation of entomopathogens against whitefly, *Aleurolobus barodensis*, application of *Aschersonia placenta* ICAR-SBIAP 01 was better than all other treatments in reduction of the whitefly population.

In field evaluation of entomopathogens against white grubs, application of *Metarhizium anisopliae* SBIMa-16, *M. anisopliae* NBAIR Ma4, *Beauveria bassiana* SBI Bb-32 and Lesenta were found to significantly reduce white grub population than in control plots. Recovered soil samples from the plots showed recovery of SBIMa-16 and SBIBb-32.

(N. Geetha and P. Malathi)

Impact of climate change on Crambid borers of sugarcane and ways of mitigation

Impact of elevated CO_2 on the growth and development of INB was assessed by rearing the species of Crambid borers for one generation under three different levels of CO_2 concentrations *viz.*, 450, 550 and 750 ppm in an insect growth chamber. The larval period was recorded as 48, 43 and 41 days at 450, 550 and 750 ppm, respectively. No significant differences were observed in the duration of the pupal and adult stages across the treatments. The results obtained with the natural host were corroboration with those observed on an artificial diet. Thus, the elevated CO_2 level did not hamper the growth and development of the species, and the species successfully completed its life cycle under elevated CO_2 concentrations. In addition, the impact of elevated CO_2 concentrations (550 and 750 ppm) on the growth and development of early shoot borer was also evaluated under growth chamber conditions. The entire life cycle of the early shoot borer was observed to be completed within 50 days at both CO_2 levels tested.

(T. Ramasubramanian and Sheela Venugopal (TNAU))

5.3.3 Nematology

Basic and applied studies of sugarcane phytonematodes and entomopathogenic nematodes

In vitro mass production, formulation and bioefficacy of entomopathogenic nematodes against white grubs

In vitro *production of EPN*: Eight entomopathogenic nematode (EPN) isolates namely *Heterorhabditis indica* SBITND78, *H. bacteriophora* SBITNHB, *Steinernema surkhetense* SBIP3, *S. thermophillum* SBIH1, *S. siamkayai* SBITNT1, *S. glaseri* SBILN1, *S. abbasi* and *S. carpocapseae* SBIP2 were used in the experiment. The respective symbiotic bacteria were isolated on NBTA media and maintained as pure cultures for liquid culturing of EPNs.

Liquid culturing of EPN: Five monoxenic culture EPN isolates *viz.*, *Steinernema surkhetense* SBIP3, *S. siamkayai* SBITNT1, *S. thermophillum* SBIH1, *S. glaseri* SBILN1 and *S. carpocapseae* SBIP2 were used in the experiment. Yeast extract-based media was prepared with four different treatments. EPN samples were collected at regular intervals and the nematode population was quantified. Successful in vitro mass production of EPNs was achieved in all media treatments; however, yield varied significantly among nematode species. The yield of infected juveniles (IJs) was ranged from 400 to 1,20,000 IJs. Among the isolates, *Steinernema surkhetense* (SBIP3) recorded the highest yield of 1,20,000 IJs / ml media.

(C. Sankaranarayanan, B. Singaravelu and K. Hari)

Selection of virulent EPN species/isolates with tolerance to environmental stresses

Variability in desiccation tolerance among EPN isolates: Desiccation tolerance of 12 EPN isolates was evaluated by subjecting them to osmotic desiccation at 97% relative humidity and it ranged from 72-100%. Among the isolates, *Steinernema glaseri* exhibited the highest tolerance (100%), followed by *S. carpocapsae*. In contrast, *Heterorhabditis* spp. showed comparatively lower tolerance, with survival ranging from 80 to 88%.

Variability in temperature tolerance of EPN isolates: Among four EPN isolates assessed for temperature tolerance (40°C) under *in vitro* conditions, *Steinernema glaseri* and *S. siamkayai* showed significantly higher tolerance in 40°C than other isolates.

Variability in UV tolerance of EPN isolates: Variability in UV tolerance among 23 EPN isolates was assessed by estimating the original virulence retained (OVR) after exposure to UV radiation for durations ranging from 1 to 15 min. All 18 *Steinernema* isolates caused larval mortality, which ranged from 33 to 100%. In contrast, among the five *Heterorhabditis* isolates, only *H. indica* SBITND78 caused mortality (33%) after 15 min of UV exposure.

Commercialization of ICAR- SBI EPN biopesticide formulation: The ICAR-SBI EPN Biopesticide formulation technology has been commercialized to two biopesticide companies. As per MoU, training programs were conducted for personnel from the licensed companies. Regular maintenance of EPN cultures was also undertaken.

Maintenance of EPN and symbiotic bacterial cultures: A total of 78 EPN strains, comprising 49 tropical and 29 subtropical isolates are being maintained in the culture collection. In addition, 45 symbiotic bacterial isolates including 26 belonging to *Photorhabdus* spp. and 19 to *Xenorhabdus* spp. are regularly subcultured and preserved in glycerol stocks.

(C. Sankaranarayanan, K. Hari and B. Singaravelu)

Management of white grubs through EPN (All India network project on white grubs and other soil arthropod pests)

Isolation of EPN: EPNs were isolated from 80 soil samples collected from Assam and 11 EPN isolates were recovered, comprising 10 *Steinernema* spp. and one *Heterorhabditis* sp. The isolated EPNs are being regularly subcultured and maintained under laboratory conditions. Five EPN isolates *viz., H.indica* SBITND78, *H. bacteriophora* SBIP5, *Steinernema surkhetense* SBIP3, *S. thermophillum* SBIH1 and *S. siamkayai* SBITNT1 were mass produced and formulated in talc and supplied to various AINPSAP centres. Mass production and formulation of EPNs are being continued for supply to other centres. Laboratory bioassays against first-instar white grubs revealed that all EPN isolates caused mortality, ranging from 25 to 100%. Under pot culture conditions using sugarcane cv. Co 11015, *H. indica* SBITND78 caused 8% mortality of white grubs. A field trial conducted at Thalavadi, Tamil Nadu to test the efficacy of five EPN isolates against white grub (*Holotrichia serrata*) in third-ratoon sugarcane cv CoVC 14061 showed that *H. indica* SBITND78 recorded 78% reduction in grub population, which was on par with the Imidacloprid treatment.

Compatibility of EPN with EPF: The compatibility of entomopathogenic fungi (EPF) with EPN was studied using *H. indica* (SBITND78) in combination with two EPF species, *Metarhizium anisopliae* and *Beauveria bassiana*. The study comprised 14 different treatments combinations tested against *Galleria mellonella* larvae and first-instar white grubs (*H. serrata*). All treatments caused larval mortality compared to the untreated control. The EPN-alone treatment recorded 100% mortality of *Galleria* larvae within two days, whereas EPF-alone treatments achieved 100% mortality by the eighth day. Combined application of EPN and EPF adversely affected each other in terms of virulence and mass production when compared to the individual applications. Inhibition of fungal growth was observed in EPN-infected *Galleria* larvae and white grubs. Overall, the results indicated a lack of compatible interaction between EPN and EPF.

(C. Sankaranarayanan, B. Singaravelu and P. Mahesh)

Artificial intelligence powered diagnostic kit for real-time monitoring of nematode pests of sugarcane (TARE -DST-SERB)

Sugarcane nematode App: To deploy the trained CNN model for sugarcane nematode identification as an Android APK application, the model was first converted into a mobile-compatible format, such as TensorFlow Lite (.tflite) or ONNX. The optimized model was then integrated into an Android project using Android Studio, with a user-friendly interface enabling image input via camera or gallery. The app processes images locally through the CNN model and displays prediction results. Finally, the project was compiled and packaged as an APK file for installation on Android devices. The developed sugarcane nematode app successfully predicts nematode images at 10× magnification with an accuracy of 92%.

(C. Sankaranarayanan, D. Suryaprabha Nehru Arts and Science College, Coimbatore and N. Seenivasan, TNAU)

5.4 Statistics and Economics Section

Sugarcane based Agri-Business Incubator (SBI-ABI)

Two incubatees joined Sugarcane Edge for development of novel food products. An online webinar series on 'Sugarcane based Agri-Startups ecosystem' was conducted with 280 registrations (245 participated in live session) comprising experts, entrepreneurs and students.

Demonstrations on sugarcane-based agripreneurship were done in AgriIntex 2025 at CODISSIA Trade Fair Complex, Coimbatore and State Level Food and natural products innovation (COXBIT), TNAU during 20-21 December 2025.

Regular visitors such as start-ups, entrepreneurs and delegates from various institutions were sensitized on sugarcane value chain at SugarcaneEdge. Process of making millet-based sweet ball susing sugarcane juice and bagasse-based fiber muffin was standardized. Training was provided to entrepreneurs for licensed institute food-based technologies.

An analysis on jaggery based entrepreneurs and startup on entrepreneurship, commercialization and business growth revealed that adulteration has severely impacted the transformation of jaggery based value chains. Food safety and quality standards (domestic and international) for jaggery and its value chain products greatly helps for enhancing consumption and exports in the global markets.

(P. Murali, K. Hari, G.S.Suresha and D. Puthira Prathap)

Network project on production systems, agribusiness and institutions: Impact assessment of agricultural technology

The study examines the evolving sugarcane value chain with a focus on varietal innovation, particularly the variety Co 0238, and its transformative impact on yield, value addition and system stability across sugar, gur, khandsari, fuel ethanol and co-product sectors. From 2013-14 to 2022-23, Co 0238 contributed over one-third of total sugar, ethanol output and half of gur and khandsari production. White sugar production (million tons) increased from 12.60 during 2004-05 to 35.70 during 2021-22, with its value nearly doubling from Rs. 580 billion in 2000-01 to Rs. 1,106 billion in 2021-22. Variety Co 0238's share in sugar production rose from 4.5% in 2014-15 to 36.3% in 2022-23, and in value from 4.5% to 36.2% over the same period.

The share of Co 0238 in sugar production increased from 4.5% in 2014-15 to 36.3% in 2022-23 and in value from 4.5 to 36.2% over the same period. Gur and khandsari production reached 6.7 million tons in 2022-23, with variety Co 0238 contributing over 78%.

The Cuddy-Della Valle Index showed reduced production instability after the adoption of variety Co 0238: sugarcane (from 5.78% to 4.53%), sugar (13.35% to 7.05%), bagasse (8.98% to 5.72%), and cogeneration (63.85% to 30.98%). These results indicate not only improved average productivity of value-added products but also reduced year-to-year variability which is crucial for market stability and farmer income security.

(P. Murali, D. Puthira Prathap and K. Hari)

Statistical tool for analysing crop science data: An expert software system

An unified analytical framework, PhysioIndexR was developed to compute widely used stress indices, physiological traits and derived metrics that are central to crop improvement, crop physiology and allied agricultural sciences. The package implements classical stress tolerance indices, including Tolerance (TOL), Stress Tolerance Index (STI), Stress Susceptibility Percentage Index (SSPI), Yield Index (YI), Yield Stability Index (YSI), Relative Stress Index (RSI), Mean Productivity (MP), Geometric Mean Productivity (GMP), Harmonic Mean (HM), Mean Relative Performance (MRP), and Percent Yield Reduction (PYR). A convenient wrapper function, all_indices(), enables simultaneous computation of all indices ensuring efficiency and reproducibility. To facilitate genotype ranking, the function mfvst_from_ indices() integrates multiple indices into a composite stress score using direction-aware membership function values scaled between 0 and 1, as well as simple averaging approaches.

PhysioIndexR further introduces two novel composite metrics: WMFVST(), which computes the Weighted Mean Membership Function Value for stress tolerance, and WASI(), which estimates the Weighted Average Stress Index. Both approaches enable flexible weighting of indices and provide robust genotype prioritization under multi-stress scenarios.

Beyond yield-based indices, the package includes functions for key physiological trait estimation. The bmap() function quantifies biomass accumulation and partitioning among leaf, cane/shoot, and root components. The chl() function estimates total chlorophyll content from SPAD and Chlorophyll Content Index (CCI) values using validated quadratic models, particularly suited for sugarcane. The ctd() function computes canopy temperature depression (CTD) from ambient and canopy temperatures, an important proxy for transpiration efficiency and stress avoidance. Growth analysis is supported through the growth() function, which estimates Leaf Area Index (LAI), Net Assimilation Rate (NAR), and Crop Growth Rate (CGR) across growth stages. Additionally, the ranking() function provides flexible utilities for genotype ranking with customizable tie-handling and missing-value options.

Collectively, PhysioIndexR enables comprehensive assessment of crop stress responses, integration of multiple indices into composite metrics and informed decision-making in breeding and physiological studies. By combining quantitative stress indices with physiology-based traits, the package supports the identification of multi-stress-resilient genotypes and contributes to sustainable production of food, fuel, and fibre under climate change situations. The current status of the packages' (CANE, PhysioIndexR) usage (measured based on number of downloads by the users) by scientific community of distinct disciplines is given in Fig. 68.

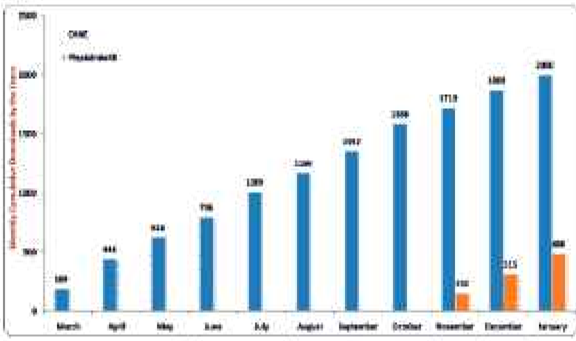


Fig. 68. Monthly cumulative CRAN downloads by the users

(Vinayaka, P. Murali, P. Rama Chandra Prasad (IIT-Hyderabad), P. Govindaraj, T. Lakshmi Pathy and K. Gopalareddy)

5.5 Extension Section

Transfer of sugarcane technologies

Utilization of extension methods and media for effective transfer of sugarcane technologies

Sponsored intra / inter-state training programs: Organized the following six sponsored training programs for farmers and cane development personnel (Fig. 69).

- Training on 'Sugarcane production' for sugarcane farmers of Ambegaon Taluk, Pune district, Maharashtra during 09-10 January 2025.
- Inter-state training on 'Enhancing sugarcane productivity' funded by ATMA for sugarcane farmers of Chengalpattu district, Tamil Nadu during 18-19 March 2025.
- Training program on 'Advances in sugarcane production' for executive trainees of Dalmia Bharat Sugar and Industries Ltd. during 29-31 July 2025. The training included lectures, on-campus and off-campus field visits and demonstrations.
- Training program on 'Maximizing sugarcane productivity' for 19 sugarcane farmers of Kottayam, Kerala on 25 November 2025.
- Five-days training program on 'Sugarcane varieties and technologies' for one official of Sugarcane Industries Department, Government of Bihar during 15-19 September 2025.
- One-day training program on 'Improving sugarcane productivity' for 25 sugarcane farmers of Modakurichi, Erode district, Tamil Nadu on 2 December 2025.

(18-19 March 2025)

(29-31 July 2025)

Fig. 69. Participants of the training programs

One-day Trainings/Exposure Visits/ Customized Advisories: Organized 22 one-day training programmes with 680 participants, 141 exposure visits benefitting 8294 students/academicians and 63 personalized advisories benefitting 180 sugarcane farmers.

Frontline demonstrations in farmers' fields: Two frontline demonstrations were completed on the newly released varieties *viz.,* Co 11015 and Co 14012 in farmers' fields. The variety Co 11015, demonstrated over 1.08 ha with a seed rate of 6.5 t/ha and 3.5 feet spacing, recorded a remarkably high yield of 146.03 t/ha, compared to the local average yield of 79.28 t/ha, registering an 84.2% increase. Pest incidence of ESB and INB was manageable, with no disease incidence reported. Farmers observed that the crop could effectively withstand waterlogged conditions, highlighting its suitability for such environments.

The variety Co 14012, demonstrated in 1 ha using 50,000 two-budded setts per hectare at 5-feet spacing, yielded 128.6 t/ha, showing a 7% increase over the local average yield of 120 t/ha. ESB and INB incidence was manageable, while Pokkahboeng disease was minimal (<1%). Farmers noted good drought tolerance, though canes were relatively thin with low single-cane weight.

Technology Park: Technology Park 2025 was planted in February 2025 with 16 varieties (Co 86032, Co 11015, Co 18009, Co 10026, Co 12009, Co 09004, Co 92005, Co 13013, Co 0212, Co 05011, Co 06030, Co 06022, Co 15023, Co 0118, Co 0238) and tissue culture plants.

National Science Day: Celebrated 'National Science Day' under the theme 'Empowering Indian youth for global leadership in science and innovation for Viksit Bharat' on 28 February 2025 (Fig. 70) with the participation of over 1000 students and teachers of schools and colleges in and around Coimbatore, Kottayam and Chennai. The program included visits to Science Exhibition, Institute Museum, Tissue Culture Lab, Institute-developed product demonstration, sugarcane-based farming system unit, drone (UAV) demonstration, impromptu quizzes, interaction with scientists and screening of Institute video films. Science Day Lecture on 'Remote sensing application in agriculture'was delivered by Dr. Balaji Kannan, Professor and Head, Department of Physical Sciences, TNAU.

Interaction with Krishi Vigyan Kendras: Participated in the Scientific Advisory Committee meeting of Avinashilingam KVK, Coimbatore on 19 March 2025 and ICAR-KVK (MYRADA), Erode district on 30 December 2025 and offered suggestions for implementation in the ensuing year. Erode KVK had implemented two of ICAR-SBI's recommendations that were finalized during the previous Scientific Advisory Committee Meeting.

Participation in exhibitions by putting up a stall (Fig. 71).

- Regional Agricultural Exhibition and Seminar at Perundurai, Erode district during 11-12 June 2025.
- Agri-Intex 2025 (International Agricultural Exhibition) at CODISSIA Trade Fair Complex, Coimbatore during 10-14 July 2025.
- Exhibition organized as part of VKSA launch in Tamil Nadu at Erode district on 29 May 2025
- Exhibition organized as part of South India Natural Farming Summit - 2025 during 19-21 November 2025 and won the 'Best Stall Award'.

Farmer-Scientist Interaction: A Farmer-Scientist interaction was organized at the Institute for the

Fig. 70. National Science Day celebrations - 2025

Regional Agricultural Exhibition (11-12 June 2025)

Agri-Intex (10-14 July 2025)

VKSA Exhibition (29 May 2025)

'Best Stall' award (19-21 November 2025)

Fig. 71. ICAR-SBI stall in agri-based exhibitions

participants of 'Farm School on All India Radio' on 9 July 2025 (Fig. 72).

Fig. 72. Farmer-Scientist Interaction

Publications: Compiled, edited and printed

- ICAR-SBI Annual Report 2024 (English)
- ICAR-SBI News: Four issues of volume 46, vol 47 (1).

DD Kisan Program: With inputs from the Institute, DD Kisan, New Delhi has produced a program 'Farmers reap benefits from improved sugarcane varieties' (in Hindi). This was telecast on 15 May 2025 at 7 pm in its Krishi Vishesh segment (290th episode) and is available at https://www.youtube.com/watch?v=a-ncXVdxDQ4&list=PLPiiF2hRQqfrM5sj9OCotKuU2iWDyjWy5&index=10

ICAR-SBI news in print and electronic media: Leading national and regional newspapers highlighted institutional milestones, promotion of agri-entrepreneurship and implementation of farmer-centric government initiatives. In addition, ICAR-SBI effectively utilized digital and social media platforms, including institutional websites and the CaneInfo YouTube channel, to extend the reach of outreach and extension activities.

A survey among the cane development personnel on perceived usefulness of social media (such as Facebook, Blog, Twitter, YouTube, WhatsApp, Telegram, Wiki, LinkedIn) revealed that a majority had agreed with the statement 'Using social media makes it easier to distribute information to stakeholders in sugarcane agriculture (1.92)' followed by 'Using social media saves me time and effort in communicating with stakeholders and clients' (1.85). Among the possible types of sugarcane information on social media 'sugarcane varieties', 'sugarcane production practices' and 'weather conditions' were the most sought after.

Use of social media for transfer of technology: ICAR-SBI has been regularly reaching out to the stakeholders of sugarcane agriculture through social media such as Facebook (https://www.facebook.com/icar.sbi), YouTube (http://www.youtube.com/@icar-sugarcane breedinginst1942; http://www.youtube. com/caneinfo) X (@BreedingIcar).

(D. Puthira Prathap and T. Rajula Shanthy)

Social impact assessment of micropropagation in sugarcane: An explanatory analysis

Survey was conducted with 229 sugarcane farmers across nine districts in Tamil Nadu state. Preliminary analysis indicated that:

- The planting material used by the respondents were mainly breeder seed from ICAR-SBI, micropropagated plants from ICAR-SBI/ Kallakurichi coop sugar mill, or single bud settlings raised from micropropagated plants from the sugar mills concerned as planting material.
- Choice of sugarcane variety was invariably Co 86032 by most of the respondents, followed by CoV 09356, Co 0212, Co 11015 and Co 18009.
- Suggestions for furthering the use of micropropagated plants are: ways to increase tillering in nursery crop so as to get more setts for planting, better and fast rooting in plants soon after it is transplanted in nursery field and nutrient management package for nursery crop.
- Perceived advantages of using micro-propagated plants were good germination of setts, uniform crop growth, high tillering, availability of good quality planting material

from nursery crop, leads to good ratoon crop, increased single cane weight, high cane yield and high profit.

- Constraints faced by growers include non-availability of plants when there is high requirement, few varieties give good tillering only if mother shoots are clipped, high cost of plants, less root development even after a month of planting. Few farmers reported thin canes when they grow tissue culture plants but was not a problem in the second cycle.
- Farmers said that they procure setts from nurseries of micro-propagated plants incurring 500 to 750 rupees more per ton than the ordinary but it gets compensated with the better cane yield. Setts are being bought at Rs. 3500-4200 per ton based on the season of planting. Case studies on farmers who had successfully taken up sugarcane settling nurseries by using micro-propagated plants procured from the Institute / sugar mills reported it to be a successful venture.

(T. Rajula Shanthy, C. Jayabose and D. Neelamathi)

Development of Cane Adviser, a mobile application for transfer of sugarcane technologies

Building on the success of Cane Adviser mobile app developed earlier, work is progressing on the development of Cane Adviser 2.0. The revised content of new technologies (varieties, crop production and crop protection) with text and images and the scheduler for tropical and sub-tropical states was developed in English. This updated content has been packaged into APK format, and is now ready for test verification to ensure accuracy and functionality in field conditions. The entire content is also being translated in Tamil and Hindi.

(T. Rajula Shanthy, P. Govindaraj, S. Alarmelu, C. Jayabose, P. Malathi, A. Vennila, M. Punithavalli and S. Anusha)

5.6 ICAR-Sugarcane Breeding Institute Regional Centre, Karnal

Breeding superior sugarcane varieties of different maturity with improved cane yield, quality and resistance to biotic and abiotic stresses

Breeding elite clones suitable for NWZ

Sugarcane variety identified in AICRPs Workshop

Co 18022 (Karan 18), a mid-late and high-yielding variety derived from the progeny of a bi-parental cross (CoS 8436 x Co 89003), exhibiting superior performance in AICRP trials was identified for North West Zone by the Variety Identification Committee (VIC) of AICRP(S) in April 2025(Fig. 73).

Fig. 73. Field stand of Co 18022 (Karan 18)

Salient features: Co 18022 had recorded CCS yield of 12.59 t/ha, which was 30.72%, 19.60% and 12.73% higher than the zonal standards CoS 767, CoPant 97222 and Co 05011, respectively. Its average cane yield (98.65 t/ha) was 27.68%, 18.61% and 11.15% higher than the standards CoS 767, CoPant 97222 and Co 05011, respectively. Sucrose content was 18.17%, which was 2.54% over CoS 767, and showed R and MR reactions against designated races of the red rot pathogen. Co 18022 is a climate resilient variety exhibiting salinity tolerance up to 8 dsm^{-1}.

(M.R. Meena, Ravinder Kumar, Bakshi Ram, R. Karuppiayan, G. Hemaprabha, N. Kulshreshtha, M.L. Chhabra, Pooja and S.K. Pandey)

Proposal submitted to the VIC of AICRP (S): Co 19017 (Karan 19), a mid-late maturing high-yielding sugarcane variety developed at Karnal performed better in the AICRP trials and its proposal was submitted to the VIC of AICRP(S), for identification.

Supply of 24 series Co canes for multiplication: Three each early (Co 24016, Co 24017 and Co 24018) and mid-late (Co 24019, Co 24020 and Co 24021) genotypes accepted for inclusion in AICRP trials in the AICRP workshop held at PAU, Ludhiana in October 2024 were supplied to the UPCSR Shahjahanpur, the seed multiplication Centre.

'Co' canes accepted for inclusion in AICRP trials: Five 'Co' canes, three under early (Co 25015, Co 25017, Co 25018) and two under mid-late (Co 25019, Co 25020) were accepted for inclusion in ZVT of NWZ in the AICRP workshop held at Jorhat, Assam in November 2025.

Season 2024-25

Hybridization: A total of 158 cross combinations (52 bi-parental cross combinations, 94 General Crosses and 12 Polycrosses) were attempted at Coimbatore and Agali during the crossing season 2024-25 and the fluff was raised in mist chamber in February 2025.

(Ravinder Kumar, M.R. Meena, R.M. Shanthi and A. Anna Durai)

Seedling raising and field transplanting in ground nursery: Around 17090 seedlings were field transplanted in ground nursery in June 2025. These seedlings were ratooned during the second fortnight of October 2025 to assess their winter ratooning potential.

(Ravinder Kumar and M.R. Meena)

Progeny evaluation and selection

Seedling selection in the ground nursery 2024-25: A total of 706 better-performing progeny representing 55 cross combinations, were selected from the 8646 seedlings (initially transplanted and winter ratooned) of the ground nursery. A total of 706 (K23-01 to K23-706) superior genotypes were selected for evaluation in clonal stage.

First clonal trial (C1) 2024-25: Out of 640 clones of K21 series evaluated at 8 months, 45 entries exhibited >21% HR Brix and nine entries recorded >22% HR Brix. Based on their field performance for phenotypic traits, juice quality, and red rot reaction, 205 clones were selected and advanced to the next stage of evaluation, *i.e.*, Preliminary trial (C2 stage) and planted.

Red rot: Among the 640 clones of C1 trial evaluated against CF13 isolate of red rot, 35 were R, 195 MR, 94 MS, 147 S and 206 were HS.

(M.R. Meena and Ravinder Kumar)

Preliminary trial 2024-25: Out of 128 test entries of K20 series along with four standards evaluated at 10 months, Co 0238 (18.00%) was the best standard for sucrose content and 24 test entries reflected higher values than it. Combining cane yield, red rot resistance and juice quality traits, 37 entries along with 14 other materials were advanced to PZVT stage of evaluation. Similarly, 28 better performing genotypes from the trial along with other desired materials were included for screening under endemic waterlogged conditions of Rauzagaon sugar mill, Uttar Pradesh and Tirupati Sugar Mill, Bagha, Bihar.

Red rot: A total of 128 preliminary clones evaluated for red rot reaction against CF08 and CF13 isolates, 18 were R, 90 MR, 9 MS and 11 S against CF 08 isolate, whereas against CF13 isolate 21, 84, 13, 9 and 1 genotypes were R, MR, MS, S and HS, respectively.

(Ravinder Kumar, M.R. Meena and M.L. Chhabra)

Pre-Zonal Varietal Trial (2024-25)

Out of 47 test entries of K19 series, along with four standards (CoJ 64, Co 0238, CoS 767, Co 05011) evaluated, K19-176 produced significantly higher NMC (1.05 lakh/ha) than the best standard

Co 05011. For sucrose% at 8 and 10 months, 10 clones (K19-010, K19-134, K19-175, K19-008, K19-127, K19-161, K19-176, K19-172, K19-012, K19-168) were top performers and at 12 months, 14 clones had higher juice sucrose than Co 0238 (18.71%). Co 0238 (97.8 t/ha) was the best standard for cane yield and 13 test clones performed better. Based on yield and quality parameters, field stand and red rot reaction, four clones (K19-175, K19-012, K19-127, K19-152)under early and two clones (K19-199, K19-234) under mid-late, were selected for assigning 'Co' status (Tables 15 and 16).

Red rot: Out of 39 PZVT clones evaluated for red rot, 25 were R, eight MR, three each were MS and S for CF08 isolate, while for CF13 isolate, 12 clones were R, 11 were MR, two were MS, four were S and 10 were HS.

(M.R. Meena, Ravinder Kumar and M.L. Chhabra)

Season 2025-26

Hybridization: A total of 81 cross combinations involving 56 biparental cross and 25 GC/PCs were attempted in November 2025 choosing trait-specific, diverse genetic makeup, old proven and newly developed 'Co' canes or genetic stock as parents.

