

# ICAR-SBI TECHNOLOGIES FOR COMMERCIALIZATION



ICAR Sugarcane Breeding Institute  
Coimbatore 641007  
Tamil Nadu, India



2025

# **ICAR-SBI TECHNOLOGIES FOR COMMERCIALIZATION**

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**ICAR Sugarcane Breeding Institute  
Coimbatore 641007,  
Tamil Nadu, India**

**2025**



**Citation: Hari K., Kalaiselvi K., Praveen Kona, Krishnapriya V.,  
Govindaraj P. 2025. ICAR-SBI technologies for  
commercialization. ICAR-Sugarcane Breeding Institute,  
Coimbatore, India pp - 76. ISBN no. : 9789385267444**

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**ISBN : 9789385267444**



Published by

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## Co 86032 (Nayana)

**K.V. Bhagyalakshmi, K.M. Naidu, T.V. Sreenivasan, B.K. Sahi,  
R. Nagarajan, Bakshi Ram and G. Hemaprabha**

### DETAILS OF THE TECHNOLOGY

Since the release of Co 6304 (hailed as a second wonder variety for tropics) in 1970 and Co 740 (suitable for Maharashtra) in 1949, there was stagnation in sugar recovery and sugarcane yield under varied agroclimatic conditions of Peninsular zone. Crossing of two high sucrose varieties as parents Co 62198 and CoC 671 and subsequent selection yielded Co 86032.



### CHARACTERISTICS OF CO 86032

High yield with high quality retaining up to 14-15 months after planting; good responds to normal cultural practices and to high fertilizer doses to yield proportionately higher yield; a good ratooner where there are farmers taking more than 18 ratoons with Co 86032; suitable under different field spacing, including normal (90 cm) and wide (120 to 150 cm) rows; field tolerant to red rot and is staying resistant to red rot even after 30 years of field cultivation; moderately resistant to smut and wilt diseases; moderately tolerant to drought and salinity; non-flowering variety at many places/ shy flowering with late flowering nature under Coimbatore conditions; a near perfect variety suited to all agroclimatic conditions of Peninsular zone of India.

### VARIETAL PERFORMANCE OVER YEARS

Co 86032 was identified for the tropics during 1994 and started spreading during 1996. Thereafter the recovery improved to 9.92% during 2004, with the establishment of Co 86032 as the predominant variety in the state. Analysis of sugarcane productivity indicated that the yield level was maintained at about 105 t/ha throughout the period



## *Sugarcane Varieties*

from 2000-01 to 2013-14 in Tamil Nadu. The ratoon yield is as equivalent with plant crop yield. The variety has recorded highest yield (324 t/ha). Higher yield (more than 200 t/ha) was reported by the many sugar mills in the state during the year 2009-2012. Cultivated about 0.85 million ha in the tropical zone of India. Sugar recovery was improved by 1 unit in Tamil Nadu sugar mills. The profit of farmers increased by about Rs. 33,000/ha (at 2018 prices). It helped sugar mills to operate in their full capacity and provided regular employment to people engaged in cane production and processing. The economic impact of this variety is in the range of over Rs. 20,354.6 crore by 2015-16 in terms of net additional value since large scale adoption of the variety in the tropical India.

**IPR:** PPV&FRA Registration Number REG/2012/164

### **RECOMMENDED REGION**

Peninsular zone of India

### **OWNERSHIP**

The rights of the variety belong to ICAR-SBI, as per the PPVFRA, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc., engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies/institutes/sugar mills.



### Co 0238 (Karan-4)

**Bakshi Ram, N.V. Nair, G. Hemaprabha, B.K. Sahi, N. Singh,  
R. Viswanathan and M. Balamuralikrishnan**

#### DETAILS OF THE TECHNOLOGY

The average sugarcane productivity and sugar recovery hovered around 59.6-71.7 t/ha and 10.03-10.55 per cent, respectively in the country during 2001-02 to 2013-14, whereas cane productivity and sugar recovery in sub-tropical part of India (including Uttar Pradesh, Punjab, Haryana, Bihar and Uttarakhand) were lower than the national average. The release of the sugarcane variety Co 0238 (Karan 4) evolved from the cross CoLk 8102 x Co 775 and developed by ICAR-Sugarcane Breeding Institute, Regional Centre, Karnal for commercial cultivation in North West Zone (Punjab, Haryana, Rajasthan, Uttarakhand, Central and Western Uttar Pradesh) has brought substantial improvement and revolutionized sugarcane cultivation in the sub-tropical part of the country.



Co 0238 has high average cane yield of 81 t/ha against 68 t/ha of the zonal check variety CoJ 64. Its high yield potential has been demonstrated to be 329.6 t/ha reported in the farmer's field in 2017-18. This variety has 18 per cent sucrose in juice at 300 days crop age that steadily increases to more than 20 per cent during March-April as



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against 17.9 per cent sucrose in the check variety. On peak maturity Co 0238 has given average recovery of 12.0 per cent and as high as 14.01 per cent sugar recovery. The variety is moderately resistant to red rot and smut diseases. It is also tolerant to water deficit, water logging and saline conditions making it widely adaptable to all prevailing situations and suitable for all planting seasons viz. autumn, spring and summer of the sub-tropical region. Has good ratoonability and tolerance to low temperature further makes it durable for raising a second ratoon crop, a practice which was not in vogue in the zone mainly for want of suitable varieties with multiratooning potential. The thick canes to match the tallness of the crop have favoured Co 0238 for wider row planting. Co 0238 has perfectly fit into the sugarcane based cropping system of sub-tropical region.

**IPR:PPV&FRA Registration No. REG/2010/34**

### **RECOMMENDED REGION**

North West Zone of India (Punjab, Haryana, Rajasthan, Uttarakhand, Central and Western Uttar Pradesh)

### **OWNERSHIP**

The rights of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc., engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies/institutes/sugar mills.



## Co 0118 (Karan-2)

**Bakshi Ram, N.V. Nair, G. Hemaprabha, B.K. Sahi and N. Singh**

### DETAILS OF THE TECHNOLOGY

The sub-tropical region of India, was known for its low sugarcane production, productivity, and sugar recovery. The low sugarcane production is due to low productivity (50.53 t/ha in the sub-tropical States vs. 71.67



t/ha in tropical States) and low sugar output is due to low sugar recovery (8.8% vs. 9.9%) both of which could be attributed to extremes of weather prevailing in the region. Another reason for the low sugar recovery in subtropical India was the lack of early maturing varieties. Cane crushing in the subtropical states starts generally from October-November. The popular varieties of this region like CoS 767, CoSe 92423, CoS 8436, CoS 88230 etc. do not attain sucrose maturity until mid-season of crushing (Dec-Jan). The high sugared early maturing variety CoJ 64, released during 1976, has made significant contribution in terms of improvement in sugar recovery (8.53 to 10.14%) and sugar yield (4.58 to 5.17 t/ha) in Punjab. Seeing the success in Punjab, it was introduced in Haryana and subsequently it spread to western UP. But the glory of CoJ 64 has diminished gradually in the region owing to its susceptibility to red rot.

Therefore, to realize a better sugar recovery of around 11-12% a need for an early maturing variety comparable or better than CoJ 64 in yield and juice quality and combined with red rot resistant gene(s) was felt. The challenge in 1990 was to evolve a high sugared, high yielding and early maturing red rot resistant variety (as a substitute for CoJ 64) befit to the sub-tropical weather by breaking the negative linkage between high yield and high sugar.



## **Sugarcane Varieties**

Co 0118 is non-flowering early maturing variety for subtropical region. Co 0118 is a selection from the progeny of the cross Co 8347 x Co 86011. This variety was identified from seedling ratoon nursery raised at ICAR-SBI, Regional Centre, Karnal and was tested under the Pre-Zonal Varietals Trial. Co 0118 is a medium thick, green yellow canes with obconoidal internodes, rectangular buds, lanceolate auricle on both sides (generally long on one side), shallow bud groove and weak spines on leaf sheath with average cane yield of 78.2 t/ha and 9.88 t/ha CCS yield. The variety is free from splits, pith and bud cushion. The fibre % is about 12.78 %. The jaggery is of A1 quality with light yellow colour. This variety is moderately resistant (MR) to the prevalent races of red rot pathogen by plug method of inoculation.

**IPR: PPV&FRA Registration Number REG/2010/33**

### **RECOMMENDED REGION**

North West Zone of India (Punjab, Haryana, Rajasthan, Uttarakhand, Central and Western Uttar Pradesh)

### **OWNERSHIP**

The ownership of the variety is with ICAR-SBI, as per the PPVFRA, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc., engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies/institutes/sugar mills.



## Co 11015 (Atulya)

G. Hemaprabha, A. Anna Durai, M. N. Premachandran, C. Appunu, K. Mohanraj, R. M. Shanthi, S. Alarmelu, P. Govindaraj, R. Viswanathan, V. Sreenivasa, R. Karuppaiyan, S. Karthigeyan, C. Mahadevaiah, T. Lakshmi Pathy, H. K. Mahadevaswamy, A. J. Prabakaran, S. Sheelamary, Adhini S. Pazhani, K. Elayaraja and Bakshi Ram

### DETAILS OF THE TECHNOLOGY

Co 11015 is evolved from the cross CoC 671 and Co 86011 at ICAR-SBI, Coimbatore. The clone showed a remarkably good performance in clonal trials with clear superiority over standards Co 86032 and CoC 671. This variety was notified in 2020 and in a short span of time has covered over 9550 acres in Tamil Nadu. It is a high yielding, high-quality, short duration variety suitable for Tamil Nadu for normal and drought prone areas. It recorded 10.23% improvement in yield (142.72 t/ha) over check Co 86032 (129.48 t/ha) in trial conducted across Tamil Nadu. Improvement of 20.13% was recorded for sugar yield (20.16 t/ha) compared to Co 86032 (16.78 t/ha) in trials conducted across Tamil Nadu. It was resistant (nodal method) and moderately susceptible (plug method) and field tolerant to red rot strains prevalent in Tamil Nadu. This is a short duration maturing clone with >17% sucrose at 240 days thereby sugar recovery during early crushing



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season can be improved. Further, the juice quality improves upto 12 months, hence can be harvested from 8 to 12 months. This clone fits well in realizing three crops in two years, hence highly suitable to regions with water scarcity. This variety is suitable for special season harvest as it recorded an improvement of 8.98, 6.93 and 9.15% sucrose over Co 86032 at 240, 300 and 360 days respectively in July planted trials. Performs well in wide rows (>4 feet spacing). Co 11015 has the ideal plant characters of height (> 250 cm) with erect plant type, excellent field stand with medium thick canes. It is a good ratooner and registered 9.61, 18.57 and 8.62% increase in cane yield, sugar yield and sucrose, respectively over Co 86032. This clone responds well with single bud settling planting under wider row spacing and hence suitable for SSI technology. Co 11015 produces A1 quality jaggery of golden yellow colour. Cane tops serve as excellent fodder.

**IPR:** PPV&FRA Registration Number REG2020/194

### **RECOMMENDED REGION**

Peninsular Zone of India

### **OWNERSHIP**

Seed of Co 11015 was produced and sold to sugar mills and farmers from ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per PPVFRA, 2001 conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc. engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settlements, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.



