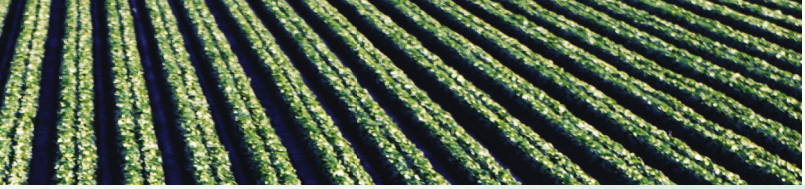
nsa National Seed Association of India

14TH INDIAN SEED CONGRESS
26th - 28th February, 2026
SEED INNOVATIONS-REACHING GLOBAL
Duangjitt Resort & Spa, Phuket, Thailand

REPORT ON INDIAN SEED CONGRESS 2026

26TH – 28TH FEBRUARY, 2026
PHUKET, THAILAND

About **National Seed Association of India**

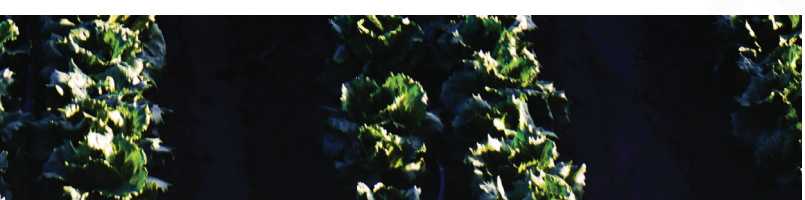


National Seed Association of India (NSAI) is the apex body representing the Indian seed industry, playing a leadership role by engaging with the Central and State Governments and working towards policy advocacy for an enabling and favourable policy environment for the growth of the seed industry in the country.

The vision of NSAI is to create a dynamic, innovative, internationally competitive, research-based industry producing high-performance, high-quality seeds and planting materials which benefit farmers and significantly contribute to the sustainable growth of Indian Agriculture. NSAI is also working towards progressive use of biotechnology in crop improvement programmes for productivity enhancement and improving the livelihood of Indian farmers. Increasing the general awareness about crop biotechnology among large number of seed stakeholders, seed technology upgradation and engaging in a continuous dialogue with regulators for the establishment of a transparent, fair and equitable regulatory ecosystem, are some of the other activities of NSAI.

The mission of NSAI is to encourage investment in the state-of-the-art R & D to bring to the Indian farmers seeds of superior genetics and technologies, which are of high performance and can be adopted under different agro-climatic conditions. It actively contributes to policy development relating to seed industry to ensure that the policies and programmes create an enabling environment, including public acceptance, so that the industry is globally competitive.

NSAI regularly communicates the latest information and knowledge related to seed trade to its members besides organizing subject specific Conferences/Seminars/Special lectures and regular training and capacity building programmes. NSAI also promotes harmonization and adoption of best commercial practices in production, processing, quality control and distribution of seeds through regular interactions and networking with global/regional seed industry organizations.



About
Indian Seed Congress

Indian Seed Congress (ISC) is the flagship event organized by NSAI annually. ISC has emerged as a much-awaited event projecting the latest trends and views of the seed industry, voice its concerns; deliberate on the new technological advances in crop improvement, provide opportunity to the industry to showcase new products and services and network among peers for business development. ISC also provides a platform to the Seed Industry to interact closely with technology developers, sector development officials and policy makers. ISC attracts participation of representatives of all major stakeholders including industry (seed & allied), policy makers, developmental agencies, scientific community and farmers' organizations from India and abroad.

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Mr. Yashpal Saini, Deputy Director -Admin & Accounts

Ms. Celeste Sarah Vargheese, Office Executive

Mr. C. M. Nautiyal (Accounts)

Report Summary

Indian Seed Congress 2026

The National Seed Association of India (NSAI) successfully organized the 14th Indian Seed Congress 2026 from 26th – 28th February, 2026 at Duangjitt Resort & Spa, Phuket, Thailand. ISC 2026 was attended by 312 delegates including professionals from the Indian and global seed industry, prominent scientists, agri-professionals and government officials. The Congress was inaugurated on February 27, 2026, by Dr. P. K. Singh, Agriculture Commissioner, MoA&FW, as the Chief Guest, in the esteemed presence of Dr. A. K. Singh, Emeritus Professor, Division of Genetics, IARI, New Delhi, who graced the occasion as the Guest of Honour. On this occasion stalwarts of the seed industry, eminent scientist, government officials, seed professionals, students were also present.

The congress was addressed by eminent personalities and professionals including **Dr. P. K. Singh**, Agriculture Commissioner, MoA&FW, **Dr. A. K. Singh**, Emeritus Professor, IARI, New Delhi, **Dr. Ravi Khetarpal**, Executive Director, APAARI, **Dr. S. Rajendra Prasad**, Ex Vice Chancellor, UASB, **Mr. Ajeet Kumar Sahu**, Joint Secretary (Seeds), **Dr. Sanjay Kumar**, Advisor, Beej Anusandhan Kendra, IFFCO and **Mr. Chetan Joshi**, Managing Director, BBSSL.

On 26th February, 2026, a CEO conclave was organized, which was addressed by **Ms. Riti MD, Ms. Kirti Hegde and Mr. Devendra,** RMG Mileage **and Mr. Ram Kaundinya,** Partner AgVaya. They enlightened the audience by sharing insights from their extensive experience in leadership and team-building activities, along with their deep knowledge of the subject. (The detailed Programme Schedule is at **Annexure I**)

On the next two days i.e. 27th February and 28th February, 2026, the event involved the showcasing of industry products and services through exhibition stalls of various national and multinational seed and allied companies, trading tables for B2B meetings, Industry Business Showcase, Close group meeting with Taiwan Seed Trade Association & Bangladesh Seed Association and more importantly the four technical sessions spread over two days of ISC 2026, which witnessed high quality presentations/deliberations by renowned scientists, agri-professionals and seed industry experts.

The technical sessions were mainly focused on interaction, discussion, and debate for developing and strengthening the Indian seed sector as a global seed hub. These were well appreciated by majority of delegates, especially scientists, researchers and technical professionals working in the industry. Various important topics were covered during the event such as Next-Generation Breeding Technologies for Global Markets, Preparing for Future: Advancements in Product Evaluation, Public Private Partnership in Seed Innovation, Smart Seed Technologies for Seed Quality Enhancement, Strengthening Seed Testing Laboratories and Quality Assurance for meeting Global Standards, Strengthening India's Seed Policy Architecture and Opportunities for Global Alignment, Global Regulatory Trends Shaping Seed Innovation, IPR & Trade, Building Sustainable Business Growth Ethically, with Strong Adherence to IPR and Legal Compliance. Discussions also focused on the Global Trends in Seed & Agri Biotech Innovations, Structural Competitiveness and Strategic Trajectory of India's Seed Sector, The Role of National/Regional Associations in Exploring Global Opportunities for the Seed Sector to achieve Sustainable Growth and Artificial Intelligence for Agricultural Development and Farmers Prosperity with Special Reference to Seed Supply Chain emerging trends in the global seed market.

The Congress witnessed an impressive participation of young seed entrepreneurs, along with seasoned professionals from large, medium, and small enterprises. The trading tables and exhibition area were vibrant hubs of interaction, with delegates actively engaging in meaningful business discussions. Attendee feedback highlighted the substantial business opportunities created during the event, generating strong expectations and appreciation for ISC 2026.

CEO Conclave

Indian Seed Congress 2026

The CEO Conclave is a key platform that brings together CEOs of leading seed and allied companies along with leadership, behavioural experts, and management professionals to envision a strong and competitive seed sector. It provides a dynamic forum for top management to engage in open discussions on critical industry issues, while addressing current and emerging challenges. The CEO Conclave helps to explore current and future challenges in a fast-changing seed industry environment in order to meet the challenges of creating a healthy work culture within the industry, ensuring a sustained business growth in a highly competitive industry and meeting the expectations of end consumers, i.e. the farmers.

The CEO Conclave was organized on 26th February, 2026 as a pre-Conference activity of the Indian Seed Congress 2026. The conclave was attended by the **top seed industry leaders from India and overseas, management experts, business strategists**. The conclave witnessed deliberations and presentations by eminent designers of leadership programme, strategic storytellers and seed industry strategists.

Session First and Second of the CEO Conclave was addressed by **Ms. Riti MD**, a Leadership Designer with a background in Journalism and Strategic storytelling and **Ms. Kirti Hegde**, Facilitator, RMG Mileage. Their engaging and insightful

session focused on the theme "Leadership Alignment and Leadership Bytes." They emphasized the importance of aligning leadership vision, communication, and decision-making across different levels of an organization. Drawing from their experience in leadership development and strategic communication, they shared valuable perspectives on how effective storytelling, clarity of purpose, and consistent leadership actions can strengthen organizational culture and direction. The speakers also highlighted practical leadership insights that help leaders enhance collaboration, inspire teams, and navigate complex organizational challenges with confidence and clarity.

The third session, focused on the theme *"Building a World Class Seed and Biotech Industry in India"*. It was addressed by **Mr. Ram Kaundinya**, Partner, AgVaya who is an expert in the field of agriculture management, an author, strategic management consultant, teacher and a policy analyst in India. Mr. Kaundinya emphasized that building a world-class seed and biotechnology industry in India requires a strong foundation of scientific innovation, supportive regulatory frameworks, and close collaboration between the public and private sectors. He highlighted the need to promote advanced research in plant breeding, biotechnology, and seed technology to develop high-yielding, climate-resilient, and pest-resistant crop varieties that can significantly enhance agricultural productivity and ensure long-term food security. He also stressed the importance of strengthening quality assurance systems, increasing investments in research and development, and encouraging innovation-driven enterprises and startups within the sector. In addition, he pointed out that fostering international collaborations, aligning with global quality standards, and implementing transparent and progressive regulatory policies will be crucial in positioning India as a global leader in the seed and biotechnology industry, ultimately benefiting farmers and the overall agricultural economy.

Mr. Devendra Facilitator, RMG Mileage interacted with the participants in the fourth and fifth session. The topic of the fourth and fifth Session were **"The Winning Bid IPL Style Auction Game"** and **"Integrated Leadership Synthesis"**. Mr. Devendra, through an engaging **IPL-style Auction Game**, effectively illustrated the importance of synchronized and disciplined decision-making within an organization. The activity demonstrated how coordination, timely communication, and strategic thinking among team members are essential for achieving common goals. By simulating a competitive yet collaborative environment similar to the IPL auction process, he highlighted that when individuals align their decisions with organizational objectives and maintain discipline in their approach, it creates a positive and healthy work culture. Such alignment ultimately enhances teamwork, improves efficiency, and leads to higher overall productivity within the organization.

All participants of the CEO Conclave thanked the organizers for hosting such a remarkable event. Many expressed that the Conclave had profoundly influenced their approach to organizational and self-management, while also reshaping their vision for the future of the Indian seed industry.


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(NSAI), mana
President of


Facilitated by RMG Mileage
RML
Co-Founder
Ms. Ritu M D
Facilitators
Mr. Devendra
14TH
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CEO CONCLAVE
14th INDIAN SEED CONGRESS
26th February, 2026, Phuket, Thailand

Highlights of Speech of the Chief Guest

Dr. P. K. Singh

Agriculture Commissioner, DAFW, MoA&FW, GoI

Dr. P. K. Singh, Agriculture Commissioner, Department of Agriculture & Farmers' Welfare, MoA&FW, Government of India, was the Chief Guest of the inaugural session of the 14th Indian Seed Congress held at Phuket, Thailand from 27th -28th February, 2026.

Dr Singh delivered an insightful inaugural address, emphasizing the need to strengthen the seed regulatory and institutional framework of India, aiming to enhance its global competitiveness. He highlighted the key features of the proposed new Seed Bill, which aims to modernize the regulatory framework governing seed production, registration, certification, and quality assurance systems in the country. He explained that the proposed legislation seeks to strengthen the seed regulatory system by introducing more efficient procedures, improved monitoring mechanisms, and clearer guidelines for the registration and release of new varieties. He further noted that the new Seed Bill is expected to streamline regulatory processes, promote greater transparency in the seed sector, and enhance accountability among stakeholders.

Dr. Singh also highlighted the proposal for establishing a comprehensive **Seed Register,** under the new Seed Bill, which would function as a centralized database containing detailed information on registered varieties, their characteristics, and performance across different agro-climatic regions. Such a system, he noted, would enhance traceability, improve regulatory oversight, and strengthen the seed quality monitoring mechanism.

Further, he stressed upon the significance of promoting **Farmer Producer Organizations (FPOs)** through the development of **variety-based clusters.** He mentioned that this approach would improve efficiency in seed production, ensure better traceability, and strengthen market linkages between farmers, seed companies, and other stakeholders in the seed value chain.

The Agriculture Commissioner concluded by emphasizing that creating a supportive policy environment, strengthening institutions involved in seed research, seed production/seed regulation, and encouraging active engagement of farmers in the seed system will be crucial for the sustained growth of the seed sector of the country. He further noted that with the right combination of recent scientific/ technological advancements, effective governance, and collaborative efforts among public and private stakeholders, India will be able to exhibit its full potential towards establishing itself as a major contributor to the global seed economy.

Highlights of the Address by

Dr. M. Prabhakar Rao, President

National Seed Association of India (NSAI)

Dr M. Prabhakar Rao, President, NSAI, extended a warm welcome to the Chief Guest, Guest of Honour, esteemed dignitaries, and delegates of ISC 2026. In his address, Dr Rao highlighted that the Indian Seed Congress has evolved over the years into a vibrant and multidisciplinary platform for dialogue, collaboration, and innovation.

He noted that the decision of organizing the 14th edition of the Indian Seed Congress in Thailand reflects the commitment of the Indian seed industry to strengthen international partnerships and establish a stronger presence in the global seed value chain. Referring to the theme **"Seed Innovations – Reaching Global",** he remarked that the theme is both timely and forward-looking, emphasizing the growing importance of seed innovations in the global seed sector.

Speaking about the progress of the Indian seed sector, the President noted that the Indian seed industry has undergone a remarkable transformation in recent decades. With strong research and development capabilities, a dynamic private sector, and a robust public research system, India has emerged as one of the leading seed markets in the world. He further noted that Indian seed companies have demonstrated excellence in developing high-value hybrids in cereals, cotton, oilseeds, and vegetables, while serving millions of farmers with quality seeds suited to diverse agro-climatic conditions. India is well-positioned not only to ensure domestic food and nutritional security but also to emerge as a major global exporter of quality seeds.

Dr Rao emphasized that the complex challenges facing agriculture today require coordinated efforts among research institutions, technology developers, seed

companies, policymakers, and international trade organizations to build a resilient and globally competitive seed ecosystem. He stressed the need for harmonized regulatory frameworks, faster approvals for innovative technologies, stronger IPR protection, and transparent licensing systems to promote investment and facilitate the flow of technologies across borders.

Highlighting the role of NSAI, he stated that the association continues to actively engage with policymakers and stakeholders to strengthen regulatory frameworks, promote ease of doing business, encourage investments in research and development, support emerging breeding technologies, and ensure the supply of quality seeds through improved systems such as digital traceability. He also mentioned that the National Seed Association of India has been actively engaging with the government and concerned departments to address key seed industry issues affecting the growth of the seed industry, including harmonization of the regulatory framework, strengthening seed testing laboratories, promoting seed exports, and addressing challenges related to seed certification and seed pricing mechanisms.

Dr Rao concluded by stating that NSAI's vision is to position India as a global hub for seed innovation, production, and exports while ensuring that advanced technologies reach farmers in an efficient, accessible, and affordable manner. He expressed hope that the Congress would provide an important platform for meaningful deliberations on expanding global market access, strengthening international partnerships, leveraging innovation for seed, and enhancing competitiveness in the global seed trade.

Glimpses of Technical Sessions


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P. K. SINGH
S. RAJENDRA PRASAD


JOHAN VAN ASBROUCK
DAMRONGVUDHI ONWIMOL


KK T


CHETAN JOSHI


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P. K. SINGH
S. RAJENDRA PRASAD


KIRTAN Y PATEL
RAJVIR RATHI


2026


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538
70%
52


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Delegate Section

The Indian Seed Congress 2026 witnessed an encouraging response from a diverse range of stakeholders across the seed sector. The event brought together a significantly large number of delegates representing both domestic and international seed sector, along with key input suppliers supporting the seed industry with diverse range of products and services. Leading scientists from premier institutions, policymakers, and government officials actively contributed to the focused discussions, enriching the deliberations with their expertise and insights.

This Congress also marked a remarkable international participation, highlighting its growing global importance as a key platform for knowledge sharing and collaboration. Presence of a diversified set of stakeholders in the ISC 2026 encouraged meaningful discussions, built stronger partnerships, and brought out innovative solutions to emerging challenges in the seed sector.

The total number of registered delegates in the Indian Seed Congress 2026 were 304, out of which Indian participants were 252 besides 52 overseas delegates representing fourteen countries (Italy, China, Thailand, Bangladesh, Belgium, Bulgaria, Denmark, Japan, Pakistan, South Korea, Switzerland, Taiwan and USA).

An analysis of the delegate participation in the ISC 2026 is presented below:

i). Delegates from India (NSAI-Member V/S Non-Member companies) and Abroad

Out of the total 304 delegates, 83% participation was from India with NSAI-members 44 % (134 delegates) as compared to 39 % of the non-member delegates participation (118 delegates). The overseas delegates participation was 17 % (52 delegates) (Fig 1).

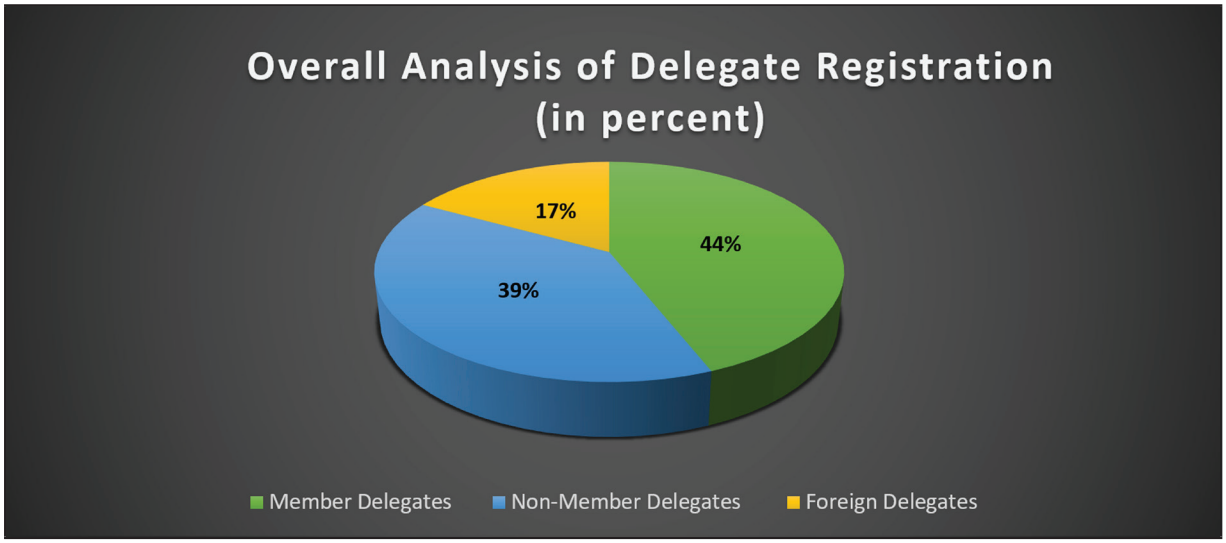

Fig 1: Overall analysis of registered delegates (in percent)

ii). Country wise participation of overseas delegates

Out of the total 304 registered delegates, 52 were overseas delegates. Among the overseas participants Thailand (12) had the highest number of delegates followed by Italy (11), China (9), Bangladesh, South Korea, Taiwan and USA (3 delegates from each country), Japan (2) Belgium, Bulgaria, Denmark, Pakistan, Switzerland and Netherlands (1 delegates from each country).

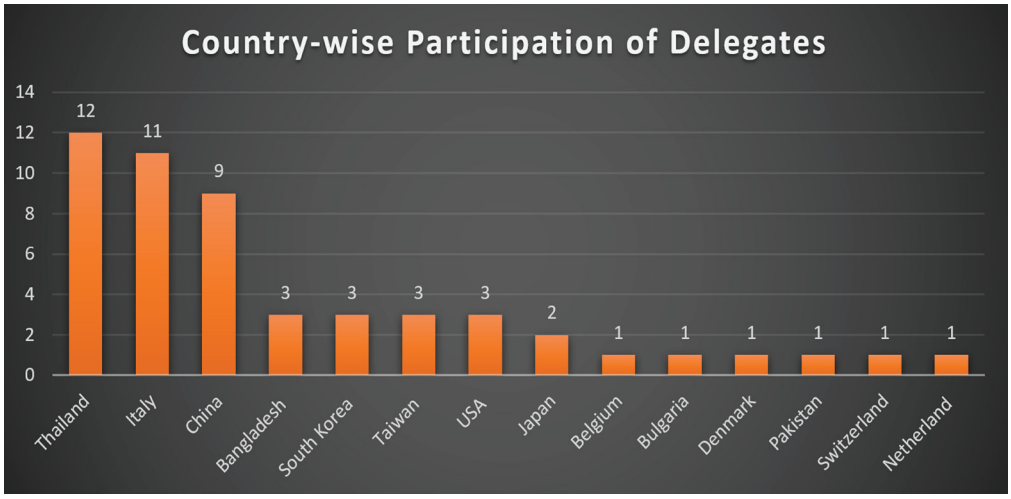

Fig 2: Country-wise participation of delegates

iii). State-wise participation of Indian delegates

Among the 252 Indian participants, Andhra Pradesh (including Telangana) had the highest delegate participation (91) followed by Karnataka (36), Gujarat (25), Maharashtra (19), West Bengal (19), Delhi (18), Tamil Nadu (16), Uttar Pradesh (9), Haryana (8), Punjab (5), Madhya Pradesh (3), Chhattisgarh (2) and Rajasthan (1).

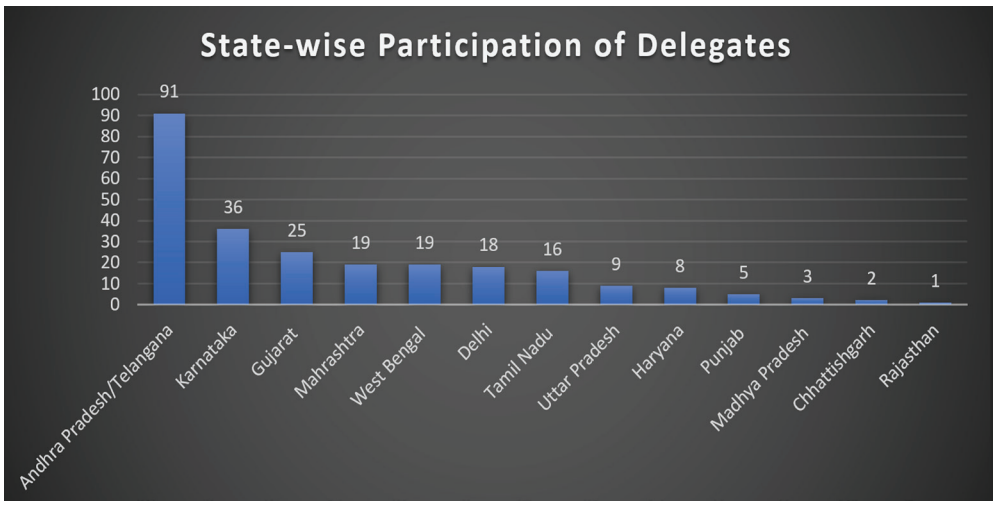

Fig 3: State-wise participation of delegates

Trading Table and Exhibition Stall Section

Trading Table and Exhibition Stall Section

To promote B2B meetings/interactions amongst the participants (National as well as Global) during the ISC, the National Organizing Committee provided Exhibition Stalls and Trading Tables for the delegates. The achievement is as under:

- This year, the participation in the Exhibition Stall witnessed an active involvement of industry with 26 stalls occupied, exhibiting their products and services by major seed and allied sector companies. The stalls were sold out much prior to the event. The demand for the exhibition stalls was on the higher side.
- In total 20 trading tables were sold out in ISC 2026.


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Presentations Made During the Technical Sessions

Technical Session - I

Dr. Yunbi Xu - Senior Research Professor, Peking University Institute of Advanced Agricultural Sciences, China

Indian Seed Congress 2026
Seed Innovations - Reaching Global
Duangjitt Resort & Spa, Phuket, Thailand
Feb. 26-28, 2026

Next-Generation Breeding Technologies for Global Markets

Yunbi Xu

Peking University Institute of Advanced Agricultural Sciences
Institute of Crop Science, Chinese Acad. Agric. Sci.

Email: yunbi.xu@pku-iaas.edu.cn
xuyunbi&@caas.cn

Peking Univ. Inst. Adv. Agric. Sci. (PKU-IAAS)

Weifeng, Shandong, China

August 18, 2017
PKU and Shandong Province signed the agreement for co-establishment

July 10, 2021
Opening ceremony for the new campus

2003 Cornell University 2006
Research Associate
Molecular Rice Breeder

1998 RiceTech, Inc. 2003
Molecular Rice Breeder

2006 CIMMYT (Mexico) 2010
Molecular Maize Breeder
Senior Scientist

1995 Cornell University 1998
Postdoc (Molecular rice breeding)

2010 Inst. Crop Sci., Chinese Acad. Agric. Sci. 2023
CIMMYT-China
Molecular Maize Breeder
Senior and Principal Scientist, Internat. Recruited Scientist

1982 Zhejiang Agric. Univ. 1995
(Zhejiang University)
M.S., Ph.D., Lecturer, Associate Prof.

2023 Peking Univ. Inst. Adv. Agric. Sci. Present
Principal Investigator and Director
Training and Conference Platform
Molecular Breeding Academy (MBA)

1978 Huazhong Agric. College 1982
(Huazhong Agric. University)
B.S.

Career Track
Molecular Breeding

My Major Crop Shifts from Rice to Maize

As a rice scientist, I wish I could be a maize scientist who can make crosses without any scissors

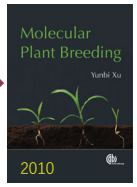
As a maize scientist, I wish I could be a rice scientist who can self-pollinate millions of plants without any bags

To be yourself

从《分子数量遗传学》到《分子植物育种》
From *Molecular Quantitative Genetics* to *Molecular Plant Breeding*

中国农业出版社

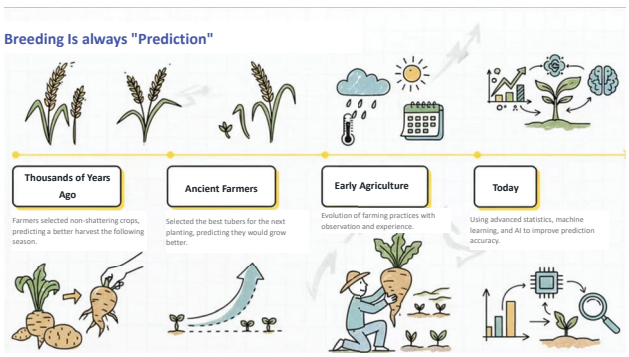
Ten years to sharpen a sword
2001 Started to prepare the proposal
2002 Signed the contract with CABI
2010 Published

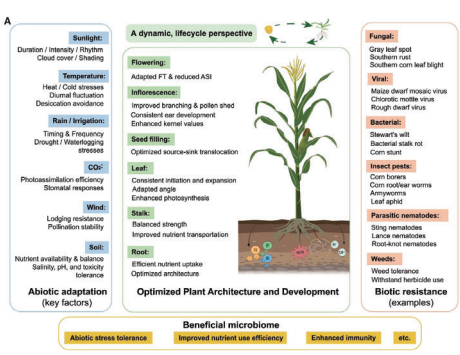


Yunbi Xu 2010 Molecular Plant Breeding, CABI 734 pages

OUTLINE

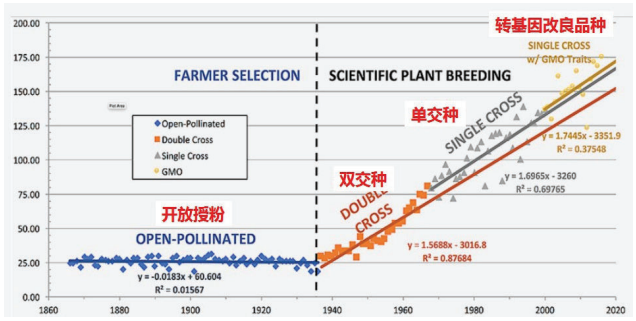
- Key breeding technologies
- All-purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- Breeding by molecular design
- Breeding in seed industry



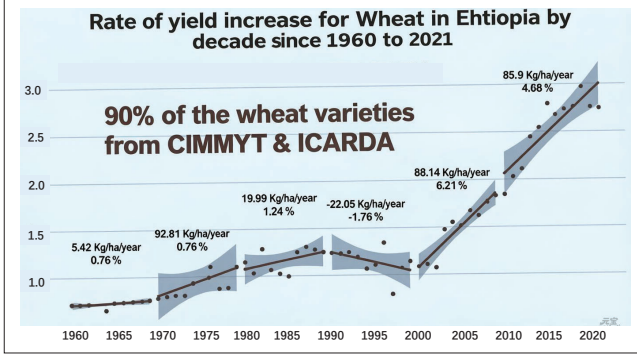


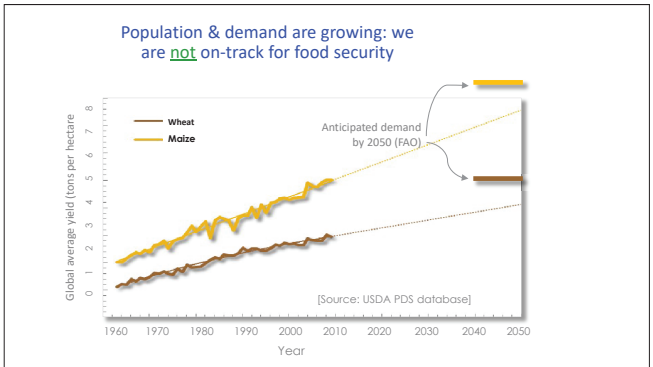
Holistic view of maize breeding goals

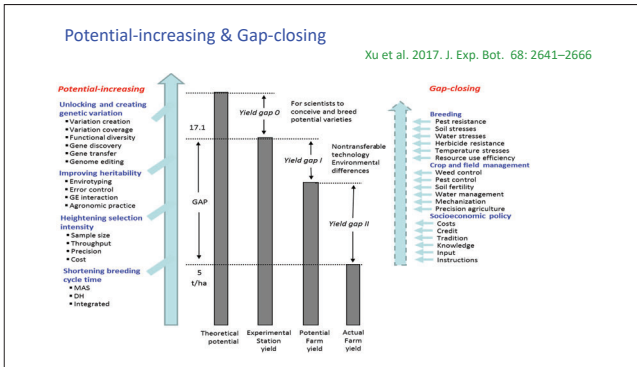
Liu et al. 2025. Mol Plant



Source: 2018 ICABR Stephen Smith, Wallace E. Huffman







Wallace et al 2018. On the Road to Breeding 4.0: Unraveling the Good, the Bad, and the Boring of Crop Quantitative Genomics. Annual Review of Genetics 52: 421-444.