(M.R. Meena, Ravinder Kumar and R. Karuppaiyan)

Table 15. Performance of early maturing clones in PZVT at ICAR-SBIRC, Karnal

Clone	CCS yield (t/ha) (10m)	Cane yield (t/ha)	CCS (%)		Sucrose (%)	
			8 m	10 m	8 m	10 m
Co 25015 (K19-175) (Co 0331 x Co 8353)	12.98	100.6	12.71	12.9	18.33	18.36
Co 25016 K19-127 (Co 15027 GC)	14.3	1112.7	11.66	12.69	16.91	18.22
Co 25017 K19-152 (CoC 671 x Co 99015)	13.15	108.7	11.63	12.10	16.74	17.59
Co 25018 K19-012 (Co 86032 x Co 97015)	12.30	100.3	11.75	12.26	17.14	17.70
Standards						
CoJ 64	64 8.60	73.69	11.51	11.68	16.80	17.00
Co 0238	10.91	90.40	11.15	12.07	16.51	17.61
CD	1.52	12.7	0.94	1.04	1.29	1.23
CV	9.32	9.21	5.47	5.44	5.11	4.49

Table 16. Performance of mid-late maturing clones in PZVT at ICAR-SBIRC, Karnal

Clone	CCS yield (t/ha) (12m)	Cane yield (t/ha)	CCS (%)		Sucrose (%)	
			10 m	12 m	10 m	12 m
Co 25019 (K19-199) (CoVc 14062 GC)	12.66	92.11	12.90	13.75	18.42	19.75
Co 25020 (K19-234) (87A380 x Co 11015)	12.52	90.52	12.6	13.9	18.3	19.6
Standards						
CoS 767	8.71	73.92	11.07	11.79	16.15	17.41
Co 05011	9.82	79.06	10.49	12.43	15.37	18.00
CD	1.53	12.7	1.04	1.3	1.23	1.68
CV	8.73	9.21	5.44	6.67	4.49	5.64

Progeny evaluation and selection

First clonal trial (C1): Out of 621 entries of K22 series (K22-001 to K20-621) evaluated for field performance and red rot reaction, 150 better performers were advanced to the next stage of evaluation *i.e.* Preliminary trial (C2 stage).

Red rot: Out of 621 clones of C1 trial evaluated against CF13 isolate of red rot, 27 were R, 162 were MR, 59 were MS, 145 were S and 228 were HS.

(Ravinder Kumar, M.R. Meena and M.L. Chhabra)

Preliminary trial (2025-26): A total of 205 test entries of K21 series along with four standards were evaluated. Nine test entries produced higher tiller population than the best standard Co 05011. At 8 months, Co 0238 (17.4%) was the best standard for sucrose content and 48 test entries recorded higher value over Co 0238 . Eight entries recorded more than 19% sucrose content.

Red rot: Out of195 preliminary clones evaluated for red rot resistance against CF13 isolate, 17 were R, 108 were MR, 22 were MS, 25 were S and 23 were HS.

(M.R. Meena, Ravinder Kumar and M.L. Chhabra)

PZVT (2025-26)

A total of 51 test entries along with four standards (CoJ 64, Co 0238, CoS 767, Co 05011) were evaluated. Mean NMC was 90.36 thousand per ha and Co 05011 (117.59) was the best standard. Co 0238 (1.34) was the best standard for single cane weight and four test entries namely K20-012 (1.71), K20-366 (1.66), K20-269 (1.51) and K15-582 (1.48) had better SCW. At 8 months, CoJ 64 with 16.55% juice sucrose was the best standard and 17 test clones were significantly superior, whereas another 15 entries were on par compared to CoJ 64.

Red rot: Out of 51 clones screened by CF 08 and CF13 isolates for red rot, 35 were R, 13 were MR and three were MS against CF 08 isolate; whereas against CF13 isolate, 16 were R, 26 were MR, five were MS, three were S and one was HS.

(Ravinder Kumar, M.R. Meena and M.L. Chhabra)

Identification of waterlogging tolerant commercial sugarcane clones suitable for Eastern Uttar Pradesh and Bihar

In two endemic waterlogging sites each at Eastern Uttar Pradesh (Rauzagaon Chini Mill, a unit of BCML in Ayodhya) and Bihar (Tirupati Sugar Mills, Bagha, West Champaran, Bihar),a set of 48 red rot resistant genotypes (against CF 13 race) including 11 'Co' canes from Karnal centre (Co 23022, Co 23023, Co 23024, Co 23025, Co 23026, Co 24016, Co 24017, Co 24018, Co 24019, Co 24020 and Co 24021), six WL clones, 26 clones of K20, two K15 series clones and one K18 series clone were planted in Spring 2025.

Red rot reaction: Out of 48 genotypes evaluated against CF13 race of red rot, one genotype was R, 16 were MR, 9 were MS, 13 were S and 9 were HS.

Tirupati Sugar Mills, Bagha, West Champaran, Bihar: Sixteen MR genotypes were evaluated for juice quality traits at 8 months as: WL13-368 (19.74), Co 23026 (19.01), WL13-456 (18.74), K20-051 (18.48), Co 24016 (18.38), K20-371 (18.35) and WL15-805 (18.07).

(Ravinder Kumar, M.R. Meena, Pooja, M.L. Chhabra and M. Nisha)

Unravelling the molecular mechanism of early maturing responsive genes in sugarcane through transcriptome analysis

Differentially expressed genes (DEGs) were analyzed comprehensively at 8, 10 and 12 months in Co 15023 and Co 0124, resulting in the identification of 1335 DEGs. Differential gene expression and KEGG analysis identified 183 genes related to sucrose transport proteins, 230 genes associated with the SWEET transporters, 259 genes involved in sugar transport, 254 genes associated with the photosynthesis pathway were identified in the early genotype. The network analysis represents interactions among sugar transport proteins (STP), with SWEET11, SWEET12, and SUC3 playing central roles. These proteins work together to regulate sugar movement across cell membranes, crucial for maintaining cellular energy balance and responding to environmental changes. The numbers of differentially expressed miRNAs in sugarcane leaves and stem tissue at different stage of sugar accumulation were identified.

SWEET transporters are critical in phloem loading/unloading and sugar efflux. Transcript DN2818 encodes SWEET13, a plasma-membrane sugar transporter that facilitates sugar efflux or influx depending on concentration gradients. Multiple miRNA families (*miR408, miR396, miR827, miR172*) are potentially targeting SWEET13, these miRNAs are downregulated, releasing SWEET13 from suppression. Its high upregulation (log2FC > 13) indicates active sugar mobilization between cells or from source to sink tissues under the SE10vsSL10 condition. microRNA, *miR172a, miR172b, miR172c, miR172d, miR172e, miR172f,* and *miR172j* (mapped to transcript id DN 7753) regulate the energy metabolism and source and sink developmental stage. Similarly, miR623b-3p regulate glycolysis and influence energy and carbon flow and miR396d, miR396g-5p, miR396h regulate the starch biosynthesis gene at stage specific are mapped to particular transcript id DN 36593.

(M.R. Meena and Ravinder Kumar)

Enhancement of sugarcane germplasm and development of pre-breeding material

Evaluation of sugarcane germplasm, ISH, and IGH clones under sub-tropical conditions

ISH trial (Plant crop): Seventeen ISH entries with four standards with two replications were evaluated under drought and normal conditions. Drought was imposed during the formative stage by withholding irrigation water. Mean tiller population under normal and drought was 0.86 and 0.67 lakhs/ha respectively. Mean cane height (cm) under normal and drought condition were 278.57 and 239 cm respectively, with 14% reduction under drought stress. The overall NMC population at 8 months under normal and drought were 0.92 and 0.76 lakhs/ha respectively with a mean reduction of 17.7% under drought conditions; The mean cane yield under normal and drought conditions was 97.5 t/ha and76.1 t/ha respectively with a mean reduction of 19.8% under drought conditions. Co 0238 had less reduction for cane yield (20.1%) under drought conditions and seven test entries had lesser reduction than Co 0238 for cane yield.

ISH ratoon trial: Twenty sugarcane genotypes were evaluated; mean cane height (cm) was 138.5 under normal and 90under drought. Clones 14-102-13, FWC 85-217, and M 167-16 recorded higher cane weight of more than 2.0kg and were better than Co 0238 (1.6kg), reflecting better biomass accumulation. The average cane diameter ranged from 1.8 to 2.9cm and the mean number of internodes was 16.04.

Screening of S. spontaneum *under salinity stress:* Ratoon crop of IND 00-1037 and IND 00-1041 were planted in microplots to evaluate their tolerance potential for physiological and growth responses under variable regimes of irrigation water salinity (EC_{iw}-8 and 10 dS/m). IND 00-1041 exhibited strong salinity tolerance with 9% reduction in tillers/clump in 10 dS/m, stable photosynthetic rate (17.5 µmol m^{-2} s^{-1}; <4% decline at 10 dS/m), good leaf area (cm^2) retention *i.e.* 443.3 (control), 396.7 (6 dS/m) and 320.7 cm^2 (10 dS/m) with 9% reduction in plant height. Moderate chlorophyll declines in terms of SPAD value (38.0 to 29.2) and anthocyanin increase from 0.4 to 0.5 reflect efficient ionic homeostasis, reduced oxidative damage and sustained nitrogen use efficiency (NBI retention ~ 58% at 10 dS/m). Likewise, IND 00-1037 also displayed notable tolerance up to 10 dS/m, particularly in photosynthetic stability (17.5

µmol $m^{-2} s^{-1}$) and increased anthocyanin (0.6 to 0.9) under stress condition. It showed only 13% reduction in plant height (135cm) and 12.9% in tillers per clump (135) under 10 dS/m. Both the clones showed low Na^+/K^+ ratio in leaf, root and stalk.

Screening of ISH clone under salinity stress: Plant crops of ISH clones (14-102-13, M18-23-2) along with the standard Co 0238 were evaluated for salinity tolerance in microplots. Both the clones were inferior to the standard Co 0238 across all salinity levels in growth, yield and physiological parameters.

Red rot: Among the 21 ISH clones evaluated for red resistance, six each were MR and MS, four were S and five were HS to CF 13 isolate.

(M.R. Meena, Ravinder Kumar, M.L. Chhabra and Pooja)

Deciphering the mechanism of drought tolerance in sugarcane through physiological traits and root characteristics under sub-tropical conditions

Evaluation of plant crop under drought stress conditions: A field experiment along with controlled trial in rainout shelter was conducted to evaluate the drought tolerance of 23 sugarcane genotypes including three standards (Co 0238, Co 0118, Co 98014) during the formative phase. Drought stress caused 28% mean reduction in tiller population; genotypes Co 20015, Co 21013 and 24018, while Co 20019, Co 22021, Co 20016, Co 21012, Co 23025, Co 23026 and Co 22023 showed significantly less reduction. A sharp decline in gaseous exchange parameters was recorded; photosynthetic, transpiration and stomatal conductance rates decreased by 54.16%, 48.92%, and 50.63%, respectively, with recorded values of 24.21 µmol $CO_2 m^{-2} s^{-1}$, 10.25 mmol H_2O $m^{-2} s^{-1}$, and 0.523 mmol H_2O $m^{-2} s^{-1}$ under normal conditions. Average chlorophyll content decreased up to 13% and a significant increase in flavanol content was observed (Fig. 74).

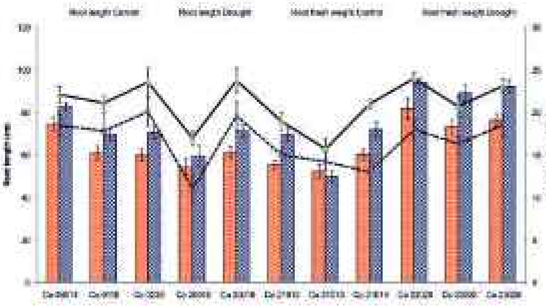


Fig. 74. Effect of drought on root length (cm) and root fresh weight (g)

Drought tolerant clones maintained up to 1.3°C cooler canopy than susceptible clones due to their deeper root system. Genotypes Co 20016, Co 23026, Co 23025, Co 98014, Co 22020, Co 21014 and Co 22021 recorded high cumulative root length, surface area and root volume. Plant height was reduced up to 36% under rainout shelter. Genotypes Co 21012, Co 20016, Co 22020, Co 23025, Co 23026 and Co 23022 showed less reduction as compared to normal irrigated (220 cm).

(Pooja and Ravinder Kumar)

All India Coordinated Research Project (Sugarcane) - Subtropical zone

Zonal Varietal Trial (NWZ)

IVT Early: Ten test entries along with three standards (CoJ 64, Co 0238, Co 05009) were evaluated for various cane yield and juice quality parameters. Co 0238 was the best standard for CCS yield, cane yield, SCW and stalk diameter, whereas CoJ 64 was the best quality standard (CCS%, sucrose% and pol in cane). At 10 months, test entry Co 21012 outperformed the best standards for major traits *viz.,* CCS t/ha (15.76), cane yield t/ha (115.93), CCS% (13.59), sucrose% (19.62), Pol in cane (15.15%) and SCW (1.57). CoPb 21182 with CCS yield (13.25 t/ha) and cane yield (109.24 t/ha) was another promising test entry which performed better over the best standard (Co 0238). The sucrose % at harvest of test entries recorded were Co 21013 (18.58), CoLk 21201 (18.35) and CoPb 21181 (18.09). In terms of cane yield, Co 21013 (101.56 t/ha) and CoH 21261 (98.68 t/ha) were the promising test entries.

AVT Early I Plant: Among the five test entries evaluated, Co 20016 recorded 16.39 t/ha CCS yield, 122.49 t/ha cane yield, 19.15% sucrose content at harvestoutperforming the best standards Co 0238 for yield and CoJ 64 for quality.

AVT Mid-late I Plant: Co 20017 (135.52 t/ha) was the best performing test entry for cane yield, whereas CoPant 97222 (108.93 t/ha) was the best standard. For sucrose % at harvesi, Co 20017 (20.2%) and CoLk 20204 (20.26%) were significantly better than the best quality standard CoPant 97222 (18.57%).

AVT Mid-late II Plant: Among the seven test entries evaluated, Co 19017 (122.11 t/ha) had better cane yield and sucrose % (19.98) than the best standard CoPant 97222 (cane yield - 108.75 t/ha, 18.97% sucrose). The test entries *viz.*, CoPb 19182 (19.73%), CoLk 19204 (19.09), CoPb 19214 (18.91%) and CoS 19232 (18.74%) had on par performance with that of CoPant 97222.

AVT Mid-late Ratoon: The cane yield of two test entries *viz.*, CoS 19235 (97.99 t/ha) and Co 19017 (94.95 t/ha) was comparable with the best standard CoPant 97222 (98.89 t/ha). Five test entries *viz.*, Co 19017 (18.44%), CoPb 19182 (18.35%), CoS 19232 (18.34%), CoS 19235 (18.19%) and CoLk 19204 (18.14%) has performed better than the best standard CoPant 97222 (17.36%) for sucrose%.

(Ravinder Kumar and M.R. Meena)

Evaluation of salinity tolerance in sugarcane genotypes under irrigation water salinity in microplot condition

Fifteen genotypes were planted in microplots to identify genotypes with high performance under salinity stress. Saline irrigation water 0 (control), 6 dS/m, and 8 dS/m EC was applied from tillering stage.

Overall mean showed 30.9% and 43.6% reduction in plant height, 35.1% and 51.3% in cane number, and 39.6% and 52.2% in single cane weight at 6 and 8 dS/m, respectively. Genotypes Co 20016, Co 20017, Co 21012, Co 21014, Co 23024 and Co 23025 showed lesser reduction than the average reduction. Photosynthetic rates in controls ranged from 26.8 to 29.8 µmol CO_2 $m^{-2} s^{-1}$. At 6 dS/m, rates dropped to 22.3 µmol CO_2 $m^{-2} s^{-1}$ on average (20.6% reduction), and at 8 dS/m (33.8% reduction). Tolerant genotypes retained higher rates, Co 20017 (21.8 µmol CO_2 $m^{-2} s^{-1}$ at 8 dS/m, 23.5% reduction), Co 20016 (22.4 µmol CO_2 $m^{-2} s^{-1}$, 24.8% reduction). Na^+/K^+ ratios increased from 0.37 in control to 1.28 at 6 dS/m and 2.15 at 8 dS/m. Chlorophyll content declined from 2.45 mg/g in control to 1.92 mg/g (21.6%) at 6 dS/m and 1.58 mg/g (35.5%) at 8 dS/m. Co 20016 showed high chlorophyll content *i.e.* 1.85 mg/g at 8 dS/m. Proline accumulation increased from 1.82 µmol/g to 5.65 µmol/g at 6 dS/m and 8.92 µmol/g at 8 dS/m respectively. The tolerant genotype (Co 20016) showed higher levels of 9.85 µmol/g at 8 dS/m. Co 21012 showed tolerance up to 6 dS/m and less reduction in height (20.8%) and maintained good photosynthetic rate (22.8 µmol CO_2 $m^{-2} s^{-1}$), chlorophyll content (2.00 mg/g), and moderate proline accumulation (5.50 µmol/g). Its superior height and physiological stability under moderate salinity makes it promising for mild to moderate saline conditions. The tolerant genotypes (Co 20017, Co 20016, Co 23024, Co 21014, Co 21012) has performed significantly better than the standard check Co 0238 for both yield and physiological traits. These clones maintained better photosynthetic efficiency, lower Na^+/K^+ ratios, and high proline accumulation, which supported sustained chlorophyll content and yield traits under salinity. These physiological mechanisms enabled better ion exclusion, osmotic adjustment and protection against oxidative stress explaining their superiority in absolute cane weight and number. Sensitive genotypes (Co 23023, Co 24017, Co 21013) showed severe photosynthetic decline and high Na^+/K^+ ratios, leading to substantial yield loss.

(Pooja)

Screening of 'Co' canes for drought tolerance

Six sugarcane genotypes (Co 20015, Co 20016, Co 20017, Co 21012, Co 21013, Co 21014) and two standards (Co 98014, Co 0238) were screened for drought by imposing drought stress during the formative phase, coinciding with high heat waves and evaporation rates. Drought stress significantly reduced tiller population (21%), plant height (15%), photosynthetic rate (29.50%), and chlorophyll fluorescence (7.6%). Canopy temperature increased by 8.6% under drought stress. Pol% was recorded in 10 months and no significant difference was recorded in control and drought. Co 20016 showed maximum pol% (19.63) followed by Co 21012 (18.61) and Co 20015 (18.60). Yield parameters, including single cane weight (26.74%) and NMC (17.70%) declined significantly resulting in a 39.62% reduction in yield as compared to normal irrigated condition (123.9 t/ha).

(Pooja)

Identification of pathotypes / races of red rot pathogen

Fourteen red rot isolates comprising eight reference pathotypes (CF 01, CF 02, CF 03, CF 07, CF 08, CF 09, CF 11, CF 13) and six local isolates collected from variety Co 0238 *viz.* Cf 238 (Balrampur), Cf 238 (Bagaha), Cf 238 (Bhabnan), Cf 238 (Mankapur), Cf 238 (RNG), and Cf 238 (KM Sugar) were inoculated independently on 15 sugarcane differentials by plug method. Pathogenic reaction on test hosts showed that pathotype CF 13 was more virulent followed by CF 02, CF 07, CF 08, CF 09, CF 03, CF 01 and CF 11. All the six CF 238 isolates were identical to pathotype CF 13; however, Bhabnan isolate was more virulent and exhibited susceptible reaction on six host differentials. Further, differential SES 594 showed complete resistance to all the test isolates.

Survey of sugarcane diseases naturally occurring in the area on important sugarcane varieties

Survey for sugarcane diseases in the reserved area of 15 sugar mills revealed the varietal breakdown of Co 0238 due to red rot incidence. *Pokkah boeng* noticed up to 27% in cultivated varieties under the zone and PB was observed at BCML in test entry Co 21012, whereas, in Co 20016 top rot was expressed at Rauzagaon. Wilt incidence (10%) was observed by in Panipat area. Further, incidence of smut up to 10% was recorded in ratoon crops of Co 0238 and Co 89003 in Karnal and Shahabad area. Mild incidence of top rot and YLD was also observed in Co 0118, Co 0238, Co 05011, Co 89003, CoH 160 and Co 15023. Sugarcane leaf fleck disease caused by Sugarcane bacilliform virus (SCBV) was recorded in some of the varieties cultivated in BCML units in Uttar Pradesh, particularly in variety CoLk 14201. However, tissue culture raised crop fields were almost free from this disease.

Evaluation of IET / Zonal varieties for resistance to red rot: Fifty-three IVT entries along with eight standards were evaluated by plug and cotton swab methods of inoculation with CF 08 and CF 13 isolates. Of the nine IVT early and mid-late entries, eight entries were R or MR to CF13 isolate by both plug and cotton swab methods.

Assessment of elite ISH clones for resistance to red rot: Thirty-six clones comprising 19 ISH, three IGH, 14 commercial hybrids and one waterlogging tolerant clone were screened for red rot resistance against CF 08 and CF13 isolates. Out of 19 ISH clones tested, 18 were R/MR to CF 08. Similarly, 15 clones were R/MR, two each were MS and S to CF13 isolate. A waterlogging clone WL-10-85 expressed MR reaction to both CF 08 and CF 13 isolates. Among the commercial hybrid clones, Co 98014 was MS to CF 13 isolate; whereas, the other test commercial hybrids were R / MR.

Yellow Leaf Disease: Among the 61 ZVT entries, 19 were R, 29 were MR, nine were MS and four were S to YLD.

Pokkahboeng: Out of 61 ZVT screened for *Pokkahboeng*, 17 were R, 31 were MR, nine were MS and 4 were S.

(M.L. Chhabra)

Evaluation of Zonal varieties /genotypes for their reaction against major insect pests of sugarcane

AVT 1st plant: Thirteen entries were screened against stalk borer, top borer and root borer. Incidence of stalk borer varied from 22.67% (Co 20016) to 53.33% (Co 05011), top borer from 18.67% (CoLk 20204) to 46.67% (CoPb 20211) and root borer from 40.0% (Co 20016) to 57.33% (CoLk 20202).

AVT 2nd Plant: Out of 13 entries, the lowest (16.00%) incidence of stalk borer was recorded in CoPb 19212 and the highest (60.00%) in CoLk 19201; top borer incidence varied from 20.0% (CoS 19232) to 42.67% (CoPb 19213) and root borer from 50.67% (CoLk 19202, CoPb 19182) to 81.33% (CoPb 19214).

AVT Ratoon: In AVT-ratoon crop, stalk borer incidence was the lowest (17.33%) in Co 19017 and CoPb 19214 and the highest (45.33%) in CoS 19232. Top borer incidence varied from 4.0% in CoS 19231 to 30.67% in CoPb 19213. Root borer incidence was the lowest in CoS 19231 (25.33%) and the highest in CoS 19232 (58.67%).

IVT trial (Early): Among the 11 genotypes screened against stalk borer, three entries (CoPb 21182, CoLk 21201, Co 0238) were LS and remaining genotypes were MS and HS. For top borer, all the entries were MS and HS.

IVT trial (Mid-late): Out of 11 entries, five entries were MS and the remaining were HS to stalk borer. For top borer, only one entry (CoS 21233) was S and remaining were MS / HS.

EXTERNALLY FUNDED PROJECTS

Survey and surveillance of sugarcane insect-pests: Field survey revealed the occurrence of root borer, top borer, stalk borer, whitefly, mite, mealybug, early shoot borer and pink borer. Top borer was the main pest noticed in the fields planted with Co 0238, Co 15023 and Co 05011, whereas, root borer was the major pest in Co 0118.

Monitoring of insect pests and bio-agents in sugarcane agro-ecosystem: Stalk borer, top borer and root borer were the predominant pests observed in Co 15023; whereas, mite, mealybug, pyrilla and black bug were observed at low levels. Among the bio-control agents, *Isotima javensis, Stenobracon deesae, Cotesia flavipes* and *Epiricania melanoleuca* were the major natural enemies observed (Table17).

Assessment of yield losses caused by borer pests of sugarcane under changing climate scenario: Yield loss due to stalk borer attack and impact of borer infestation on juice quality traits was assessed in Co 15023. The percent incidence of pests was 20.0-64.0% and at harvest, yield and quality parameters in relation to the infestation parameters were not significant.

(P. Mahesh)

Table 17. Prevalence of insect pests of sugarcane ecosystem and their bio- agents

Insect-pests	Incidence range (%)	Bio- agents
Top borer	30.0-54.29	*Isotima javensis* *Stenobracon deesae*
Stalk borer	20.0-62.86	*Cotesia flavipes*
Root borer	40.0-76.67	-
Early shoot borer	2.0-10.0	-
Black bug	2.0/leaf	-
Pyrilla	5.0/leaf	*Epiricania melanoleuca*
Mealybug	Trace	Coccinellids
Mites	0.0-90.0	-

Identification, characterization and verification of new sugarcane varieties for DUS testing

Maintenance of reference varieties (RV) of sugarcane: A collection of 171 sub-tropical sugarcane reference varieties and DUS reference varieties are maintained.

Re-characterization of Reference Varieties: DUS traits of 171 RVs maintained were verified /re-characterized and the database of all the verified DUS reference varieties were submitted to the PPV&FR.

DUS testing for new sugarcane variety: Second year DUS testing was conducted for three sugarcane candidate varieties (CoLk 15201, CoLk 15207, CoLk 15466) along with RVs (CoPant 97222, CoPant 90223, CoSe 1434, Co 1158, Co 1148, BO 130, CoS 90268). Observations recorded on 27 morphological traits showed that the candidate varieties were morphologically distinct from one another and from the RVs, confirming that it maintained distinctness and uniformity. The essential traits of these varieties remained stable over two years, fulfilling the DUS criteria required for variety release consideration.

(M.R. Meena and Ravinder Kumar)

ICAR-Seed Project, Sugarcane (RFS, Karnal)

Breeder seed crop was planted in six acres area at the Centre and in 40 acres in Farmers Participatory Seed production (FPSP) fields. A total of 19005.20 quintals of breeder seed were produced and supplied to various stakeholders. From the sale of the seed cane, Rs. 17.42 lakhs was earned as revenue. Among the varieties Co 15023 (711.72 quintals), Co 16030 (1042.30), Co 17018 (1611.09) and Co 0118 (16131.1 quintals) were supplied in large quantity. The on-farm seed production was 2075.31 quintals and from FPSP seed production was 16929.89 quintals.

Single bud setts sale: A total of 2,55,959 single bud setts worth Rs 2,55,959 of the varieties Co 0118 (1650), Co 0238 (200), Co 15023 (1590), Co 16030 (10815) and Co 17018 (241694) were produced and supplied to farmers of the region.

Settling production and sale: A total of 3622 settlings of important varieties worth Rs 10,866 were produced and sold to various stakeholders.

Tissue culture plantlets production and sale: Nearly 50,000 plantlets of Co 0118, Co 15023 and Co 17018 were produced. From these nearly four-acre area under varieties Co 17018 (2 acre), Co 15023 (1 acre) and Co 0118 (1 acre) were transplanted as nucleus seed crop. A total of 10,033 tissue culture plantlets of variety Co 15023 (330), Co 0118 (500) and Co 17018 (9203) worth Rs 1,00,330 were sold to various stakeholders including farmers and sugar mills.

Sale of mother culture flasks: A total of 49 mother flasks of Co 0118, Co 15023 and Co 17018 worth Rs. 2.45 lakhs were sold to sugar mills for the production of tissue culture plantlets.

Licensing of variety Co 17018: The seed production and sale license of variety Co 17018 was awarded to six sugar mills (Mawana Sugars Pvt Ltd, Mawana, Meerut; Uttam Sugars Mill Ltd unit Barkatpur, Bijnor, UP; Rana Sugar Mill Ltd Buttar Seviyan, Amritsar, Punjab; Avadh Sugars and Energy Pvt Ltd unit Seohara, Bijnor, UP; PBS Foods Sugar Pvt Ltd, Chandpur, Bijnor, UP; Piccadily Agro Industries Pvt Ltd, Bhadson, Karnal, Haryana). A revenue worth Rs 3.6 lakhs was generated @ Rs 60000 per license.

Total revenue generated: A sum of Rs 27.14 lakhs/- was generated as revenue.

(Ravinder Kumar and M.R. Meena)

Identification of salt tolerant sugarcane clones for commercial cultivation in Haryana (RKVY Haryana)

Eleven 'Co' canes with standard Co 0238 were screened for their salinity tolerance in microplots under variable regimes of irrigation water salinity

(Control (best available water), EC_{iw} - 6 and 8 dS/m.) (Fig. 75).

