IAPSIT. ISC-2026
Nanning . PR China

# Souvenir de Presentation

## 9th IAPSIT International Sugar Conference (ISC 2026) & Sugarcon 2026

***Next-Gen Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation***

**Venue: Nanning Hotel, Nanning, Guangxi, P.R. China**

**November 17-20, 2026**




**Compiled by**

G.P. Rao
S. Solomon
Yang-Rui Li
Dong-Liang Huang
Prakash Lakshmanan


**ISC-2026**
P.R. China
www.sugarcon2026china.com

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IAPSIT

# International Association of Professionals in Sugar and Integrated Technologies (IAPSIT)

## Objectives

- To bring together professionals and organizations related to sugar crops research, production, processing, energy, socio-economic and environmental issues.
- To facilitate linkages and a network among members, scientific organizations and non-government organizations to disseminateup-to-date and relevant technology/information needed for the sugar industries through organizing specialized workshops. seminars, meetings and the exchange of professionals.
- To identify a host country and extend technical support in organizing the International Symposium every two years.
- The IAPSIT Secretariat will approach the government, sugar industry and integrated organizations of the host country to obtain sponsorship for such a symposium.
- To publish a newsletter as part of the Sugar Tech journal, highlighting sugar and integrated industries news from across the developing sugar-producing countries, technological updates, scientific meetings, workshops and other relevant environmental and socio-economic issues
- To support research and development projects and extend services in the environmental and social welfare activities, especially in the areas and communities supported by the sugar industry and to assist in relief work in times of need.
- To provide a base for the affiliation with and of international, national or local relevant societies of sugar crops with the IAPSIT.

**Membership of IAPSIT :** Individual members: Any professional who has an interest in the objectives of the IAPSIT is eligible for membership. Membership will be approved by the EC. Individual membership fee is US $100 for three years.

**Fellow members:** Fellowship will be conferred upon individual members who have distinguished themselves in the sugar and integrated industries and have made an outstanding contribution to the LAPSIT. Fellows shall not be required to pay dues and will enjoy full status in the Association. They shall be nominated by the EC and conferred by the President.

**Association members:** Other societies of sugar crops and integrated technologists represented by an affiliated member. The Association membership fee is US$500 for three years.

**Institutional members:** Research institutions, universities, industrial and commercial organizations willing to support the objectives of the IAPSIT. The Institutional membership fee is US$450 for three years.

## IAPSIT Executive Committee (2026-2027)

President : Dr. YR. Li

Vice-President : Dr. S. Solomon, India

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# Foreword

The global sugar industry stands at a critical crossroads, confronted by an increasingly volatile and challenging operating environment. Fluctuating production and consumption patterns, geopolitical tensions, trade barriers, tariff wars, market uncertainties and escalating production costs are reshaping the global sugar economy. These challenges are further compounded by climate change, erratic rainfall, prolonged droughts, rising temperatures, water scarcity and the growing incidence of pests and diseases, threatening sugarcane productivity and industrial sustainability across major producing regions. Simultaneously, the sector faces mounting pressure to enhance resource-use efficiency, reduce its environmental footprint, ensure remunerative returns to farmers, strengthen mill viability and respond to the rapidly evolving global energy transition. Addressing these interconnected challenges demands a paradigm shift towards science-driven innovation, technological transformation, enabling policies and strategic international partnerships.

Next-generation technologies will be instrumental in redefining the future of sugarcane agriculture and processing industries. Advanced breeding approaches, including molecular breeding, genomic selection, genome editing and biotechnology, offer unprecedented opportunities to develop high-yielding, climate-resilient, disease-resistant and resource-efficient varieties. The integration of artificial intelligence, precision agriculture, remote sensing, drone-based surveillance, digital decision-support systems and smart mechanization can revolutionize crop monitoring, farm management and input-use efficiency. Equally critical are climate-smart production systems encompassing integrated nutrient and water management, conservation agriculture, biological crop protection and sustainable agronomic practices. On the industrial front, transforming conventional sugar mills into integrated bio-refineries represents a strategic imperative. Scientific and commercially viable technologies for the efficient utilization of sugarcane biomass, industrial by-products and renewable energy resources can unlock new value chains encompassing bio-ethanol, sustainable aviation fuel, bio-CNG, green power, biochemicals and bioplastics. Realizing this transformation requires a strong and sustained convergence of research institutions, universities, industry, policymakers and farming communities, ensuring that scientific breakthroughs translate into scalable, commercially viable solutions.

Against this backdrop, the 9th IAPSIT International Sugar Conference (ISC-2026) & Sugarcon-2026, under the theme *"Next-Gen Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation,"* assumes particular significance. It provides a distinguished international forum for scientists, researchers, sugar technologists, industry leaders, policymakers and development agencies to exchange knowledge, showcase technological advances and collectively shape the future direction of the global sugar sector. Bringing together expertise from more than 15 major sugarcane- and sugar-producing countries, the conference will address critical priorities spanning genetic improvement, climate-smart agriculture, mechanization, digital transformation, crop protection, sustainable processing, bioenergy, product diversification and emerging industrial technologies.

We are confident that the scientific deliberations, technological exchanges and strategic recommendations emerging from this conference will help shape a forward-looking roadmap for a resilient, diversified, sustainable and globally competitive sugar industry. By placing scientific excellence, innovation and international collaboration at the heart of its transformation, the global sugar sector can convert emerging challenges into unprecedented opportunities and strengthen its contribution to sustainable agriculture, renewable energy and the expanding bioeconomy.

We express our sincere appreciation to the International Association of Professionals in Sugar and Integrated Technologies (IAPSIT); the Sugarcane Research Institute, Guangxi Academy of Agricultural Sciences, Nanning, China; the Society for Sugar Research & Promotion, New Delhi, India; and all collaborating organizations, host institutions, sponsors, distinguished speakers, participating scientists and members of the organizing committee for their invaluable support and commitment. We extend a warm welcome to all delegates and participants to ISC-2026 and wish the conference resounding success, impactful deliberations and an enriching scientific experience.

**S. Solomon**
**Prakash Lakshmanan**
**Yang-Rui Li**
**Dong Liang Huang**
**Govind P. Rao**

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Date : November 5, 2026

# Message



The global sugar industry is at a critical juncture, balancing food security, farmers' livelihoods, industrial competitiveness and the transition towards renewable energy. According to the Food and Agriculture Organization of the United Nations (FAO), global sugarcane production exceeded 2 billion tonnes in 2023, while the United States Department of Agriculture (USDA) forecast global sugar production at approximately 186 million metric tonnes for the 2025–26 marketing year. Developing nations, particularly India, China, Vietnam, Indonesia, Thailand and Pakistan, play a pivotal role in global sugarcane and sugar production, employment generation and rural economic growth. In these countries, sugar industry supports millions of farming households and sustains extensive agro-industrial networks. However, the industry faces persistent challenges, including fluctuating sugar prices, rising production costs, uncertain water availability, climate variability, low and inconsistent farm productivity, and pressure to improve environmental performance. Differences in cane yield, sucrose content, sugar recovery and resource-use efficiency also reveal substantial opportunities for improvement. The priority must therefore be to build a more productive, economically viable and resilient sugar industry that benefits farmers as well as processors, while responding to changing market demands and sustainability imperatives.

Next gen technologies such as artificial intelligence, remote sensing, drones, the Internet of Things and digital decision-support systems can strengthen crop monitoring, optimise resource use and improve operational efficiency, provided these technologies are affordable and supported by effective extension services. At the factory level, automation, energy efficiency, improved process control and data-driven management can enhance sugar recovery and profitability. Equally important is diversification beyond conventional sugar production. Bioethanol, biomass-based electricity, sustainable aviation fuel (SAF), biochemicals and other bio-based products offer opportunities to diversify revenues and advance the transition towards a circular, sugarcane-based bioeconomy.

The 9th IAPSIT International Sugar Conference (ISC-2026), scheduled for 17–20 November 2026 in Nanning, Guangxi, People's Republic of China, under the theme "Next-Generation Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation," will highlight these technologies, strengthen partnerships and address common challenges. I extend my sincere appreciation to IAPSIT, SSRP, GXAAS, the Sugarcane Research Institute and all supporting organisations, scientific contributors, sponsors and international partners for their efforts in bringing this global gathering together.

I wish ISC-2026 every success and look forward to its contribution to a sustainable future for sugarcane, sugar and the wider bioeconomy.

Yangrui Li

**Yang-Rui Li**
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Date : October 29, 2026

# Message



The global sugar industry stands at a defining moment in its evolution. Sustainability, scientific innovation and economic resilience must now converge to transform the sector into a competitive, diversified and future-ready bioeconomy. Amid climate change, water scarcity, energy transition and market uncertainties, the industry must move beyond conventional sugar production and fully harness the extraordinary potential of sugarcane as a renewable biological resource.

Sugarcane offers far more than sugar. It provides a strategic foundation for expanding bioethanol, Sustainable Aviation Fuel (SAF), Bio-CNG, biomass-based power, biochemicals, bioplastics and other high-value products. Realising this potential can reduce dependence on fossil fuels, promote circular bioeconomy models, strengthen rural livelihoods and accelerate progress towards the United Nations Sustainable Development Goals (SDGs).

However, this transformation will not happen through incremental improvements alone. It demands a decisive shift towards climate-smart agriculture, precision farming, mechanisation, artificial intelligence, digital technologies, water and energy efficiency, advanced biorefineries and the sustainable utilisation of biomass and industrial by-products. Equally critical is stronger collaboration among farmers, researchers, sugar mills, technology providers, policymakers and investors. The future of the sugar industry will depend on how effectively we translate scientific knowledge into field-level impact, industrial innovation and measurable economic and environmental gains.

The 9th IAPSIT International Sugar Conference (ISC-2026**)**, to be held from 17–20 November 2026 in Nanning, Guangxi, under the theme *"Next-Generation Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation,"* comes at a particularly opportune time. By bringing together international experts, researchers, industry leaders and policymakers, the conference will provide a vital platform for sharing breakthroughs, forging strategic partnerships and developing actionable solutions across the sugar value chain.

Supported by IAPSIT, SSRP, GXAAS and collaborating research and industry organisations, ISC-2026 reaffirms the importance of global cooperation in shaping a resilient, innovative and sustainable sugarcane-based bioeconomy.

I commend the organisers, scientific contributors, sponsors and international partners for their commitment to this important initiative. I warmly welcome all delegates to Nanning and encourage them to turn dialogue into collaboration, innovation into implementation, and shared vision into tangible progress.

I wish ISC-2026 every success in advancing a stronger, smarter and more sustainable global sugar industry.

**(S.Solomon)**

**Dr. G.P. Rao**
**ICAR-Emeritus Scientist**
**(Crop Protection)**
**Secretary, SSRP & IAPSIT**

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# Message from Organizing Secretary



The sugar industry sustains millions of farming families, generates employment and drives industrial growth and rural development, particularly across South and Southeast Asia. Amid climate change, resource constraints, market volatility and the transition towards a low-carbon economy, its future depends on enhancing productivity, farmers' incomes and resource-use efficiency while safeguarding the environment. Achieving these goals requires climate-resilient varieties, quality planting material, effective pest and disease management, precision agriculture, mechanisation, digital technologies and advanced industrial automation.

Beyond conventional sugar production, sugarcane offers immense potential for bioethanol, Sustainable Aviation Fuel, renewable electricity, biochemicals, bioplastics and other value-added products. Integrated biorefineries and circular resource management can diversify revenue streams, minimise waste and reduce carbon emissions, transforming the industry into a sustainable and competitive bioeconomy.

The 9th IAPSIT International Sugar Conference (ISC-2026), being held from 17–20 November 2026 in Nanning, Guangxi, People's Republic of China, provides an important international platform to exchange knowledge, foster partnerships and advance innovative solutions for a productive, diversified and climate-resilient sugar industry.

I sincerely appreciate IAPSIT, SSRP, GXAAS, the Sugarcane Research Institute, Nanning and all supporting organisations for their valuable contributions to this important global gathering. I warmly welcome all delegates to Nanning and wish them fruitful deliberations and lasting collaborations.

It is particularly gratifying to celebrate 20 glorious years of IAPSIT and to felicitate its President, Prof. Yang-Rui Li, a founder member who played a pivotal role in establishing the association in 2004. I extend my heartfelt wishes for his continued good health, happiness and an active, fulfilling life.

May ISC-2026 inspire scientific excellence, technological innovation and international cooperation for a sustainable future of the global sugar industry.

I wish ISC-2026 a grand success.

Date : November 12, 2026

**(Govind Pratap Rao)**
Organizing Secretary,
ISC-2026 & Sugarcon 2026

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Dated : November 15, 2026

# Message



The sugar industry is entering an era in which incremental improvements may no longer be sufficient to meet the demands of the future. With growing pressure to increase productivity, reduce production costs and withstand climatic uncertainties, we must ask ourselves some fundamental questions: Are our current research approaches delivering the gains the industry needs? Are the solutions we develop reaching the farmers who need them most? And are we investing enough scientific effort in addressing the underlying causes of the industry's persistent productivity constraints? These questions deserve serious reflection as we chart the next phase of development of the global sugar sector.

One concern is the persistent yield plateau in sugarcane despite decades of breeding and molecular research. This situation calls for a critical reassessment of our strategies for genetic improvement and a willingness to explore fundamentally different approaches to unlocking the crop's yield potential. At the same time, many crop-management practices capable of improving productivity are already available, yet their implementation remains inconsistent and limited across production systems. The challenge, therefore, is not always the absence of technology, but our ability to make existing knowledge work effectively under real-world conditions. Equally concerning is the wide gap between achievable and actual yields. Closing this gap deserves to be a major research and development priority, particularly as climate change makes production increasingly uncertain and threatens the stability of farmers' income.

These issues lie at the heart of the theme of the 9th IAPSIT International Sugar Conference (ISC-2026), *"Next-Generation Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation."* The conference offers an opportunity to move beyond familiar discussions, challenge prevailing assumptions and identify new research priorities that can deliver tangible outcomes. I hope our deliberations will encourage fresh scientific thinking, greater accountability for technology adoption and a stronger commitment to translating research investments into measurable improvements in productivity, resource-use efficiency and climate resilience.

I sincerely appreciate the efforts of IAPSIT, SSRP, GXAAS, Guangxi Sugarcane Society, and the host Sugarcane Research Institute, and the organising team, and all scientists, industry representatives and supporting organisations contributing to this important gathering. I warmly welcome the delegates to Nanning, Guangxi, China, and hope that the conference will stimulate candid discussions, inspire bold ideas and establish lasting partnerships. Above all, I hope it help us define a more ambitious and practical direction for the future of the sugar industry, one grounded in scientific innovation, effective implementation and tangible benefits for farmers, millers and all industry stakeholders.

I wish the 9th IAPSIT International Sugar Conference every success.

With best wishes,

**(Prakash Lakshmanan)**
Conference Convenor

**Dr. Dong-Liang Huang**
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Guangxi Academy of Agricultural Sciences
Director, Key Laboratory of Sugarcane Biotechnology and Genetic Improvement (Guangxi), Ministry of Agriculture and Rural Affairs, P.R. China
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Dated : November 15, 2026

# Message



For millions of farmers across developing countries, particularly in South and Southeast Asia, the sugar industry supports livelihoods, employment, and rural transformation. As the world confronts climate change, resource scarcity, volatile markets and the transition towards low-carbon economies, a defining question emerges: How can we produce more sugar, generate greater value and enhance farmers' prosperity while conserving natural resources and protecting the environment? The scale of the opportunity is enormous. According to the Food and Agriculture Organization of the United Nations, global sugarcane production exceeded 2 billion tonnes in 2023, while the United States Department of Agriculture forecast global sugar production at approximately 186 million metric tonnes for the 2025/26 marketing year. These figures highlight the importance of sugarcane to global agriculture and industry. For developing economies, sustainable growth of sugar industry is essential to improve farmers' incomes, energy security, industrial competitiveness and rural development.

Achieving these objectives requires a transition towards science-led, technology-enabled and climate-resilient production systems. The industry faces mounting biotic challenges, including emerging and evolving diseases and pests, and varietal degeneration, alongside recurring abiotic stresses such as drought, heat waves, waterlogging, and nutritional imbalances and unpredictable weather patterns. Addressing these threats requires resilient varieties, quality planting material, integrated crop management, precision agriculture, mechanisation, and robust surveillance systems. Digital technologies, artificial intelligence, remote sensing, and advanced factory automation offer further opportunities to improve industry productivity and profitability. Equally important is product diversification beyond sugar production. Sugar industry by-products can serve as renewable feedstocks for bioethanol, Sustainable Aviation Fuel, electricity, biochemicals, bioplastics and other value-added products. In this context, the 9th IAPSIT International Sugar Conference (ISC-2026), scheduled for 17–20 November 2026 in Nanning, Guangxi, P.R.China, under the theme *"Next-Generation Challenges, Opportunities & Future-Proofing the Sugar Industry through Innovation,"* provides an important platform to advance these priorities.

I firmly believe that the future of the global sugar industry will depend on our ability to boost scientific excellence, technological innovation and industry collaboration to maximise productivity sustainably. Research institutions, universities, industry and governments must work together to translate scientific discoveries into affordable technologies that benefit farmers, millers and society. By fostering dialogue among leading research organisations and sugar-producing countries, ISC-2026 can advance research, technology adoption and the transition towards a diversified, competitive and climate-resilient bioeconomy. I extend my sincere appreciation to IAPSIT, SSRP, GXAAS, the Sugarcane Research Institute and all supporting organisations, scientific contributors, sponsors and international partners for their valuable efforts in convening this important global gathering. I warmly welcome all delegates to Nanning, Guangxi, and wish them productive deliberations, fruitful collaborations and a pleasant stay. May ISC-2026 serve as a catalyst for scientific excellence, technological transformation and international cooperation, accelerating the development of a more productive, sustainable and climate-resilient sugar industry worldwide.

I wish every success for the 9th IAPSIT Conference.
Best Wishes

**Dr. Dong-Liang Huang**
**Organizing Secretary**
**ISC-2026 & Sugarcon-2026 Conference, Nanning, China**

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# 27 Years of Glorious Journey of Sugar Tech (Springer Nature): Serving the Global Sugar and Integrated industries

The golden record of any publication is a delightful moment to look back to the significant historical achievements and also plan towards a better future. The **Sugar Tech** journal (Springer Nature; www.springer.com/journal112355; ISSN-0972-1525) has successfully completed its 27 years of glorious journey. The first Editorial Board and Advisory Board were constituted and the first issue (Vol. 1 & 2) was published in 1999, with 10 articles. The Sugar Tech journal became an official publication of Society for Sugar Research & Promotion, New Delhi since 1999 and International Conferences organized by IAPSIT, China since 2004.




In 2008, Springer-Nature, took over the publication of Sugar Tech as co-publisher with four issues a y which was subsequently increased to six issues in 2020 which became breakthrough and a milestone in the journey of Sugar Tech. On time publication of high quality papers during the last two and half decades (1999-2026) was our main priority. Special theme based special issues were also planned to increase the visibility and scope of the journal worldwide. At present, Sugar Tech is published as a peer reviewed bi-monthly research journal, with high quality research articles and reviews on the innovative and eco-friendly technologies related to the sustainability, improvement, production, processing and valorization of sugar crops (sugarcane, sugar beet, sweet sorghum, stevia, palm sugar, etc) and their by products & co-products, aligning with the spirit of SDGs. It is one of the leading journals in the world on sugar crops and ancillary industries with current ISI Impact Factor of 1.9 (2025), over 2,22,800 downloads per year, Scopus h-index of 51 and quartile (Q2) along with circulation in over 130 countries.

The journal is cited in more than fifty international citation services, with ISI Thomspon Reuters, SCOPUS, Google Scholar, INSDOC, Elsevier Biobase, Dimensions, Indian Science Abstracts, SCImago, Science Citation Index, Expanded, Chemical Abstracts Service (CAS), Google Scholar, AGRICOLA, CAB Abstracts, CNKI, Current Contents/ Agriculture, Biology & Environmental Sciences, EBSCO Discovery Service, Elsevier Biobase, EMBiology, Expanded Academic, Japanese Science & Technology, OCLC WorldCat, Pro Quest, Meta, Naver, OCLC World Cat Discovery Service, Portico, Wanfang etc. The high IF has also led to a dramatic increase in the number of international submissions, from more than 75 countries worldwide. It is encouraging to see Sugar Tech articles being cited by the major internationally recognized high Impact journals and many other publications, reflecting its high standard and content of the research publications (www.springer.com/journal112355).

The editors, advisory and executive board members, reviewers and authors are the real strength who constantly ensured the quality standard of the papers being published. We would like to extend our sincere thanks to all those who have helped in sustaining the quality and ensuring timely publication of all the issues and also look forward for this supporting spirit in the coming years too. We would also like to thank Springer Nature Pvt. Ltd. for co-publishing Sugar Tech, which has become a milestone for recognisation and acceptance of the journal to worldwide audience. We are hopeful that Sugar Tech will reach the pinnacle of expectations of authors working in the area of sugar crops,

## Glimpses of International Sugar Conferences


IS 2004, Nanning, China


IS 2011, New Delhi, India


IS 2006, Guilin, China


IS 2022, Lucknow, India



IS 2018, Udon Thani, Thailand


IS 2006, Guilin, China



IS 2011, New Delhi, India


IS 2011, New Delhi, India



IS 2008, Al-Ahrish, Egypt


IS 2006, Nanning, China

sugar processing, technologies, bioenergy and by-products etc. Currently, a large number of articles published in Sugar Tech journal address social, environmental, and economic issues related to the SDGs.

So far, Sugar Tech has published more than 2,381 articles, including research articles, reviews, short communications, scientific correspondence, opinions, editorials and news,


IS 2022, Lucknow, India


IS 2008, Al-Ahrish, Egypt


IS 2011, New Delhi, India



IS 2018, Udon Thani, Thailand


IS 2006, Nanning, China


IS-2024, Quy Nhon, Vietnam

along with 12 special issues over the last 27 years. In the 2026 Journal Citation Reports, the journal has an Impact Factor of 1.9 and a 5-year Impact Factor of 2.0. It ranks 60/133 by JCI in the Agronomy category, which places it in Q2 with a JCI percentile of 54.9%. The journal also has a Scopus h-index of 51 and an SJR (2025) of 0.45. In total, Sugar Tech has received 11,100 citations.

Besides publication of scientific articles related to sugar and integrated industries, Sugar Tech journal has also promoted various conferences especially those organized by IAPSIT and SSRP. Our journey of excellence with Sugar Tech started in 2004 with the International Symposium on Sustainable Sugarcane and Sugar Production Technology held at Nanning, from 29th November to 2nd December, 2004. Since, then the Sugar Tech journal became an official publication several International Conferences organized by IAPSIT

As Editors-in-Chiefs of Sugar Tech and Executive Chief Editors at present, it becomes our moral responsibility to ensure continuity of the activities of Sugar Tech and SSRP/IAPSIT with greater zeal and dedication. We would like to thank our eminent editorial board members round the world, who have been instrumental in supporting the editorial activities of Sugar Tech. On behalf of the SSRP and IAPSIT, we welcome all the delegates to ISC-2026, Nanning, PR China from November 17-20, 2026 and hope that you will continue to patronize **Sugar Tech** for publishing your valuable research and review articles. Our sincere greetings and thanks to the esteemed contributors, readers and the publisher.