**Co 09004 (Amritha)**

**P. Govindaraj, K.V. Bhagyalakshmi, S. Alarmelu, G. Hemaprabha, R. Nagarajan, K. G. Somarajan, R. M. Shanthi, K. Mohanraj, A. Annadurai, Ravindra Kumar, Bakshi Ram, R. Viswanathan, N. Prakasam, A. Ramesh Sundar, P. Padmanaban, Arjun Tayade, S. Vasantha, R. Gomathi, A. Bhaskaran, C. Palaniswami, A. Vennila**

**DETAILS OF THE TECHNOLOGY**

Co 09004 is a high yielding, high quality and early maturing sugarcane variety suitable for cultivation in Peninsular zone comprising parts of Tamil Nadu, Telangana, Karnataka, Maharashtra, Gujarat, Madhya Pradesh, Chhattisgarh and Kerala. The variety was selected from progenies of the cross CoC 671 x CoT 8201 and was identified as Co cane during the year 2009 from ICAR-SBI, Coimbatore. This variety recorded cane yield of 109.85 t/ha, sugar yield of 14.56 t/ha, Pol % cane of 14.50% and juice sucrose of 18.94% at 300 days across the zone. It showed 17.89% and 17.84% improvement over the best standard CoC 671 for sugar and cane yield, respectively. This clone was numerically superior to the best standard for sucrose %. Co 09004 has the ideal plant characters of tall canes (250 cm), early fast growing, high tillering, medium thick canes, non-flowering and non-lodging. This variety is an excellent ratooner and recorded 18.60% improvement for cane yield in ratoon crop over the best standard CoC 671. Co 09004 is moderately resistant to red rot and resistant to smut. This variety is less susceptible to top borer in all the AICRP(S) locations tested. It was less to moderately susceptible for early shoot borer, internode borer and scale



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insect. This variety is tolerant to drought and salinity conditions, the major yield limiting abiotic stress in Peninsular zone. It possesses A1 quality jaggery of golden yellow colour.

Co 09004 is expected to improve productivity under normal condition and in red rot and smut prone regions of Peninsular zone. Co 09004 recorded cane yield upto 139 t/ha at Pugalur, 140 t/ha at Sirugamani (Tamil Nadu) and 198 t/ha at Sameedwadi, 145 t/ha at Sankeshwar (Karnataka), 152 t/ha at Basmathnagar (Maharashtra).

**IPR: PPV&FRA Registration Number REG /2019/78**

### **RECOMMENDED REGION**

Peninsular Zone of India

### **OWNERSHIP**

Seed of Co 09004 was produced and sold to sugar mills and farmers from ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.



## Co 0212

**S. Alarmelu, R. Nagarajan, R. M. Shanthi, G. Hemaprabha,  
K. G. Somarajan, M. N. Premachandran, Dr. K.V. Bhagyalakshmi,  
C. Appunu, A. Anna Durai, Ravinder Kumar, C. Mahadevaiah,  
P. Padmanabhan, S. Vasantha, R. Gomathi, N. Vijayan Nair, Bakshi Ram,  
R. S. Purushothaman, S. Panneerselvam, M. Jayachandran,  
P. Parasuraman, D. Packiaraj, R. Sudhagar, R. Latha, M. Shanmuganathan,  
T. Ragavan, A. Thirumurugan, K. Sathiya, S. Ganapathy**

## DETAILS OF THE TECHNOLOGY

Midlate maturing sugarcane clone Co 0212 is a high yielding and high quality variety suitable for Tamil Nadu and Puducherry. It was evolved through hybridization and selection involving two high yielding and high-quality parents Co 7201 and ISH 106 at ICAR-Sugarcane Breeding Institute (SBI), Coimbatore.



Performance of the proposed sugarcane clone Co 0212 was tested in the station trials at SBI, Coimbatore, different centres in advanced varietal trials under All India Coordinated Research Project on Sugarcane [AICRP(S)] in Peninsular zone and in different factory farms or farmers fields under Coordinated Agronomic Experiments (CAE) in Tamil Nadu. In station trials, it recorded a cane yield of 156.43 t/ha, CCS % of 14.76 % and sugar yield of 23.04 t/ha. It had 30.17 %, 12.41 % and 37.64 % increase over the standard Co 86032 for cane yield, CCS % and sugar yield, respectively. The clone Co 0212 was evaluated under AICRP(S) during 2006-2008 across Peninsular zone and recorded an average cane yield of 108.8 t/ha and sugar yield of 15.22 t/ha. The superiority of this clone over Co 86032 for cane yield and sugar yield were 4.99 % and 6.84 %, respectively. In CAE trials conducted in Tamil Nadu and



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Puducherry during 2011-2012 & 2012-2013 seasons, the clone Co 0212 recorded significantly higher cane yield, CCS % and sugar yield than the standard variety Co 86032. Overall mean performance of the clone was 150.56 /ha of cane yield, 12.80 % of CCS and 19.27 t/ha of sugar yield. The per cent increase over the standard Co 86032 for cane yield, CCS % and sugar yield were 14.43, 2.70 and 17.75, respectively. Co 0212 possesses A1 quality jaggery. It is a good ratooner with excellent field stand, erect and medium thick canes, easily detrashing, purple canes with heavy wax coating, open drooping leaves, purple red dewlap, moderate spines and short lanceolate ligular process on both sides. It is moderately resistant to red rot disease and tolerance to drought and salinity.

### **RECOMMENDED REGION**

Agro-climatic regions of Tamil Nadu and Puducherry

### **OWNERSHIP**

Seed of Co 0212 was produced and sold to sugar mills and farmers from ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.



## Co 14012 (Avani)

G. Hemaprabha, R. M. Shanthi, S. Karthigeyan, K. Mohanraj,  
H. K. Mahadevaswamy, S. Alarmelu, P. Govindaraj, A. Anna Durai,  
C. Appunu, Adhini S. Pazhani, Bakshi Ram, P. Malathi,  
R. Viswanathan, M. Punithavalli, S. Anusha, R. Gomathi

### DETAILS OF THE TECHNOLOGY

Co 14012 is a high sugar yielding and cane yielding midlate variety with excellent ratoonability and combines red rot resistance and drought tolerance. This clone performed well in Coimbatore, Kolhapur, Navsari, Padegaon, Pravaranager, Pune, Rudrur, Sameerwadi, Sankeshwar and Thiruvalla centres exhibiting its wide adaptability to diverse environments. Plant is erect, yellow green dewlap, incipient inner auricle, curved tip leaves without leaf sheath spines. Medium thick purple light waxy canes with prominent coky patches and ivory marks. Internode is conoidal, light waxy with coky patches and ivory marks and zig zag alignment. Medium size and round buds. Internode cross section is round without pithiness. Suitable for growing under medium and high fertile soil in Peninsular zone. The overall mean performance of the clone was 109.82 t/ha of cane yield, 14.57 % of CCS and 16.16 t/ha of sugar yield at 360 days. This clone is suitable for



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January – March planting season (Midlate maturing).

**IPR:** Application submitted to PPV&FR Authority, New Delhi

### **RECOMMENDED REGION**

Peninsular zone of India

### **OWNERSHIP**

Seed of Co 14012 was produced and sold to sugar mills and farmers from ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.



## Co 18009

G. Hemaprabha R. M. Shanthi, K. Mohanraj, S. Alarmelu, C. Appunu, T. Lakshmi Pathy, A. Anna Durai, P. Govindaraj, Bakshi Ram, V. Srinivasa, R. Karuppayain, S. Karthigeyan, V. Vinu, Adhini S. Pazhani, C. Mahadevaiah, S. Sheelamary, K. Elayaraja, H. K. Mahadevaswamy, A.J. Prabhakaran, R. Viswanathan, A. Ramesh Sundar, C. Babu, M. Shanmuganathan

### DETAILS OF THE TECHNOLOGY

Middle maturing sugarcane clone with high yield and quality suitable for Tamil Nadu and Puducherry including coastal regions for harvest at 360 days. It was evolved through hybridization and selection involving two high yielding and high-quality diverse parents Co 07027 and ISH 69 at I C A R - S B I , Coimbatore. It gives cane yield of 135.77 to 171.2 t/ha. It recorded 13.09% improvement in yield (160.39 t/ha) over the check Co 86032 (141.82 t/ha) in trials conducted across Tamil Nadu. Improvement of 13.61% recorded for sugar yield (20.71 t/ha) compared to the check Co 86032 (18.23 t/ha) in trial conducted across Tamil Nadu. It is a climate resilient crop with tolerance to drought and resistant to red rot and moderately resistant to moderately susceptible to smut disease. It is non-lodging, non-flowering, erect cane with medium thickness and good plant stand in both in plant and ratoon crops. It is a good ratooner and registered 7.03%, 7.06%, and 1.56% increase in cane yield, sugar yield and sucrose percent respectively over Co 86032. It produces A1 quality jaggery of golden yellow colour.



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IPR: PPV&FRA Registration Number REG/2024/1078

## **RECOMMENDED REGION**

Tamil Nadu and Puducherry

## **OWNERSHIP**

Seed of Co 18009 was produced and sold to sugar mills and farmers from ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

## **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.



### Co 17018 (Karan 17)

Ravinder Kumar, M.R. Meena, R. Karuppaiyan, Bakshi Ram,  
Neeraj Kulshrestha, G. Hemaprabha, M.L. Chhabra,  
S.K. Pandey, Pooja, B. Parameswari, Vijay Kumar, Rajesh Kumar

#### DETAILS OF THE TECHNOLOGY



Co 17018 is a progeny of the cross Co 0327 GC effected at National Hybridization Garden during 2011-12. Co 17018 has high average cane yield of 91.48 t/ha against 81.31 t/ha of the zonal check variety CoS 767 and 84.64 t/ha of latest released check Co 05011. In AICRP trials it demonstrated 116.21 t/ha cane yield at Pantnagar in AVT I Plant (2021-22). Its sucrose% in juice at harvest (Feb/March) was 18.38 per cent (average of AICRP trials data). as against 17.48 per cent sucrose in the check variety CoS 767. At Karnal, in November (8<sup>th</sup> month stage) it recorded 17.20% sucrose against 16.57% in Co 0238 (2024-25) and in December (9<sup>th</sup> month stage) it recorded 18.50% sucrose against 17.10% in Co 0238, indicates its high sugar content potential. The variety is moderately resistant to red rot and smut diseases. It is also tolerant to water deficit, water logging and saline conditions indicates that it can easily acclimatize to all prevailing situations and suitable for all planting seasons viz. autumn, spring and summer of the sub-tropical region. Good ratoonability and tolerance to low temperature further makes it durable for raising a second ratoon crop, a practice which was



## *Sugarcane Varieties*

not in vogue in the zone mainly for want of suitable varieties with multi ratooning potential. The non-lodging nature and thick canes makes it a suitable candidate for wider row planting a prelude for mechanical harvesting. The rare combination of increased yield with resilience to harsh climatic conditions and stay green characters favours its growth all through the year. Thus, Co 17018 has perfectly fit into the sugarcane based cropping system of sub-tropical region.

### **RECOMMENDED REGION**

North West Zone of India

### **OWNERSHIP**

Seed of Co 17018 was produced and sold to sugar mills and farmers from RS, ICAR-SBI, Karnal and ICAR-SBI, Coimbatore. Since the ownership of the variety is with ICAR-SBI, as per the Protection of plant varieties and Farmers' Rights Act, 2001 and the conditions specified in section 47 of the said Act, and to the conditions and provisions specified by any other law for the time being in force, ICAR-SBI only has the exclusive right to produce, sell, market, distribute, import or export this variety. Hence, any person, firm, company etc engaged in sale of seed of this variety in any form viz., setts, single bud sett, bud chips, settling, TC plants etc., need to obtain license or permission before engaging themselves in seed business otherwise will attract legal action.