2010.5.18 China Agricultural University

OUTLINE

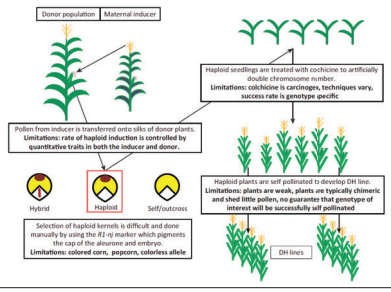
- Key breeding technologies
- All-purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- Breeding by molecular design
- Breeding in seed industry

Doubled Haploid (DH) populations

Five methods for haploid production

- Distant hybridization crosses followed by chromosome elimination from one parent of a cross, usually the pollination parent. 远缘杂交和染色体消失
- Gynogenesis: cultured unfertilized isolated ovules and ovaries of flower buds develop embryos from cells of the embryo sac. 雌核发育
- Androgenesis: cultured anthers or isolated microspores undergo embryogenesis or organogenesis directly or through intermediate callus. 雄核发育
- Parthenogenesis: development of an embryo by pseudogamy, semigamy or apogamy. 单性生殖
- Inducer-based approach: haploid-inducing lines are used to produce haploids. 诱导系途径

Doubled haploid approaches to breeding-true within two generations



Inducer-based approach

De La Fuente et al 2013 Trends Plant Sci

DH production in China

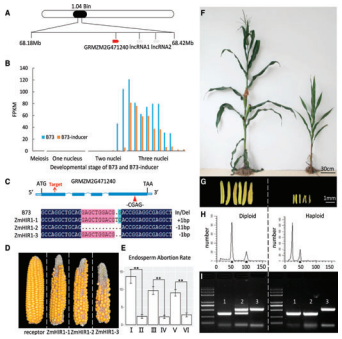
Chinese seed companies now can produce hundreds of thousands of DH lines every year

Tieling Eastern-Rising Corn Variety Testing Center

Process 2000 ears and generate 30000 tissue-culture D0 plants per day. Several millions of DH lines produced each year.

- Tissue culture facilities
- 60 greenhouses, including acclimatization greenhouses, cold greenhouses and heated greenhouses

Cloning of haploid induction



ZmPLA1 (GRMZM2G471240) Mutation Causes Haploid Induction in Maize

Liu et al 2017 Mol Plant 10:520-522

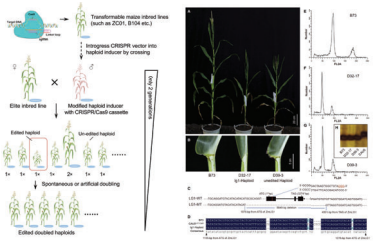
Two other reports:

Kelliher et al. 2017. MATRILINEAL, a sperm-specific phospholipase, triggers maize haploid induction. Nature 542: 105-109

Gilles et al. 2017. Loss of pollen-specific phospholipase NOT LIKE DAD triggers gynogenesis in maize. EMBO J 36:707–717

DH technology for all crops (Shaojiang Chen. CAU)

Development of a haploid-inducer mediated genome editing system in maize



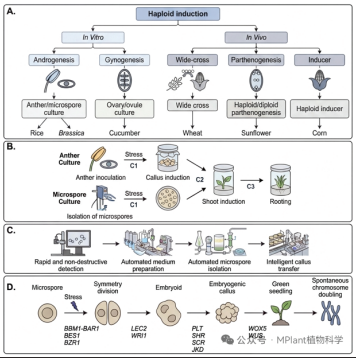
Wang et al 2019. Mol Plant 12: 597–602

Left: The procedure of haploid-inducer mediated genome editing

Right: Haploid-inducer mediated genome editing of *ZmLG1*

DH breeding will be implemented in all crops due to increasing breeding cost (land and labor) and requirement for speed breeding

DH techniques



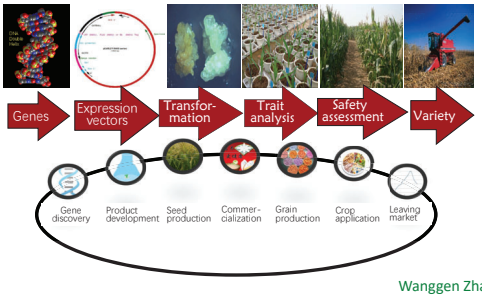
A. Large-scale DH generations in crops
B. Challenges and innovation in rice anther/microspore culture
C. Key components in automatic and smart anther/microspore culture in rice
D. Key related genes

Chen et al. 2026. Molecular Plant https://doi.org/10.1016/j.molp.2026.02.002

OUTLINE

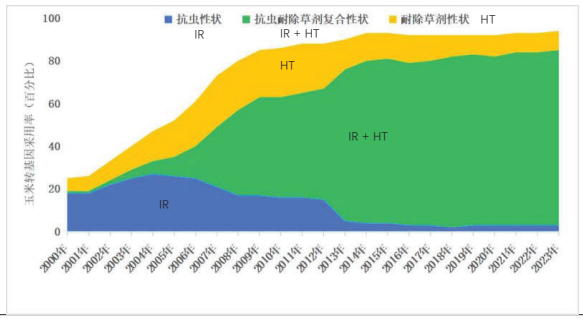
- Key breeding technologies
- All purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- Breeding by molecular design
- Breeding in seed industry

Flowchart for development of transgenic crop products

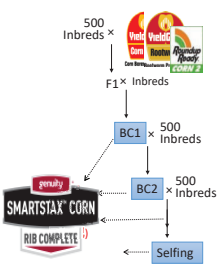


Wanggen Zhang (2016)

Biotech maize with insect resistance (IR) and herbicide tolerance (HT)



Transgenics + MABC



Why integrated transgenic breeding:

- Option of using transgenic lines suitable for tissue-culture
- Transgenic lines are usually bad for agronomic traits
- Removing somaclonal variation

- Simultaneous conventional and transgene integration
- Transferring 2-7 transgenes into several hundreds of inbreds/ varieties
- Grow 2-3 generations per year
- Developed inbreds/varieties are highly similar to the recurrent parents
- Supported by about 100M data points per year

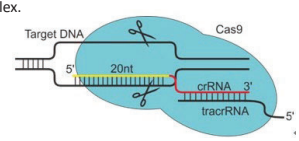
Kunsheng Wu (2017) National Maize Genetics and Breeding Conference

Genome editing breeding

CRISPR (/ˈkrɪspər/) is a family of DNA sequences in bacteria. The sequences contain snippets of DNA from viruses that have attacked the bacterium. These snippets are used by the bacterium to detect and destroy DNA from further attacks by similar viruses. These sequences play a key role in a bacterial defence system, and form the basis of a genome editing technology known as **CRISPR/Cas9** that allows permanent modification of genes within organisms.

crRNA (CRISPR-derived RNA) combines with tracrRNA (trans-activating RNA) to form double strain RNA, tracrRNA/crRNA complex.

CRISPR/Cas 9 Workflow
tracrRNA/crRNA complex guides Cas9 protein to search and break double strand DNA. The blue color indicates Cas9 protein.



Crop improvement strategies based on genome editing

Gao. 2021. Cell 184: 1621-1635

- Directed mutagenesis
- Multiplex genome editing
- Editing of quantitative loci
- De novo domestication
- Haploid induction and artificial apomixis
- Large-scale screening and directed evolution
- Plant synthetic biology
- Plant microbial engineering

Examples of crop improvement by base editing and prime editing

Zhu et al. 2020. Nature Reviews Molecular Cell Biology
Molla et al. 2021. Nature Plants

- Stacking beneficial alleles
- Herbicide tolerance
- Altered nutrients
- Rapid domestication
- Disease resistance
- Removal of deleterious alleles
- Yield improvement
- Input use efficiency

Opportunities

- Whole genome editing
- Creating favorable haplotypes
- Breakthrough in polyploidy species
- New genome editing technologies

OUTLINE

- Key breeding technologies
- All-purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- Breeding by molecular design
- Breeding in seed industry

Plants under controlled E ≠ "Greenhouse Flowers" (温室里的花朵)

AI managed environments could be better than natural environments, resulting in higher yield, better quality and more environment-friendly.

Photo from
Zhiqiang Gao
Hunan Agric. Univ.

Environments affecting plant accelerators

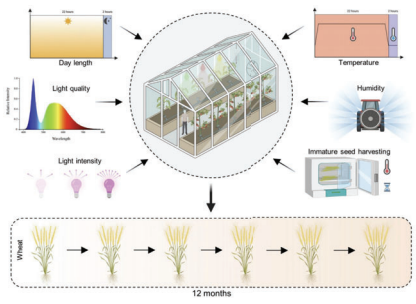
—— Speeding growth and development
—— Healthy growth and development

- Light: intensity, spectrum, quality, photoperiod
- Temperature: day-night difference, Maximum temperature, average temperature
- Moisture
- CO_2
- Nutrients
- Water

Multiomics affecting plant accelerators

- Crop canopy phenomics
- Metagenomics of soil microorganisms
- Genomics for companion organisms
- Enviromics and genomic-enviromic interomics
- Spatiotemporal omics

Speed breeding by using optimal day length, light intensity, light quality, and temperature to improve biomass accumulation and stimulate flowering and seed production



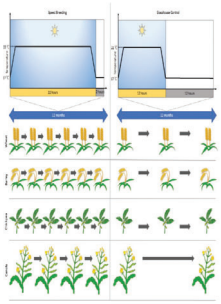
Xu et al 2023 Feeding the world using speed breeding technology. Trends in Plant Science

Speed Breeding in Crops (1)

Grown in a controlled environment room with extended photoperiod (22 hours light/2 hours dark)

Speeding reproduction process by regulating all genes that affect plant growth and development (Fasong Zhou 2019)

MAS:
Best combination of genes affecting plant growth and development



Speed Breeding Accelerates Generation Time

Watson et al 2018
Nature Plants 4: 23-39

Water-Fertilizer-Air-Temperature-Light

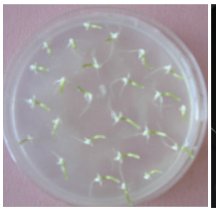
CO_2
Better or as good as in nature

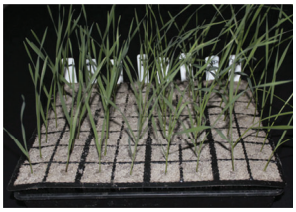
Speed Breeding in Crops (2)

A procedure allowing up to eight generations of wheat and nine generations of barley per annum

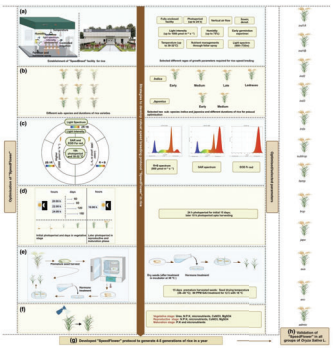
Zheng et al. 2013. Euphytica191:311–316

Embryo culture with managements of watering regimes, lighting intensity and duration, and temperature and quantity of potting mixture





Facility Breeding
Factory Breeding



Optimization of speed breeding protocol 'SpeedFlower' for rice

(a) Selection of growth parameters
(b) Selection of diverse rice varieties
(c) Optimization of spectrum and intensity
(d) Optimization of photoperiod
(e) Optimization of growth stage-specific foliar spray to accelerate flowering
(f) Early germination experiment to reduce maturity duration

Kabade et al 2023 SpeedFlower- a comprehensive speed breeding protocol for rice

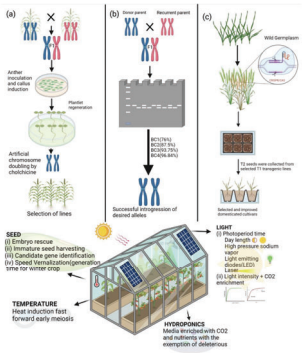
IUA-CAAS（都市所）研究进展

Qichang Yang 2023 Chinese Soc Crop Sci

Speeding Breeding for Upland Crops by Precision Management of Environment & Nutrition

- 揭示了植物工厂环境下旱地作物“旱作水养” 快速繁育根际控水规律
- 突破小麦、玉米、大豆、苜蓿等作物快速繁育关键技术，缩短生育期46%-67%

品种	植物工厂生育期（天）	大田生育期(天)	缩短比例(%)
小麦 wheat（中科糯麦系列）	65±1	180-190	66.7
玉米 maize（荣玉系列）	64±2	120-130	50.8
大豆 Soybean（中黄系列）	68±2	130-140	51.2
苜蓿 Alfalfa（中苜1号）	70±2	130	46.2



Integration of speed breeding with other breeding techniques accelerates the rate of progress

(a) DH production
(b) Marker-assisted selection
(c) Gene editing

Samantara et al 2022 Breeding more crops in less time: a perspective on speed breeding

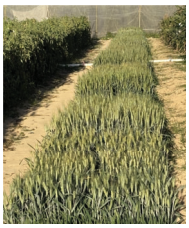
Article | Published: 04 January 2024

A molecular mechanism for embryonic resetting of winter memory and restoration of winter annual growth habit in wheat

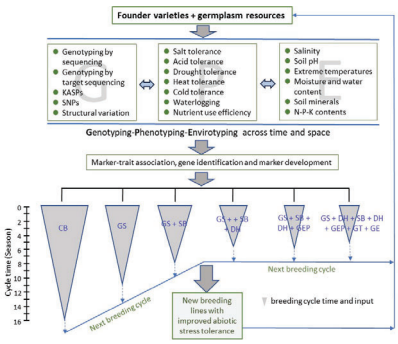
De Niu, Zheng Gao, Bowen Cui, Yongxing Zhang & Yuehui He

Nature Plants 10, 37–52 (2024) | Cite this article

Winter wheat DH lines can be multiplied in Hainan, China, after could treatment of germinating seeds



Unpublished



Integrated genetics, genomics and breeding approaches

Several integrative breeding strategies are compared for their breeding cycle time and resource inputs (time, land and lab, etc.).

CB, conventional breeding; DH, doubled haploid; GE, genome editing; GEP, genomic-enviromic prediction; GS, genomic selection; GT, gene transfer; SB, speed breeding.

Xu et al 2023. Crop J 11: 969–974

+ Smart Breeding

OUTLINE

- Key breeding technologies
- All purpose doubled haploid breeding
- Gene transfer and genome editing
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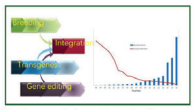
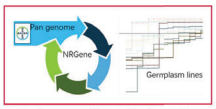
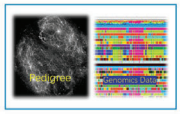
- Breeding in seed industry

Genomic Breeding at Scale Using Genomics Data





Effective, scaled product pipelines require strategic approaches to implementing and leveraging genomics data. High quality data, functioning data systems, and talented scientists are all required for scientific insight, pipeline design & product development.



Wagner R (2019) PAG from Bayer (Monsanto)

Factor Analytic Model

$$y = X\tau + Zu + Z_p u_p + e \qquad var(u) = G_{te} \otimes G_g$$

Phenotypes for all trait-environment combinations

Random genotype effects

Residual effects including spatial modeling

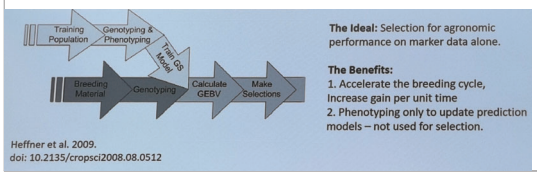
Random non-genetic effects

Fixed effect: (trait within environment means)

G_{te} has a factor analytic structure

Model for multiple traits in multiple environments

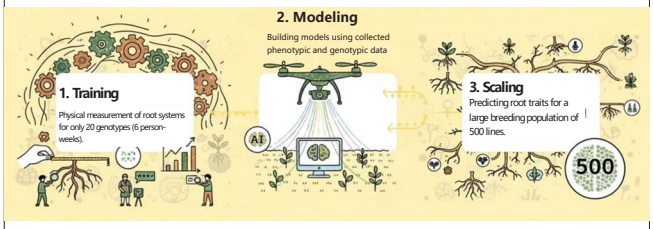
Bancic et al. 2023
Theor Appl Genet



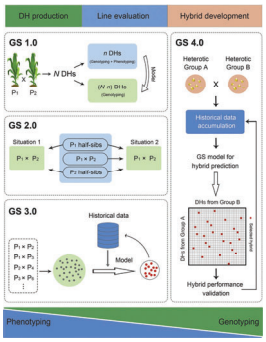
The Ideal: Selection for agronomic performance on marker data alone.

The Benefits:
1. Accelerate the breeding cycle, increase gain per unit time
2. Phenotyping only to update prediction models – not used for selection.

Heffner et al. 2009.
doi: 10.2135/cropsci2008.08.0512



The accuracy for root traits predicted by AI reached up to 0.9



Integration of genomic selection with doubled-haploid evaluation in hybrid breeding: From GS 1.0 to GS 4.0

Fu J, Hao Y, Li H, Reif JC, Chen S, Huang C, Wang G, Li X, Xu Y, Li, L. 2022. Molecular Plant 15:577–580.

- Millions of DH lines generated via routinized procedure.
- A huge number of crosses can be made among these lines.
- Saving can be made using a part of DH lines to predict the rest.

Predictive models integrating big data and artificial intelligence for smart breeding

Prediction method	Model	Components	Data size	AI
GP across environments	$p = g + e + ge$	$g' = (g_1, g_2, g_3, ..., g_n)$	g: 100K to 100M$^+$	Not needed
iGEP with envirotypic data	$p = g + e + ge$	$g' = (g_1, g_2, g_3, ..., g_n)$ $e' = (e_1, e_2, e_3, ..., e_i)$	g: 100K to 100M$^+$ e: 10K to 10M$^+$	Preferable
iGEP with multiomic and envirotypic data	$p = G + e + Ge$	$G' = (g_1, g_2, g_3, ..., g_n)$ $e' = (e_1, e_2, e_3, ..., e_i)$	G: 2^+gs g_i: 100K to 100M$^+$ e: 10K to 10M$^+$	Preferable
iGEP with spatiotemporal multiomic and envirotypic data	$p = G + E + GE$	$G' = (g_1, g_2, g_3, ..., g_n)$ $E' = (e_1, e_2, e_3, ..., e_i)$	G: 2^+gs g_i: 100K to 100M$^+$ E: 2^+es e_k: 10K to 10M$^+$	Required for best efficiency
iGEP for multiple traits	$P = G + E + GE$	$P' = (p_1, p_2, p_3, ..., p_m)$ $G' = (g_1, g_2, g_3, ..., g_n)$ $E' = (e_1, e_2, e_3, ..., e_i)$	P: 10^+ps p_i: 2^+ G: 10^+gs g_i: 100K to 100M$^+$ E: 2^+es e_k: 10K to 10M$^+$	Required for full function

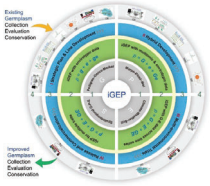
Xu et al. 2022. Mol Plant 15: 1664–1695

Big data, AI, and Genomic-Enviromic Prediction

https://www.sciencedirect.com/science/article/pii/S1674205222002957

Xu Y. et al. 2022. Mol. Plant. 15: 1664–1695.

Top at the most read (last 30 days) until Dec 15, 2022
Top at the most downloaded articles in the last 90 days (April 3, 2023)



Accepted 2 September 2022
Available online 7 September 2022
Smart breeding 赶上了一个好时光
OpenAI于2022年11月推出 ChatGPT

1. Breeding theories
GCA, SCA & heritability
Simulation
Prediction
Breeding process
Genetic gain
Breeding experience
Individual & population
Heterosis

智能育种 Smart Breeding

Yunbi Xu (2018, unpublished)

2. Evaluation and selection
Three typing technologies
Comprehensive evaluation
Data treatment, analysis and mining

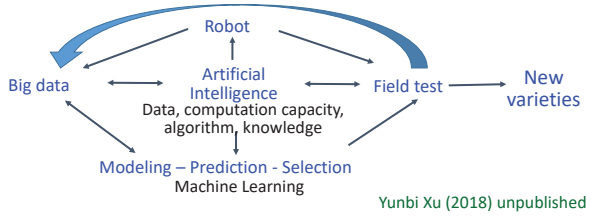
3. Breeding procedure
Germplasm evaluation
Breeding design
Parent selection
Trait evaluation
Field test
Variety release

4. Field management
Seeding
Irrigation
Weeding
Fertilization
Spraying
Harvest

5. Breeding information system
Collection
Analysis
Sharing
Utilization

Three key components in smart breeding

Big data = Foundation for AI development
AI = Four factors: data, computation capacity, algorithm, knowledge
Robot = Way to realized AI



Yunbi Xu (2018) unpublished

未来的智慧育种机器人 The Future of Breeding Robos

图片来自
http://www.sohu.com/a/215470854_656712

创造变异 Create mutation 通过基因分离、重组、转基因、基因编辑等获得遗传变异

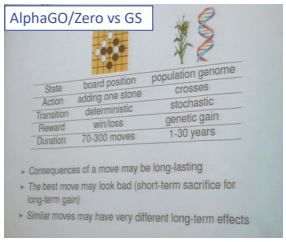
观测鉴定 Identification/observation/selection 观察并直接读取G、P、E等数据

信息分析 Informatics 整合所有数据（包括育种家经验）、建立模型并做出决策

育种决策 Breeding decision 行使各种功能：选择、淘汰、继续交配或进入下一轮育种

Yunbi Xu (2018) Unpublished

What we can predict from AlphaGo and AlphaZero?
From molecular breeding to AI-assisted breeding



From Lizhi Wang, Iowa State Univ.

DeepMind开发的AlphaFold

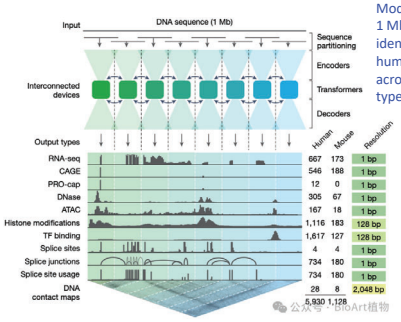
精准预测蛋白质的三维结构

人工智能 + 基因科学

改造人体内的生命软件

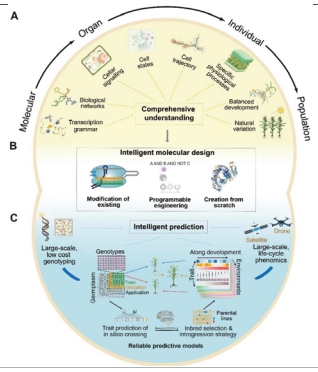
2018: 蛋白质折叠奥运会: 成功预测25/43 蛋白质的结构 (遥遥领先第二名 的3/43)
2020: AlphaFold 2 significantly outperformed other teams with a median score of 92.4 GDT across all targets

Yunbi Xu (2021) unpublished



Model overview. **AlphaGenome** processes 1 Mb of DNA sequences and species identity (human/mouse) to predict 5,930 human or 1,128 mouse genome tracks across diverse cell types and 11 output types at specific resolutions (far right)

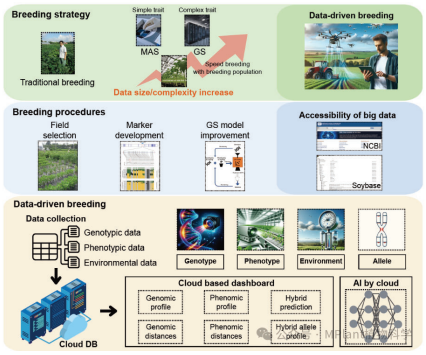
Avsec et al. 2026. Nature **649**: 1206–1218



Integrating intelligent molecular design and predictive genomics for holistic maize improvement.

2035 Maize

Liu et al. 2025. Mol Plant



Soybean breeding strategies driven by big data

2035 Soybean

Tian et al. 2025. Mol Plant

AI Large Model for Crop Breeding: BreedingGPT

Dr. Hang He, PKU

Policy Support

- The Ministry of Agriculture and Rural Affairs released the "**Guiding Opinions on Developing Smart Agriculture**" and "**National Smart Agriculture Action Plan (2024-2028)**"
- The Central Committee and the State Council issued the "**Plan for Building a Strong Agricultural Country (2024-2035)**".

Technology-driven

- Multi-technology integration drives AI breeding. Advances in AI, with strengths in data processing, computer recognition and deep learning, deliver remarkable results in new variety design, crop trait improvement, cost/resource reduction and food safety assurance.

Demand-driven

- Efficient use of human resources, production materials, knowledge and data is a key challenge in China's agriculture. "AI + agriculture" offers an innovative solution. **AI breeding** effectively addresses resource shortages, boosts productivity and meets growing food demand.

01 Intelligent Q&A
02 Intelligent Reading
03 Intelligent Retrieval
04 Data Interpretation
05 Intelligent Design

BreedingGPT focuses on four types of scenarios

Research Q&A	Gene Analysis	Literature Retrieval	Research Assistant
Corpus Scale	Parameter Scale	Computing Power Scale	Inference Performance
28 million knowledge entries 10T+ experimental data	DeepSeek R1 671B EVO2 40B	32 Huawei 910B2 cards 8 NVIDIA H20 cards 4 NVIDIA V100cards	Multi-path recall rate: 96% Average response time: 5 seconds Average interface response time: 500ms

PKU Institute of Advanced Agricultural Sciences | Shandong Laboratory of Advanced Agricultural in Weifang

OUTLINE

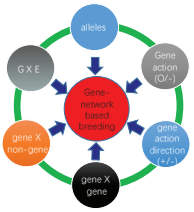
- Key breeding technologies
- All purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- **Breeding by molecular design**
- Breeding in seed industry

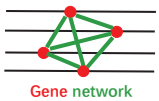
Strategies for crop redesign at the micro and macro scales (1)

Levels	Models	Strategies	Examples
Micro scale	Gene design	Site-directed gene knockout, mutation, or gene editing; RNA interference; transgenics; marker-assisted selection	Favorable alleles or haplotypes, allele/haplotype combinations generated and selected via marker-assisted selection
	Metabolic design	Substitution, modification, optimization and improvement of metabolic pathways	Metabolic pathways modified for improved photosynthetic rate
	Network design	Design and improvement of parameters such as network regulators, network structure, network nodes, and borders	Rain-fed, direct-seeding, and drought tolerant rice

Xu et al. 2022. Mol Plant 15: 1664–1695.