**G. P. Rao, Chief Executive Editor**

**S. Solomon, Chief Executive Editor**
**Prakash Lakshmanan, Editor-in-Chief**
**R. Viswanathan, Editor-in-Chief**
**www.ssrp.net, www.springer.com/12355**



# Technical Session - I

## Future-proofing Sugar Crop Production

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## PLENARY LECTURES

**PL-I-01**

# Introduction of Chinese Sugar Industry

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In China, the main sugar crops are sugarcane and sugar beet. Sugarcane is produced in Southern China, which provides 87-94% of the total sugar in China. Sugar beet is produced in Northern China, which provides 6-13% of the total sugar in China. In 2025/2026 milling season, he total sugar production in China was 13.28 MT, 1.90 MT or16.68% higher than that in the previous milling season. Among it, cane sugar production was 11.65 MT, 1.86 MT or 18.68% higher than that in the previous milling season; beet sugar production was 1.63 MT, 0.04 MT or 2.16% higher than that in the previous milling season. In 2025/2026 milling season, there were 178 mills in operation. Among them 149 are cane mill while 29 beet mill. The total millable crop tonnage was 105.95 MT in 2025/2026 milling season, which was 18.96 MT or +21.79% higher than that in the previous milling season. Among it, the total millable cane tonnage was 92.24 MT, 18.93 MT or +25.93% , which was , 18.93 MT or +25.93% higher than that in the previous milling season; the total millable beet tonnage was 13.71 MT, which was 3.70 MT or 0.27% higher than that in the previous milling season. The total sugar recovery was 12.53% in 2025/2026 milling season, which decreased by 0.34 percent points than that in the previous milling season. Among it, the cane sugar recovery was 12.63% , which was decreased by 0.48 percent points than that in the previous milling season; the beet tonnage was 11.86, which decreased by 0.28 percent point than that in the previous milling season. The industrial crop yield was 75 t/ha in 2025/2026 milling season, which increased by 7.4 t/ha or 10.86% than that in the previous milling season. Among it, the millable cane yield was 77.3 t/ha, which increased by 8.4 t/ha or 12.20% than that in the previous milling season; the millable beet yield was 56.7 t/ha, which decreased by 5.1 t/ha or 8.25% than that in the previous milling season. The average machine harvest rate in sugarcane was 12.39% in 2025/2026 milling season, which decreased by 5.92 percent points than that in the previous milling season; that in Guangxi was 12.97% , which was increased by 8.14 percent points than that in the previous milling season; that in Yunnan was 13.42, which decreased by 0.91 percent point than that in the previous milling season.

Guangxi's sugar production accounts for approximately 60% of the total sugar output and 70% of the cane sugar production in China. After Guitang (GT) 11 became the predominant variety in the early 1980s to mid-1990s, the varieties from Taiwan such as ROC16 and ROC22 once dominated the mainland for a long time.

Since 1999, the innovation efforts in GT sugarcane variety breeding have been intensified through continuous introduction of high-quality domestic and international sugarcane germplasm, creating and screening elite parents, screening good hybrid combinations, appropriately increasing the quantity of seedlings and hybrid combinations, continuously exploring innovative breeding methods and improving breeding techniques. Through these efforts, a series of high-quality parental lines have been successfully selected, enabling the ongoing development of sugarcane varieties adapted to diverse ecological conditions. In 2025, the cultivation area of GT sugar cane varieties reached 513.6 kha in Guangxi, accounting for 62.41% of the region's total sugarcane acreage. Notably, GT44 has achieved rapid and leapfrog development, expanding its cultivation area to 234.0 kha and rising from third place in 2024 to the top position. Meanwhile, GT42 saw its cultivation area decrease to 213.3 kha, dropping from the first to second position. GT55 ranked the fourth among sugarcane varieties, only behind GL05136. Additionally, G42, GT44, and GT55 were designated as Guangxi's leading sugarcane varieties. The large-scale application of high sugar and high yield sugarcane varieties has provided the foundation for the sustainable and stable development and benefit improvement of Guangxi sugar industry. The sugar recovery of sugarcane in Guangxi reached 13.30% in 2024/2025 milling season, which is a record. A large number of newly bred sugarcane varieties with their own characteristics are being widely demonstrated and promoted in various places. Among them, the most outstanding one is GT76, which is characterized by early maturity, high sugar, high resistance to smut, automatic leaf detachment, strong ratoon ability, drought and poor soil tolerance, and is deeply loved by sugar enterprises and sugarcane farmers, and has a strong development momentum. In the field of sugarcane germplasm collection and innovative utilization, the Guangxi Sugarcane Germplasm Resource Repository has been established. It has collected and preserved 4,693 germplasm resources of 16 species from 6 genera across 18 countries and 10 provinces (autonomous regions/ municipalities) in China. The repository has developed 126 new germplasm resources with high resistance to smut, strong tillering ability, and excellent stress tolerance. Significant progress has been made in creating the *Eriathus arundinaceus-Saccharum spontanium* composite (E-S complex) and its backcross improvement, as well as in hybridization and utilization of *Narenga porphyrocoma* with sugarcane. A batch of high-quality materials has been bred, which are expected to be applied in conventional sugarcane breeding.

For sugarcane production in China, drought is still the most important abiotic limit. At the same time, smut and borer continue to be the most critical biotic constraints, production cost needs to be lowered, and machine harvest is not popular. The R & D priorities for sustainable sugarcane production in China include creating elite parents by utilizing wild germplasm, breeding high yield, high sugar, highly resistant and nitrogen efficient sugarcane varieties with strong ratoon ability by conventional and biotechnological approaches, promoting the commercial supply of healthy seedcane for millable cane production, to provide the foundation for the sustainable and stable development of the sugarcane industry.

PL-I-02

# Technologies for improving sugar crop yields in China

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PL-I-03

# Drought tolerance in sugarcane: Emerging concepts

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Stress memory is a native capacity of living beings and its importance for sugarcane cultivation in rainfed region has been explored. Briefly, previous research carried out under controlled conditions revealed that sugarcane can store information from past experiences, such as drought, and improve plant performance under recurrent stressful conditions. Enhancements in photosynthesis, water use efficiency and antioxidant responses are among the physiological processes modulated by drought memory caused by cycles of dehydration/rehydration. As consequence, sugarcane plants presented higher root growth and were less impacted in terms of biomass production by recurrent drought. Sugarcane memory was also transgenerational and propagules taken from previous stressed-plants also presented improved performance under greenhouse conditions. The relevance of such drought memory for sugarcane was finally tested under field conditions using those sugarcane propagules mentioned earlier. Stress memory caused higher tillering, stalk and biomass production, root growth while increasing juice quality in a rainfed sugarcane field. The intensity of such responses was dependent on sugarcane variety and on the phenological phase in which the origin plants faced drought. Taken together, these findings revealed the importance of stress memory for sugarcane management as an alternative for increasing crop yield while saving resources such as water in field conditions.

PL-I-04

# Optimized nitrogen management for synergistic improvement of sugarcane yield and sucrose accumulation

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In China, sugarcane production has shown a clear transition since 2008: total production has become increasingly dependent on yield improvement rather than area expansion. Since 2011, China's average sugarcane yield has recovered continuously, surpassing the world average in 2014 and Brazil's average in 2017. However, a large yield gap remains, i.e., China's average yield is still around 80 t/ha, while leading countries exceed 120 t/ha. Meta-analysis indicates that both plant-cane and ratoon-cane have more than 50% yield improvement potential, with ratoon-cane showing a slightly higher potential. Similarly, sucrose accumulation has considerable room for improvement. The theoretical sucrose content of sugarcane can reach 25%, and the highest domestic record is 20.3%. Based on field experiments conducted in China from 1972 to 2022, the top 10% high-sucrose level averaged 17.61%, whereas the national average was 14.67%, indicating a 2.94 percentage-point absolute increase potential. Nutrient management is a critical driver for closing both yield and sugar gaps. Here, we integrate meta-analysis, long-term field trials, and demonstration experiments to evaluate the importance of optimized nitrogen (N) fertilization on sugarcane production. Usually excessive N supply is used in China's sugarcane production, causing high risks of N loss by gases and leaching and soil acidification. There is a big potential to reduce N application without yield loss. Compared with farmer's high N input of 560 kg/ha, optimized N application at 300 kg/ha produced similar high cane yield while largely decreasing environmental footprints. Sucrose content followed a quadratic response to N rate, peaking at a moderate level. Excessive N increased stem nitrate and asparagine contents, inhibited SPS activity, and enhanced SS-I, S-AI, and NI activities, thereby promoting sucrose decomposition. Controlled-release N combined with organic substitution reduced N input by 46.4% while maintaining yield and achieving the highest sugar yield and soil multifunctionality. Integrated nutrient management (IKPS), combining NPK optimization, controlled-release N, organic fertilizer, and straw return, reduced fertilizer input by 47%, increased yield by 4.6–5.8%, and increased sugar by 6.2–

9.0%. Green intelligent formula fertilizer with optimized N design reduced fertilizer input by 17.3–46.7%, increased yield by 2.5–17.0%, and increased sugar yield by 3.8–20.1% across main sugarcane producing regions. These results demonstrate that optimized N management can synergistically enhance sugarcane yield and sucrose accumulation, improve N use efficiency, reduce environmental costs, and support the green transformation of the sugarcane industry.

PL-I-05

# Next-generation technologies for improving sugar beet productivity and profitability

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Sugar beet production is increasingly challenged by climate variability, soil degradation, rising production costs, and the need to reduce the environmental impact of agricultural practices. Next-generation technologies offer new opportunities to address these challenges by improving crop monitoring, resource-use efficiency, yield stability, and farm profitability. This invited presentation will examine recent advances in high-throughput phenotyping, proximal and remote sensing, precision agriculture, and data-driven crop management for sugar beet. Particular attention will be given to the integration of multispectral imaging, unmanned aerial vehicles, portable X-ray fluorescence spectrometry, optical leaf analysis, and molecular diagnostic tools. These technologies enable the rapid and non-destructive assessment of crop growth, nutritional status, physiological responses, and tolerance to environmental stresses. Selected case studies will illustrate the application of UAV-based imaging, portable XRF spectrometry, optical sensing, and molecular tools for sugar beet phenotyping and nutritional assessment. The integration of sensor-derived information with genomic, physiological, soil, and agronomic data can support the identification of superior genotypes and the development of more efficient breeding strategies. At the same time, artificial intelligence and predictive modelling can transform complex datasets into practical decision-support tools for farmers and agricultural advisers. These approaches may facilitate site-specific fertilisation, the early detection of nutritional imbalances and crop stress, and the more efficient use of water and other agricultural inputs. However, the successful adoption of these innovations requires robust calibration, field validation, standardised protocols, and economically accessible technologies. Strong collaboration among researchers, breeders, technology developers, farmers, and the sugar industry will therefore be essential. By combining advanced phenotyping, precision crop management, and multidisciplinary data integration, next-generation technologies can contribute to a more productive, profitable, resilient, and environmentally sustainable sugar beet sector.

PL-I-06

# High-throughput next-generation phenotyping, remote sensing, and AI technologies for sugarcane crop management

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Sugarcane occupies an important position in global agriculture with high economic output value. As a perennial crop featuring a long growth cycle, sugar accumulation in stalks, and harvestable stems as its primary economic product, sugarcane exhibits distinct agronomic characteristics that restrict the direct transplantation of precision management strategies developed for other annual crops. In this context, developing remote sensing and artificial intelligence workflows for high-throughput acquisition of sugarcane eco-physiological phenotypic traits across critical growth stages is essential to support refined field crop management and accelerate breeding efficiency.

This paper systematically summarizes recent research progress achieved by our research group covering remote sensing monitoring, physical phenotype extraction, and digital approaches for sugarcane DUS (Distinctness, Uniformity and Stability) testing. The main works are outlined as follows. (1) Seedling detection and gap mapping based on aerial RGB imagery and AI. We acquired UAV RGB imagery from both commercial sugarcane fields for production management and progeny assessment test (PAT) trial plots for breeding purposes. Modified Faster-RCNN and YOLO-series models were deployed for sugarcane seedling recognition, coupled with preprocessing strategies for tiled image mosaics and post-processing pipelines for duplicate detection removal and gap localization, to quantify seedling missing status, support timely risk evaluation and field decision-making. (2) Leaf-scale physiological and disease phenotyping under natural field conditions. RGB leaf images of healthy and diseased sugarcane samples were collected to build dedicated datasets for chlorophyll estimation and disease diagnosis. An ordinal regression model based on SwinMWR was established to predict leaf chlorophyll content; a lightweight Vision Transformer termed SLViT (Shuffle-convolution-based lightweight Vision Transformer) was developed to identify six categories of sugarcane leaf diseases; furthermore, a generative model SugarcaneGAN was proposed, adopting a lightweight U-RSwinT module for leaf region extraction and image generation to perform data augmentation for limited disease samples. (3) Remote sensing-based

yield prediction modelling. Using time-series satellite multispectral observations, we constructed a random forest yield prediction model built on fitted extreme values of multi-temporal spectral indices. Separately, a Gradient Boosting Decision Tree (GBDT) model was developed using multi-variable vegetation indices derived from time-series UAV multispectral imagery. (4) Three-dimensional point cloud-based extraction of early-stage morphological phenotypes for breeding selection. An integrated algorithm combining PointNext and Quickshift++ was proposed for sugarcane organ segmentation from point cloud data, enabling automated computation of key morphological traits including plant height, canopy diameter, stalk height and individual leaf area, which improves the objectivity and accuracy of elite genotype screening. (5) AI-enabled phenotypic scoring pipeline from RGB imagery for DUS testing. We developed vision-based recognition workflows for sugarcane morphological descriptors and implemented automated quantification of measurable phenotypic traits, aiming to deliver convenient and robust technical support for sugarcane DUS evaluation.

Collectively, the integrated technical framework established in this study provides scalable, non-destructive, high-throughput phenotyping solutions that serve dual demands: real-time monitoring and precision regulation in commercial sugarcane production, as well as objective, efficient trait evaluation to streamline sugarcane breeding and variety registration procedures. The findings highlight the great potential of synergistic remote sensing, computer vision and machine learning technologies to advance digital sugarcane agriculture.

PL-I-07

# Sugarcane machine harvesting in small holdings and its challenges

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Sugarcane production in small holdings is an important component of global sugarcane production. However, the use of large harvesters is restricted by fragmented fields, narrow headlands, and limited road access. Therefore, this paper systematically reviews mechanized sugarcane harvesting in small holdings. Regional characteristics, harvesting modes, representative equipment, key technologies, and adaptability are examined. Mechanized harvesting is classified into two modes: combined harvesting and two-stage harvesting. Multiple operations can be performed continuously by combined harvesters, but they require relatively regular fields, sufficient headland space, and adequate transport support are required. Two-stage harvesting is more suitable for hilly and mountainous areas and scattered small holdings, but effective coordination is required among cutting and laying, field collection, transport, loading, and leaf and stalk separation. Based on these characteristics and constraints, future research should focus on lightweight and modular equipment, coordination between the two harvesting stages, cost-effective sensing, harvesting quality detection, navigation in narrow headlands and coordination among multiple machines.

ORAL PAPER PRESENTATION

TS-I-01

# Eliminating monsoon blindness: A sovereign quantum-SAR framework for future-proofing sugarcane yield and sugar recovery potential

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The global sugar industry is currently governed by "Best Guess" estimates due to a fundamental "Visibility-Velocity" paradox. Traditional manual audits are non-scalable, while optical satellite data (NDVI) is weather-dependent and effectively "Chlorophyll-blind"—it cannot detect dry biomass and is rendered ineffective useless by 100% cloud cover during the critical Monsoon and Kharif seasons. This creates a massive "data void" that blinds stakeholders for months, precisely when pests, diseases, and moisture stress are most active. AgriCPS proposes a Sovereign Truth Layer: a hybrid Quantum-Classical engine that fuses multi-mission Copernicus streams (Sentinel 1, 2, & 3) into a Continuous Audit Pipeline. High-resolution C-Band SAR radar backscatter pierces 100% cloud cover to measure structural density, allowing for the quantification of Cane Tonnage and Biomass Volume. In parallel, we utilize Variational Quantum Eigensolvers (VQE) to forecast the crop's entropy trajectory between satellite passes. This predictive maturation modeling allows mills to schedule harvests with forensic precision. Our proprietary algorithms utilize Volumetric Radar Backscatter to determine Sugar Recovery Potential by measuring structural maturation and Brix levels independently of visual greenness. To validate this, we utilize a "Double-Blind" protocol: reconstructing harvest reports from archival radar data and verifying them against actual weighbridge receipts. By transitioning from "Optical Guesses" to "Physical Truth," this infrastructure narrows Carbon MRV uncertainty by 56% and allows for a 70% reduction in chemical inputs via early anomaly detection. This framework is currently being scaled into 300 Kelvin (ambient temperature) quantum silicon, positioning it as the physical sensory nervous system for the global bio-economy.

TS-I-02

# Enrichment of fermented organic manure and liquid fermented organic manure for increasing soil organic carbon content

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Soil Organic Carbon (SOC) is a key indicator of soil health, productivity, and sustainability. Continuous use of chemical fertilizers, intensive cultivation, residue burning, and inadequate application of organic matter have resulted in a significant decline in soil organic carbon levels in many agricultural regions. Restoration of SOC has become essential for improving soil fertility, nutrient-use efficiency, water-holding capacity, and crop productivity. Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (LFOM) are emerging as valuable organic inputs capable of improving soil carbon status while supplying essential nutrients and beneficial microorganisms. Enrichment of FOM and LFOM using nutrient-rich organic materials, microbial inoculants, and bio-stimulants further enhances their effectiveness. This article discusses the role of enriched FOM and LFOM in increasing soil organic carbon, improving soil health, and promoting sustainable agriculture through the recycling of agro-industrial and CBG plant residues.

TS-I-03

# Divergent responses of $C_4$ kranz anatomy and chloroplast ultrastructure to drought stress in sugarcane: The role of carbon allocation

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In sugarcane, $C_4$ photosynthesis is structurally tied to Kranz anatomy, yet how stomatal defense and internal carbon fixation coordinate under water deficit remains poorly resolved. This study examined whether genotype-specific carbon allocation strategies explain differences in Kranz structural homeostasis. Three sugarcane cultivars (ROC22, GT42, and GT44) were subjected to natural drought stress from early elongation, with well-watered plant serving as the control. At the severe drought stress stage, stomatal complexes, chloroplast ultrastructure, and Kranz anatomy in plant leaves were assessed by electron microscopy, together with relative water content, osmotic adjustment compounds, and antioxidant enzyme activities in leaves. Under well-watered conditions, GT42 showed the highest stomatal density (233.97 $\pm$ 6.12 $mm^{-2}$), pronounced epicuticular wax deposition, tightly stacked thylakoids, and compact Kranz rings; ROC22 had wider thylakoid lamellar spaces. After severe drought stress, the epidermal protection was ranked as GT42 > GT44 > ROC22. The chloroplasts swelled in all genotypes, but the plastoglobuli (PGs) responded divergently: GT42 showed reduced PG accumulation, implying the carbon flux was preferentially redirected towards defense, with minimal membrane damage; GT44 and ROC22 amassed PGs, reflecting carbon allocation imbalance and severe membrane injury. In Kranz anatomy, GT42 retained intact but narrower vascular bundles, while GT44 showed bundle shrinkage and bundle-sheath cell damage, and ROC22 displayed severe deformation and loosening of vascular bundles and sheath cells. GT42 also exhibited the strongest osmotic adjustment and antioxidant capacity, with proline content and peroxidase (POD) activity significantly higher than those of other cultivars ($p < 0.05$). The superior drought tolerance of GT42 is attributed to more efficient carbon allocation, which helps preserves stomatal complexes, chloroplast membranes, and $C_4$ Kranz architecture. Overall, drought

tolerance was ranked as GT42 > GT44 > ROC22. These ultrastructural findings identify cellular determinants of drought tolerance among different sugarcane genotypes, and provide useful references for breeding drought-tolerant sugarcane cultivars.

TS-I-04

# Empirical estimation of relative evaporative loss in weight of harvested sugarcane by mechanical and manual harvesting

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Empirical estimates of desiccative weight loss, based on daily evaporation rates, indicated that manual harvesting of sugarcane with two cut ends resulted in minimal weight loss (< 0.5%) across time lapses ranging from 6 to 24 hours between harvesting to milling. In contrast, machine harvesting exhibited substantially higher evaporative losses, which increased with increasing cuts. Under a 10 mm/day evaporative regime with 24 hours delay between harvesting and milling, estimated weight losses were 3.92%, 5.88%, 7.85% and 9.81% of average sugarcane yield (40 t/ac) under 8, 12, 16 and 20 cuts, respectively. The magnitude of these losses increased with greater cutting intensity from 8 to 20 cuts and longer time lapses before milling. Conversely, losses declined proportionally with reduced delays (12 and 6 hours) and lower evaporative regime from 10 to 5 mm/day. Even though cutting intensity, time lapse and desiccative evaporation is reduced, the weight losses associated with machine harvesting were 8, 12, 16 and 20 times higher than observed under manual harvesting. These findings suggest that minimizing the time interval between harvesting and milling is critical for reducing evaporative losses in machine-harvested cane. Additionally, machine harvesting is more suitable during periods of moderate evaporative demand (November to February; ~5 mm $day^{-1}$), whereas manual harvesting is preferable during periods of high evaporative demand (March onwards; $\geq$10 mm $day^{-1}$).



# Technical Session - II

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## PLENARY LECTURES

**PL-II-01**

# Effective disease management in the Australian sugarcane industry: key elements for success, and where to from here?

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Diseases continue to pose a serious risk to the Australian sugarcane industry, a natural result of long-term monoculture coupled with very limited crop rotation. This was recognised very early in the development of the Australian industry with pathologists employed and trained early in the 20th Century. The major diseases were quickly recognised, causes identified and management strategies developed and implemented - in close consultation with the farming community. The industry developed an effective research development and extension organisation to increase the flow of information from researchers to farmers and vice versa. Key management strategies consist of resistant varieties, disease-free seed-cane, sanitation, termination of diseased crops and pathogen detection in planting material.

Many improvements in these systems have been developed and adopted since that time. Traditional clonal selection for resistance has involved pathogen inoculation and manual inspection of inoculated plants.. The development of rapid and relatively cheap genomic selection has enabled the early selection of clones with increased resistance to disease such as smut (*Sporisorium scitamineum*). Though traditional resistance tests are still needed, a greater percentage of resistant clones progress through the selection process with genomic selection, increasing the probability of high performing resistant commercial varieties. Research is also investigating remote sensing soon after pathogen inoculation to refine selection and a shift in population disease resistance.