### **STAKEHOLDERS**

Sugar mills, sugarcane nurseries, tissue culture firms, seed companies, individuals in seed business, foreign agencies / institutes / sugar mills.

### **COMMERCIALISATION**

This variety has been licensed to four firms.



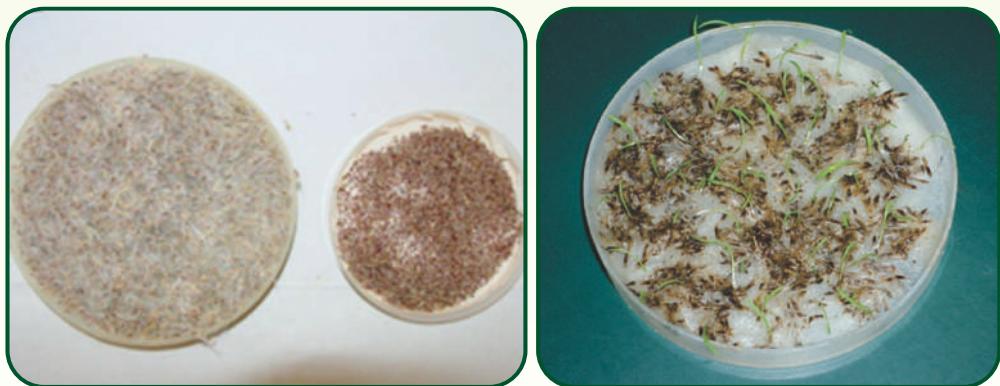
## True seed (Fluff/Fuzz)

ICAR-Sugarcane Breeding Institute, Coimbatore

### DETAILS OF THE TECHNOLOGY

Sugarcane is the second most important commercial crop in the country. The natural climatic conditions around Coimbatore ( $11^{\circ}$ N Latitude and  $77^{\circ}$  Longitude) were found to be most ideal for profuse flowering and seed setting without any cost on artificial equipment. True seed harvested from sugarcane flowers commonly known as fluff or fuzz' is the basic material for selection and development of new improved varieties. This is the natural strength of ICAR-SBI and offers a great opportunity for commercialisation of sugarcane seed fluff through sustained efforts of hybridization for commercialisation of true seed(fluff/fuzz) to the needy.

True seed on any variety can be collected, processed and sent to the indenter. Seed Technology Laboratory, ICAR-Sugarcane Breeding Institute, Coimbatore has got the proven techniques and technologies for handling sugarcane true seed viz. seed processing, testing for germination, seed storage, packing and transport. Defuzzing is practiced to improve the handling of fluff in sowing. Disinfection also becomes easier. Through reduction of weight and volume the storage, transport becomes easier.



**SBIEC 14006**

**An energycane with high biomass production**

**P. Govindaraj and Bakshi Ram**

Energycanes were developed at ICAR-SBI, Coimbatore having high fibre content and dry matter production. Among the six clones evaluated, SBIEC 14006 with *E. arundinaceus* genome was identified as promising clone based on high harvestable biomass and fibre content in cane. This was a selection from open pollinated fluff of



*E. arundinaceus* clone IK 76-75 and mainly selected for tall and erect canes, free from pests and diseases, high fibre and high harvestable biomass production. This clone recorded the highest mean harvestable biomass of 265.28 t/ha. Percent improvement was more in ratoon crop (28.98%) compared to plant crop (24.17%) under normal irrigation conditions. Under limited irrigation condition also it recorded high biomass production. The mean harvestable biomass yield under limited irrigation condition was 241.41 t/ha while under normal irrigation condition the yield was 289.08 t/ha.

SBIEC 14006 is a type II energycane wherein total biomass yield and fibre % are the important economic traits and the by-product juice is not intended for any use as it has only 8.94% juice brix and 4.72% of juice

sucrose. This low-quality juice can be added to biogas digester or composting yard or any other purpose after the economic feasibility studies. This energycane is about 2.18 cm cane diameter and 1.24 kg of single cane weight. The cane grows up to 4-5 m tall in 12 months. The leaf sheath is tightly attached to the cane hence available up to harvest without wasting the biomass. This clone can be ratooned for at least 7-8 years hence no need for replanting every year which brings down the cost of cultivation of biomass in ratoon crop. SBIEC 14006 has large potential to ensure uninterrupted supply of feedstock for biofuel industries throughout the year. The whole canes with trash and tops can be harvested and directly fed into the boilers for producing electricity. The identified clones are not recommended for cultivation under normal agroclimatic conditional as these clones should not compete with sugarcane for area. Hence it should be planted where any other agricultural crop cannot be profitably cultivated like low rainfall, water logging, saline and alkaline soils etc., Preliminary studies in pulping parameters indicated that the energycane bagasse is comparable to the sugarcane bagasse hence can be an alternate and cheap raw material for the paper mills. The energycane biomass can be used for green energy production thus saving fossil fuel and as feedstock for the paper industries hence dependence of the forest wood will be reduced

**IPR:** SBIEC 14006 Clone registered with NBPGR INGR 20112

### **COMMERCIALIZATION:**

Technology has been licensed to four firms across the country.



### Soil Moisture Indicator (SMI)

K. Hari, D. Puthira Pratap, K. Sivaraman, P. Rakkiyappan,  
B. Singaravelu, A. Ramesh Sundar and P. Murali

Soil Moisture Indicator is a user-friendly moisture indicating device developed by ICAR-Sugarcane Breeding Institute through 'farmers' participatory research. This device works based on the principle that soil electrical resistance is inversely proportional to soil moisture content. Field capacity, available soil moisture and permanent wilting point (PWP) are the key parameters considered for soil moisture indication. It works by inserting the metal rods in the soil and pressing the switch, after pressing the switch, the electronic circuit translates soil resistance into a colour glowing light emitting diode (LED). SMI will not provide the precise soil moisture status, as it is only an objective indication. SMI is portable, requires no permanent installation in the field and can be used in the field to ascertain the soil moisture level as per the user's choice. SMI has various advantages viz., inexpensive, simple to use, no recurring expenses, relatively less maintenance, useful in subsurface drip system, irrigation water saving of about 15% and 8% improvement in cane yield. Implementation of SMI had resulted in reduction in the number of irrigations to the sugarcane crop from 42 to 36. This has helped in saving labour, electricity in sugarcane cultivation. Since it is generic in nature can be deployed in sugarcane, coconut, groundnut, mustard, brinjal, bhendi, coconut, banana, pomegranate, grapes, flowers, upland paddy, sesame, black gram, green gram, tomato etc., crops. Widespread usage of SMI in all cultivated crops would save water and other resources significantly.



**IPR:** One patent filed No. 2685/CHE/2010 and registered four designs (Nos 231432, 231433, 231434 and 231435); These were the first design patents registered by ICAR.



## COMMERCIALIZATION

Technology has been licensed to 22 firms across the country.

## SPECIAL NOTE

This technology has been included in the schemes of Department of Agriculture and farmers welfare, Government of India viz., (a) Sub Mission of Agricultural Mechanisation (SMAM), (b) National Food Security Mission (NFSM) and (c) More Crop Per Drop Scheme Per Drop More Crop of the PMKSY for water conservation with subsidy for the benefit of farmers and other stakeholders.

## AWARDS

This technology bagged (1) First place in the National Water Awards - 2019, under the category "Best Research / Innovation / Adaptation of New Technology for Water Conservation" by Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Government of India and (2) First in the TERI-IWA-UNDP Water Sustainability Award 2021 under the category "Excellence in water use efficiency – Agricultural Sector" by The Energy and Resources Institute, New Delhi in association with International Water Association, London, United Kingdom and United Nations Development Programme, New York, USA.



### Digital Soil Moisture Sensor (DSMS)

S. Anusha, K. Hari, R. Arun Kumar, C. Palaniswami,  
D. Puthira Prathap, B. Singaravelu, A. Ramesh Sundar, P. Murali

DSMS is an upgraded version of ICAR-SBI Soil Moisture Indicator to assess the soil moisture level at field conditions. DSMS was developed by ICAR-SBI and M/s SKR Agrotech, Nagpur through a PPP project. DSMS device is a simple, handy and IoT enabled portable device to provide quantitative level of available soil moisture as a digital display. DSMS has sensor rods which has to be inserted in the soil to know the available soil moisture level. Maintaining optimum soil moisture level is crucial by efficient irrigation management and better crop productivity. It is recommended to maintain DSMS readings of above 30% ASM and below 75% ASM most of the time. The cost of DSMS is about Rs. 3,200 (plus GST). A farmer needs only one unit for the entire field and no recurring expenses. The use of DSMS results in a saving of about Rs. 2,500 per hectare due to reduced labour and energy conservation by 250 units of electricity per year per hectare.



#### Model No.1- DSMS (Economic)

DSMS comprises microcontroller-based sensor rod and a casing. There are either two metal sensor rods (two individual rods spaced at distance of about 5 cm) or a combined rod. The casing houses an electronic printed circuit board with an integrated circuit, electronic components, a provision for lithium battery and a control switch. To assess the soil moisture, the stainless-steel sensor rods are to be inserted into the soil. The resistance between the sensor rods depends on the moisture content in the soil between the rods. Lower the soil moisture higher will be the resistance and vice versa. When a direct current voltage is applied between the sensor rods, there will be a voltage change in relation to the soil moisture. This altered voltage is fed to the



signal input of the integrated circuit. The integrated electronic circuits translate conductivity into soil moisture content through OLED display and displays quantitative moisture percentage. The electronic circuit is designed in such a way to display moisture levels digitally. The moisture level indication will be as quantitative analysis of water holding capacity in 0 to 100 % range. A provision is given in the electronic circuit for fine-tuning the device to suit different soil conditions like sandy, clay and loamy.

### **Model No.2- DSMS (with GSM Module)**

Similar to Model 1 but has additional feature with GSM module.

### **COMMERCIALIZATION**

This technology has been developed in partnership with M/s SKR Agrotech, Nagpur.

### **SPECIAL NOTE**

This technology has been included in the schemes of Department of Agriculture and farmers welfare, Government of India viz., (a) Sub Mission of Agricultural Mechanisation (SMAM), (b) National Food Security Mission (NFSM) and (c) More Crop Per Drop Scheme Per Drop More Crop of the PMKSY for water conservation with subsidy for the benefit of farmers and other stakeholders.