Smart Breeding: Molecular approaches based on gene networks





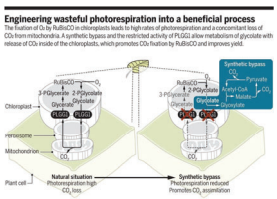
Gene network

Gene network-based molecular breeding

大数据、元分析与元育种（Mega-data-based Breeding）和云育种（Cloud-technology-based Breeding)

Yunbi Xu (2018) unpublished

The fixation of O_2 by RuBisCO in chloroplast leads to the increase of tobacco biomass by 40%

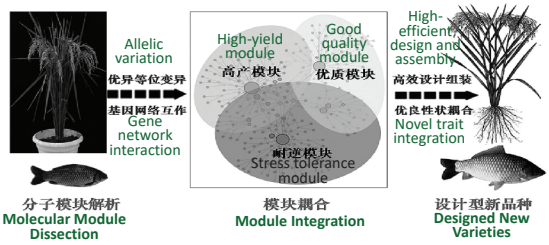


Graphic: A. Kitterman. Science

通过转入植物苹果酸合成酶和绿藻乙醇酸脱氢酶到叶绿体，将乙醇酸直接转化为苹果酸进入卡尔文循环。同时，利用RNA干扰（RNAi） 抑制叶绿体上的乙醇酸/甘油酸转运蛋白PLGG1以防止乙醇酸离开叶绿体，实现了转基因烟草植物的生长量比野生型烟草植物提高了40%

South et al 2019. Science 363: eaat9077

Breeding by molecular modules design



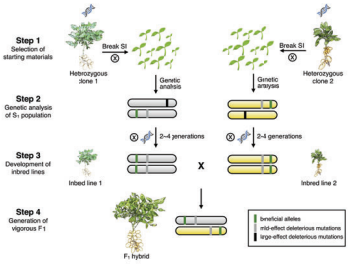
薛勇彪 等 2013 面向未来的新一代生物育种技术—分子模块设计育种. 中国科学院院刊 28: 308-314

Strategies for crop redesign at the micro and macro scales (2)

Macro scale	Individual design	Morphology, ideotype, assimilate distribution, biotic and abiotic stress tolerance, trait interaction and complementation.	Ideotype by combining semi-dwarfism, erect top leaves, and strong stems
	Population design	Structural optimization, ecological stabilization, adaptability improvement, high density planting, functional canopy, photosynthetic efficiency, and source-sink coordination and compensation	Maize plants suitable for high-density planting and mechanized grain harvesting; small and miniaturized crops for facility agriculture and verticulture
	Species design	Integration of favorable traits from different species and adaptation to different ecological environments and breeding methodologies: environment-friendly, resource-saving, product-diversified, usage-flexible, and more efficient breeding	Perennial cereals (rice, wheat and maize); diploid potato suitable for hybrid breeding; *de novo* domestication of wild plants; introgression of new alleles from nearby species

Xu et al. 2022. Mol Plant 15: 1664–1695.

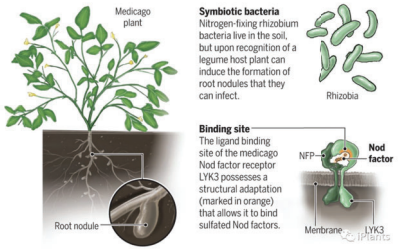
Genome design for hybrid potato breeding



- Initial germplasm accessions selected for breeding inbred lines
- Genetic analysis of self-populations derived from the initial accessions
- Breeding inbred lines
- Breeding hybrids

Zhang et al. 2021 Cell 184: 3873–3883

Nitrogen-fixation in non-legume crops created via synthetic biology

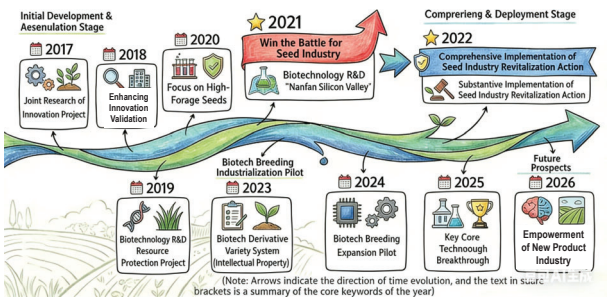


Bozsoki et al., Science 369, 663–670 (2020)

OUTLINE

- Key breeding technologies
- All purpose doubled haploid breeding
- Gene transfer and genome editing
- Speed breeding: from field to factory
- Intelligent and genomic breeding
- Breeding by molecular design
- Breeding in seed industry

Timeline of Key Policy Evolution in China's Seed Industry (2017-2026)

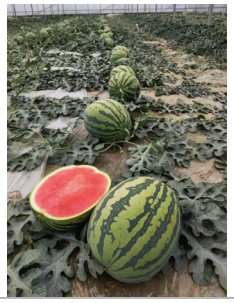


(Note: Arrows indicate the direction of time evolution, and the text in square brackets is a summary of the core keywords of the year)

Summary of Six Major Transformation Trends in China's Seed Industry Over the Past Decade

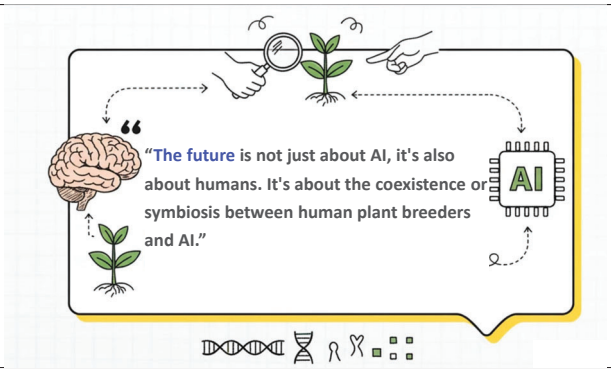
Past: Start and Accumulation	Present & Future: Revitalization and Leapfrog
【Positioning】Scientific and Technological Support	【Positioning】National Strategic Security
【Biotech Breeding】Basic Research	【Biotech Breeding】Industrialization
【Innovation Subject】Research Institutes as the Mainstay	【Innovation Subject】Enterprise Leadership
【Protection Awareness】Quality Supervision	【Protection Awareness】Intellectual Property Protection
【Resource Utilization】Inventory Taking	【Resource Utilization】Precise Identification and Utilization
【Breeding Goal】Single High Yield	【Breeding Goal】Multi-dimensional Needs (High Quality, Stress Tolerance, Adaptation)

Development of Seedless Watermelon Product for Fast Food and Cinema



Watermelon sticks to replace French fries

W104



Molecular Breeding Academy (MBA)

Lecturers: Yunbi Xu & Xingping Zhang

(1) Breeding objectives and programs
(2) Populations of genetics and breeding
(3) Molecular markers and genotyping
(4) Phenotyping and envirotyping
(5) Gene mapping and function analyses
(6) Evaluation, utilization and conservation of germplasms
(7) Selection: MAS-MARS-GS-GES
(8) Breeding for biotic and abiotic stresses
(9) Breeding through transgenes
(10) Speed and smart breeding
(11) Breeding by molecular design
(12) Gene editing
(16) Breeding informatics and decision support systems

Molecular Breeding Academy (MBA)

Every September
(2023, 2025, 2026)
Sept 21-28, 2026
https://en.pku-iaas.edu.cn

WeChat Official Account

Xiashan Conference
Every June
(2023, 2024, 2025, 2026)
Synthetic Biology,
May 8-10, 2026

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Senior Editor

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Agronomy & Crop Sci: Top 4%
JCR: **Q1**

Research themes

- Crop genetics and breeding
- Crop genomics and molecular breeding
- Crop domestication and important germplasm
- Crop molecular physiology and ecology
- Crop cultivation and farming system
- Crop and microbe interaction
- Crop and environment interaction and adaptation
- Crop genome evolution and selection
- Development of important agronomic traits
- Biotechnology/Tools/Big data

Article type:

- Research paper
- Review
- Short communication
- Editorial
- Perspective
- Spotlight
- Highlight

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Contact: cropjournal@caas.cn
https://www.sciencedirect.com/journal/the-crop-journal

Acknowledgements

Peking University Institute of Advanced Agricultural Sciences (PKU-IAAS)
北京大学现代农业研究院
Institute of Crop Sciences, Chinese Academy of Agricultural Sciences (ICS-CAAS)
中国农业科学院作物科学研究所
The Project of Maize Speed Breeding, BGI Bioverse
华大万物"玉米快速育种"项目

Funding
- Provincial Technology Innovation Program of Shandong
- Agricultural Science and Technology Innovation Program (ASTIP) of the Chinese Academy of Agricultural Sciences
- Shenzhen Science and Technology Program (KQTD20230301092839007O)

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xuyunbi&@caas.cn

Dr. Taweesak Pulam - Managing Director, Thai Seed Research Company Limited

ADVANCEMENTS
IN
PRODUCT EVALUATION

Taweesak Pulam

Sweet Seed Co., Ltd.
Thai Seed Research Co., Ltd.
Sweet Corn Co., Ltd.
Sweet Corn Products Co., Ltd.

February 27, 2026
Indian Seed Congress 2026

TAWEESAK PULAM

Education:

1972 B. Sc. (Hons), Kasetsart University, Thailand
1978 Ph.D. Dept of Agronomy and Soil Science, University of Hawaii
2022 Ph.D. (Honorary) Kasetsart University, Thailand

TAWEESAK PULAM

Professional Work:

1978-1979 Lecturer at Dept of Agronomy, Kasetsart University
1980-1991 Research Station Manager, Pioneer Overseas Corporation (Thailand), breeding sorghum hybrid and field corn
1992-pres Managing Director, Sweet Corn Products Co., Ltd.
1992-pres Plant Breeder, Managing Director, and Owner Sweet Seeds Co., Ltd.
1997-2008 Sweet Corn Business Manager for Asia-Pacific, Syngenta Seeds
2006-pres Plant Breeder, Managing Director, and Owner, Thai Seed Research Co., Ltd.
2010-pres Managing Director and Owner, Sweet Corn Co., Ltd.

TAWEESAK PULAM

Many awards from my career

-Outstanding Soil Science Alumni
-Outstanding KU Alumni
-Recognized alumni U of Hawaii
-Taguchi Award
-Research Council Award for Inventing ATS-2
-Outstanding Citizen Award by Prime Minister Office and given by the Crown Princess
-Qilu Friendship Award, Shandong, PRC

I would like to thank to organizing committee to invite me to talk online to this meeting.

I was requested to talk on Products advancement in evaluation processes.

Plant breeding is both art and science.

Product advancement is also both art and science.

Plant breeding processes
-prebreeding or germplasm development
-line development
-line evaluation
-hybrid formation
-hybrid evaluation
-commercialization

I will talk on line and hybrid evaluation and advancement of the products.

Line advancement
-F2 to S1: individual plant
-S1 to Sn: family basis and per se
-Sn to Coded line: GCA with other lines
-Coded lines to parental lines: GCA and SCA

Line advancement is an art in the first few steps.
Later, it has science behind.

Cautions in Line advancement
-advance only good plants in good family
-drop any family if it does not perform well
-continue breeding with poor family will not be efficient
-discard about 50% of breeding lines

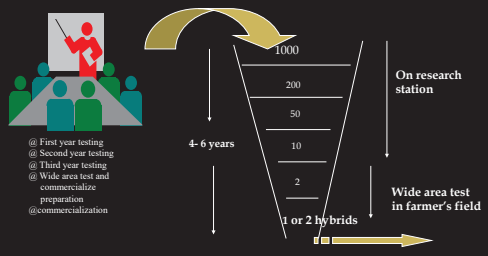
Before we do to hybrid evaluation we should know hybrid stages.
Different organization use different product stages.
Some starts from line development.
Few just start from hybrids which is the easiest one.

Product stages
-new hybrids R1
-retest hybrids R2
-advanced retest hybrids R3
-precommercial R4
-commercial R5

Testing system
Testing is the most expensive part of plant breeding program.

Nature of testing
-multi stage
-multi location
-large variation in environment

Product evaluation processes



Credited: Wichai Phamontri

Product advancement in public organization
-standard experimental designs
-ANOVA R1 to R2
-ANOVA R2 to R3
-ANOVA and Stability R3 to R4

Release to public.

Small and Large Plant Breeding Programs

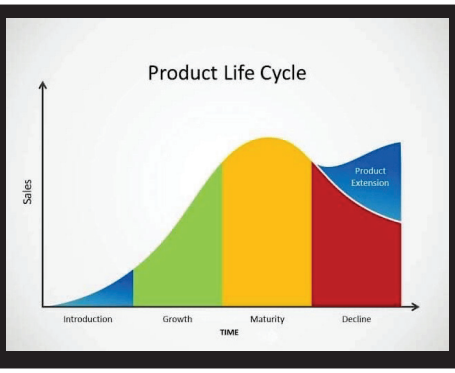
All individual plant breeding programs are small and exist as private and government organizations

They have similar characters
-small budget
-work as a single organization

In large private organizations, the program at a single research is small. But, the joint efforts among many research stations make a very big and efficient breeding program.

Product advancement in large international organization
-R1 to R2: standard experimental designs that will accommodate large number of new hybrids
-R2 to R3: multi-location trial using ANOVA and Stability
-R3 to R4:
*similar and more locations
*strip test in farmer's field using side by side comparison
*cooperation from various department at this stage
-R4 to R5: market test and market response

Products go into PLC management.



Product advancement in small organization
-simple evaluation of new hybrid in RCBD
-use ANOVA to advance R1 to R2
-multi location to advance R2 to R3
-strip test in farmer's field to advance R3 to R4
-market response to advance R4 to R5

Product advancement in my own organization
My organization
-small company works on 5 kinds of corn
*sweet corn
*high quality sweet corn
*red super sweet corn
*waxy corn
*grain corn

Hybrid testing...

-the most difficult process
-take long time
-most expensive

But, it must be done.

		Loc	Rep
Year 1	2000	1	1
Year 2	200	2	2
Year 3	20	5	2
Year 4	4	10-50	Strip
Year 5	1		Comm

Product advancement in my own organization
-R1 to R2: 1 rep of running check
-R2 to R3: 2 rep, 1 loc
-R3 to R4: strip test in farmer's field
-R4 to R5: small market test and production test

Product advancement in my own organization

We do things differently from other small organizations.
-we use experimental design to control error .
-we don't do ANOVA to see difference
-we use simple statistic like mean , minimum and maximum
-we use minimum acceptable values of each trait to advance R1 to R2.

This is rarely done in plant breeding.
But, independent culling is always used in animal selection.

Product advancement in my own organization
-simple statistics behind
-use all historical data
-win and loose in strip test

Product advancement in my own organization

We do things differently from other small organizations.
-we use mean of several location and season to advance R2 to R3
-we use mean of all strip test to move R3 to R4
-we use market response to move R4 to R5

Our method is not very well accept by academic people and many commercial people.

Few things to remember in hybrid evaluation
-drop hybrids as soon as disvover bad points
-testing will not make better hybrid
-consider production points

Communication with me

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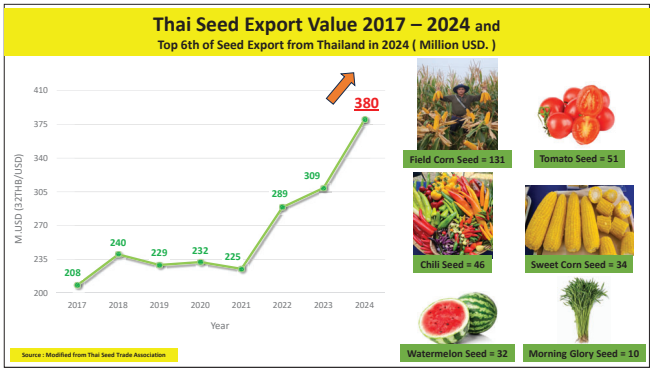
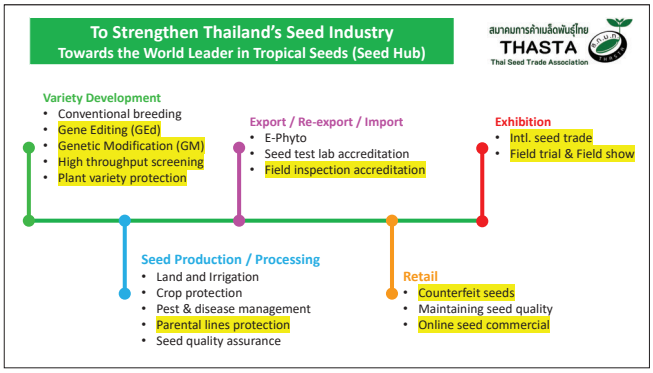
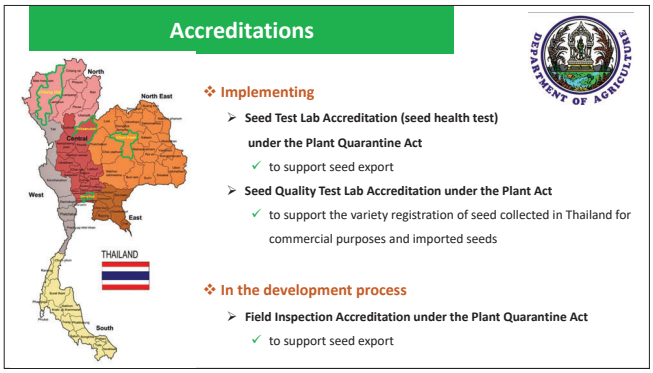
Messenger: Taweesak Pulam
WhatApp: +66818250403
WeChat: +66818250403
gmail: pulamta@gmail.com

Dr. Sadawud Koonmanee - Executive Vice President, Charoen Pokphand Produce Company Limited, Thailand

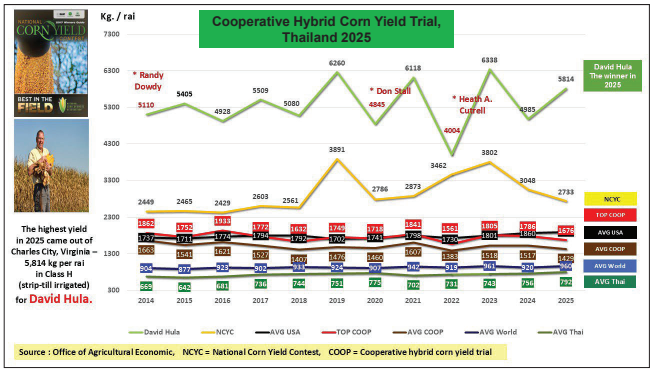


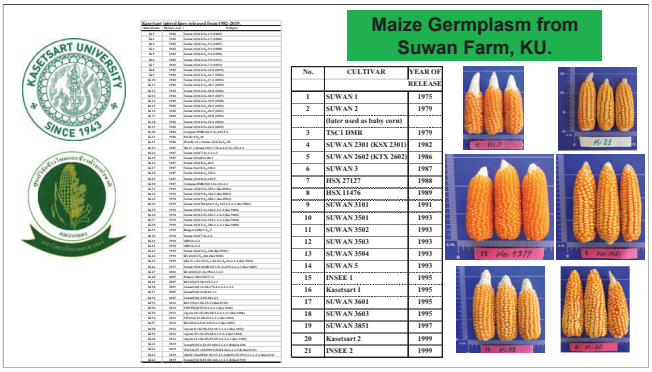




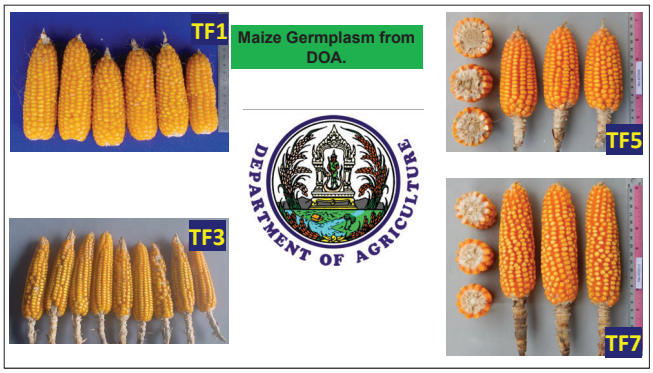
Combined yield and agronomic data from the 2025 Cooperative Hybrid Corn Yield Trial 11 environments, Thailand

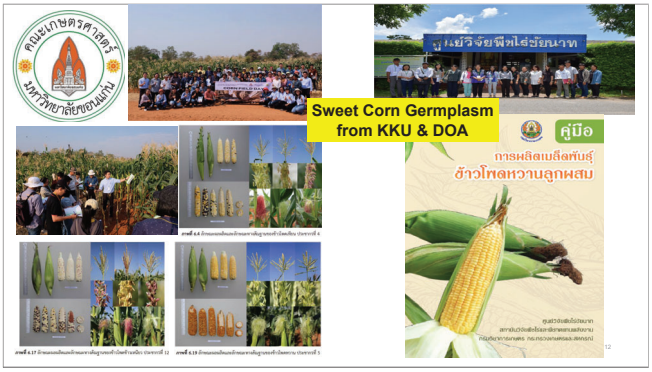
Pedigree	Origin	Entry no.	Grain yield at 15% moist. kg/rai	Grain yield at 15% moist. kg/ha	Relative to check	Relative to mean	Days to 50% silking	Height Plant cm	Height Ear cm	Plant stand no	Foliar dis. (1-5)	Lodging root %	Lodging stalk %	Poor husk cover %	Poor Rotten ear %	wEars/ 100 plants %	Moisture %	Shelling %	Grain type
STG114	Syngenta	18	1676	10474	123	117	53	241	130	51	-	0.1	0.4	6.7	9.4	98.7	26.5	82.4	OYSF
DKO259	Monsanto	12	1643	10271	121	115	54	234	124	51	-	1.0	0.2	7.4	6.1	98.5	28.6	83.5	OYSF
STG173	Syngenta	28	1625	10156	120	114	53	239	126	51	-	1.0	0.3	7.3	16.8	96.6	28.2	83.0	OYSD
PAC132	Pacific seeds	13	1607	10043	118	112	54	226	128	51	-	1.7	2.8	1.4	5.4	96.7	29.7	85.9	OYSF
TSF2411	CPP	3	1596	9972	118	112	55	252	141	50	-	0.4	0.8	2.4	0.5	98.3	28.4	80.6	OYSF
STG195	Syngenta	19	1584	9903	117	111	52	227	129	51	-	1.1	1.0	9.6	8.2	96.0	27.5	83.6	OYSF
BD123	Agritech	1	1557	9730	115	109	53	223	122	51	-	0.8	2.1	8.0	3.8	97.6	27.9	84.6	OYSF
TSF2414	CPP	4	1540	9623	113	108	56	238	141	51	-	1.4	0.3	14.4	13.7	95.7	28.8	80.5	OYSF
LG38635	Lanagrain	10	1526	9536	112	107	53	233	130	50	-	0.4	1.0	2.7	14.2	96.6	28.7	78.5	OYSF
PAC789	Pacific seeds	14	1518	9488	112	106	54	223	121	50	-	2.5	2.0	3.2	10.5	93.8	28.5	85.4	OYSF
DKR249	Monsanto	11	1516	9478	112	106	53	241	130	51	-	2.1	0.1	6.2	13.4	99.8	25.8	81.7	OYSF
World Seeds25606	World Seeds	20	1511	9442	111	106	54	241	130	48	-	1.4	1.4	1.6	15.8	94.4	28.5	80.5	OYSF
CTVA8837	Corteva agriscience	6	1488	9301	110	104	54	243	127	50	-	0.4	0.6	10.4	21.2	94.7	29.5	79.6	OYSF
PM165	Premier Seeds	15	1474	9214	109	103	53	233	122	51	-	0.6	1.1	6.6	7.1	95.3	28.0	81.9	OYSF
GTX23046	Golconda asia	8	1460	9183	108	103	50	238	127	51	-	3.9	1.2	19.9	0.2	98.1	25.4	83.7	OYSD
CTVA8831	Corteva agriscience	5	1462	9140	108	102	55	236	127	50	-	0.7	1.9	15.0	12.1	90.3	27.7	80.5	OYSF
LG38565	Lanagrain	9	1440	9055	107	101	53	244	134	50	-	1.3	1.3	4.9	8.0	95.6	26.1	81.0	OYSF
BD777	Agritech	2	1440	9008	106	101	53	230	116	51	-	0.5	0.3	7.6	9.4	94.6	28.3	80.9	OYSF
NSX2342061	DOA	23	1404	8777	103	98	53	240	125	51	-	1.5	2.4	5.1	17.1	93.9	26.1	82.4	OYSF
NSX2430332	DOA	22	1400	8752	103	98	54	258	141	50	-	1.9	1.7	2.0	6.6	94.0	28.2	83.3	OYSF
UP3614	UP	27	1377	8607	101	96	53	230	126	50	-	4.0	2.4	5.5	6.1	96.3	26.8	82.9	OYSF
KSX0720	KU	25	1366	8540	101	96	55	237	136	50	-	0.3	2.2	11.5	12.9	95.4	28.0	78.3	OYSF
UP0127	UP	26	1339	8370	99	94	52	230	121	40	-	1.3	0.3	9.8	12.1	95.4	24.1	79.2	OYSF
SP68003	Supart	16	1338	8361	99	94	56	238	131	50	-	1.3	0.3	13.9	19.9	95.6	30.0	80.5	OYSF
World Seeds25909	World Seeds	21	1328	8298	98	93	56	237	150	48	-	0.9	1.0	5.0	14.8	90.3	27.4	82.3	OYSD
GTX23006	Golconda asia	7	1308	8177	96	92	53	240	124	50	-	1.6	3.4	4.0	21.7	94.2	28.5	78.3	OYSF
NS3	DOA	30	1293	8083	95	91	54	231	134	51	-	2.3	1.7	2.6	5.9	97.2	23.9	81.5	OYSF
SP68020	Supart	17	1248	7797	92	87	55	245	137	51	-	0.5	0.8	17.9	19.1	89.9	28.8	77.8	OYSF
CP888	CPP	29	1239	7745	91	87	55	241	145	51	-	8.8	6.6	4.1	8.8	98.3	24.4	81.0	OYSF
KSX9410	KU	24	1175	7345	87	82	54	246	133	50	-	0.4	0.3	4.9	17.0	83.2	28.4	82.9	OYSD
Suwan1(S)C18	KU	31	871	5442	64	61	57	235	128	50	-	4.0	4.2	7.6	18.1	85.3	26.4	75.2	OYF
Suwan3720 (check)	KU	32	1358	8486	100	95	54	244	135	50	-	2.6	1.7	11.0	13.6	90.7	28.5	80.5	OYSF
Mean			1420	8931	105	100	54	237	131	50	-	1.6	1.5	7.5	12.1	94.7	27.5	81.4	
CV (%)			9.1	9.1	-	-	2.1	4.4	22.5	4.5	-	280.0	250.6	75.7	56.8	7.2	4.8	1.9	
LSD (0.05) (env trt)			209	1309	-	-	1.8	16.7	ns	3.6	-	7.4	6.2	9.1	11.0	10.9	2.1	2.4	
LSD (0.01) (env trt)			275	1722	-	-	2.4	22.0	ns	ns	-	9.7	8.1	12.0	14.4	14.4	2.8	3.2	





No.	CULTIVAR	YEAR OF RELEASE
1	SUWAN 1	1975
2	SUWAN 2 (later used as baby corn)	1979
3	TSC1 DMR	1979
4	SUWAN 2301 (KSX 2301)	1982
5	SUWAN 2602 (KTX 2602)	1986
6	SUWAN 3	1987
7	HSX 27127	1988
8	HSX 11476	1989
9	SUWAN 3101	1991
10	SUWAN 3501	1993
11	SUWAN 3502	1993
12	SUWAN 3503	1993
13	SUWAN 3504	1993
14	SUWAN 5	1993
15	INSEE 1	1995
16	Kasetsart 1	1995
17	SUWAN 3601	1995
18	SUWAN 3603	1995
19	SUWAN 3851	1997
20	Kasetsart 2	1999
21	INSEE 2	1999



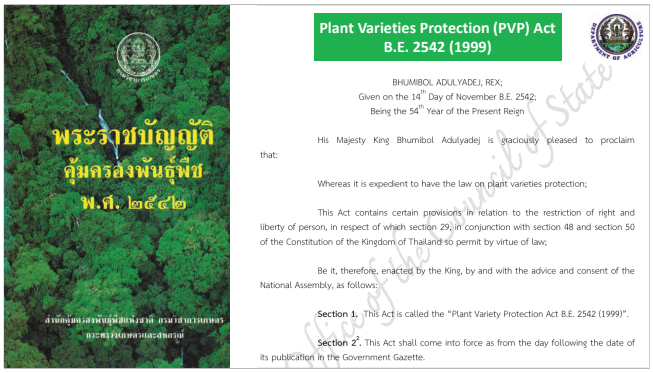


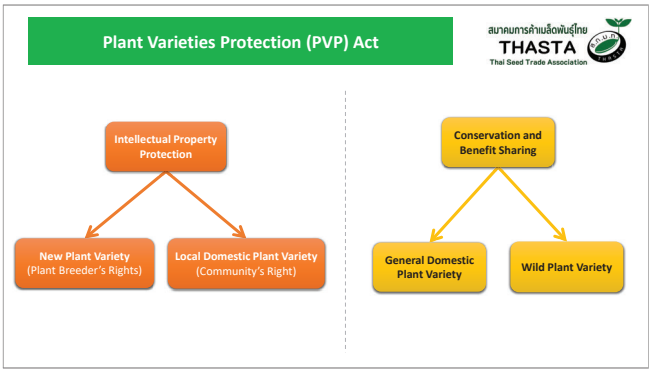
อธิบดีกรมวิชาการเกษตรเปิดศูนย์ผลิตเมล็ดพันธุ์ผักมาตรฐานสากล ขอนแก่น เดินหน้าไทยสู่ World Tropical Seed Hub เพิ่มรายได้เกษตรกร