Detection technologies have changed dramatically over the last 20 years. Sensitive molecular assays for the most important Australian diseases, such as RSD, chlorotic streak, Fiji leaf gall and leaf scald have been developed. These provided reliable and highly sensitive assays for testing plant sources, planting material in quarantine and disease-free seed-cane. Recently, a LAMP assay was developed to detect RSD in the field (Bhuiyan et al, 2022); other similar molecular tests have been developed in various other countries.

In 2018, research began to determine if *Leifsonia xyli subsp. xyli* (RSD) could be detected in juice expressed during the milling process (from the first mill in the milling train). LAMP and qPCR assays successfully detected the bacterium (Magarey et al, 2022) in unfiltered expressed cane juice; the technology was further investigated to calibrate NIR reflectance data - which is normally used to test cane quality

parameters. Reliable NIR data would provide no-cost automatic recording of the RSD status of every crop supplying to the sugar factory. RSD maps for every crop in the whole factory area would transform our understanding of RSD. Satellite remote sensing is also being tested using factory-based molecular assay data

Such breakthroughs offer for the first time the ability to determine the disease incidence, the effectiveness of disease management, trends in disease incidence over time, estimated economic impacts of the disease, and the patterns of disease spread that may link contract harvesters, planters or plant sources to disease incidence at an industry-wide scale in Australia. It also allows for historical data retrieval, if adequate storage of NIR data occurs.

Genomic analyses have also led to the discovery of disease etiology - solving pathogen mysteries, such as *Phytocercomonas vananatans*, the cause of chlorotic streak. Genomic analyses have also led to the identification of several previously unknown *Peronosclerospora* species in PNG.

The Australian industry has been strategically proactive in identifying pest and disease risks in neighbouring countries, with joint research aimed at identification, yield loss assessment and importantly, effective disease management. This allowed the Australian sugar industry to prevent or prepare for new pest and disease incursion. Next-gen technologies are increasingly providing better understanding of both the incidence and nature of sugarcane diseases. Prospects for the future are bright when it comes to effective disease management and the minimisation of economic losses.

PL-II-02

# From observation of disease symptoms to the development of molecular assays: over a century of diagnostic improvements in a context of changing sugarcane pathology

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Sugarcane germplasm has been moved between sugarcane growing regions worldwide for numerous centuries, but the first record of a sugarcane disease in the literature dates only to 1869 when symptoms and signs of gumming were described in Brazil. At the end of the 19th century and the first half of the 20th century diagnosis of sugarcane diseases was solely based on i/ symptom observation (including cytology and light microscopy investigations), ii/ isolation and characterization of the pathogens (fungi and bacteria) isolated on culture media, and iii/ inoculation assays (including for viruses). Application of these methods resulted in the identification of pathogens that caused important disease outbreaks such as leaf scald, mosaic, orange rust, red rot, smut, etc. A major breakthrough in disease diagnosis occurred during the second half of the 20th century when serological assays were developed. This allowed better and faster detection of pathogens, especially viruses such as sugarcane mosaic viruses and bacteria such as *Xanthomonas albilineans* and *Leifsonia xyli* subsp. *xyli*. Simultaneously, viruses could be visualized in diseased plants using electron microscopy. At the end of the 20th century, the advent of nucleic acid sequencing resulted in the development of molecular diagnostic methods based on DNA/RNA probing and amplification assays. All these molecular methods targeted specific genome sequences of a pathogen and were developed for most diseases threatening sugarcane production. A new and transformative breakthrough occurred at the beginning of the 21st century with the development of high-throughput sequencing (HTS) technologies that permitted the detection of known and unknown pathogens. HTS was used to investigate the virome of sugarcane and to discover new viruses but also to solve a ninety-year mystery regarding the causal agent of sugarcane chlorotic streak. Numerous and powerful diagnostic methods are currently available to detect and identify pathogens that can cause more than one hundred sugarcane diseases. They can also be used to ensure safe movement of germplasm among sugarcane producing locations. Nevertheless, though very powerful methods to detect and identify pathogens are available, sampling of the best plant location for disease diagnosis remains a challenge, especially when infected plants do not exhibit visible symptoms. Knowing and understanding disease development, especially the infection and incubation stages, is also essential for optimal application of powerful and highly sensitive molecular diagnostic assays.

PL-II-03

# Deciphering the genetic architecture of sugarcane smut resistance: From comparative genomics to molecular breeding

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Sugarcane smut, caused by *Sporisorium scitamineum*, is a major constraint to sugarcane production worldwide. Developing resistant cultivars remains the most effective strategy for disease management. However, the complex polyploid genome of sugarcane, extensive allelic heterozygosity, and quantitative inheritance of resistance complicate the identification and utilization of resistance-associated genes. Understanding the genomic and molecular basis of resistance is therefore critical for accelerating sugarcane breeding. This presentation focuses on the comparative analysis of Zhongzhe 1 (ZZ1), a smut-resistant sugarcane genotype, and ROC22, a susceptible cultivar, to explore the genetic architecture and molecular mechanisms underlying contrasting disease responses. Comparative genomic approaches provide a framework for investigating resistance-associated sequence variation, gene presence–absence variation, copy-number differences, and the organization of defense-related gene families. Particular attention is given to dirigent (DIR) proteins and their potential contributions to phenylpropanoid metabolism, lignin deposition, and cell-wall-mediated defense. Integrating genomic comparisons with pathogen colonization dynamics, transcriptomic profiling, and biochemical measurements offers opportunities to identify regulatory networks associated with pathogen restriction and resistance expression. A central challenge is translating genomic differences between resistant and susceptible genotypes into reliable breeding tools. Candidate resistance loci identified through comparative genomics require validation across genetically diverse populations to distinguish functional resistance alleles from background-specific polymorphisms. Integrating quantitative disease phenotyping, genome-wide association analysis, and functional characterization can support the development of diagnostic molecular markers. Furthermore, incorporating resistance-associated haplotypes, allele dosage, and genome-wide marker information into genomic prediction models may improve selection accuracy for complex resistance traits. The comparison between ZZ1 and ROC22 provides a foundation for connecting genomic variation with disease resistance mechanisms and breeding applications. By integrating comparative genomics, functional genetics, and quantitative breeding approaches, this research aims to advance the identification of resistance-associated genetic determinants and facilitate the development of sugarcane cultivars with durable smut resistance and favorable agronomic performance.

ORAL PAPER PRESENTATION

TS-II-01

# Sustainably increased sugarcane productivity and greatly improved environmental impact by enhancing the soil's microbiome

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Sugarcane, with its large capacity for $CO_2$ capture, has the capacity for sustainable increases in yield that could greatly assist the impacts of climate change associated with global population growth. Maize, rice, and wheat each occupy about 200 million hectares (Mha) of global agricultural land. Sugarcane occupies about 25 Mha, but whereas rice and wheat each only produce only about 0.8 million metric tonnes (Mt) annually, and maize about 1.2 Mt, sugarcane produces about 2 Mt. Therefore, a marked global increase in sustainable sugarcane yields would greatly increase $CO_2$ capture and help reduce the impacts of climate change. Sugarcane's potential for sustainably increased productivity has been demonstrated on the 100 ha Tweed floodplain cane farm under the management regime described by Quirk (2024). The regime has increased yields and profitability while reducing fertilizer and cultivation inputs, improving and maintaining soil structure, and achieving marked sequestration of soil carbon. It is now clear that this success has been achieved in part of the activities of soil microbes, particularly arbuscular mycorrhizal fungi (AMF). These organisms have developed and maintained a symbiotic relationship with about 80% of all terrestrial plants throughout their evolutionary history. AMF spores in the soil germinate and infect the surface cells of roots, forming a tree-like structure called an arbuscle within the root, and a large network of hyphal thread-like hyphae through the soil. The hyphae acquire water and nutrients from the soil and transfer them to the plant, eventually supporting nutrient acquisition by the leaves and other plant tissues. In return, the plant provides photosynthetes, particularly sugars, to sustain and grow the AMF. There is now a significant and rapidly growing scientific literature on AMF and their role in sequestering soil carbon, captured from the atmosphere by plant photosynthesis. Some of this carbon capture is associated with the growth of fungal hyphae, but these organisms are involved in many chemical and physical changes in the soil biome, mineralogy, and particularly soil structures. One such effect results from the production of glomalin, a sticky, glue-like proteinaceous substance that helps bind soil particles into stable aggregates, often containing stable micropores that enhance water retention, and increased mineral surface area for nutrient chemical exchange. Such glomalin

production may contribute to the difference in vehicle trafficability under prolonged periods between Quirk's differences and neighbouring cane lands. The role of the rhizosphere microbiome in sustainably increasing crop yields is now probably the main driver of soil and crop research. Sugarcane should take a leading role in this science. The scientific literature shows that there are already many appropriate existing groups in most of the world's leading sugarcane countries and these groups have established global linkages. Sugarcane can have a huge new impact by increasing yields sustainably on existing sugarcane growing lands, without requiring substantial expansion of the cultivated area.

TS-II-02

# Metagenomic insights and comparative genomic analysis of '*Candidatus* phytoplasma sacchari' strains associated with sugarcane grassy shoot and sugarcane white leaf diseases in India and China

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Phytoplasmas are uncultivable, phloem-limited bacterial pathogens characterized by highly reduced genomes, limited metabolic capabilities, and dependence on host & insect-vector cellular environments. Sugarcane is one of the world's most important commercial plantation crop and phytoplasma-associated diseases such as sugarcane grassy shoot (SCGS) and sugarcane white leaf (SCWL) can cause substantial losses in plant growth and productivity all over Asian countries. Despite their economic importance, genomic information on phytoplasmas associated with these diseases remains limited. In the present study, metagenomic sequencing and comparative genomic analyses were compared to characterize the SCGS phytoplasma strain from India and the SCWL phytoplasma strain from China, both classified as '*Candidatus* Phytoplasma sacchari' (16SrXI-B subgroup). The draft genome assemblies of the Indian SCGS and Chinese SCWL strains were reported as 505,173 bp and 538,951 bp, with G+C contents of 19.86% and 20.54%, respectively. Genome annotation predicted 404 and 459 protein-coding sequences, two rRNA operons, and 12 & 27 tRNA genes in the Indian and Chinese strains, respectively. Comparative genomic analysis revealed an average nucleotide identity (ANI) of 99.01% between the two strains, demonstrating their close genomic relatedness despite differences in genome size, gene content, and genome organization. Genome-wide analyses further identified genes and genomic regions potentially associated with host–pathogen interactions, stress adaptation, and genome plasticity. Signal peptide prediction and homology-based analyses identified candidate secreted proteins, including a secreted α/β-hydrolase associated with an SVM/DUF2130/DUF5320-containing gene region and other putative/hypothetical effector-associated proteins. The Indian SCGS strain contained genes associated with potential mobile-unit-related regions, including *tra5* (IS3-family transposase), *dnaB, dnaJ*, and *dnaK*, whereas the Chinese SCWL strain contained *tra5, tmk, dnaB*, and *dnaG*, together with conserved genes such as *ssb, rpoD*, and *himA*. Notably, homologues of several well-characterized phytoplasma effectors, including TENGU, SAP05, SAP11, and SAP54, were not detected in either genome, suggesting possible differences in effector repertoires and host-interaction strategies among closely related phytoplasma lineages. Overall, these genomic features highlight the compact and highly specialized nature of the '*Ca*. P. sacchari' genome strains associated with SCGS and SCWL in India and China and provide a valuable foundation for understanding phytoplasma evolution and host–pathogen interactions and for developing genome-informed diagnostic markers and disease-surveillance strategies for sugarcane phytoplasma diseases.

TS-II-03

# Changing sugarcane cultivation, hydrology, and harvesting techniques to greatly improve carbon management

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Sugarcane is a major agricultural crop in the world's tropics and subtropics. It provides sucrose and raw material for many industrial products. Its land use has important environmental, social, and economic aspects. The world's news suggests that sugarcane is a major contributor to climate change because of its large carbon emissions. However, a floodplain management regime for sugarcane in the Tweed River region of Australia, developed over the past 30 years, has greatly changed this outcome. The new regime has resulted in a soil system that sequesters carbon and develops and maintains better soil structure. In recent prolonged rainfall and flood events, this improved soil structure has maintained the trafficability of machinery, in contrast to nearby cane fields. The Tweed estuary floodplain, like many such coastal areas, is composed of acid sulfate soils (ASS). These sulfidic materials were deposited over the past 20k years and have undergone various geomorphic and pedogenic changes. Of particular importance has been acidification from oxidation of the contained pyrite during drought episodes. Measurements of numerous whole ASS profiles across the Tweed and nearby floodplains show an existing acidity store of about 50 tonnes of sulfuric acid equivalent per ha. European-age flood-mitigation drainage systems, used for sugarcane, may have made a small contribution to this store, but they are the important conduit for enabling the discharge of acid and dissolved metals discharge from this store to the estuary. Therefore, sugarcane hydrological management must recognise the possible occurrence of ASS at the site and minimise this environmental hazard. The 100 ha Tweed study site is about 50 cm below mean sea level (MSL), and the laser-levelled drainage system, with automatic electric pumps, removes rainfall and flood waters quickly, down to a setting of -60 cm MSL. Rapid establishment of an aerated soil environment for the cane roots system is assisted by planting cane stools in 10cm hills. Crop rotation, including sun hemp, has allowed a 50% reduction in N applied as urea. As with most global production of sugarcane, green cane harvesting (GCH) has now eliminated pre-harvest burning. The Tweed regime sprays 8 kg urea/300L of water onto GCH trash, immediately following harvesting. The measured soil carbon shows this practice has sequestered about 80,000 tonne of $CO_2$ equivalent. The principles of this successful sugarcane management regime should be widely applied across global coastal soils to greatly increase yield/hectare, with reduced costs and increased carbon capture. The increased sugarcane production resulting from these innovative approaches should attract new investment as well as interest and participation in ongoing research and development.

TS-II-04

# Colonization of endophytic entomopathogenic fungi for sustainable sugarcane pest management: Mechanistic insights, formulation advances, and future IPM horizons

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Sugarcane (*Saccharum* species hybrids) is a premier agro-industrial, semi-perennial monocot crop cultivated in more than 120 tropical and subtropical countries, with an annual global production of approximately 1.89 billion tons. India ranks as the world's second-largest producer, with an average area of 5.8 million hectares under cultivation and an annual cane production of 9.0 million tons. Despite its economic significance, long-term intensive monocropping and excessive application of inorganic agro-inputs have contributed to soil degradation and water pollution. These ecological disturbances, further exacerbated by climate change and intensive crop management, have favoured the emergence and persistence of complex pest and disease problems. Globally, sugarcane is vulnerable to over 1,200 insect pest species and 80 diseases. In India alone, nearly 60 insect species and 70 diseases have been reported to affect the crop at different growth stages. The primary yield-limiting constraints include a destructive complex of Defoliators: Fall armyworm (*Spodoptera frugiperda*); Sap-sucking insects: mealybugs (*Phenacoccus saccharifolii; Saccharicoccus sacchari*), aphid (*Melanaphis sacchari);* sugarcane woolly aphid (*Ceratovacuna lanigera*), and thrips (*Fulmekiola serrata),* sugarcane mites (*Oligonychus sacchari* or *Schizotetranychus andropogoni)*; Stalk feeders: early shoot borer (*Chilo infuscatellus*), internode borer (*Chilo sacchariphagus indicus*), and top borer (*Scirpophaga excerptalis*); root borer (*Emmalocera depressella)*: white grubs (*Holotrichia consanguinea* and *Holotrichia serrata)*, and termites (*Odontotermes obesus; Microtermes obesi*); sugarcane mites (*Oligonychus sacchari* or *Schizotetranychus andropogoni*) and rodents (*Bandicota bengalensis* and *Millardia meltada*); Phytopathogens: red rot (*Colletotrichum falcatum*; Perfect stage / teleomorp: *Glomerella tucumanensis*); smut (*Sporisorium scitamineum* (=*Ustilago scitaminea*), and pokkah boeng (*Fusarium proliferatum; Fusarium sacchari)*. Although synthetic pesticides have historically been central to pest management, their potential adverse effects on soil health, environmental quality, and non-target organisms highlight the need for sustainable biocontrol approaches. Fungal biocontrol agents, particularly *Beauveria bassiana* and *Metarhizium anisopliae*, are important entomopathogens capable of establishing systemic endophytic associations in

sugarcane. These fungi can suppress insect pests while promoting plant growth, enhancing abiotic stress tolerance, and improving productivity. We critically evaluate five core operational and scientific nuances: strain selection and characterization, bioformulation, delivery architecture, induced systemic resistance (ISR), and integration with integrated pest management (IPM). Particular emphasis is placed on developing virulent, stable, and ecologically adapted strains, improving formulation stability and field persistence, optimizing plant colonization, and elucidating defense mechanisms. These approaches offer promising, sustainable tools for sugarcane pest management.

TS-II-05

# A single-copy, four-gene transgenic stack in sugarcane confers broad-spectrum insect and herbicide resistance

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Sugarcane (*Saccharum* spp. hybrids) is an important sugar and energy crop. It is urgent to develop new varieties with broad-spectrum insects and herbicide resistance to promote the sustainability of the sugarcane industry. However, sugarcane lacks sufficient insect and herbicide resistance gene resources, and a feasible strategy for breeding resistant varieties is to introduce exogenous resistance genes through transgenic technology. Here, an efficient genetic transformation selection system was established utilizing *CP4-epsps* (a glyphosate-resistance gene) as the selectable marker. Subsequently, a four-gene stack (comprising *cry1Ab+cry2Ab+cry1Fa* and *CP4-epsps*) was successfully transformed into the sugarcane elite cultivar ROC22 through this selection system. After molecular assays, a single-copy transgenic line was identified and selected for further in-depth study. The results demonstrated that this transgenic sugarcane line exhibited herbicide tolerance and broad-spectrum insect resistance against at least five insects (*Chilo infuscatellus*, *Ostrinia nubilalis*, *Spodoptera frugiperda*, *Oriental armyworm*, and *Helicoverpa armigera*), with no adverse effects observed on primary agronomic traits under the present test conditions. Further investigation revealed that the integration of the four exogenous genes altered the levels of endogenous hormones and secondary metabolites associated with insect resistance. This suggests that the insect resistance in transgenic plants may arise from synergistic interactions between the introduced genes and endogenous defense-related genes. The present work provides a theoretical foundation and technical support for resistance-oriented biological breeding in sugarcane, and also offers novel insights into the molecular mechanisms underlying the enhanced insect resistance in transgenic sugarcane.

TS-II-06

# A smut effector exploits natural *cis*-regulatory variation to activate the ScWRKY1 susceptibility module in sugarcane

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Sugarcane smut severely restricts global sugarcane production, and the molecular mechanisms underlying sugarcane smut resistance, particularly the host susceptibility programs hijacked by pathogens, remain largely elusive. Here, we identified the transcription factor ScWRKY1 as a critical susceptibility regulator governing sugarcane smut infection. ScWRKY1 exhibited significantly stronger induction in susceptible sugarcane cultivars than in resistant genotypes during the key invasive stages of smut pathogen infection. Mechanistically, ScWRKY1 directly binds to the promoters of flavonoid synthesis gene *ScCHS,* and the lignin biosynthesis gene *ScCAD*, repressing their transcriptional expression. This repression suppresses flavonoid-mediated chemical defense and lignification-associated structural defense, thereby facilitating pathogen colonization and host susceptibility. We further elucidated the upstream regulatory module: smut pathogen effectors trigger the transcriptional activation of ScWRKY1 to promote infection. Importantly, natural cis-regulatory variations in the ScWRKY1 promoter differentiate resistant and susceptible cultivars, altering the magnitude of ScWRKY1 activation in response to pathogen signals, which ultimately shapes varietal differences in smut resistance. Collectively, our findings uncover a comprehensive molecular cascade whereby the smut pathogen hijacks a host ScWRKY1-mediated susceptibility program to circumvent plant defenses. This study also reveals a causal link between cis regulatory variation in promoter and variation in disease resistance, providing valuable genetic targets and mechanistic insights for the molecular breeding of smut resistant sugarcane.

TS-II-07

# Research progress of sugarcane white leaf disease and brown stripe disease

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Sugarcane is the world's most important tropical crop and a major sugar-producing crop. Pests, diseases and weeds constitute the primary threat to the safe production of sugarcane. Sugarcane white leaf disease (SCWL) was first discovered in Lampang Province, northern Thailand, in 1954 and is listed as a quarantine disease in China. This disease was first detected in Baoshan, Yunnan Province, China, in 2012. To curb its further spread, this paper reviews the advances in detection technologies, transmission pathways, insect vectors, and prevention and control strategies of sugarcane white leaf disease. Sugarcane brown streak disease is a major foliar fungal disease of sugarcane, which can cause yield losses of over 2 tons per mu and a sugar content decline of more than 30%. To date, it has been reported in many countries and all sugarcane-growing regions across China. For the effective management of this disease, this paper summarizes the research progress of sugarcane brown streak disease with respect to its pathogen, occurrence and epidemic dynamics, and control measures. By reviewing the research advances in sugarcane white leaf disease and sugarcane brown streak disease, this study aims to provide technical support for the green control of the two diseases and facilitate the high-quality development of the sugar industry.