### ICAR-SBI-CIAE Sett treatment device

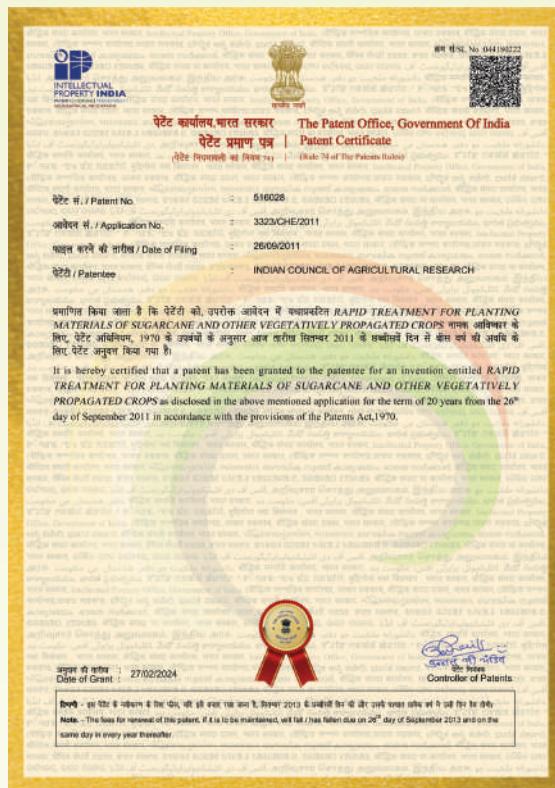
**ICAR-SBI:** P. Malathi, R. Viswanathan, P. Padmanabhan,  
A. Ramesh Sundar, K. Hari and V. Jayakumar  
**ICAR-CIAE:** Ravindra Naik and Jacob Annamalai

Invention relates to new technique for the treatment of sugarcane planting material (single/ double/ triple budded setts/ bud chips) with any agrochemicals or microbes for protection from diseases/ pests and improvement of plant growth. This novel technique has principle of creating negative pressure followed by absorption. This method of sett treatment is an improved method over conventional application as sett soaking at different periods of time. The setts were taken in the container having lid with connector provision for connecting tube. The suspension to be treated with the setts was prepared and added to the container till the setts were immersed in the solution. The solution can be of any agrochemicals viz., fungicide/ insecticide/ growth regulator/ adhesives/ nutrients or microbials prepared in water. The container was closed airtight with its lid and the outlet from the lid was connected to the vacuum pump. Then the vacuum was applied slowly @ 100 to 300 mmHg for 15 to 20 min. Under vacuum, it removes air in the container and setts i.e. it creates negative pressure and then the vacuum was released slowly for 5-10 minutes which led to absorption of surrounding solution inside the tissue.



## Machinery / Device / Equipment

**IPR:** A patent has been obtained for this technology No. 3323/CHE/2011 titled “Rapid treatment for planting materials of sugarcane and other vegetative propagative crops”.



## COMMERCIALIZATION

Technology has been licensed to 2 firms across the country.

## SPECIAL NOTE

This technology has been included in the schemes of Department of Agriculture and farmers welfare, Government of India viz., Sub Mission of Agricultural Mechanisation (SMAM)



## Machinery / Device / Equipment

### ICAR-IISR-SBI Deep furrow sugarcane cutter planter suitable for tropical region

**ICAR-CIAE: A K Singh; ICAR-SBI: T. Arumuganathan, Bakshi Ram and A.S. Tayade**

Different designs of sugarcane planters have been developed by ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow to mechanise the planting operation and most of the designs are suitable for sub-tropical conditions. The soil type, crop spacing, varieties and seasonal parameters are entirely different in tropical region compared to sub-tropical region. Introducing sugarcane machineries developed at ICAR-Indian Institute of Sugarcane Research, Lucknow with suitable & required modifications for the tropical conditions can certainly help the Sugarcane growers in tropical region to get the benefits of mechanization. The deep furrow sugarcane cutter planter has been designed and developed for adjustable wide row spacing (4 feet and 5 feet) and capable for doing furrow planting in heavy soils in tropical region. This will further reduce the cost of planting as well as the labour requirement for planting. Table 1 shows the various components and details of a tractor operated two row deep furrow sugarcane sett planter. Introducing this planting machinery can certainly help the sugarcane growers in tropical region to get the benefits of mechanization.



There is no doubt this machinery is labour and cost saving and will make sugarcane cultivation more profitable besides reducing human drudgery.

## COMMERCIALIZATION

Technology has been licensed to one firm across the country.



## **ICAR-SBI-CIAE Sugarcane settling transplanter**

**ICAR-CIAE:** S.J.K. Annamalai, T. Senthilkumar and Ravindra Naik  
**ICAR-SBI:** N Vijayan Nair, N. Rajendra Prasad and Bakshi Ram

A two-row tractor drawn mechanical planter for sugarcane bud chip settling raised in protrays has been developed by ICAR-Central Institute of Agricultural Engineering, Regional Station, Coimbatore in collaboration with ICAR-SBI, Coimbatore. This tractor mounted planter considerably reduced the planting cost and resulted in good establishment of the crop.

The equipment consists of mainframe to be attached to standard three point hitch arrangement of a 40 hp tractor with adjustable arrangement for altering row to row spacing 90, 120 and 150 cm. Bud chip settling to be dropped through the metering mechanism by two operators who are seated behind the equipment with adjustable arrangements for altering plant to plant spacing of 30, 45 and 60 cm. Furrow openers open the furrow, in which the settling with soil are to be planted with adjustable arrangement for altering depth of planting 2



## Machinery / Device / Equipment

to 6 cm. The same furrow is used for irrigation after the settling have been planted for better establishment. The furrow closer which follows the soil opener closes the soil thereby giving stability to the settling plants. The field capacity of the equipment is 0.15 ha/h and the missing of 3 to 4 per cent at a working speed of 1.4 km/h. The plant establishment was more than 95%. The yield and quality parameters are on par when compared with manual planting.

### SPECIFICATIONS OF THE MECHANICAL PLANTER

Over all dimensions (l x b x h): 2400 x 2000 x 1500 mm; Weight: 590 kg; Source of power: 35 HP or above Tractor; Row spacing: 2 rows, 900, 1200, 1500 mm (Adjustable); Plant spacing in rows: 300, 450, 600 mm (Adjustable); Field capacity: 0.10 – 0.20 ha/h; Nominal working width: 1350 - 1800 mm (Adjustable); Depth of planting: 20 - 100 mm (Adjustable); Type of metering mechanism: Horizontal disc indexing mechanism; Furrow opener and closer: Shoe type furrow opener, Wheel type furrow closer; Drive mechanism: Two numbers of ground wheel for independent drive to two indexing mechanism with bevel gear box.

### COMMERCIALIZATION

Technology has been licensed to three firms across the country.



### ICAR-CIAE-SBI EPN Applicator

**ICAR-CIAE:** T. Senthilkumar and Syed Imran

**ICAR-SBI:** T. Arumuganathan, C. Sankaranarayanan and Rajesh Kumar

EPN are tiny microscopic worms, barely visible to the naked eye. As the name suggests they are insect killing (Entomopathogenic) nematodes. They are natural predators of the white grubs. They have proven to be the safest and most effective way of controlling white grubs as both organisms spend a large portion of their life cycle in the soil. Majority of the farmers follow the above spot application method to control white grub by manually. Manual application method of EPN application involve more drudgery and non-uniform quantity of EPN solution in sugarcane root zone. Keeping the above view, a mini tractor operated EPN applicator has been developed by ICAR, Central Institute of Agricultural Engineering Regional Centre, Coimbatore in collaboration with ICAR Sugarcane Breeding Institute, Coimbatore. The developed mini tractor operated EPN applicator consists of main frame, tank holding assembly, agitator, water pump, furrow opener



## **Machinery / Device / Equipment**

and standard three-point hitch. A 150-liter tank was placed to carry the EPN solution. The tank consists of agitator and two EPN solution outlet flexible tubes. The agitator consists of two numbers of baffles at the end of vertical shaft. The agitator shaft was operated by 12 V high torque DC motor. The speed of the agitator shaft and discharge rate can be adjusted by using control units. The agitator provides continues agitation of EPN solution and avoid suspension of particles so that it results in uniform delivery of the EPN. Pumping of EPN solution was done by two numbers of 4.0 LPM/ 12v DC Water Sprayer Motor Diaphragm pump and it was powered by 12 V Battery. The cost of operation was workout as Rs. 2550 per ha and cost saving is 47% when compare to manual method of application. Uses / applications of equipment: The equipment can be used for application of EPN solution and similar bio agents to be applied in the root zone of any wider row crops.

## **COMMERCIALIZATION**

Technology has been licensed to one firm across the country.



## **ICAR-SBI-CIAE Rind removing equipment**

**ICAR-CIAE: Ravindra Naik, S.J.K. Annamalai**

**ICAR-SBI: K. Hari and Bakshi Ram**

Spoilage of sugarcane juice is accelerated by presence of enzyme polyphenol oxidase in the rind of the cane, which causes oxidation of the sugars and thereby changing the colour of the juice by reacting with phenolic compounds – present in outer rind. Rind removing/ peeling enhances hygiene as it enables the removal of dirt and other unwanted particles as well as microbial load from the stalk in juice. Traditional manual method by using knife is time consuming, unsafe and unhygienic. In view of this, development of a power operated sugarcane rind removing equipment has been developed.

The sugarcane rind remover consists of four metallic brushes attached to the rotating shaft. When the sugarcane is inserted between the four metallic brushes, the upper, lower and two sides skin of the



## **Machinery / Device / Equipment**

sugarcane is removed due to the rotation of the brushes (because of the abrasion action between the brushes and sugarcane).

The pair of metallic brushes are mounted on the shafted through the gear box so that the brushes rotate in the opposite direction at about 1050 rpm. The feeding arrangement is made of two nylon roller rotating at about 270rpm, which enables retention of the canes to be peeled for sufficient time in the peeling zone. The power transmission is through 1.5 hp single phase/ three phase motor. The equipment is mounted on the wheel enabling easy transportation from one place to another. Capacity of the power operated sugarcane rind removing equipment is 240 canes/h and 175-200 kg/h.

## **COMMERCIALIZATION**

Technology has been licensed to one firm across the country.



## **Detrashing tool**

**T. Arumuganathan, N. Vijayan Nair, C. Palaniswami, K. Sivaraman,  
C. Jayabose and T. Rajula Shanthi**

Detrashing in sugarcane cultivation is a recommended practice, which involves removal of unwanted bottom dried and yellowish green leaves on fifth and seventh month after planting. Though detrashing has several advantages, physical labour for doing this operation is hard to obtain because of the drudgery. When the de-trashing operation is done manually without any tool, the labourers hands are often injured and they were subjected to the "Irritant Contact Dermatitis (ICD)", "Allergic dermatitis (AD)" and "Keratinization" (The deposition of keratin in cells occurring in the epidermis of the skin and structures in nails and hair. In view of avoiding the direct contact with hands and sugarcane leaves and also to reduce the drudgery involved in detrashing, an ergonomically improved sugarcane detrashing tool was designed and developed with a substantially reduced weight.

This ergonomically improved sugarcane detrashing tool was designed for 280 g weight using the design software as against the existing model of 430 g and developed. This tool has two stainless steel (SS) knives fitted in a 'U' shaped stainless-steel flat with tension. These knives are 8 inches in length with varying width of 2.5 inches to 1 inch



## **Machinery / Device / Equipment**

from top to bottom. The knives are welded with 4inch length stemmed 18 x 3mm stainless steel flat, which gives tension by which the knives are stiff enough to detach the leaves. At the bottom of the 'U' shaped steel flat a stainless-steel pipe of 25 mm diameter with 30 mm length is attached. It is provided with a wooden handle (1 inch diameter and 5 inches length) for convenience. An adjustable oval shaped loop of 3 mm thickness made up of SS rod was provided which can be moved to and fro to adjust the gap between two knives depending upon the diameter of the sugarcane stalk. The knives are inserted between the internodes at the top and pulled vertically down for removing the dry and unwanted leaves. Detrashing angle of 5 degree and varying approaching/ cutting width ranging from 25 to 50 mm were provided in the tool to ease the detrashing process. This ergonomically improved detrashing tool can be comfortably used for detrashing the sugarcane leaves during fifth and seventh month and the field capacity of the tool is 0.3 acre per day.