Control EC_{iw} ~ 8 dS/m EC_{iw} ~ 6 dS/m

Fig. 75. Overview of salinity experiment

A gradual increase was recorded in Na^+/K^+ ratio of leaf under salinity stress in all the studied clones. In leaves, Na^+/K^+ ratio increased from 0.125 (control) to 0.501 and 0.695 under 6 dSm^{-1} and 8 dSm^{-1}, respectively. Lipid peroxidation in terms of MDA content (µmol/g FW) was 0.776 and increased up to 53% under 8 dS/m. Average photosynthetic rate was 23.15 µmol CO_2 m^{-2} s^{-1} under normal irrigated control while 37% and 51.2% mean reduction was recorded under EC_{iw} – 6 and 8 dS/m, respectively (Fig. 76). Significant reduction was recorded in chlorophyll content (SPAD readings). Genotypes Co 17018, Co 18022, Co 20016, Co 21012 and Co 21014 showed less reduction, while maximum reduction was recorded in Co 0238. At maturity stage, average plant height was 232.83 cm under normal irrigated control whereas 17.51% and 29.18% reduction were recorded under 6 and 8 dS/m, respectively. Genotypes Co 17018, Co 18022, Co 20016, Co 21014 and Co 20017 were identified as best performers under 6&8 dSm^{-1}

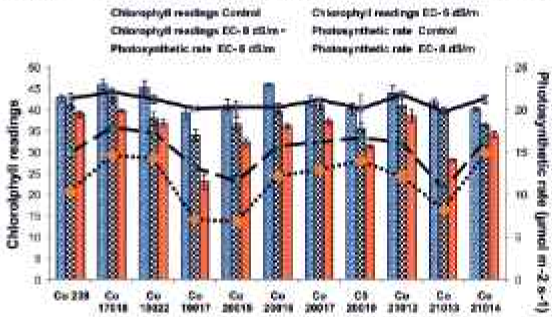


Fig. 76. Effect of salinity stress on chlorophyll (SPAD reading) and photosynthetic rate (µmol m^{-2} s^{-1})

salinity stress. Co 21012 was tolerant in 6 dSm^{-1}; Co 21013 was found susceptible under both the levels of salinity stress.

(Pooja, Ravinder Kumar, M.R. Meena and M.L. Chhabra)

Identification of climate resilient drought-tolerant sugarcane varieties suitable for Haryana state (RKVY)

The experiment with 12 new sugarcane clones, along with standards Co 0238, CoS 767, Co 98014 and Co 05011 were screened for drought tolerance under rainout facility by imposing drought stress during formative phase. Canopy coverage during stress period was higher in Co 21012, Co 21013, and Co 22020 where it was lesser in Co 23025 than the best standard Co 0238 (40%). Genotypes Co 22022, Co 21012 Co 23022, Co 23023 Co 23025 and K21-127 retained higher chlorophyll content under drought stress than best standard Co 0238 (37.7). Co 23022 (2.0), Co 22020 (3.5), Co 21012 (3.1) and Co 16029 (3.2) exhibited lower canopy temperature difference under both normal and drought conditions compared to the best standard Co 98014 (4.8), indicating better thermal regulation under stress.

Tensiometer reading under normal conditions ranged from 20-24 kPa, whereas under drought stress, it ranged from 60-64 kPas confirming the imposition of moisture stress. The mean tillers count at 120 DAP under normal and drought condition was 1.34 lakhs/ha, and 1.11 lakhs/ha respectively, reflecting a 21.70% reduction due to drought. Mean leaf area under normal and drought stress was 529.34cm^2 and 414.3cm^2 respectively, corresponding to a 27.8% reduction under drought. Plant height showed a mean reduction of 52.7% under drought stress; however, entries such as Co 22020, Co 23023, Co 21012 and Co 16029 recorded lower reductions compared to the best standard Co 0238 (34%).

Recovery observations indicated that for plant height, Co 21012, Co 21013, Co 22020 and

Co 23022 exhibited faster recovery than the best standard Co 98014. Rapid recovery in numbers of internodes was observed in Co 21012, Co 23022 and Co 23025, while, Co 21012, Co 20019, and Co 23024 showed quicker recovery in leaf area. The mean number of leaves formed at nodal region was 11.9 under normal conditions and 10.6 drought stress.

(*M.R. Meena, Ravinder Kumar, Pooja and M.L. Chhabra*)

5.7 ICAR-Sugarcane Breeding Institute Research Centre, Kannur

Breeding superior sugarcane varieties of different maturity with improved cane yield, quality and resistance to biotic and abiotic stresses

Breeding varieties resistant to waterlogging

Three waterlogging (WL) tolerant clones (WL 20-1027, WL 20-1321, WL 20-1169) were evaluated under the Pre-Zonal Varietal Trial at Coimbatore. At 10months, sucrose content (%) of these clones was 19.7, 17.8 and 18.7, respectively, while the corresponding CCS yield (t/ha) was 16.8, 13.9 and 12.2 in the final clonal trial at Kannur. The CCS yield was numerically higher that the check varieties Co 99006, Co 86032 and Co 62175 and all the three clones were MR to red rot.

In a final clonal evaluation,17 test clones were evaluated along with three check varieties. At 10 months, the range was 18.1 to 20.7%, with the lowest value recorded in Co 62175 and the highest in WL 21-2621. Sucrose content varied from 15.6 to 18.7%; WL 21-3189, WL 21-4270 and WL 21-4776 exhibited high sucrose content, indicating their potential as genetic stocks for sucrose improvement. Cane yield ranged from 34 to 81 t/ha; Co 62175, WL 21-2559, WL 21-3107, WL 21-4546 and WL 21-4033 were the highest yielders. CCS yield ranged from 4.2 to 9.4 t/ha and eight clones (WL 21-2559, WL 21-4546, WL 21-4033, WL 21-3189, WL 21-4776, WL 21-2539, WL 21-2472,WL 21-3107) recorded numerically higher CCS yield than the best-performing check variety. Eight clones (WL 21-2559, WL 21-4546, WL 21-3189, WL 21-2539, WL 21-2472, WL 21-4786, WL 21-4270, WL 21-3396) were MR, while two clones (WL 21-4776, WL 21-3429) were R to red rot.

In the second clonal trial, 37 clones along with three check varieties were evaluated. At 10 months, Brix percentage ranged from 13.9 to 19.3 (Co 99 006 had the highest value), sucrose content varied from 11.0 to 17.4% (Co 99006 and WL 22-279 had the maximum), cane yield ranged from 11 to 87 t/ha and CCS yield varied from 1.1 to 9.7 t/ha, indicating substantial differences in yield potential among the clones.

Seedlings from 12 crosses were evaluated at 8 months, NMC ranged from 1-18 with an average of 4, cane thickness (cm) ranged from 0.5-2.1with an average of 1.4 and HR Brix ranged from12 to 24.2% and the average was 15.2%.

A total of 24 biparental crosses were made for developing waterlogging resistant clones involving foreign hybrids and 'Co'canes.

Potential waterlogging-resistant sugarcane clones, maintained consistently over several years were evaluated for yield and quality traits and allthe clones were R or MR to red rot pathogen. NMC ranged from 15 to 52 with an average of 26, mean cane thickness was 2.4 cm, and 11 clones recorded over 2.5 cm. SCW ranged from 0.8 to 1.5 kg, with WL 16-457 registering the highest. At 11 months, Brix varied from 16.4% in WL 08-270 to 22.7% in WL 10-24, sucrose content ranged from 13.6% (WL 08-270) to 21.5% (WL 05-499). Seven clones (WL 16-498, WL 13-711, WL 12-749, WL 11-2230, WL 10-102, WL 10-24, WL 05-499) had over 20% sucrose. WL 05-726, WL 10-85, and WL 10-102 recorded better CCS yield than the check variety Co 99006, highlighting their potential for further utilization as genetic stocks for waterlogging tolerance and quality improvement.

(M. Nisha, R. Gopi, E.K. Saneera, M. Alagupalamuthirsolai and V.G. Dhanya)

Enhancement of sugarcane germplasm and development of pre-breeding material

Utilisation of germplasm resources for developing new genetic stocks: The clone GUK 14-48 (INGR25037), a rare interspecific hybrid (ISH) of *Saccharum robustum* characterized by red flesh, high number of canes, superior cane yield and elevated levels of phenolics, antioxidants, and anthocyanins, has been registered as a genetic stock with NBPGR (Fig. 77).

Fig. 77. GUK 14-48 (INGR25037)

Another clone, GUK 17-301 (GUK 15-474 × WL 12-101), with bamboo and waterlogging resistance in its lineage has attained 'Co' status Co 24015, based on its consistent performance in yield and quality parameters.

Three clones *viz.*, GUK 20-381, GUK 20-401 and GUK 20-473 derived from the biparental cross GUK 19-1709 × WL 10-102 evaluated in PZVT recorded sucrose content of 15.8%, 16.8%, and 16.3%, respectively, and were categorized as either R or MR to red rot.

A final clonal trial conducted with 18 clones representing different backcross progenies of inter-specific crosses revealed that GUK 21-960, GUK 21-2275, GUK 21-1681, GUK 21-1425, and GUK 21-833 recorded high early Brix (>21%) at 7 months and were either R or MR to red rot. GUK 21-1615 was significantly superior for CCS yield and two clones (GUK 21-2248, GUK 21-2275) were on par to the check varieties indicating their potential for further advancement.

In the second clonal trial, out of 38 clones evaluated, three clones (GUK 22-1079, GUK 22-965, GUK 22-2086) had CCS yield on par with the check varieties. Sixty seven clones of various interspecific crosses were evaluated in first clonal trial along with two check varieties for cane thickness, brix at bottom, middle and top, NMC and tillering. About 20% of the clones were having HR Brix above 20%.

A total of 24 interspecific crosses involving various *Saccharum* species and commercial hybrids were made.

(M. Nisha, E.K. Saneera, R. Gopi and V.G. Dhanya)

Maintenance of world collection of sugarcane germplasm

Maintenance and evaluation of germplasm: The world collection of sugarcane germplasm, comprising 3380 clones is conserved in the field gene bank through annual replanting. The collection includes *S. officinarum* (757), *S. barberi* (42), *S. sinense* (30), *S. robustum* (129), *S. edule* (16), *S. spontaneum* (79), Indian hybrids (1,040), foreign hybrids (614), *S. spontaneum* (Indian collections) (305), IA clones (130), allied genera/natural hybrids (152), and Indian allied genera (88). Flowering among germplasm accessions ranged from 3 to 95% with Indo-American hybrids exhibiting the highest flowering percentage and *S. sinense* showed the lowest. The flowering percentage in other groups were *S. officinarum* (7%), *S. spontaneum* (exotic collections) (41%), exotic hybrids (33%), allied genera (exotic collections) (7%), *S. robustum* (17%), Indian hybrids (31%), *S. barberi* (10%), *S. spontaneum* (Indian collections) (25%), and Indian allied genera (8%). The exotic hybrids (614 clones) maintained in the field gene bank were characterized for key yield and quality parameters. Clones *viz.*, LF 68-7639 B, LF 70-920, LF

74-2113 (Fiji), B 40-98(Barbados), YUETANG85-177(China), PR 1085(Puerto Rico), C 278(Cuba), M 31/45 (Mauritius), Q 62(Australia), CB 36-24(Brazil) had high CCS yield. The clones CP 29-320, CP 89-1762, CP 92-1641, CP 94-1100, CP 72-2086, CP 53-99, CP 61-84 (Canal point), Q 73, RAGNAR, Q 68 (Australia), LF 68-7639 B, LF 65-4329 (Fiji), PR 1069 (Puerto Rico) and CB 36-24 (Brazil) recorded more than 19.5% sucrose at 10 months.

(M. Nisha)

Monitoring of diseases: Ring spot disease of scale 3 to 5 was recorded in 21clones of *S. officinarum*, 23 Indian hybrids, 12 clones of foreign hybrids,10 clones of *S. sinense* and one clone of *S. barberi*. The highest disease rating of 5 was observed in CoK 34 of Indian hybrid. The clones such as Co 404, Creoula Rayada 28 NG 262 IK 76-70A of *S. officinarurn* recorded *Pokkah boeng* and later shortening of internodes was observed. Brown spot was recorded in Co 244, Co 755 and in S. *spontaneum* clones (IND 81-102, IND 81-151, IND 81-156, IND 81-164, IND 81-172, IND 81-320) with disease rating of 3-4. Stalk rot was found in 57 NG 140 (*S. officinarum*) and H 54-807, 56-334 (Foreign hybrid). Nine clones were affected by smut. Rust was observed in Indian hybrids {Co 214(4), Co 362(3), Co 371(7), Co 377(7), Co 695(3)} as well as in *S. spontaneum* clones {IND 81-20(5), 81-74(5), IND 81-82(9), IND 81-83(7), 81-99(5), 81-177(4)}. Freckle and chlorosis due to SCBV was found in Listada, Castilla, China, Guam A, Irang Malang, Hawai Original 36, Hawai Original 38 and Pilimoi 60 of *S. officinarum*. The affected clones were treated with hot water and 0.1% carbendazim for 30 minutes for the management of smut and stalk rot before planting.

(R. Gopi)

Monitoring for pest incidence, biological control of the pests: Insect pests *viz.,* internode borer (*Chilo sacchariphagus indicus),* pink borer (*Sesamia inferens*) and leaf web mite (*Schizotetranychus krungthepensis)* were found to be occurring at various ranges. In addition to that, sporadic infestation of armyworms, rice skipper, mealy bugs, scale insects, and sugarcane aphid, *Melanaphis sacchari* were noticed. INB incidence was noticed in less than 4% of the accessions across all crop assemblages with per cent infestation ranging from 0-20% and an average infestation of 8.94% on cane basis. Pink borer incidence was noticed in less than 6% of the accessions across all crop assemblages with the average percent infestation of 9.51% across crop assemblages on dead heart basis. Pyrilla population was effectively suppressed by the introduced ecto-parasiotoid, *Epiricania (=Fulgoraecia) melanoleuca* (Fletcher) (Lepidoptera: Epipyropidae) and the population remained at <0.1 nymphs and adults per leaf throughout the year. The isolated incidence of sugarcane aphid, *M. sacchari* with colonies showing mummification from the parasitoid, *Aphelinus sp.* was noticed. There was also activity of predators like syrphids and ladybird beetle, *Pseudaspidimerus sp.* effectively preying on sugarcane aphid colonies recorded.

(E.K. Saneera and P. Mahesh)

In vitro conservation of germplasm and cryopreservation

Cryopreservation: Moisture absorption isotherm was estimated for delineating the pattern of moisture loss in true seeds of sugarcane indicated that seeds reach equilibration (EMC- equilibrium Moisture Content) in 3±0.2 hours. Glycerol as cryoprotectant was added to seeds at EMC and immersed to liquid nitrogen, where the viability was retained for 8 days.

Maintenance of germplasm under in vitro *conditions:* A total of 56 *Saccharum* clones were maintained under *invitro* conditions using shoot tip culture. To reduce the bacterial contamination in tissue culture, different concentrations of antibiotics were added to the culture media and Streptomycin was found effective.

(V.G. Dhanya)

Molecular characterization: The SSR profiling of *S. officinarum* clones were done using 20 SSR primers. Maximum similarity was observed between Kea21 and Khajuria and the least between Vellai and Poona. Clones Thellacherukku and Vellai were showing less similarity with the other clones studied.

(M. Nisha)

Enhancing germination percentage and planting value in true seeds of *Saccharum* species

Pattern of seed set in Saccharum officinarum*:* Studies on the pattern of floral initiation and seed set in five clones of *S. officinarum* indicated that a three-stage pattern of floral development occurs from top to bottom. The first one-third extends from anthesis to seed maturation (physiological maturity stage) in a time gap of 23 days followed by post maturation phase in 26 days (harvest maturity) where the moisture content declined from 13 to 6%.

Germination dynamics in Saccharum sp: Dynamics of germination in the clone NC 99 was studied in the different stages of seed maturation *viz.*, plumpy stage (21 days from anthesis, moisture content 14-18%), maturation stage (23 days, moisture content 11-13%) and post maturation (26 days, moisture content 6-8%) and was correlated with percentage of germination. In plumpy stage, moisture content and germination percentage were negatively correlated indicating the immature stage of embryo development, while positive correlation was observed in maturation stage (completion of embryo development). The percentage of germination declined in post maturation phase (embryo dehydration started), hinting that there is no apparent harvest maturity phase in *Saccharum* clones.

(V.G. Dhanya, M. Nisha and M. Alagupalamuthirsolai)

5.8 ICAR-sugarcane Breeding Institute Research Centre, Agali

Germplasm maintenance, hybridization and offseason nursery

Germplasm maintenance: A total of 1394 germplasm clones including 'Co' canes, 'Co' allied clones, exotic hybrids, inter-specific and inter-generic hybrids, active collection of *S. officinarum, S. barberi, S. sinense, S. robustum, Erianthus* spp, *Sclerostachya* and *Narenga* are clonally maintained in the field.

Flowering during 2025 season: Out of 1394 germplasm clones, 871 accessions flowered with 62% flowering intensity. Among the 205 *S. officinarum* clones maintained at National Distant Hybridization Facility (NDHF), Agali, 55 clones (27%) flowered. Six clones of *S. sinense*, four clones of *S. robustum* and three clones of *S. barberi* flowered during the season. Intensity of flowering in Co canes and Co allied clones was 86%. *S. officinarum* clones *viz.*, Mongetgayam and Naz, Exotic clones *viz.*, BN-135 and KM 436 were the early flowering clones that flowered during the first week of September 2025.

Sugarcane distant hybridization: Two hundred and thirty four crosses were made at Agali. Sixteen AICRP(S) centres (Buralikson, Cuddalore, Faridkot, Lucknow, Kapurthala, Mandya, Motipur, Padegaon, Pantnagar, Perumallapalle, Pune, Pusa, Sankeshwar, Seorahi, Shahjahanpur, and Thiruvalla) visited the centre and utilized the facility. A total of 92 crosses (wide crosses: 8, commercial-type crosses: 04) and 70 General Collections were effected for the participating centres. Diverse clones were utilized for crossing: *S. officinarum*: 12, *S. barberi*: 01, *S. sinense*: 04, *S. robustum*: 01, CYM: 03, Exotic clones: 19, GUK: 01, ISH: 04, PIO: 04, Hybrid: 14.

Off-Season banana nursery: Under the project 'Improvement of banana through conventional breeding', 1100 plants from 150 unique and breeding potential varieties/accessions of ICAR-NRC Banana, Trichy are maintained at Agali. Facilitated in making crossing in 161 bunches with various cross combinations. Twenty five bunches have been harvested and 514 hybridised seeds were collected from 14 successful hybridised bunches. During 2024-25, 120 elite germplasm from various genomic groups and subgroups have been included.

ICAR-CRIJAF, Barrackpore: Jute and allied fibre seed multiplication and generation advancement was undertaken in 1500 m^2 area at Agali centre. A total of 170 genotypes were planted and seed was multiplied.

(R.T. Maruthi and A. Anna Durai)

DUS testing of sugarcane

A total of 248 Reference Varieties (RVs) were raised and re-characterization of 246 RVs for 27 DUS traits have been completed and the data was sent to the PPV & FR Authority. In addition, images of 100 reference varieties were taken for digital database development. During 2024-25 season, DUS test was conducted for four varieties namely, Phule-11082 (CoM 11082), Phule Sugarcane 15012 (MS 17082), VSI 08005 (VSI 12121) and Phule Sugarcane 13007 (MS 14082). First year DUS testing of the NV, VSI 08005 (VSI 12121) was conducted along with closely resembling RVs and was distinct from the RVs (Co 94008 and Co 62175) for DUS traits *viz.*, hairiness, shape of inner auricle, colour not exposed to sun and it was distinct from the RV Co 8347 for internode shape, rind surface appearance and waxiness. Phule Sugarcane 13007 (MS 14082) was distinct from the RVs (CoC 773 and 93 V 297) for DUS traits *viz.*, hairiness, inner auricle, colour of dewlap, leaf sheath curvature and it was distinct from the RV CoM 0265 for growth crack, waxiness, bud shape and bud tip in relation to growth ring. Second year DUS testing of two NVs, namely Phule-11082 and Phule Sugarcane 15012 was conducted along with closely resembling RVs (Co 8347, Co 8371, CoA 89081, Co 7805 and Co 8347, Co 8371, Co 853, Co 6304) and zonal standards Co 86032 and CoC 671. The candidate variety Phule-11082 (CoM 11082) was distinct from the RVs (Co 8347, Co 8371, CoA 89081, Co 7805) for DUS traits *viz.*, plant growth habit, hairiness, shape of ligule, inner auricle, leaf blade curvature, adherence of leaf sheath, internode colour (exposed to sun) and prominent growth ring. The candidate variety Phule Sugarcane 15012 (MS 17082) was distinct from the RVs (Co 8347, Co 8371, Co 853 and Co 6304) for DUS traits *viz.*, plant growth habit, hairiness, shape of ligule, inner auricle, internode colour (exposed to sun), internode shape, rind surface appearance, waxiness, bud groove and bud tip in relation to growth ring.

(R.T. Maruthi and R. Karuppaiyan)

Government Schemes

Development Action Plan for Scheduled Tribe Component (DAPSTC)

This project was implemented in ChinnaKalrayan hills of Salem district, Tamil Nadu and tribal settlements of the Tiruppur division of Anamalai Tiger Reserve (ATR).

Need assessment: Baseline survey on need assessment, identification of gaps and possible interventions was conducted using a schedule prepared. Focus group discussions were conducted in the following tribal settlements of ATR, Tiruppur: Poochakottamparai, Porupparu, Karattupathi, Attumalai, Manjampatti, Karumutti and Thippippaarai.

Awareness cum Training Campaign for Enhancement of Tribal Income: The Campaign was organized by ICAR-SBI in collaboration with ICAR-KVK, Palakkad on 7 February 2025 at ICAR-SBIRC, Agali. The campaign featured training sessions on income enhancement, distribution of livelihood inputs, 'biodiversity'-themed quizzes and poster competitions for school children, and millet-based recipe competitions for tribal women. Technical pamphlets on mushroom cultivation, backyard poultry, and fruit and vegetable processing were released. Inputs including chicks, tissue culture banana seedlings, wild boar repellent, first-aid kits and value-added products were distributed to tribals from 10 settlements. Multiple line departments and institutions showcased technologies and schemes. Over 300 tribal beneficiaries participated in the program.

Training for tribal sugarcane farmers: Organized an on-campus training program on 'Sugarcane farming for prosperity' for the tribal farmers of Karumanthurai, Salem district. Power tillers and battery-operated sprayers were distributed to two tribal settlements *viz*., Molayanoor and Vilampatti of Salem district. A DAPSTC video on 'Empowering tribals: Transforming lives' was screened during the occasion and a Tamil publication on 'Sugarcane farming for prosperity' was released. A radio feature on the program was broadcast through All India Radio, Coimbatore from 15 July to 8 August 2025.

Distribution of power tillers to tribal sugarcane farmers

Felicitation by District Collector, Salem

Awareness campaign for tribal farmers: An awareness campaign for the tribal farmers of Sadivayal tribal settlement in Coimbatore district was organized on 19 November 2025. The farmers were made aware of the government schemes available for tribal farmers and were provided farm tools and other inputs.

Interaction with ATR Tribals: Seven tribal settlements were identified for focused interventions. Following need assessments with tribal leaders and families in Attumalai, Porupparu and Thippipparai, interactions were held to explore livelihood opportunities, training, and distribution of seeds, farm tools, and essential items.

Recognition for DAPSTC: Recognizing the efforts of ICAR-SBI towards enhancing the quality of life of the tribals in the district, District Collector of Salem district presented a 'Certificate of Appreciation' during the Republic Day Ceremony held at Mahatma Gandhi Stadium in Salem on 26 January 2025.

(D. Puthira Prathap, K. Mohanraj, P. Geetha and R. Gobi)

Development Action Plan for Schedule Caste

The beneficiaries identified for this scheme were Iduhatti Watershed Association, Panchayat Union Primary School in Dhoddanni village of Nilgiris district, dryland farmers and Government Adi Dravidar Welfare Primary School, Kalimangalam, Coimbatore.

Awareness cum demonstration on 'Mechanization in hill agriculture' was conducted at Dhoddannifor 40 farmers of Dhoddanni, Periyarnagar and Jeeva Nagar villages of Iduhatti Watershed Association on 25 April 2025. The use of diesel engine coupled with mono block water lifting pump in watershed areas and farm implements like tea leaf harvester and tea pruner were demonstrated to the farmers. Farm implements including 10 diesel pump sets, a tea harvester and a tea pruner to the beneficiaries

Distribution of farm implements

Training on Mechanization in Hill Agriculture

Distribution of teaching aids

of Dhoddanni village; one power tiller, two leaf harvesters and two tea pruners to the farmers of Periyarnagar and ae tea harvester and a tea pruner to the beneficiaries of Jeevanagar were provided. Teaching and learning aids, furniture and public address system were provided to Panchayat Union Primary School in this village to improve the teaching and learning experience of the teachers and students. Five dryland farmers of Kalimangalam village of Thondamuthur taluk were provided with manual back carrying power sprayer. A public address system, hand held brush cutter, podium, computer table and chair were supplied to the Adi Dravidar welfare Primary School.

(A. Anna Durai, K. Kannan, R. Ramesh, T. Arumuganathan, R. Arunkumar and P.T. Prathima)

6 EDUCATION AND TRAINING

6.1 Education

Project work /Training program for students

- *UG / PG project work:* Forty-two post graduate students (three months project: 38 students, six months project: four students) of various degree programs *viz.*, Biotechnology, Biochemistry, Botany, Microbiology, Food science, Zoology, Life science, Bioinformatics and Genetic Engineering fromvarious colleges / Universities in Tamil Nadu and Kerala underwent project work at the Institute.
- *Exposure training:* A total of 161 students underwent exposure training (Internship) of 15/21/30 days in the aspects of Biotechnology, Biochemistry, Botany, Microbiology and Food science, Plant Pathology, Entomology, Crop Physiology and Nematology.
- A total revenue of Rs.16,85,000 was generated through the fees paid by the project students and exposure trainees.

Deputation abroad

- Dr. R. Valarmathi participated in the Plant and Animal Genome Conference/PAG 32 held at San Diego, California, USA through DST Travel Grant during 10-15 January 2025.
- Dr. R. Manimekalai, attended Short Term Overseas Training in Genome Editing under

the guidance of Professor Altpeter Fredy, University of Florida, Gainesville, USA16 under ICAR EFC Project on 'Enhancing climate resilience and ensuring food security with genome editing tool' (1st Batch, 2024-25) sub-scheme 'Basic and strategic research and education' of the scheme 'Crop science for food and nutritional security' during 15 March to 15 August 2025.

- Dr. P. Govindaraj, Director visited Sugarcane Research Institute, Nanning, China as a member of high level delegation of Indian Sugar and Bioenergy Manufacturers Association (ISMA) and participated in SRI annual sugarcane workshop held in Nanning, China during 17-21 November 2025.
- Dr. C. Appunu has been deputed for a short term overseas training in Genome editing on 'Advancing in planta transformation and precise genome editing technologies in crop' in the Molecular Crop Improvement Lab, IGCAST, Texas Tech University, USA under ICAR EFC Project 'Enhancing climate resilience and ensuring food security with genome editing tool', sub-scheme 'Basic and strategic research and education' of the scheme 'Crop science for food and nutritional security' for six months from 17 September 2025 to 04 March 2026.

6.2 Training and capacity building

6.2.1 Training programs organized

ICAR-SBI, Coimbatore

- An orientation program to Dr. Santhoshkumar Pujer, Assistant Professor (Plant Breeding) on 'Sugarcane tissue culture technical procedure and operation' during 6-9 January 2025.
- One day training program for the staff of the sugar mills from tropical zone under ICAR-SBI-ISMA collaborative project on 09 January 2025.
- A hands-on training program on 'Advanced tools of molecular biology and biotechnology' sponsored by Society of Plant Biochemistry and Biotechnology, New Delhi during 20-25 January 2025.
- A webinar on 'Sugarcane based agri-startups ecosystem' at the Institute by ICAR-SBI-Sugarcane Edge (ABI) on 03 February 2025.
- Four one-day training cum demonstrations on 'Mechanized priming technology for healthy nursery and disease management in sugarcane' to cane officials and entrepreneurs in four sugar mills in Bihar during 19-22 February 2025.
- Two one-day training and demonstrations on Mechanized priming technology for healthy nursery program and its role in improved production and protection in sugarcane' on 11 and 12 March 2025 for entrepreneurs who had procured sett treatment device andcane staff at M.R.K. Co-op Sugar Mills Ltd., and Arignar Anna Public Sugar Mills of Tamil Nadu.
- Six demonstrations on 'Micronutrient spray using drone in sugarcane' for 257 farmers of Kallakurichi, Thiruvannamalai, Erode, Thiruchirapalli and Ariyalur districts of Tamil Nadu in April 2025.
- A comprehensive hands-on training program on 'Biological data analysis using R' during 20-23 May 2025.
- Two 5-days training on 'Recent technologies for increased productivity in sugarcane 'for cane officials from co-operative and public sugar mills of Tamil Nadu under RKVY scheme during 8-12 and 22-26 September 2025.
- An exposure training to one staff from Sugarcane Research Centre (TNAU), Cuddalore on 'Sugarcane pathology' during 9-11 September 2025.
- Two one-day training programs on 'Sugarcane production' at SNJ Sugars and

Distilleries Ltd, Pennadam unit and Thugili unit, Tamil Nadu for over 400 farmers on 4, 5 December 2025.