TS-II-08

# Construction of whole chain closed loop quality control technical system for virus free healthy sugarcane seed canes

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Sugarcane seed canes serve as the core vegetative propagating material for sugarcane production. Their health status, varietal purity and bud vigor directly determine field seedling emergence, population establishment, cane yield and sucrose content. Since 2014, Guangxi has established a three tier sugarcane seed multiplication base system, including primary (pre basic seed cane), secondary (basic seed cane), and tertiary (certified seed cane) bases, which has promoted the popularization of virus free and healthy sugarcane seed canes. Nevertheless, prominent problems persist in practical production, i.e., variety admixture, high risks of seed borne diseases, severe bud damage during processing and transportation, and vitality decline of seed canes. Management across seed multiplication, processing and field planting is fragmented, and unified whole process technical specifications for quality control are lacking. Based on the multi-years demonstrations, 4 tissue culture seedling enterprises, 32 seed multiplication bases and 20 seed cane processing plants in Guangxi, combined with different field demonstrations, on site processing measurements and quality verification tests, this study constructed a whole chain closed loop quality control technical system for virus free healthy sugarcane seed canes. The system covers source virus free seed conservation, step by step propagation, standardized field management, harvesting and processing, storage and transportation, field application monitoring, as well as quality inspection, traceability and feedback optimization. Technical research for each link was carried out as "source end control, standardized processes, strict inspection, and traceable management". At the source link, varietal authenticity verification was performed, disease resistant mother plants were screened, and virus free nurseries were established. Virus free tissue culture plantlets were obtained as original propagation materials via "stem tip virus elimination plus pathogen re verification". Access control measures including crop rotation and isolation buffer zones were implemented for multiplication bases, and step by step propagation system was built to block risks at the source. For field multiplication quality control, integrated water fertilizer management and green pest and disease prevention control technologies were adopted. Dynamic monitoring was based on agronomic indicators, such as stalk diameter, plant length and disease incidence index. A dual identification method combining field phenotypic assessment and

DNA fingerprinting was applied to distinguish genetic variants from phenotypic variations induced by environmental stress. Repeated field roguing of off type, diseased and weak plants was implemented, and "one nursery, one file" archive system was enforced. High throughput molecular detection was applied for plot based pathogen sampling screening to guarantee healthy seed sources. In harvesting and processing, appropriate harvesting periods were defined and time limited processing was enforced. Standardized workflows for mechanical operation adapted cutting, disinfection and coating, quality inspection and packaging were established to reduce mechanical damage and pathogen infection. Bud quality and germination rate were inspected batch by batch to secure seed cane quality. In storage and transportation, seed canes were stacked separately by variety and batch with scheduled planting requirements. Specifications for temperature humidity conditions, stacking modes and storage transportation time limits were clarified. Bud vigor was tested at three circulation nodes, i.e., ex warehouse, transit and arrival, so as to prevent quality deterioration caused by water loss, over heating and mildew. For end application quality control, re inspection of seed canes was conducted before planting. Field indicators including seedling emergence, tillering, population growth and sugar yield related traits were monitored. Once problems, such as variety admixture and disease outbreak occurred, reverse traceability was performed to corresponding multiplication and processing batches. Regarding quality inspection, digital traceability and closed loop feedback mechanism, a multi dimensional quality testing system was developed, covering varietal authenticity purity identification, pathogen molecular detection, effective bud and germination rate measurement, as well as visual pest disease inspection. Two sets of grading evaluation systems were formulated for virus free and non virus free seed canes respectively. Sugarcane seed labels were produced and unique batch traceability codes were constructed with dual track paper electronic archives to realize forward tracing and reverse accountability for the whole workflow. A closed loop feedback mechanism was established, in which field application results were fed back to iterate production standards. The established technical system forms a closed loop workflow of "seed conservation, propagation, processing, quality inspection, storage transportation, field application and feedback driven optimization". It transforms seed cane production from empirical management to index based standardized control and stabilizes seed cane quality. This study fills the domestic gap in whole process quality control technical system for virus free sugarcane seed canes. The research outcomes can provide comprehensive technical support for seed cane multiplication, processing, quality assessment, digital traceability, market sampling inspection and mechanical planting. It facilitates large scale and commercialized sugarcane seed industry and provides solid guarantee for the industrialization of sugarcane seed sector and high quality development of sugar industry.



# Technical Session - III

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## PLENARY LECTURES

**PL-III-01**

# From crosses to code: Reimagining sugarcane breeding

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As the primary sugar source in China, sugarcane accounts for over 90% of national sugar supply, yet the self-sufficiency rate has long fluctuated between 60–70%, with an annual gap of approximately 5 million tons. Against this backdrop, the author's team at the National Key Laboratory for Tropical Crop Biological Breeding has been pursuing a comprehensive research program encompassing germplasm innovation, variety development, and industrial application. Core Scientific Breakthroughs. Our team has systematically elucidated the resistance mechanisms of sugarcane against smut disease and identified key regulatory genes including ScWRKY2, JAZ1 etc. Notably, the team established a genotype-independent genetic transformation system for sugarcane with a transformation efficiency of 40%, placing it at the global forefront, alongside an all-allele editing efficiency of 5% . These achievements have enabled the creation of new sugarcane germplasm with high yield, high sugar content, insect resistance, and herbicide tolerance, marking a significant step in integrating transgenic technologies into conventional breeding. Intelligent Breeding Framework. We have pioneered an intelligent breeding architecture, transitioning sugarcane breeding from "experience-dependent" to "data-driven" approaches. By comprehensively collecting historical breeding data and deploying big-data analytical models, the team enables computer-assisted selection and parent matching. This framework supports the design of optimal parental combinations, prediction of superior progeny from hundreds of thousands of hybrid offspring, and identification of varieties likely to perform well under future conditions. The team also released a novel smart breeding architecture and initiated a global sugarcane whole-genome design breeding collaboration initiative. Industrial Translation. Beyond laboratory breakthroughs, We emphasized the "Three-Chain" empowered mechanism, integrating the Innovation Chain for gene discovery, the Industry Chain for platform construction, and the Support Chain for sustained funding and talent development. This "government-industry-academia-research-application" model provides a practical framework for translating breeding advances into field-ready varieties. The team's varieties and technologies have been applied across over 1 million mu, providing technological for the high-quality development of China's sugarcane industry. Conclusion. Sugarcane breeding is at a pivotal transition from traditional experience-based models to data-driven systems, integrating genomic tools, intelligent analytics, and efficient genome manipulation technologies offers a viable pathway to narrow China's sugar supply gap and strengthen the competitiveness of its sugar industry.

PL-III-02

# Genomic selection for enhancing cross-prediction and selection in sugarcane breeding

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Sugarcane breeding has delivered improved varieties through field evaluation, family selection and the recycling of successful parents and crosses. Long breeding cycles and complex polyploid inheritance have nevertheless constrained the pace of improvement and made progeny performance difficult to predict. This talk reviews progress in genomic selection for sugarcane, connecting conventional breeding approaches with current genomic methods and future opportunities for parent selection, cross prediction and mate allocation. Genomic selection offers a way to address two complementary objectives through estimates of additive breeding value for parent selection and total genetic value for clonal selection. Developments in single nucleotide polymorphism (SNP) chips and sequencing technologies have expanded the genomic information available for breeding. Studies of genotype representation and statistical and machine learning models have examined how this information can best support prediction across traits. Incorporating non-additive effects and genome-wide heterozygosity increased cane-yield prediction correlations by 17-31% relative to additive models in forward validation. Extending these predictions to simulated progeny has shown how mating objectives influence cross rankings and the balance between expected clonal superiority and additive gain. These findings provide a foundation for using genomic information earlier in the breeding cycle to identify promising parents and crosses. The next phase is to connect these advances across breeding stages. Integrating family and clonal trial data offers opportunities for earlier parent selection and prioritisation of untested crosses. Combining optimal contribution selection with genomic mate allocation provides a framework for balancing parental merit, expected progeny performance and genetic diversity. Future priorities include field validation of cross predictions, better representation of polyploid inheritance and crossing plans that accommodate flowering and resource constraints. By connecting prediction with these decisions, genomic selection can support both the development of superior varieties and the continued improvement of the breeding population over successive generations.

ORAL PAPER PRESENTATION

TS-III-01

# Establishment of an efficient Prime editing system for precise base changes and genomic replacements in sugarcane

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The high complexity and ploidy of the sugarcane genome hamper conventional breeding and biotechnology-based improvement processes. Gene-editing technologies, particularly CRISPR/Cas-based approaches, have emerged as powerful tools to accelerate the development of improved cultivars with agronomically relevant traits. Although prime editing (PE) represents a promising next-generation strategy with high precision and efficiency, its application in sugarcane remains unexplored. Here, we report the development of the T5-ePPEi system, a highly efficient prime-editing system, and its application for introducing precise base changes, large genomic deletions, and replacements. To develop the T5-ePPEi system, we introduced the activity-enhancing R221K and N394K mutations into Cas9-SpG from the previously described ePPE vector. In addition, we fused a T5 exonuclease to the N-terminus of Cas9-SpG to reduce competition between newly generated and original DNA flaps. Furthermore, paired engineered Prime editing guide RNAs (epegRNAs) were used to favor W545L installation in the *ScALS* gene, and the Csy4-based multiplexing system was employed to express the epegRNAs. This optimized PE approach resulted in edited events at a frequency of 59.3% (35 edited transgenic events out of 59 transgenic events), as determined by PCR-RE screening for a G>T base change in the ScALS gene. Importantly, twelve edited transgenic events were highly tolerant to commercial doses of imazapyr. Oxford Nanopore long-read sequencing revealed multiallelic editing and an allelic G>T editing frequency of up to 92% for W545L installation among the six most resistant edited transgenic events. Importantly, imazapyr tolerance was maintained in the next vegetatively propagated generation. In addition to base changes, we employed the T5-ePPEi system with the GRAND (Genome editing by RTTs partially Aligned to each other but Nonhomologous to target sequences within Duo pegRNA) strategy to promote a large genomic replacement in the gibberellin pathway-related gene *ScGAI*, thereby generating knockout plants carrying an inserted Lox66 recombination site. The PE-GRAND strategy generated edited events at a frequency of 84.4% (27 edited transgenic events out of 32 transgenic events), as determined by PCR-based screening using primers flanking the target genomic deletion. Moreover, PCR-based screening using Lox66-specific primers detected the intended insertion in 43.8% of the transgenic events (14

out of 32). Notably, Oxford Nanopore long-read sequencing revealed a correct Lox66 insertion frequency of up to 82.73% among the edited events, and phenotyping of these plants is underway. In summary, this work establishes a highly efficient genome-editing system for precise base changes and large genomic deletions and replacements in sugarcane. Importantly, it establishes an efficient strategy for producing imazapyr-resistant sugarcane lines and paves the way for the development of site-specific transgene integration approaches in sugarcane.

TS-III-02

# Drone-powered phenotyping accelerates stress-tolerant sugar beet selection

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Identifying sugar beet varieties that maintain canopy function under disease stress requires phenotyping beyond visual assessment and canopy size. We evaluated repeated drone-based spectral monitoring to support objective varietal selection under naturally occurring Cercospora leaf spot pressure in northern Italy. Thirty-three sugar beet varieties were evaluated at the Adria Experimental Farm in a randomized complete block design with four replicates. Four unmanned aerial vehicle (UAV) surveys between July and August 2025 used an AIRFARM multirotor platform equipped with a MAPIR Survey3W OCN camera. Calibrated imagery provided plot-level spectral measurements, the Normalized Difference Vegetation Index (NDVI) and canopy occupancy estimates. These observations were integrated with SpectraVue leaf spectroscopy and final root and sugar-related traits. Temporal monitoring revealed increasing varietal differences as field stress developed. The relationship between NDVI and canopy structure shifted from positive to negative, indicating that canopy maintenance did not necessarily reflect maintenance of functional greenness. Late-season NDVI rankings corresponded with agronomic performance and highlighted varieties maintaining higher canopy greenness under disease pressure. Leaf-level spectral measurements complemented the interpretation of canopy responses. Cross-platform comparison with Drone2Report showed highly correlated Orange reflectance, near-infrared reflectance and NDVI outputs ($r > 0.999$). Repeated UAV monitoring therefore provides an indirect, non-destructive assessment of varietal responses to naturally occurring *Cercospora* stress. Integrating temporal spectral measurements with canopy structure, physiology and agronomic performance can strengthen breeding decisions by identifying promising material for further evaluation. The results highlight the importance of phenotyping timing and support UAV-based workflows for more efficient selection of stress-tolerant sugar beet varieties.

TS-III-03

# Breeding for bioenergy canes through utilization of *Erianthus arundinaceus* in sugarcane

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The genetic base of sugarcane needs to be broadened through gene introgression to transfer the genes conferring resistance to abiotic and biotic stresses, enhance multi-ratoonability, improve adaptation under changing climatic conditions and facilitate product diversification. Numerous attempts have been made to achieve introgression using wild genera. *Erianthus arundinaceus* is used in wide crosses with sugarcane, with fairly encouraging results. In this study, a wide cross involving *Erianthus arundinaceus* IK 76 -99 (2n = 60), a heavy tillering, fast growing, and drought resistant accession was made by pollinating with CoC 671, a sucrose rich commercial clone. Similarly, another cross between *Saccharum* (Co 7201) x *Erianthus* (IK 76-91) was made for comparative studies and to test feasibility of both types of hybrids for their utilization in breeding programmes. After careful evaluation of the seedlings at 12 months of crop age, it was observed that some *Saccharum* x *Erianthus* hybrids recorded more than 21.00% fibre with relatively less sucrose content ranging from 15.22%-16.42% and *Erianthus* x *Saccharum* intergeneric hybrids recorded high sucrose contents ranging from 17.56% to 21.62% and low fibre contents ranging from15.34% to 16.83%. In view of the future needs of sugar industry, Vasantdada Sugar Institute, Pune, India, has started to introduce Type I energy cane through *Erianthus* x *Saccharum* hybrids and their derivatives that are being selected and optimized for both sugar and fibre content so that they can be processed in the existing sugarcane mill. Another set of *Saccharum* x *Erianthus* hybrids designated as Type II energy canes would be bred, selected, and cultivated for their fibre content, making them unsuitable for processing in existing sugar mill operations. The results are encouraging and both types of hybrids are now under testing in plant and ratoon crops and are being backcrossed with other commercial types for further improvement.

TS-III-04

# Research progress of sugarcane breeding at Guangxi Academy of Agricultural Sciences

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Sugar produced from sugarcane in Guangxi accounts for approximately 60% of China's total sugar output, and 70% of the national total sugarcane-derived sugar production. Sugarcane varieties form the most fundamental pillar underpinning the development of the sugar industry. The Sugarcane Research Institute of Guangxi Academy of Agricultural Sciences is the earliest-established and most prominent specialized sugarcane breeding research institution in Guangxi. The Institute developed GT11 between the 1980s and mid-1990s, which once served as the dominant sugarcane variety across Guangxi. Since 1999, it has stepped up breeding innovation: it continuously introduces elite germplasm resources from domestic and international sources, conducts germplasm improvement, screens superior parental lines, designs cross combinations, expands the scale of seedling evaluation, and optimizes breeding protocols. A series of fine varieties adapted to diverse ecological conditions have been successively released. As the first research institute in China to scale up sugarcane seedling populations, it maintains an annual breeding scale of roughly 600–800 cross combinations and 200,000 seedlings. Meanwhile, new breeding technologies including family selection and ratoon selection have been developed and validated. Beyond the core breeding targets of high sugar content and high yield, targeted selection is performed for traits such as disease resistance (primarily resistance to the devastating diseases smut and pokkah boeng), stress tolerance, mechanical harvest suitability, high nitrogen fixation capacity, strong tillering ability and good ratoon performance. Since the beginning of the 14th Five-Year Plan period, multi-dimensional research has been ongoing, covering parental combination evaluation, mutation breeding and stress-resistant breeding. More than 20 years of sustained research has yielded remarkable breakthroughs in hybrid breeding of the Guitang (GT) series. A large number of elite new varieties have been developed, including GT29, GT42, GT44, GT55 and GT76. These varieties have held the largest share of China's sugarcane planting area for consecutive years. In the 2024/2025 harvesting season, Guitang varieties accounted for 39.80% of the national sugarcane acreage, making the Guitang series the most widely planted sugarcane variety series in China. In 2025, the planting area of Guitang varieties in Guangxi reached 513.6 thousand hectares, representing 62.41% of Guangxi's total sugarcane area. Among them, GT44 covered 234.0 thousand hectares, rising from the third rank in 2024 to the first place of both in Guangxi and China,. GT42 ranked second with 213.3 thousand hectares, and GT55 took the fourth position and the first rank in Guangdong province. All three varieties are listed as leading sugarcane varieties in China. The core varieties each possess distinctive strengths:

GT42 combines the merits of both parents with high yield, high sugar content and strong stress tolerance, and ranked first nationwide in single-variety planting area for five consecutive years. GT44 is China's first early-maturing, high-sugar variety tolerant to mechanical harvesting with strong ratoon performance, and is the primary recommended variety for mechanized sugarcane production in Guangxi. GT55 features high genetic heterogeneity, strong stress resistance, high yield, high sugar content and wide adaptability. The large-scale popularization of high-yield, high-sugar Guitang varieties lifted Guangxi's sugar extraction rate to a record high of 13.30% in the 2024/2025 harvesting season. Multiple new superior varieties are now undergoing accelerated demonstration and extension. In particular, GT76 is widely favored by sugar mills and sugarcane growers for its traits of extra-early maturity and high sugar content, strong smut resistance, natural leaf shedding, excellent ratoon ability, drought tolerance and poor-soil adaptability, showing strong promotion potential.

PL-III-03

# Innovative approaches for breaking sucrose plateau in sugarcane – Challenges and way forward

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Development of superior sugarcane varieties with improved cane yield, based on which farmers are mostly paid, and increased sugar recovery, which is profitable for sugar mills is essentially required for sustainable sugarcane production. Significant genetic enhancement for cane yield was achieved through conventional breeding in the last century, however improving sucrose content is always a challenging task. Sucrose accumulation is genetically controlled although climatic conditions influence the sugar recovery as the high diurnal temperature different favours the high sugar accumulations. *S. officinarum* is the major species which contributed genes for sucrose content worldwide through nobilisation process during the early part of twentieth century. Later convergence of sucrose genes from *S. sinense* and *S. barberi* were also attempted to increase the allelic diversity. At ICAR-Sugarcane Breeding Institute, it was experimented that when relatively high sucrose *S. spontaneum* accessions are used as the male parent, greater the genetic gain for sucrose content in the progeny was realised. Intraspecific improvement for sucrose content in *S. spontaneum* had identified several potential clones.

The decade-wise analysis of the sucrose content in the varieties developed by ICAR-SBI indicated that the mean sucrose content increased from 14.72% during 1912–1921 to 20.15% in 2011-20, representing an increase of approximately 36.9%. However, the momentum of increase in sucrose content was not in pace with the genetic gain realised for cane yield in the last century. CoC 671, Co 86032, Co 0238, CoJ 64, Co 11015, Co 09004, Co 99004, Co 13001 and Co 16001 were some the varieties/near commercial canes and RK 2020-12 and SCGS 00-0402 were some of the genetic stocks developed for high sucrose content in juice. At ICAR-SBI, successive cycles of selfing of Co 775 and Co 7201 had resulted in the selection of improved inbred for sucrose content with the advancement of generation. A simple recurrent selection approach also substantially improved sucrose up to three cycles and our experience indicated that after four selection cycles, sucrose content improved to the extent of 19.06 % compared to the base population and one of the selected clone INGR 09053 recorded sucrose content of 21.62% at eight months and is used as a parent in hybridisation programmes.

Under these challenging conditions, modern biotechnological tools are integrated with the conventional breeding and recently the genome edited Cana Flex II was developed by suppressing the gene BAHD05 gene by Brazilian CTNBio group with approximately 15% more sucrose in sugarcane stalks. Another novel approach to develop low GI sugar transgenic sugarcane with the integration of Isomaltulose

genes has showed 81% of IM in total sugars of the whole-cane juice. Preliminary works on SWEET genes and low-calorie sugar gene Allulose epimerase are found to be promising.

Improving profitability and financial sustainability of the sugar mills through higher sugar recovery is crucial to make timely payments to the farmers. Introgression of new sources of sucrose genes from untapped *S. officinarum*, *S. barberi*, *S. spontaneum*, recurrent selection, family selection, Marker Aided Selection for early generation selection, genomic selection for minor alleles, Genetic transformation, Genome editing and breeding for alternate and low-calorie sugars are discussed.

PL-III-04

# Breeding beyond yield: From conventional breeding to climate-resilient and future-ready sugarcane in Thailand

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Sugarcane breeding has been an important part of the development of Thailand's sugar industry. For several decades, the Department of Agriculture (DOA) has conducted a national sugarcane improvement program based mainly on conventional hybridization, selection, evaluation, and varietal release. The program has produced improved cultivars adapted to major sugarcane-growing areas, with DOA Khon Kaen 3 (DOA KK3) becoming one of the most widely grown cultivars in Thailand.

Breeding objectives, however, have changed as production conditions have become more challenging. While cane yield and sugar content remain important, recent breeding efforts have placed greater emphasis on disease resistance, drought tolerance, ratooning ability, adaptation to different environments, and suitability for mechanical harvesting. This shift can be seen in recent breeding results. For example, the variety DOA Nakhon Sawan 1 produced 17.62 tons/ha of sugar yield, 18% higher than LK92-11, while the newer variety DOA Nakhon Sawan 2 produced 14% higher cane yield than DOA KK3 under the evaluation conditions. These results illustrate the continued potential of conventional breeding and the importance of selecting materials under specific production environments.

This presentation reviews the development of sugarcane breeding by the DOA, with particular attention to changes in breeding objectives, genetic resources, selection methods, and field evaluation. Recent breeding work has increasingly considered performance under rainfed conditions, different soil types, and major disease pressures. Multi-environment testing and disease screening are being used to identify clones that combine productivity with better adaptation and stability.

Looking ahead, further progress in sugarcane breeding will require broader genetic resources and stronger pre-breeding efforts, together with more efficient approaches to selection and evaluation. Molecular markers, genomic selection, and other data-driven tools offer opportunities to complement conventional breeding and help shorten the breeding cycle. Breeding objectives will also need to reflect the changing requirements of farmers, sugar mills, and emerging sugarcane-based industries. For Thailand, the challenge is no longer simply to breed higher-yielding cultivars, but to develop cultivars that can maintain good productivity and quality under increasingly variable production conditions.

ORAL PAPER PRESENTATION

TS-III-05

# Breeding and application of new sugarcane varieties with high sugar content and high yield in Yunnan, China

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Sugarcane is the core feedstock for sugar production in China, Yunnan is the second-largest sugarcane growing area in China. Breeding high-sugar and high-yield cultivars is critical to safeguarding national sugar security. This study focuses on the breeding chain and application of new high-sugar and high-yield sugarcane varieties in Yunnan. We have collected and conserved more than 7,000 sugarcane germplasm accessions, and developed a series of elite breeding parents with peak sucrose content exceeding 20%. Among them, the parent YZ1640 achieves a peak sucrose content of 23.18%, laying a solid genetic foundation for high-sugar breeding. By innovating photoperiod induction technology and constructing supporting facilities, we overcame the natural obstacle of poor flowering in the Kaiyuan sugarcane region, an environment unsuitable for sugarcane flowering. The flowering rate of induced parent clones reached 98%, and the annual production of hybrid tassels exceeds 1,000, which greatly expands the scale of cross breeding and breaks the bottleneck of hybrid seed preparation in southern Yunnan. A zonal breeding platform was established across six distinct ecological zones in Yunnan. More than 30 new sugarcane varieties have been released, providing vital seed-industry support for the sustainable development of Yunnan's sugar industry. YZ081609, known as the "The king of Sugar", realizes the synergistic improvement of high sucrose and high yield, with a peak sucrose content of 20.3% and a maximum cane yield of 229.2 t/ha. YZ0551 shows outstanding drought tolerance; its yield reached 138 t/ha in large-scale continuous dryland demonstration plots, setting a yield record for sugarcane under rainfed conditions. YZ081609 and YZ0551 together account for 76% of the total sugarcane planting area in Yunnan. Driven by the popularization of these two leading varieties, the average cane yield in Yunnan has increased from 62 t/ha to 82 t/ha, and the sugar extraction rate has risen from 12.41% to 13.39%, staying above 13.3% for four consecutive years. Yunnan has become the sugarcane region with the highest sugar recovery nationwide. In future, we will accelerate the demonstration and extension of new-generation high-sugar and high-yield varieties including YZ141313, YZ1696, YZ1658 and YZ1727. Beyond high sugar and high yield targets, we will prioritize high-fiber breeding to raise cane fiber content to 12%–14%, and improve the mechanized harvest suitability of new sugarcane cultivars to adapt to the mechanization transformation of the sugarcane industry.