## **COMMERCIALIZATION**

Technology has been licensed to two firms across the country.



## Sugarcane Elevated Hybridization Runway

**ICAR-SBI: N. Vijayan Nair, P. Govindaraj  
ICAR-CIAE: S.J.K. Annamalai and Ravindra Naik**

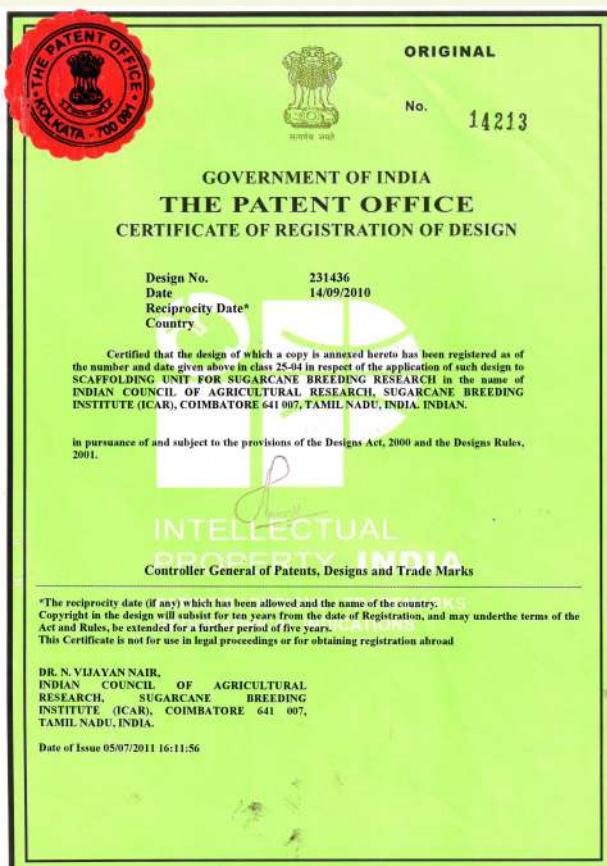
This technology relates with an Elevated Hybridisation Runway (EHR) structure for crossing sugarcane during the hybridisation programme by ICAR- SBI, Coimbatore and ICAR-Central Institute of Agricultural Engineering - Regional centre, Coimbatore. Elevated Hybridisation Runway structure, comprises of vertically extending H shaped steel stanchion or pipes ; two levels of standing platform member attached to the main support member and extending runway structure platform at two levels generally perpendicularly, a diagonal brace member extending at an angle between the main support member and the platform member and connected at each end by means of hook attached to the platform member for limiting motion for a plank member supported on the platform member. A guard rail system is running along the scaffold structure at second working level. The platform member is attached to the main support member by means of a



## Machinery / Device / Equipment

clamp. A set of ladder is provided to reach to the different levels of Elevated Hybridisation Runway structure. Scientists can complete all the crosses to be carried out in different rows without getting down every time since all the rows are interconnected enabling saving in time and manpower when compared to the conventional methods. The new design will facilitate large number of pollination in shorter time without losing viability of pollens which have short life period. The design is ergonomic in nature keeping the safety of operator in mind.

**IPR:** One patent filed No. 771/CHE/2011 and registered one design No. 231436



## **Quatro Sugarcane Single Bud Cutter**

**Ravinder Kumar, M.R. Meena, N. Kulshreshtha,  
C. Appunu, Bakshi Ram**

Traditionally, sugarcane cultivation requires huge quantity of seed material nearly 7.5 to 10 t/ha, which accounts 10-15% of total the productivity. The seed multiplication rate of sugarcane is very low (1:8). Due to bulky nature of propagating material, very low average germination (35-40%), the non-uniform and inadequate germination of crop causes huge fluctuation in productivity. Planting of sugarcane crop with pre germinated settling plants is the best solution for improving seed health, seed multiplication ratio and uniformity in plant population, which ultimately assures higher sustainable crop yield. The foremost requirement of settling raising and transplanting work is the availability of cost-effective cutting tool for detaching uniform size mini single bud setts. To address this issue, ICAR-SBIRC, Karnal have designed and developed, a cost effective single budded sett cutting tool namely "Quatro Sugarcane Single Bud Cutter" which



## Machinery / Device / Equipment

bagged design patent in the country "Design No. 297432". Nearly 7000 to 8000 single bud setts, adequate to grow settling for transplantation in an acre area, can effectively be detached in one hour by this machine, when it runs at full capacity i.e. four persons operating on each cutting slot of the machine.

The Quattro Sugarcane Single Bud Cutter (QSSBC) was designed towards mechanization of planting operation in sugarcane. This unique design is very effective in sizing the mini setts in the form of 35 mm size (fixed size) of sugarcane single buds useful for planting in cavity trays or poly bags. In one hour four people can detach 7000-8000 single buds for raising settling suitable for one acre. The implement runs on 1 hp power single phase motor. The maintenance is very easy. If the same work is being done by four persons using manual operator bud cutters it takes whole day. In one day (8 hours) it can detach single buds from 7-8 tonnes of sugarcane stalk. This implement is extensively used for rapid multiplication of the new varieties and improvement of seed health at ICAR-SBI Regional Centre, Karnal. To reduce volume of the seed cane material sugar mills and farmers were allowed to use QSSBC for detaching single bud setts.

## COMMERCIALIZATION

Technology has been licensed to two firms across the country.



## **ICAR-CIAE-SBI Motorised double headed sugarcane single bud cutting machine**

**ICAR-SBI: N. Vijayan Nair, P. Govindaraj**

**ICAR-CIAE: S.J.K. Annamalai and Ravindra Naik**

For raising settling, a single bud along with a portion of the nodal region is cut off and planted either in raised bed nurseries / polybags / protrays filled with FYM or press mud, soil and sand at 1:1:1 proportion. Seed



material required under this technique is only 2 to 3 t/ha and the remaining cane can be used for milling/ jaggery making. Nursery raised from sugarcane mini chips was found to be more economical than traditional methods. Single buds required per hectare is 24,700 (at a spacing of 90×45 cm). The process is time consuming and cumbersome. Thus, with an urgent need for mechanization of this operation, the motorised double headed single bud cutting machine was developed by ICAR-SBI along with ICAR-CIAE. This machine has two pairs of two circular blades made of high carbon steel, which rotates at a speed of 2800 rpm. A spacer provided between the two blades allows variation in the size of single bud sett as per requirement. Two persons can operate simultaneously and can cut about 3000 single buds in an hour. The machine can be operated by 0.75 kW (1 hp) electric motor which powers both the sets of cutting blades. The cost of the equipment is Rs. 25,000. Cost economics of adoption of single bud cutting machine gave savings in time and cost of 89 and 64%.

### **COMMERCIALIZATION**

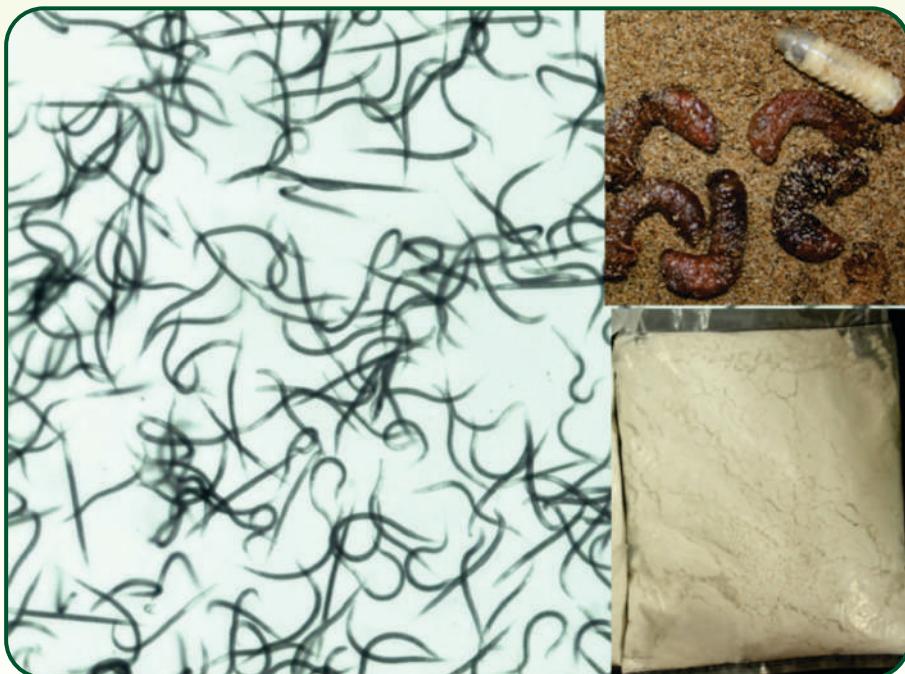
Technology has been licensed to two firms across the country.



## **ICAR-SBI EPN Biopesticide formulation**

**C. Sankaranarayanan, B. Singaravelu, M. Rajesh Kumar,  
Nici Ashok and K. Hari**

ICAR-SBI EPN formulation is first of its kind in a unique combination of carrier materials with talc powder to attain a longer shelf life with viable infective nematode juveniles (IJs) of EPN by providing adequate aeration and moisture. The formulation containing *Heterorhabditis indica* has a shelf life of nine months with 92% survival of nematodes at a temperature range of  $30\pm5^{\circ}\text{C}$ . The formulation containing *Steinernema glaseri* has a shelf life of 12 months with 90% survival of nematodes at a temperature range of  $30\pm5^{\circ}\text{C}$ . The EPN formulation caused mortality of the insect larvae of coleopteran white grub *Holotrichia serrata* and lepidopteron wax moth larvae *Galleria mellonella*. Successful control of white grub under field conditions obtained with ICAR-SBI EPN formulation. Recommended dose of EPN @  $1 \times 10^8$  IJs / ac (2 kg powder formulation / ac). EPN should be applied at first beetle emergence during onset of summer shower (April – June).





Irrigate the field prior and after EPN application and keeping the treated area wet for at least 5 days post application. The ideal time of application is at evening hours. Give more concentrated application in the border rows extending to five to seven meters inside (white grub infestation generally seen on the boundaries of the plots and extending to a few meters inside). Thoroughly Mix the EPN powder formulation with 100kg soil or FYM and broadcast in the field or Mix the EPN formulation with water (150g EPN formulation/ sprayer tank) and can be applied using knapsack sprayer (nozzle and inside filters of the spray equipment should be removed to prevent them from becoming clogged with nematodes) in each sugarcane clump / any crop by making a 15-20cm pit using a crowbar.

**IPR:** One patent application filed titled “A process for producing biopesticide formulation of entomopathogenic nematodes with extended shelf life” Application No. 2020411003560

## COMMERCIALIZATION

Technology has been licensed to fourteen firms across the country.