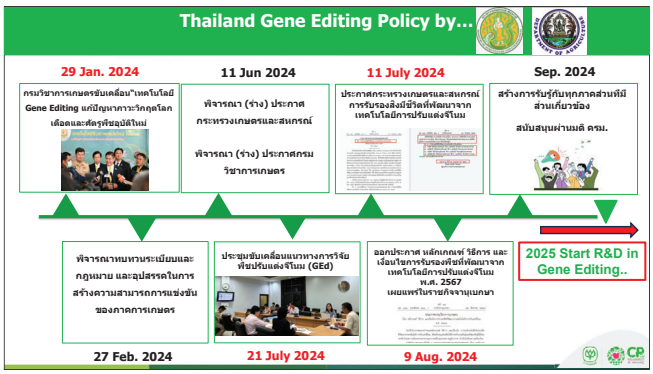
ภาครัฐเดินหน้าส่งเสริมความร่วมมือกับภาคเอกชน เปิดศูนย์ผลิตเมล็ดพันธุ์ผักมาตรฐานสากล ในจังหวัดขอนแก่น วางรากฐานการพัฒนาอุตสาหกรรมเมล็ดพันธุ์พืชเขตร้อนของไทยสู่ตลาดโลก ควบคู่การสร้างทางเลือกเพิ่มรายได้ให้เกษตรกร ผ่านระบบการผลิตเมล็ดพันธุ์คุณภาพสูงตามมาตรฐานสากล

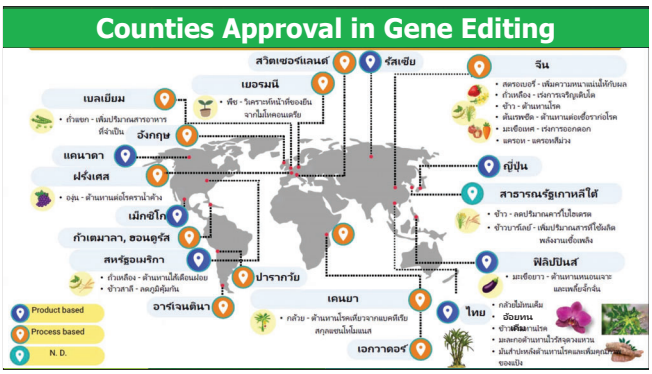
เมื่อวันที่ 25 กุมภาพันธ์ 2569 นายพงศกร จันทรศิริวงศ์ อธิบดีกรมวิชาการเกษตร ได้ร่วมเยี่ยมชมงานเจาะนาเปิดบ่อน้ำบาดาล พร้อมส่งสุข ปลัดกระทรวงเกษตรและสหกรณ์ เป็นประธานในพิธีเปิด "ศูนย์ผลิตเมล็ดพันธุ์ผักคุณภาพเพื่อการส่งออก" ของบริษัท ไบเออร์ ไทย จำกัด ณ ตำบลโนนหอม อำเภอเมืองขอนแก่น จังหวัดขอนแก่น นับเป็นก้าวสำคัญในการขับเคลื่อนประเทศไทยสู่การเป็นศูนย์กลางเมล็ดพันธุ์พืชเขตร้อนของโลก (World Tropical Seed Hub) อย่างเป็นรูปธรรม

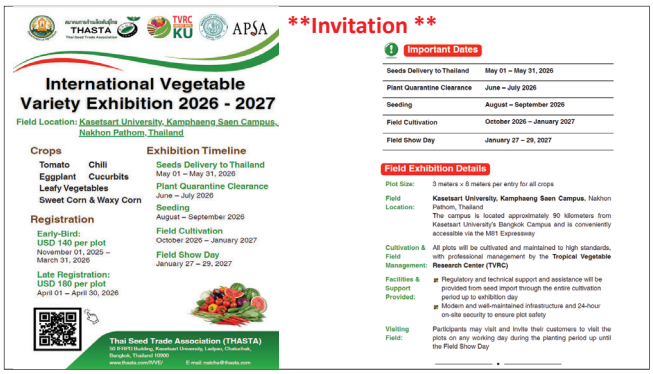
อธิบดีกรมวิชาการเกษตรเปิดเผยว่า การจัดตั้งศูนย์ผลิตเมล็ดพันธุ์ดังกล่าว สอดคล้องกับนโยบาย Big Quick Win ของกระทรวงเกษตรและสหกรณ์ ที่มุ่งยกระดับภาคการเกษตรไทยจากการผลิตสินค้าโภคภัณฑ์ ไปสู่สินค้าเกษตรมูลค่าสูงที่ขับเคลื่อนด้วยเทคโนโลยีนวัตกรรม และมาตรฐานสากล โดยศูนย์แห่งนี้จะเป็นฐานการผลิตเมล็ดพันธุ์ผักที่สำคัญในภูมิภาคเอเชีย เพื่อรองรับความต้องการของตลาดโลก ทั้งสหรัฐอเมริกา สหภาพยุโรป และประเทศในเอเชีย


พระราชบัญญัติ
คุ้มครองพันธุ์พืช
พ.ศ. ๒๕๔๒
Plant Varieties Protection (PVP) Act
B.E. 2542 (1999)
BHUMIBOL ADULYADEJ, REX;
Given on the 14th Day of November B.E. 2542;
Being the 54th Year of the Present Reign
His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that:
Whereas it is expedient to have the law on plant varieties protection;
This Act contains certain provisions in relation to the restriction of right and liberty of person, in respect of which section 29, in conjunction with section 48 and section 50 of the Constitution of the Kingdom of Thailand so permit by virtue of law;
Be it, therefore, enacted by the King, by and with the advice and consent of the National Assembly, as follows:
Section 1. This Act is called the "Plant Variety Protection Act B.E. 2542 (1999)".
Section 2. This Act shall come into force as from the day following the date of its publication in the Government Gazette.


Plant Varieties Protection (PVP) Act
สมาคมการค้าแล็ดพันธุ์ไทย
THASTA
Thai Seed Trade Association
Intellectual Property Protection
New Plant Variety (Plant Breeder's Rights)
Local Domestic Plant Variety (Community's Right)
Conservation and Benefit Sharing
General Domestic Plant Variety
Wild Plant Variety


Thailand Gene Editing Policy by...
29 Jan. 2024
กรมวิชาการเกษตรรับเคลื่อน"เทคโนโลยี Gene Editing แก้ปัญหาภาวะวิกฤตโลกเดือดและศัตรูพืชอุบัติใหม่
11 Jun 2024
พิจารณา (ร่าง) ประกาศกระทรวงเกษตรและสหกรณ์
พิจารณา (ร่าง) ประกาศกรมวิชาการเกษตร
11 July 2024
ประกาศกระทรวงเกษตรและสหกรณ์ การรับรองสิ่งมีชีวิตที่พัฒนาจากเทคโนโลยีการปรับแต่งจีโนม
Sep. 2024
สร้างการรับรู้กับทุกภาคส่วนที่มีส่วนเกี่ยวข้อง
สนับสนุนผ่านมติ ครม.
พิจารณาทบทวนระเบียบและกฎหมาย และอุปสรรคในการสร้างความสามารถการแข่งขันของภาคการเกษตร
27 Feb. 2024
ประชุมรับเคลื่อนแนวทางการจัดที่ชปรับแต่งจีโนม (GEd)
21 July 2024
ออกประกาศ หลักเกณฑ์ วิธีการ และเงื่อนไขการรับรองพืชที่พัฒนาจากเทคโนโลยีการปรับแต่งจีโนม พ.ศ. 2567
เผยแพร่ในราชกิจจานุเบกษา
9 Aug. 2024
2025 Start R&D in Gene Editing..

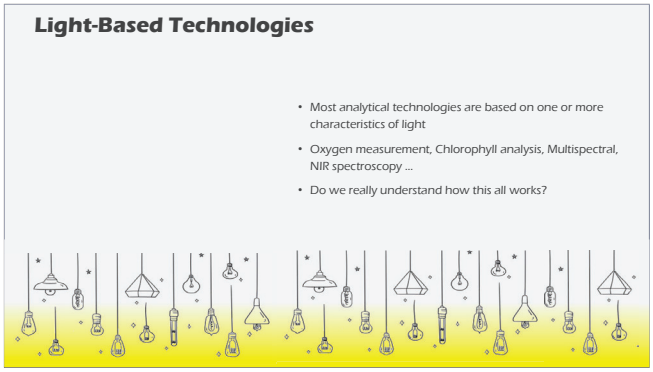

Counties Approval in Gene Editing
สวิตเซอร์แลนด์
รัสเซีย
จีน
เบลเยียม
เยอรมนี
แคนาดา
อังกฤษ
ฝรั่งเศส
เม็กซิโก
กัวเตมาลา, ฮอนดูรัส
สหรัฐอเมริกา
ปารากวัย
ญี่ปุ่น
สาธารณรัฐเกาหลีใต้
ฟิลิปปินส์
อาร์เจนตินา
เคนยา
ไทย
เอกวาดอร์
Product based
Process based
N. D.

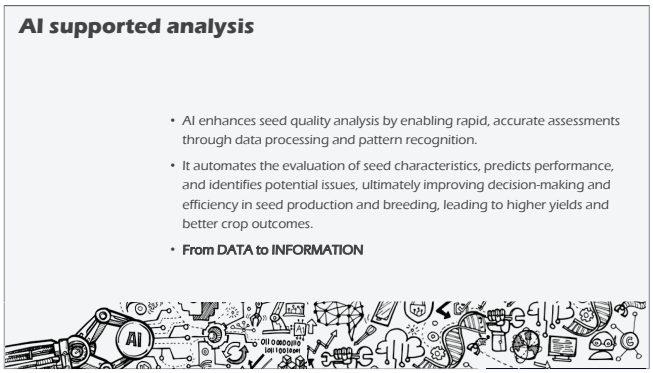

THASTA
TVRC KU
APSA
International Vegetable Variety Exhibition 2026 - 2027
Field Location: Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom, Thailand
Crops
Tomato
Chili
Eggplant
Cucurbits
Leafy Vegetables
Sweet Corn & Waxy Corn
Registration
Early-Bird: USD 140 per plot
November 01, 2025 – March 31, 2026
Late Registration: USD 180 per plot
April 01 – April 30, 2026
Exhibition Timeline
Seeds Delivery to Thailand
May 01 – May 31, 2026
Plant Quarantine Clearance
June – July 2026
Seeding
August – September 2026
Field Cultivation
October 2026 – January 2027
Field Show Day
January 27 – 29, 2027
Thai Seed Trade Association (THASTA)
**Invitation **
Important Dates
Seeds Delivery to Thailand May 01 – May 31, 2026
Plant Quarantine Clearance June – July 2026
Seeding August – September 2026
Field Cultivation October 2026 – January 2027
Field Show Day January 27 – 29, 2027
Field Exhibition Details
Plot Size: 3 meters x 8 meters per entry for all crops
Field Location: Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom, Thailand
The campus is located approximately 90 kilometers from Kasetsart University's Bangkok Campus and is conveniently accessible via the M81 Expressway
Cultivation & Field Management: All plots will be cultivated and maintained to high standards, with professional management by the Tropical Vegetable Research Center (TVRC)
Facilities & Support Provided: Regulatory and technical support and assistance will be provided from seed import through the entire cultivation period up to exhibition day
Modern and well-maintained infrastructure and 24-hour on-site security to ensure plot safety
Visiting Field: Participants may visit and invite their customers to visit the plots on any working day during the planting period up until the Field Show Day

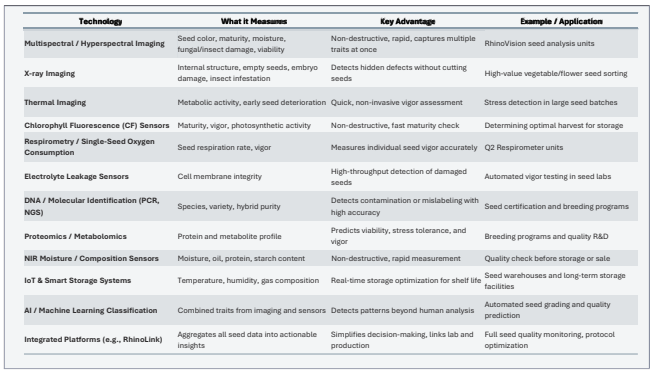

สวัสดีครับ
Thank you

Technical Session - II

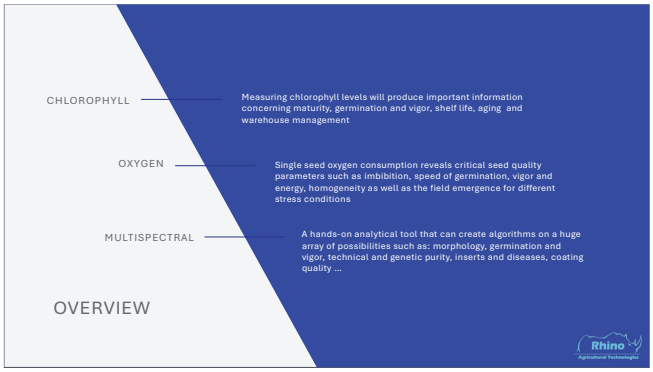
Mr. Johan Van Asbrouck - (Ex-Chair, APSA Standing Committee for Seed Technology) Executive President, Rung Rueng Consulting Co., Ltd. (Rhino Research), Bangkok, Thailand

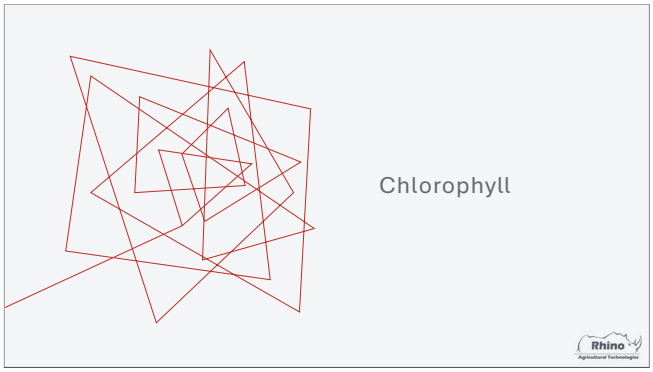






Technology	What it Measures	Key Advantage	Example / Application
Multispectral / Hyperspectral Imaging	Seed color, maturity, moisture, fungal/insect damage, viability	Non-destructive, rapid, captures multiple traits at once	RhinoVision seed analysis units
X-ray Imaging	Internal structure, empty seeds, embryo damage, insect infestation	Detects hidden defects without cutting seeds	High-value vegetable/flower seed sorting
Thermal Imaging	Metabolic activity, early seed deterioration	Quick, non-invasive vigor assessment	Stress detection in large seed batches
Chlorophyll Fluorescence (CF) Sensors	Maturity, vigor, photosynthetic activity	Non-destructive, fast maturity check	Determining optimal harvest for storage
Respirometry / Single-Seed Oxygen Consumption	Seed respiration rate, vigor	Measures individual seed vigor accurately	Q2 Respirometer units
Electrolyte Leakage Sensors	Cell membrane integrity	High-throughput detection of damaged seeds	Automated vigor testing in seed labs
DNA / Molecular Identification (PCR, NGS)	Species, variety, hybrid purity	Detects contamination or mislabeling with high accuracy	Seed certification and breeding programs
Proteomics / Metabolomics	Protein and metabolite profile	Predicts viability, stress tolerance, and vigor	Breeding programs and quality R&D
NIR Moisture / Composition Sensors	Moisture, oil, protein, starch content	Non-destructive, rapid measurement	Quality check before storage or sale
IoT & Smart Storage Systems	Temperature, humidity, gas composition	Real-time storage optimization for shelf life	Seed warehouses and long-term storage facilities
AI / Machine Learning Classification	Combined traits from imaging and sensors	Detects patterns beyond human analysis	Automated seed grading and quality prediction
Integrated Platforms (e.g., RhinoLink)	Aggregates all seed data into actionable insights	Simplifies decision-making, links lab and production	Full seed quality monitoring, protocol optimization

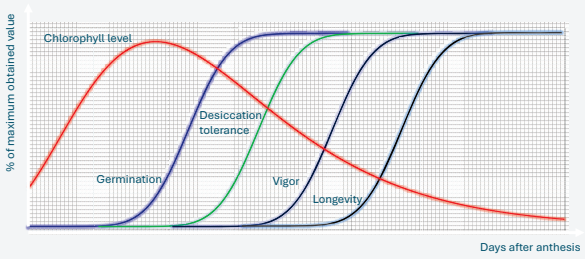




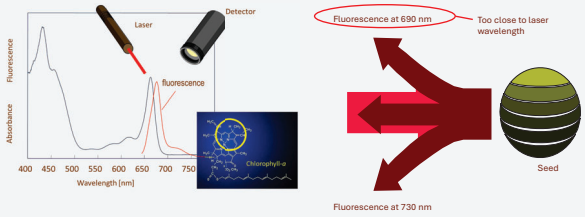
SEED MATURITY AND DEVELOPMENT

- Metabolism decreases and protection increases during maturation
- Damage accumulates during 'dry' storage
- Upon imbibition damage is repaired
- Metabolism increases and protection decreases during germination

Seed maturity and development



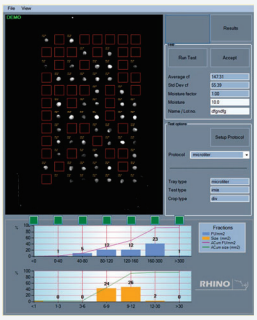
Techniques



- CF Analyzer

- CF Mobile

- CF sensor



Three major reasons for using the Chlorophyll measurement

1. Warehouse management, what seed lot could be stored successfully
2. Grouping for blending small seed lots after production
3. Harvest decision support

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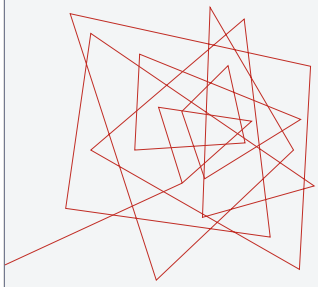
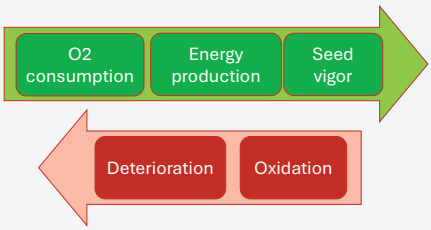
Take away message

- CF gives a strong indication for shelf life of your seeds
- CF gives a strong indication for your harvesting index
- CF gives a strong indication on germination and vigor



Oxygen

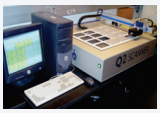
Rhino Agricultural Technologies



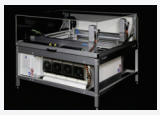
Oxygen duality

POSSIBLE EQUIPMENT

Q2



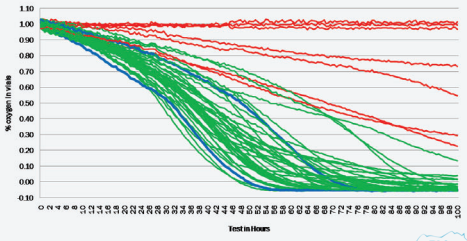
SRA



RESPIROMETER

Single seed results

Cucumber – one 48 wells plate

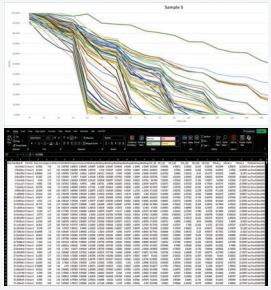


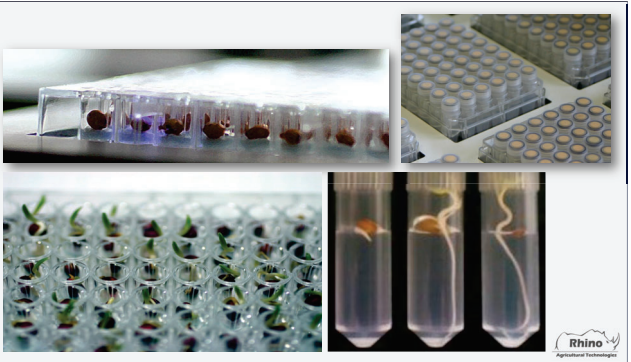
Transformation from data to information

Data obtained :
Oxygen levels > Oxygen consumption

Information translated:

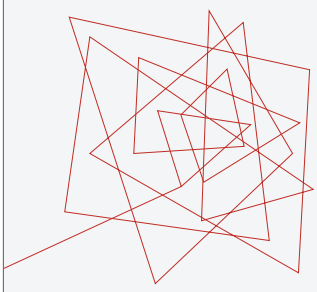
- Germination
  - % of dead seeds
  - % of dormant seeds
  - % of germinating seeds
    - high vigor
    - medium vigor
    - low vigor
- Increased Metabolism time – Imbibition time
- Oxygen Metabolism rate – vigor, energy produced per hour during germination
- QT 50 – time germination speed
- Homogeneity



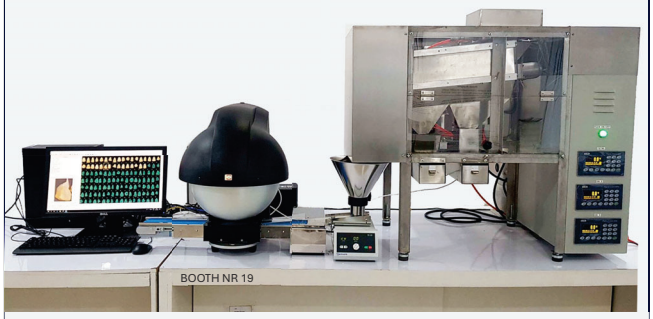


Take away message

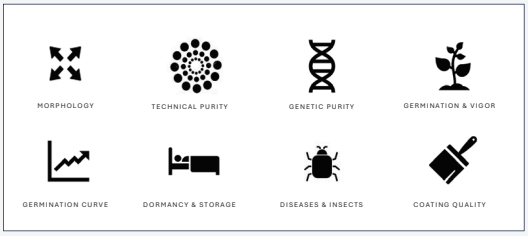
- A complete overview on seed vigor, speed, imbibition, germination ...
- An easy method for comparing before and after treatments
- A perfect view on the homogeneity of a seed lot
- Fast and reliable (no need to wait till we can see the germ)



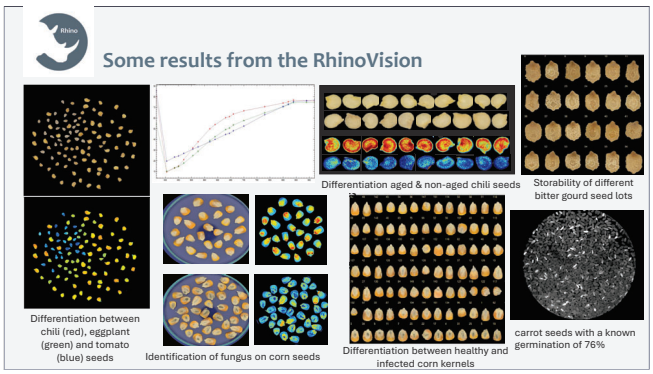
Multispectral

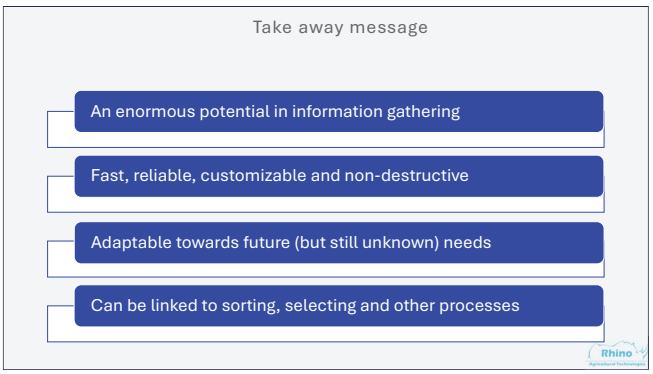


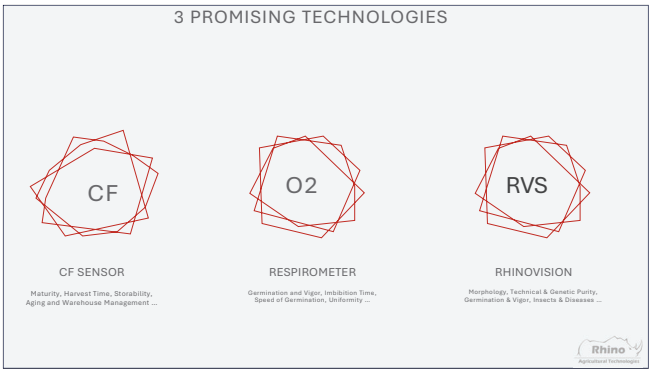
Uses in the seed industry



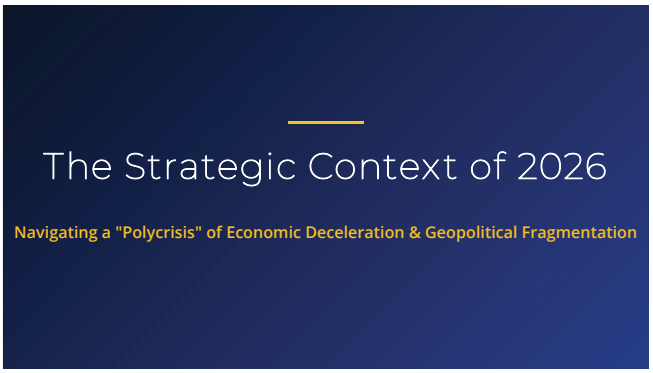
And many more ...







Dr. Damrongvudhi Onwimol - Associate Professor, Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok,



TRUST

Process vs Product

Comparative Analysis: India vs. Thailand - Key Metrics (2025)

INDIA		THAILAND
Young / Expanding Median Age: ~29.5 yrs 0-14 yrs: ~24.6% 65+ yrs: ~7.2%	1. POPULATION STRUCTURE (AGE)	Aging / Constrictive Median Age: ~41.1 yrs 0-14 yrs: ~14.4% 65+ yrs: ~16.0%
Male Skewed ~106-108 Males : 100 Females	2. POPULATION STRUCTURE (GENDER)	Female Skewed ~94.7 Males : 100 Females
~USD 3.91 Billion High Volume, Cereal-Dominant	3. AG. SEED MARKET CAP	~USD 184 Million* High Value, Veg/Export Focus *Domestic market, total sector value higher
High Recurring Risk Consistently in Top 10 Long-Term	4. CLIMATE RISK INDEX (CRI)	Rising Vulnerability Ranked 17th in 2026 (Worsened from 72nd in 2022)
Developing Internet Penetration: ~55-60% (Rural Divide)	5. DIGITAL LITERACY	Advanced / Ubiquitous Internet Penetration: ~88%+

Synthesis: India offers FERTILE SOIL of MASSIVE DEMAND & SCALE. Thailand acts as a HIGH-VIGOR SEED LOT for PRECISION & VALUE.

SEED PRODUCTION PROCESS

QUALITY CONTROL:
Inspecting every step for excellence.

Global Landscape & Opportunity

The Challenge

Rising Non-Tariff Barriers and "Securitized Supply Chains" are our reality. Protectionism and regulatory divergence are disrupting global trade flows, forcing a strategic reassessment of export readiness.

The Opportunity

India's leadership in the International Seed Testing Association (ISTA) and Industry 4.0 technologies position Indian laboratories as trusted worldwide hubs, making compliance a competitive advantage.

Core Testing Pillars

Physical Purity

A rigorous composition analysis is conducted to separate pure seed from inert matter and weed seeds.

Genetic Purity

Ensuring trueness to type, which is critical for hybrids where "nicking" errors can compromise yield.

Standardization

Adherence to ISTA International Rules ensures that a test result in Hyderabad is valid in Rotterdam.

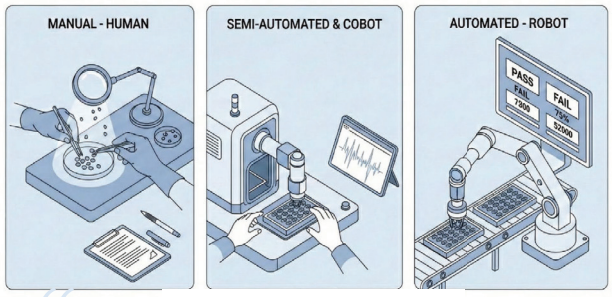
Beyond Basic Germination

Germination (Mandatory)

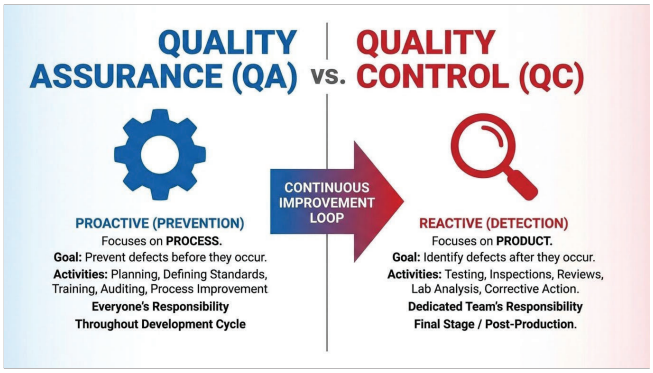
Measures performance under optimal conditions. It answers the question: "Can this seed grow?" This is the regulatory baseline for market access.