TS-III-06

# Subgenome-biased transcriptional architecture for sucrose accumulation in sugarcane

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Sucrose accumulation is a major determinant of sugarcane yield and quality, but its transcriptional control remains poorly resolved within the highly polyploid sugarcane genome. Here we profiled leaves, immature stems and mature stems from 53 genetically diverse *Saccharum* clones spanning a broad sucrose gradient. We uncover pervasive transcriptional asymmetry between the *S. officinarum* (SO) and *S. spontaneum* (SS) subgenomes, arising from both unequal gene representation and homoeolog expression bias, with pronounced effects on carbon metabolism, hormone signalling and expression regulation. Integration of differential expression, co-expression networks and transcriptional trajectories converged on *ScWRKY* as a candidate regulator of sucrose accumulation. Overexpression and silencing established *ScWRKY* as a negative regulator of sucrose content. Genome-wide binding and molecular assays further showed that *ScWRKY* directly binds to and represses *ScGFS*, whose expression increases with sucrose content. These findings link subgenome-biased transcriptional architecture to a defined regulatory module and provide a mechanistic framework for sucrose accumulation in polyploid sugarcane.

TS-III-07

# Modern breeding strategies for bioenergy optimization in sugarcane (*Saccharum* species hybrids)

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Sugarcane (*Saccharum* species hybrids) is a premier global cash crop traditionally cultivated across tropical and subtropical regions for sugar production. In the contemporary bioeconomy, it has emerged as a cornerstone for sustainable bioenergy, bioethanol, and bioelectricity, serving as a viable green alternative to fossil fuels. Beyond first-generation ethanol, the integration of sugarcane's lignocellulosic residues enhances total biofuel yield per unit area without expanding agricultural land, thereby driving a significant net reduction in carbon dioxide emissions. Maximizing this bioenergy potential requires strategic genetic improvement. Traditional sugarcane breeding programs have historically focused on cane tonnage and high sucrose levels to maximize commercial sugar yield. However, to meet escalating energy demands, modern breeding initiatives are increasingly leveraging the vast genetic diversity of energy-cane hybrids. This paradigm shift aims to optimize distinct bioenergy traits, including lignocellulosic biomass accumulation, fiber composition, multi-genic disease resistance, and environmental stress tolerance. Currently, the integration of advanced biotechnological platformsuch as genomic selection, marker-assisted selection, and innovative gene-editing technologiesis accelerating the generation of elite, climate-resilient bioenergy cultivars, bypassing the challenges posed by sugarcane's complex polyploid genome.

TS-III-08

# *NpWRKY38*, a WRKY transcription factor from *Narenga porphyrocoma*, negatively regulates drought tolerance by impairing ABA/SA signaling and photosynthesis

**Shuangcai Li and Xihui Liu**

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Drought stress is a major constraint on sugarcane production. *Narenga porphyrocoma*, a wild relative of sugarcane with remarkable drought tolerance, is an important genetic resource for sugarcane improvement. Transcriptome analysis combined with Weighted Gene Co-expression Network Analysis (WGCNA) identified the WRKY transcription factor gene *NpWRKY38*, which was significantly downregulated under drought. Functional assays in transgenic rice demonstrated that overexpression of *NpWRKY38* compromises ABA signal transduction and SA biosynthesis, represses photosynthetic pathways and disrupts chloroplast ultrastructure, leading to increased drought sensitivity. Physiological characterization revealed aggravated oxidative damage, impaired photosynthetic capacity and altered hormone homeostasis in transgenic lines. These findings reveal a regulatory module mediated by *NpWRKY38* for drought adaptation in wild sugarcane germplasm and provide a potential gene target for molecular breeding of drought-resistant sugarcane.

TS-III-09

# Heavy-ion beam irradiation reprograms hormone and MAPK signaling in the abscission zone of an easy-defoliation sugarcane mutant

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Efficient leaf removal is an important agronomic trait for improving mechanical harvesting of sugarcane. However, the molecular mechanisms underlying natural leaf abscission in sugarcane remain poorly understood. In this study, an easy-defoliation mutant, FS30, was obtained from the sugarcane cultivar'Guitang 42' (GT42) following carbon-ion beam irradiation and three generations of phenotypic selection. To investigate the molecular basis of the enhanced leaf-abscission phenotype, abscission zone tissues from mature FS30 and GT42 plants were subjected to RNA sequencing and comparative transcriptomic analysis. A total of 41.14 Gb of high-quality clean data were generated from six biological samples, with Q30 values exceeding 97.14%. Functional enrichment analysis revealed that differentially expressed genes were mainly associated with protein-containing complexes, protein transport and localization, protein processing in the endoplasmic reticulum, plant MAPK signaling, and plant hormone signal transduction. Several hormone- and signaling-related genes showed pronounced expression changes in FS30. In particular, ACS2, encoding a key enzyme involved in ethylene biosynthesis, was significantly up-regulated, together with SAM4, whereas MPK6, a central component of MAPK signaling, and the ABA receptor gene PYL5 were strongly down-regulated. These results suggest that heavy-ion-induced genetic variation may alter protein homeostasis and reprogram hormone and MAPK signaling in the abscission zone, thereby changing the regulatory balance controlling cell separation and leaf abscission. The identified pathways and candidate genes provide useful molecular targets for functional validation and for breeding sugarcane cultivars with improved defoliation characteristics suitable for mechanized harvesting.

TS-III-10

# Assembly and comparative genome analysis of four mitochondrial genomes from *Saccharum* complex species

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*Saccharum* complex includes genera *Saccharum*, *Miscanthus*, *Erianthus*, *Narenga*, and *Tripidium*. Since the *Saccharum* complex/Saccharinae constitutes the gene pool used by sugarcane breeders to introduce useful traits into sugarcane, studying the genomic characterization of the Saccharum complex has become particularly important. Here, we assembled graph-based mitochondrial genomes (mitogenomes) of four Saccharinae species (*T. arundinaceum*, *E. rockii*, *M. sinensis*, and *N. porphyrocoma*) using Illumina and PacBio sequencing data. The total lengths of the mitogenomes of *T. arundinaceum*, *M. sinensis*, *E. rockii* and *N. porphyrocoma* were 549,593 bp, 514,248 bp, 481,576 bp and 513,095 bp, respectively. Then, we performed a comparative mitogenomes analysis of Saccharinae species, including characterization, organelles transfer sequence, collinear sequence, phylogenetics analysis, and gene duplicated/loss. Our results provided the mitogenomes of four species closely related to sugarcane breeding, enriching the mitochondrial genomic resources of the Saccharinae. Additionally, our study offered new insights into the evolution of mitogenomes at the family and genus levels and enhanced our understanding of organelle evolution in the highly polyploid *Saccharum* genus.

TS-III-11

# Next-generation sustainable production of open pan sweetener using energy-efficient solar induction heating technology

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Open-pan sweetener, popularly known as lump sugar or *jaggery* in India, is traditionally produced using conventional systems which are often constrained by inefficient heat utilization, limited process control, and inconsistent product quality. To address these challenges, this study developed and evaluated a next-generation sustainable jaggery production system using energy-efficient solar induction heating technology. The work focused on designing a solar-powered induction heating-based jaggery production unit, optimizing the processing parameters, and characterizing the jaggery produced under the optimized conditions. The developed unit provided controlled and uniform heating during sugarcane juice concentration, which improved thermal management and reduced dependence on conventional fuel sources. Optimization of processing parameters helped standardize the jaggery-making process and enhanced operational consistency. The optimized system produced jaggery samples with improved process efficiency and desirable quality attributes. Under the optimized conditions, the jaggery demonstrated better physical appearance, acceptable chemical quality, and improved sensory characteristics compared with conventionally prepared samples. The results indicate that the integration of solar energy with induction heating can serve as a practical and sustainable approach for modern jaggery processing. The technology offers advantages in terms of cleaner energy use, improved heating efficiency, reduced processing variability, and enhanced product standardization. These findings support the feasibility of adopting renewable-energy-based thermal systems in small- and medium-scale jaggery production units. Overall, the study shows that solar induction heating can contribute to future-ready, energy-efficient, and environmentally responsible jaggery manufacturing. The proposed system has strong potential for wider application in traditional sugar-based processing industries seeking innovation, sustainability, and quality improvement.



# Technical Session - IV

## Future-proofing Sugar Milling and Value-addition

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## PLENARY LECTURES

**PL-IV-01**

# Sustainability in Thai sugar industries

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The Thai sugar industry is one of the main agro-industrial sectors in Thailand. This consists of sugarcane production in field, sugar production in the mills and several co-products generation. In 2017/18, Thailand produced up to134.9 million tons of sugarcane and 14.7 million tons of Sugar and then, became the second largest sugar exporter.Thai sugar mills have increasingly incorporated zero-waste operations, turning manufacturing by-products into high-value resources. Bagasse is used as renewable fuel to power cogeneration systems for heat and electricity, molasses serves as a feedstock for ethanol fermentation, and filter cake is transformed into agricultural fertilizer. These initiatives directly support Thailand's national Bio-Circular-Green (BCG) economic framework, driving long-term environmental sustainability and promoting economic competitiveness.

In sugarcane cultivation with environmental concerns, especially PM2.5 air pollution linked to pre and post -harvest sugarcane burning, are driving a shift toward cleaner farming practices. Agricultural mechanization is increasingly adopted to reduce dependency on human labor and minimize burning.Furthermore, the green leaves and cane tops gathered during mechanical harvesting serve as valuable biomass and can be further converted into biochar. Returning these materials to the fields enriches soil organic matter and recycle carbon, which also corresponds to. regenerative agriculture principles. To continue further, converting bioethanol into Sustainable Aviation Fuel (SAF) represents a crucial pathway for decarbonizing in the aviation sector. This will enhance the utilizing of sugar molasses to produce higher value biofuel as well as reduce lifecycle greenhouse gas emissions compared to conventional fossil jet fuel. Together, these approaches enhancing the overall sustainability of Thailan's sugar industry.

PL-IV-02

# Exploiting lignocellulosic feedstocks for lignin and chemicals

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Lignin, a major component of lignocellulosic biomass, has attracted increasing attention as a renewable feedstock for the production of fuels, chemicals and advanced materials. Interest in lignin valorisation emerged alongside the development of cellulosic biofuels, where lignin is generated as a by-product during the separation of cellulose and hemicellulose from agricultural residues and wood waste. Rather than being combusted for process energy, lignin is now recognised as a potentially valuable raw material whose effective utilisation could significantly improve the economics of lignocellulosic biorefineries. Recent research demonstrates that lignin can be converted into a wide range of value-added products. These include carbon fibre composites, aerogels, drop-in fuels such as diesel and gasoline, concrete plasticisers, biodegradable coatings, asphalt sealants and a variety of aromatic chemicals. For example, blending lignin with polyacrylonitrile precursors can reduce the cost of carbon fibre production while maintaining mechanical strength, while lignin-derived aerogels have shown promising insulation properties. Lignin is also being explored as a renewable source of chemicals such as catechol, muconic acid and polyurethanes. Despite these opportunities, the exploitation of lignin remains challenging. Its complex and heterogeneous structure, variability between biomass feedstocks and the presence of strong carbon–carbon linkages complicate separation, purification and conversion processes. Traditional extraction methods, such as kraft pulping, often produce low-purity lignin streams that are difficult to upgrade into high-value products. Recent technological advances are beginning to address these limitations. Processes such as Reductive Catalytic Fractionation enable more efficient lignin depolymerisation, while new solvent systems including ionic liquids and deep eutectic solvents allow cleaner lignin extraction. The emergence of commercial biorefineries demonstrates that lignin valorisation is moving from research to industrial application, supporting the development of a sustainable bio-based chemical industry.

PL-IV-03

# Evolving dynamics in the Indian sugar industry: Policy priorities

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Sugarcane remains a cornerstone of rural livelihoods and India's agro-industrial economy, supporting >10 millions of farmers, over 550 sugar mills, and numerous allied enterprises. However, the sector is entering a period of unprecedented pressure from climate variability, water scarcity, declining soil health, rising input costs, fragmented landholdings, labour shortages and the urgent need to reduce carbon, water and energy footprints. At the same time, rapid advances in precision agriculture, digital technologies, mechanisation, improved climate-resilient varieties, and the emerging bioeconomy—particularly bioethanol, CBG, Green hydrogen and Sustainable Aviation Fuel (SAF)—offer new opportunities for growth and diversification. India must therefore move beyond a conventional productivity-centric approach towards an integrated framework that delivers higher productivity with fewer resources, greater climate resilience, lower environmental footprints, and improved farmer incomes. The national ambition should be to develop a climate-resilient, water- and resource-efficient, digitally enabled, fully mechanised and circular sugarcane–bioenergy economy, with a target of raising average cane productivity to >125 t/ha/year, while improving profitability and sustainability. A foremost priority is strengthening climate-resilient breeding programmes to develop varieties with higher cane and sugar yields, drought and heat tolerance, improved water-use efficiency, resistance to emerging pests and diseases, and suitability for mechanized harvesting. Greater investment in genomics, biotechnology, precision phenotyping and accelerated breeding can shorten varietal development cycles with better field stability. Universal access to micro-irrigation, particularly drip and fertigation should also become a central policy priority. The next transformation will be driven by digital agriculture and artificial intelligence (AI), which can provide real time, location specific advisories on irrigation, weather, nutrient management, pests, diseases and harvesting. Government incentives should encourage farmers, especially small growers and sugar mills to adopt precision technologies, such as sensors, GPS-enabled machinery, variable-rate input application, soil testing, and digital farm mapping. A stronger ecosystem of public-private research partnerships is equally essential. State agricultural universities and research institutions (ISRI, SBI, VSI) possess scientific expertise and germplasm resources, while private companies & organizations (ISMA, STAI, NFCSF) and progressive sugar mills can contribute technology, investment, field-testing capacity and market orientation. Structured partnerships can accelerate the development and commercialization of climate-resilient technologies and innovation. The industry should progressively

adopt a circular bioeconomy model, ensuring efficient utilization of bagasse, molasses, press mud, vinasse and other by-products can support bioenergy, biofertilizers, biochemicals, bioplastic and other value-added products. Carbon-credit mechanisms and water-footprint-based planning should reward sustainable parties and promotes water efficient production, particularly in water stressed regions. Technology adoption will depend on capacity building, sustainability certification, and smart mechanisms for smallholders. Training should focus on precision farming, digital platforms, climate adaptation, irrigation integrated pest management, and mechanization. Compact machinery, custom-hiring centres, cooperative ownership models and machinery-as-a-service platforms can address labour shortages. Start-ups and MSMEs involving youth and rural women in biofertilizers, biopesticides, biological control agents, entomopathogenic nematodes, and seed nurseries should also be promoted. India's sugarcane policy should maximize value from land, water, energy, and biomass while minimizing environmental impacts, strengthening farmer incomes, resource security, enhance industry competitiveness, and position India as a leader in the sustainable agriculture, energy security and a low-carbon bioeconomy.

ORAL PAPER PRESENTATION

TS-IV-01

# Fungal fermentation of sugarcane bagasse using *Poria cocos*: A strategy for enhancing bioactive compounds and fiber properties

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Sugarcane bagasse remains largely underutilized in the food sector due to its recalcitrant lignocellulosic structure and limited functionality. Sustainable and low-input biotransformation strategies are therefore required to unlock its food application potential. *Poria cocos*, a white-rot medicinal fungus with strong lignocellulolytic capacity, represents a promising biological modification strategy. This study aimed to systematically evaluate the structural, metabolic, and functional changes in sugarcane bagasse after solid-state fermentation with *Poria cocos*. After fermentation with *Poria cocos*, the activity of endoglucanase in sugarcane bagasse increased from 0.015 U/mL to 0.13 U/mL, â-glucosidase activity rose from 0.015 U/mL to 0.16 U/mL, and total cellulase activity increased from 0.03 U/mL to 0.11 U/mL. Microstructural loosening and partial hemicellulose degradation were accompanied by a shift in dietary fiber composition, reducing insoluble dietary fiber from 93% to 77% and increasing soluble dietary fiber from 5% to 13%. Antioxidant capacity was significantly enhanced, as reflected by increases in ferric reducing antioxidant power values (0.68 to 2.85 ìmol Trolox/g) and 2,22 -azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) radical-scavenging activity (13.09 to 18.92 ìmol Trolox/g). Metabolomic analysis identified 1702 differential metabolites, including upregulated flavonoids and phenolic acids such as gallic acid (9.20-fold) and diosmetin (8.86-fold). Correspondingly, á-amylase and á-glucosidase inhibition improved from 44.30% to 89.50% and 26.73% to 72.90%, respectively, supported by molecular docking. These results demonstrate that *Poria cocos* fermentation offers an efficient bioprocess for converting low-value bagasse into a fiber-enriched, antioxidant-active, and hypoglycemic-functional ingredient, supporting the development of fiber-enriched functional food ingredients and circular bioeconomy pathways within the sugar industry.

TS-IV-02

# Decarbonizing biomass cogeneration through digital automation and energy efficiency: A sugar industry case study

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The Ponni Sugars cogeneration plant has implemented an integrated programme of biomass fuel optimization, digital automation, equipment reengineering, water-side improvements, and disciplined operation to improve energy performance and reduce its carbon footprint. Major initiatives include controlled blending of bagasse pith, juliflora/wood chips, and agro-residues; DCS-based fuel-feeding control; real-time air-fuel ratio control using $O_2$ , CO, steam pressure, and fuel-feed inputs; sealing-air automation; boiler feed-pump reengineering with DP-based VFD control; direct reuse of first-body condensate; DM-pump speed control; demand-based dense-phase fly-ash conveying; installation of high-efficiency ACC fan blades; and replacement of an auxiliary induced-draft cooling tower with a fanless cooling system. These measures were supported by a structured energy-management framework aligned with ISO 50001, together with preventive and predictive maintenance practices. The initiatives improved combustion stability, reduced auxiliary power consumption, enhanced equipment reliability, and supported lower-emission operations. Based on the plant data presented in this study, the combined measures resulted in approximately 3 tonnes/day of biomass fuel savings and about 1.25 million kWh/year of electrical-equivalent energy savings, with an estimated $CO_2$ emission reduction of approximately 832 tonnes/year. The case study demonstrates that the systematic integration of digital automation, equipment optimization, energy management, and operational discipline provides a practical and replicable approach for improving the energy efficiency, reliability, and environmental sustainability of biomass-based cogeneration plants in the sugar industry.

TS-IV-03

# Weather relationship of regional diversity in sugarcane recovery of Maharashtra state

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The correlation and regression analysis between weather parameters during sugarcane maturity (October to December) as independent variables and sugar recovery from sugarcane as the dependent variable was carried out for the crushing season 2024-25 and 2025-26, along with their pooled mean values, across eight sugarcane growing divisions of Maharashtra. The correlation analysis revealed that mean maximum temperature was negatively associated (r= - 0.67) with recovery and emerged as the major factor causing variability in sugar recovery in Maharashtra. All other parameters were positively associated with sugar recovery, with daily rainfall (r=0.66) and mean relative humidity (r=0.40) exhibiting comparatively stronger correlations. Collectively, all the weather parameters during October to December explained 53% of the variation in sugar recovery, whereas temperature, rainfall and surface wetness together accounted for 58% of the variation. In contrast, minimum, maximum temperature and surface wetness jointly explained 46 % of the variation in sugar recovery. On average, a mean maximum temperature between 28.27 and 28.68 $^{o}$C, minimum mean temperature between 12.41 and 13.55 $^{o}$C, and mean relative humidity between 80.19% and 81.47% were associated with higher sugar recovery. In contrast, maximum temperature exceeding 29 $^{o}$C and minimum temperature below 12 $^{o}$C in association with relative humidity below 80%, were associated with reduced sugar recovery in Maharashtra.

TS-IV-04

# Importance of employee engagement with job satisfaction and implementation of good corporate governance for right organisational culture fit for productivity enhancement in the Indian Sugar Industry

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An employee's engagement level and job satisfaction greatly impact on the standard of service they provide to their customers which is also very essential for an organization to sustain itself in a competitive market. The current economy is putting much strain on the business to remain profitable and competitive. It is indispensable for the organizations to do the cost cutting with reduced investments and downsizing its employees. To ensure the productivity and profitability, it is very pertinent for the organizations to engage their current staff by communicating the strategy of the organization and critical skill building of the managers in the firm. Based on recent research and studies focused on the Indian sugar industry, employee engagement and job satisfaction are critical drivers of organizational culture change, productivity, and retention. Research indicates that while many sugar factories in India are technically modern, they require a, "human-centric culture change" to advance productivity and employee commitment. the whistleblowing has helped in the developments of the whistleblowing and has helped develop good corporate governance, which is indispensable for the growth and development of the sugar industry. Whistle-blower policy has been documented and considered one of the basic structures of good corporate governance. Through this research work the author investigated the relationship of employee engagement with job satisfaction with effective implementation of the good corporate governance on the culture change in the Indian sugar industry.

TS-IV-05

# Smart retrofit strategies for high-efficiency biomass cogeneration : Integrating process automation and boiler feed pump reengineering

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This paper presents an integrated retrofit approach adopted in a 19.5 MW biomass-based cogeneration plant to improve combustion performance, auxiliary power efficiency, reliability, and operating consistency without altering the basic steam-cycle configuration. The programme combined process automation with targeted mechanical reengineering. The automation measures implemented during 2020–2025 included DCS-based fuel-feeding logic, sealing-air automation, additional flue-gas $O_2$ measurement, air-to-fuel ratio control through VFD-driven FD and secondary-air fans, radar-based fuel-silo level monitoring, DCS control of wood chipper feeding, furnace and equipment condition monitoring, and water- and power-optimization controls. These interventions improved combustion stability, maintained $O_2$ typically within the range of 3–5%, reduced average CO to below 400 ppm, maintained stack SPM below 50 mg/Nm³, and supported boiler efficiency above 71% under the reported operating conditions. The second major intervention addressed boiler-feed-pump oversizing. An existing KSB HGC 3/14 pump was replaced with an HGC 3/13+1b configuration selected with OEM support, reducing rated head from 1580 m to 1471 m and brake power at the stated duty point from about 401 kW to 373 kW while retaining similar hydraulic efficiency. Feed-pump speed was further optimized using VFD control referenced to drum level, and feed-check-valve differential pressure. The feed-pump project reported approximately 4,00,000 kWh/year of electrical savings, corresponding to about Rs. 20 lakh/year at ₹ 5/kWh for 200 operating days. Together, the two sets of measures demonstrate how brownfield biomass cogeneration plants can achieve meaningful performance improvement through selective automation, hydraulic matching, and data-based control rather than major plant replacement.