- An one-day training program on 'Mechanization in sugarcane farming' along with KVK, Dharmapuri under DAPSC for farmers on 24 December 2025.

ICAR-SBIRC, Karnal

- A five-days training program sponsored by Sugarcane Industry Department, Govt. of Bihar, 40 sugarcane farmers of Bihar during 27-31 January 2025. Mini seed kits and settlings of sugarcane varieties Co 16030 and Co 17018 were distributed to the trainees.
- A six- days training program sponsored by Lal Bahadhur Shastri Ganna Kisan Sansthan, Lucknow for 22 farmers during 17-22 March 2025.
- An interaction meeting of scientists with officials from Sugarcane Industries Department, Govt. of Bihar on 16 April 2025.
- Interaction Meet of scientists with a group of District Development Managers of NABARD, Rajasthan Regional Office on 14 July 2025.

27-31 January 2025

17-22 March 2025

Participants of the training programs

- A six-days training program for farmers of Uttar Pradesh during 15-20 December 2025.
- Organized three one-day training programs for 85 farmers from Uttar Pradesh, Uttarakhand and Madhya Pradesh; Two exposure visits for students from Meerut and Karnal.

ICAR-SBIRC, Kannur

- Organised training on Powder jaggery making' for two cane officials from Papuan Global Pvt Ltd. on 17 September 2025.
- Sugarcane cultivation' for jaggery farmers of Marayoor, Kerala on 9 January 2025.

6.2.2 Training programs attended

- Drs. R. Karuppaiyan, M. Alagupalamuthirsolai, P.T. Prathima, V. Krishnapriya, Vinayaka, Shweta Kumari: 'Intellectual Property (IP) awareness program' (online) coordinated by ZTMCs of crop science Institutes at ICAR-IARI and ICAR-IIMR with guidance of IPTM Unit during Intellectual Awareness week,16-23 January 2025.
- Drs. P. Geetha, V.Krishnapriya, S.Anusha: 'Unravelling the innovative approaches for future farming' organized by CAFT in Agronomy, TNAU, 5-25 February 2025.
- Dr. R. Gopi: Winter school on 'Advancement in biological control of plant diseases in the Omics: Prospects and challenges' held at TNAU, Coimbatore, 25 February-17 March 2025.
- All staff of the Institute underwent an online I-GoT Karmayogi trainings through i-GoT platform, HRM Unit-ICAR, in March 2025.
- Dr. P. Murali: Foundations of Computable General Equilibrium (CGE) modeling for economic policy analysis jointly organized by IFPRI, New Delhi and NAARM, Hyderabad, 23-27 June 2025.

- Dr. P. Murali: 'IP awareness / training program' organized by Intellectual Property Office, 25 July 2025.
- Dr. P. Murali: 'Carbon credits in agriculture' (online) organized by PAMETI and MANAGE Hyderabad, 06-08 August 2025.
- Dr. R. Valarmathi: 'RNP based genome editing' at Dr. Ramu S Vemanna's Lab at Regional Centre for Biotechnology, Faridabad, 13-18 August 2025.
- Drs. T. Arumuganathan, R. Arunkumar, V. Kasthuri Thilagam: 'Impactful AI tools in agriculture' (online) organized by ICAR-NAARM, 15-19 September 2025.
- Dr. T. Arumuganathan: 'Advances in ergonomics for enhanced safety and comfort' (online) organized by the Division of Agricultural Engineering, ICAR-IARI, New Delhi, 29-31 October 2025.
- Dr. P. Malathi: 'MDP on Intellectual property valuation and technology management' at ICAR-NAARM, Hyderabad, 24-28 November 2025.
- Dr. T. Lakshmi Pathy: 'Fundamentals of genomic predictions and data-driven crop breeding' organized by ICAR-Indian Institute of Rice Research, Hyderabad, 24-28 November 2025.
- Dr. T. Ramasubramanian: 'Right to Information - Public information officers (RTI PIO-43)' at ISTM, New Delhi, 08-09 December 2025.
- Dr. T. Subramani: 'Development of Master Trainer under Rashtriya Karmayogi Jan Seva Program Phase II (Zone V)'organized by ICAR-HRM unit at ICAR-NAARM Hyderabad, 15-17 December 2025.

6.2.3 Resource Person in Training / Workshop / Seminar / Meeting

- Dr. D. Puthira Prathap delivered a lecture on 'Scientific writing and publishing high quality research papers' in the ICAR-sponsored short course on Advanced research methods in behavioural sciences at Kerala Agricultural University on 20 February 2025.
- Dr. A. Ramesh Sundar delivered an invited lecture on 'Proteomic approaches for biotic stress management' in the ICAR sponsored Winter school organized by Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore during 25 February to 17 March 2025.
- Dr. D. Puthira Prathap served as a panel member in the Technical session on Information smart, climate triumph: National Workshop on Road map to climate-resilient villages in Tamil Nadu: Building a sustainable future at Tamil Nadu Agricultural University, Coimbatore on 19 March 2025.
- Dr. P. Geetha served as external expert for Scientific Writing Workshop at Directorate of Crop Management, Tamil Nadu Agricultural University, Coimbatore during 22-24 May 2025 and 26-28 May 2025.
- Dr. T. Rajula Shanthy delivered an invited lecture on 'Agricultural Innovation System' for I M.Sc (Agricultural Extension) students of Tamil Nadu Agricultural University, Coimbatore, 5 June 2025.
- Dr. D. Puthira Prathap delivered a lecture on 'Career options post-UG' in the Career orientation Workshop at Vanavarayar College of Agriculture on 7 June 2025.
- Dr. D. Puthira Prathap deliver a lecture on 'Tips for writing popular and scientific articles' in Veterinary College and Research Institute, Namakkal on 12 June 2025.
- Drs. A. Vennila and V. Kasthuri Thilagam served as resource persons for discussion on 'World Day to combat desertification and drought' at AIR, Coimbatore broadcast during 17 and 18 June 2025.

- Dr. D. Puthira Prathap participated in a radio program on 'Challenges faced by sugarcane farmers and their solutions', All India Radio, Dharmapuri on 20 June 2025.
- Dr. P. Geetha delivered a lecture on 'Sustainable sugarcane farming: A way forward' at of ADAC & RI, Trichy on 20 June 2025.
- Dr. T. Rajula Shanthy delivered an invited lecture on 'Advances in sugarcane production technology' during the seminar on 'Sugarcane cultivation technology' for farmers jointly organized by ICAR-KVK, Erode and IPL, Chennai at MYRADA campus, Gobichettipalayam on 18 July 2025.
- Dr. Vinayaka delivered a guest lecture on 'Path Analysis' in the online training program on Advanced statistical and machine learning techniques for data analysis using open-source software for abiotic stress management in agriculture organized by ICAR-National Institute of Abiotic Stress Management, Baramati during 16 July to 5 August 2025.
- Dr. P.T. Prathima served as NABL assessor at Food testing Laboratory, NIFTEM, Tanjore during 9-10 August 2025.
- Dr. Vinayaka delivered a guest lecture on 'Path analysis and design of experiments' in the Online comprehensive training program on Statistical data analysis and interpretation organized by College of Agriculture, Guru Kashi University, during 20-21 September 2025.
- Dr. Vinayaka delivered a guest lecture on 'Statistics for data science (descriptive statistics & inferential statistics)' in the 21-days Multi-domain AI training program organized by Avyagraha Research and Analytics LLP, Ballari, Karnataka during 27 September to 18 October 2025.
- Dr. V. Kasthuri Thilagam served as external expert for evaluation of a project proposal on 'Harnessing genetic enhancement of potential metabolites in buckwheat for personalized nutrition and nutraceuticals: A step toward a circular bioeconomy' for Anusandhan National Research Foundation (ANRF) erstwhile SERB on 21 October 2025.
- Dr. K. Mohanraj delivered a lecture on 'Pre-breeding approaches for developing climate-smart sugarcane' at CPBG, TNAU, Coimbatore on 28 October 2025.
- Dr. M. Nisha served as the Chief Guest and delivered a lecture on the occasion of the 129th birth anniversary of Dr. E.K. Janaki Ammal at SN College, Kannur on 4 November 2025.
- Dr. P. Malathi delivered akeynote lecture on 'Recent trends in the management of sugarcane diseases for food in the CEFIPRA-funded Indo-French seminar on Interface of plant disease epidemics, food safety and food security: Implications for one health held at Coimbatore during 12-14 November 2025.
- Dr. T. Rajula Shanthy served as Convener and Chairperson for the technical session on 'Keynote addresses on Digital initiatives in Agricultural Extension' in the second International Extension Education Congress on 'Rethinking social ecology in a digital landscape' jointly organized by Society of Extension Education, Agra, Shiksha-O-Anusandan, Bhubaneshwar and Central University of Odisha, Koraput at Institute of Agricultural Sciences, Bhubaneshwar during 24-26 November 2025.
- Dr. K. Mohanraj served as Chairman for the thematic area 'Next-generation breeding and genomic innovations for climate-resilient crop improvement' in the National Conference on 'Sustainable and resilient agriculture: Innovations, strategies and policy frameworks' held at VIA Campus, Pollachi during 5-6 December 2025.

7 AWARDS AND RECOGNITION

- Dr. M. Alagupalamuthirsolai: Fellow of Indian Society for Spices during the Annual General Body Meeting of Indian Society for Species held at ICAR-IISR, Kozhikode on 8 January 2025.
- Drs. P. Geetha, A. Vennila, K. Hari, and S. Anusha: Best oral presentation certificate for 'Conservation agriculture for sustainable use and management of natural resources to improve productivity in sugarcane' in the International Conference on Advanced Innovations and Technology Frontiers in Agricultural sciences, Agricultural Engineering, Sericulture, Food Technology, Biotechnology, Fisheries Sciences, Veterinary and Animal Sciences 2025 at RVS, Technical Campus, Coimbatore during 8-9 January 2025.
- Dr. M. Alagupalamuthirsolai: Innovation Excellence Award 2025 in the international conference AGRI INNOVA 2025 organized by Prosper Foundation and Western Ghat Researcher Association of Agricultural Sciences and Technology on 10 January 2025.
- Dr. R. Valarmathi: Department of Science and Technology travel grant to attend Plant and Animal Genome Conference (PAG32) at San Diego, California, USA during 10-15 January 2025.
- Dr. M. Alagupalamuthirsolai: Best oral presentation award for the paper entitled 'Effect of co-occurrence of high night temperature and water deficit stress in sugarcane'in the International Conference on 'Advances in plant health improvement for sustainable agriculture' organized by VOC Agricultural College and Research Institute, Killikulam during 14-16 February 2025.
- Dr. R. Maruthadurai: Fellow of the Society for Biocontrol Advancement during the second International Conference on 'Biological control: Biocontrol contributions to one health' held at ICAR-NBAIR, Bengaluru on 27 February 2025.
- Dr. P. Mahesh: Fellow of the Society of Biocontrol Advancement in recognition of outstanding contribution in the field of biological control during the second International Conference on 'Biological control: Biocontrol contributions to one health' held at ICAR-NBAIR, Bengaluru on 27 February 2025.
- Drs. P. Geetha, T. Rajula Shanthy, C. Palaniswami and M. Thirunavukkarasu: Best Oral presentation for the paper 'Sustaining sugarcane production through sugarcane based farming system in tropical India' in the 1st International Farming Systems Conference: Transforming food, land and water systems under global climate change at ICAR-IIFSR, Modipuram during 07-09 March 2025.
- Dr. D. Puthira Prathap: 'Scientific Tamil Leadership Award' in the 10th National Conference on Agricultural Scientific Tamil held in TANUVAS, Chennai on 04 April 2025.
- Dr. R. Gomathi: 'Lifetime Achievement Award' in the 10th National Conference on Agricultural Scientific Tamil held in TANUVAS, Chennai during 4-5 April 2025.
- Dr. P. Malathi: 'Best Innovator Award'in the INNOVATORS MEET organized by ICAR-

National Institute of Research on Commercial Agriculture (ICAR-NIRCA) on 8 April 2025.

- Dr. T. Rajula Shanthy: Subject Expert in the Selection Committee for the direct recruitment of Assistant Professor in Agricultural Extension at Kerala Agricultural University, Thrissur on 15 May 2025.
- Dr. T. Lakshmipathy: Dr. G. Shivashankar memorial Gold medal certificate, Dr. K Muraleedharan Nayar memorial Gold medal certificate and University Gold medal for the highest OGPA in Ph.D. degree program held during the 59th convocation of UAS, Bangalore on 15 May 2025.
- Dr. R. Maruthadurai: Appreciation Certificate for his commendable services to the farmers of Ariyalur District during the 'Viksit Krishi Sankalp Abhiyan Pre-Kharif Campaign' conducted by ICAR-CREED KVK, Ariyalur during 29 May to 12 June 2025.
- ICAR-SBI RC, Karnal: 'Third prize for excellent work in the field of official language Hindi' for 2024-25 during the 81st meeting of TOLIC held at ICAR-NDRI, Karnal on 30 June 2025.
- Dr. K. Mohanraj: Appreciation Award for serving as member in the scrutinizing committee constituted by MASU awards held on 14 July 2025.
- Drs. K. Hari, D. Puthira Prathap, P. Murali, A. Ramesh Sundar, B. Singaravelu: 'Rashtriya Krishi Vigyan Puraskar 2025 - Innovation and Technology in the field of agriculture and allied sciences' from Shri Shivraj Singh Chouhan, Honorable Cabinet Minister of Agriculture and farmers' welfare and Shri Bhagirath Choudhary, Minister of State, Ministry of Agriculture and Farmers' Welfare, Govt. of India on 16 July 2025.
- Dr. A. Vennila: External Expert in the Selection Committee for the promotion of Scientist in the faculty of Agricultural Chemicals, Soil Science and Agricultural Chemistry under Career Advancement Scheme at TNAU on 23 August 2025.
- Dr. T. Lakshmi Pathy: First place in meritorious student awards from Indian Society of Plant Breeders for highest OGPA in Ph.D. degree program during the 31st general body meeting of Indian Society of Plant Breeders, TNAU, Coimbatore on 26 September 2025.
- Dr. S. Sheelamary: 'Outstanding Achievement Award' by the Society for Scientific Development in Agriculture and Technology in 10th International Conference on Global Research Initiatives for Sustainable Agriculture & Allied Sciences held at MPUAT, Udaipur, Rajasthan during 05-07 October 2025.
- Dr. V. Kasthuri Thilagam: Women Scientist Award-2024 from the Society for the science of climate change and sustainable environment (SSCE) on 16 October 2025.
- Dr. T. Rajula Shanthy: Certificate of appreciation under Principal Scientist category during the 114th Foundation Day celebration of the Institute on 23 October 2025.
- Dr. P. Geetha: Certificate of appreciation under Senior Scientist category during the 114th Foundation Day celebration of the Institute on 23 October 2025.
- Shri K. Selvamuthu and Mrs. Nici Ashok: Certificate of appreciation under Technical category during the 114th Foundation Day celebration of the Institute on 23 October 2025.
- Smt. N. Priyadharsini and Smt S.K. Anumalaviga: Certificate of appreciation under Administrative category during the 114th Foundation Day celebration of the Institute on 23 October 2025.

- Smt. R. Velumani, Smt. P. Seema, Shri M. Shobhanbabu, Smt. M. Nagamani: Certificate of appreciation under Supporting staff category during the 114th Foundation Day celebration of the Institute on 23 October 2025.
- Dr. Mintu Ram Meena: Fellow Award by the Indian Society of Genetic and Plant Breeding during the National Seminar on 'Advances in climate-conscious crop science' at UAS, Bengaluru from 31 October to 02 November 2025.
- Dr. V.G. Dhanya: Young Woman Scientist award and Best Oral Presentation Award at the 12th International conference on Agriculture & Veterinary: Transformative approach, research and innovations forum (online) organized by Goa College of Agriculture, Goa during 16-18 November 2025.
- ICAR-SBI, Coimbatore: 'Best Knowledge Partner Award' & 'Best Exhibition Stall Award' during South India Natural Farming Summit 2025 held in CODISSIA trade fair ground Coimbatore inaugurated by Hon'ble Prime Minister on 19 November 2025.
- Dr. T. Rajula Shanthy: 'Outstanding Social Scientist award' and 'Certificate of Appreciation for being a Lead Speaker' in the second International Extension Education Congress held at Bhubaneshwar during 24-26 November 2025.
- Dr. P.T. Prathima: Expert for selecting best posters at the ICPP 2025 conference held at Tamil Nadu Agricultural University, Coimbatore during 15-18 December 2025.

ICAR-SBI scientists receiving 'Rashtriya Krishi Vigyan Puraskar' 2025

8 LINKAGES AND COLLABORATION IN INDIA INCLUDING EXTERNALLY FUNDED PROJECTS

The Institute has established linkages with ICAR Institutes like IARI, NBPGR, NRCPB, NBAIR, ISRI, Sugarcane Research Centres of SAUs under AICRP, International Centre for Genetic Engineering and Biotechnology (ICGEB), Ministry of Consumer Affairs, Food and Public Distribution, Ministry of Agriculture-and Farmers Welfare, GoI, Ministry of Food Processing Industries, DST, DBT/GoI, Directorate of Sugarcane Development, TNPL (a Govt. of Tamil Nadu Undertaking), MSSRF, Chennai, ISMA and sugar industry in critical areas in emerging technologies for deriving maximum benefit.

Project Title and Scientists involved	Source of funding	Total outlay (Rs. in Lakhs)
Identification, characterization and verification of new sugarcane varieties for DUS testing at Coimbatore - R. Karuppaiyan, S. Alarmelu, C. Jayabose	PPV & FRA	5.87

Project Title and Scientists involved	Source of funding	Total outlay (Rs. in Lakhs)
CRISPR-Crop Network-targeted improvement of stress tolerance, nutritional quality and yield of crops by using genome editing - R. Manimekalai, V. P. Sobhakumari, C. Appunu; M. Ravi, IISER, Trivandrum	NASF	66.10
Improving tillering and yield in sugarcane through creating novel alleles of strigolactone biosynthesis gene MAX4-1 using CRISPR / CAS9 - R. Valarmathi, C. Appunu, K. Mohanraj	DBT	40.00
Deciphering the genetic basis of root-system architecture developing climate resilient sugarcane (BRNS) - R. Valarmathi, C. Appunu, Ashish Kumar Srivastava (BARC)	GoI-DAE-BRNS	25.336
Identification and characterization of SWEET genes associated with sugar content and disease susceptibility in sugarcane - P.T. Prathima	DST-SERB	31.00
Targeted genome editing in sugarcane: CRISPR/Cas9-mediated lignin modification towards lignocellulosic biofuel production - K. Lakshmi	DST-SERB	44.53
Development of genome consortium databank from plants and microbial population emerging from India - P.T. Prathima	DBT-NNP	26.076
Genome editing in sugarcane for improved yield, quality, biotic stress tolerance and biomass modification for biofuel production (Central Sector Scheme Crop Science for food and nutritional security, Sub-scheme: Enhancing climate resilience and ensuring food security with genome editing tools) - A. Ramesh Sundar, R. Manimekalai, C. Appunu, K. Lakshmi, G.S. Suresha, P.T. Prathima, R. Valarmathi	EFC-ICAR	270.53
Transgene free genome editing in sugarcane and banana (DBT) - R. Manimekalai, C. Appunu	DBT	98.48
Agriculture Drone Project under Sub Mission on Agricultural Mechanization: Drone technology demonstration - T. Arumuganathan, K. Kannan	ICAR-ATARI, Hyderabad	35.00
Promoting sustainable sugarcane production through natural farming practices -Competitive Research Grants (CRG) Scheme under National Mission on Natural Farming (NMNF) - P. Geetha, T. Subramani, K. Hari, M. Alagupalamudhirsolai, S. Anusha	NMNF	22.00
Identification of salt tolerant sugarcane clones for commercial cultivation in Haryana - Pooja, Ravinder Kumar, M.R. Meena, M.L. Chhabra	RKVY-Haryana	242.00

Project Title and Scientists involved	Source of funding	Total outlay (Rs. in Lakhs)
Development and application of diagnostics to viruses and phyto plasmas infecting sugarcane - K. Nithya, D. Neelamathi, R. Selvakumar, R. Gopi	ICAR-CRP	75.82
Mechanized priming of planting material and technology popularization for revival of sugarcane productivity in Tamil Nadu (RKVY) - P. Malathi, A. Ramesh Sundar, R. Selvakumar, R. Gopi, T. Rajula Shanthy, A. Vennila, T. Ramasubramanian, Ravindra Naik (CIAE-RS, CBE)	RKVY	27.75
Decoding the molecular events of PAMP-triggered immunity (PTI) by unlocking the interactome of the PAMP-CfEPL1 of *Colletotrichum falcatum* during interaction with sugarcane - A. Ramesh Sundar, V. Jayakumar, G.S. Suresha, P. Malathi	DST-SERB	49.50
Development of onsite field diagnostics to sugarcane grassy shoot disease candidatus phytoplasma sacchari by RPA-LFD method to ensure healthy seed chain and sustain sugar production - K. Nithya, Susheel Kumar Sharma (ICAR-IARI)	DST-SERB-CRG	61.62
Red rot resistance in sugarcane by genome editing of LOX3 gene - A. Ramesh Sundar, A. Jeevalatha, R. Ramesh	AINP on Biotech Crops	35.325
Dissemination of technology on mechanized priming of planting material for sustainable sugarcane agriculture - P. Malathi, R. Gopi, M.L. Chhabra	NFSM	3.75
Impact of climate change on crambid borers of sugarcane and ways of mitigation - T. Ramasubramanian, Sheela Venugopal (TNAU)	DST-SERB-TARE	18.3
Sugarcane based Agri-Business Incubator (ABI)(National Agricultural Innovation Fund Scheme (NAIF) – Component II, IP & TM, ICAR) - P. Murali, K. Hari, D. Puthira Prathap	NAIF	89.50
Intellectual Property Management and Technology Transfer/ Commercialization–Institute Technology Management Unit (ITMU) (National Agricultural Innovation Fund Scheme (NAIF) – Component I, IP &TM, ICAR) - K. Hari, Kona Praveen, V. Krishnapriya	NAIF	6.20
Network project on Production systems, Agribusiness and Institutions NAIP-Component 1: Impact assessment of agricultural technology - P. Murali, D. Puthira Prathap, K. Hari, Vinayaka	ICAR-NIAP	15.00
Identification, characterization and verification of new sugarcane varieties for DUS testing - M.R. Meena, Ravinder Kumar	PPV&FRA	7.00

Project Title and Scientists involved	Source of funding	Total outlay (Rs. in Lakhs)
ICAR Seed project– Seed production in agricultural crops and fisheries–sugarcane (RFS, Karnal) - Ravinder Kumar, M.R. Meena	ICAR	11.00
Identification of climate resilient drought tolerant sugarcane varieties suitable for Haryana state - M.R. Meena, Ravinder Kumar, Pooja, M.L. Chhabra	RKVY- Haryana	198.00
DUS testing of sugarcane (Agali) - R.T. Maruthi , R. Karuppaiyan	PPV&FRA	5.80
Development Action Plan for Scheduled Tribe Component - D. Puthira Prathap, K. Mohanraj, P. Geetha, R. Gopi	GoI	50.00
Development Action Plan for Scheduled Caste - A. Anna Durai, K. Kannan, R. Ramesh, T. Arumuganathan, R. Arun Kumar, P.T. Prathima	GoI	38.00
Evaluation of biofertilizer and biostimulant combination in sugarcane - M. Alagupalamuthirsolai, K. Hari	BomLife Pvt Ltd. Kolkata	15.78
Enhancing sugar productivity in Tamil Nadu through Institute-Industry approach (SWEET BLOOM 2.0) - P. Govindaraj, C. Appunu, R.M. Shanthi, S. Alarmelu, S. Karthigeyan, A. Annadurai, R. Karuppaiyan, K. Mohanraj, R.T. Maruthi, K. Elayaraja, S. Sheelamary, H.K. Mahadevaswamy, R. Gobu, Adhini S. Pazhany, Kona Praveen, T. Lakshmi Pathy, D. Neelamathi, C. Jayaboss, R. Valarmathi, B. Singaravelu, P. Malathi, R. Selvakumar, T. Ramasubramanian, M. Punithavalli, P. Mahesh; D. Sassikumar & Satheeshkumar, SRS Cuddalore, V. Anbanandan, SRS Sirugamani, N.A. Saravanan, SRS Melalathur	SISMA	53.00
Identification of suitable location specific sugarcane varieties for commercial cultivation under different agro-climatic situations in India - P. Govindaraj, K. Mohanraj, R.M. Shanthi, S. Alarmelu, A. Anna Durai, S. Karthigeyan, R. Karuppaiyan, C. Appunu, R.T. Maruthi, S. Sheelamary, K. Elayaraja, Adhini S. Pazhany, H.K. Mahadeva Swamy, R. Gobu, Kona Praveen, T. Lakshmi Pathy, D. Neelamathi, A. Ramesh Sundar, Ravinder Kumar, M.R. Meena and M.L. Chhabra, M. Nisha	ISMA	750.00
Improving water use efficiency and economizing water use in sugarcane cultivation in sub-tropical India - P. Geetha, S. Anusha, Pooja, Ravinder Kumar	ISMA	12.87

9 ALL INDIA COORDINATED RESEARCH PROJECT ON SUGARCANE

The All India Coordinated Research Project on Sugarcane was started in the year 1971. A National Hybridization Garden was established in the Institute to facilitate the national breeding programs. The following are the research areas under this project:

- Fluff supply to various sugarcane research institutes / centres.
- Collaboration for development of varieties across the nation.
- Collaborative research on Agronomy, Soil science, Plant Physiology, Entomology and Plant Pathology.

Dr. P. Govindaraj, Director is the Principal Investigator of Crop Improvement.

10 PUBLICATIONS

Research papers

1. Abhilash., Satpathi, A., Harshangkumar, T., Subramani, T., Jaisankar, I. and Shahi, N.K. 2025. Climatological and hydrological extremes of the Andaman and Nicobar Islands, India, and its database for public users. *Atmosphere* 16: 301. doi.org/10.3390/atmos16030301.

2. Adamala, S., Velmurugan, A., Swarnam, T.P., Palakuru, M., Subramani, T., Jaisankar, I., Nanda, B.K., Kumari, N. and Srivastava, A. 2025. Soil moisture mapping in Indian tropical islands with C-band SAR and artificial neural network models. *Environmental Monitoring and Assessment* 197: 758. https://doi.org/10.1007/s10661-025-14239-4.

3. Ajay, B.C., Rajanna, G.A., Gangadhara, K., Rani, K., Kona, P., Kumar, N., Tomar, R.S. and Bera, S.K. 2025. Mature pod yield reduction and membership function value of drought tolerance (MFVD) as a selection criterion for identifying drought-tolerant donors from global groundnut collections. *Genetic Resources and Crop Evolution* 73: 18. https://doi.org/10.1007/s10722-025-02663-x.

4. Alagupalamuthirsolai, M., Arun Kumar, R., Krishnapriya, V., Gomathi, R. and Kannan, K. 2025. Effect of co-occurrence of high night temperature and low moisture stress in sugarcane. *Plant Science Today* 12(sp3): 1–11.

5. Alarmelu, S., Sheelamary, S., Anusheela, V., Arun Kumar, R., Vasantha, S. and Kona, P. 2025. Assessment of interspecific hybrids of *Saccharum* spp. for morpho-physiological traits and identification of drought-tolerant genotypes. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01687-y.

6. Alarmelu, S., Sheelamary, S., Anusheela, V., Arun Kumar, R., Vasantha, S., Mahadevaswamy, H.K. and Anna Durai, A. 2025. Identification of drought tolerance indicators in interspecific hybrid derivatives of *Saccharum* spp using membership function value of drought tolerance (MFVD). *Sugar Tech*

27: 860-872. https://doi.org/10.1007/s12355-025-01533-1.

7. Amaresh, G., Aswini, N., Gopalareddy, K., Anna Durai, A., Manimekalai, R., Mahadeva Swamy, H.K., Lakshmi Pathy, T., Vinayaka., Dhanya, V.G., Rathan, N.D., Nandakumar, S., Shwetha, K., Sreenivasa, V., Maruthi, R.T., Suresha, G.S., Hemaprabha, G. and Govindaraj, P. 2025. Next-generation molecular breeding tools to harness higher genetic gains in sugarcane. *Planta* 262(5): 122. https://doi.org/10.1007/s00425-025-04842-7.

8. Amaresh, G., Nunavath, A., Appunu, C., Viswanathan, C., Kumar, R., Gujjar, R.S. and Manimekalai, R. 2025. Advanced genome editing technologies: Potentials and prospects in improvement of sugar crops. *Sugar Tech* 27(1): 14-28.