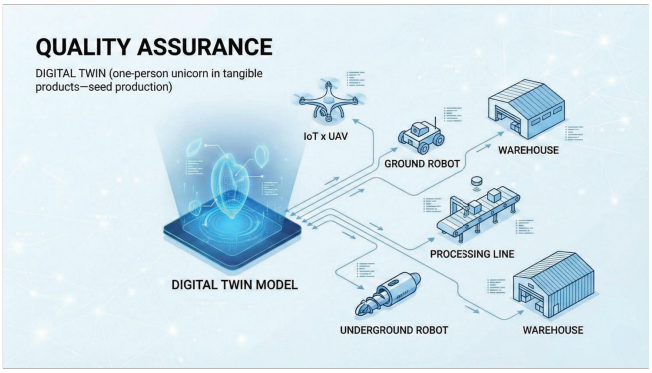
Vigor (Competitive Edge)

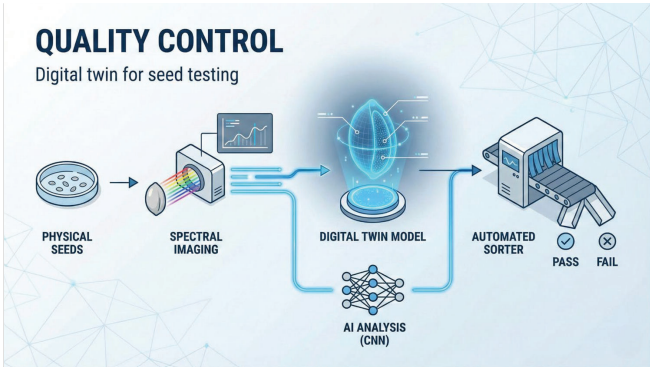
Measures performance under stress (drought, salinity). It answers: "Will this seed thrive?" In 2026, this is the key differentiator for premium export markets.



"Humans develop standards upon training, whereas robots possess standards from birth."


QUALITY ASSURANCE (QA) vs. QUALITY CONTROL (QC)
CONTINUOUS IMPROVEMENT LOOP
PROACTIVE (PREVENTION)
Focuses on PROCESS.
Goal: Prevent defects before they occur.
Activities: Planning, Defining Standards, Training, Auditing, Process Improvement
Everyone's Responsibility
Throughout Development Cycle
REACTIVE (DETECTION)
Focuses on PRODUCT.
Goal: Identify defects after they occur.
Activities: Testing, Inspections, Reviews, Lab Analysis, Corrective Action.
Dedicated Team's Responsibility
Final Stage / Post-Production.

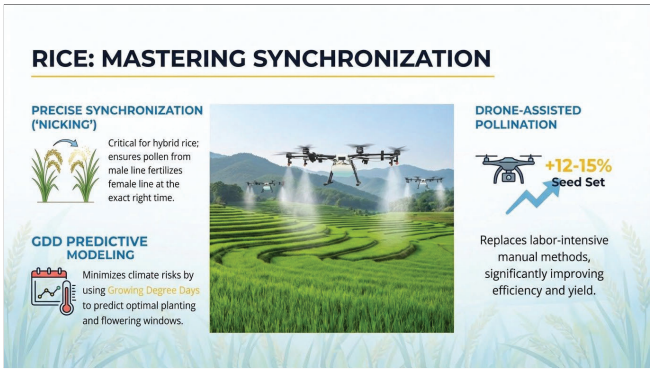

QUALITY ASSURANCE
DIGITAL TWIN (one-person unicorn in tangible products—seed production)
IoT x UAV
GROUND ROBOT
WAREHOUSE
PROCESSING LINE
DIGITAL TWIN MODEL
UNDERGROUND ROBOT
WAREHOUSE


QUALITY CONTROL
Digital twin for seed testing
PHYSICAL SEEDS
SPECTRAL IMAGING
DIGITAL TWIN MODEL
AUTOMATED SORTER
PASS
FAIL
AI ANALYSIS (CNN)


Commercial Production
Innovations in Rice and Corn


dyson


Vertical Farming
Internal Consum.
Exports
Horizontal Farming
dyson

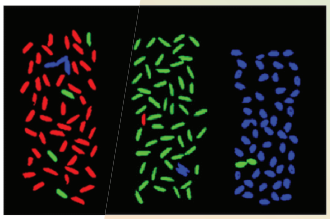

RICE: MASTERING SYNCHRONIZATION
PRECISE SYNCHRONIZATION ('NICKING')
Critical for hybrid rice; ensures pollen from male line fertilizes female line at the exact right time.
GDD PREDICTIVE MODELING
Minimizes climate risks by using Growing Degree Days to predict optimal planting and flowering windows.
DRONE-ASSISTED POLLINATION
+12-15% Seed Set
Replaces labor-intensive manual methods, significantly improving efficiency and yield.


Corn: Precision Detasseling
In maize production, a single missed tassel can ruin an entire seed lot's genetic purity.
The industry is shifting toward vision-guided robotics which achieve >99.5% detasseling accuracy, significantly outperforming manual labor and ensuring strict hybridity.

Precision in Rice Purity

Genetic purity is non-negotiable for high-value exports.

- **Spectral Scanning:** Drone-based multispectral sensors scan fields to identify off-types based on canopy spectral signatures before pollen shed.
- **Lab Verification:** Hyperspectral imaging differentiates aromatic vs. non-aromatic lines instantly without grow-out trials.

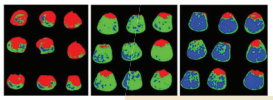


Seeing the Invisible

Detecting Internal Damage

Mechanical shelling often causes micro-cracks in the pericarp that are invisible to the naked eye but serve as entry points for pathogens.

Hyperspectral Imaging (HSI) penetrates the seed coat to detect internal bruising and embryo damage, allowing for the automated sorting of compromised seeds.



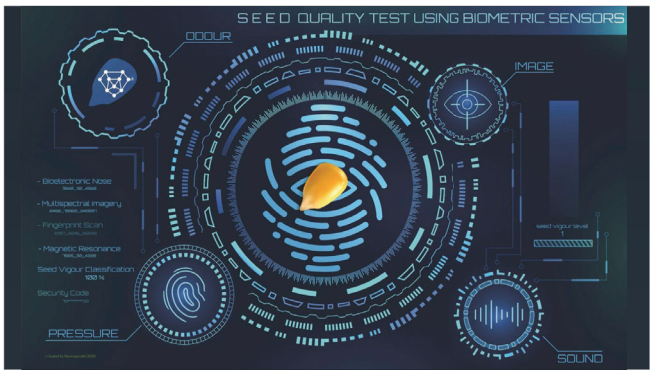
Classification images by LS-SVM model based on data fusion

Wang, Lu, et al. "Application of hyperspectral imaging to discriminate the variety of maize seeds." *Food Analytical Methods* 9.1 (2016): 225-234.

The Dry Chain Revolution

Post-harvest deterioration is the "leaky bucket" of value. We are adopting the **Dry Chain** concept.

Using **Zeolite Drying Beads** and hermetic storage, we dry seeds to a "glassy state" (low eRH). This arrests metabolic activity and doubles longevity for every 1% drop in moisture.



Digital Twins in Seed Production

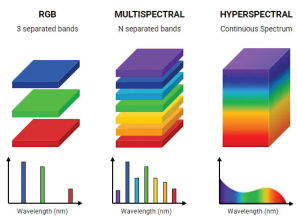
Spectral Imaging Technologies

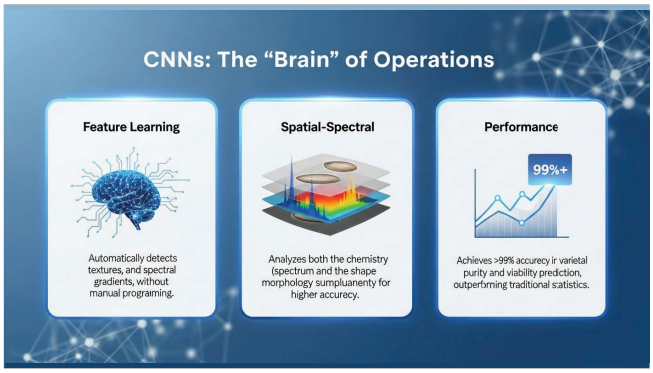
Multispectral Imaging (MSI)

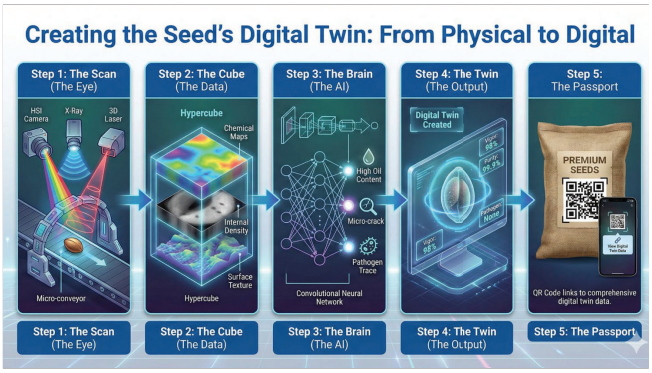
Captures 3 to 30 discrete bands of light. It is cost-effective and high-speed, making it ideal for real-time sorting based on surface color and basic features.

Hyperspectral Imaging (HSI)

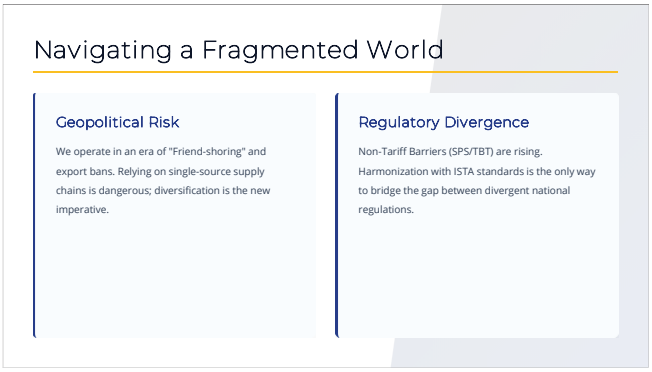
Captures 1000+ continuous bands, creating a "Hypercube" of data (x, y, λ). It enables deep chemical mapping to detect oil content, protein distribution, and hidden infections.



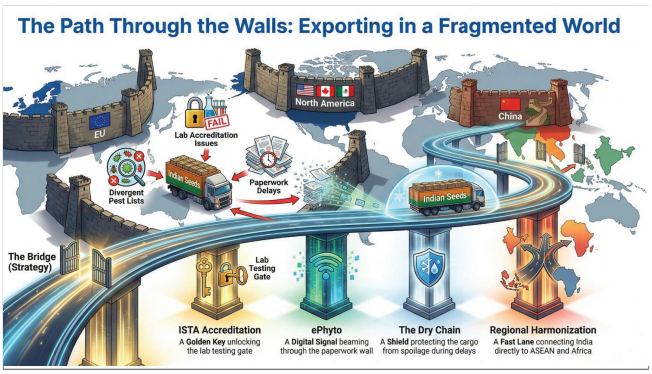

CNNs: The "Brain" of Operations
Feature Learning
Automatically detects textures, and spectral gradients, without manual programing.
Spatial-Spectral
Analyzes both the chemistry (spectrum and the shape morphology sumpluanenty for higher accurecy.
Performance
99%+
Achieves >99% accurecy ir varietal purity and viability prediction, outperbrning traditional satistics.


Creating the Seed's Digital Twin: From Physical to Digital
Step 1: The Scan (The Eye)
Step 2: The Cube (The Data)
Step 3: The Brain (The AI)
Step 4: The Twin (The Output)
Step 5: The Passport
HSI Camera
X-Ray
3D Laser
Micro-conveyor
Hypercube
Chemical Maps
Internal Density
Surface Texture
High Oil Content
Micro-crack
Pathogen Trace
Convolutional Neural Network
Digital Twin Created
PREMIUM SEEDS
QR Code links to comprehensive digital twin data.


AI-POWERED AGRONOMIC SEED PRICING
SEED LOT #4521 - CORN
Farm A (Historical Data) $210/unit
Farm B (Soil Analysis) $235/unit
Farm C (Volume + Loyalty) $195/unit


Navigating a Fragmented World
Geopolitical Risk
We operate in an era of "Friend-shoring" and export bans. Relying on single-source supply chains is dangerous; diversification is the new imperative.
Regulatory Divergence
Non-Tariff Barriers (SPS/TBT) are rising. Harmonization with ISTA standards is the only way to bridge the gap between divergent national regulations.


Global Leadership
1st
Asian President of ISTA
Dr. K. Keshavulu is driving a strategic transition toward tropical crops and ensuring that "Uniformity in Seed Quality Evaluation" becomes a reality for the Global South.


The Path Through the Walls: Exporting in a Fragmented World
EU
North America
China
Lab Accreditation Issues
FAIL
Divergent Pest Lists
Paperwork Delays
Indian Seeds
The Bridge (Strategy)
Lab Testing Gate
GO
ISTA Accreditation
A Golden Key unlocking the lab testing gate
ePhyto
A Digital Signal beaming through the paperwork wall
The Dry Chain
A Shield protecting the cargo from spoilage during delays
Regional Harmonization
A Fast Lane connecting India directly to ASEAN and Africa


AI OPTIMISTIC | ELON MUSK
Empowering Humanity's Future
VS.
PESSIMISTIC OF AI | WAR - GPU, UAV, DATA CENTER
The Risk of Unintended Consequences


ROADMAP TO 2030
HARMONIZE
Align national protocols with ISTA and IPPC (ePhyto) standards.
DIGITIZE
Transition from wet labs to AI-driven 'Digital Twins'.
OPTIMIZE
Implement the Dry Chain to preserve physiological quality.
UNIVERSALIZED
Leverage Indian leadership to secure global market access.

Thank you for your attention

Questions?

Dr. P.K. Singh	Dr. K. Keshavulu	Mr. Johan Van Asbrouck
Agri Commissioner, GoI	President, TSSOCA	President, Rhino Research

Image Sources


https://maxmag.org/wp-content/uploads/2025/06/unnamed-1024x683-1.jpg
Source: maxmag.org


https://www.specim.com/wp-content/uploads/2026/01/Seed-webinar-featured.jpg
Source: link.springer.com


https://link.springer.com/article/10.1007/s12161-014-9916-5
Source: bigjohnmfg.com


https://www.frontiersin.org/files/Articles/1361309/fpls-15-1361309-HTML/image_m/fpls-15-1361309-g001.jpg
Source: www.frontiersin.org


https://www.technologyreview.com/2017/02/13/154046/absorbent-beads-could-save-energy-and-lives/
Source: www.technologyreview.com

Diverse applications of the CNN model

Seed consumer

RGB image and low-weight model on the smartphone

Seed scientist

MSI / HSI with a heavyweight model in the laboratory

Seed producer

MSI / HSI with a medium-weight model in the sorter

Technical Session - III

Mr. Rajvir Rathi - Vice Chairman, Federation of Seed Industry of India

Global Regulatory Trends in Seeds

Rajvir S Rathi
Vice Chairman
Federation of Seed Industry of India
New Delhi

Indian Seed Congress 2026, Phuket, Thailand

ABOUT US

Federation of Seed Industry of India (FSII) is an association of research-focused plant science companies in India producing high quality seeds for food, feed, and fiber.It acts as a liaison between the seed industry, government, farmers, and other relevant associations.

FSII members are driven by the fundamental values of respecting research, intellectual property rights/ of members and companies committed to the seed business, while working for welfare of Indian agriculture.

Alliance for Agri Innovation is a leading agriculture industry body working towards accelerating agriculture growth in India. The Special interest group of FSII is created by like-minded agricultural organizations driven by research and innovations, committed to investment in India and respect for intellectual property rights.

COLLABORATORS

Why Seeds Matter

The Global Factors Determining Regulatory Overhauls Across the Globe

- Global Population > 9 billion by 2050
- Increasing Vagaries of Nature
- Research, Digital & AI
- Need for Nutrition Security
- Sustainability
- Circular/Bio-economy Demands

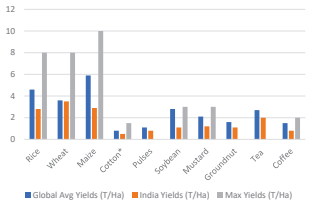
Sources: FAO, Different Publications

Overview of Indian Agriculture

- **Seeds** : $4 billion
- **Vegetables:** $740 million in 2023–24 to $970 million by 2030
- **Row Crops:** High adoption of hybrids in cotton, maize, millets
- **Agroclimatic Zone** : 15
- **Farmers :** 85% small & marginal farmers
- **R&D investment:** 10-12% of Turnover by research-focused companies
- **Private sector** share in high value and hybrid : 65% in 2024
- **Partnerships** between global and domestic ag companies
- **Investments** in high yielding, pest-resistant, and bio-treated seeds.

Indian Seed Congress 2026, Phuket, Thailand

Indian Ag – Challenge No.1: Yield improvement an imperative to feed 1.4 B people



* Lint cotton yields in T/Ha
Source: Ministry of Agriculture and Farmer's Welfare, data 2022-23, USDA .

Crop	Global Avg Yields (T/ha)	India Yields (T/ha)	Max Yields (T/Ha)
Sugarcane	70-73	75-80	85-90 (Brazil)

Yields of Key crops in India are significantly lower than global average or there is potential to pursue yield increases.

Factors behind Yield gaps

Biotic & Abiotic Stesses. Large scale yield losses due to pests, diseases, water stress and other reasons.

Inadequate use of modern science and technology in inputs, digital data systems and similar areas

Access to modern inputs: Many farmers continue to use traditional seed varieties and practices. Access to high-quality seeds, fertilizers and pesticides is improving in many rural areas

Agronomic practices: Most of the agronomic practices are in transition from old/traditional to modern / science based. Lack of efficiency in water use is an area of concern.

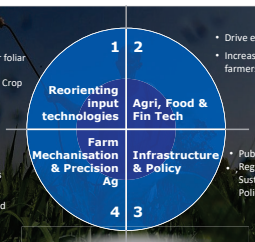
Soil degradation: Overuse of chemical fertilizers and improper land management have led to depletion of soil carbon and declining soil fertility in many areas.

A large part of India's food production goes into meeting domestic demand but current agri exports at 50B$.

With increasing prosperity, there's a stated need for improving yields as well as nutrition in the food crops

Integrated Technology Architecture for Indian Agriculture

- Breeding and Biotechnology – GM & Non GM; New Breeding Tools
- Safer chemical Crop Protection technologies, Non-bulk fertilizers for foliar application, Reduce soil application; Biological inputs for CP and Crop Nutrition
- Nutrition fortified outputs
- Micro irrigation to replace flood



- Drive ecosystem transformation
- Increase convenience & connect farmers to markets and services
- Public Digital Infra, Data, Research, Regulatory, Crop portfolio, Sustainable food system and Public Policy
- Mitigates labour related costs and challenges
- Improves efficiency in the field
- New agronomic practices facilitated by mechanization

Tata-Cornell Institute Seminar

Regulatory Issues are not Simple for Seed Business

Plethora of Regulations from Production to Movement

Policy & Regulatory Enablers

- ❖ **Science- and data-based decision making**
- ❖ **Greater public-private partnerships – Outcome-focused**
- ❖ **Consistency & harmonization with global export rules, germplasm exchange and phytosanitary standards**
- ❖ **Effective enforcement and protection of Intellectual Property Rights**

Indian Seed Congress 2026, Phuket, Thailand

Opportunities in Seed Industry

- **Biotech & advanced genomics application in crops**

Application of whole genome sequence to climate-resilient varieties of seeds & improved nutrition value

- **Genome Editing**

Unlock potential to meet populational needs

- **Biofertilizers / Biopesticides / Biocontrol agents / Bio stimulants**

Critical for sustainable agriculture

- **Seed Technology**

Seed advancements, processing and management

- **Digital Agriculture + Precision Farming**

Remote sensing and tech imaging are new frontiers

- **Crop Improvement of underutilized / traditional crops & millets**

Value addition and improvement in neglected crops

- **Public-Private R&D partnerships**

Contract research, license deals, trials, product development

- **Export-oriented seed production / seed export zones**

Develop India as a global seed hub

- **Agri Startup**

Support and leverage their breakthroughs to foster the next ag revolution.

Indian Seed Congress 2026, Phuket, Thailand

Why Investments in Indian Seed Industry is Increasing

Fastest Growing Economies in the World

Globally ~$60 billion in 2023 → to grow to $89 billion by 2032

- Ranked at 5th largest – valued at $4 billion (INR 33,000 Cr)
- Indian industry is investing nearly **10-12%** of yearly turnover on R&D

Key drivers:

- Increasing demand for 4Fs – Food, Feed, Fiber, Fuel
- Modernization of agriculture
- Seed replacement rate (SRR) increasing
- Export of hybrid corn, hybrid rice and hybrid vegetable seeds
- Demand for vegetable seeds is driven by the need for disease-resistant and high-yield potential seeds
- But India has < 2% share in global seed trade

*Seed Cost varies between **3% to 7% and is among the lowest cost items,** which delivers disproportionate benefits to the farmers*

Global Seed Market - Overview

- **Valued at USD 52.06 billion in 2023 → to grow to USD 82.04 Billion by 2031**
- Growth - CAGR of 5.8% in the forecast period (2024-2031).
- Drivers –
  - Increasing demand for 4Fs – Food, Feed, Fiber, Fuel
  - Modernization of agriculture
- The global hybrid seeds market was estimated at USD 26.8 billion in 2023. The cereals and grains segment had the largest revenue share of 38.4% in 2023.
- The demand for vegetable seeds is driven by the need for disease-resistant and high-yield potential seeds for tomatoes, cucumbers, cabbage, and pumpkins.
- The global seed market is segmented into five major regions: North America, Europe, Asia Pacific, South America, and Middle East & Africa.
- Asia is one of the fastest growing markets.

Plant breeding is the heart of our agri-food systems

Regulatory Framework

Noteworthy Examples

NORTH AMERICA

US & CANADA AMONG FIRST COUNTRIES WITH CONCRETE REGULATORY DECISIONS ON NEW BREEDING INNOVATIONS

SOYBEANS PRODUCING HIGH-OLEIC SOYBEAN OIL SOLD AS CALYNO

FIRST COMMERCIALIZED GENE-EDITED CROP IN THE US IN 2019 DEVELOPED USING TALENs

EUROPE

EU PROPOSAL ON NEW GENOMIC TECHNIQUES RELEASED IN JULY 2023

UK'S PRECISION BREEDING BILL

INTRODUCED IN MAY 2022; BECAME A LAW IN MARCH 2023 AFTER RECEIVING ROYAL ASSENT

INTRODUCES SCIENCE-BASED AND STREAMLINED REGULATORY SYSTEM TO FACILITATE RESEARCH

AFRICA

4 COUNTRIES WITH ESTABLISHED GUIDELINES ON NEW BREEDING INNOVATIONS:

NIGERIA (FEBRUARY 2022)
KENYA (MARCH 2022)
MALAWI (AUGUST 2022)
GHANA (OCTOBER 2023)

LATIN AMERICA

8 COUNTRIES WITH ESTABLISHED CRITERIA OF NEW BREEDING INNOVATIONS:

BRAZIL • CHILE • COLOMBIA • ECUADOR
GUATEMALA HONDURAS • PARAGUAY
ARGENTINA

ARGENTINA PIONEER REGULATION ISSUED IN 2015

GENE-EDITED NON-BROWNING POTATO DEVELOPED USING CRISPR RELEASED IN 2018

ASIA AND THE PACIFIC

AUSTRALIA, JAPAN, PHILIPPINES, AND INDIA

ISSUED IMPLEMENTING REGULATIONS AND SOME APPROVED THEIR FIRST GENE-EDITED PRODUCTS

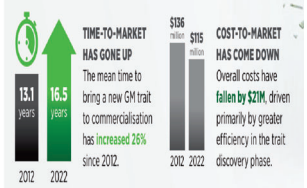
JAPAN
STARTED SALE OF GENE-EDITED HIGH GABA TOMATO IN 2021

PHILIPPINES
REDUCED BROWNING GENE-EDITED BANANA DETERMINED AS NON-GMO IN 2023
FIRST GENE-EDITED PRODUCT TO GO THROUGH THE PHILIPPINES' GENE EDITING REGULATORY PROCESS

Source: ISAA.org

Long Route to Commercial Launch of GM Traits

The most recent Time and Cost to Market report from AgbioInvestor indicates the following significant trends:



TIME-TO-MARKET HAS GONE UP
The mean time to bring a new GM trait to commercialisation has increased 26% since 2012.

COST-TO-MARKET HAS COME DOWN
Overall costs have fallen by $21M, driven primarily by greater efficiency in the trait discovery phase.

Source: CropLife International

Delivering a new GM trait to market requires an average investment of:

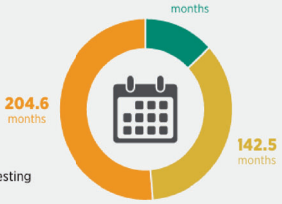
16.5 YEARS More than half that time – 8.5 years – is spent on regulatory approval alone.

AND

$115 MILLION The regulatory phase accounts for 37.6% of total costs.

WHAT'S TAKING SO LONG?

The regulatory phase accounts for **37.6% of the total cost** – but takes up **51.1% of the time.**



- Discovery (Early, Late)
- Genetic Event Construction and Testing
- Regulatory

Source: ISAA, CropLife International

How Do We Fix It?

A Harmonized Global Regulatory Framework Would:

Regulators

- Improve Time to Market
- Leverage experience & existing data submissions and safety assessments
- Free up resources, monetary and personnel
- Provide regulatory framework for emerging regions
- Achieve Sustainable Development Goals

Farmers

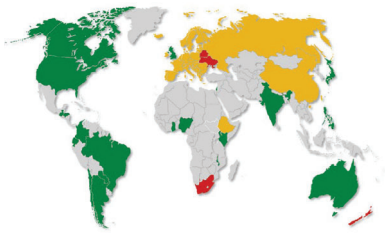
- Promote Innovation
- Greater options
- Faster sustainable cultivation adoption
- Better potential yields
- Higher income
- Greater contribution towards the bio-economy

Consumers

- Aid Growers & Consumers
- Nutritional sufficiency
- Higher affordability
- Sustainability goals
- Assured crop inputs with desired traits and features

Global Regulatory Landscape for Gene-edited Crops

Based on Regulations over the Past Decade

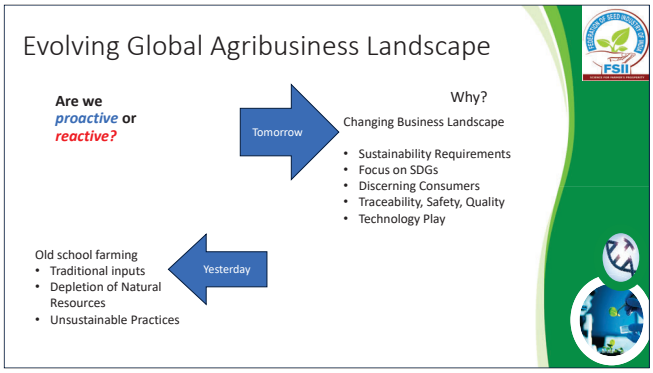


Countries where products are likely to be regulated as conventional new varieties after recent regulatory policy updates.

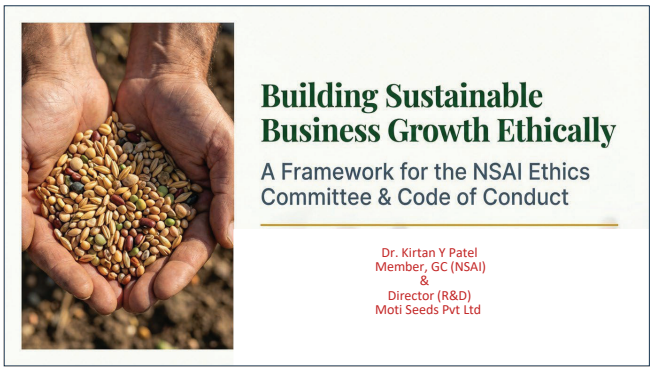
Countries where there are noticeable policymaking discussions over proposals to treat SDN1 as conventional new varieties.

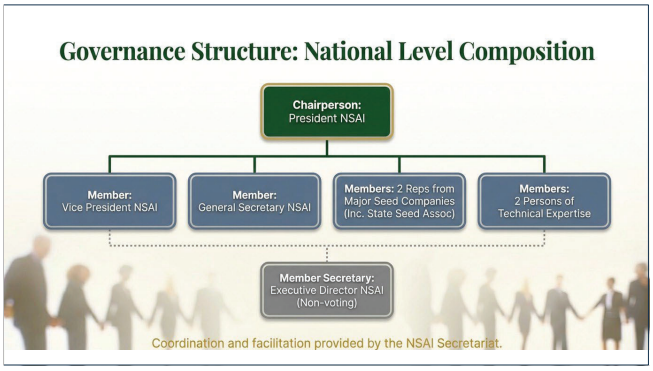
Countries where SDN1 products should be treated as GMO according to court interpretations based on old regulations.