# Poster
# Interactive Session

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P-01

# Effects of mechanical stubble shaving on stubble and yield of ratoon sugarcane

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In order to understand the effect of mechanical stubble shaving on stubble and yield of ratoon sugarcane, mechanical stubble shaving experiments were carried out on Zhongzhe 3 in Changping Township, Fusui County and Guitang 44 in Chengxiang Township, Wuming County, Guangxi. The change of the stubble, yield performance of ratoon sugarcane and the influence on the stubble of the next ratoon sugarcane were investigated by mechanical stubble shaving treatment with no stubble shaving as the control (CK). The results showed that the underground stem length of 1-year and 2-year ratoon sugarcane treated with mechanical stubble shaving for Zhongzhe 3 was 13.70 and 11.64 cm, and the underground bud number was 7.09 and 6.40, respectively, which were extremely significantly lower than the CK. The underground stem length and underground bud number of 1-year ratoon sugarcane treated with mechanical stubble shaving for Guitang 44 were 11.86 cm and 7.83, which were also extremely significantly lower than the CK. After harvesting, the underground stem length of next ratoon sugarcane with mechanical stubble shaving for Guitang 44 was 17.61 cm, which was significantly higher than that in CK. The underground bud number was 9.17, which was 41.73% higher than in CK, and also significantly higher than in CK. There were no significant differences in underground stem weight, root fresh weight and root-stem ratio compared with CK. The number of seedlings emerging, the number of seedlings at tillering stage, the number of effective stems and the yield in 1-year and 2-year ratoon sugarcane after mechanical stubble shaving treatment for Zhongzhe 3; the number of millable canes in 1-year ratoon sugarcane after mechanical stubble shaving treatment for Guitang 44 were all significantly higher than the CK; the yield of sugarcane increased by 7.98%-11.16%. Mechanical stubble removed the above and upper buds, promoted the germination and growth of the middle and lower buds, increased the millable canes, increased the yield of sugarcane, delayed the upward movement of the position of sugarcane stump, increased the number of underground buds of the next ratoon stubble, and extended the years of ratoon.

P-02

# Artificial intelligent for accurate identification of major sugarcane fungal diseases

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Sugarcane smut, red rot, ring spot, and brown spot are important fungal diseases of sugarcane that severely affect sugarcane yield and sugar recovery. Traditional manual disease surveys require strong professionalism and are time-consuming, highly subjective, prone to error, and inefficient. In this study, an intelligent identification for major fungal diseases of sugarcane was developed based on object detection and image segmentation techniques, thereby providing technical support for sugarcane disease-resistance breeding, smart crop protection, and sustainable disease management. For sugarcane smut, improved YOLOv5s was employed in sugarcane smut identification. An optimized lightweight detection model was developed through multidimensional enhancements balancing performance and model compression. Architecturally, replacing the original backbone network with EfficientNetV2 significantly reduced complexity while maintaining accuracy. During feature extraction, integrating the CBAM attention mechanism strengthened effective feature learning, while upgrading C3 modules to C3STR enhanced global large-target detection capability. For bounding box regression, replacing CIoU with WIoU loss improved localization precision. Experimental results showed the optimized model achieved a mean Average Precision(mAP) of 97.8%, representing a 0.2 percentage point improvement over the original YOLOv5s. Compared to the original model, the computational load of the model is 4.9 G FLOPs, with a parameter count of 3.25 million, corresponding to reductions of 70.3% and 54%, respectively. The YOLOv5s-ECCW model meets the urgent need for the accurate real-time identification of sugarcane smut, supporting better disease management and selection of resistant varieties. For red rot, ring spot, and brown spot, a sugarcane disease image dataset and a lightweight HHPA-UNet segmentation model were Constructed. A total of 1ÿ440 leaf images of sugarcane infected with red rotÿring spotÿand brown spot were collected from major production areas in Guangxiÿfollowed by pixel-level annotation and data augmentation. Based on the UNet architectureÿhalf convolution was introduced to realize model lightweightÿreducing computation to 1/4 of standard convolution. A Hybrid Pooling Attention (HPA) module was embedded into the skip connections to enhance the extraction of key lesion features and suppress interference from complex backgrounds. The results showed that the improved HHPA-UNet model achieved 75.56% mIoU, 83.48% mAP, and 83.94% F1-score, with only 21.22M parameters and 118.42 GFLOPs. Its comprehensive performance outperformed mainstream models including UNet, SegNet, DeepLabV3+, and YOLO11L, enabling high-precision and lightweight segmentation of sugarcane lesions and providing an efficient algorithm for accurate disease monitoring.

P-03

# NpSCI2A, a potato inhibitor I protein from a wild sugarcane relative, negatively regulates drought tolerance by targeting subtilases

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Drought stress severely limits sugarcane yield. Narenga porphyrocoma, a drought-tolerant wild relative of sugarcane, serves as a valuable germplasm for sugarcane genetic improvement. Transcriptome analysis combined with Weighted Gene Co-expression Network Analysis (WGCNA) identified NpSCI2A, which was markedly downregulated under drought conditions. NpSCI2A encodes a potato inhibitor I-type protease inhibitor. Protein interaction assays confirmed that NpSCI2A directly binds to subtilases SBT1.2 and SBT1.8 and inhibits their activity. Transgenic rice overexpressing NpSCI2A exhibited increased drought sensitivity, with aggravated oxidative damage and impaired chloroplast protein homeostasis. Collectively, this study reveals a mechanism by which a protease inhibitor regulates drought adaptation in wild sugarcane, providing candidate gene resources for drought-resistance breeding.

P-04

# Comparison of sugarcane responses to humic acids by product from the leonardite Mae Moh Mine's on seed cane under greenhouse conditions

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Early growth stage of sugarcane is a germination and root system development. Humic acid is organic materials with the potential to promote plant growth and humic acids from the leonardite Mae Moh Mine's by product. This study aimed to compare the responses of sugarcane to different humic acid products and application rates used for sett soaking during early growth under greenhouse conditions. The experiment was conducted using a randomized complete block design (RCBD) with 10 treatments and four replications. The treatments consisted of different concentrations of EGAT Humic, Humic X, KU Humic (K Humate), and Himas 120, with water-soaked setts serving as the control. Sugarcane growth was evaluated at 45 days after planting (DAP) based on plant height, leaf number, leaf greenness (SPAD value), root number, root length, root fresh weight, and root dry weight. The results showed significant differences among treatments in plant height, leaf number, and SPAD value ($p<0.05$). KU Humic at 200 mL per 20 L of water produced the greatest mean plant height of 60.3 cm, whereas EGAT Humic at 400 mL per 20 L of water resulted in the highest mean leaf number of 7.5 leaves per plant. Himas 120 at 30 mL per 20 L of water produced the highest SPAD value of 53.4. In contrast, root number, root length, root fresh weight, and root dry weight did not differ significantly among treatments. These findings indicate that sugarcane responses varied among humic substance products and application rates. Significant treatment effects were observed in aboveground growth traits, whereas no significant differences were detected in root growth traits under the experimental conditions. These findings provide preliminary information on the effects of different humic substance products and application rates on early sugarcane growth under greenhouse conditions.

P-05

# Interplay between cropping modes and microbiomics-metabolomic cross-talk modulates sugarcane crop yield and biomass

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Sugarcane productivity is influenced by cultivation practices that modify plant-microbe-soil and metabolic interactions. However, the relationships among cropping mode, root-associated microbiome assembly, metabolite reprogramming, and yield remain poorly understood. This study aims to evaluate the effects of mono- and mixed cropping systems on sugarcane yield and to elucidate the interactions among root endosphere, rhizosphere, and bulk soil microorganisms, metabolites, and yield-related pathways, thereby informing sustainable cultivation practices. This study evaluated two main cultivated sugarcane varieties (YZ081609 and YZ1658) in the Yunnan cane area under monocropping and mixed-variety cropping to determine effects on yield and biomass, compartment-specific microbiomes (root endosphere, rhizosphere, bulk soil), and rhizosphere metabolomes at three time points (September, October, and December). Bacterial and fungal communities were profiled using Illumina MiSeq and analyzed with QIIME2, diversity metrics, LEfSe, and Random Forest. Non-targeted metabolites were quantified by UHPLC-MS/MS and analyzed using multivariate statistics, differential accumulation criteria, KEGG enrichment, and microbe-metabolite co-occurrence networks. Monocropped YZ081609 (SA) achieved the highest cane yield (191.2 t/ha) and stalk number (91,563/ha), exceeding monocropped YZ1658 (SB 149.8 t/ha; 62,188/ha) and mixed cropping (DAB; 187.28 t/ha total, with variety A contributing 135.59 t/ha and variety B contributing 51.69 t/ha on an equal-area basis, indicating asymmetric competition that severely suppressed variety B). Biomass partitioning also differed among cropping modes.

Across compartments, Proteobacteria and Actinobacteriota dominated, and both cropping mode and variety shaped microbial recruitment and community patterns. Metabolomics identified 2,886 metabolites and 137 differentially accumulated metabolites, with SA marked by cyclo (His Pro) upregulation and mixed systems by defense-associated signatures. Functional inferences and networks linked SA to enriched metabolic pathways and more positive microbe-metabolite associations, whereas mixed cropping showed more negative associations, suggesting competitive interactions and suppression of variety B. Collectively, variety-specific monocropping, particularly YZ081609, showed better synchronized microbial recruitment and metabolic reprogramming to support yield and biomass. Our integrated microbiomics and metabolomics study demonstrates that variety-specific monocropping more effectively synchronizes the plant-microbe-soil ecosystem than mixed cropping. This strip monocropping approach can be adopted as a sustainable strategy for future crop production.

P-06

# Eco-efficiency assessment for sustainable sugarcane production in China

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Sustainable crop production is critical to address the grand challenges of climate change and food security, and eco-efficiency is increasingly used to assess systems sustainability. Sugarcane is a major high biomass, high input sugar and bioenergy crop but with a relatively large carbon footprint, accounting for 88% of Chinese sugar output. However, its production eco-efficiency remains unclear. A reliable assessment of sugarcane crop production eco-efficiency is necessary to identify the most important targets and effective strategies to improve its economic and environmental outputs. Here, we combined life cycle assessment (LCA) and data envelopment analysis (DEA) to determine eco-efficiency and sustainability of small-holder sugarcane farm production system in southern China. Six modelling approaches, including both input- and output-oriented, were used to assess sugarcane agriculture eco-efficiency. An output-oriented DEA model with yield and profit as desirable and carbon footprint as undesirable outputs proved to be superior to the other approaches for sugarcane production eco-efficiency assessment. The estimated average eco-efficiency of plant (first year) and ratoon (second year) crops were 0.803 and 0.869, respectively. Under this model, yield and profit were increased by 16.6% and 180% for plant crop, and 9.62% and 38.2% for ratoon crop, respectively, with a substantial reduction, up to 21.0%, 27.5% and 13.2% for N, P, K fertilizer input, respectively, resulted in 28% reduction in carbon footprint The farm performance analysis indicated that the most eco-efficient farmers had large farms with crop rotation systems, lower fertilizer input, a relatively higher education, more acceptance of new farming practices and products, and better access to agriculture resources, compared with eco-inefficient farmers. Adopting the model outputs reported here will help eco-inefficient farmers to narrow their productivity gap, increase profit and make Chinese sugarcane farming more eco-efficient. This is the first report of eco-efficiency and sustainability assessment in sugarcane production using LCA + DEA framework, with potential for adopting it to other agricultural systems.

P-07

# Regenerative agriculture and role of sub surface drainage technology in maintaining soil health, biodiversity and its socio-economic impact

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Agriculture is facing a severe threat to its sustainability due to the growing demands for food, feed, and other renewable nonfood raw materials in the face of global warming. Regenerative agriculture is increasingly recognized as a vital solution to a range of ecological and social issues. It actively revitalizes ecosystems, focusing on soil health, biodiversity, and mitigating climate change, going beyond sustainable practices. Governments and other organizations at all levels, from global to regional, are exploring how regenerative agriculture can be integrated into climate change initiatives to sustain ecosystem. This powerful benefit can be achieved without reducing yields or farmer profits. Soil, as a living and dynamic environment, is home to a diverse range of micro- and macro biota that contribute to its characteristics. Healthy soil is characterized by favorable physical properties (texture, bulk density, water-holding capacity), chemical properties (pH, Ec, soil organic carbon), and biological properties (microbial diversity, and soil respiration), which are essential for nurturing nutritious and profitable crops and improve human health. Regenerative farming is attracting interest from the public, private, and nonprofit sectors to improve soil health and sustain ecology. Several academics and non-governmental organizations have attempted to explain the scope and significance of regenerative agriculture. This review outlines how regenerative agriculture practices can mitigate global warming, improve soil health, boost biodiversity, and its socio ecological impacts. As we move towards a future where every drop counts and every harvest matters, implementing agriculture drainage with top-tier technology is no longer a luxury, but a necessity for the word's food security and sustainability. Waterlogging and soil salinity has a major problem in most of villages of Shirol Taluka of Maharashtra (India).with the efforts of Shree Datta SSSK ltd.as a promoting agency, SSD was implemented on 3250 ha. area. During this study it was observed that the mean soil salinity reduced was reduced from 8.66ds/m to 2.95ds/m(65%reduction),average soil bulk density reduced by 4.5%,while the gross income of farmer increased by 269% in plant cane and 297% in ratoon cane under post SSD condition. Massive urbanization is putting pressure on agricultural lands, resulting in shrinking of land holdings. The possibility of area expansion under agriculture, therefore, exists in restoring the degraded lands. Nearly 147 million ha of land is subjected to soil degradation, including 94 million ha from water erosion, 23 million ha from salinity/alkalinity/acidification, 14 million ha from water-logging/flooding, 9 million ha from wind erosion and 7 million ha from a combination of factors due to different forces. Government of India has fixed a target of restoring 26 million ha of degraded lands, including salt-affected soils, by

the year 2030 to ensure food security for the people. Around 6.74 million ha area in the country is salt-affected. Estimates suggest that every year nearly 10% additional area is getting salinized, and by 2050, around 50% of the arable land would be salt-affected. Saline soils occupy 44% area covering 12 states and one Union Territory, while sodic soils occupy 47% area in 11 states. The ICAR-Central Soil Salinity Research Institute and many State Agricultural Universities are engaged in studying salt-affected soils and developing reclamation technologies and strategies For future prospects, further scientific research required to examine the effects of regenerative agriculture on both livestock and human health, in order to promote a healthier community.

P-08

# Integrating multi-spectral unmanned aerial vehicle sensing and variable rate technology for sustainable sugarcane agriculture: A paradigm shift

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Sugarcane (*Saccharum* spp.) is a vital global C4 crop cultivated primarily for sugar and ethanol production. India represents a critical production hub, accounting for 17.5% of global cultivation area and 19.4% of total output. However, conventional management faces several bottlenecks, including intensive manual labor, inefficient inputs, and delayed pest diagnostics. This study evaluates the integration of Artificial Intelligence (AI) and Unmanned Aerial Vehicles (UAVs) as a transformative precision agriculture paradigm to optimize resource use and enhance crop productivity under subtropical conditions. By pairing drone-based multi-spectral aerial imaging with GPS-guided machinery and in-situ soil sensors, growers can extract real-time datasets on crop health, soil moisture, and nutrient dynamics. AI-assisted UAVs enable early detection and monitoring of pest and disease outbreaks, facilitating localized spot-interventions that reduce excessive pesticide dependency. Concurrently, the use of Variable Rate Technology (VRT) via autonomous drone-based spraying systems guarantees uniform, low-volume application of agrochemicals. This automation reduces input wastage, mitigates chemical runoff, lowers manual labor overheads, and refines yield estimation accuracy. While UAV workflows improve spray efficiency and reduce environmental costs, commercial scaling requires addressing key research gaps—particularly regarding the biochemical interactions between drone-delivered droplet dynamics and long-term crop physiological responses. Cross-industry collaboration among researchers, manufacturers, and policymakers is vital for developing cost-effective, customized drone platforms. In conclusion, adopting autonomous UAV frameworks provides a sustainable, data-driven path toward higher productivity, resource efficiency, and climate resilience in the sugarcane industry.

P-09

# Impact of in-situ single eye bud settling technology for cost-effective, sustainable sugarcane cultivation and yield enhancement

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Sugarcane is a major commercial crop in India, contributing to the production of sugar, ethanol, cogenerated power, and compressed biogas (CBG). Despite being the world's second-largest sugarcane producer, India faces challenges in ensuring sustainable and cost-effective sugarcane cultivation. In Maharashtra, (India) recurring cane shortages and policy-related constraints on input and output prices have raised concerns about the long-term viability of the sugar industry. This study evaluates the impact of in-situ single eye bud settling plantation technology, developed by Shree Datta SSSK. Ltd., on sugarcane productivity and production economics. Conventional two-budded sett planting requires about 5.3 MT, whereas the in-situ settling method only about 1.6 mt of seed cane per hectare. The technology enables direct field establishment, reducing seed cane use by 3.5 MT per hectare while maintaining crop performance. With Maharashtra's annual sugarcane planting area of 7–8 lakh hectares, widespread adoption of this technology could save an estimated 26-28 lakh tons of sugarcane annually. The conserved cane can be diverted for crushing, helping to alleviate raw material shortages and improve sugar industry profitability. This also will to reduce the burden on SBI's to produce large quantity of seed cane. This is very low cost user friendly method of raising settlings for sugarcane plantation. This innovative sugarcane planting technology enables 100% field germination, optimum & early strong tillers, less tiller mortality (49% against 60% in conventional method) better average single cane weight(18%more) and hence the 16% more cane yield. If state average yield which is 78mt/ha and 16% yield improvement is considered 100 lakh MT more cane will be available for crushing of worth 3500 cr. and the annual economic value of the saved cane is estimated at approximately Rs.980 cr. highlighting the potential of in-situ settling single eye bud technology as a sustainable and economically beneficial innovation for sugarcane cultivation.

P-10

# Identification of smut resistance and physiological and transcriptomic analysis of resistant and susceptible germplasm in 158 inbred progenies of *Saccharum spontaneum*

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Sugarcane smut is one of the most devastating fungal diseases threatening sugarcane production. *Saccharum spontaneum*, the wild species with the richest genetic diversity in the genus *Saccharum*, is an important gene source for disease resistance breeding. Here we crossed the highly smut-resistant *S. spontaneum* germplasm Yunnan82-1 (@&) and 2017-22 (B&), selected the highly resistant and elite individual A1 from the F  generation, and obtained 158 S, inbred lines through selfing. These lines were subjected to resistance evaluation, physiological measurements, and transcriptomic analysis to identify elite germplasm and dissect the resistance mechanism. Resistance evaluation revealed that the resistance frequency of the SA1 population exhibited a right-skewed distribution, with highly resistant materials accounting for 57.0%, indicating that the high resistance of both parents was well maintained during crossing and selfing. Single stalk weight and millable stalk number showed considerable variation and were the main contributors to yield. Resistance rating was weakly negatively correlated with millable stalk number and yield per pot, but not significantly correlated with plant height, stalk diameter, Brix, or single stalk weight. Cluster analysis divided the population into five groups, among which groups I and V showed better agronomic traits and resistance. Based on dual identification using dipping and needle-prick inoculation methods, two new germplasms, SA1-1 (more millable stalks, highly resistant) and SA1-8 (larger stalk diameter, highly resistant), were selected, both combining high resistance with excellent agronomic traits. After inoculation, CAT activity exhibited a greater increase in resistant materials, whereas POD activity showed a greater increase in susceptible materials. GO enrichment analysis showed that resistant and susceptible lines shared common response pathways in phosphorylation signaling and amino acid metabolism, but resistant genotype was specifically enriched in flavonoid metabolic process and hormone catabolic process, while susceptible genotype was specifically enriched in auxin biosynthesis, abscisic acid biosynthesis, and cell redox homeostasis.

GSEA further revealed that flavonoid biosynthesis was significantly enriched in resistant line, whereas glutathione metabolism and plant-pathogen interaction were more strongly enriched in susceptible line. Among the differentially expressed genes responding to inoculation, 10 candidate resistance genes involved in pathogen recognition, secondary metabolism, and transcriptional regulation were further identified. Based on transcriptome and WGCNA analyses, *SsTGA2.2*, a key regulator of the salicylic acid (SA) signaling pathway, was identified from *Saccharum spontaneum*. *SsTGA2.2* contains conserved bZIP and DOG1 domains and is a typical transcription factor. It is highly expressed in germinating buds and shoot apical meristems and is localized to the nucleus. Transient expression of *SsTGA2.2* in tobacco activated reactive oxygen species (ROS) accumulation and induced the expression of the defense gene *PR5*. Furthermore, overexpression and gene editing confirmed that *SsTGA2.2* positively regulates the resistance of *Saccharum spontaneum* to smut disease. This study provides elite materials and gene resources for germplasm innovation and molecular breeding of smut-resistant *Saccharum spontaneum*.

P-11

# Transcriptomic and metabolomic profiling reveals endophyte-induced resistance mechanisms against sugarcane smut

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Sugarcane production is significantly threatened by smut disease, caused by the fungal pathogen *Sporisorium scitamineum* (SS). In this study, we evaluated the biocontrol efficacy of two bacterial endophytes, *Bacillus* sp. QN2MO-1 (BS) and *Pseudomonas chlororaphis* (PS), applied individually or in combination to two sugarcane cultivars, ROC22 and Zhongtang 3. A comprehensive assessment was performed by integrating genotypic characterization, stress-related damage indicators, phytohormone profiling, hydrolytic enzyme activities, antioxidant responses, and transcriptomic and metabolomic analyses. Endophyte application markedly enhanced plant growth, photosynthetic performance, antioxidant capacity, hydrolytic enzyme activities, and the expression of stress-responsive defense mechanisms. Integrated transcriptomic and metabolomic analyses identified 20 candidate resistance genes and 10 metabolites potentially associated with sugarcane resistance to smut disease. Of the identified genes, 12 were upregulated and 4 were downregulated following endophyte application, while an additional four genes exhibited consistent induction in response to endophyte treatment but were suppressed under smut infection. Among the candidate genes, those involved in ethylene signaling (*Sc05Bg379000*), jasmonic acid signaling (*Sc05Dg189200* and *Sc05Bg331800*), and phenylpropanoid metabolism (*Sc07Eg089200* and *Sc05Ag165800*) were strongly induced, suggesting their involvement in the activation of secondary metabolite biosynthesis and defense responses. LC–MS-based metabolomic analysis further revealed distinct metabolic responses to the two endophytes. *P. chlororaphis* treatment enhanced the accumulation of luteolin-7-glucoside, jasmonic acid, linolenic acid, methyl salicylate, and phenylacetic acid, whereas *Bacillus* sp. treatment increased the levels of salicylic acid â-D-glucoside, trans-ferulic acid, malvidin-3-O-glucoside, syringic acid, and D-(+)-malic acid. In contrast, SS infection resulted in substantial disruption of the metabolic profile. Notably, combined application of the two endophytes promoted a synergistic and more stable accumulation of defense-associated metabolites. Overall, these findings demonstrate that endophytic bacterial

consortia can enhance sugarcane resistance to SS by modulating physiological, biochemical, hormonal, transcriptional, and metabolic defense responses. This study provides valuable insights into endophyte-mediated disease resistance and highlights bacterial consortia as promising biological tools for improving sugarcane smut resistance and supporting future biotechnological and targeted breeding strategies.