9. Anitha, R., Jeyakumar, P., Sassikumar, D., Vijayalakshmi, D., Arul, L., Manimekalai, R., Thirumurugan, T., Nageswari, R., Jayachandran, M., Vanitha, K. and Sritharan, N. 2025. Assessing sugarcane clones' resilience to waterlogging stress and comprehending the physiological and morphological processes. *Plant Science Today* 10(10): 1-13. https://doi.org/10.14719/pst.6369.

10. Anitha, R., Jeyakumar, P., Vijayalakshmi, D., Sassikumar, D., Arul, L., Manimekalai, R., Thirumuguan, T., Nageswari, R. and Yuvaraj, M. 2025. Impact of waterlogging stress on the yield of specific sugarcane genotypes yields northeastern coastal region of Tamil Nadu. *Plant Science Today* 12(2): 1-9. https://doi.org/10.14719/pst.7797.

11. Anusha, S., Yogambal, C., Singaravelu, B. and Ramasubramanian, T. 2025. Dissipation kinetics and environmental risk assessment of halosulfuron methyl in the sandy clay loam soil of tropical sugarcane crop ecosystem. *Water, Air and Soil Pollution* 236: 244.

12. Ariharasutharsan, G., Pooja Negi., Vinoth, P., Malarvizhi, A., Senthilrajan, P., Appunu, C., Ashish, K.S. and Valarmathi, R. 2025. Gamma ray induced significant phenotypic and metabolite changes in sugarcane variants derived through *in vitro* mutagenesis. *Applied Radiation and Isotopes* 217: 111597. https://doi.org/10.1016/j.apradiso.2024.111597.

13. Aswini, N., Monisha, J., Keerthana, S., Amaresh., Nandhini, M., Prathima, P.T., Mohanraj, K., Kumari, S. and Manimekalai, R. 2025. Genomic exploration for the sucrose content in sugarcane. *Tropical Plant Biology*. https://doi.org/10.1007/s12042-025-09413-4.

14. Balaji Rajkumar, M., Sivaranjani, R., Senthil Kumar, C.M., Punithavalli, M., Honnappa, A. and Ankegowda, S.J. 2025. Impact of thrips (*Sciothrips cardamomi*) damage on volatile composition and other attributes of cardamom capsules (*Elettaria cardamomum*). *Annals of Applied Biology volume* 1-14. https://doi.org/10.1111/aab.70077.

15. Batra, S., Gujjar, R.S., Kumar, R., Goswami, S.K., Tiwari, R.K., Appunu, C., Manimekalai, R., Valarmathi, R. and Kumar, S. 2025. *Colletotrichum falcatum* proteome unraveled the promising functions of myosin-1 and polyketide synthase proteins in instigating the pathogen virulence. *Journal of Crop Health* 77: 81. https://doi.org/10.1007/s10343-025-01148-2.

16. Boopathi, N., Karthikeyan, G., Raveendran, M., Johnson, I., Marthasalam, S., Srinivasan, T. and Manimekalai, R. 2025. Characterization of phytoplasma associated for its sensitive diagnostics. *Journal of Microbiological Methods* 228: 107072. https://doi.org/10.1016/j.mimet.2024.107072.

17. Chandar, S.H., Mahalakshmi, S., Sangari, M.G., Aparna, J., Shanmugapriya, P., Valarmathi, R. and Appunu, C. 2025. Isolation, genome-wide identification and expression profiling of

CYC/TB1 like transcription factor from *Saccharum*complex under water deficit stress condition. *Tropical Plant Biology* 18(1): 27.

18. Chandramohan, S., Swati, K., Kona, P., Radhakrishnan, T. and Bera, S.K. 2025. Genome-wide identification of the delay of germination (DoG1) gene and ethrel mediated regulation of seed dormancy in peanut. *Plant Gene* 44: 100555. https://doi.org/10.1016/j.plgene.100555.

19. Choudhary, S.B., Sharma, H.K., Arroju, A.K., Thimmaiah, M.R., Kumar, D. and Mitra, J. 2025. Phenological traits and molecular markers established genetic relationship and population structure in jute (*Corchorus species*) populations collected from Southern India. *Genetic Resources and Crop Evolution* 72(3): 2843-2864. doi.org/10.1007/s10722-024-02122-z.

20. Dhansu, P., Kaushik, S., Kumar, R., Krishnapriya, V., Appunu, C., Shariff, A., Kaur, G., Singh, P., Kumari, A. and Kumar, A. 2025. Intricate relationship of physiological, biochemical and molecular mechanisms in deciphering abiotic stress tolerance in sugarcane. *South African Journal of Botany* 188: 135-150. https://doi.org/10.1016/j.sajb.2025.10.052.

21. Dharshini, S., Swathi, T., Lekshmi, L.A., Surya Krishna, S., Harish Chandar, S.R., Manoj, V.M., Ashwin Narayan, J., Sarath Padmanabhan, T.S., Valarmathi, R., Kumar, R.A. and Boominathan, P. 2025. Overexpression of abiotic stress-responsive SsCor413-1 gene enhances salt and drought tolerance in sugarcane (*Saccharum spp*. Hybrid). *International Journal of Molecular Sciences* 26(20): 9868. https://doi.org/10.3390/ijms26209868.

22. Greeshma, M., Bhat, I., Jeevalatha, A. and Malavika, P. 2025. Development of a lateral flow immunoassay for rapid detection of piper yellow mottle and cucumber mosaic viruses in black pepper. *Journal of Virological Methods.* 338: 1-11. https://doi.org/10.1016/j.jviromet.2025.115238.

23. Gujjar, R.S., Kumar, R., Goswami, S.K., Sanjeev Kumar., Appunu, C., Manimekalai, R. and Valarmathi, R. 2025. Catalases are induced during fungal infections in sugarcane to instigate the defense responses during red rot and wilt disease. *Journal of Crop Health* 77: 1-13. https://doi.org/10.1007/s10343-024-01084-7.

24. Harish Chandar, S.R., Subramanian, M., Surya Krishna, S., Swathi, T., Girija Sangari, M., Viswanathan, C., Saranya, N., Sobhakumari, V.P., Gomathi, R. and Appunu, C. 2025. Isolation, characterization and genome-wide identification of cys-2/His-2 type zinc finger nuclease, a transcription activator in *Saccharum* complex under abiotic stress conditions. *Sugar Tech* 27(1): 179-192.

25. Jayabose, C., Anusheela, V., Prabakaran, M., Shreelakshmi, C., Neelamathi, D., Valarmathi, R. and Raffee Viola, V. 2025. Studies on changes in the cellular pattern of cryopreserved explants of *Saccharum* spp and sugarcane cultivar. *Electronic Journal of Plant Breeding* 16(1): 12-23. https://doi.org/10.37992/2025.1601.011.

26. Jeevalatha, A., Bhaskar Reddy., Eapen, S.J., Javed, M., Anandaraj, M. and Kumar, A. 2025. Pathogenomics insights into *Phytophthora capsici* and *Phytophthora tropicalis* -sibling species causing black pepper foot rot: Genomic architecture, metabolic pathways and effector diversity. *Gene* 947: 149238.

27. Kaleeswaran, M., Ramasubramanian, M., Puthira Prathap, D., Venkatesan, P., Jegadeesan, M., Subash, S., Shanmugasundaram, B. and Ramesh, R. 2025. Analyzing PM-KISAN fund utilization in Southern Indian agriculture. *Plant Science Today* 12: 1-13. https:/doi.org/10.14719/pst.6068.

28. Kandasamy, T., Ansari, M.F., Ekbai, S. and Sharma, K.K. 2025. Effects of seedlac on soil bacterial diversity: An indication of environmental safety. *Revista De Biologia Tropical* 73: 1-12. https://doi.org/10.15517/re.bio.trop.v73i1.60353.

29. Kannan, K., Babu, C., Sundarambal, P., Rajan, K. and Raja. P. 2025. Potential grass species for soil conservation and fodder production in the Nilgiri hills of the Western Ghats. *Indian Journal Soil Conservation* 53(2): 162-169.

30. Karthik Raja, R., Prabu Kumar, S., Balasubramani, G., Sankaranarayanan, C., Bo Liu., Selcuk, H. and Narayanan, M. 2025. An updated review on green synthesized nanoparticles to control insect pests. *Journal of Pest Science* 98:31-50. https://doi.org/10.1007/s10340-024-01863-1.

31. Kasirajan, L., Sebastiar, S., Muthukumar, R., Vargheese, R.L., Elumalai, K., Kamaraj, K., Valiyaparambth, R., Angannan, S., Ayyadurai, A., Raju, G., Athiappan, S., Krishnamoorthy, D., Kanagavel, G., Karthikeyan, N., Palanivel, S.K. and Sankararaj, I.Y. 2025. Unravelling drought stress adaptation in sugarcane interspecific hybrids: A multi-level analysis. *PLoS One* 20(12): 1-22. e0338698. https://doi.org/10.1371/journal.pone.0338698.

32. Kasirajan, L., Vargheese, R.L., Sankararaj, I.Y. and Venkatachalam, A.D. 2025. CRISPR/Cas9 Off-target effect induces albinism via phytoene desaturase (pds) gene disruption in sugarcane. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01659-2.

33. Kasthuri Thilagam, V. and Manivannan, S. 2025. Climate change implications on soil health and agronomical interventions to increase soil carbon sequestration under different land uses. *International Journal of Environmental & Agriculture Research* 11(6): 124-130.

34. Kausik, P., Biman M., Mounika, C., Chauhan, J.K. and Rajula Shanthy, T. 2025 Nurturing human resource talent for sustainable livelihood through youth skill development in agriculture. *Indian Research Journal of Extension Education* 25(4): 105-112.

35. Krishnapriya, V., Manimekalai, R., Gomathi, R., Duong, V.H., Arunkumar, R., Prathima, P.T., Devakumar, K., Thamilarasi, K., Mahadeva Swamy, H.K., Amaresh, G., Govindaraj, P. and Dash, P.K. 2025. Strategic considerations for nutrient use efficiency in sugarcane: Physiological, molecular and genetic perspectives. *Plant Science* 364: 112940. https://doi.org/10.1016/j.plantsci.2025.112940.

36. Kumar, P.G.S., Vargheese, R.L., Karthikeyan, N., Yazhini, I.S., Venkatachalam, A.D., Manimekalai, R. and Kasirajan, L. 2025. *In silico* analysis of phospholipases involved in drought stress in lipid signalling: A genome-wide study in *Saccharum* species. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01677-0.

37. Kumar, R., Meena, M., Dhansu, P., Chhabra, M.L., Appunu, C., Sreenivasa, V., Anna Durai, A., Mahadeva Swamy, H.K. and Amaresh, G. 2025. Disclosure of productive and stable sugarcane genotypes for cane yield and quality traits using various stability statistics. *Tropical Plant Biology* 18: 11. https://doi.org/10.1007/s12042-024-09374-0.

38. Kumari, S., Harshavardhini, R.K., Murugan, N., Keerthana, S., Aispriya., Vinayaka., Ramaswamy, A., Prabhakaran, J. and Ramaswamy, M. 2025. Comparative genomics and synteny analysis of PP2C phosphatases in modern and wild sugarcane cultivars for insights into abiotic stress response. *Frontiers in Plant Science* 16: 1596800. doi: 10.3389/fpls.2025.1596800.

39. Likhitha, A., Kona, P., Sangh, C., Kulkarni, G., Singh, S., Tomar, R.S. and Chavada, Z. 2025.

Germplasm characterization for early maturity and fresh seed dormancy at morphological and molecular levels in groundnut. *Journal of Food Legumes* 38(2): 255-263. https://doi.org/10.53550/jfl.v38.i2.267.

40. Lohot, V.D., Thamilarasi, K., Ghosh, J., Mohanasundaram, A. and Thakur, V.V. 2025. Assessment of changes in leaf biochemical constituents of *Palas* (*Butea monosperma*) during different stages of lac insect (*Kerria lacca* Kerr) life cycle. *International Journal of Tropical Insect Science* 45: 1483-1488. https://doi.org/10.1007/s42690-025-01519-2.

41. Mahesh, P., Srikanth, J., Appunu, C., Singaravelu, B., Puthira Prathap, D., Alfred Danie, J., Mahendran, B., Mohanraj, K., Gopi, R. and Nirmala, R. 2025. Spotted stem borer *Chilo partellus*: Occurrence, biology and relative resistance in *Erianthus arundinaceus*. *Sugar Tech* 27: 433-446. https://doi.org/10.1007/s12355-024-01516-8.

42. Mahesh, P., Srikanth, J., Singaravelu, B., Mahendran, B. and Iswarya, B. 2025. A method to screen sugarcane hybrids against *Chilo sacchariphagus indicus* using artificial diet. *International Journal of Tropical Insect Science* 45: 457-461. https://doi.org/10.1007/s42690-025-01426-6.

43. Malathi, P., Viswanathan, R. and Ramesh Sundar, A. 2025. Mechanized sett treatment– An innovative technology to deliver various agro-inputs for the management of sugarcane diseases including GSD. *Phytopathogenic Mollicutes* 15(1): 145-146.

44. Manimekalai, R., Jain Mary, A., Mohanraj, K., Narayanan, J., Vanish, R., Mrudula, K.P., Saranya, J., Gokul, M., Rajeev Kumar., Gujjar, R.S., Selvi, A., Vasantha, S. and Hemaprabha, G. 2025. Evaluation of genetic variability, phenotypic stability and interrelationships among the quantitative traits of sugarcane under drought stress. *Journal of Applied Biotechnology Report* 12(2): 1652-1667. doi:10.30491/jabr.2024.463598.1747.

45. Manimekalai, R., Nair, S., Rao, G.P., Babu, M.K., Baranwal, V.K. and Gandhi, K. 2025. Current and future molecular diagnostics of palms phytoplasmas. *Technology Society of Basic and Applied Sciences* 15(1): 163-164.

46. Maruthadurai, R., Das, B. and Kumar, P. 2025. Predicting the global invasion risk of ambrosia beetle *Euplatypus parallelus* under climate change based on CMIP6 projections. *International Journal of Biometeorology* 69(11): 3035-3048. doi:10.1007/s00484-025-03005-3.

47. Mathesh, S., Sanbagavalli, S., Geetha, P., Janaki, P., Gnanachitra, M. and Sritharan, N. 2025. Perspectives on nutrient management through different farming practices for sugarcane production. *Plant Science Today.* https:/doi.org/10.14719/pst.9627.

48. Murugavelu, G.S., Harish Chandar, S.R., Sakthivel, S.K., Ramaswamy, M., Swaminathan, A. and Chinnaswamy, A. 2025. Progress and updates of CRISPR/Cas9-mediated genome editing on abiotic stress tolerance in agriculture: A review. *Sugar Tech* 27(1): 29-43.

49. Nandini, K., Kumar, P.G.S., Sheelamary, S., Selvi, A., Rachel, L.V., Indusha Yazhini, E., Karpagam, E. and Lakshmi, K. 2025. Proteomics-based genetic regulation of sugarcane cell wall biosynthesis for bioenergy applications. *Sugar Tech* 27: 1382-1396. https://doi.org/10.1007/s12355-025-01599-x.

50. Narendra Kumar., Dutta, R., Rathnakumar, A.L., Ajay, B.C., Gangadhara, K., Praveen, K., Rani, K. and Bera, S.K. 2025. Phenotyping of groundnut genotypes in different environments to identify resistant sources of *Alternaria* leaf blight. *Journal of Advances in Biology & Biotechnology* 28(9): 1234-1243.

51. Nareshkumar, V., Harish Chandar, S.R., D'Orso, F., Aparna, J., Girija Sangari, M., Sumega, R., Viswanathan, C. and Appunu, C. 2025. Genome editing for trait optimization: The role of CRISPR, base editing and prime editing in modern era of plant science. *Journal of Plant Biochemistry and Biotechnology* 3: 1-26.

52. Neelavathi, R., Indurani, C. and Arumuganathan, T. 2025. Optimization of water blanching and cabinet drying conditions for preservation of nutritional and phytochemical properties of moringa leaves. *Plant Science Today*. https://doi.org/10.14719/pst.6672.

53. Nithya, K., Manimekalai, R., Kaverinathan, K., Nithiyananatham, R. and Viswanathan, R. 2025. Diagnostics of sugarcane grassy shoot phytoplasma for a healthy seed nursery programme in sugarcane. *Phytopathogenic Mollicutes* 15(1): 149-150.

54. Nithya, K., Ramaswamy, M., Kaverinathan, K., Ramasamy, N. and Viswanathan, R. 2025. Diagnostics of sugarcane grassy shoot phytoplasma for a healthy seed nursery programme in sugarcane. *Technology Society of Basic and Applied Sciences* 15(1): 149-150.

55. Noopur Kohima., Chauhan, J.K. Pant, K.S., Kausik, P., Rajula Shanthy, T. and Panwar, A.S. 2025. Sustainable vegetable production through natural farming: A review. *Indian Research Journal of Extension Education* 25(4): 75-83.

56. Nunavath, A., Murugan, N., Keerthana, S., Kumari, S., Singaravelu, B., Sundar, A. and Manimekalai, R. 2025. Transcription factors in plant biotic and abiotic stress responses: Potentials and prospects in sugarcane. *Tropical Plant Biology 18(1)*:1-13. https://doi.org/10.1007/s12042-025-09398-0.

57. Padmanabhan, D., Manimekalai, R., Senthil Nathan., Suganthi, M. and Senthil Kumar, P. 2025. Biosynthesis, therapeutic characteristics, origin and strategies to improve the yield of vasicine in plants. *Vegetos*. https://doi.org/10.1007/s42535-025-01161-w.

58. Padmanathan, P.K., Parimalam, P., Thambidurai, S., Nallakurumban, B. and Arumuganathan, T. 2025. Development and ergonomic evaluation of hand-held vegetable seedling transplanter. *Plant Science Today*. https://doi.org/10.14719/pst.6279.

59. Pathy, T.L., Vinu, V., Arunkumar, R., Gopalareddy, K., Mahadeva Swamy, H.K., Valarmathi, R., Dhanapal, K., Amaresh, G., Govindaraj, P., Hemaprabha, G. and Bakshi Ram. 2025. Multi-trait index based elucidation of drought tolerance potential of *Saccharum spontaneum*. *Plant Physiology Reports* 30: 928-941. https://doi.org/10.1007/s40502-025-00911-x.

60. Pooja, D., Shruti, K., Ravinder, K., Krishnapriya, V., Appunu, C., Anusha, S., Guruvarinder, K., Palampreet, S., Anita, K. and Ashwani, K. 2025. Intricate relationship of physiological, biochemical and molecular mechanisms in deciphering abiotic stress tolerance in sugarcane. *South African Journal of Botany* 188: 135-150.

61. Punithavalli, M., Govindaraj, P. and Balaji Rajkumar, M. 2025. Resistance mechanism of energy canes developed from *Saccharum spontaenum* and *Erianthus arundinaceus* against sugarcane borer pests. *Journal of Asia-Pacific Entomology* 28:102408. https://doi.org/10.1016/j.aspen.2025.102408.

62. Punithavalli, M., Mohanraj, K. and Salin, K.P. 2025. Laboratory cum glass house screening methods for the evaluation of sugarcane varieties against borer Pests. *Indian Journal of Plant Protection* 53(1): 33-37.

63. Punithavalli, M., Mohanraj, K., Rajula Shanthy, T. and Yuvan Sankar Pandian, M. 2025.

Mechanism of biochemical resistance in sugarcane varieties derived from *Saccharum* and *Erianthus* against borer pests. *Sugar Tech* 27(3): 667-680. https://doi.org/10.1007/s12355-024-01521-x.

64. Raj, C., Singh, S., Viswanathan, R., Sundar, A.R. and Appunu, C. 2025. Insights into the role of climate change on major sugarcane diseases and their mitigation strategies. *Sugar Tech* 12: 1-5.

65. Ramasubramanian, T., Yogambal, C. and Singaravelu, B. 2025. First report on the comparative biology of white grub, *Holotrichia serrata* (Coleoptera: Scarabaeidae) in sugarcane and artificial diet and its implications in pest management. *Annals of Applied Biology* 187: 387–397.

66. Ramesh, K.B., Gambhir, S., Gouda, M.R., Vinayaka., Sagar, D. and Sabtharishi, S. 2025. Differences in life history traits and demographic parameters of three Asian genetic groups of *Bemisia tabaci* (Aleyrodidae: Hemiptera). *Scientific Reports* 15(1): 35316.

67. Sajeena, A., Rao, G.P., Gupta, S., Ranebennur, H. and Manimekalai. R. 2025. First report of the association of a clover proliferation phytoplasma strain with shoot proliferation and little leaf disease of mangosteen (*Garcinia mangostana*) in Kerala, India. *New Disease Reports* 52: e70070.

68. Sasi, M., Kumar, S., Prakash, O., Krishnan, V., Vinayaka., Tomar, G.S. and Dahuja, A. 2025. Evaluation of sensory properties and short-chain fatty acid production in fermented soymilk on addition of fructo oligosaccharides and raffinose family of oligosaccharides. *Fermentation* 11(4): 194. https://doi.org/10.3390/fermentation11040194.

69. Selvakumar, R., Lakshmi Pathy, T. and Gopalareddy, K. 2025. Temporal dynamics and characterization of sugarcane parental pool for rust resistance under tropical climate. *Tropical Plant Biology* 18(52). DOI:10.1007/s12042-025-09417-0.

70. Senthil Kumar, C.M., Samyuktha., M., Balaji Rajkumar, M., Punithavalli, M., Sharon D'Silva., Geethu, C., Ahalya, P., Jacob, T.K., Devasahayam, S. and Bhat, A.I. 2025. Physiological host range and virulence of *Metarhizium pingshaense* against three key *Chilo* species, and temporal expression of virulence genes during infection of its original host, *Conogethes punctiferalis*. *Scientific Reports* 15: 18506. https://doi.org/10.1038/s41598-025-03643-y.

71. Shah, P., Wright, G., Nwosu, C.V., O'Connor, D., Tsatsos, P., Janila, P., Praveen, K., Singh, K., Bera, S.K., Thudi, M., Kole, C., Varshney, R.K. and Pandey, M.K. 2025. Industry perspective, genetics and genomics of peanut blanchability. *Plant Science* 355: 112473. https://doi.org/10.1016/j.plantsci.2025.112473.

72. Sheelamary, S., Karthigeyan, S., Jayabose, C., Mahadevasamy, H.K., Govindaraj, P., Dhanapal, K., Ponselvan, A. and Vivek Kumar, R. 2025. Exploring genetic diversity and population structure of a wild sugarcane (*Saccharum spontaneum* L.) germplasm collected from southern states of India. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01686-z.

73. Sinha, A.K., Bhavana, P., Singh, A.K., Ranjan, J.K., Choudhary, H., Mishra, G.P., Thamilarasi, K., Chaukhande, P., Shinde, R., Kumar, P., Rajak, J. and Ekbal, S. 2025. Unravelling genetic diversity in pointed gourd (*Trichosanthes dioica*) genotypes from India's eastern plateau and hill region: Insights from morphological and molecular markers. *Journal of Genetic Engineering and Biotechnology* 23(3): 100542. https://doi.org/10.1016/i.igeb.2025.100542.

74. Thangavel, S., Ramanathan, V., Rassappa, V. and Chinnaswamy, A. 2025. Standardization of protocol for maximizing isolation efficiency and purity of protoplasts and lytic vacuoles from sugarcane stalk. *Sugar Tech* 19: 1-5.

75. Thangavel, S., Subramanian, M., Perumal Thirugnanasambandam, P., Gunasekaran, A., Ramanathan, V. and Chinnaswamy, A. 2025. Integrative metabolome profiling and docking study of sugar-related metabolites in lytic vacuoles of mature sugarcane stem. *Tropical Plant Biology* 18(1): 1-9.

76. Valarmathi, R., Pradhan, A.K., Gandham, P., Chinnaswamy, A., Mahadeva Swamy, H.K., Mohanraj, K., Rasitha, R. and Baisakh, N. 2025. Identification of new genetic resources for drought tolerance-related traits from the world *Erianthus* germplasm collection. *Frontiers in Plant Science* 16: 1684712.

77. Valarmathi, R., Prasad Gandham., Appunu, C., Mohanraj, K., Sudhagar, R., Vinoth, P., Ariharasutharsan, G., Malarvizhi, A., Senthilrajan, P. and Baisakh, N. 2025. Deciphering the differentially expressed proteins with possible involvement in tiller bud development in sugarcane. *Tropical Plant Biology* 18: 30.

78. Venkatarayappa, S., Channappa, M., Amaresh, G., Kumar, R., Raja, A.K., Meena, M.R., Ayyadurai, A.D., Chinnaswamy, A., Hemaprabha, G. and Govindaraj, P. 2025. Evaluation of *Saccharum* and *Erianthus* introgressed early generation novel sugarcane hybrids as potential sources of biomass for cogeneration. *Sugar Tech* 27(1): 158-172.

79. Vennila, A., Anusha, S., Palaniswami, C., Malathi, P. and Kasthuri Thilagam, V. 2025. Sugarcane settling transplanting technology for improving yield and profit maximization. *Journal of Science for Society* 7(1): 1-7. DOI: 10.5958/2583-3715.2025.00001.8.

80. Vinayaka., Prasad, P.R.C., Avinash, G., Amaresh, G., Arun Kumar, R., Murali, P., Palaniswami, C. and Govindaraj, P. 2025. Harnessing AI and remote sensing for precision sugarcane farming: tackling water stress, salinity, and nitrogen challenges. *Frontiers in Agronomy* 7: 1681294. https://doi.org/10.3389/fagro.2025.1681294.

81. Vinaykumar, L.N., Varghese, C., Harun, M., Karmakar, S., Varghese, E., Vinayaka. and Jaggi, S. 2025. Efficient partially replicated designs for multi-environment early-generation breeding trials. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01684-1.

82. Vinayaka., Krishnapriya, V., Lakshmi Pathy, T., Amaresh, G., Gopalareddy, K., Suresha, G.S. and Govindaraj, P. 2025. PhysioIndex R: Physiological and stress indices for crop evaluation. R package Version 0.1.0. Comprehensive R Archive Network (CRAN). https://doi.org/10.32614/CRAN.package.PhysioIndexR.

83. Vinayaka., Lakshmi Pathy, T., Gopalareddy, K., Kumari, S., Murali, P., Govindaraj, P., Prasad, P.R.C. and Vinaykumar, L.N. 2025. CANE: Comprehensive groups of experiments analysis for numerous environments. R package Version 0.1.1. Comprehensive R Archive Network (CRAN). https://doi.org/10.32614/CRAN.package.CANE.

84. Vinayaka., Mandal, B.N., Parsad, R., and Vinaykumar, L.N. 2025. NPBBBDA efficiency: A-efficiency for nested partially balanced bipartite block (NPBBB) designs. R package Version 0.1.0. Comprehensive R Archive Network (CRAN). https://doi.org/10.32614/CRAN.package.NPBBBDAefficiency.

85. Vinu, V., Lakshmi Pathy, T., Mahadeva Swamy, H.K., Krishnappa, G., Arun Kumar, R., Valarmathi, R., Gobu, R., Sreenivasa, V., Maruthi, R.T. and Govindaraj, P. 2025. Deciphering drought tolerance potential of

Saccharum spontaneum in tropical climates using multivariate techniques. *Sugar Tech.* 27:1593-1605.

86. Viswanathan, R., Selvakumar, R., Malathi, P., Sundar, A.R. and Durai, A.A. 2025. Impact of wilt on flowering and ratoon establishment in parental clones of sugarcane. *Sugar Tech* 27(3): 681-693.

87. Viswanathan, R., Selvakumar, R., Raj, C., Gopi, R., Malathi, P., Sundar, A.R., Annadurai, A., Balasaravanan, S., Nithyanantham, R., Kaverinathan, K. and Manivannan, K. 2025. Molecular mapping and diversity of *fusarium* isolates associated with wilt and pokkah boeng of sugarcane in tropical India. *Sugar Tech*. https://doi.org/10.1007/s12355-025-01646-7.

88. Viswanathan, R., Singh, S.P., Selvakumar, R., Raj, C., Singh, D., Bharti, Y.P., Chhabra, M.L., Sharma, A., Minnatullah, M., Mehra, R., Yadav, H.S., Goswami, S.K., Singh, S. and Tiwari, R.K. 2025. Widespread occurrence of *Colletotrichum falcatum* pathotype CF13 in the subtropical India dictates continuous pathogenic virulence and severe sugarcane crop destructions. *Sugar Tech* 27: 1397–1408. DOI:10.1007/s12355-025-01587-1.

89. Zumaila, F., Jeevalatha, A. and Biju, C.N. 2025. Haplotype studies and population structure analysis of the South Indian population of *Phytophthora* species infecting black pepper. *Fungal Biology* 130: 101693.

Books/Compendiums/Training Manuals

1. Chandra Shekara, P. and Puthira Prathap, D. 2025. Rural tourism in Asia and Pacific: Concept, practices and opportunities. CIRDAP, Bangladesh. ISBN: 978-93-49562-29-5. p.140.