Source:isaaa.org



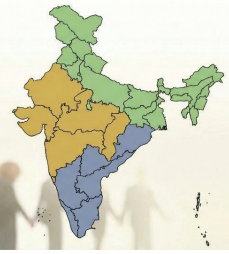
Dr. Kirtan Y. Patel - Director (Research), Moti Seeds Pvt Ltd.





Future Roadmap: The Zonal Framework

Expansion after successful National implementation



Zone A: UP, Punjab, Haryana, WB, Bihar, NE States

Zone B: Andhra, Telangana, Karnataka, TN, Odisha

Zone C: Gujarat, Maharashtra, MP, Chhattisgarh

Each Zonal Committee: Max 7 members, chaired by a GC member or leading State Seed Company

Core Ethical Principles & Guidelines

APPROVED DENOMINATIONS
Use only GEAC/ICAR approved names. No unauthorized synonyms.

ZERO TOLERANCE
No sale of unapproved GM events or products.

ANTI-FLY-BY-NIGHT
Curb operators exploiting the market. Support Dept of Agriculture.

TRUTH IN MARKETING
Zero misrepresentation or false propaganda.

TRACEABILITY
Mandatory implementation of the SATHI Portal.

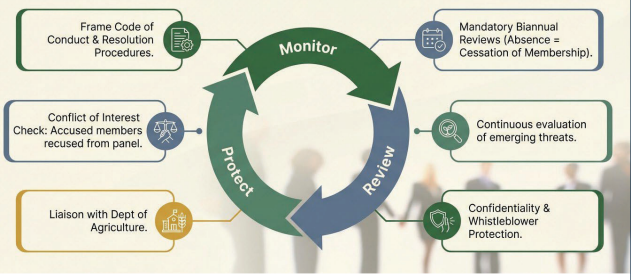
COMMITMENT
Undertaking of ethical practice required for membership renewal.

The Legal Framework

The EC operates strictly within the pillars of Indian Law.

Operational Mandate: Respect IP rights, use Material Transfer Agreements (MTA), and maintain sanctity of research varieties.

Obligations of the Ethics Committee



Strategy for Education & Awareness

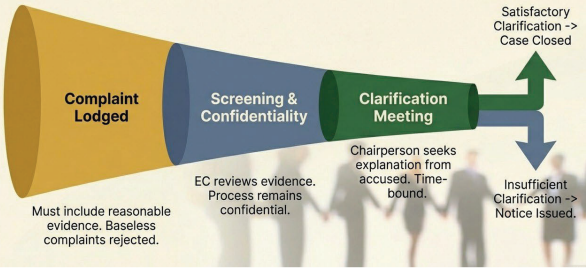
National Workshop
Flagship event on 'Ethics in Seeds Trade".

Farmer Outreach
Training on proprietary materials & consequences of illegal seeds.

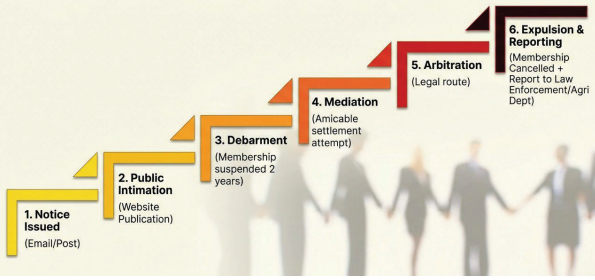
System Advocacy
Promoting the SATHI Portal for traceability.

Prevention is better than cure: Building a culture of compliance.

Dispute Resolution: Intake & Screening



Dispute Resolution: Escalation & Enforcement



Ensuring Fair Competition & Contract Honor

- **Contract Adherence**: Members must honor all valid contracts regarding production and marketing.
- **Facilitation**: EC acts as a mediator for disputes.
- **Anti-Collusion**: EC actively prevents collusion by demanding transparency.
- **Fair Play**: A commitment to no trust violations.


The Way Forward
1. Trust Building through unbiased resolution.
2. Continuous Improvement of EC procedures.
3. Partnership with Central/State enforcement machinery.
4. Digital Adoption for awareness.
Let's make it together.

Technical Session - IV

Dr. G. Chaluvaraju - Asia Head R&D-BASF NUNHEMS India, Bengaluru

Global trends in Seed & Agri-Biotech Innovations & Investments: What It Means for India

Dr. G Chaluvaraju
Asia Head - R&D, BASF Nunhems India.

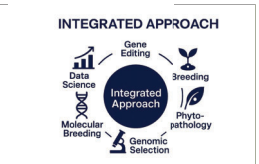
Growth Trends

From input industry to strategic national infrastructure

- Expected to grow USD 70 billion in 2024 to over USD 100 billion by the 2030s driven by innovation and demand.
- Innovation for Climate and Efficiency & and product development speed to meet future agricultural challenges.
- Dominance of Major Row Crops - Maize, rice, wheat, soybean, and cotton dominate market value and R&D investment due to their scale and trait stacking potential.
- Specialty Crops and Innovation Cycles - Specialty crops like vegetables and pulses benefit from rapid innovation in controlled environments enhancing production.
- Investment shifting from broad , early-stage hype to concentrated bets on gene editing, biologicals, digital genetics & precision breeding and climate resilient traits
- Shift from science only competition to Capital + IP +Policy Ecosystems
- No longer just and input market but strategic intersection of biotechnology , climate resilience , food security & national policy

Scientific and Technological Convergence

- Gene Editing - CRISPR technology enables precise genetic modifications to improve crop yield, stress tolerance, and disease resistance.
- AI and Predictive Breeding - AI and machine learning integrated with genomics power predictive breeding models optimizing trait selection for crops.
- Speed Breeding and Automation - accelerate multiple crop generations yearly, improving research efficiency and timelines.
- Technological Convergence Impact - The merging of genome engineering, digital agronomy, and microbial treatments drives innovation and investment in agriculture.



Recent breakthrough innovations of high impact

From incremental gain to system level performance gains

Innovation	Lead Organization(s)	Impact Highlights (Why it matters)	Examples / Deployment	Key Sources
Genome-edited Rice (CRISPR) for Yield & Climate Resilience	ICAR–IARI; ICAR–IIRR	India's first approved gene-edited (SDN-1/2) rice; improved drought/salt tolerance, earlier maturity, higher yield; policy signal for pipeline acceleration	Official launch May 4, 2025; scaling via ICAR/state seed agencies; elite backgrounds (Samba Mahsuri, MTU 1010)	Nature (May 4, 2025); SABP/BCIL (May 2025)
Short-Stature Corn & Smart Corn System	Bayer Crop Science	Reduced lodging/greensnap, stronger stalks; season-long ground access enabling precise in-season inputs; scalability via U.S. rollout	Trials on planting dates/tillage/cover crops; commercial rollout via Ground Breakers® and broader U.S. launch	Bayer explainer; Bayer US trial note (2024); Bayer 2024 innovation update
CRISPR Seedless & Compact Blackberries	Pairwise (Fulcrum™ platform)	Consumer pull for seedless fruit; compact, thornless ideotypes for higher density & harvest efficiency; template for other specialty crops	Scale-up underway; potential licensing across global berry value chains; leafy-green edits already commercialized	The Grower (Jun 2024); ISAAA (Jun 2024); GLP/NC State (Aug 2024)
High-Resolution Soil Intelligence (EarthOptics × Pattern Ag)	EarthOptics + Pattern Ag (merged Aug 2024)	Fuses physical sensing with bio/chem analytics to create soil digital twins; predictive agronomy for compaction, biofertility, pathogens, nutrients	Used for seed trial placement, trait validation, variable-rate tillage; predictive pathogen risk mapping pre-planting	EarthOptics PR (Aug 28, 2024); Global Ag Tech (Sept 2024); Global Agrinvesting (2024/2025)
Vorceed® Enlist® Corn (Multi-MOA CRW + Herbicide Flexibility)	Corteva Agriscience (Pioneer®, Brevant®)	Stack with multiple insect protections incl. RNAi for CRW; tolerance to 2,4-D choline, glyphosate, glufosinate, FOPs; integrated refuge	Deployment across U.S. Corn Belt via Pioneer/Brevant; integrated with Enlist herbicide system (near-zero volatility 2,4-D choline)	Corteva Vorceed page; Enlist.com; Pioneer summary

Breakthrough Technologies Showing Real Impact Genome-edited rice (+19% yield), short-stature corn, soil-intelligence platforms, and next-gen trait stacks demonstrate measurable productivity and resilience gains.

Innovation	Impact Highlights	Evidence	Examples
AI-Powered Predictive Agriculture	Forecasts yield, pest & nutrient needs using real-time + historical data	60% of large farms adopting AI tools; major OEM investments	John Deere, AGCO digital platforms
Indoor & Vertical Farming 2.0	High-efficiency CEA with hydroponics/aeroponics & smart LEDs	Market growing to $68B by 2029 (12.9% CAGR)	UAE, Japan, US retail supply chains
Agricultural Robotics & Automation	Autonomous tractors, harvesters, vision-AI sprayers	Addresses 2.4M labor gap; validated in 2026 AgTech trends	Robotic harvesters, AI drones
Blockchain & DNA Crop Traceability	Tracks food origin, safety, quality end-to-end	1 in 10 fall ill due to contamination; reduces food waste by 20%	Walmart, Carrefour pilots
Regenerative Agriculture + Digital MRV	No-till, cover crops, carbon farming with digital verification	Regen ag market 15.97% CAGR; high adoption in surveys	Carbon projects in India, LATAM, EU

Next Top 5 Agricultural Innovations (2025–2026)

Regional Capital Flow Dynamics

- **North America and Western Europe -** dominate agricultural biotech investment due to strong intellectual property rights and stable regulatory frameworks.
- **Asia-Pacific Growth Hub -** leads rapid growth driven by rising food demand, climate resilience, and national food security strategies.
- **Latin America Commercial Production -** Brazil and Argentina sustain strong biotech investment from large-scale corn and soybean production with trait stacking.
- **Africa's Emerging Market -** Africa focuses investment on smallholder farming systems and resource-efficient technologies to tackle food security.

Global leaders invest 9-14% of sales - Public institutions & CGIAR advancing gene editing - Domestic companies in many markets focus on incremental traits

Global Investment Trends Reshaping R&D

- Fewer deals, larger strategic investments
- Corporate venture arms highly active in genome editing platforms, biologicals , digital breeding tools
- Platform companies favored over single-product firms
- Climate-resilient genetics prioritized
- Major players investing aggressively
- Targeted selective investments by Specific crop groups/technology

Innovation is a capital allocation decision – Are we allocating accordingly

Metric	India	USA	China	Brazil	EU
Overall R&D spending (% of GDP)	~0.6 -0.7% , low	~3.5% , high	~2.6% , high	~1.3 - 1.5%*	~2.1%
Private share of total R&D	Low	Very high , private drives R&D	High & rising	Moderate	High
Agricultural R&D intensity(public research % of Ag GDP)*	~0.3 -0.4% , low	~0.7%	~0.5%	~0.9%	~0.7%
Dominant funder of agricultural R&D	Public sector	Private + public	Public + growing private	Public	Public + private
Trend in Agri R&D funding	Growing, but low	Declined public but high private	Rapid growth , now the largest global funder	Increasing	Moderate growth

- Global Agri Leadership is being re written – Genetics, Traits, Data, IP
- India: ~0.7% (Public heavy , limited private scale, then global leadership remain elsewhere
- R&D Intensity = Competitive Speed = Speed Compounds = Countries Invest move faster in biotech, AI Breeding

India: Strengths, Gaps, and Regulatory Shifts

- **Scientific Capabilities**
  India's public agricultural research system is best , driving global advancements in crops like rice and millet crop development.
- **Regulatory Shift in Crop Technology**
  2025 approval of genome-edited crops marks progress toward advanced breeding technologies without GMO controversies.
- **Capital and Commercialization Gaps**
  Private investment in seed R&D is low due to fragmented markets, weak IP protection, and policy inconsistencies.
- **Bridging the Gaps**
  Strengthening investment ecosystems and regulatory clarity is vital for translating innovations into scalable products.

Strong Science, Capital Gap

Internal

Two Asian Models – Strategic Contrast

Leaning from China

- **Massive Public Investment** - China's large-scale public funding supports seed security and biotechnology research as national priorities.
- **Accelerated Biotechnology Approvals** - Rapid approvals and strong government coordination help quickly close technological gaps in biotech.
- **Strengthened IP Enforcement** - Improved intellectual property laws and penalties foster private-sector innovation and attract investment.
- **Strategic Policy Direction** - Combines state capital and cohesive policies to lead advancements in biotechnology innovation.

- **Scale Driven , state backed – China**
- **Science – rich , execution constrained – India**

Internal

The IP Challenge and Its Implications

- **IP Protection Challenges**
  Seeds are easily reproduced, making intellectual property enforcement challenging and hindering innovation incentives.
- **Inconsistent Enforcement**
  Fragmented policies and overlapping jurisdictions weaken enforcement, reducing incentives for private R&D investment in India.
- **Need for Stronger IP Systems**
  Strengthening IP protection and clear regulatory processes are essential for stimulating high-risk breeding investments.
- **Risk of Global Lag**
  Without strict & coordinated efforts of reforms, India risks falling behind global competitors in the innovation-driven agricultural biotechnology ecosystem.

Internal

India Advantage – Capital decisions

Unmatched Natural Advantages

- Agroclimatic diversity
- Skilled scientists & human resources
- Large Germplasm diversity
- Production cost efficiency
- Massive domestic market
- Non controversial & faster pathway for non-transgenic edits

What is missing - Scale of private R&D capital - Cost centric to Valuation driver approach

- 8-12% of revenue into R&D – Tax Incentives
  - Genomics + AI Breeding platforms
  - Trait pipeline with 5-10 year horizon
  - Export focussed , high value trait (breakthrough traits) breeding programs
- PPP Collaboration for pre competitive research – University research farms, Corporate R&D centers, Incubation ecosystems
  - Cell Biology , Tissue Culture, Molecular breeding labs, Controlled phenotyping facilities, Seed quality labs
- Harmonized IP policies & implementation

Internal

Key Takeaways and Strategic Imperatives

KEY STRATEGIC PILLAR	CURRENT STATUS INDIA	GLOBAL BENCHMARK
Scientific Capability	World-class public research, strong in crops like rice and millets	Integrated with private sector, rapid commercialization
Private R&D Investment	Low, fragmented markets, limited scale	High, driven by capital and IP protection
IP Enforcement	Inconsistent, fragmented policies	Strong, clear, incentivizes innovation
Regulatory Pathways	Improving, but still slow for next-gen traits	Streamlined, supports rapid adoption
Innovation Capital Intensity	~0.4 to 0.7% of Ag GDP (public-heavy)	2–3.5% of GDP, private-led

The next decade will not reward incremental breeders. It will reward crop system platform builders

Internal

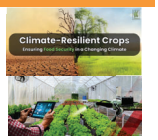
Dr. S Rajendra Prasad - Ex. Vice Chancellor, University of Agricultural Sciences, Bangalore.

Structural Competitiveness and Strategic Trajectory of India's Seed Export Sector

Dr. S. Rajendra Prasad
Former Director ICAR-NISST, Mau
Former Vice-Chancellor
UAS Bangalore-65

Why seed export is a high-potential business for India ?

- **Global demand is rising** due to
  - Intensification of agriculture
  - Shift to hybrids/high-value varieties
  - Climate-resilient seed demand
  - Protected cultivation/precision farming
  - Representing India as a global seed hub



- **Vegetable seeds are a particularly strong segment globally, with Asia-Pacific as a major consuming/producing region.**
- **Seeds as premium IP assets**
- **Anchor of national food security**

Indian Seed Export Landscape – Key Statistics (2024-2030)

- ✓ **India is the world's fifth-largest seed market and has one of the most thriving seed industries. Additionally, India's seed sector grew at a compound annual growth rate (CAGR) of 10.9%.**
- ✓ **Fruits & Vegetables Seeds exports (India):**

2024–25: 13,605.72 MT, worth **₹1,222.54 crore / USD 144.81 million**.

- ✓ **Major destinations (2024–25): USA, Netherlands, Bangladesh, UAE, Thailand, Malaysia.**

Destination shares: USA (18.82%), Netherlands (15.37%), Bangladesh (12.72%), UAE (5.15%), Thailand (4.42%)

https://apeda.gov.in/FruitsAndVegetablesSeeds

Global Demand Drivers for Seeds

Macro-trends shaping the international market

- **Demographic surge:** The global population is projected to reach 9.7 billion by 2050, amplifying the need for higher per-acre productivity through superior seed genetics.
- **Nutrition transition:** Rising middle-class incomes in emerging economies are shifting diets toward protein-rich legumes and oilseeds, spurring demand for nutritionally dense germplasm.
- **Climate-adaptive cropping:** Erratic weather patterns compel importing nations to replace traditional varieties with drought-tolerant, flood-resilient or salinity-smart seeds.

- **Biotech and hybrid uptake:** Adoption of genetically engineered solutions—enabled by breakthroughs in CRISPR, gene stacking and hybrid vigor and cytoplasmic male-sterile hybrids is accelerating, especially in regions seeking rapid yield gains and pest resistance.

Institutional Enablers for Seed Export

How national and international organisations streamline market access, compliance and value capture

- **ISTA – Global seed quality benchmark:** ISTA sets internationally harmonized seed testing standards and issues internationally recognized certificates that facilitate trade by reducing technical disputes.
- **OECD – Trade policy intelligence & advocacy:** Through its Agricultural Outlook and Trade Policy Reviews, the OECD supplies granular market forecasts, tariff analyses and best-practice guidelines that help Indian exporters position their varieties strategically. OECD certification eliminates non-tariff barriers, allowing easier entry for Indian seeds into developed markets.
- **UPOV – Intellectual-property security:** UPOV provides international plant breeders' rights protection; India operates under the PPV&FR Act, which offers sui generis protection.
- **APEDA – Government-driven export promotion:** The Agricultural and Processed Food Products Export Development Authority runs market-development missions, offers export-linked subsidies, and maintains a dedicated seed-export portal that connects Indian firms with overseas importers.
- **National Seed Corporations (NSC) – Domestic aggregation & export facilitation**

ISTA OECD UPOV APEDA NSC

Factors Strengthening Export Potential

Structural, market and policy levers that amplify India's seed export outlook

- **World-class breeding pipeline and germplasm depth:** India's public-private breeding consortia leverage >150,000 accessions, high-throughput phenotyping, and CRISPR-enabled trait stacking, delivering a continuously refreshed portfolio of climate-smart, biofortified and hybrid varieties that meet diverse agro-ecologies abroad.
- **Cost-effective production and economies of scale:** Low input prices, a skilled agronomic workforce, and large-scale seed multiplication farms generate per-unit seed costs that are 20-30 % below the global average, enabling price-competitive export offers without compromising quality.
- **Strategic trade accords and preferential market access:** Bilateral FTAs, South-South cooperation frameworks, and APEDA-negotiated tariff concessions open duty-free or reduced-tariff lanes into Africa, Southeast Asia and the Middle East, shortening lead-times and enhancing margin sustainability.
- **Advanced phytosanitary compliance and digital traceability:** State-of-the-art seed processing plants equipped with ISO-17025 labs, blockchain-based lot tracking, and automated phytosanitary certification reduce border rejections by >40 % and build buyer confidence in high-risk markets.
- **Alignment with rising global demand for climate-resilient and nutrition-enhanced seeds:** The surge in demand for drought-tolerant, salt-tolerant, and micronutrient-rich cultivars linked with India's varietal pipeline, turning external demand drivers into a direct export pipeline.
- **Targeted government incentives and export financing:** Export credit guarantees, R&D tax credits, and seed-export subsidy schemes lower capital barriers for SMEs, while dedicated export-promotion missions generate qualified buyer pipelines and market intelligence.

Regulatory Framework & Export Compliance

Navigating licenses, standards and bio-security

- **APEDA licensing architecture:** Exporters secure a Registration-cum-Membership Certificate (RCMC) for scheduled products under APEDA, complemented by product-specific authorisations that are renewed annually through a digital portal maintained by DGFT.
- **Phytosanitary clearance:** Every consignment requires a phytosanitary certificate attesting freedom from quarantine pests, with risk-based inspections aligned to the International Standards for Phytosanitary Measures (ISPM).

- **GMO and bio-security protocols:** Exports containing transgenic material must obtain a prior approval from the Ministry of Environment, Forest and Climate Change (GEAC), adhering to the Environmental protection act of 1986 (containment and post-release monitoring mandates).
- Recent reforms have streamlined the "Lab-to-Export" pipeline:
  - **Biotechnology for Economy, Environment, and Employment Bio-E3 Policy (2025):** The BioE3 initiative aims to strengthen India's biotech innovation ecosystem, indirectly supporting export competitiveness.
  - **Patent Reforms (2024-25):** Time limit for submitting a **Request for Examination (RFE)** for biotech patents cut from 48 to 31 months, accelerating IP protection for new traits.

Draft Seed Bill 2025: Catalyzing India's Export Ambitions

Core provisions, regulatory uplift, and export-enabling mechanisms

- **Fast-track Variety Registration for Export:** The draft Bill proposes compulsory variety registration and digital compliance, which could reduce administrative delays for export-oriented seed firms, depending on implementation

- **Unified Phytosanitary Standards & Mandatory Seed Certification:** The Bill strengthens nationally notified seed quality and seed-health standards and enables digital traceability, which can support SPS compliance for exports, subject to importer-country requirements
- **Central Accreditation System:** Aims to promote "Ease of Doing Business" by allowing multi-state seed companies to receive national accreditation

- **Export-Oriented Financial Incentives:** The Bill strengthens institutional mechanisms for standards and registration; any export single-window facilitation would typically sit with DGFT/Plant Quarantine systems alongside agriculture portals
- **Traceability (SATHI Portal):** Implements mandatory QR codes on all seed packaging to ensure transparency and track origin.

Key Seed Categories & Comparative Advantages

Differentiated value propositions for global markets

- **Cereals – rice & maize hybrids: India's public-private hybrid programs deliver 15-20 % yield uplift, early-maturity traits and resistance to bacterial leaf blight, meeting the bulk requirements of South Asian and African importers.**
- **Pulses & legumes – climate-smart genetics: Improved chickpea, pigeonpea and lentil lines exhibit drought-avoidance mechanisms, deep rooting systems and enhanced protein content, aligning with nutrition-security agendas in Sub-Saharan Africa.**
- **Oilseeds – mustard & soybean resilience: Disease-resistant soybean varieties with engineered Phytophthora tolerance and high-oleic mustard seeds provide both agronomic stability and premium oil quality for East Asian markets.**
- **Horticultural & vegetable seeds – premium niche: High-value cucumber, capsicum and chilli hybrids deliver uniform fruit size, extended shelf-life and reduced pesticide dependence, catering to upscale European and Middle-Eastern retail chains.**

Where the export opportunities are highest

A) High-value horticultural seeds

Why: high price/kg, frequent replacement, high demand for hybrids, strong protected cultivation growth.

Product focus:

- **Hybrid seeds:** tomato, chilli, capsicum, cucumber, melon, gourds, okra, brassicas, onion, leafy vegetables.
- **Tropical vegetable lines** that perform well in Africa, South Asia, Southeast Asia, and Gulf protected systems.

Target markets

- **Middle East** : high import dependence + protected cultivation.
- **Africa**: expanding vegetable area + hybrid adoption.
- **South Asia & ASEAN**: similar agro-climates, fast varietal turnover.

B) Field crop seeds with OECD certification advantage

- **For cross-border trade, OECD varietal certification helps buyers trust genetic identity and quality. OECD Seed Schemes are a harmonized international system used in seed trade. Good candidates: maize, sorghum, pearl millet, sunflower, oilseeds/fibre crops, forage grasses/legumes (where India has seed production ecology + cost advantage).**

C) Forage & pasture seeds (niche but growing)

- **Dairy/meat expansion in West Asia/Africa drives forage seed demand.**
- **India can supply tropical forage legumes/grasses if purity + quarantine standards are met.**

D) "Specialty" opportunities

- **Parent lines / breeder seed services (contract multiplication) for global seed companies.**
- **Seed production outsourcing using India's diverse seasons and skilled labor (two-season multiplication, off-season nurseries).**

Market Entry Strategies & Trade Channels

Pathways to capture overseas demand

- **Direct export model:** Leveraging in-house logistics and APEDA-certified warehouses enables full margin capture, suitable for high-volume cereals where price sensitivity is paramount.
- **Local distribution partners:** Engaging established seed dealers in target countries accelerates market penetration by exploiting existing sales networks and regulatory familiarity.
- **Joint ventures with foreign seed firms:** Co-development arrangements combine Indian germplasm with overseas R&D, granting access to proprietary breeding pipelines and brand equity in premium segments.
- **Agritech e-platforms:** Digital marketplaces (e.g., include Cybex Exim Solutions, Seair Exim Solutions, and TradeImeX) provide scalable, data-driven channels for small-holder order aggregation, especially effective in Southeast Asian corridors.
- **Regional bulk distributors:** Strategic alliances with regional aggregators facilitate consolidated shipping, lower freight costs and simplify customs clearances for multi-country consignments.

Logistics, Quality Assurance & Certification

Ensuring seed integrity from farm to foreign field

- **Temperature-controlled supply chain:** Maintaining ambient temperatures between 4 °C-10 °C during transport preserves germination vigor, particularly for moisture-sensitive vegetable seeds.
- **Moisture and purity testing:** Accredited labs (e.g., NABL-certified) conduct moisture content analysis (<12 %) and varietal purity assays using SSR markers, ensuring compliance with import standards.
- **ISO 9001 & IPP certification:** Adherence to ISO 9001 quality management systems and the International Seed Federation's IPP guidelines validates process consistency, boosting buyer confidence.
- **End-to-end traceability:** Blockchain-based batch identifiers enable real-time tracking from seed production to field deployment, facilitating rapid recall if phytosanitary issues arise.

Risk Management & Government Incentives

Mitigating exposure and leveraging support schemes

- **MEIS (Merchandise Exports from India Schemme) export promotion scheme:** Eligible exporters receive a merchandise export incentive of up to 5 % of FOB value, contingent on compliance with product-specific eligibility criteria.
- **Subsidies for R&D & certification:** The Ministry of Agriculture offers grants covering up to 40 % of costs for seed breeding trials, varietal registration and third-party certification.
- **Export credit insurance:** EXIM Bank's policy protects against commercial and political loss.
- **Currency hedging mechanisms:** Forward contracts and options facilitated by authorized banks enable exporters to lock in rupee-dollar rates, safeguarding margins amid exchange-rate volatility.
- **Geographic diversification:** Spreading shipments across Southeast Asia, Africa and the Middle East reduces dependence on any single market's regulatory or demand fluctuations.