P-12

# Low ammonium and high nitrate input improves nitrogen use efficiency and growth in sugarcane through coordinated reprogramming of nitrogen and carbon metabolism

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Providing plants with adequate nitrogen (N) through an appropriate ammonium-to-nitrate-ratio ($NH_4^+/NO_3^-$-ratio) can enhance nitrogen use efficiency (NUE) and promote growth. However, how different $NH_4^+/NO_3^-$-ratios affect N and carbon (C) metabolic processes and growth in sugarcane, a fast-growing high-biomass crop, remain unclear. Here, a hydroponic experiment was conducted using sugarcane variety 'Yunzhe05-51', applying seven $NH_4^+/NO_3^-$-ratios under a constant total N supply level of 10 mmol·$L^{-1}$. Plant growth, activities of N-related enzymes, and dual transcriptomic and untargeted metabolomic responses were measured to investigate the regulation of N and C metabolism. The results indicated that an $NH_4^+/NO_3^-$-ratio of 20/80 was optimal for sugarcane growth. Enhanced activities of leaf $NO_3^-$ reductase and $NH_4^+$ anabolic enzymes, together with more balanced C and N metabolic processes, explained the potential regulatory mechanisms that promoted sugarcane growth under this ratio. $NO_3^-$-only treatment downregulated the expression and abundance of several genes and metabolites associated with photosynthesis, while promoting $NO_3^-$ transport and reduction. When $NH_4^+$ supply exceeded 4 mmol·$L^{-1}$, sugarcane showed signs of toxicity. Although activities of $NH_4^+$ assimilation enzymes were relatively lower under exclusive $NH_4^+$ supply, high $NH_4^+$ concentrations resulted in higher L-glutamate levels, indicating growth inhibition under such conditions related to disruptions in protein posttranslational modifications. Furthermore, several metabolites and metabolic pathways associated with stress tolerance and detoxification were activated under high $NH_4^+$ conditions. Collectively, this study elucidates the optimal $NH_4^+/NO_3^-$-ratio for sugarcane growth under adequate N availability and provides insights into the underlying metabolic regulatory mechanisms.

P-13

# Harnessing silicon-mediated structural, biochemical, and ecological defense mechanisms against sugarcane insect pests: Implications for IPM

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Silicon (Si) is established as a critical beneficial element that fortifies graminaceous crops, particularly sugarcane (*Saccharum* spp.), against biotic stresses. Globally, sugarcane cultivation remains highly vulnerable to insect herbivory, which accounts for estimated production losses of roughly 20% in cane yield and 15% in commercial sugar recovery. To mitigate this threat, exogenous Si supplementation via soil amendments, foliar sprays, and engineered nanoparticles has been deployed, with significant improvements in crop resistance observed under both field and controlled environmental conditions. This resistance operates via a multi-dimensional defense matrix that coordinates mechanical, biochemical, and ecological defense pathways. *Mechanical Reinforcement:* Deposited amorphous silica forms abrasive epidermal phytolith barriers. These structures cause substantial mandibular wear in pestiferous lepidopterous/coleopterous larvae, delay tissue penetration, and reduce boring efficiency in destructive stalk borers such as *Eldana saccharina*, *Chilo infuscatellus*, and *Diatraea saccharalis*. *Biochemical Modulation:* Beyond functioning as a passive structural barrier, silicon actively regulates jasmonic acid (JA), salicylic acid (SA), and ethylene signaling cascades. This molecular regulation promotes the synthesis of defensive enzymes (peroxidases, polyphenol oxidases, phenylalanine ammonia-lyase) and alters plant sap quality, reducing the nutritional value of phloem sap and disrupting the reproduction, and survival of sap-sucking pests like aphids, whiteflies and mealybugs. *Ecological Mechanisms:* Si modulates the third trophic level by intensifying the emission of herbivore-induced plant volatiles (HIPVs). These volatile blends serve as chemical signals that attract natural enemies such as the egg parasitoids, *Trichogramma* spp. and specialized canopy predators (spiders, coccinellids, praying mantis), thereby accelerating natural biological control. Concurrently, phytolith-induced delays in feeding may prolong the vulnerability of chewing larvae, increasing their exposure to adverse weather, starvation, and predation. By optimizing natural biological regulation, lengthening pest vulnerability phases, and altering nutritional suitability, silicon acts as a powerful multi-trophic regulator. Despite these clear benefits, the precise physiological and transcriptomic mechanisms driving silicon-mediated immunity remain poorly understood, and its incorporation into

commercial integrated pest management (IPM) systems remains limited. This paper clarifies the combined mechanical, biochemical, and ecological mechanisms of silicon-driven resistance, addresses the operational challenges of field-scale delivery, and highlights strategies for reducing dependence on chemical insecticides while maintaining sugarcane productivity.

P-14

# Integrated impact of PGRs, nutrients and pesticides (Oos Sanjeevani) towards crop resilience to diverse growing environments and quantum jump in productivity of sugarcane under farmers participatory intervention program in Gujarat and Maharashtra

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Farmers participatory trials conducted during 2019 to 2021 across 1988 acres in six tehsils involving of South Gujarat, India, involving 409 farmers, demonstrated that sugarcane yield could be substantially enhanced through an integrated crop management approach. The adoption of a technology package comprising plant growth regulators (PGRs), nutrients, and pesticides constituting 5 foliar sprays resulted in double yield from 21 t/ac to 43 t/ac (representing a 104.7% increase) and farm income increased from Rs. 58000 per acre to Rs. 20400 per acre, with only a 15.5% increase in input cost. A similar farmer participatory, mission mode program implemented during 2022-23 with 43 farmers under Shri Shankar Sahakari Sakhar Karkhana (SSK), Tembhurni (Solapur district, Maharashtra), further validated these findings. The implementation of stage PGR-based integrated foliar applications enhanced productivity of sugarcane from factory average of 36 t/ac to 66.28 t/ac, reflecting an 84 % rise, where 52 % of participating farmers achieved yields ranging from 70 to 120 t/ac in the plant crop. The millable cane yield of ratoon was also improved 2.5 times (i.e. from 43 t/ac to 75t/ac). The participatory PGR integrated program was further extended during 2022-2024 to 112 farmers across 30 villages under SSK, Pravara, Ahilyanagar (Maharashtra) in which 67% of participating farmers achieved sugarcane productivity between 43 to 75 t/ac, representing nearly a 100% increase over the factory average yield of 22 t $ha^{-1}$. These results consistently demonstrate the effectiveness of integrating PGRs, nutrients, and pesticides in enhancing sugarcane productivity under diverse agro-climatic conditions.

P-15

# Key yield components underlying ratooning ability and cane yield maintenance under early-season drought stress in a diverse set of sugarcane genotypes

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Early drought decreases sugarcane production and ratooning ability. The yield components underlying drought resilience in ratoon cane are not well understood. Responses of cane productivity, ratooning capacity, growth and yield-component in six diverse set of sugarcane genotypes under optimal watering (WW) and early-season drought stress (DS) were evaluated in this research. The experiment was a split plot with three replications. Drought was imposed from 1 to 6 months after harvest, followed by rewatering until harvest. Correlation, hierarchical clustering and principal component analysis were used to evaluate trait associations and genotypic reactions. Drought reduced ratoon cane production by 28% and the ratooning capacity from 77.4% to 69.1%. Also, millable cane, stalk length and individual stalk weight were reduced by 18.2%, 20.4% and 14.1%, respectively. Height growth recovery differed among genotypes after rewatering. F03-362 showed better cane production and ratooning ability in different water regimes but KK09-0358 produced good cane yield under arid condition by sustaining single stalk weight. High ratoon productivity and good ratooning ability were positively correlated with increased stalk length and number of millable canes. These findings suggest that stalk population and growth maintenance are important for maintaining ratoon yield in dry conditions. The high efficiency of interspecific hybrids indicates their importance as major genetic resources for improving drought resistance and ratooning ability of sugarcane.

P-16

# Root morphology, xylem anatomy, and physiology of interspecific sugarcane hybrids under early drought

**Suttida prom-aiam [1], Patcharin Songsri [1,2,3] and Nakorn Jongrungklang[1,2,*]**

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Early-season drought during the tillering stage is a major constraint on rainfed sugarcane production in northeastern Thailand, where most cane is planted in the early rainy season. Although growth and physiological traits are widely used as selection criteria for drought tolerance, the root anatomical responses of interspecific sugarcane hybrids remain poorly characterized, leaving their contribution to yield maintenance under water deficit unclear. This study evaluated the growth, physiological, root morphological, and root anatomical responses of interspecific hybrids to simulated early-season drought to identify traits associated with tolerance. Six genotypes were evaluated: three drought-tolerant (KK3, BC1-21, BC1-44) and three drought-susceptible (UT12, BC1-36, BC1-63), with the BC1 clones derived from interspecific hybridization between commercial cane and *Saccharum spontaneum*. A pot experiment was conducted in an open greenhouse at Khon Kaen University in 2024 as a 2 × 6 factorial in a randomized complete block design with three replications. Plants were either maintained at field capacity (FC) or subjected to water withholding (WW) from 30 to 48 days after transplanting (DAT), followed by rewatering until 78 DAT. Data were collected on soil water content, plant height, tiller number, and leaf, stalk, and root dry weight; SPAD chlorophyll meter reading (SCMR), maximum quantum efficiency of photosystem II (Fv/Fm), leaf gas exchange, and relative water content; root length, surface area, and volume using WinRhizo image analysis; and xylem vessel number and size at three positions along the root. Drought tolerance indices, correlation analysis, and Ward's cluster analysis were used to integrate trait responses. Water withholding lowered soil water content to 8–9%, compared with 11–12% under FC, and reduced plant growth, biomass accumulation, photosynthetic performance, leaf water status, and root development. KK3, BC1-21, and BC1-44 maintained higher growth and biomass under stress and recovered more strongly after rewatering, whereas UT12 and BC1-63 were more severely affected. Drought altered xylem vessel number and size depending on genotype and root position, and some genotypes maintained or enlarged their vessels under stress, which may help sustain root water transport. Stalk dry weight correlated positively with root dry weight, root length, surface area, and volume, and with total and metaxylem vessel size ($p < 0.05$), but only weakly with leaf gas exchange, indicating that belowground traits rather than short-term physiological responses underpin biomass maintenance under early drought. Root morphological traits, xylem vessel characteristics, and recovery capacity after rewatering can therefore serve as practical selection criteria in sugarcane breeding programs targeting early rainy-season planting systems prone to intermittent drought.

P-17

# Quality characterization and processing optimization of traditional brown sugar from sugarcane

**Yang Ting[1,2], Yang Liu[1,2], Hui Fuyi[1,2], Qu Shaokui[1,2] and Ying Xiongmei[1,2*]**

*[1]State Key Laboratory of Tropical Crop Breeding, Yunnan Academy of Agricultural Sciences, Kunming 650205; [2]Sugarcane Research Institute, Yunnan Academy of Agricultural Sciences/Yunnan Key Laboratory of Sugarcane Genetic Improvement, Yunnan, Kaiyuan 661699*

Brown sugar is a non-centrifugal sugar product that retains various components derived from sugarcane juice. Its quality is influenced by sugarcane variety, raw material storage conditions, and processing methods. To improve the understanding of brown sugar quality and provide a scientific basis for raw material selection and processing optimization, a series of studies were conducted to investigate the physicochemical properties, nutritional composition, texture, and volatile flavor profiles of brown sugar. Sixteen sugarcane varieties were evaluated for their suitability for brown sugar production by analyzing their nutritional and quality indicators, mineral elements, free amino acids, and total polyphenols. The results identified Xuansan, Liucheng 05-136, Chuantang 61-408, Taitang 134, and CO 419 as promising varieties for producing high-quality brown sugar. Storage duration also affected sugar composition and textural properties. In particular, changes in sucrose and reducing sugar contents were associated with variations in hardness and sensory characteristics, with the magnitude of these changes differing between sugarcane varieties. Furthermore, comparative analyses of 24 commercial brown sugar products revealed differences in physicochemical properties, nutritional composition, and volatile profiles among traditional, industrially manufactured, and reprocessed brown sugars. Analysis of 15 brown sugar samples identified 67 volatile compounds, and D-(-)-pantolactone and furfuryl alcohol were detected across all samples and showed relatively high abundance and odor activity. Principal component analysis was used to develop a comprehensive evaluation of brown sugar aroma quality. Collectively, these findings demonstrate that brown sugar quality is closely associated with raw material characteristics, postharvest storage, and processing practices. The results provide a basis for selecting suitable sugarcane varieties, managing raw material storage, evaluating product quality, and developing strategies for improving the nutritional and sensory characteristics of brown sugar.

P-18

# Nitrogen supply modulates sugar accumulation in sugar beet (*Beta vulgaris* L.) via regulating carbon-nitrogen balance and carbon partitioning

**Shifeng Dong[1,2], Liuxi Yi[2], Lei Wei[2], Shude Shi[2*] and Xuming Xing[3]**

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Nitrogen (N) supply strongly influences the balance between taproot yield and sugar content in sugar beet (*Beta vulgaris* L.), yet excessive N often improves yield while reducing sugar concentration. However, the physiological and metabolic mechanisms underlying this yield–sugar trade-off remain insufficiently understood, particularly regarding how N supply coordinates carbon–nitrogen metabolism in source and sink organs. A field experiment with seven N application rates (0–300 kg N $ha^{-1}$) was conducted to investigate canopy development, biomass accumulation, carbon–nitrogen metabolism, and metabolomic responses in leaves and taproots. N supply significantly affected canopy development, biomass partitioning, and the activities of key carbon–nitrogen metabolism enzymes, with moderate N (N180) sustaining higher sucrose metabolism enzyme activities and a more balanced taproot carbon-to-nitrogen (C:N) ratio. Taproot yield and sugar content exhibited a clear nonlinear trade-off; sugar yield plateaued at approximately 180 kg N $ha^{-1}$, whereas sugar content stabilized beyond 123.5 kg N $ha^{-1}$. Correlation analysis indicated that taproot C:N ratio was positively associated with sugar content but negatively associated with yield, whereas leaf sucrose synthase activity showed the opposite pattern. Weighted gene co-expression network analysis (WGCNA) identified four key functional modules. Among them, the eigengene of the taproot red module was positively correlated with sugar content ($r = 0.76$, $P < 0.05$), whereas the eigengene of the taproot blue module was positively correlated with taproot total N. High N supply was associated with activation of N metabolism modules and suppression of carbon storage modules, accompanied by the accumulation of aromatic amino acids and polyamine precursors alongside the decline of sugars such as sucrose. These coordinated shifts suggest that excessive N is associated with reduced sucrose storage and enhanced N assimilation. This study provides a basis for further investigation of N management strategies to balance yield and sugar production in sugar beet.

P-19

# Sustainable sugarcane production in China

**Ting Luo[1], Xiaoyan Liu[1], Xinyi Li[1], Lihang Qiu[1], Haifeng Yan[1], Huiwen Zhou[1], Ling Yao[1], Jiepeng Huang[1], Kejun Huang[1], Linsheng Yang[2], Yan Deng[3], Xinping Chen[4], Fusuo Zhang[4]* and Prakash Lakshmanan[1]***

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Demand for sugar in China is projected to grow for the foreseeable future, with imports currently accounting for approximately one-third of domestic consumption. However, sugarcane production in China is very unlikely to increase substantially due to high production cost, declining profit margin, and limited arable land. The persisting yield stagnation, despite substantial efforts in varietal improvement, remains a major productivity constraint. Equally concerning is the status of current cropping system with unsustainable use of fertilisers and other agri-chemicals, declining soil health, and the limited mechanised harvesting. Sugarcane and sugar production are an integral part of the socio-economic fabric of Southern China, particularly for Guangxi and Yunnan provinces, which directly supports the livelihood of ~28 million farmers. Thus, sustaining and improving the Chinese sugarcane industry is a social and economic imperative. More compellingly, to meet the ever-increasing market demand will require annual sugar production to increase from the current 10-11 MMt to the projected 16 MMt by 2030, with sugarcane expected to contribute 80-90% of sugar production. Achieving this target, however, will be very challenging considering the current sugarcane yield, production inefficiencies, and technological limitations. Increasing sugar yield and crop productivity in an environmentally sustainable way must therefore become strategic priorities. Undoubtedly, improved varieties, farm consolidation and continued mechanisation remain essential; however, substantial additional gains are also possible through better crop management and resource use. Our analysis of sugar industries globally suggests that sustained improvements in industry productivity and resource-use efficiency are more likely to be achieved through better crop management and more effective crop utilisation than through the relatively slow, incremental genetic gains delivered by conventional breeding. Beyond agronomic constraints, structural barriers, including small farm holdings, overly protective industrial policies, limited cross-institutional research and development, and weak industry stewardship, continue to impede progress. In many underperforming sugar industries, institutional inertia and/or genuine constraints in adopting and scaling up proven, low-hanging technologies further limit productivity gains. Similar challenges are evident in the Chinese sugarcane sector. Here, we highlight major roadblocks and potential solutions to transform Chinese sugarcane agriculture more productive and economically and environmentally sustainable.



# Awards and Honours

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# Awards and Honours

## Lifetime Contribution to Science, Technology and Innovation Award - 2026



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Chinese Academy of Agricultural Sciences, GXAAS, Guangxi
Nanning, P.R. China & President, IAPSIT

## Industry Excellence Award 2026

**COFCO Tunhe Chongzuo Sugar Co. Ltd.**
Chongzuo City, Guangxi,China



**R. Chandrasekaran**
Ponni Sugars Limited, India

## Life Time Achievement Award 2026



**Dr. Philippe Rott**
French Agricultural Research Centre for International Development (CIRAD)
UMR PHIM, Montpellier, France



**Mr. Arvind Chudasama**
Sugar Industry International, Berlin, Germany

## SSRP Fellow Award-2026



**Dr. T. Rajula Shanthy**
ICAR-Sugarcane Breeding Institute, Coimbatore 641007,
Tamil Nadu India



**Dr. Piergiorgio Stevanato**
University of Padova, Italy

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**Mr. Sanjay Awasthi**
ISGEC Heavy Industry Pvt. Ltd. Noida, India

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# ISC-2026 Technical Programme

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# 9th IAPSIT International Sugar Conference & Sugarcon-2026

**November 17-20, 2026**

**Venue: Nanning Hotel, Nanning, Guangxi, P. R. China**

## PROGRAMME SCHEDULE

**Monday, November 16, 2026**

| Time | Activity | Venue |
|---|---|---|
| 16.00-19.00 | **Arrival of Guests in Nanning, China** | Nanning Hotel |
| 18.00-20.00 | **Dinner** | Nanning Hotel |
| 09.00-20.00 | **Registration Desk Open**<br>**(Registration will continue on 17 and 18 November)** | Nanning Hotel Reception |

## Day I

**Tuesday, November 17, 2026**

| Time | Activity | Venue |
|---|---|---|
| | **Inaugural Session of ISC-2026 : Nanning Hotel Main Hall 9:00-12:30** | |
| 09.00-09.10 | **Welcome of Guests:** Dr. Prakash Lakshmanan | Main Hall |
| 09.10-9.15 | **Formal opening of ISC-2026 & Welcome address**: Prof. Yang-Rui Li, President IAPSIT | Main Hall |
| 09.15-09.20 | **Opening address** by Prof. Jian Sun, President, GXAAS, Nanning | Main Hall |
| 09.20-09.25 | **Welcome address** by Dr. S. Solomon, President SSRP &Vice-President, IAPSIT | Main Hall |
| 09.25-09.30 | **Welcome address** by Academician Fusuo Zhang, CAU | Main Hall |
| 09.30-09.40 | **Welcome address to ISC-2026 Nanning**: Governor | Main Hall |
| 09.40-10.00 | **Photo session** | Main Hall |
| 10.00-10.25 | **Plenary Talk:** Academician Wei Zhou | Main Hall |
| 10.25-10.50 | **Plenary Talk:** Academician Fusuo Zhang | Main Hall |
| 10.50.11.10 | **TEA BREAK** | |

| | | |
|---|---|---|
| 11.10-11.30 | **Video Presentation:** 70th anniversary of SRI, GXAAS.<br>**Video Presentation:** IAPSIT: 22 Years of Glorious Service to Global Sugar Industry | Main Hall |
| 11.30-12.00 | **Felicitation function of Prof. (Dr.) Yang-Rui Li**<br>**Introductory remarks** by **Dr. S. Solomon** : Celebrating Excellence, Honoring a Legacy<br>**Video presentation :** A Visual Tribute to Life and Legacy of Prof. Yang Rui Li<br>**Presentation of memento & souvenir to Prof. Y.R. Li** by Dr S. Solomon, Dr. G.P. Rao and Dr. Prakash Lakshmanan<br>**Release of a Special Biography of Prof Y.R. Li**: By Prof Jian Sun, Dr S. Solomon, Prof Yue-Bin Zhang | Main Hall |
| 12.00-12.05 | **Release of ISC-2026 Conference Souvenir** and a recent issue of **Sugar Tech** journal by Chief Guest | Main Hall |
| 12.05-12.25 | **Award Ceremony :** IAPSIT & SSRP Awards to Outstanding Researchers/ Sugar Industry by Chief Guest and dignitaries on the dais | Main Hall |
| 12.25-12.30 | **Vote of Thanks:** Dr. Dong-Liang Huang | Main Hall |
| 12.30-13.45 | **LUNCH : NANNING HOTEL** | |