2. Gomathi. R., Krishnapriya, V., Alagupalamuthirsoli, M. and Arunkumar, R. 2025. Climate change and sugarcane farming (Tamil). Agricultural Scientific Tamil Society, New Delhi. ISBN: 978-93-91853-67-9. p.168.

3. Govindaraj, P., Velmurugan, A., Karuppaiyan, R., Murugan, P.P., Rao, V.A., Gopalakannan, V., Ravichandran, N., Manamalli, S., Ramprasadh, C., Sudha, C., Bhaskaran, A., Prakash, A.H., Rajendiran, A.S., Sairam, C.V., Naik, R., Kumar, R.N., Vinod, K., Loveson, E.L., Manivel, P., Somasundaram, P., Mhatre, P., Karpagam, C., Nanjundan, J., Jayaprakash, P., Kumara, K.T.N., Thangaraja, K., Shylaja, K.K., Rao, C.T., Reddy, D.M.G., Kumaran, S.S., Sarmah, N., Aravazhi, E., Kumar, S., Murugan, P.E., Abinaya, S., Palaniswami, C., Pazhani, A.S. and Praveen, K. 2025. Viksit Krishi Sankalp Abhiyan (VKSA)-State specific road map and action plan: Tamil Nadu, ICAR-Sugarcane Breeding Institute, Coimbatore. E Book, ISBN: 978-93-85267-49-9. p.127.

4. Hari, K., Kalaiselvi, K., Praveen, K., Krishnapriya, V. and Govindaraj P. 2025. ICAR-SBI technologies for commercialization. ICAR-Sugarcane Breeding Institute, Coimbatore, India, ISBN: 9789385267444. p.76.

5. Karuppaiyan, R., Govindaraj, P., Velmurugan, A., Murugan, P.P., Rao, V.A., Gopalakannan, V., Pazhany, A.S., Praveen, K., Geetha, N., Alarmelu, S., Elayaraja, K., Gomathi, R., RajulaShanthy, T., Suganya, A., Geetha, P., Prathap, D. P., Devakumar, K., Mutharasu, S., Ponselvan, A., Prakash, A.H., Naik, R., Karpagam, C., Manivel, P., Somasundaram, P., Mhatre, P., Nanjundan, J., Jayaprakash, P., Rajendiran, A.S., Lal, K.K., Narayanakumar, R., Vinod, K. and Loveson, E.L. 2025. Recent agro-technologies and package of practices for important crops of Tamil Nadu. ICAR-Sugarcane Breeding Institute, Coimbatore. E-book, ISBN No. 978-93-85267-48-2. p.138.

6. Kumar, R., Meena, M.R., Pooja, D. and Chhabra, M.L. 2025. Training manual on Challenges and solutions for sugarcane crop. (Hindi). ICAR-

Sugarcane Breeding Institute Research Centre, Karnal. p. 90.

7. Malathi, P., Rajula Shanthy, T., Vennila, A., Ramesh Sundar, A. and Govindaraj, P. 2025. Recent technologies for increased productivity in sugarcane (Tamil). ICAR-Sugarcane Breeding Institute, Coimbatore, Tamil Nadu, India. ISBN: 978-93-85267-47-5. p.168.

8. Murali, P., Lakshmi Pathy, T., Vinayaka. and Jagadeshwaran, P. 2025. Basic and applied R programming for agricultural research. ICAR-Sugarcane Breeding Institute, Coimbatore, India. ISBN 978-93-85267-46-8. p. 214.

9. Murali, P., Singh, N.P., Jain, R., Jagadeshwaran, P. and Govindaraj, P. 2025. India's sugarcane revolution: Role of breeding innovations. Policy Paper 55, ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi. p.59.

10. Pooja, D., Kumar, R., Meena, M.R. and Chhabra, M.L. 2025. Training manual on Modern sugarcane production techniques (Hindi). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana, India. p.90.

11. Puthira Prathap, D. 2025. Sugarcane farming for prosperity (Tamil). ICAR- Sugarcane Breeding Institute. Coimbatore. ISBN - 978-93-85267-45-1. p. 224.

Chapters in Books/Training manuals

1. Abu-Ellail, F.F., Sakr, E.A., Ibrahim, A.A., Aung, N.N., Khaing, E.E., Sathyabhama, M., Viswanathan, R., Appunu, C., Murugavelu, G.S. and Salem, K.F. 2025. Genetic improvement of sugarcane (*Saccharum* spp.) for sugar, fibre and biomass energy through breeding and biotechnology. In: Breeding and biotechnology of grass and bast fiber crops, Cham: Springer Nature Switzerland, pp. 237-299.

2. Amaresh., Lakshmi Pathy, T., Gopalareddy, K. and Vinayaka. 2025. Genetic diversity analysis using R: Concept and applications. In: Basic and applied R programming for agricultural research. P. Murali, T. L. Pathy, Vinayaka. andP. Jagadeshwaran (Eds), Vol. 1. ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN 978-93-85267-46-8. pp. 105-126.

3. Anusha, S., Hari, K., Arun Kumar, R., Palaniswami, C., Puthira Prathap, D., Singaravelu, B., Ramesh Sundar, A. and Murali, P. 2025. Digital Soil Moisture Sensor (DSMS). In: ICAR-SBI technologies for commercialization. Hari, K., Kalaiselvi, K., Kona, Praveen, K., Krishnapriya, V. and Govindaraj, P. (Eds), ICAR-Sugarcane Breeding Institute, Coimbatore, pp. 24-25.

4. Arumuganathan, T. 2025. Mechanization in sugarcane farming. In: Sugarcane farming for prosperity (Tamil). D. Puthira Prathap (Ed.), ICAR-Sugarcane Breeding Institute, Coimbatore, ISBN: 978-93-85267-45-1. pp: 103-126.

5. Arumuganathan. T. 2025. Farm machinery and implements for sugarcane production. In: Recent technologies for improved sugarcane productivity. Malathi, P., Rajula Shanthy., T., Vennila, A., Ramesh Sundar A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN:978-93-85267-47-5. pp. 43-58.

6. Bakshi Ram., Kumar, R. and Singh, B.D. 2025. History of sugarcane (*Saccharum officinarum* L.) cultivation. In: Historical aspects of plantation and spice crop production systems in the tropics. Sasikumar, B. and Mohan Kumar, B. (Eds). Cambridge scholars publishing, Newcastle upon Tyne, UK, pp. 584–617.

7. Chhabra, M.L. 2025. ICAR-Sugarcane Breeding Institute, Regional Centre, Karnal - An Introduction. In: Challenges and solutions for sugarcane crop (Hindi). Kumar, R. Meena, M.R.,

Pooja, D. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 1-2.

8. Chhabra, M.L. and Singhwal, S. 2025. Identification and management of major diseases of sugarcane crop in North India. In: Challenges and solutions for sugarcane crop (Hindi). Kumar, R., Meena, M.R., Pooja, D. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 46-52.

9. Chhabra, M.L. and Singhwal, S. 2025. Integrated disease management in sugarcane crop. In: Modern sugarcane production techniques (Hindi). Pooja, D., Kumar, R., Meena, M.R. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp.46-52.

10. Geetha, N. 2025. Sugarcane sucking insects, soil insects and non-insect pests (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi, P., Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Ed.). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 111-120.

11. Geetha. P., Anusha, S. and Kannan. K. 2025. Agronomic management for sugarcane production. In: Recent Technologies for improved Sugarcane productivity. Malathi, P., Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 25-42.

12. Geetha. P., Anusha, S. and Kannan. K. 2025. Irrigation and ratoon management in sugarcane. In: Sugarcane farming for prosperity (Tamil). D. Puthira Prathap (Ed), ICAR-Sugarcane Breeding Institute, Coimbatore, ISBN: 978-93-85267- 45-1. pp: 67-76.

13. Gomathi. R., Arunkumar, R., Krishnapriya, V. and Alagupalamuthirsoli, M. 2025. Impact of salinity and drought stress in sugarcane and their management. In: Recent technologies for improved sugarcane productivity. Malathi., P., Rajula Shanthy., T., Vennila, A., Ramesh Sundar A. and Govindaraj. P. (Eds). ICAR - Sugarcane Breeding Institute, Coimbatore. ISBN:978-93-85267-47-5. pp: 43-58.

14. Hari, K. 2025. Commercialized technologies for sugarcane cultivation. In: Recent technologies for improved sugarcane productivity. Malathi., P., Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds.). ICAR - Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 149-158.

15. Jagadeshwaran, P., Murali, P. and Vinayaka. 2025. Qualitative response regression models. In: Basic and applied R programming for agricultural research. Murali, P., Pathy, T. L., Vinayaka, and Jagadeshwaran, P. (Eds). ICAR Sugarcane Breeding Institute, Coimbatore. Vol. 1. ISBN 978-93-85267-46-8. pp. 169-178.

16. Kannan. K., Geetha, P. and Anusha. S, 2025. Cane agronomy. In: Sugarcane farming for prosperity (Tamil). D. Puthira Prathap (Ed.), ICAR-Sugarcane Breeding Institute, Coimbatore, ISBN: 978-93-85267- 45-1. pp: 47-66.

17. Kumar, R., Meena, M.R., Pooja, D. and Chhabra, M.L. 2025. Important sugarcane varieties and their management for North West zone through genetic improvement process. In: Modern sugarcane production techniques (Hindi). Kumar, R. Meena, M.R., Pooja, D. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 3-18.

18. Kumar, R., Meena, M.R., Pooja, D., Chhabra, M.L. and Kashyap, S. 2025. Healthy sugarcane seed production operations: Handling and

marketing of seed crop. In: Modern sugarcane production techniques. Pooja, D., Kumar, R., Meena, M.R. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 30-41.

19. Kumari, S., Amaresh. and Manimekalai, R. 2025. Bioinformatics essentials: From sequence data to genomic analysis in R. In: Basic and applied R programming for agricultural research, ICAR-Sugarcane Breeding Institute. Murali, P., Lakshmi Pathy, T., Vinayaka. and Jagadeshwaran, P. (Eds). ISBN 978-93-85267-46-8. pp. 127.

20. Lakshmi Pathy, T., Vinayaka and Amaresh. (2025). Hypothesis testing in R. In: Basic and applied R programming for agricultural research, P. Murali, T. L. Pathy, Vinayaka, & P. Jagadeshwaran (Eds.), ICAR–Sugarcane Breeding Institute, Coimbatore. Vol. 1. ISBN 978-93-85267-46-8. pp. 79-90.

21. Malathi, P., Rajula Shanthy, T., Ramesh Sundar, A., Selvakumar, R., Gopi, R., Vennila, A., Ramasubramanian, R. and Ravindra Naik. 2025. Healthy nursery programme for sustainable sugarcane agriculture - Role of mechanized priming of sugarcane setts (Tamil). In Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds.). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp: 93-98.

22. Mohanraj, K. and Hemaprabha, G. 2025. Breeding clonally propagated crops. In: Next generation plant breeding. Sree Rangasamy, S.R. and Subbarayan, S. (Eds). Professional Prints, New York, USA. ISBN: 978-1-966695-28-8. pp. 663-682.

23. Murali, P., Hari, K., Suresha, G.S., Puthira Pratap, D., Jagadeshwaran, P. and Lawanya, S. 2025. Role of Agri-Business Incubator unit of ICAR-SBI for entrepreneurship development. In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp: 159-167.

24. Neha, P., Meena, M.R., Aappnu, C. and Nikhil, M. 2025. Plant small RNAs: Research progress and applications in regulating plant stress responses. In: Functional RNAs in plants, developing climate-resilient and stress-resistant crops. Chen, J.T. (Ed). Academic Press. DOI: 10.1016/C2024-0-00085-9. ISBN: 978-0-443-33341-5. pp. 67-80.

25. Palaniswami, C., Vennila, A. and Kasthuri Thilagam, V. 2025. Soil health management in sugarcane (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore, ISBN:978-93-85267-47-5. pp. 73-80.

26. Palaniswami, C., Kasthuri Thilagam, V. and Vennila, A. 2025. Nutrient management for sustainable sugarcane cultivation (Tamil). In: Sugarcane farming for prosperity. D. Puthira Prathap. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore, ISBN: 978-93-85267-45-1. pp: 87-102.

27. Pooja, D. and Kumar, R. 2025. Importance of soil testing for a healthy sugarcane crop. In: Challenges and solutions for sugarcane crop (Hindi). Pooja, D., Kumar, R., Meena, M.R. and Chhabra, M.L. (Eds). ICAR-Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 53-55.

28. Pooja, D., Kumar, R. and Meena, M.R. 2025. Integrated nutrient management in sugarcane crop, deficiency symptoms and diagnosis. In: Challenges and solutions for sugarcane crop (Hindi). Kumar, R. Meena, M.R., Pooja, D. and Chhabra, M.L. (Eds). ICAR-

Sugarcane Breeding Institute Research Centre, Karnal, Haryana. pp. 56-62.

29. Puthira Pratap, D. and Murali, P. 2025. Use of ICT in sugarcane. In: Recent technologies for improved sugarcane productivity (Tamil) (Eds.). Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp: 143-148.

30. Rajula Shanthy, T. 2025. Strategies for effective transfer of technologies in sugarcane. In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore, pp: 136-142. ISBN: 978-93-85267-47-5.

31. Ramasubramanian, T., Yogambal, C., Singaravelu, B. and Malathi, P. 2025. Pesticide management in sugarcane (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 121-128.

32. Ramesh Sundar, A. and Malathi, P. 2025. Integrated disease management in sugarcane (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 85-92.

33. Sankaranarayanan, C. 2025. Sugarcane nematode management under tropical conditions. In: Climate smart sugarcane cultivation. Bhatt, Varma, R., K. K., Prasad, S. and Oliveira, M. (Eds). CRC Press, USA, ISBN: 9781774919972. pp. 443-473.

34. Sankaranarayanan, S. 2025. White grub control in sugarcane using insecticidal nematodes (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5.

35. Singaravelu, B., Ramasubramanian, T. and Mahesh, P. 2025. Management of sugarcane pests in Tamil Nadu (Tamil). In: Recent technologies for improved sugarcane productivity. Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN: 978-93-85267-47-5. pp. 99-110.

36. Singode, A., Sager, R., Prathima, P.T., Domathoti, B., Dheeravathu, S.N., Pandey, S. and Satyavathi, C.T. 2025. Proso millet. In: Plant genebank utilization for trait discovery in millets, IV, Singapore: Springer Nature Singapore, pp. 187-213.

37. Vennila, A., Kasthuri Thilagam V., Palaniswami, C. and Malathi, P. 2025. Settling Transplanting Technology (Tamil). In: Recent technologies for improved sugarcane productivity Malathi., P. Rajula Shanthy., T., Vennila, A., Ramesh Sundar, A. and Govindaraj. P. (Eds). ICAR-Sugarcane Breeding Institute, Coimbatore. ISBN:978-93-85267-47-5. pp. 67-72.

38. Vinayaka. and Jagadeshwaran, P. 2025. Introduction to R and descriptive statistics. In: Basic and applied R programming for agricultural research. Murali, P., Pathy, T.L., Vinayaka, and Jagadeshwaran, P. (Eds), ICAR–Sugarcane Breeding Institute, Coimbatore. Vol. 1. ISBN 978-93-85267-46-8. pp. 17–22.

39. Vinayaka. and Kumari, S. 2025. R software – RStudio download and installation. In: Basic and applied R programming for agricultural

research. Murali, P., Pathy, T.L., Vinayaka, and Jagadeshwaran, P. (Eds), ICAR–Sugarcane Breeding Institute, Coimbatore. Vol. 1. ISBN 978-93-85267-46-8. pp. 1–16.

40. Vinayaka. and Murali, P. 2025. Data visualization. In: Basic and applied R programming for agricultural research. Murali, P., Pathy, T.L., Vinayaka and Jagadeshwaran, P. (Eds), ICAR–Sugarcane Breeding Institute, Coimbatore. Vol. 1. ISBN 978-93-85267-46-8. pp. 23-44.

41. Vinayaka, Lakshmi Pathy, T., Gopalareddy, K. and Amaresh. 2025. Design of experiments and practical applications using R. In: Basic and applied R programming for agricultural research. Murali, P., Pathy, T.L., Vinayaka. and Jagadeshwaran, P. (Eds), ICAR–Sugarcane Breeding Institute, Coimbatore. Vol. 1, ISBN 978-93-85267-46-8. pp. 45-78.

Presentations in conference/ Symposia/ Seminars/Workshops/R & D workshops

1. Akila Dharshini Venkatachalam., Rachel Lissy Vargheese., Indusha Yazhini Sankararaj., Hariprasath, M. and Lakshmi Kasirajan. 2025. LIM transcription factor as a key regulator of salt stress tolerance in the sugarcane cultivar TS-GS 20-24: An integrated morpho-physiological and gene expression study. In: 6th International Conference on Plant physiology for translational genomics and physiology for sustainable agriculture at TNAU, Coimbatore during 15-18 December 2025. pp:172.

2. Alagupalamuthirsolai, M., Arun Kumar, R., Hari, K., Krishnapriya, V., Gomathi, R. and Kannan, K. 2025. Effect of co-occurrence of high night temperature and water deficit stress in sugarcane. In: The International Conference on Advances in plant health improvement for sustainable agriculture at VOC Agricultural College and Research Institute, Killikulam during 14-16 February 2025. pp.273.

3. Alagupalamuthirsolai, M., Arun Kumar, R., Hari, K., Krishnapriya, V., Gomathi, R. and Kannan, K. 2025. Combined application of melatonin and chitosan mitigate water deficit stress in sugarcane. In: 6th International Conference on Plant physiology for translational genomics and physiology for the sustainable agriculture organized by Tamil Nadu Agricultural University and Indian Society for Plant Physiology at TNAU, Coimbatore during 15 -18 December 2025. pp.55.

4. Alarmelu, S., Jayabose, C., Anusheela, V., Karuppaiyan, R. and Govindaraj, P. 2025. Assessment of distinctiveness, uniformity and stability of sugarcane varieties (*Saccharum officinarum*). In: 54th Annual convention of SISSTA at Thirupathi, Andhra Pradesh during 19-20 September 2025. pp.125-130.

5. Alarmelu, S., Vasantha, S., Sheelamary, S., Anusheela, V., Arunkumar, R., Lakshmipathy, T., Mutharasu, S. and Amburose, S. 2025. Estimation of genetic variability in introgressed sugarcane hybrids and their response to drought stress. In: 54th Annual convention of SISSTA at Thirupathi, Andhra Pradesh during 19-20 September 2025. pp. 118-124.

6. Anitha., Jeyakumar., Vijayalakshmi., Sassikumar., Manimekalai, R., Gomathi, R., Djanaguiraman., Vanitha. and Nageswari. 2025. Responses of sugarcane genotypes to hypoxia: Physiological and molecular analysis. In: 6th International Conference on Plant Physiology, for Translational Genomics and Physiology for Sustainable Agriculture (ICPP 2025) at TNAU, Coimbatore during 15-18 December 2025. pp.156.

7. Anusha, S., Kannan, K., Hari, K., Krishnapriya, V. and Geetha, P. 2025. Effect of tillage and weed management practices on sugarcane weed productivity, profitability and energetics in tropical India. In: 6th International Agronomy

Congress on Re-envisioning agronomy for smart agri-food systems and environmental stewardship at CSIR-National Physical Laboratory (NPL), New Delhi during 24 - 26 November 2025. pp. 176-178.

8. Appunu Chinnaswamy., Harish Chandar, S.R., Mahalakshmi Subramanian., Sakthivel Surya Krishna., Swathi Thangavel., Girija Sangari Murugavelu., Viswanathan Chinnusamy., Saranya Nallusamy., Sobhakumari, V.P., and Gomathi, R. 2025. A polycistronic tRNA-gRNA guided Cas9 multiplexing approach for targeted improvement of abiotic stress tolerance in sugarcane. In: International Genomics and crops abiotic stress tolerance symposium at Texas Tech University, Lubbock, Texas during 20-21 November 2025.

9. Appunu Chinnaswamy. 2025. Exploration of abiotic stress-responsive genes from wild species of *Saccharum* complex to improve multiple abiotic stress tolerance in sugarcane. In: International genomics and crops abiotic stress tolerance symposium at Texas Tech University, Lubbock, Texas during 20-21 November 2025.

10. Appunu Chinnaswamy. 2025. Targeted gene editing in sugarcane for improved tolerance to drought and salinity stresses. In: National Seminar on Advanced technologies of sugarcane production in relation to climate Resilience at VSI, Pune during 30-31 July 2025.

11. Arun Kumar, R., Alarmelu, S., Mohanraj, K., Krishnapriya, V., Anusha, S., Alagupalamuthirsolai, M., Arumuganathan, T., Sreenivasa, V., Gomathi, R., Palaniswami, C., Kannan, K., Raja, R., Vasantha, S., Hemaprabha, G. and Govindaraj, P. 2025. Morpho-physiological traits and drone-based indices for sugarcane productivity in tropical conditions. In: 6th International Conference on Plant physiology (ICPP) for translational genomics and physiology for sustainable agricultureat TNAU, Coimbatore during 15 -18 December 2025. pp. 39.

12. Geetha, P., Hari, K., Subramani, T. and Anusha, S. 2025. Building resilience in sugarcane-based cropping systems through nature-based approaches. In: Sixth International Agronomy Congress at CSIR-NPL, New Delhi during 24-26 November 2025. pp. 262-263.

13. Geetha, P., Hari, K., Vennila, A. and Anusha, S. 2025. Conservation agriculture for sustainable use and management of natural resources to improve productivity in sugarcane based cropping system. In: International Conference on Advanced innovations and technological frontiers in agricultural sciences, agricultural engineering, sericulture, food technology, biotechnology, fisheries science, veterinary and animal sciences at RVS college, Coimbatore during 9 -10 January 2025. pp.68.

14. Geetha, P., Rajula Shanthy, T., Palaniswami, C. and Thirunavukkarasu, M. 2025. Sustaining Sugarcane Production through Sugarcane based Farming System in Tropical India. In: 1st International Farming systems conference for transforming food, land and water systems under global climate change at ICAR-IIFSR, Modipuram, Meerut during 07-09 March 2025. pp.154.

15. Gomathi, R., Arun Kumar, R., Krishnapriya, V., Shanthi, R.M. and Govindaraj, P. 2025 Evaluation of climate resilient drought-tolerant sugarcane clones for the Peninsular Zone of India. In: The South Indian Sugarcane & Sugar Technologists' Association (SISSTA) 54th Annual Convention at Tirupati during 19-20 September 2025. pp. 236-242.

16. Gomathi R., Arun Kumar, R., Shanthi, R.M. and Govindaraj, P. 2025. Critical analysis of screening for drought tolerance in sugarcane under tropical conditions. In: 83rd The Sugar Technologists' Association of India Annual

Convention at New Delhi during 24-26 July 2025. pp. 26-33.

17. Gomathi, R. and Venkataramana. 2025. Climate-smart practices for sustaining sugarcane productivity under changing climate. In: Proceedings of The South Indian Sugarcane & Sugar Technologists' Association 54th Annual Convention at Shree Convention, Tirupati during 19-20 September 2025. pp. 243-249.

18. Gomathi, R. 2025. Phenotyping for abiotic stress tolerance in sugarcane. In: Proceedings of National Conference on Sustainable and resilient agriculture: Innovations, strategies, and policy frame works at Vanavayaran Institute of Agriculture, Pollachi, Tamil Nadu during 5-6 December 2025. pp.188-198.

19. Gomathi, R., Arun Kumar, R. and Krishnapriya, V. 2025. Physiological approaches for developing climate resilient sugarcane. In: 6th International Conference on Plant physiology for translational genomics & physiology for sustainable agriculture at Tamil Nadu Agricultural University, Coimbatore during 15-18 December 2025. pp. 47.

20. Kasthuri Thilagam V., Vennila, A. and C. Palaniswami. 2025. Temporal dynamics of waterlogging induced changes on redox chemistry and nutrient availability under sugarcane soils. In: 33rd National conference on Land and water management for ecological restoration and agricultural sustainability at Punjab Agricultural University, Ludhiana during 08 -10 December 2025.

21. Kasthuri Thilagam, V. and Manivannan. S. 2025. Assessing the carbon sequestration potential of soil and water conservation interventions at the watershed level. In: International Conference on Sustainable technologies for energy and environment at PSG Institute of Advanced Studies, Coimbatore during 27-29 November 2025. pp 68- 69.

22. Krishnapriya, V., Arunkumar, R., Anusha, S., Alagupalamuthirsolai, M., Gomathi, R. and Vinu, V. 2025. Physiological approaches to decode nutrient use efficiency in sugarcane. In: 6th International Conference on Translational genomics and physiology for sustainable agriculture at Tamil Nadu Agricultural University, Coimbatore during 15-18 December 2025. pp.37.

23. Lakshmi, K. 2025.Transcriptomic insights on lignin biosynthesis and precise gene modification towards biomass conversion in sugarcane. In: The Plant and Animal Genome Conference at New Delhi during 18-20 March 2025.

24. Lakshmipathy, T. 2025. Partial least square regression-based selection of traits conferring drought tolerance in *Saccharum spontaneum*. In: 6thInternational Conference on Plant Physiology at Tamil Nadu Agricultural University, Coimbatore during 15-18 January 2025. pp.106.

25. Mahadeva Swamy, H.K., Hemaprabha, G., Mohanraj, K., Appunu, C., Manimekalai, R., Gopalareddy, K., Annadurai, A., Prabhakaran, A.J., Vinith, N., Mutharasu, S., Amaresha, R., Maruthi, R.T., Lakshmi Pathy, T., Kona Praveen., Gobu, R., Alarmelu, S., Shanthi, R.M. and Govindaraj, P. 2025. Identification of molecular markers associated with drought tolerance in sugarcane (*Saccharum* spp.). In: 6thInternational Conference on Plant physiology at Tamil Nadu Agricultural University, Coimbatore during 15-18 January 2025. pp.168.

26. Mahesh, P., Singaravelu, B., Srikanth, J., Hari, K., Sankaranarayanan, C., Salin, K.P., Appunu C., Suresha, G.S., Nirmala, R. and Ishwarya, 2025. In: 2nd International Conference on Biological control: Biocontrol contributions to one

health organized by Society for Biocontrol Advancement and ICAR-NBAIR, Bengaluru during 25-28 February 2025. pp. 265.

27. Manimekalai, R. and Viswanathan, C. 2025. Advancing sugarcane improvement through emerging gene. In: 6th International Conference on Plant physiology at TNAU, Coimbatore during 15-18 December 2025. pp.44.

28. Maruthi, R.T., Vinayaka., Anna Durai, A., Mohanraj, K., Pratheepa, M., Mazhar, B.I., Mahadeva Swamy, H.K., Lakshmi Pathy, T., Gobu, R. and Praveen Kona. 2025. Database system as an aid in the sugarcane crossing program. In: International Conference on Plant physiology translational genomics and physiology for sustainable agriculture at TNAU, Coimbatore during 15-18 December 2025. pp.247.

29. Meena, M.R., Kumar, R., Alarmelu, S., Lakshmipathy, T., Amaresh, Pooja., D., Chhabra, M.L. and Govindaraj, P. 2025. Towards climate-smart bioenergy: Identifying high biomass drought-tolerant sugarcane clones. In: National conference on Advance in climate-conscious crop science organized by University of Agricultural Sciences at Bangalore from 31 October to 02 November 2025. pp. 248.

30. Murali, P. 2025. Role on Agri Business Incubator (SugarcaneEdge@) for profitable business option for sugarcane farmers In: Regional Agricultural Exhibition and Seminar organized by the Department of Agriculture and Farmers Welfare, Tamil Nadu at Tiruvannamalai during 27-28 December 2025.

31. Pooja, D., Kumar, R., Preet, K., Appunu, C., Rana, R., Meena, M.R. and Chhabra, M.L. 2025. Effect of prolonged salinity stress on physiological and yield traits in recently evolved sugarcane genotypes. In: International Salinity Conference on Worldwide efforts on cutting-edge approaches for restoring saline ecosystems organized Jointly by ICAR-CCARI and ICAR-CSSRI at Goa from 29 October to 01 November 2025. pp. 54.

32. Rachel Lissy Vargheese., Indusha Yazhini Sankaraj., Akila Dharshini Venketachalam. and Lakshmi Kasirajan. 2025. Lignin modification in sugarcane using CRISPR/Cas9 for improved bioethanol production. In: 6th International Conference on Translational genomics and physiology for sustainable agriculture at TNAU, Coimbatore during 15-18 December 2025. pp:136.

33. Rajula Shanthy, T. and Jayabose, C. 2025. Sharing success of demand based technological interventions for sustainable livelihood in tribal expanses. In: 2nd International Extension Education Congress on Rethinking social ecology in a digital landscape at Institute of Agricultural Sciences, Bhubaneshwar during 24-26 November 2025.