### Mass multiplication of parasitoids with parasitoid release station

P. Mahesh, J. Srikanth, B. Singaravelu, M. Punithavalli,  
R. Nirmala and K. P. Salin

Sugarcane, like many other field crops, is ravaged by stem borer pests which cause significant losses in yield and quality. Of the several control measures available, biological control with parasitoids is an environment-friendly and convenient method facilitated by the long-duration stable crop system. *Cotesia flavipes* is a major and regular larval parasitoid of borers of sugarcane, sorghum and maize in India. The parasitoid occurs naturally at significant levels effecting natural control and offers scope for applied biological control by field colonization. Laboratory mass multiplication methods have been standardized for the parasitoid using target and alternative hosts. The usefulness of the parasitoid in borer control through augmentative releases has been demonstrated. The parasitoid is generally dispensed in the field as adults after they emerge from cocoons in captivity. This not only demands monitoring of parasitoid emergence in the laboratory to time the release of adults but also renders it difficult to transport live adult stages over long distances. These problems can be surmounted by deploying a device which dispenses the parasitoid in the cocoon (resting) stage which, incidentally, is amenable to transport. The present device was designed and evaluated to enable delivery of cocoons in the field such that adults emerging in a day or two would find their way out and disperse in the field.



Telenomus dignus



Cotesia flavipes



Field release station



Recent studies with the egg parasitoid *Telenomus dignus* have shown its field activity throughout the year and preliminary augmentative releases produced encouraging results. Integrated biocontrol involving agents of more than one hoststage is likely to be more effective than using them individually. However, such studies are not available, particularly in a combination using *T. dignus*, against INB. Laboratory mass multiplication methods have been standardized for the parasitoids using target and alternative hosts. The usefulness of these parasitoids in borer control through augmentative releases has been investigated.

To overcome the problems faced in the handling of adults, characteristically black ready-to-emerge cocoons can be dispensed in the field through field-release stations a day prior to the likely adult emergence. Trials have shown that the adults emerging from the cocoons inside the field-release station would exit through the window and cocoons are not subject to predation.

**IPR:** A design (No. 396729) was granted to parasitoid release station

## COMMERCIALIZATION

Technology has been licensed to two firms across the country.



### Bacillus thuringiensis biopesticide formulation

P. Mahesh, B. Singaravelu, J. Srikanth, K. Hari, K.P Salin, C. Sankaranarayanan, G.S. Suresha, C. Appunu, R. Nirmala and M. Rajeshkumar

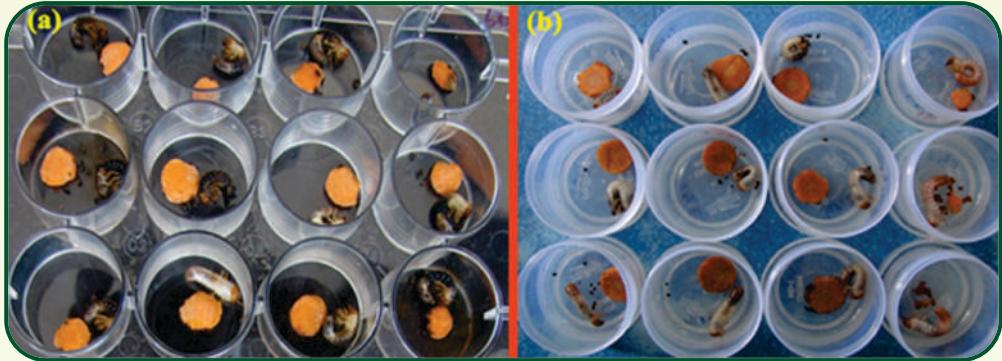
The invention relates to the process of preparation of bio-insecticidal formulation of a novel strain of scarabaeid-specific *Bacillus thuringiensis*, isolate Bt-62, using low-cost bioprocess technology for management of white grub *Holotrichia serrata*. The white grub *Holotrichia serrata* is a polyphagous pest of national importance infesting several cultivated crops such as sugarcane, peanut, soybean, sweet potato, etc. as well as forest trees in India. The larvae being subterranean in nature destroy the underground parts of plants and cause extensive economic loss in various crops. Though *Bacillus thuringiensis* (Bt) proved to be an effective bio-insecticide and a valuable alternative to chemical pesticides for controlling major crop pests, Bt has not been considered in our country against white grubs as is evident from the lack of literature. However, recently a Bt isolate Bt-62 (GenBank Accession Number JQ740599) with specific mode of action against *Holotrichia serrata* was isolated in India by ICAR-Sugarcane Breeding Institute, Coimbatore, India. Efficacy of the isolate against the target pest was demonstrated in laboratory, pot culture and field tests indicating its potential as a biopesticide. A novel process in which Bt 62 was mass cultured on sugar industry products and by-products such as sugarcane juice, jaggery and trash using fermentor which was far more economical than conventional nutrient T3 media. The addition of supplements like yeast, CaCl<sub>2</sub> and urea in the production process



further enhanced bacterial output. A liquid biopesticide formulation was developed with extended shelf-life of Bt 62 to more than 200 days.

(As per the government regulations toxicological data is mandatory. For this Bt and its formulation, toxicological data has not yet generated.)

**IPR:** One patent application titled “Novel process for formulating a low-cost scarabid-specific *Bacillus thuringiensis* biopesticide for management of white grub *Holotrichia serrata*” has been filed (No. 202241011397)



## Cane Jam from Sugarcane Juice

G.S. Suresha, R. Lavanya, K. Hari, P. Murali and Bakshi Ram



Canejam is a novel value-added product developed by ICAR-Sugarcane Breeding Institute, wholly from sugarcane juice. The process and methodology have been standardized for various processing parameters such as juice filtration, arresting the browning effect, temperature-controlled boiling of juice, fixing the juice Brix and boiling temperature for addition of thickening agents and final setting point of jam. For flavoured variants of canejam, any permitted natural and synthetic flavouring agents can be added. Cane jam is rich in minerals, vitamins, and other functional nutrients. Canejam can be used to enrich our regular breakfast with bread, chapatti, dosa, croissant, jam smoothie, barbecue sauce, cake layering, pan cake, donuts, pudding, puff pastry, muffins, frankie, fruit salad dressing etc. Canejam is made from sugarcane juice without the addition of white or invert sugar or any artificial sweetener and has huge potential as a commercial product. Canejam has a Brix content of 61-70% and titratable acidity of 0.57%. Water activity of around 0.8 aw and moisture content of 8.39% in canejam is far below the commercially available fruit jams (water activity 0.9 aw, moisture content 20-30%), attributing to the longer shelf

life in canejam. Total sugars in canejam was 46.5%, lower than that recorded in other fruit jams (50-65%). Total calorific value of cane jam was 262 kcal, which is slightly lesser than commercial fruit jams (272 kcal). Canejam is rich in vitamin B complex, vitamin E and minerals such as sodium, potassium, calcium, phosphorus, zinc and copper. Potassium content of canejam is ten times higher than other commercially available fruit jams.

**IPR:** One patent application titled “A semisolid sugarcane juice composition” (No. 202041021560) has been filed. One trademark (No. 5359283) was granted to Canejam

### **COMMERCIALIZATION**

Technology has been licensed to five firms across the country.



### **SUGARCANE JAM IN VARIOUS FLAVOURS**



*The different flavours has been indicated on the lable*



## *Value added products*

### **ICAR-SBI standardised liquid jaggery process**

**I. Rajendran, K. Chandran, A. Bhaskaran, G. S. Suresha, C. Palaniswami, K. Hari, B. Mahendran, M. Nisha, R. Gopi and A. Vennila**

ICAR-SBI developed a standardised liquid jaggery process to get appreciable gloss and shelf life of the final product. The sugarcane juice obtained from both matured and immature canes with age varying from 7 to 12 months could be used for the preparation of liquid jaggery. The good sugarcane juice had the density of 1.07 to 1.10 g/ml. Optimum clarity was achieved by the removal of impurities by initial filtration of sugarcane juice, removal of heat coagulated suspension and floating impurities during two stages to get the final product. Heating facilitates the separation of dissolved colloidal albumins, wax and gum in the form of dark coloured waxy coagulated matter floating on the surface. Product pH range was 5.0 to 6.8, and the moisture content was less than 12%. Sugarcane juice obtained from 7½ month old cane yielded only 14.6% on the volume of sugarcane juice as against 24% yield from 11- or 12-month-old cane. The liquid jaggery can be manufactured by this hassle-free process without chemical additives like clarificants, colouring agents or preservatives, thereby ensuring the production of a healthy sweetener. Liquid jaggery manufactured using this standardized process can form an adulterant free healthy raw material for various confectionery items and Ayurvedic medicines. If required, further extension of shelf life can be ensured by addition of permissible level of preservatives.



### **COMMERCIALIZATION**

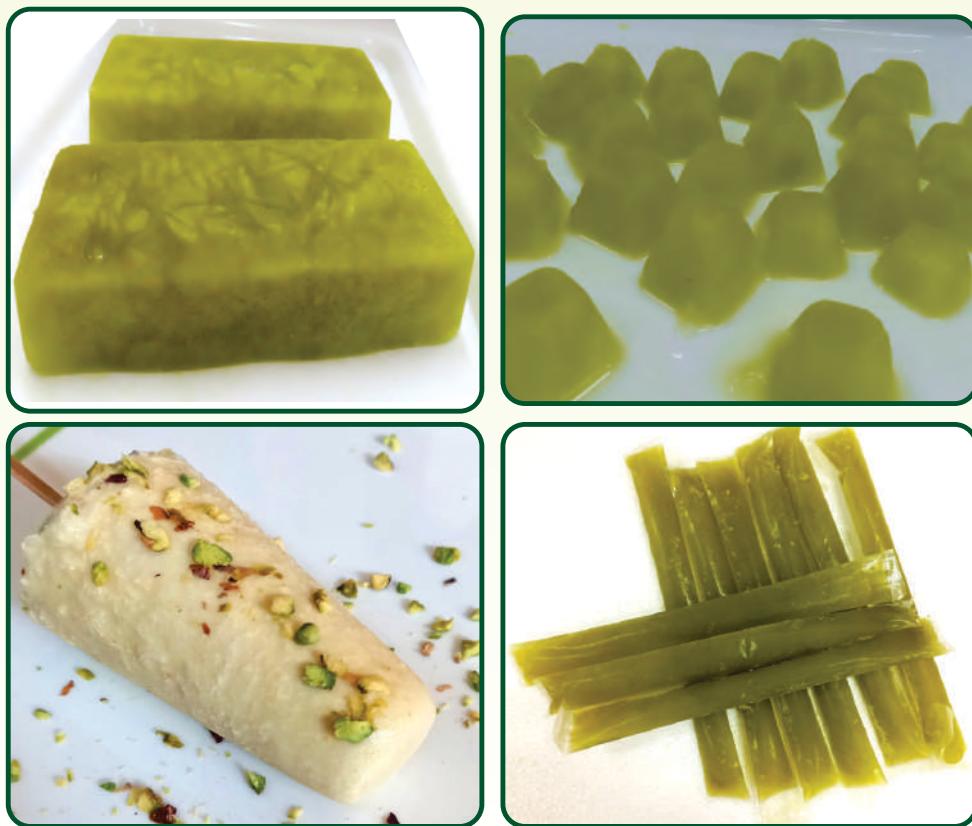
Technology has been licensed to 23 firms across the country.