## Tuesday, November 17, 2026
## (Venue : Main Hall, Ground Floor)

### Technical Session I

## Future-proofing Sugar Crop Production

| | | | |
|---|---|---|---|
| **Chairman:** Dr. Robert Magarey, Australia<br>**Co-Chairman:** Dr. Govind Raj, India<br>**Coordinator:** Ms. Shivani Gupta, India | | | |
| **PLENARY LECTURES** | | | |
| 13.45-14.05 | PL-01 | Introduction of Chinese Sugar Industry | Yang-Rui Li, SRS, GXAAS, Nanning, China |
| 14.05-14.25 | PL-02 | Technologies for Improving Sugar Crop Yields in China (in Chinese with English translation) | Yuebin Zhang |
| 14.25-14.40 | Special Lecture | Research integrity, improving journal metrics and visibility | Eti Dinesh, Nature-Springer, India |

| | | | |
|---|---|---|---|
| 14.40-15.05 | PL-03 | Drought Tolerance In Sugarcane: Emerging Concepts | Dr. Rafael Vasconcelos Ribeiro, University of Campinas, Brazil |
| 15.05-15.20 | PL-04 | Optimized Nitrogen Management for Synergistic Improvement of Sugarcane Yield and Sucrose Accumulation | Yan Deng, Interdisciplinary College of Resources and Environment, Southwest University, Chongqing, China |
| 15.20-15.40 | | **TEA BREAK** | |
| 15.40-16.05 | PL-05 | Next-Generation Technologies for Improving Sugar Beet Productivity and Profitability | Piergiorgio Stevanato University of Padova, Italy |
| 16.05-16.30 | PL-06 | High-throughput next-generation phenotyping, remote sensing, and AI technologies for sugarcane crop management | Xiuhua Li, Guangxi University, Nanning Guangxi, China |
| 16.30-16.55 | PL-07 | Sugarcane Machine Harvesting in Small Holdings and its Challenges | Shaochun Ma, College of Engineering, China Agricultural University, Beijing, China |
| **ORAL PRESENTATIONS** | | | |
| 16.55-17.10 | TS-I-01 | Eliminating "Monsoon Blindness": A Sovereign Quantum-SAR Framework for Future-Proofing Sugarcane Yield and Sugar Recovery Potential. | Sheriff Babu AgriCPS Chennai, Tamil Nadu, India |
| 17.10-17.25 | TS-I-02 | Enrichment of Fermented Organic Manure (FOM) and Fermented Organic Manure (LFOM) for Increasing Soil Organic Carbon Content | Ravi Shrinivasan Vela Biotech Pvt. Ltd. Coimbatore, Tamil Nadu, India |
| 17.25-17.40 | TS-I-03 | Divergent Responses of C4 Kranz Anatomy and Chloroplast Ultrastructure to Drought Stress in Sugarcane: The Role of Carbon Allocation | Gui Zhou/Dr. Yang-rui Li, SRS, GXAAS, Nanning, China |
| 17.40-17.55 | TS-I-04 | Impirical Estimation of Relative Evaporative Loss in weight of Harvested Sugarcane by Mechanical and Manual Harvesting | B. P. Patil Deccan Sugar Technologists' Association, Pune, India |
| 18:00- | | **WELCOME DINNER** | **Nanning Hotel** |

## Day II

## Wednesday, November 18, 2026

### Technical Session II

# Future-proofing Sugar Crop Protection

**(Venue : Main Hall, Nanning Hotel)**

| | | | |
|---|---|---|---|
| **Chairman:** Dr. Phillip Rott, France<br>**Co-Chairman:** Zhang Mu-Qing, China<br>**Coordinators:** Dr. Krishan K. Verma, China | | | |
| **PLENARY LECTURES** | | | |
| 08.45-09.10 | PL-01 | Effective Disease Management in the Australian Sugarcane Industry: Key Elements for Success, and Where to From Here? | Rob Magarey, Sugarcane Disease Consultancy, Tully, Australia |
| 09.10-09.35 | PL-02 | From Observation of Disease Symptoms to the Development of Molecular Assays: Over A Century of Diagnostic Improvements in A Context of Changing Sugarcane Pathology | Philippe Rott, CIRAD, Montpellier, France |
| 09.35-10.00 | PL-03 | Deciphering the Genetic Architecture of Sugarcane Smut Resistance: From Comparative Genomics to Molecular Breeding | Zhang Muiqing, Guangxi University, Nanning, China |
| **ORAL PAPERS** | | | |
| 10.00-10.15 | TS-II-01 | Sustainably Increased Sugarcane Productivity and Greatly Improved Environmental Impact by Enhancing the Soil Microbiome | M. Melville, Civil & Env. Engg., UNSW, Sydney, Australia |
| 10.15-10.30 | TS-II-02 | Metagenomic Insights and Comparative Genomic Analysis of *Candidatus* Phytoplasma sacchari Strains Associated with Sugarcane Grassy Shoot and Sugarcane White Leaf Diseases in India and China | Shivani Gupta, Indian Agricultural Research Institute, New Delhi, India |
| 10.30- | **TEA** | | |
| 10.45-11.00 | TS-II-03 (Special Lecture) | Changing Sugarcane Cultivation, Hydrology, and Harvesting Techniques to Greatly Improve Carbon Management | Robert Quirk, Civil & Env. Engg., UNSW, Sydney, Australia |

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|---|---|---|---|
| 11.00-11.15 | TS-II-04 | Colonization of Endophytic Entomopathogenic Fungi for Sustainable Sugarcane Pest Management: Mechanistic Insights, Formulation Advances, and Future IPM Horizons | V. Ambethgar Professor (Retired) - TNAU, Tamil Nadu, India |
| 11.15-11.25 | TS-II-05 | A Single-Copy, Four-Gene Transgenic Stack in Sugarcane Confers Broad-Spectrum Insect and Herbicide Resistance | Tingting Sun, Sanya Research Institute, Hainan, China |
| 11.25-11.35 | TS-II-06 | A Smut Effector Exploits Natural Cis-Regulatory Variation to Activate the *Scwrky*1 Susceptibility Module in Sugarcane | Dongjiao Wang Chinese Academy of Tropical Agricultural Sciences, Haikou, China |
| 11.35-11.45 | TS-II-07 | Research Progress of Sugarcane White Leaf Disease and Brown Stripe Disease | Hongli Shan, Sugarcane Research Institute, Yunnan Academy of Agricultural Sciences, Kaiyuan, China |
| 11.45-11.55 | TS-II-08 | Construction of Whole chain Closed loop Quality Control Technical System for Virus free Healthy Sugarcane Seed canes | Xu Lin, Sugarcane Research Institute, GXAAS, Nanning, China |
| 12.00-13.30 | | **LUNCH** | |

## Day II

## Wednesday, November 18, 2026

### Technical Session III

## Future-proofing Sugar Crop Variety Development

**(Venue : Main Hall, Nanning Hotel)**

| | | | |
|---|---|---|---|
| **Chairman:** Dr. Perumal Govindaraj<br>**Co-Chairman:** Dr. (Ms.) Nattapat Khumla<br>**Coordinator:** Dr. Kapil Sushir | | | |
| **PLENARY LECTURES** | | | |
| 13.30-13.55 | PL-01 | From Crosses to Code: Reimagining sugarcane breeding | Youxiong Que, Sanya Research Institute, Sanya, China |

| | | | |
|---|---|---|---|
| 13.55-14.20 | PL-02 | Genomic Selection for Enhancing Cross-Prediction and Selection in Sugarcane Breeding | Seema Yadav, The University of Queensland, Brisbane, Australia |
| **ORAL PRESENTATIONS** | | | |
| 14.20-14.35 | TS-III-01 | Establishment of an Efficient Prime Editing System for Precise Base Changes and Genomic Replacements in Sugarcane | Vitor Favaretto Pinoti<br>Instituto de Biologia, UNICAMP, Campinas, Brazil |
| 14.35-14.50 | TS-III-02 | Drone-Powered Phenotyping Accelerates Stress-Tolerant Sugar Beet Selection | Samathmika Ravi<br>University of Padova, Italy |
| 14.50-15.05 | TS-III-03 | Breeding for Bioenergy Canes Through Utilization of *Erianthus arundinaceus* in Sugarcane | Kapil Sushir V.<br>Vasantdada Sugar Institute, Manjari, Pune |
| 15.05-15.20 | TS-III-04 | Research Progress of Sugarcane Breeding at Guangxi Academy of Agricultural Sciences | Hui Zhou, Guangxi Academy of Agricultural Sciences, Nanning, China |
| **15.20-** | **TEA** | | |
| **PLENARY LECTURES** | | | |
| 15.35-16.00 | PL-03 | Innovative Approaches for Breaking Sugar Plateau in Sugarcane- Challenges and Way Forward | Perumal Govindaraj, Sugarcane Breeding Institute, Coimbatore, India |
| 16.00-16.20 | PL-04 | Breeding Beyond Yield: From Conventional Breeding to Climate-Resilient and Future-Ready Sugarcane in Thailand | Nattapat Khumla<br>Nakhon Sawan Field Crops Research Center, Nakhon Sawan, Thailand |
| **ORAL PRESENTATIONS** | | | |
| 16.20-16.35 | TS-III-05 | Breeding and Application of New Sugarcane Varieties with High Sugar Content and High Yield in Yunnan, China | Zhao Peifang, Yunnan Academy of Agricultural Sciences, Kunming, China |
| 16.35-16.50 | TS-III-06 | Subgenome-biased Transcriptional Architecture for Sucrose Accumulation in Sugarcane | Ao-Mei Li, SRS, GXAAS, Nanning, China |

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| 16.50-17.05 | TS-III-07 | Modern Breeding Strategies for Bioenergy Optimization in Sugarcane (*Saccharum officinarum* L.) | R. Arulnangai, Bharathidadan University, Tiruchirapalli, Tamil Nadu, India |
| 17.05-17.20 | TS-III-08 | *NpWRKY38*, a WRKY transcription factor from *Narenga porphyrocoma*, Negatively Regulates Drought Tolerance by Impairing ABA/SA Signaling and Photosynthesis | Shuangcai Li and Xihui Liu, GXAAS, Nanning, China |
| 17.20-17.30 | TS-III-09 | Heavy-Ion Beam Irradiation Reprograms Hormone and MAPK Signalling in the Abscission Zone of an Easy-Defoliation Sugarcane Mutant | Ming Li, SRS, GXAAS, Nanning, China |
| 17.30-17.40 | TS-III-10 | Assembly and Comparative Genome Analysis of Four Mitochondrial Genomes from *Saccharum* Complex Species | Sicheng Li, Sugarcane Research Institute, Guangxi Academy of Agricultural Sciences, China |
| 17.40-17.50 | TS-III-11 | Next-generation Sustainable Production of Open Pan Sweetener Using Energy-Efficient Solar Induction Heating Technology | Mohammed Haris Siddiqui, Integral University, Lucknow, India |
| **18.00** | **DINNER** | | |

## Day III

## Thursday, November 19, 2026

### Technical Session IV

## Future-Proofing Sugar Milling And Value-Addition

**(Venue : Main Hall, Nanning Hotel)**

| | | | |
|---|---|---|---|
| **Chairman:** Dr. Wirat Vanichsriratana<br>**Co-Chairman:** Mr. R. Chandrasekaran<br>**Coordinator:** Mr. B. P. Patil | | | |
| **PLENARY LECTURES** | | | |
| 08.45-09.05 | PL-01 | Sustainability in Thai Sugar Industries | Wirat Vanichsriratana, National Research Council of Thailand, Bangkok, Thailand |

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|---|---|---|---|
| 09.05-09.25 | PL-02 | Exploiting Lignocellulosic Feedstocks for Lignin and Chemicals | Arvind Chudasama, Sugar Industry Internatonal, Berlin, Germany |
| 09.25-09.45 | PL-03 | Evolving Dynamics in the Indian Sugar Industry: Policy Priorities | S. Solomon, Indian Sugar & Bioenergy Manufacturing Association, New Delhi, India |
| **ORAL PRESENTATIONS** | | | |
| 09.45-10.00 | TS-IV-01 | Fungal Fermentation of Sugarcane Bagasse Using *Poria Cocos*: A Strategy for Enhancing Bioactive Compounds and Fiber Properties | Fuyi Hui, Sugarcane Research Institute, Yunnan Academy of Agricultural Sciences, Kaiyuan, China |
| 10.00-10.15 | TS-IV-02 | Deccarbonizing Biomass Cogeneration through Digital Automation and Energy Efficiency: A Sugar Industry Case Study | R. Chandrasekaran, Ponni Sugars (Erode) Ltd., Tamil Nadu, India |
| **10.15** | | **TEA BREAK** | |
| 10.35-10.50 | TS-IV-03 | Weather Relationship of Regional Diversity in Sugarcane Recovery of Maharashtra State | B. P. Patil, Deccan Sugar Technologists' Association, DSTA, Pune, India |
| 10.50-11.05 | TS-IV-04 | Importance of Employee Engagement and Job Satisfaction for culture change in the Indian Sugar Industry | Girish Kohli , Triveni Engineering & Industries Ltd, Saharanpur, U.P., India |
| 11.05.11.15 | TS-IV-05 | Smart Retrofit Strategies for High-Efficiency Biomass Cogeneration: Integrating Process Automation and Boiler Feed Pump Reengineering | R. Chandrasekaran, Ponni Sugars (Erode) Ltd., Tamil Nadu, India |
| **12.00-14.00** | **LUNCH** | | |
| **14.30-18.00** | **Visit to Sugarcane Research Institute, GXAAS, Nanning, China**<br>**Coordinators :** Dr. Prakash Lakshmanan, Nanning, China<br>**Co-coordinator :** Dr. Krishan K. Verma, Nanning, China | | |

## Poster Interactive Session

**(Poster session will continue on 18th & 19th near the Main Hall of Nanning Hotel)**

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| **Chairman:** Dr. G.P. Rao, India<br>**Co-Chairman:** Prof. Dong-Liang Huang, Nanning, China<br>**Coordinator:** Dr. Sao Chun Ma, Beijing, China | | |
| P-01 | Effects of Mechanical Stubble Shaving on Stubble and Yield of Ratoon Sugarcane | Luo Yawei, Sugarcane Research Institute, Guangxi Academy of Agricultural Sciences, Nanning, China |
| P-02 | Artificial Intelligent for Accurate Identification of Major Sugarcane Fungal Diseases | Meixin Yan, Sugarcane Research Institute, Guangxi Academy of Agricultural Sciences, Nanning, China |
| P-03 | *NpSCI2A*, A Potato Inhibitor I Protein from a Wild Sugarcane Relative, Negatively Regulates Drought Tolerance by Targeting Subtilases | Xihui Liu, Guangxi Academy of Agricultural Sciences, Nanning, China |
| P-04 | Comparison of Sugarcane Responses to Humic Acids by Product from the Leonardite Mae Moh Mine's on Seed Cane Under Greenhouse Conditions | Sarawut Rungmekarat, Kasetsart University, Ladyao, Chatuchak, Bangkok, Thailand |
| P-05 | Interplay Between Cropping Modes and Microbiomics-Metabolomic Cross-Talk Modulates Sugarcane Crop Yield and Biomass | Shaolin Yang (YSRI), College of Agriculture, Fujian Agriculture and Forestry University, Fuzhou, China |
| P-06 | Eco-Efficiency Assessment for Sustainable Sugarcane Production in China | Linsheng Yang, Anhui Academy of Agricultural Sciences, China |
| P-07 | Regenerative Agriculture and Role of Sub Surface Drainage Technology In Maintaining Soil Health, Biodiversity and its Socio-Economic Impact | Ganpatrao A. Patil, Shree Datta Shetkari Sahakari Sakhar Karkhana Ltd., Maharashtra, India |
| P-08 | Integrating Multi-Spectral Unmanned Aerial Vehicle (UAV) Sensing and Variable Rate Technology (VRT) for Sustainable Sugarcane Agriculture: A Paradigm Shift | V. Ambethgar, Professor (Retired) -TNAU, Tamil Nadu, |
| P-09 | Impact of In-Situ Single Eye Bud Settling Technology for Cost-Effective, Sustainable Sugarcane Cultivation and Yield Enhancement | Ganpatrao A. Patil, Shree Datta Shetkari Sahakari Sakhar Karkhana Ltd., Dattanagar, Shirol, Kolhapur, India |

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| P-10 | Identification of Smut Resistance and Physiological and Transcriptomic Analysis of Resistant And Susceptible Germplasm in 158 Inbred Progenies of *Saccharum spontaneum* | Xin-Hu, Yunnan Academy of Agricultural Sciences, Kunming, China |
| P-11 | Transcriptomic and Metabolomic Profiling Reveals Endophyte-Induced Resistance Mechanisms Against Sugarcane Smut | Faisal Mehdi, Institute of Tropical Bioscience and Biotechnology, Haikou, China |
| P-12 | Low Ammonium and High Nitrate Input Improves Nitrogen Use Efficiency and Growth in Sugarcane Through Coordinated Reprogramming of Nitrogen and Carbon Metabolism | Jian Zhan, Southwest University, Chongqing, PR China |
| P-13 | Harnessing Silicon-Mediated Structural, Biochemical, and Ecological Defense Mechanisms Against Sugarcane Insect Pests: Implications for IPM | V. Ambethgar, Thiruvarur District, Tamil Nadu, India |
| P-14 | Integrated Impact of PGRs, Nutrients and Pesticides (Oos Sanjeevani) Towards Crop Resilience to Diverse Growing Environments and Quantum Jump in Productivity of Sugarcane under Farmers Participatory Intervention Program in Gujarat and Maharashtra | B. P. Patil, Deccan Sugar Technologists' Association, Pune, India |
| P-15 | Key Yield Components Underlying Ratooning Ability and Cane Yield Maintenance under Early-Season Drought Stress in a Diverse Set of Sugarcane Genotypes | Patcharin Songsri , Khon Kaen University, Khon Kaen, Thailand |
| P-16 | Root Morphology, Xylem Anatomy, and Physiology of Interspecific Sugarcane Hybrids under Early Drought | Nakorn Jongrungklang, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand. |
| P-17 | Quality Characterization and Processing Optimization of Traditional Brown Sugar from Sugarcane | Yang Ting, Yunnan Academy of Agricultural Sciences, Kunming, China |
| P-18 | Nitrogen Supply Modulates Sugar Accumulation in Sugar Beet (*Beta vulgaris* L.) via Regulating Carbon-Nitrogen Balance and Carbon Partitioning | Shude Shi, Inner Mongolia Agricultural University, Hohhot, China |
| P-19 | Sustainable sugarcane production in China | Prakash Lakshmanan, Sugarcane Research Institute, Nanning, China |

## Day IV

## Friday, November 20, 2026

### LOCAL SUGAR INDUSTRY VISIT (OPTIONAL)

***Interested delegates should contact Organizing Secretary for this tour at Registration Desk.***

**Buses will be available at the Hotel at 08.30 am sharp for the tour. Lunch will be served at the Factory.**

**Note :** The delegate attending factory tour should make their own arrangement for stay in the hotel on November, 20 2026 at their own cost. Those who paid US$ 150.00 will cover the extra night hotel and food on 20th Nov. 2026. Airport drops are available from the hotel on November, 20 2026 by the organizer.

# Society for Sugar Research and Promotion (SSRP)

(Registered Under Societies Registration Act 1860)

25 Anniversary
SSRP
Serving Global Sugar Industry Since 1999

## Aims and objectives

- To constitute a forum at international level for bringing together individual and organizations involved in sugar crops and related industry
- To develop international research/development linkages and disseminate up-to-date technologies in the field of sugar production/by-product utilization/effluent treatment/alcohol production and environmental management through rapid information system
- To promote and undertake Research and Development and Extension Services in the field of sugar crops and value added products
- To explore new areas related to cane production technologies, cane developmental activity and logistic management;
- To propagate utilization of non-conventional and renewable sources of energy and development of improved systems and devices in sugar industry for sugar processing including fermentation and effluent treatment technologies;
- To offer recognition and awards to professional groups and individuals for attainment of excellence in the field of sugar crops and related industries;
- To interact with government agencies, scientific organizations and NGOs to promote and protect interests of sugar crop growers and producers;
- To organize symposia, seminars and workshops and bring out scientific publications to meet the objectives of the society.

Sugar Tech is the official journal of SSRP. One hundred five issues in twenty four volumes of Sugar Tech have already been published in last sixteen years. We have been receiving research articles from all over the world. Concerned libraries from all over the World have been subscribing Sugar Tech journal. Sugar Tech has come to be a leading international journal with its unique quality and standard. We have been covering current references on sugarcane, sugarbeet, industry and technology along with addresses of corresponding authors, so that interested person could contact them as per their own interest. Sugar Tech is being indexed in Thomson Reuters, SCOPUS, CAB International, UK; INSDOC, India and Elsevier Biobase, Netherlands and Chemical Abstracts, USA. The Society requests all the scientists/ industrialists/technologists engaged in sugarcane, sugarbeet and related industries to contribute their research findings to Sugar Tech and also to become members of the society with their active participation so that the aims and objectives of the Society could be fulfilled in their true perspectives.

## Executive Council

| | | |
|---|---|---|
| President | **Dr. S. Solomon,** Lucknow, India | email: presidentssrp@gmail.com |
| Vice-President | **Dr. Yang-Rui Li,** Nanning, P.R.China | email:liyr@gxaas.net |
| Secretary | **Dr. G.P. Rao,** New Delhi, India | email: sugartech@rediffmail.com |
| Joint Secretary | **Dr. Priyanka Vishen,** Lucknow, India | email: priyanka.vishen75@gmail.com |
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| Registered Office | 22, Naval Apt., Vasundhara Enclave, New Delhi - 110 096, India | |

*For membership and other activities of SSRP please write to*

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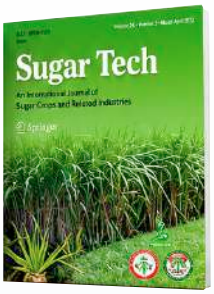








# Welcomes
# ISC-2026 Delegates in Nanning, PR China

*27-Years of Illustrious Journey of*

# Sugar Tech

***(An Internationl Journal of Sugar crops & Related Industries)***
***(https://link.springer.com/journal/12355)***

**Sugar Tech** is a peer-reviewed, bi-monthly international research journal established in 1999 and co-published by Springer Nature. Since its inception, the journal has been dedicated to disseminating high-quality original research papers, reviews, and scholarly communications on innovative, sustainable, and environmentally friendly technologies related to the improvement, production, processing, utilization, and valorization of sugar crops, including sugarcane, sugarbeet, sweet sorghum, stevia, palm sugar, and other related crops. The journal strongly aligns with the principles and objectives of the United Nations Sustainable Development Goals (SDGs). Over the years, *Sugar Tech* has emerged as one of the world's leading journals in the field of sugar crops and allied industries. It enjoys a global readership and circulation spanning more than 127 countries.

**Sugar Tech** is the official publication of the International Association of Professionals in Sugar and Integrated Technologies (IAPSIT) and the Society for Sugar Research & Promotion (SSRP), New Delhi, India. Sugar Tech has ISI (Thompson Reuters) IF 1.9 (2025).

In addition to publishing full-length research articles and short communications, the journal regularly features review articles, invited papers, commentaries, scientific correspondence, and special thematic issues. During the past 27 years Sugar Tech has published numerous landmark special issues, reviews, and research papers addressing scientific, technological, social, environmental, and economic dimensions of sugarcane/sugarbeet/ other sugar crops and their industries. These contributions have significantly enriched global knowledge and supported sustainable development of the sugar and bio-energy sectors worldwide.

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