34. Ramesh Sundar, A., Kana Valiyaveettil Lakshana., Ashwin, N.M.R., Amalamol, Dharmaraj., Jeevalatha, A., Ramesh, R., Malathi, P. and Viswanathan, R. 2025. Decrypting molecular signatures of *Colletotrichum falcatum*, the red rot pathogen of sugarcane - way forward to engineer pathogen-derived resistance. In: National Conference on Emergence issues and sustainable strategies in plant health management: A global perspective organized by Indian Phytopathological Society jointly with ICAR-CCRI at Nagpur during 19-21 January 2025.

35. Ramesh Sundar, A., Kana Valiyaveettil Lakshana., Ashwin, N.M.R., Amalamol, Dharmaraj., Jeevalatha, A., Ramesh, R., Malathi, P. and Viswanathan, R. 2025. Shifting paradigms in understanding plant disease resistance from gene-to-gene concept to the era of omics applications. In: International

conference on One health perspectives in global plant protection research at TNAU, Coimbatore during 19-21 February 2025.

36. Ramesh Sundar, A., Kana Valiyaveettil Lakshana., Ashwin, N.M.R., Amalamol, Dharmaraj., Jeevalatha, A., Ramesh, R., Malathi, P. and Viswanathan, R. 2025. Proteomic approaches for biotic stress management. In: ICAR sponsored Winter school, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore from 25 February to 17 March 2025.

37. Sankaranarayanan, C. 2025. Entomo pathogenic nematodes in pest control: From lab to commercialization. In: International Conference on One health perspectives in global plant protection research at Tamil Nadu Agricultural University, Coimbatore during 19-21 February 2025. pp. 347-353.

38. Sankaranarayanan, C., Salin, K.P., Hari, K., Singaravelu, B., Sivakumar, U., Karthikeyan, S. and Rajeshkumar. M. 2025. Molecular and biochemical characterization of symbiotic bacteria *Photorhabdus / Xenorhabdus* spp. and its insecticidal activity against *Galleria mellonella* larvae L, white grub *Holotrichia serrata* F. and purification of insecticidal metabolites. In: Second International Conference on Biological control: Biocontrol contributions to one health organized by Society for Biocontrol Advancement and ICAR-NBAIR, Bengaluru during 25-28 February 2025. pp. 200.

39. Shanthi, R.M., Pathy, T.L., Gomathi, R. and Govindaraj, P. 2025. Co 13013 (AKSHAYA) – A high yielding climate resilient variety for Peninsular India. In: SISSTA 54th Annual Convention at Thirupathi, Andhra Pradesh during 19-20 September 2025. pp. 232-235.

40. Sheelamary, S. 2025. Sugarcane research for enhanced productivity and climate resilience. In: International conference on Crops - climate resilience optimization for productivity and sustainability at Mohan Babu University, Tirupathi, Andhra Pradhesh during 9-11 December 2025.

41. Sheelamary, S., Karthikeyan, S., Sobhakumari, V.P., Dhanapal, K., Vivek Kumar, R., Ponselvan, A. and Govindaraj, P. 2025. Breeding climate-resilient sugarcane utilizing different cytotypes of *Saccharum spontaneum*. In: 10th International Conference on Global research initiatives for sustainable agriculture & allied sciencesat MPUAT, Udaipur, Rajasthan during 05-07 October 2025. pp.64-65.

42. Sheelamary, S., Kasirajan, L., Suganya, A., Annadurai, A. and Gomathi, R. 2025. Harnessing phenotypic variation in sugarcane (*Saccharum* spp.) interspecific hybrids to enhance drought adaptability. In: 6th International Conference on Plant physiology on translational genomics and physiology for sustainable agriculture at TNAU, Coimbatore during 15-18 December 2025. pp: 72.

43. Sheelamary, S., Shanthi, R.M., Ponselvan, A., Sridhar, V., Appunu, C. and Govindaraj, P. 2025. Genotype × environment interaction and cane yield stability analysis in sugarcane using the AMMI approach. In: 54th Annual convention of SISSTA at Thirupathi, Andhra Pradhesh during 19-20 September 2025. pp. 225-231.

44. Singaravelu, B., Suresha, G.S., Appunu, C., Crickmore, N., Shu, C., Zhang, J., Srikanth, J., Hari, K., Sankaranarayanan, C., Mahesh, P. and Nirmala, R. 2025. Novel *Bacillus thuringiensis* Berliner crystal toxin gene Cry8Sa1 for resistance against white grub *Holotrichia serrata* F. in sugarcane. In: 2nd International Conference on Biological control: Biocontrol contributions to one health organized by Society for Biocontrol Advancement and ICAR-NBAIR, Bengaluru during 25-28 February 2025. pp. 202.

45. Suganya, A., Lakshmi, K., Sheelamary, S., Praveen Kona., Sandhya, M., Kiruthika, R., Pradeep, M. and Govindaraj, P. 2025. Functional root anatomy and assessment of MYB transcription factor in sugarcane clones under drought condition. In: SISSTA 54th Annual Convention at Thirupathi, Andhra Pradesh during 19-20 September 2025. pp.277-284.

46. Valarmathi, R., Anjan Pradhan., Prasad Gandham., Appunu, C., Mahadeva Swamy, H.K., Mohanraj, K. and Niranjan Baisakh. 2025. Drought response of *Erianthus* germplasm clones and comparative transcriptomics: Identifying potential genetic resource for breeding high biomass and drought adaptive sugarcane genotypes. In: International Conference on Plant and Animal Genome at San Diego, California, USA during 10-15 January 2025.

11 RESEARCH PROGRAMMES

1. Breeding superior sugarcane varieties of different maturity with improved cane yield, quality and resistance to biotic and abiotic stresses.
2. Enhancement of sugarcane germplasm and development of pre-breeding material.
3. Sugarcane genomics and molecular markers.
4. Gene discovery and genetic transformation in sugarcane.
5. Development of cropping systems and improved agronomic practices to enhance sugarcane productivity.
6. Enhancing physiological efficiency of sugarcane.
7. Natural resource management for enhancing productivity and sustainable sugarcane production.
8. Host resistance, interactomics, pathogen variability, diagnosis and disease management in sugarcane
9. Studies on sugarcane pest and their management.
10. Basic and applied studies of sugarcane phytonematodes and entomopathogenic nematodes.
11. Economic and statistical studies in sugarcane and sugar production system.
12. Transfer of sugarcane technologies.
13. Value addition and product diversification in sugarcane.
14. All India Coordinated Research Project (Sugarcane).
15. All India Coordinated Research Project on Biological Control .
16. AICRP on Seed (Crops)-Sugarcane.
17. All India Network Project (AINP) on soil arthropod pests, Management of white grubs through EPN and Bt.
18. All India Network Project (AINP) on Biotechnology.

12 CONSULTANCY, SERVICES, INTELLECTUAL PROPERTY, TECHNOLOGY MANAGEMENT AND COMMERCIALIZATION

- MTA was signed between ICAR-SBI and ICAR-CICR for two novel Cry8 genes discovered by ICAR-SBI towards the development of transgenic cotton for the management of cotton stem weevil.
- Received registration certificates for Co 12029 (Karan 13), Co 18009 and Co 13035 (Karan 14) from PPV&FRA. One application was submitted to PPV&FRA as extant variety for Co 17018.
- Annual return forms pertaining to nine ICAR-SBI sugarcane varieties, KARAN-2 (Co 0118), KARAN-9 (Co 05011), Co 0238, Co 06030, Co 09004 (Amritha), Co 12006 (UPAHAR), Co 11015 (Atulya), Sankalp (Co 12009) and Co 15023 (Karan-15) and paid annual fee of Rs. 18,000. Copyright applications were submitted for 14 publications of which five certificates were received.
- World Intellectual Property Day was celebrated on 2 May 2025. Dr. A. Vidhyavathi, Professor and Head (Agricultural Economics), IPMC, CARDS, TNAU, Coimbatore delivered a lecture on 'Capitalizing the research outcomes into IPR in research institutions: Some insights'.
- Licenses: Licensed SBIEC 14006 - An Energy cane with high biomass production to M/s Radix Lifespaces Pvt. Ltd., Bangalore, Karnataka with a revenue of Rs. 3.35 lakhs. ICAR-SBI EPN Biopesticide formulation to two firms M/s Biowall Agrihealth Private Limited, Nagpur, Maharashtra and M/s Gannamaster Agro Industries Private Limited, Sangli, Maharashtra for Rs. 5.00 lakhs. *Cotesia flavipes* and *Telenomus dignus* mass multiplication technology against INB with release station to M/s Ramdev Sugars Private limited, Madhya Pradesh with a revenue of Rs. 0.60 lakhs. ICAR-SBI variety Co 17018 to six firms: M/s Rana Sugars Limited, Amritsar, Punjab; M/s Uttam Sugar Mills Ltd. Bijnor, Uttar Pradesh; M/s Mawana Sugars Limited, Rajendra Place, New Delhi; M/s Avadh Sugar & Energy Ltd., Bijnor, Uttar Pradesh; M/s PBS Foods (Sugar) Pvt. Ltd., Chandpur, Uttar Pradesh and M/s Piccadily Agro Industries Limited, Karnal, Haryana with a revenue of Rs. 3.60 lakhs.
- A total of 10 MoUs were signed and overall commercialization activity gave a revenue of Rs. 12.55 lakhs through licensing and paid a GST of Rs. 2.26 lakhs.

Dr. A. Vidhyavathi delivering lecture (02 April 2025)

Licensed SBIEC 14006 to M/s Radix Lifespaces Pvt. Ltd., Bangalore

Licensed ICAR-SBI EPN Biopesticide formulation to M/s Biowall Agrihealth, Nagpur

Licensed ICAR-SBI EPN Biopesticide formulation to M/s Gannamaster, Sangli

Licensed *C. flavipes* and *T. dignus mass* multiplication technology to M/s Ramdev Sugars Pvt Ltd., Madhya Pradesh

Licensed variety Co 17018 to M/s Uttam Sugar Mills Ltd. Bijnor, Uttar Pradesh

Genetic stocks registered

- Chandran, K., Nisha, M., Mahendran, B., Gopi, R., Suresha, G.S., Hari, K., and Hemaprabha, G. 2025 Germplasm GUK14-48 of sugarcane (INGR25037).

Copyrights obtained

- Gomathi, R. Training Manual on 'High throughput sampling using optical properties (Understanding and Application)'. LD-20250176791; Dt. 07/11/2025) on 7 November 2025.
- Rajula Shanthy, T., Alarmelu, S., Jayabose, C., Malathi, P., Bakshi Ram. Glimpses of Cane Adviser - A digital compendium on sugarcane' LD-20250177105 on 12 November 2025.
- Malathi, P., Viswanathan, R., Ramesh Sundar, A., Ravindra Naik, Rajula Shanthy, T., Vennila, A., Ramasubramanian, T. Sugarcane Sett Treatment Device User Manual. LD-20250178151 on 05 December 2025.

13 MEETINGS, WORKSHOPS AND EVENTS ORGANIZED

Zonal Breeders and Plant Protection Scientists Meet-2025

ICAR-SBI and AICRP on Sugarcane jointly organized the Zonal Breeders and Plant Protection Scientists Meet-2025 at ICAR-SBIRC, Kannur on 17 January 2025. Dr. T.R. Sharma, DDG (CS), ICAR was the Chief Guest.

Republic Day (26 January 2025)

Republic Day and Independence Day

Republic Day was celebrated on 26 January 2025. Independence Day was celebrated in the Institute on 15 August 2025. Dr. P. Govindaraj, Director hoisted the national flag and addressed the staff of the Institute.

Independence Day celebration

Interactive Meeting

An interactive division wise meeting chaired by Dr. Prasanta Kumar Dash, ADG (CC) was held on 24 February 2025 to discuss the progress of research projects.

International Women's Day

International Women's Day was celebrated in the Institute on 10 March 2025 with the theme 'For all women and girls: Rights, equality and empowerment'. Ms. Pradeepa Saravanan, Clinical Dietician and Diabetes Educator, Coimbatore graced the occasion as Chief Guest.

Women's Day celebration (10 March 2025)

Inauguration of Institute facilities

Dr. D.K. Yadava, DDG (CS), ICAR inaugurated Dr. K.V. Srinivasan Sugarcane Disease Screening and Quarantine Complex, National Sugarcane Flower Induction Facility and laid the Foundation stone of the Breeding Laboratory Annexe of the Institute on 12 April 2025.

Ladies Common Room

A well-furnished 'Ladies Room' was established at the Institute by the Women's Cell and inaugurated by the Director on 22 December 2025.

ICAR-South Zone Sports Meet

Organized the ICAR-South Zone Sports Meet at Nehru Stadium, Coimbatore during 8-11 April 2025. In all, 978 participants from 28 ICAR-institutes participated in the Meet. The Opening Ceremony was inaugurated by Shri S. Hariharan, Deputy General Manager, State Bank of India, Coimbatore and presided over by Dr. P. Govindaraj, Director, ICAR-SBI and Chairman of the Organizing Committee. Dr. R. Selvarajan, Director, ICAR-NRCB, Tiruchirapalli and Shri Ranganathan Ramasami, Regional Manager, State Bank of India, Coimbatore were Guests of Honour. Dr. D.K. Yadava, DDG (CS) was the Chief Guest of the Closing Ceremony. Dr.

ICAR-South Zone Sports Meet (8-11 April 2025)

Inauguration of Quarantine Complex by DDG (CS)

Inauguration of National Sugarcane Flower Induction Facility

Foundation stone laying of the Breeding Laboratory Annexe

Venkatesa Palanichamy, Dean (Agriculture), TNAU, Coimbatore graced the occasion. ICAR-IIHR, Bengaluru secured the Overall Championship Trophy.

'Poshan Pakhwada' 2025

ICAR-SBI celebrated 7th 'Poshan Pakhwada' 2025 by organizing a series of events during 08-22 April 2025. Nutrition Awareness programs were organized in three nearby Anganwadis and a lecture on 'Balanced diet for healthy life' was delivered by Dr. A. Jenit Osborn, Associate Professor, Department of Community Medicine, PSGIMSR, Coimbatore on 22 April 2025.

Nutrition Awareness Lecture (22 April 2025)

Orientation Workshop on *Viksit Krishi Sankalp Abhiyan* (VKSA)

ICAR-SBI had actively participated in the nation-wide VKSA-Kharif campaign, which aimed to modernize Indian agriculture through scientific farming, farmer training, sustainable practices and tech-driven growth from 29 May to 12 June 2025. Sixty staff from the Institute interacted with farmers on climate-resilient varieties, technologies and the benefits of existing Central and State Government Schemes in 17 districts of Tamil Nadu and Puducherry. An Orientation Workshop on 'Viksit Krishi Sankalp Abhiyan' was conducted for the scientists who were deputed for the campaign on 27 May 2025, wherein the Deputy Director of Agriculture, Coimbatore, Bank Officers and other officials handled the sessions.

All the Scientists of SBI-RC, Karnal were part of the ICAR-NDRI constituted VKSA team, visited many villages and interacted with farmers from 29 May to 12 June 2025.

International Yoga Day

The 11th International Yoga Day was celebrated on 21 June 2025 with activities including lectures, video campaign, yoga practice, quiz and yoga competitions.

ICAR-SBI and ICAR-CICR Collaborative Meet

ICAR-SBI collaborated with ICAR-CICR in conducting a meeting on 'Stakeholders consultation on enhancing cotton production' at ICAR-Sugarcane Breeding Institute on 11 July 2025. The Meet was chaired by Shri Shivraj Singh Chauhan, Hon'ble Union Minister of Agriculture and Farmers Welfare. Shri. Giriraj Singh, Hon'ble Union Textile Minister, Government of India, Agricultural Ministers of Haryana and Punjab, Dr. M.L. Jat, Secretary, DARE and Director General, ICAR, Dr. D.K. Yadhava, DDG (CS), Dr. Prasanta Kumar Dash, ADG (CC) and Dr. P. Govindaraj, Director, ICAR-SBI graced the occasion. An interaction between scientists and farmers was held to discuss the issues related to cotton.

Shri. Shivraj Singh Chauhan addressing the gathering

ICAR-SBI stall in ICAR Foundation Day

A stall depicting the Institute technologies was put up in ICAR Foundation Day at NASC Complex New Delhi on 16 July 2025.

Mera Gaon Mera Gaurav

Eighteen teams comprising four scientists each had identified 90 villages (Coimbatore - 75, Karnal -

Dignitaries visiting ICAR-SBI stall

10 and Kannur - 5) for adoption. Baseline surveys were conducted initially and the major constraints identified were drought, non-availability of inputs in time, poor marketability of the produce, high cost and unavailability of labour and livestock health issues. Periodical visits were made to the adopted villages and technical guidance was provided to the farmers for improving their livelihood. Group meetings and demonstrations on new technologies like sett treatment device were conducted in turmeric, banana and vegetables in the adopted villages. Extension literature on specific topics was distributed. Several meetings, campaigns and training programs were organized in the adopted villages in Coimbatore, Karnal and Kannur.

Hindi Day

Hindi Day was celebrated at the Institute on 30 September 2025. Various competitions were conducted and winners were awarded.

Awareness Campaign on PM-DDKY organized

An awareness campaign on '*Pradhan Mantri Dhan Dhaanya Krishi Yojana* (PMDDKY)', a new scheme by the Indian government to support farmers was organized at the Institute on 11 October 2025. The

Awareness Campaign on PM-DDKY at ICAR-SBI

launch by the Hon'ble Prime Minister was broadcast live for the benefit of farmers in Coimbatore region. Shri. Amman K. Arjunan, MLA for Coimbatore North inaugurated the campaign and urged farmers to maximize the benefits of schemes such as the National Mission on Natural Farming and the 'PM Krishi Sinchayee Yojana'. Presiding over the event, Dr. P. Govindaraj, Director, ICAR-SBI emphasized the advantages of the newly launched initiatives by the Hon'ble Prime Minister. Over 330 farmers participated in the campaign.

Swachchh Bharat Abhiyan

The Institute actively maintains a clean and green environment through regular cleanliness campaigns involving all staff. Special Campaign 5.0 was implemented in the Institute for institutionalizing swachhta and minimizing pendency in government offices in two phases. Activities during the 'Preparatory phase' (15-30 September 2025) included identification of

Activities under Swachchh Bharat Abhiyan pending references, identification of campaign sites for cleanliness and beautification drives and assessment of redundant / scrap material for disposal. 'Implementation Phase' (2-31 October 2025) focused on space management, cleaning of black spots, beautification of office, disposal of scrap / redundant materials, cleanliness drives in the campus, fields and chosen villages. 'Swachhta pakhwada' was implemented in the Institute and Research Centres during 15-31 December 2025 and the activities included pledge taking, cleanliness / sanitation drives, Swachhta Awareness Day, review and weeding out of old records, Swachhta runs, green / plantation drives, community outreach, signature campaign and 'Kisan Samman Diwas'.

ICAR-SBI Foundation Day

The 114th Foundation Day of the Institute was celebrated on 23 October 2025. Dr. Sanjay Kumar, Chairperson, Agricultural Scientists Recruitment Board, New Delhi was the Chief Guest and Dr. Raman Thangavelu, Director, ICAR-NRIIPM was the Guest of Honour of the function.

114th Foundation Day of ICAR-SBI

Vigilance Awareness Week

Vigilance Awareness Week was observed from 27 October 2025 to 2 November 2025. Pledge taking ceremony, Vigilance awareness walkathon and essay competitions were organized. Dr. S. Jayaprahasam, I.R.S., Additional Director General, DGGI, Coimbatore Zonal Unit delivered the Vigilance Awareness lecture on 'Vigilance: Our shared responsibility'.

National Unity Day

All the staff participated in the National Unity Day celebration on 31 October 2025, starting with Pledge taking ceremony followed by short video screening on the theme 'Ek Bharat Shreshtha Bharath' and a Walk for unity to promote the message of national integration and collective strength.

Release of PM-KISAN scheme

All staff of the Institute and sugarcane farmers from nearby villages participated in the live webcast of the Hon'ble Prime Minister's event on '21st release of the PM-KISAN scheme' as well as inauguration of 'South India Natural Farming Summit -2025' in CODISSIA Trade Fair Complex, Coimbatore on 19 November 2025. Special lectures on 'Central and State schemes for farmers' and 'Natural farming in sugarcane' were arranged.

Commemoration of 150 years of National Song

On commemoration of 150 years of National Song 'Vande Mataram', all staff of the institute participated virtually in the formal launch of the commemoration by Hon'ble Prime MInister at Indira Gandhi Indoor Stadium, New Delhi on 07 November 2025. A mass singing of 'Vante Mataram' was organised to mark the occasion.

Constitution Day

To commemorate the adoption of the Constitution of India, Constitution Day was celebrated at the Institute (*Samvidhan Diwas*) on 26 November 2025, wherein all the staff participated in the scheduled 'Reading of the Preamble of the Constitution', reaffirming their commitment to uphold its ideals.

World Soil Day 2025

World Soil Day 2025 was celebrated at Bannari Amman Sugars Ltd, Thirukovilur with the participation of over 120 farmers from Tiruvannamalai and Tirukoilur districts of Tamil Nadu on 2 December 2025. Four progressive farmers were honoured with 'Best Farmer Awards' appreciating their efforts for sustainable soil health management in sugarcane farming.

World Soil Day (2 December 2025)

Seminar / Lectures

- An invited lecture on 'Reviving sugar industry in Tamil Nadu: Challenges and opportunities' by Dr. R. Viswanathan, Director, ICAR-ISRI was organized by NAAS Chapter, Coimbatore on 15 April 2025 (hybrid mode).
- An interaction meeting of scientists with officials from Sugarcane Industries Department, Govt. of Bihar at ICAR-SBIRC, Karnal to discuss on the future prospects of SBIRC, Karnal technologies in Bihar on 16 April 2025.

14 COMMITTEES

Institute Management Committee Meeting

The 102nd Institute Management Committee Meeting was held at the institute on 25 February 2025.

Research Advisory Committee meeting

The XXXI Research Advisory Committee meeting of the Institute was held on 28 July 2025 at ICAR-SBI, Coimbatore under the Chairmanship of Prof. S.K. Sharma, Former Vice Chancellor, CSK Himachal Pradesh Agricultural University, Palampur. The following members of the committee participated in the meeting: Dr. B.L. Jalali, Dr. A.R. Sharma, Dr. R. Srinivasan, Dr. S.S. Singh, Dr. J. Singh, Dr. Prasanta Das, ADG (Commercial Crops), ICAR (online), Dr. P. Govindaraj, Director ICAR-SBI, Dr. Dinesh Singh, Director, ICAR-ISRI, Lucknow. Dr. A. Ramesh Sundar, Member Secretary, all Heads of Divisions, Sections, Regional Stations and all the scientists of SBI participated in the RAC meeting.

Recommendations

1. The second phase of CRP on Agro-biodiversity being coordinated by NBPGR, New Delhi is to start during 2026 and sugarcane should be included in the programme.
2. Precise phenotyping of germplasm for traits of interest such as red rot, waterlogging, drought, biotic and abiotic stress tolerance, multiple ratooning potential etc. should be a priority under the regular programme of the institute and the digital database is to be prepared and continuously updated for the use of breeders.
3. High throughput genotyping of the most promising clones is required to be undertaken systematically. The combination of phenotyping and genotyping marker data of the clones will help in undertaking GWAS and GS studies to reveal their overall genetic merit,

which is pre-requisite to modern data-driven sugarcane improvement.

4. The phenotypic and genotypic data will help in identifying markers linked to the traits of interest, which are to be validated and used in the markers assisted selection and breeding sugarcane varieties for multi-ratooning potentiality, resistant to red rot and waterlogging.

5. The long-term trials of Natural Farming and Conservation Agriculture should encompass all the related aspects of productivity, profitability, soil health, microbiome and climate change mitigation.

6. Effective collaboration of the scientists from Crop Production Division (Plant Physiology and Biochemistry) and Crop Improvement is required so that the superior lines / plant ideotypes identified with higher photosynthetic efficiency, tolerance to drought, waterlogging, salinity, and other abiotic stresses are utilized in the breeding programme.

7. Drones, Artificial Intelligence, Sensor and Nano-based technologies, Machine learning etc. are to be utilized in an appropriate manner to enhance sugarcane productivity.

8. Tractor-operated sugarcane sett planter and settling transplanter showing improved efficiency and resource-saving are to be validated through on-farm trials.

9. Survey and surveillance of emerging pests and pathogens of sugarcane and their management by integrating botanicals/bio-pesticides/new generation pesticides.

10. Screening of advance lines/interspecific hybrids/germplasm lines against major pest and pathogens of sugarcane using artificial epiphytotic conditions/hot spots/molecular techniques to identify new and reliable donors.

11. Biological control should be made as a field reality and the results are to be demonstrated at the stakeholders' level for better conviction.

12. A long-term ecological research programme to be initiated to establish correlation among soil health, microbiome and soil organic matter content.

13. Impact assessment of diffusion of the ICAR-SBI technologies as well as the related constraints analysis should be carried out.

14. Field level demonstrations by each scientists involving other concerned scientists should focus on Institute developed varieties and technologies with large up-scaling potential.

RAC meeting in progress

Institute Research Committee Meeting

Institute Research Committee Meeting was held at the Institute during 22-26 September 2025 to discuss the progress of the research projects. Eleven new research projects were approved for the ensuing year.