Launching Your First Seed Export: A Step-by-Step Playbook

Operational roadmap for Indian seed firms entering global markets

1. Market Feasibility Assessment

Objective: Identify commercially viable export corridors
- ➢Agro-Ecological Zoning (AEZ) compatibility mapping
- ➢Demand–supply gap & hybrid adoption rate analysis
- ➢Import tariffs & SPS barrier screening
- ➢Competitive landscape benchmarking (EU, China, Israel, regional players)
- ➢Price elasticity & premium tolerance modelling
- **Output:** Shortlisted high-potential micro-markets

2. Regulatory & Phytosanitary Alignment

Objective: Ensure zero regulatory friction
- ➢Destination NPPO requirement mapping
- ➢ISPM compliance under International Plant Protection Convention
- ➢ISTA-accredited seed testing certification
- ➢Export clearance via Directorate of Plant Protection, Quarantine & Storage
- ➢Digital traceability documentation (lot-wise tracking)

Output: Regulatory-ready export consignment

3. Germplasm Validation & Quality Assurance

Objective: Guarantee genetic and physiological performance
- ➢Genetic identity verification (molecular profiling where required)
- ➢Germination & vigor testing (ISTA standards)
- ➢Simulated destination-climate stress testing
- ➢Genetic purity & physical purity validation
- ➢QA documentation for buyer audit compliance

4. Trade Partner Identification & Contract Structuring

Objective: Secure commercially viable agreements
- Importer accreditation & distribution network verification
- Participation in trade fairs & bilateral missions
- Incoterm optimization (FOB / CIF / DAP risk balance)
- Germination guarantee & liability clauses
- Clear claim settlement timelines

Output: Risk-balanced export contract

5. Logistics & Viability Risk Management

Objective: Preserve seed quality during transit
- Moisture-proof & temperature-stable packaging
- Refrigerated containers (high-value hybrids)
- Pre-shipment fumigation (if mandated)
- Customs documentation & GPS-enabled tracking
- Transit-time vs viability cost modelling

Output: Quality-preserved border delivery

6. Post-Sale Support & Feedback Integration

Objective: Build long-term export ecosystem
- Field performance monitoring via local agronomists
- Structured buyer feedback analytics
- Data integration into breeding pipeline
- Market repositioning & repeat contract strategy

Output: Continuous improvement export cycle

OPPORTUNITY MAP

1) USA & EU

- **High-value veg seeds; strict quality, traceability, IP compliance.**
- **Opportunity: specialty tropical lines, niche vegetables, and contract seed production (if compliance is strong).**
- **Evidence: USA + Netherlands are top importers of India's fruit/veg seeds.**

2) Bangladesh / South Asia

- **Proximity + similar agro-ecology.**
- **Strong demand for rice/veg seeds, fast adoption of improved varieties.**
- **Evidence: Bangladesh is among top destinations.**

3) UAE/Gulf

- **Protected cultivation; heavy import dependence; premium for reliable hybrid veg seeds.**
- **Evidence: UAE is a major destination.**

4) Southeast Asia

- **Warm climate crops; large vegetable markets; opportunity for competitive hybrids.**

5) Africa

- **Growth in vegetable consumption + hybrid penetration; opportunity for "value + resilience" seeds (heat/drought tolerance, virus tolerance).**

Conclusion

Roadmap for scaling Indian seed exports

- **Focus on high-growth regions:** Prioritise entry into Southeast Asian and African corridors where seed demand is expanding fastest and market entry barriers are moderate.
- **Phased export blueprint:** Implement a three-stage plan: pilot shipments of cereals, scale to pulses and oilseeds, and finally introduce premium horticultural lines.
- **Strengthen ecosystem collaboration:** Facilitate joint platforms linking farmers, research institutes, APEDA, and private exporters to streamline breeding, certification and logistics.
- **Continuous regulatory vigilance:** Establish a dedicated compliance cell to track amendments in seed laws, phytosanitary protocols and GMO approvals across target markets.
- **Invest in certification infrastructure:** Allocate resources to upgrade testing labs, attain ISO 9001/IPP accreditations and embed blockchain traceability for all seed batches.
- **Creation of cetral facilites for advanced techniques and tools**
- **Focus also on nutri rich crop/varieties (like Boifortified varieties.)**

Ms. Francine Sayoc - Executive Director, APSA

The role of national and regional associations in exploring global opportunities for the seed sector

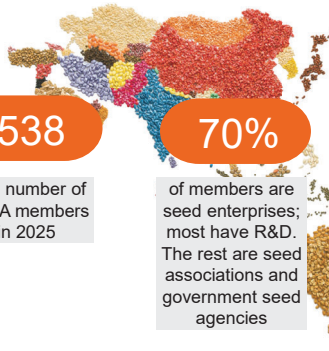
Francine Sayoc, Executive Director, APSA
28 February 2026 | Indian Seed Congress 2026 | Technical Session: Global Opportunities, Investments and Future Growth

APSA
Seed Comes First

APSA's mission

To support **sustainable agriculture** through the production and trade of **quality seeds** for the **world**

APSA



538
total number of APSA members in 2025

70%
of members are seed enterprises; most have R&D. The rest are seed associations and government seed agencies

52
countries represented: 25 are in APAC, 27 from outside the region

What drives growth in the seed industry?

- Access to markets
- Access to innovation
- Strong networks and trust

APSA

What hinders growth in the seed industry?

Access to markets
- Technical barriers to trade
- Fragmented regulation
- Market information gaps

Access to innovation
- Regulations limiting use of new breeding techniques
- Lack of opportunities for knowledge exchange and professional development

Strong networks and trust
- Isolation
- Low trust and credibility
- No collective action

APSA

How can seed associations support growth in the seed industry?

Access to markets
- Facilitating regulatory harmonization
- Market intelligence
- Business matchmaking

Access to innovation
- Advocating science-based regulatory frameworks
- Training, capacity building, knowledge exchange
- Facilitating public-private collaboration

Strong networks and trust
- Community of peers
- Unified industry voice
- Promoting ethical standards within the industry

APSA

REGULATORY AND POLICY ADVOCACY

APSA works on behalf of the seed sector to advance policies that encourage business, trade, and innovation:

- ✓ Phytosanitary matters, seed movement across borders
- ✓ Intellectual property, plant variety protection
- ✓ Access to new breeding techniques
- ✓ Access and use of genetic resources

Seed associations cultivate our industry's freedom to operate.

APSA

3 APSA flagship consultations held in 2025

Phytosanitary Expert Consultation
(Feb, Bangkok)

Plant Breeding Innovation Regional Consultation
(July, Kuala Lumpur)

PVP and Biodiversity Regional Consultation
(Aug, Tokyo)

Platforms for public-private and public-public dialogue towards policy coherence

APSA

Our technical committees

Seed associations bring knowledge and expertise together which shape the future of the industry

Standing Committees

- International Trade and Quarantine
- Plant Breeding Innovation
- IP and Biodiversity
- Seed Technology

Special Interest Groups

- Vegetables and Ornamentals
  - R&D Advisory Group
  - Working Group of Integrated Vegetable Companies
  - Disease Resistance Terminology Group
- Field Crops
- Seed Production

APSA

MEMBERS AND PARTNERS ENGAGEMENT

Asian Seed Congress

Knowledge Hub
Seed Academy e-learning
Webinars
Study Tours
Scientific roundtables

Research partnerships
APSA-WorldVeg Vegetable Breeding Consortium

Seed associations enable:

- **Business, Networking**
- **Learning and professional development**
- **Accelerated research, faster time-to-market**

APSA

Conclusion

- National and regional seed associations can drive industry growth through access to markets, innovation, and networks.
- Seed associations can make the most impact through:
  - advocacy and dialogue that shape enabling policies
  - knowledge exchange
  - community- and trust-building

APSA

APSA
Asia & Pacific Seed Alliance
Seed Comes First

web.apsaseed.org

Francine Sayoc
Executive Director, APSA
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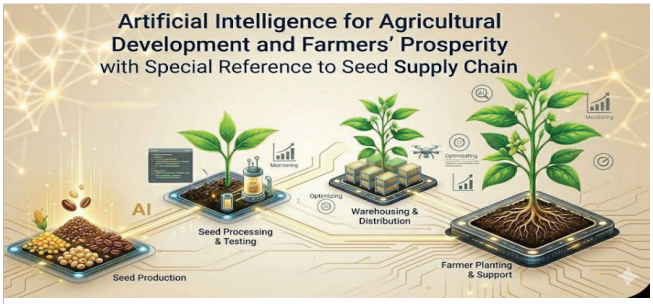
Connect with me on LinkedIn

Scan to subscribe APSA newsletter

APSA

Dr. Kavya Dashora - Associate Professor, Centre for Rural Development and Technology, Yardi School of Artificial Intelligence, IIT, Delhi



Dr Kavya Dashora
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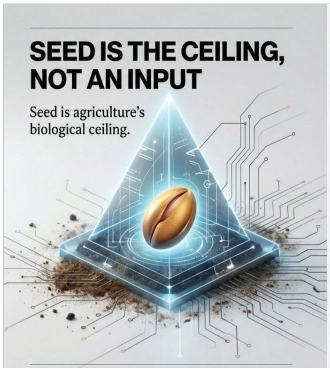


WHY BEGIN WITH SEED? THE BIOLOGICAL IMPERATIVE

- 20-30% yield variability is directly linked to seed quality and suitability.
- Current failures: Poor germination, genetic impurity, and climate mismatch silently reduce productivity.
- Climate volatility demands predictive deployment over reactive management.
- The Domino Effect: Farmers absorb risk at the sowing stage; failure here amplifies losses downstream.

THE BROKEN CHAIN: DATA SILOS AND STRUCTURAL GAPS

The Paradox: A supply chain that should be an intelligence network.

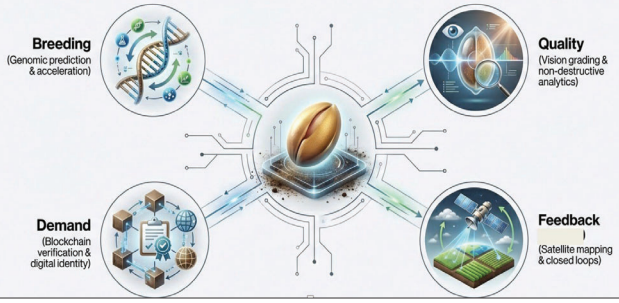
Pain Point — Forecasting
Demand forecasting remains reactive: Overproduction/shortages.

Pain Point — Certification
Quality certification is compliance-based, not predictive.

Pain Point — Traceability
Weak traceability erodes farmer trust: Adulteration, mislabeling.

Pain Point — Feedback
Field feedback rarely informs breeding cycles in real time.

THE INTERVENTION ECOSYSTEM: FOUR NODES OF AI TRANSFORMATION

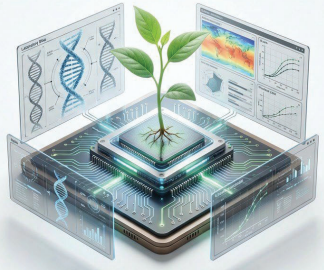


NODE 1: INTELLIGENT BREEDING ACCELERATION

Core Function: Genomic prediction models (predict G × E × C performance).

Technical Features:
- Image-based high-throughput phenotyping.
- Climate simulation layers (reduce cycle duration).

Impact: Reduced breeding cycle, faster delivery of climate-ready varieties.

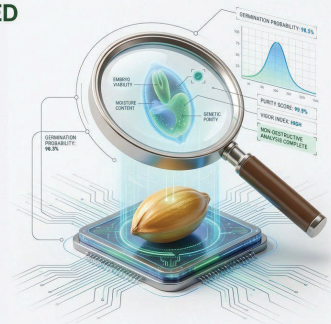


NODE 2: PREDICTIVE SEED QUALITY ANALYTICS

Core Function
Converting quality testing into performance forecasting.

Technical Features
- Computer Vision Grading: Analysis beyond just size and color.
- Hyperspectral Signatures: Non-destructive damage detection.
- Machine Learning: Models for lot-wise germination probability.

Outcome
AI converts quality testing into performance forecasting.



NODE 3: SMART DEMAND FORECASTING

Core Function:
Lot-level digital identity for seed packets (QR code).

Technical Features:
- Blockchain-based supply verification.
- AI anomaly detection in distribution networks.

Outcomes:
- Reduced unsold inventory.
- Reduced artificial scarcity.
- Stabilized farmer access.

NODE 4: Traceability and Trust Architecture

Making trust measurable and brand credibility strengthen.

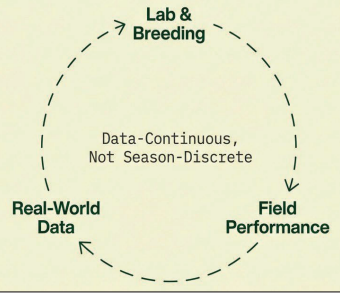
Digital Identity
Lot-level QR-enabled traceability for individual seed packets.

Blockchain Verification
Tamper-proof supply chain validation.

Anomaly Detection
AI identifies unusual stock movements or clustering patterns.

→ Result: Adulteration and mislabeling are identified through data patterns rather than manual inspection alone.

Node 5: Closing the Feedback Loop



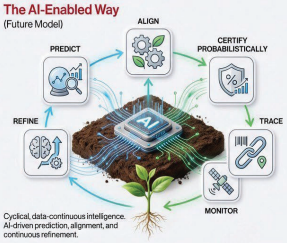
1. Satellite Mapping (Cluster yield variability)
2. Farmer Mobile Integration (Structured reporting)
3. Stress Pattern Clustering (Informing next cycle)

FROM SEED SELLER TO INTELLIGENCE PARTNER

The Old Way
(Traditional Model)

Linear, volume-driven process.
High biological uncertainty.
Reactive to market needs.

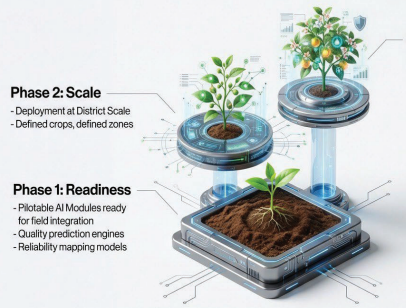
The AI-Enabled Way
(Future Model)



Cyclical, data-continuous intelligence.
AI-driven prediction, alignment, and continuous refinement.

Key Shift: The seed company of the future will not compete on volume alone. It will compete on predictive reliability.

EXECUTION STRATEGY: FROM CONCEPT TO DEPLOYABLE MODELS



STRATEGIC RISKS AND COLLABORATIVE INNOVATION

The Strategic Risk

- Static breeding in a dynamic climate.
- Inventory losses from inaccurate demand prediction.
- Rising farmer skepticism toward performance claims.
- Global competition adopting AI-led platforms.

The Innovation Opportunity

- Industry-Academia Innovation.
- Joint data-sharing sandboxes for predictive modelling.
- AI-driven pilot projects at district scale.
- Co-development of Predictive Seed Performance Index.

Transitioning from Reactive Supply Chains to Biological Intelligence Networks.

Current State	Future State
Discrete	**Networked**
Season-Discrete	**Data-Continuous**
Compliance-Based	**Predictive**

The 5 Intervention Nodes:
1. Intelligent Breeding | 2. Predictive Quality | 3. Smart Demand | 4. Traceability & Trust | 5. The Feedback Loop

From Seed Seller to Seed Intelligence Partner

The Traditional Model

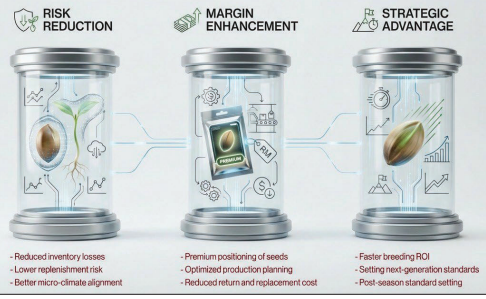
Produce → Certify → Distribute → Distribute → Sell

The Future Model

Predict → Align → Certify Probabilistically → Trace → Monitor → Refine

The seed company of the future will not compete on volume alone.
It will compete on predictive reliability.

THE ECONOMIC LOGIC FOR EARLY AI ADOPTION



Policy and Infrastructure Roadmap (India Context)

- **Phase 1: National Seed Data Grid**
  Integrate ICAR trials, private datasets, and agro-climatic data.
  - **Phase 2: AI-Enabled Certification 2.0**
    Implement probabilistic quality indexing rather than static germination values.
    - **Phase 3: District-Level Suitability Maps**
      Annual updates using dynamic climate projections.
      - **Phase 4: Farmer Recommendation Engines**
        Localized advisory based on soil and rainfall forecasts.

Governance and Ethical Considerations

Data Ownership
Clarity required between farmer and company.

Algorithmic Transparency
Visibility into recommendation logic.

Market Dynamics
Prevention of monopolization of predictive intelligence.

Inclusion
Ensuring access for small seed enterprises.

The Future Seed Ecosystem

The seed becomes a decision-support tool.

```
ATTRIBUTE LIST:
----------------------------------------------
1. Genetic Profile: [DATA]
2. Storage History: [LOGS]
3. Predicted Germination Probability: [98.5%]
4. Agro-Climatic Suitability Score: [HIGH]
5. Risk Index for Coming Season: [LOW]
```

The Strategic Risk of Inaction

Inventory Volatility

Excess production in low-demand zones and shortages in stress-prone regions due to inaccurate regional demand prediction.

The Trust Deficit

Rising farmer skepticism toward performance claims. Field performance variability is widening, threatening brand loyalty.

Breeding Obsolescence

Without predictive integration, varieties are becoming obsolete faster than current breeding cycles can replace them. Static breeding is failing in a dynamic climate.

Global Disruption

Multinational competitors are heavily investing in AI-led breeding platforms. The technology gap is widening rapidly.

The question is not whether AI will transform seed systems. The question is who will build that intelligence layer first.

We are moving from a competition of volume to a competition of predictive reliability.

Industry–Academia Innovation Platforms

01 The Data Sandbox

Creation of secure frameworks where anonymized lot data, climate data, and field performance data integrate for model development.

02 The Seed Intelligence Hub

Building India's first AI-enabled hub at the intersection of AI, predictive modelling, and agri-biological systems to translate data into decision tools.

03 The New Standard

Co-development of a Predictive Seed Performance Index—an industry-backed standard that evolves beyond the traditional germination percentage.

Phase 1: Pilotable AI Modules

Module A: Seed Quality Prediction Engines
Utilization of image analytics and spectral signatures to assess quality before planting.

Module B: Demand Forecasting Models
Integration of acreage data, weather patterns, and historical adoption data to predict market needs.

Module C: Suitability Mapping
Genotype–environment clustering models that map specific seed varieties to the most suitable districts.

Phase 2: District Scale Integration

1 **Zone Selection**
Deployment of models across 2–3 specific agro-climatic zones with defined crops.

2 **Season-Long Monitoring**
Tracking germination, vigor, and yield stability throughout the growing cycle.

3 **Feedback Loops**
Using field data to refine the predictive algorithms.

Economic Logic: Risk Reduction

Inventory Optimization: Reduced inventory losses through accurate demand prediction.

Reputational Protection: Lower reputational risk by minimizing performance variability.

Micro-Climate Alignment: Reduction in mismatch costs by ensuring variety alignment with specific micro-climates.

Economic Logic: Margin Enhancement

Premium Positioning: The ability to price performance-predictive seeds at a premium due to higher reliability.

Production Efficiency: Optimized production planning reduces waste and operational overhead.

Cost Recovery: Reduced costs associated with returns and replacements of underperforming seed lots.

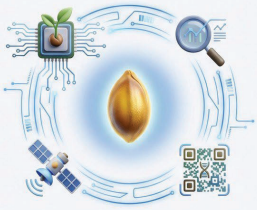
The Strategic Moat

First-Mover Advantage
Early adoption allows for standard-setting rather than standard-following.

Data Ownership
Accumulation of proprietary performance data strengthens the competitive moat over time.

Accelerated R&D
Faster breeding ROI achieved through feedback analytics from the field.

THE NEW STANDARD: BIOLOGICAL INTELLIGENCE



We are moving from a volume-driven model to an intelligence-driven model.

Future seed companies will sell risk reduction and value-added predictive assurance.

The Choice

Those who integrate AI early will shape standards. Those who delay will adapt to standards shaped by others.

The era of the Seed Intelligence Partner has arrived.

The Future of Farmers' Prosperity Begins at the Seed

Genetics
Data
Prediction
Seed
Farmer
Stability
Prosperity

From Seed Production to Seed Intelligence

Artificial Intelligence must become the intelligence layer of the seed system.

When biology meets prediction at the earliest stage, farmers sow with confidence — not uncertainty.

Dr. Kavya Dashora
AI-Enabled Agri-Biological Systems
Indian Institute of Technology Delhi

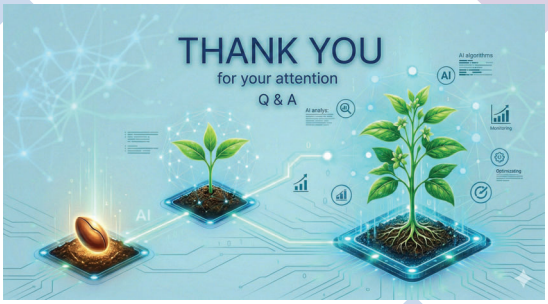
Email: kavya.dashora@iitd.ac.in

Open to pilot collaborations for AI-driven seed intelligence platforms.

THANK YOU

for your attention

Q & A

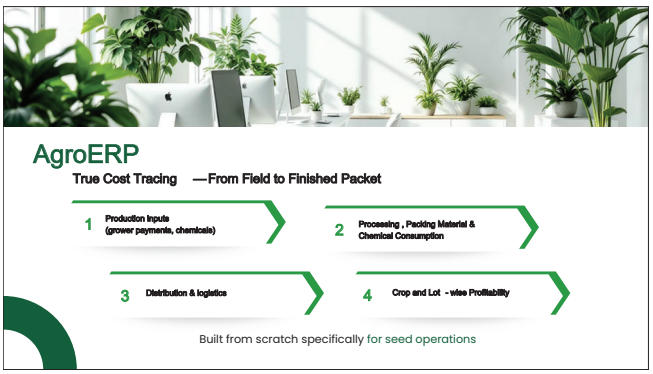


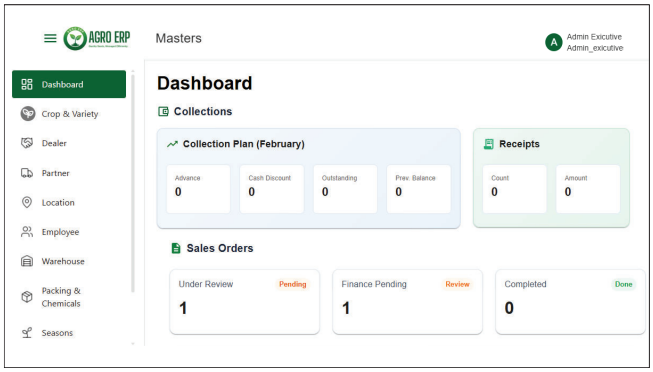
kdashora@rdat.iitd.ac.in

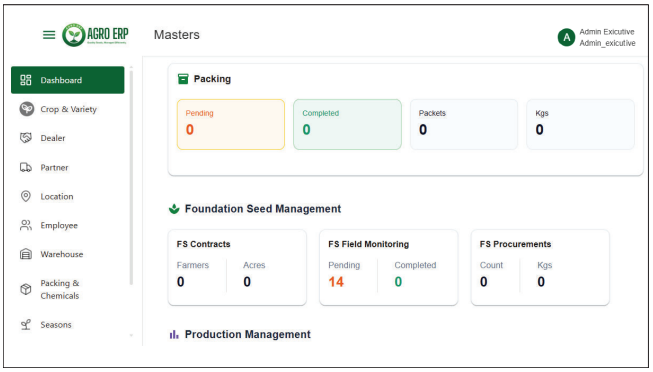
Industry Business Showcase

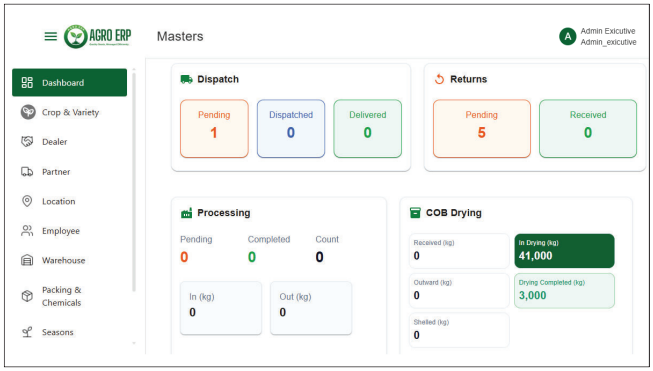
PRESENTATIONS

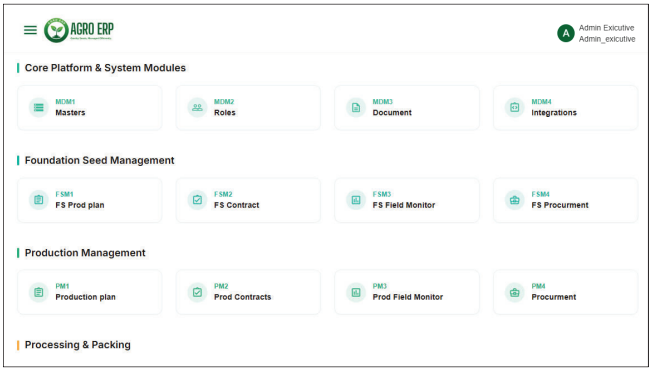
Presenter- Nalam Vignan (Agro ERP)





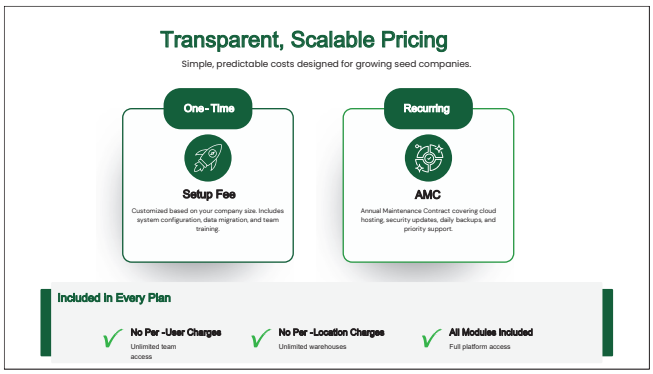



AGRO ERP
Masters
Admin Excutive
Admin_excutive
Dashboard
Crop & Variety
Dealer
Partner
Location
Employee
Warehouse
Packing & Chemicals
Seasons
Dispatch
Pending 1
Dispatched 0
Delivered 0
Returns
Pending 5
Received 0
Processing
Pending 0
Completed 0
Count 0
In (kg) 0
Out (kg) 0
COB Drying
Received (kg) 0
In Drying (kg) 41,000
Outward (kg) 0
Drying Completed (kg) 3,000
Shelled (kg) 0


AGRO ERP
Admin Excutive
Admin_excutive
Core Platform & System Modules
MDM1 Masters
MDM2 Roles
MDM3 Document
MDM4 Integrations
Foundation Seed Management
FSM1 FS Prod plan
FSM2 FS Contract
FSM3 FS Field Monitor
FSM4 FS Procurment
Production Management
PM1 Production plan
PM2 Prod Contracts
PM3 Prod Field Monitor
PM4 Procurment
Processing & Packing

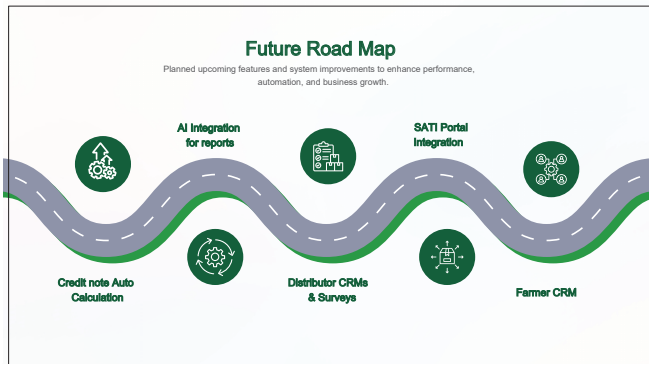

AGRO ERP
Admin Excutive
Admin_excutive
Processing & Packing
PPM1 Processing
PPM2 Packing
PPM3 Cob Drying
Inventory & Storage
ISM1 Inventory view
ISM2 Wh Manage
ISM3 Consumables
Sales & Distribution
SDM1 Sales Plans
SDM2 Orders
SDM3 Dispatch
SDM4 Returns
SDM5 Sales Contract


Go Live in Just 2 Weeks
Rapid implementation methodology designed to minimize business disruption.
Setup & Import
Configuration of organization hierarchy, warehouses, and bulk import of master data (crops, varieties, dealers).
Training & Customization
Tailored training and system setup to match your business processes for smooth adoption and maximum efficiency.
Full Launch
Start tracking every seed lot, every location, and every cost in real-time. System is fully operational.