## Novel frozen sugarcane juice products

G. S. Suresha, K. Hari, P. Murali, R. Lavanya, and Antony Leo

Sugarcane juice is highly perishable product. Juice cannot be stored under room conditions for long period, but can be stored in frozen condition at -20°C for about 6 to 8 months. Immediately after extraction, the juice colour tends to change from green to grey or brown due to enzymatic browning reaction of polyphenol oxidases and invertases. Likewise, when rind is not removed, pigments in the rind contribute to the juice colour which is not appealing to the eye, but juice loses the functional nutrients present in the rind if the latter is removed. Therefore, ICAR-SBI has developed several novel frozen sugarcane juice products including frozen sugarcane juice in blocks or cubes, moulded ice sticks, popsicles, kulfi, high fat ice cream, low fat ice cream and soft serve ice cream. ICAR-SBI has developed an improved novel process for extracting juice from sugarcane without removing rind, but

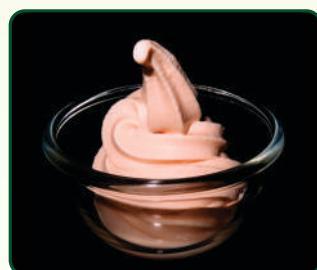
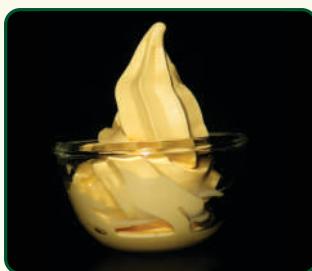


## ***Value added products***

storing the juice under frozen condition for longer period without change in colour, flavour, and other physical, biological and nutritional qualities. The frozen juice can be easily transported from one place to another without affecting the quality of juice. The frozen juice can be thawed whenever juice is required for consumption. Also, frozen blocks can be used for production of various value-added products whenever required. Juice can be used to make moulded ice sticks, popsicles etc., for consumption. Juice cubes can be added to fruit juices, cocktails and other beverages. ICAR-SBI has developed a novel process of making good quality kulfi using sugarcane juice as sweetener along with custom optimised stabilizers and emulsifiers to retain the juice flavour. ICAR-SBI has developed a process to prepare high fat ice cream using commercially available whipping cream and sugarcane juice as sweetener. ICAR-SBI has developed a process to prepare low fat ice cream directly from sugarcane juice using different combination of emulsifier and stabilizer. ICAR-SBI has developed a novel process of preparation of sugarcane juice based soft serve suitable for most of commercial soft serve machines.

### **COMMERCIALIZATION**

Technology has been licensed to three firms across the country.



## **Freeze dried sugarcane juice**

**K. Hari, G. S. Suresha, K. Sivaraman, P. Sivaraj, P. Murali**

ICAR-SBI has developed a process to produce a dry product of sugarcane juice having longer shelf life and suitable for commercial applications. The overall process involves freeze dried sugarcane juice product by employing freeze drying or lyophilization process to dry the filtered sugarcane juice followed by (a) blending natural and permitted synthetic food flavours, colour, stabilizers, anti caking agents etc., (if needed) (b) applying dry extrusion to prepare dry extrudes, (c) applying spheronization/ granulation on dry extrudes to produce spheroid/ granule product and (4) packing the spheroid/ granule product. Freeze drying is carried out at temperatures around -40 °C with 0.5 m Torr or lesser vacuum, with or without addition of other agents to obtain dry sugarcane juice powder in 12 to 48 h depending on the capacity of the freeze dryer used. The dried product is highly hygroscopic, glistening flaky or dry lumps in nature, with a water activity of about 0.3 aw. This freeze dried sugarcane juice product



## ***Value added products***

possesses consumer acceptable qualities. It can be reconstituted to juice at any time. Freeze dried sugarcane juice product is an attractive option to replace the synthetic soft drinks. Different qualities and grades of freeze dried sugarcane juice product offer wide range of uses like instant sugarcane juice mix, preparation of beverages, nutritious sweetening agent for regular use like sweetener for tea, coffee & beverages, sweetener for preparation of conventional sweets, candies, confectionery, bakery products, dairy products, weaning food and medicinal preparations. Novel foods can be prepared by this process using sugarcane juice. Special purpose freeze dried sugarcane juice product can be prepared by optionally fortifying with vitamins, minerals, nutraceuticals, herbal extracts, and medicinal / pharmaceutical substances.

**IPR:** One patent application titled “Process for the production of freeze dried sugarcane juice” (No. 202441008502) has been filed.



## Cane dietary fibre food products

**G. S. Suresha, R. Lavanya, K. Hari, P. Murali, S. D. Chandrashekhar and Bakshi Ram**

Considering the projected rise in diabetic population in India to 80 million by 2030 and wide popularity of bakery products among the young Indians and in the metros as a convenient food, transformation to new health and wellness foods is essential to add value to the food products. To diversify the use of sugarcane bagasse flour for fibre enrichment, technology was developed at ICAR-SBI to use bagasse as a source of dietary to produce array of bakery products enriched with cane fibre. Sugarcane bagasse, an abundant agricultural lignocellulosic by-product, is a fibrous residue of cane stalks left over after extraction of the juice from the sugarcane. Bagasse, obtained as a by-product of sugarcane processing, is composed of fibre, pith, insoluble solids and water. Its morphological structure is not strong in comparison with other fibres such as wood. An important advantage is that it is directly obtained and concentrated in the sugar factory as a process of by-product, thus simplifying its handling and transport operations. Thousands of tonnes of waste by-products from the sugar industry are generated annually in the form of bagasse. Bagasse is an excellent source of dietary fibre, both soluble and insoluble fibres. Bagasse flour can be introduced along with wheat flour, and can be used to prepare variety of food products. Bread, rusk and cookies are considered as a



## *Value added products*

vehicle for combating malnutrition especially in the developing world. It is to be fortified with fibre of acceptable cooking quality. At ICAR-SBI, bread, rusk and cookies were produced in different combinations of cane fibre content. The invention mainly focused on developing the process and methods to use cane fibre as source of dietary fibre in various food products. Finely ground sugarcane bagasse fibre was pretreated with alkaline solution and cocktail of enzymes to soften the fibre. The resultant flour used in different concentrations as a source of dietary fibre to produce various food products.

### **COMMERCIALIZATION**

Technology has been licensed to two firms across the country.



## Powder jaggery processing from sugarcane juice with organic clarificants

**K. Chandran, Bakshi Ram, R. Gopi, M. Nisha, B. Mahendran and P. P Gireesan**

Powder jaggery is produced from sugarcane juice by concentrating and allowing crystallization with continuous aeration to form powder or granular form. Traditional method of solid jaggery or jaggery powder making is a conventional one wherein various chemicals, clarificants and emulsifiers are used indiscriminately. Powder jaggery has advantages over block jaggery as the powder gets equilibrated at lower moisture as compared to jaggery blocks. Continuous stirring involved in making jaggery increases the crystallinity of the powder compared to solid blocks, making the product more user friendly. Jaggery powder is stable even under severe storage conditions and hence has a longer shelf life. To improve the selling potential of jaggery with better colour or appeal, manufacturers add chemical clarificants such as Hydros, sodium carbonate, sodium bicarbonate, super phosphate alum, sodium formaldehyde sulfoxylate, Tri sodium phosphate and magna floc at an indiscriminate rate. Hence, there is a necessity to improve methods to produce quality powder jaggery to tap indigenous and export market. In this direction, ICAR-SBI has developed an improved method for Powder jaggery processing from sugarcane juice with organic clarificant. Calcium carbonate is an approved constituent in organic preparation of food products by APHEDA to improve the pH of the juice. If the juice pH is higher ( $>6$ ), the addition of Calcium carbonate can be avoided. Instead of chemical clarificants, mucilage extracted from plant parts are used as clarificant. This optimized organic process ensures that product is of good quality with longer shelf life.



### COMMERCIALIZATION

Technology has been licensed to three firms across the country.



## Spray dried sugarcane juice

**K. Hari, G. S. Suresha, K. Sivaraman, S. Asokan, P. Sivaraj,  
P. Murali**

ICAR-SBI has developed a process to produce a dry product of sugarcane juice having longer shelf life and suitable for commercial applications. The overall process involves filtered sugarcane juice added with bulking agents and spray dried to a dry product following standardized process parameters. The dry product thus obtained may be blended either with natural or permitted synthetic food flavours, colour, stabilizers, anti caking agents etc. Further downstream processing carried out by applying dry extrusion and spheronization/granulation to produce a spheroid/granule product. The critical problem associated with spray drying is that sugarcane juice is high sugar material, and the sugars, due to its low glass transition temperature, results in a sticky or candy like material, not a powder product. With the standardized method and downstream processing, the juice will result in to a product with very low moisture content, good



flow ability and low hygroscopicity and has good shelf life when stored in ambient conditions and exposure to atmospheric air. The dry product can be stored about six months under ambient conditions. If stored under refrigerated conditions can be stored for more than a year. Compositional analysis indicated that this product retains all the flavour components, sugars, protein, ash, minerals, vitamins, phenol, flavonoids and antioxidant activity. Organoleptic test indicated that the product is comparable with fresh sugarcane juice. This product can be used for production of healthier products for human consumption like preparation of instant sugarcane juice or as a regular sweetener. This dry sugarcane juice product is also useful as flavour enhancer of food, beverages, sweets, confectioneries, bakery items, dairy products, weaning food, novel value-added foods, and medicinal/pharmaceutical preparations.

**IPR:** Two patents were filed for “Method for preparing spray dried sugarcane juice” (No. 1829/CHE/2006), and “Process for preparation of sugarcane juice powder” (No.1309/CHE/2011)

### **COMMERCIALIZATION**

Technology has been licensed to one firm across the country.



### **Freeze preservation of sugarcane juice with natural additives**

**K. Chandran, R. Gopi, M. Nisha and B. Mahendran**

Sugarcane juice is one of the healthiest fresh juices widely consumed in our country. Besides, being a nutritious drink containing natural sugars, minerals, and organic acids, sugarcane juice is a good energizing drink with good medicinal properties. Sugarcane juice strengthens the digestive and excretory systems and stimulates the brain and reproductive systems. It is also used for gaining weight and is a rich source of iron. The present method was standardized by quick freezing of the juice and adding the organic substances which prevent polyphenol oxidation and avoid spoiling under storage. The calorific value was maintained low by choosing the varieties with low sugar/the traditional varieties of chewing canes. A certain amount of inversion happens in the presence of citric acid available in lemon juice, which also adds to the refreshing taste. The addition of fresh spices and herbal extracts helps to buildup immunity and adds potential health benefits. The juice can be consumed not only as an energizer but at the same time



as a healthier drink. This technology is a foolproof method for preserving sugarcane juice without any preservatives or chemical additives by maintaining colour, quality, and freshness with a shelf life of over three months under frozen conditions. Frozen sugarcane juice with natural additives has the following advantages viz., keep freshness and raw taste over a period of three months, transportable as juice without a freezing chamber, make it available round the clock, easy to maintain the hygienic condition, no loss of sugar content due to microbial action or inversion, no loss of nutrients, enhanced medicinal value of natural additives promote consumers of all age groups, and lastly no preservative or chemical additives at any point of the process.

## **COMMERCIALIZATION**

Technology has been licensed to one firm across the country.