15 PARTICIPATION IN CONFERENCES, MEETINGS, WORKSHOPS, SYMPOSIA AND SEMINARS

Title	Date	Participant(s)
Annual General Body Meeting of Indian Society for Spices held at ICAR-IISR, Kozhikode	8 January 2025	Dr. M. Alagupalamuthirsolai
International Conference on 'Advanced innovations and technological frontiers in agricultural sciences 2025' at RVS college, Coimbatore organized by Western Ghat Researcher Association of Agricultural Sciences and Technology	9-10 January 2025	Dr. P. Geetha
Plant and Animal Genome Conference, San Diego, California, USA	10-15 January 2025	Dr. R. Valarmathi
Zonal Breeders and Plant Protection scientists meet -2025 of AICRP on Sugarcane at ICAR- SBI, Regional Centre, Kannur	17 January 2025	Drs. A. Ramesh Sundar, M.L. Chhabra, M.R. Meena
National conference on 'Emerging issues and sustainable strategies in plant health management: A global perspective' organized by Indian Phytopathological Society at Nagpur	19-21 January 2025	Dr. A. Ramesh Sundar
Cotton Germplasm Field day held at ICAR-CICR Regional Station, Coimbatore	24 January 2025	Dr. P. Govindaraj
National Conference on 'Innovations in Biology and Biotechnology for their application in agriculture and animal sciences for food security' at AC & RI, Pudukkottai, TNAU	28-29 January 2025	Dr. C. Appunu
International conference on 'Global research initiative for agriculture science and technology' (online) organized by IGKV, Raipur and NADCL	20-22 January 2025	Dr. Shweta Kumari
Board of Studies Meeting, IARI-Mega University Karnal Hub at ICAR-IIWBR, Karnal	24 January 2025	Dr. M.L. Chhabra
Online Brainstorming session on '360 degree approach to exploring new horizons in Agricultural Extension Education' organized by IART, NMV University, Virudhunagar	27 January 2025	Dr. D. PuthiraPrathap
Annual DUS review meeting at Authority Bhawan, New Delhi	30-31 January 2025	Dr. M.R. Meena
Webinar on 'Sugarcane based Agri-Startup ecosystem' organised by Sugarcane Edge®, Agribusiness Incubation Centre, ICAR-SBI, Coimbatore	03 February 2025	Dr. V. Krishnapriya

Title	Date	Participant(s)
National Seminar on 'Computational mining integrative omics for biomedical research' at Bharathiar university, Coimbatore	14 February 2025	Dr. Shweta Kumari
28[th] meeting of ICAR Regional Committee No. 05 at NASC Complex, New Delhi	18 February 2025	Dr. M.L. Chhabra
International Phytoplasmologists working group workshop at ICAR-IISR, Lucknow	23-28 February 2025	Drs. P. Malathi, K. Nithya, R. Manimekalai
2[nd] International conference on 'Biological control: Biocontrol contributions to one health' held at ICAR-NBAIR, Bengaluru, organized by Society for Biocontrol Advancement	25-28 February 2025	Drs. C. Sankaranarayanan, B. Singaravelu, P. Mahesh
Webinar on 'Investing in Innovations' followed by 'Gene bank for crops germplasm' organized by Department of Science & Technology at ICAR-SBI, Coimbatore	5 March 2025	All scientists
Webinar on 'SmartCane: AI and satellite tech for high-yield sugarcane farming' organized by ISMA at ICAR-SBI, Coimbatore	6 March 2025	All scientists
National symposium on 'Emerging innovations in Biochemistry and Biotechnology for holistic development of agriculture' held at SKAUST, Jammu	6-7 March 2025	Dr. C. Appunu
1[st] International Farming Systems Conference organized by FSRDA- Farming Systems Research and Development Association at Meerut	7-9 March 2025	Dr. P. Geetha
18[th] Scientific Advisory Committee of Krishi Vigyan Kendra, Panniyur, Kannur	13 March 2025	Dr. M. Nisha
The Plant and Animal Genome Conference (PAG Asia 2025) at New Delhi	18-20 March 2025	Dr. K. Lakshmi
44[th] Scientific Advisory Committee meeting of KVK, Coimbatore	19 March 2025	Dr. T. Rajula Shanthy
Networking and knowledge sharing session in the Innovators Meet organized by ICAR- NIRCA	8 April 2025	Dr. P. Malathi
Institutional Biosafety Committee (IBSC) meeting at ICAR-IISR, Calicut	5 May 2025	Dr. A. Ramesh Sundar
CTC-FONTAGRO Executive Seminars on Strategic dialogues for the future: Shaping the agricultural science agenda in Latin America, the Caribbean and the United States, University of Florida, Gainesville, Florida	3-15 May 2025	Dr. R. Manimekalai
13[th] Sugarcane Workshop organized by Ganna Master Agro Industries	11 May 2025	Dr. S. Anusha

Title	Date	Participant(s)
Inaugural of 'Viksit Krishi Sankalp Abhiyan' at Kallipatti village, Erode	29 May 2025	Dr. P. Govindaraj
VKSA program organized at Meerut in a sugarcane dominated area	01 June 2025	Drs. M.L. Chhabra, Ravinder Kumar
Webinar on 'Combating plastic pollution for healthy environment' organized by Academy of Natural Resource Conservation and Management, Lucknow	05 June 2025	Dr. V. Kasthuri Thilagam
Stakeholder Brainstorming Session on 'Sustainability and enhancement of sugarcane productivity in India', organized by the Department of Food and Public Distribution, Ministry of Consumer Affairs, Food and Public Distribution, GOI, New Delhi	12 June 2025	Drs. P. Govindaraj, M.L. Chhabra, Ravinder Kumar
National workshop on 'Techniques in focus: Enhancing cytological skills' organized by University of Calicut	12-13 June 2025	Dr. V.P. Sobhakumari
32nd NAAS Annual General Body Meeting (online)	15 June 2025	Dr. A. Ramesh Sundar
81st review meeting of TOLIC at ICAR-NDRI, Karnal	30 June 2025	Dr. M.L. Chhabra, Pramod Kumar
Technical session on 'Integration of artificial intelligence in sugarcane farming' organized by National Federation of Cooperative Sugar Factories Ltd, New Delhi	02 July 2025	Dr. P. Govindaraj
Board of Studies meeting of the IARI-Mega University Karnal Hub at ICAR-IIWBR, Karnal	14 July 2025	Dr. M.L. Chhabra
National Webinar on 'Best management practices to prevent red rot of sugarcane in North India' organized by ICAR–IISR, Lucknow and the Society for Sugarcane Research and Promotion, New Delhi	18 July 2025	Dr. M.L. Chhabra
Brainstorming session on 'Researchable issues in Agricultural Extension' at TNAU, Coimbatore	24 July 2025	Dr. D. Puthira Prathap
83rd Sugar Technologists' Association of India (STAI) Annual Convention at New Delhi	24 -26 July 2025	Dr. R. Gomathi
National seminar on 'Advanced technologies of sugarcane production in relation to climate resilience' at VSI, Pune	30-31 July 2025	Dr. C. Appunu
Workshop on 'Transforming food, land and water systems to combat climate crisis for Tamil Nadu state at ICAR-IISWC, Udagamandalam	12 August 2025	Drs. V. Kasthuri Thilagam, S. Sheelamary, Ms. Adhini S. Pazhany

Title	Date	Participant(s)
Meeting for screening of awards applications to recognize the best AICRP Centre under AICRP (Wheat & Barley) at ICAR- IIWBR, Karnal	13 August 2025	Dr. M.L. Chhabra
Zoom meeting on 'Future-proofing sugarcane: Global breakthroughs in breeding for enhanced performance' organized by ISMA	19 August 2025	Dr. P. Govindaraj
32nd Foundation Day and Kisan Mela of ICAR-National Research Centre for Banana, Trichy	21 August 2025	Dr. P. Govindaraj
ANRF Project Advisory Committee meeting (under ARG Plant Science) at KIIT University, Bhubaneswar	1-2 September 2025	Dr. A. Ramesh Sundar
94th CVRC meeting held at New Delhi	08 September 2025	Dr. P. Govindaraj
Presentation on 'Future-proofing sugarcane: Global breakthrough in breeding for enhanced Performance' at India Sugar and Bioenergy Conference organized by ISMA, New Delhi	11-12 September 2025	Dr. P. Govindaraj
Nodal Officer's meet of VKSA Rabi campaign at NASC, New Delhi	15-16 September 2025	Dr. P. Govindaraj
Steering Committee meeting of Directorate of Open and Distance Learning, TNAU Coimbatore	16 September 2025	Dr. T. Rajula Shanthy
54th Annual Convention organized by SISSTA at Tirupati	19-20 September 2025	Drs. R.M. Shanthi, R. Gomathi, S. Alarmelu, P. Malathi, A. Suganya, S. Sheelamary
Workshop on 'Creation of agricultural advisories using 'Kisan Sarathi Kosh' at ICAR-IARI, New Delhi	23 September 2025	Dr. T. Rajula Shanthy
AICRP- QRT meeting held at CMFRI, Kochi	23 September 2025	Dr. V. Jayakumar
Meeting on National Consultation on Sustainable Sugarcane Economy jointly organized by Rural Voice, NFCSF, and ICAR at NASC Complex, New Delhi	30 September 2025	Drs. P. Govindaraj, Ravinder Kumar, M.R. Meena
10th International Conference on Global research initiatives for sustainable agriculture & allied sciences at MPUAT, Udaipur	05-07 October 2025	Dr. S. Sheelamary
43rd IMC meeting at ICAR - Central Citrus Research Institute, Nagpur, Maharashtra	6 October 2025	Dr. R. Manimekalai
Global Startup Summit 2025 at CODISSIA Trade Fair Complex, Coimbatore	9-10 October 2025	Dr. P. Murali
Visit to Amaravathi Co-operative Sugar Mills as a nominated member of the Expert Committee under Dept. of Sugar, Tamil Nadu	10 October 2025	Dr. C. Palaniswami

Title	Date	Participant(s)
National Symposium on 'Innovative approaches for integrated pest management' organised by SRM College of Agricultural Sciences at Madhuranthagam, Chengalpattu	10 October 2025	Dr. T. Ramasubramanian
Seminar on 'Sugarcane farming in the context of a changing climate, cost savings in production, and achieving sustainable sugarcane production' at Kohlapur	11 October 2025	Drs. K. Kannan, H.K. Mahadeva Swamy
Annual review meeting of the ICAR-SBI-ISMA collaborative project on varietal evaluation at DCM Shriram Ltd., Ajbapur, Uttar Pradesh	13-14 October 2025	Drs. P. Govindaraj, K. Mohanraj, Ravinder Kumar
Haryana Cane Control Board meeting at Chandigarh	18 October 2025	Drs. M.L. Chhabra, Ravinder Kumar
3rd International Online Conference on Agriculture, organized by MDPI	22-24 October 2025	Drs. A. Vennila, V. Kasthuri Thilagam
International Salinity Conference 3.0 on 'Worldwide efforts on cutting-edge approaches for restoring saline ecosystems' at ICAR-CCARI, Goa	29 October 01 November 2025	Dr. Pooja
Stakeholders meeting on price policy for sugarcane crop for the 2026-27 sugar season at New Delhi	30 October 2025	Dr. P. Murali
National seminar on 'Advance in climate-conscious crop science' at UAS, Bangalore	31 October-02 November 2025	Dr. M.R. Meena
ANRF Project Advisory Committee meeting (under ARG Plant Science) at IISER Pune	6-7 November 2025	Dr. A. Ramesh Sundar
12th International Conference on Agriculture and Veterinary jointly organized by College of Agriculture, Goa & UAS, Dharwad	16-18 November 2025	Dr. V.G. Dhanya
International Genomics and crops abiotic stress tolerance symposium at Texas Tech University, Lubbock, Texas	20-21 November 2025	Dr. C. Appunu
Second International Extension Education Congress on 'Rethinking social ecology in a digital landscape' at Institute of Agricultural Sciences, Bhubaneshwar	24-26 November 2025	Dr. T. Rajula Shanthy
6th International Agronomy Congress on 'Re-envisioning Agronomy for smart agri-food systems and environmental stewardship'	24-26 November 2025	Drs. P. Geetha, S. Anusha
Group Meeting of AICRP on Sugarcane at Assam Agricultural University, Jorhat, Assam	27-28 November 2025	Drs. P. Govindaraj, A. Ramesh Sundar, K. Kannan, R.M. Shanthi, S. Alarmelu, A. Anna Durai, R. Gopi, P. Mahesh,

Title	Date	Participant(s)
		K. Elayaraja, B. Singaravelu, M.L. Chhabra, M.R. Meena, Ravinder Kumar
International Conference on 'Sustainable technologies for energy and environment' at PSG Institute of Advanced Studies, Coimbatore	27-29 November 2025	Dr. V. Kasthuri Thilagam
AGM-AICRP on IFS at RARI, Jaipur, Rajasthan	28-29 November 2025	Dr. P. Geetha
National Conference on 'Sustainable and resilient Agriculture: Innovations, strategies and policy frameworks' at Vanavayaran Institute of Agriculture, Pollachi	05-06 December 2025	Dr. R. Gomathi
33rd National Conference on 'Land and water management for ecological restoration and agricultural sustainability' organized by the Soil Conservation Society of India at PAU, Ludhiana	08-09 December 2025	Dr. V. Kasthuri Thilagam
International conference on Crops - climate resilience optimization for productivity and sustainability at Mohan Babu University, Tirupati	9-11 December 2025	Dr. S. Sheelamary
2nd International workshop-cum-Webinar on 'Advances in CRISPR Cas genome editing in plants' organized by Glostem Private Limited, Chandigarh	10-12 December 2025	Drs. R. Ramesh, A. Jeevalatha
6th International Conference on 'Translational genomics and physiology for sustainable agriculture' at TNAU, Coimbatore	15-18 December 2025	Drs. R. Gomathi, V. Krishnapriya, R. Arunkumar, R. Manimekalai, P.T. Prathima, R.T. Maruthi, K. Elayaraja, M. Alagupalamuthirsolai, R. Valarmathi, S. Sheela Mary, T. Lakshmipathy, H.K. Mahadeva Swamy
Regional Agricultural Exhibition and Seminar organized by the Department of Agriculture & Farmers Welfare at Tiruvannamalai	27-28 December 2025	Dr. P. Murali
International Conference on 'Sustainable innovations in agriculture, veterinary and allied sciences' organized by UAS Raichur, Baramulla	29-31 December 2025	Dr. Swetha Kumari

16 DISTINGUISHED VISITORS

- Dr. M.L. Jat, Secretary, DARE and Director General, ICAR visited the Institute on 11 July 2025. He paid visits to tissue culture lab, *ex situ Saccharum spontaneum* collection, National sugarcane flower induction facility, agronomy fields, integrated farming system unit, Dr.K.V. Srinivasan sugarcane disease screening facility and sett treatment device unit.

Dr. M.L. Jat, Secretary, DARE and Director General, ICAR visiting germplasm collections

DG visiting National sugarcane flower induction facility

DG visiting Dr. K.V. Srinivasan sugarcane disease screening facility

- Dr. D.K. Yadava, DDG (CS), ICAR visited the Institute during 11-12 April 2025 to inaugurate several newly created infrastructural facilities.

- Dr. Prasanta Dash, ADG (CC), ICAR visited the institute during 24-25 January 2025 for MTA signing between ICAR-SBI and ICAR-CICR. He also addressed the participants of the Hands on training program on 'Advanced tools of molecular biology and biotechnology' and distributed certificates.

- Board of Directors from The Malegaon Sahakari Sakhar Karkhana', Baramati, Maharashtra on 20 August 2025.

- Mr. Prakash Naiknavare, Managing Director and Dr. R.B. Doule, Chief Cane Advisor, National Federation of Cooperative Sugar Factories Ltd., for the discussion on the identification of location-specific climate-resilient sugarcane varieties for the progress and prosperity of the Indian sugar industry on 11 March 2025.

- Shri B. Kartikey Dhanji, I.A.S., Secretary, Sugarcane Industries Dept, Govt. of Bihar on 07 July 2025.
- A team of executive members from South Indian Sugar Mills Association, Tamil Nadu (SISMA-TN) for a technical discussion on a project proposal entitled 'Artificial Intelligence based precision farming platform for sustainable sugarcane production' with the scientists on 14 October 2025.
- A team of delegates from Agricultural Development Trust, Baramati, Maharashtra to gain insights into the ongoing varietal development and advanced research activities during 17-18 December 2025.

Dr. Prasanta Dash, ADG (CC), ICAR
(24-25 January 2025)

Officials from NFCSF, New Delhi
(11 March 2025)

Shri B. Kartikey Dhanji, I.A.S., Secretary, Govt. of Bihar
(7 July 2025)

Board of Directors from The Malegaon SSK
(20 August 2025)

17 PERSONNEL

Name	Designation & Discipline	Email ID
P. Govindaraj	Director	P.govindaraj@icar.org.in
Division of Crop Improvement		
R.M. Shanthi	Pr. Scientist (Plant Breeding) & Head	rm.shanthi@icar.org.in
A.J. Prabakaran	Pr. Scientist (Plant Breeding)	Prabakaran.aj@icar.org.in
D. Neelamathi	Pr. Scientist (Seed Technology)	D.Neelamathi@icar.org.in
S. Alarmelu	Pr. Scientist (Plant Breeding)	S.Alarmelu@icar.org.in
A. Selvi	Pr. Scientist (Biotechnology)	A.Selvi@icar.org.in
V.P. Sobhakumari	Pr. Scientist (Gen.&Cyto)	Vp.sobhakumari@icar.org.in
A. Suganya	Pr. Scientist (Economic Botany)	A.Suganya@icar.org.in
S. Karthigeyan	Pr. Scientist (Plant Breeding)	Karthikeyan.s@icar.org.in
A. Anna Durai	Pr. Scientist (Plant Breeding)	A.Annadurai@icar.org.in
R. Manimekalai	Pr. Scientist (Biotechnology)	R.Manimekalai@icar.org.in
R. Karuppaiyan	Pr. Scientist (Plant Breeding)	Karuppaiyan.r@icar.org.in
C. Jayabose	Pr. Scientist(Genetics)	C.jayabose@icar.org.in
K. Mohanraj	Pr. Scientist (Plant Breeding)	k.mohanraj@icar.org.in
K. Devakumar	Sr. Scientist (Plant Biotechnology)	Devakumar.k@icar.org.in
C. Appunu	Pr. Scientist (Plant Breeding)	c.appunu@icar.org.in
K. Lakshmi	Pr. Scientist (Biotechnology)	k.lakshmi@icar.org.in
K. Thamilarasi	Pr. Scientist (Biotechnology)	Thamilarasi.k@icar.org.in
P.T. Prathima	Pr. Scientist (Biotechnology)	Prathima.pt@icar.org.in
Adhini S. Pazhany	Scientist	Adhini.sp@icar.org.in
K. Elayaraja	Sr. Scientist (Plant Breeding)	Elayaraja.k@icar.org.in
S. Sheelamary	Sr. Scientist (Plant Breeding)	Sheela.mary@icar.org.in
K.T. Ravi Kiran	Scientist(Plant Breeding)	ravi.kt@icar.org.in
R. Valarmathi	Scientist (Eco. Bot. and PGR)V	alarmathi.r@icar.org.in
H.K. Mahadeva swamy	Scientist (Plant Breeding)	Mahadevaswamy.hk@icar.org.in
T. Lakshmi Pathy	Scientist (Plant Breeding)	Lakshmipathy.t@icar.org.in
Kona Praveen	Scientist (Plant Breeding)	Kona.praveen@icar.org.in
R. Gobu	Scientist (Genetics & Plant Breeding)	Gobu.r@icar.org.in
Shweta Kumari	Scientist (Bioinformatics)	Shweta.kumari@icar.org.in

Name	Designation & Discipline	Email ID
Amaresh	Senior Technical Officer	Amaresh@icar.org.in
L. Elango	Technical Officer	L.Elango@icar.org.in
R. Raja	Technical Officer	r.raja@icar.org.in
V. Raffee Viola	Technical Officer	Raffee.viola@icar.org.in
K. Selvamuthu	Technical Officer	Selvamuthu.k@icar.org.in
M. Pradheep Kumar	Senior Technical Assistant	Pradheep.Kumar@icar.org.in
K. Dhanapal	Senior Technical Assistant	K.Dhanapal@icar.org.in
K. Raja	Technical Assistant	Raja.k@icar.org.in
K. Kannaian	Senior Technician	M.Kannaian@icar.org.in
S. Mutharasu	Senior Technician	Mutharasu.s@icar.org.in
K. Muraleekrishnan	Senior Technician	k.muraleekrishnan@icar.org.in
I. Saravanakumar	Technician	Saravanakumar.I@icar.org.in
Suman Saurabh	Technician	Suman.saurabh1@icar.org.in
Satyendra Kumar	Technician	Satyendra.kumar3@icar.org.in
R. Gopalakrishnan	Technician	Gopalakrishnan.r@icar.org.in
P. Bhuvanamuzhuthudaiyal	Principal Private Secretary	p.bhuvana@icar.org.in
N. Murugesan	Skilled Support Staff	Murugesan.N@icar.org.in
R. Thimmappan	Skilled Support Staff	Thimmappan.r@icar.org.in
M. Mallika	Skilled Support Staff	Mallika.M@icar.org.in
R. Velumani	Skilled Support Staff	r.velumani@icar.org.in
S. Manickaraj	Skilled Support Staff	s.manickaraj@icar.org.in
G. Suresh	Skilled Support Staff	g.suresh@icar.org.in
Division of Crop Production		
K. Kannan	Pr. Scientist (Agronomy) & Head	Kannan.k@icar.org.in
C. Palaniswami	Pr. Scientist (SCFM) & PME i/c	Palaniswami.c@icar.org.in
K. Hari	Pr. Scientist (Microbiology)	K.Hari@icar.org.in
R. Gomathi	Pr. Scientist (Plant Physiology)	R.Gomathi@icar.org.in
A. Vennila	Pr. Scientist (Soil Science)	Vennila.A@icar.org.in
T. Arumuganathan	Pr. Scientist (Farm Machinery & Power)	T.Arumuganathan@icar.org.in
R. Arun Kumar	Pr. Scientist (Plant Physiology)	R.Arun@icar.org.in
G.S Suresha	Pr. Scientist (Biochemistry)	GS.Suresha@icar.org.in
V. Kasthuri Thilagam	Sr. Scientist (Soil Science)	Kasthuri.V@icar.org.in
P. Geetha	Sr. Scientist (Agronomy)	Geetha.P@icar.org.in

Name	Designation & Discipline	Email ID
M. Alagupalamuthirsolai	Sr. Scientist (Plant Physiology)	Alagu.M@icar.org.in
S. Anusha	Scientist (Agronomy)	Anusha.s@icar.org.in
V. Krishnapriya	Scientist (Plant Physiology)	k.vengavasi@icar.org.in
S. Mathesh	Technical Officer	s.mathesh@icar.org.in
P. Harunipriya	Senior Technical Assistant	Harunipriya.P@icar.org.in
G. Aswathy	Senior Technical Assistant	G.Aswathy@icar.org.in
U. Dinesh	Technical Assistant	U.Dinesh@icar.org.in
T. Kavitha	Senior Technician	Kavitha.T@icar.org.in
Pramod Sharma	Technical Trainee	Pramod.sharma1@icar.org.in
P. Kannan	Skilled Support Staff	P.kannan@icar.org.in
Eswari	Skilled Support Staff	eswari@icar.org.in
K. Saraswathi	Skilled Support Staff	k.saraswathi@icar.org.in
Division of Crop Protection		
A. Ramesh Sundar	Pr. Scientist (Plant Pathology) & Head	A.Rameshsundar@icar.org.in
N. Geetha	Pr. Scientist (Agrl. Entomology)	Geetha.N@icar.org.in
C. Sankaranarayanan	Pr. Scientist (Nematology)	Sankaranarayanan.C@icar.org.in
B. Singaravelu	Pr. Scientist (Agrl. Entomology)	Singaravelu.B@icar.org.in
P. Malathi	Pr. Scientist (Plant Pathology)	Malathi.p@icar.org.in
R. Selvakumar	Pr. Scientist (Plant Pathology)	R.Selvakumar@icar.org.in
R. Ramesh	Pr. Scientist (Plant Pathology)	r.ramesh@icar.org.in
V. Jayakumar	Pr. Scientist (Plant Pathology)	v.jayakumar@icar.org.in
T. Ramasubramanian	Pr. Scientist (Agrl. Entomology)	T.Ramasubramanian@icar.org.in
R. Gopi	Sr. Scientist (Plant Pathology)	r.gopi@icar.org.in
A. Jeevalatha	Sr. Scientist (Plant Pathology)	a.jeevalatha@icar.org.in
M. Punithavalli	Sr. Scientist (Agrl. Entomology)	M.Punithavalli@icar.org.in
P. Mahesh	Sr. Scientist (Agrl. Entomology)	P.Mahesh@icar.org.in
R. Maruthadurai	Sr. Scientist (Agrl. Entomology)	Maruthadurai.r@icar.org.in
K. Nithya	Sr. Scientist (Plant Pathology)	Nithya.K@icar.org.in
S. Aravindan	Scientist(Plant Pathology)	aravindan.s@icar.org.in
K. Kaverinathan	Technical Officer	Kaverinathan.K@icar.org.in
C. Yogambal	Senior Technical Assistant	Yogambal.c@icar.org.in
M. Rajesh Kumar	Technical Assistant	M.Rajeshkumar@icar.org.in
R. Nithiyanantham	Technical Assistant	R.Nithiyanandham@icar.org.in
S. Ananthakumar	Technician	Ananthakumar.s@icar.org.in

Name	Designation & Discipline	Email ID
C. Shanmugaraj	Skilled Support Staff	Shanmugaraj.c@icar.org.in
V.R. Nagarajan	Skilled Support Staff	Vr.nagarajan@icar.org.in
Statistics and Economics Section		
P. Murali	Pr. Scientist (Agrl. Economics) & Officer I/c	P.Murali@icar.org.in
Vinayaka	Scientist (Agrl. Statistics)	Vinayaka@icar.org.in
AKMU		
S. Karuppasamy	Technical Officer	S.Karuppasamy@icar.org.in
M. Shobhanbabu	Skilled Support Staff	Shobhanbabu.M@icar.org.in
Extension Section		
T. Rajula Shanthy	Pr. Scientist (Agrl. Extension)	Rajula.shanthy@icar.org.in
D. Puthira Prathap	Pr. Scientist (Agrl. Extension) & Officer I/c	Dp.prathap@icar.org.in
Malakappa B. Medegar	Senior Technician	MB.Medegar@icar.org.in
R. Sekar	Skilled Support Staff	Sekar.R@licar.org.in
PME Cell		
R. Nirmala	Chief Technical Officer	R.Nirmala@icar.org.in
S. Kandasamy	Skilled Support Staff	Kandasamy@icar.org.in
Estate		
P. Sivaraj	Technical Officer	P.Sivaraj@icar.org.in
P. Amshaveni	Technical Officer (civil)	P.Amshaveni@icar.org.in
A. Shanmugavel	Skilled Support Staff	Shanmugavel.A@icar.org.in
K. Rajeevan	Skilled Support Staff	Rajeevan.K@icar.org.in
R. Aribabu	Skilled Support Staff	Aribabu.R@icar.org.in
K. Shanmugaraj	Skilled Support Staff	k.shanmugaraj@icar.org.in
C. Nagarajan	Skilled Support Staff	c.nagarajan@icar.org.in
A. Muthusamy	Skilled Support Staff	a.muthusamy@icar.org.in
Farm		
J. Emily Florence Daisy Rani	Assistant Administrative Officer	Emily.Daniel@icar.org.in
K. Manivannan	Technical Officer	k.manivannan@icar.org.in
M. Gnanavel	Technical Officer	m.gnanavel@icar.org.in
S. Jothimani	Senior Technician	Jothimani.s@icar.org.in
Abhishek Kumar	Technician	Abhishek.kumar22@icar.org.in
M. Chandran	Skilled Support Staff	Chandran.M@icar.org.in

Name	Designation & Discipline	Email ID
M. Nagamani	Skilled Support Staff	Nagamani.M@icar.org.in
R. Palaniammal	Skilled Support Staff	Palaniammal.r@icar.org.in
A. Karuppusamy	Skilled Support Staff	a.karuppusamy@icar.org.in
K. Rangasamy	Skilled Support Staff	k.rangasamy@icar.org.in
M. Natarajan	Skilled Support Staff	m.natarajan@icar.org.in
Library		
S. Manoharan	Chief Technical Officer	S.manoharan@icar.org.in
R. Monikandan	Technician	Monikandan.r@icar.org.in
Hindi Cell		
S. Maheshwari	Assistant Chief Technical Officer	S.Maheshwari@icar.org.in
Administrative Staff		
V. Ashakumari	Administrative Officer	Ashakumari.v1@icar.org.in
Establishment		
B.V. Santhosh	Assistant Administrative Officer	BV.Santhosh@icar.org.in
V. Sridhar	Assistant	Sridhar.v1@icar.org.in
M. Jainub	Upper Division Clerk	Jainub.m@icar.org.in
A. Sathasivam	Upper Division Clerk	Sathasivam.a@icar.org.in
A. Sindhu	Lower Division Clerk	Sindhu.A@icar.org.in
M. Manickam	Skilled Support Staff	Manickam.M@icar.org.in
R. Chandran	Skilled Support Staff	r.chandran@icar.org.in
Cash & Bills		
Sushma Preetha P	Assistant	Sushma.preetha@icar.org.in
N. Priyadharshini	Upper Division Clerk	N.Priyadharshini@icar.org.in
Stores		
P. Sivakumar	Assistant Administrative Officer	Sivakumar.p@icar.org.inVasudev
V. Galagali	Assistant	Vasudev.Galagali@icar.org.in
N. Deepa	Assistant	Deepa.n@icar.org.in
K. Maruthi	Upper Division Clerk	K.Maruthi@icar.org.in
S.K. Anumalaviga	Upper Division Clerk	Anumalaviga.SK@icar.org.in
C. Vasanthamani	Skilled Support Staff	C.vasanthamani@icar.org.in
Audit & Accounts		
S.B. Baburaj	Senior Finance & Accounts OfficerS	B.Baburaj@icar.org.in
Kratika Sharma	Assistant Finance & Accounts Officer	Kratika.Sharma@icar.org.in
K.S. Tharani	Assistant	Tharani.ks@icar.org.in

Name	Designation & Discipline	Email ID
S.T. Subramanyan	Upper Division Clerk	St.subramanyan@icar.org.in
R. Mahalakshmi	Lower Division Clerk	Mahalakshmi@icar.org.in
T. Rajan	Skilled Support Staff	t.rajan@icar.org.in
Director's Personal Cell		
P. Chinnaswamy	Skilled Support Staff	Chinnaswamy.p@icar.org.in
ICAR-SBI, Regional Centre, Karnal		
M.L. Chhabra	Pr. Scientist(Plant Pathology) & Officer I/c	ml.chhabra@icar.org.in
Ravinder Kumar	Pr. Scientist (Plant Breeding)	Ravinder.kumar6@icar.org.in
Mintu Ram Meena	Pr. Scientist (Plant Breeding)	Mr.meena@icar.org.in
Pooja	Senior Scientist (Plant Physiology)	pooja@icar.org.in
K. Rajasekar	Scientist (Soil Science)	Rajasekar.k@icar.org.in
Pramodkumar	Assistant Chief Technical Officer	Pramod.kumar7@icar.org.in
Vijay Kumar	Technical Officer	Vijay.kumar@icar.org.in
Rajesh Kumar	Senior Technical Assistant	Rajesh.Kumar11@icar.org.in
Rameshchand	Senior Technician	Ramesh.Chand21@icar.org.in
Sharique Buhuzaifa	Technical Trainee	Sharique.buhuzaifa@icar.org.in
ICAR-SBI, Research Centre, Kannur		
M. Nisha	Sr. Scientist (Plant Breeding) & Officer I/c	Nisha.M@icar.org.in
V.G. Dhanya	Scientist (Seed Technology)	Dhanya.vg@icar.org.in
Nici Ashok	Technical Officer	Nici.ashok@icar.org.in
Dharmendra Kumar	Technical Trainee	Dharmendra.kumar4@icar.org.in
P. Seema	Skilled Support Staff	Seema.p@icar.org.in
ICAR-SBI, Research Centre, Agali		
R.T. Maruthi	Sr. Scientist (Plant Breeding) & Officer I/c	Maruthi.rt@icar.org.in
K. Praveen Kumar	Senior Technician	K.Praveenkumar@icar.org.in

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ICAR - SBI
Regional Centre, Karnal

ICAR - SBI
Research Centre, Kannur

ICAR - SBI
Research Centre, Agali