### **Production of sugarcane wine with different fruit blends**

**K. Chandran, G.S. Suresha, K. Hari, R. Gopi, M. Nisha, B. Mahendran, R. Lavanya, R. P. Murali and G. Hemaprabha**

Sugarcane wine is an alcoholic beverage made from sugarcane juice without the addition of white sugar. Sugarcane wine is known to have many nutritional benefits. It promotes healthy digestion by acting as a digestive tonic. When compared to refined sugar, using sugarcane juice has many health benefits and a cheaper sweetener. So, it is ideal to use sugarcane juice as a source of sugar for the fermentation process. Sugarcane wine promotes weight loss as it is high in soluble fibre and helps in removing bad cholesterol from the body. Sugarcane wine has a considerable amount of minerals such as calcium, phosphorous, and magnesium. The benefits of sugarcane wine make it a good alternative to other liquors. This technology developed at ICAR-SBI mainly focused on preparation of sugarcane juice-based wine along with different fruits blends. Wine prepared exclusively from sugarcane juice lacks the aroma and colour, with low alcohol content (<10%). Blending fruit pulps with sugarcane juice is the novel step to ensure optimum alcohol content. Sugarcane juice-based wine will have better acceptability, flavour and colour when blended with fruit pulps. The flavour from the fruit will mask the odour of fermented sugarcane juice. Commercially available fruits like grapes, pomegranate, banana and pineapple were used to blend with sugarcane juice.



## Process of ice cream preparation based on sugarcane syrup and powder jaggery

M. Nisha, K. Chandran, R. Gopi and B. Mahendran

Though desserts like ice creams are being relished by all people irrespective of age, lifestyle diseases like diabetes restrict the use of sugar intake and stop many people from consuming ice creams. Thus, replacing the sugar in ice cream preparation with healthy sweeteners can help people to have their favourite ice creams without any worry about the sucrose content. ICAR-SBI has developed two methods to prepare ice cream from sugarcane syrup/ powder jaggery and sugarcane juice replacing the sugar in the ice cream with a healthier form of sugar. (i) In this method, commercially available whipping cream (can be with or without sugar), evaporated milk sweetened with organically prepared powder jaggery/ sugarcane syrup and flavouring agents (chocolate or butterscotch) are used. The milk is condensed by boiling to reduce the volume to one-third and further sweetened with the powdered jaggery/ sugarcane syrup. The ice cream is garnished with caramel prepared from sugarcane syrup. The sucrose content in the ice cream ranged from 14.1 to 17.3%. (ii) In this method, concentrated fresh sugarcane juice mixed with corn flour is used. The juice is concentrated by boiling to increase the Brix%. During the preparation sugarcane syrup/ powder jaggery is also added to the mixture to increase the sweetness. In this process, juice is extracted from the fully matured sugarcane with a brix >20%. Other flavours are not added to retain the actual flavour of sugarcane juice. The sucrose content in this ice cream ranged from 21.3 to 22.8%. Other nutritional parameters estimated were 166 Kcal energy, 8.99 g fat, 192.8 mg calcium, 5.5 mg iron, 0.43 g crude fibre and 1.0 mg zinc per 100 g of ice cream.



## Powder jaggery based, fortified cookies and cakes

**K. Chandran, R. Gopi, M. Nisha, B. Mahendran, C. Keerthi and G. Hemaprabha**

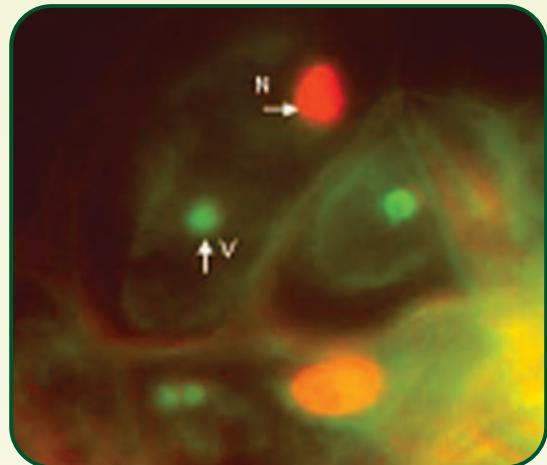
The common method of cookies and cake preparation is invariably based on refined, bleached wheat flour (maida) and white sugar, which are considered unhealthy on regular consumption. Tea cakes and “Chay biscuits” are developed as brands based on their common usage along with tea. In this technological intervention, ICAR-SBI have formulated the batter either with maida fortified with rice bran (for dietary fiber and other nutrients) or using sole wheat flour. The sweetener used was organically processed powder Jaggery with better nutrient values. The technology involves replacing maida and white sugar, by baking foods with healthy sugar as well as sole wheat flour or maida fortified with fibre-rich rice bran. The sweetening agent was prepared organically by heat processing the sugarcane juice to powder jaggery. The rice bran was heat stabilized to avoid rancidity. Sugarcane juice was boiled, clarified with organic clarificants, concentrated at a temperature up to 132°C and stirred continuously to make a fine powder. This powder is used for making the cookie dough and cake batter.



## **Vacuolar targeting of proteins to the lytic vacuoles of sugarcane for molecular farming**

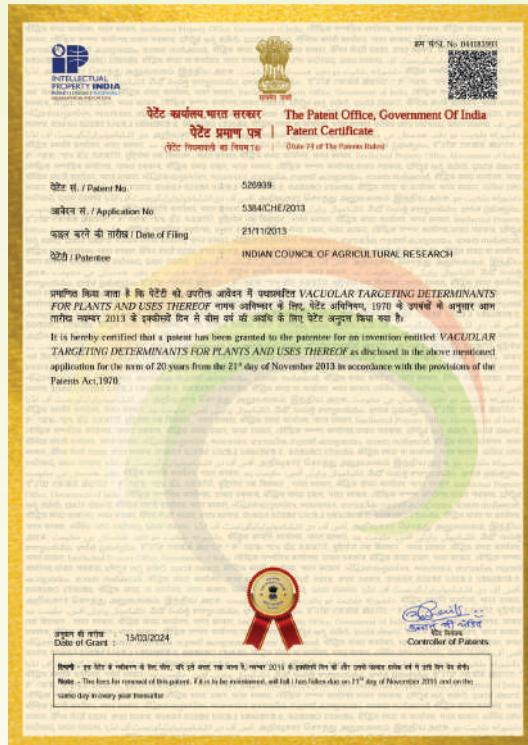
**P. S. Divya, N. Subramonian and P. Harunipriya**

There is a growing interest in using plants as a platform to produce high value protein molecule such as therapeutic proteins, vaccines, etc. Sugarcane, being a monocot C4 plant is a suitable candidate as a platform for molecular farming due to its huge biomass production, availability of a large above-ground storage tissue in the form of parenchyma cells with a large storage space in the vacuole that stores sugar. In addition, sugarcane has many significant advantages for transgene product containment that makes it a "safe" platform to produce high value molecules. Sugarcane juice is stored in the vacuoles which occupy about 80% of the parenchymatous storage cells in the stem. Sugar is stored in lytic vacuoles. To produce any high value molecules, these should be targeted to the vacuole to extract and purify the protein of interest from the juice. This has prompted ICAR-SBI to identify a vacuolar targeting determinant that would be helpful to use sugarcane as a platform for molecular farming. Through *in silico* analysis, a novel vacuolar targeting determinant was identified and the gene was synthesized. Using this vacuolar targeting sequence, sugarcane transgenics were developed with three candidate gene (genes coding for *gfp*, *aprotinin* and *gus*) and vacuolar targeting of these proteins were demonstrated and these proteins (aprotinin and *gus*) were extracted and purified from the transgenic sugarcane juice, thus demonstrating applicability of this technology. Moreover, these proteins were stable and biologically active. This technology is expected to be highly useful to use sugarcane as a platform for molecular farming for the first time.



## Molecular Technology

**IPR:** A patent has been obtained for this technology No. 3323/CHE/2011 titled “Rapid treatment for planting materials of sugarcane and other vegetative propagative crops”.



## COMMERCIALIZATION

Technology has been licensed to one firm across the country.

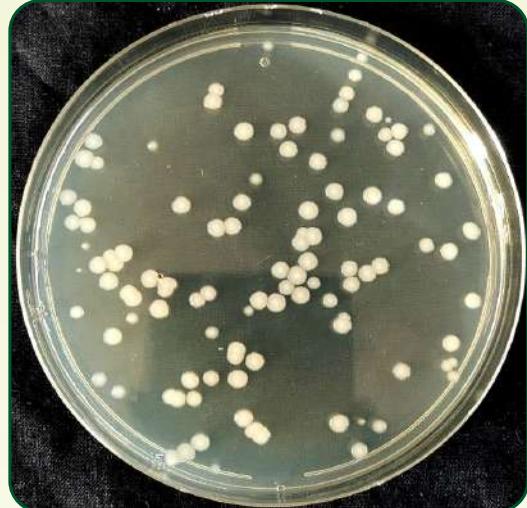


## Novel *Bacillus thuringiensis* (Bt) crystal toxin genes for transgenic crop development

B. Singaravelu, P. Mahesh, J. Srikanth, K. Hari,  
C. Sankaranarayanan, G. S. Suresha, C. Appunu, R. Nirmala  
and M. Rajeshkumar

*Bacillus thuringiensis* is a gram-positive bacterium which produces several toxins that are toxic to several insect orders and other phyla. The genes producing these toxins are widely used in the development of insect resistant transgenic crops. At ICAR SBI, soils from different ecosystems and various states were prospected for novel Bt isolates

harbouring novel toxin genes. Such prospecting efforts lead to the isolation of three novel Bt isolates producing novel crystal toxin genes. Bt isolate Bt 62 is novel Coleopteran active isolate producing Cry 8 toxin protein that are toxic to the white grub *Holotrichia serrata* which a polyphagous pests infesting sugarcane, groundnut and other important agricultural as well as horticultural crops. One of the Cry8 toxins produced by Bt 62 has been found toxic to *H. serrata* and currently being used in the development of white grub resistant transgenic sugarcane. Bt 41 is another coleopteran active Bt isolate isolated by us which produce two novel Cry8 toxins. Bioassays with this isolate revealed it toxicity towards to grubs of Coconut rhinocerous beetle *Oryctes rhinoceros*, Cotton stem weevil *Pempherulus affinis* and White grub *Holotrichia sikkimensis*. The Cry 8 toxin genes from this isolate is being currently evaluated against Cotton stem weevil. SBI KK 27 is lepidopteran active Bt isolate isolated at ICAR-SBI which carries 7 toxin genes out of which two are novel Cry1 toxin subfamily genes. One of the



## *Molecular Technology*

subfamilies cry1 gene was found toxic to the Bollgard resistant pink boll worm of cotton. Bt 8 another isolate producing Cry 9 toxin protein was also identified at ICAR-SBI for development of transgenic against sugarcane borers belonging to the genera Chilo.

**IPR:** The original culture deposits of Bt 62 (NAIMCC-IDA-3), SBI KK 27 (NAIMCC-IDA-4) and Bt 41 (NAIMCC-IDA-7) were made in compliance with the BUDAPEST treaty for the purpose of patent with the International Deposit Authority at National Agriculturally Important Microbial Culture Collection, ICAR-NBAIM, Uttar Pradesh

## **COMMERCIALIZATION**

Technology has been licensed to one firm across the country.



**For licence terms and technical information of technologies,  
interested individuals / parties / firms / companies etc.,  
to kindly contact**

**The Director**

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## *Notes*





## *Notes*





**ICAR Sugarcane Breeding Institute**  
**Coimbatore 641007,**  
**Tamil Nadu, India**

A standard barcode graphic consisting of vertical black bars of varying widths, used for identification and tracking.

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