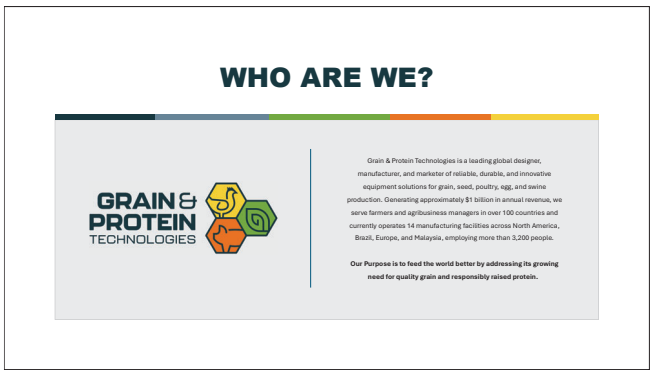

Transparent, Scalable Pricing
Simple, predictable costs designed for growing seed companies.
One-Time
Setup Fee
Customized based on your company size. Includes system configuration, data migration, and team training.
Recurring
AMC
Annual Maintenance Contract covering cloud hosting, security updates, daily backups, and priority support.
Included In Every Plan
No Per -User Charges
Unlimited team access
No Per -Location Charges
Unlimited warehouses
All Modules Included
Full platform access

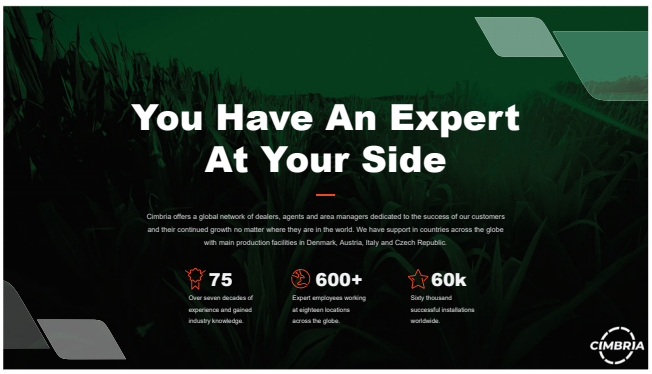

Special Pricing for ISC - 2026 Delegates
Simple, predictable costs designed for growing seed companies.
One-Time
Setup Fee
₹ 5,00,000/-
₹ 3,00,000/ -
Recurring
AMC
₹ 1,20,000/-
₹ 60,000/ -
Included In Every Plan
No Per -User Charges
Unlimited team access
No Per -Location Charges
Unlimited warehouses
All Modules Included
Full platform access

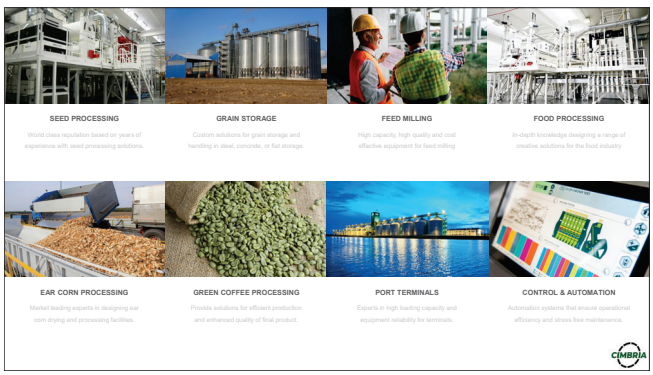

Real Results from
Real Seed Companies
75%
Faster Reporting
100%
Real-Time Visibility
0
Compliance Issues
Trusted By Industry Leaders
"AgroERP transformed how we manage our seed operations. What earlier took hours in Excel now happens instantly. Our team focuses on growth instead of paperwork. The cost tracking alone revealed savings we never knew existed."
— Ram Babu
Sri Rama Agri Genetics
What impressed us most about AgroERP was Our team adapted to it within days — The transition was smooth, the training was practical, and we went live much faster than expected. — it feels like a system built for us
— Dwaraka Srinivas
Godavari Plant Sciences

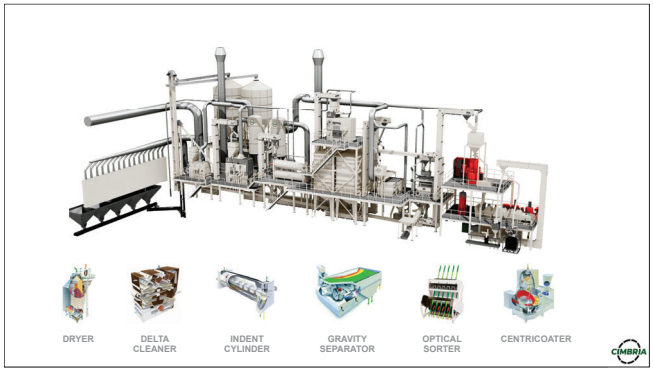

Future Road Map
Planned upcoming features and system improvements to enhance performance, automation, and business growth.
AI Integration for reports
SATI Portal Integration
Credit note Auto Calculation
Distributor CRMs & Surveys
Farmer CRM

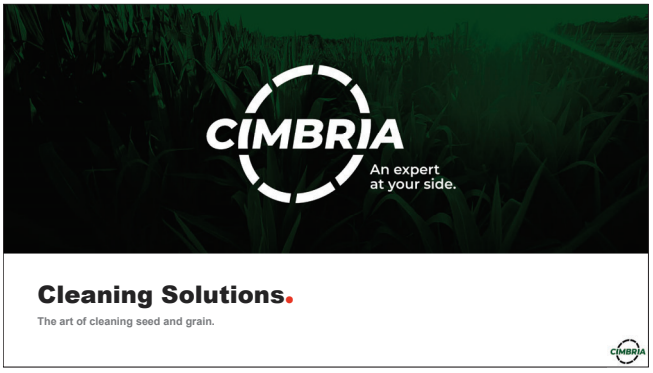
Presenter: Michael Petzmann, Regional Sales Manager – Cluster Lead Asia Pacific (APAC) **(CIMBRIA)**









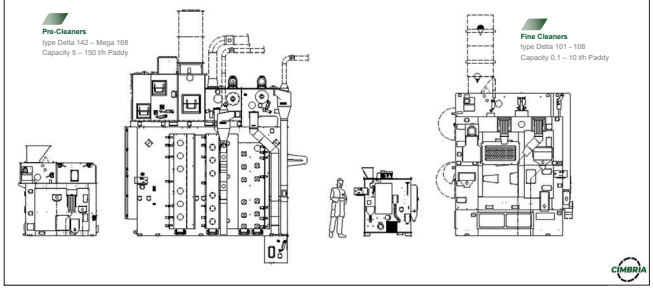


Cleaning Solutions

By size, shape and weight	By density	By length	By vision
• Delta Screen Cleaner • Drum Scalper • Additional Equipment	• Gravity Separator • Destoner	• Indented Cylinder	• Optical sorting

With the use of **CIMBRIA** Seed Processing Equipment, up to 5% more good seed can be recovered from the raw material.

Range of Capacities



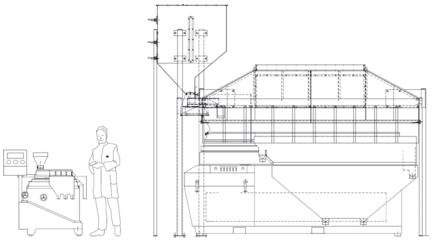
HMI screen

Our Delta series of screen cleaners are equipped with a new intuitive, efficient, and user-friendly HMI screen, in an advanced interactive 9-inch touch panel for controlling the cleaner.

Powered by an advanced next-gen Siemens PLC, our OPC UA-compatible Delta HMI pushes your production capabilities into a new digital era.

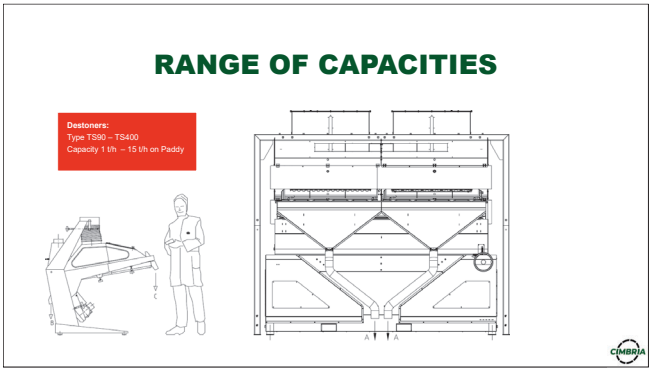
- Recipe control to easily switch between products
- Alarm notification
- PDF viewer for user manual
- Remote connectivity (optional)

RANGE OF CAPACITIES



Gravity Tables:
Type GA-Lab – GA310
Capacity 50 kg/h – 15 t/h Wheat


DESTONER

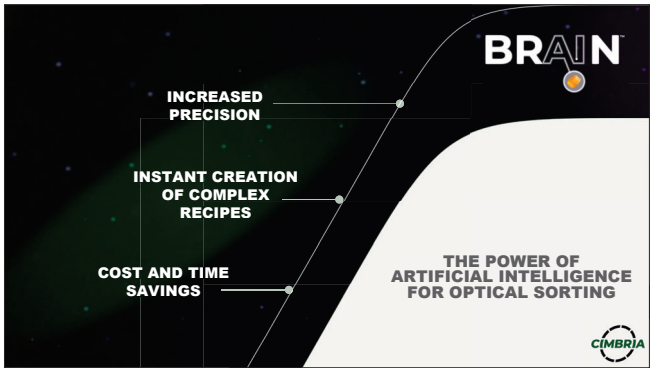

RANGE OF CAPACITIES
Destoners:
Type TS90 – TS400
Capacity 1 t/h – 15 t/h on Paddy

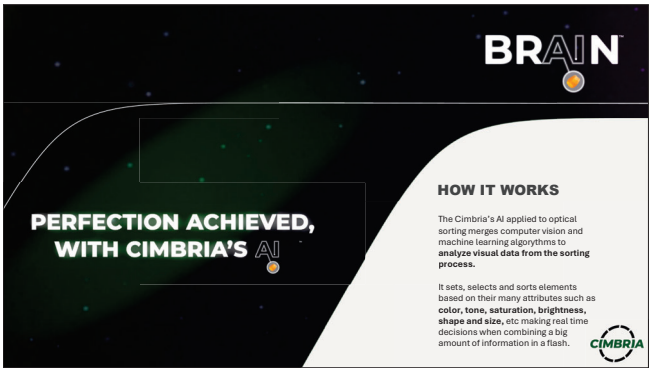

INDENTED CYLINDER - HSR
Separation based on LENGTH and THICKNESS

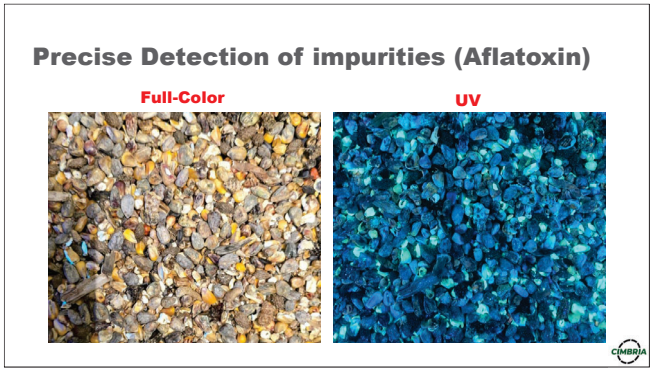

You & Performance

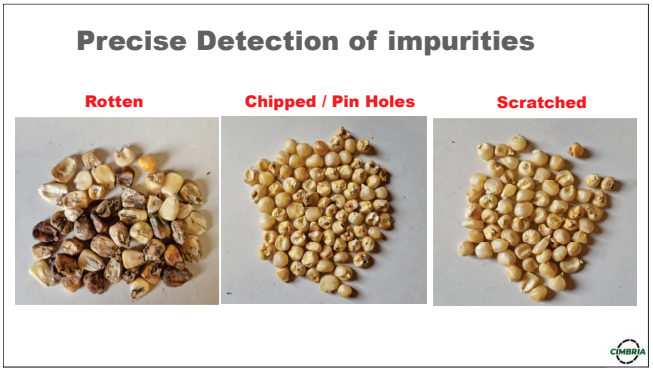

Extreme Sorting Performance
• The most sophisticated technology that combines real-color & multi-frequency SWIR in the same inspection system.
• The highest safety and purity, integrating defect size control and shape-sizing
• Flexible production capacity and configurations for multiple passes
Recognizing up to 16 families of defects.

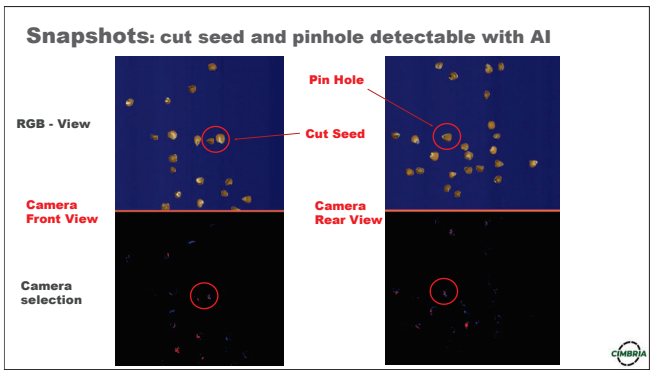

SEA.IQ PLUS (powered by AI)
The all-new optical sorter
SEA.IQ Plus is the latest optical sorting solution in the Cimbria products' portfolio.
Its all-new optical system integrates Full-Color RGB and NIR cameras, that can be combined with SWIR and UV technologies to remove any color defect and foreign body like shells, stones, wood and glass: great purity, optimized yield and food safety.
The Cimbria SEA sorting technology is the most advanced and reliable solution to meet the high-quality standards of any processing industry.

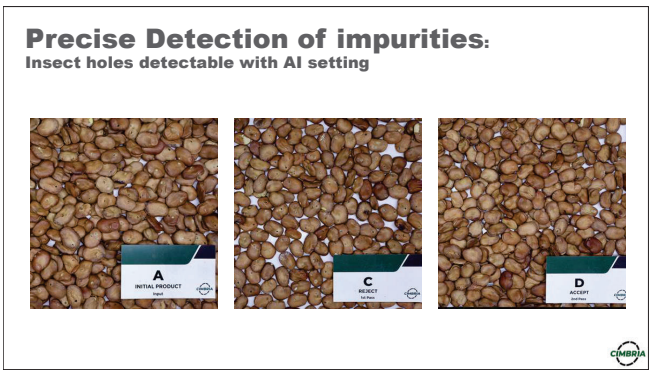

BRAIN
INCREASED PRECISION
INSTANT CREATION OF COMPLEX RECIPES
COST AND TIME SAVINGS
THE POWER OF ARTIFICIAL INTELLIGENCE FOR OPTICAL SORTING

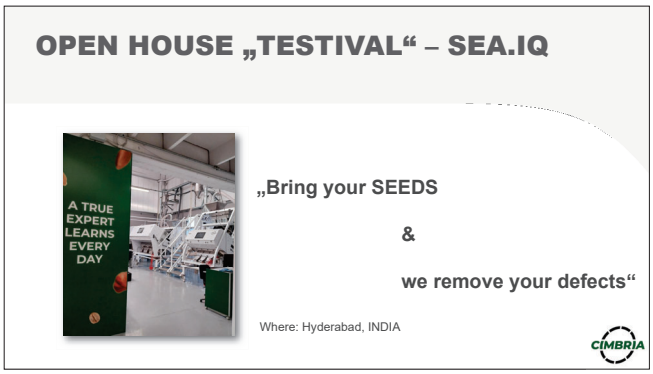

BRAIN
PERFECTION ACHIEVED, WITH CIMBRIA'S AI
HOW IT WORKS
The Cimbria's AI applied to optical sorting merges computer vision and machine learning algorythms to analyze visual data from the sorting process.
It sets, selects and sorts elements based on their many attributes such as color, tone, saturation, brightness, shape and size, etc making real time decisions when combining a big amount of information in a flash.



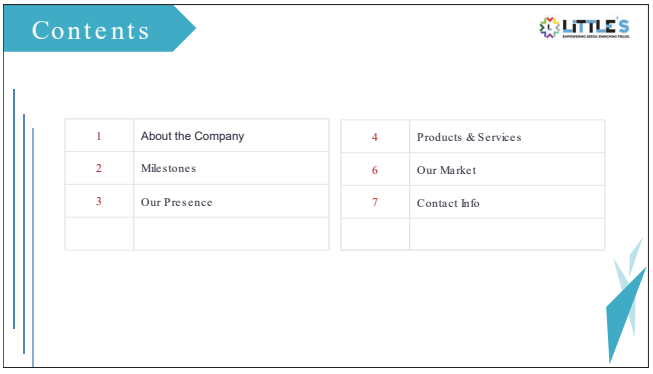








Presenter- Ezra E A, GM Works (Littles Agrivet Pvt Ltd)



About the Company

Littles Agrivet, with over 150 years of heritage and expertise, has been at the forefront of agricultural innovation. Originating from the prestigious Littles Oriental Balm & Pharmaceuticals Limited, our company has evolved into a leading force in the agricultural industry. At Littles Agrivet, we are proud to be at the forefront of seed-coating polymer technology. Our state-of-the-art solutions are designed to enhance seed quality and empower farmers around the globe.

Milestones

- **1885** – British Origin Company
- **1950** – Acquired by Jhaver group
- **2000** – Little's Polykote- Seed Coating polymer

Milestones

- **2002** – Venture into International Market
- **2019** – Field crops -Asia; #1 Market Leader
- **2021** – Introduction of Value-added Products; Polykote
- **2023** – Introduction of Speciality Polymers; Ecokote

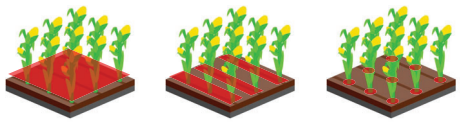
Importance of Seed coatings:

Seed coatings are becoming more important in modern agriculture. Technological advancements have made polymers more efficient and easier to use.

Benefits of Seed Coating:

- Most efficient for initial protection to seeds.
- Targeted application, Ultra low dosages, Reduce wastages, Save costs.

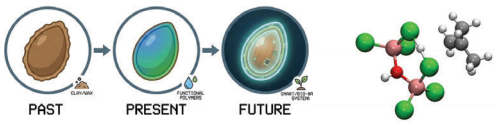
Maximum resource efficiency



Up to 90% reduction Chemical use (AI) on field....

Evolution of Polymers

History → Only Binding → Binding + Colour → Binding + Colour + Effect (Shine) → Binding + Colour + Effect + Value Added → Micronutrients, Bio Stimulants, Growth regulators, Biologicals, Nano Technology



Current trends in the global market

1. **Climatic changes –** majorly abiotic stress are prevalent like draught, high temperature and shifting rainfall conditions.
2. **Soil Health** - Nutrition loss, water quality, depleting resources, increasing costs.
3. **Sustainable farming** / coating practices.
4. **Precision agriculture** for optimiizing resource use efficiency. Growing demand for affordable crop protection solutions (**High Efficacy**)
5. **Microplastic free** - By 2028 EU plans to paves the path to microplatics free law for seed coating binders & 2031 for AI/ Chemicals.
6. **Biodegradble** and eco friendly polymers with value addition.

Way Forward:

Maximizing efficiency through Seed Coatings:

1. Moisture retention/ Dry Seed Applications.
2. Controlled Release Coatings.
3. Biological coatings.
4. Precision Coating Technologies.
5. Bio-Polymer/ Natural Based Coatings.
6. High-efficacy coatings (nano coatings).

Seed Coatings

Our Film Coating Range

Polykote	Polykote SPL	Polykote Plus	Polykote Active	Ecokote
Seed Coatings for Vibrant Color, Superior Binding, and Enhanced Shine	Advanced Coatings for Dust Control, Abrasion Resistance, Good Flowability and Enhanced Seed Performance	Seed Coatings Enriched with Nutrients and Bio-Stimulants	Seed Coatings with Advanced Biological Agents	Eco-Friendly, Microplastic-Free, and Biodegradable Seed Coatings

Seed Enhancements

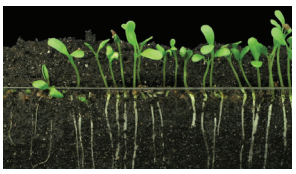
Our Seed Enhancement Range

Polykrust
Binders and fillers for your Seed Encrusting needs.

Polypel
Pelleting powders and binders / Technology transfer Solutions for Pelleting of Seeds.

Polyprep
Providing technical solution for all your priming needs.

Results



SWEET CORN
Control Vs Polykote Vs Polykote Plus

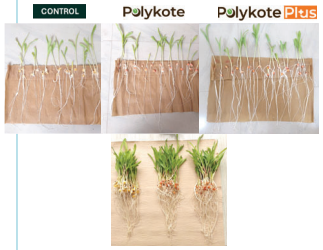
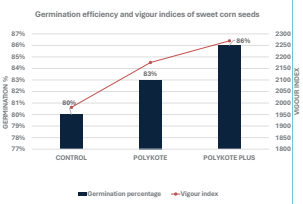


Figure 1: Germinated Sweet Corn seeds; Control, Polykote, and Polykote Plus (From left to right)



Seed vigour:
Control: 1981.25
Polykote: 2175.93
Polykote Plus: 2269.84

PADDY
Control Vs Polykote Vs Polykote Plus

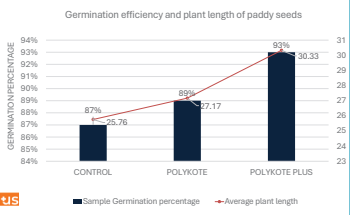


Figure 1: Trial 1: Germinated paddy seeds; Control, Polykote and Polykote Plus(From left to right)

APSA

TOMATO
Control Vs Polykote Vs Polykote Plus

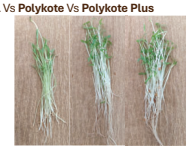
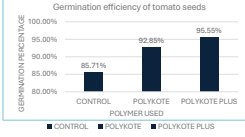


Figure 1: Germinated tomato seeds; Control, Polykote and Polykote Plus (From left to right)



WATERMELON
Polykote Vs Polykote Plus

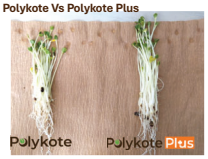
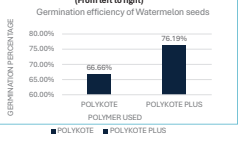


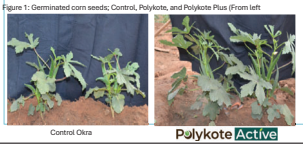
Figure 1: Germinated watermelon seeds; Polykote and Polykote Plus (From left to right)



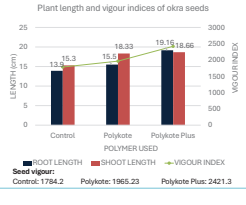
OKRA
Control Vs Polykote Vs Polykote Plus Vs Polykote Active

Figure 1:Germinated okra seeds; Control, Polykote Plus and Polykote (From left to right) Germinated corn seeds; Control, Polykote, and Polykote Plus (From left to right)

Figure 1: Germinated corn seeds; Control, Polykote, and Polykote Plus (From left



Yield of okra (5 plants): Control vs Polykote Active (From left to right)



Seed vigour:
Control: 1784.2 Polykote: 1965.23 Polykote Plus: 2421.3

YELLOW CORN
Control Vs Polykote Vs Polykote Plus Vs Polykote Active

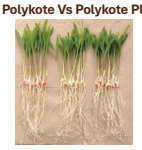
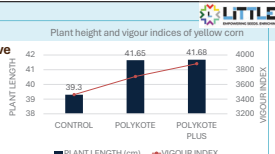
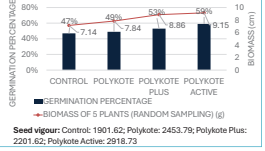


Figure 1: Trial 1- Germinated corn seeds; Control, Polykote, and Polykote Plus (From left to right)

Figure 1: Trial 2&3- Germinated corn seeds; Control, Polykote, Polykote Plus and Polykote Active (From left to right)





Seed vigour: Control: 1901.62; Polykote: 2453.79; Polykote Plus: 2201.62; Polykote Active: 2918.73

BITTER GOURD
Control Vs Polykote Plus Vs Polykote Active Vs Polykote Plus & Polykote Active

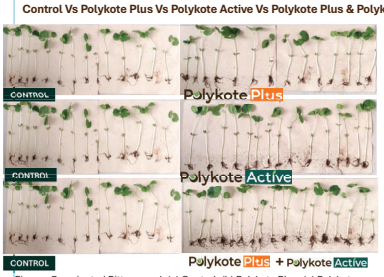
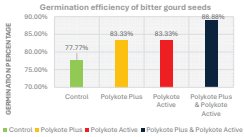
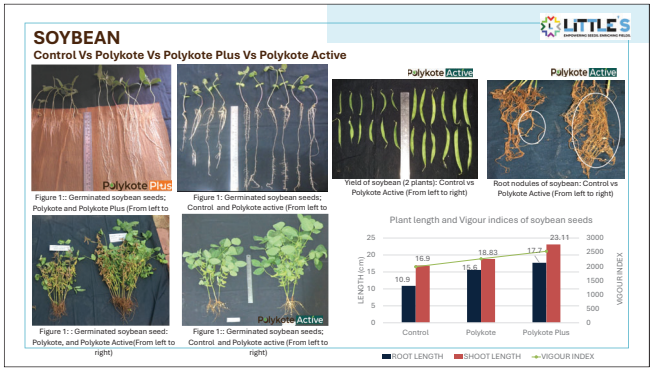
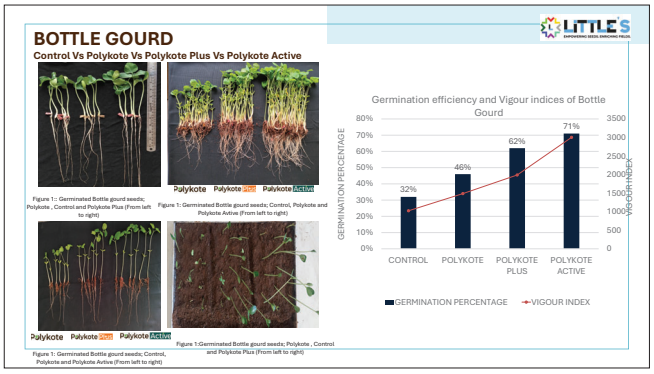


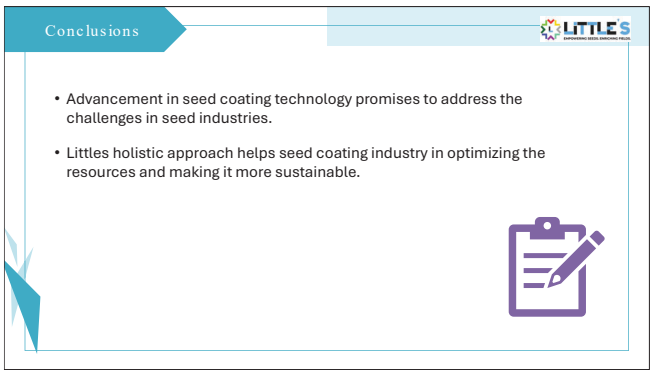
Figure : Germinated Bitter gourd; (a) Control, (b) Polykote Plus, (c) Polykote Active, (d) Polykote Plus & Polykote Active

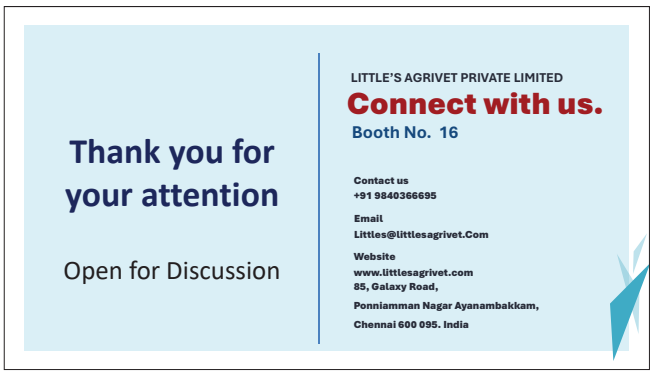
Figure : Germinated Bitter gourd seeds; Control, Polykote Plus, Polykote Active, Polykote Plus & Polykote Active (From left to right)



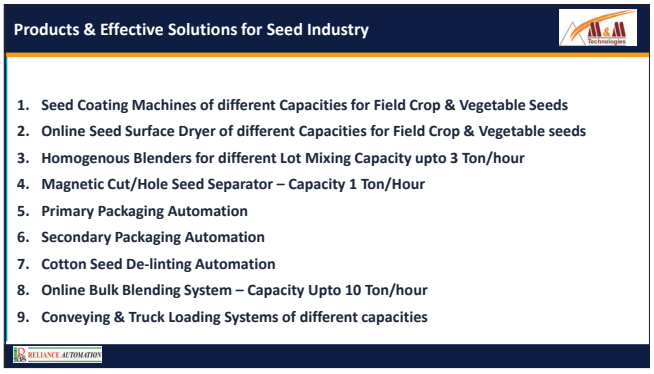


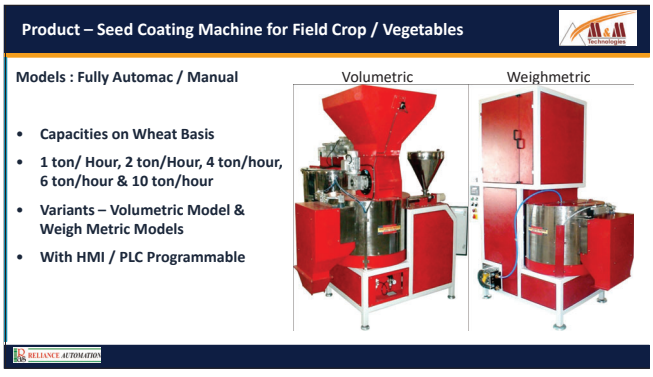






Presenter- Vanka Raghavaiah (Reliance Automation Solutions)





Product – Online Seed Coating & Seed Dryers - Field Crop & Vegetables

- Capacities on Wheat Basis
- 1 & 2 ton / Hour
- With HMI / PLC Programmable

Vegetables--->

Product – Online Secondary Packaging Automation Solutions

For Field Crop & Vegetables

1 Kg – 6 Kg & upto 10 Kgs

Magnetic Separators for Cotton

Magnetic Separator for Cut/Hole seed

- Seed Elevator for Feeding of Seed
- Powder Elevator for Iron Power Feeding
- Control Panel with HMI PLC Version

Magnetic Separator – Capacity upto 1 ton/Hour

Online Bulk Blending, Treatment & Drying Systems

- Homogenous Blending System – Capacity upto 3 Ton/Hour
- Online Chemical Treatment & Drying Unit

Online Bulk Blender

Online Cotton Delinting System – New Launch

- System Consisting of:
- De-lint Seed Loading Conveyor
- Batch Weighing Conveyor
- Reactor with Diluted Chemical Mixing Tank with LPG Gas
- Online Seed Dryer
- 2 Buffer Tanks
- Neutralising System

Peanut Dryer – New Launch

- Customised Solution
- 6 Ton/Hour
- Available in Single & Double Pass

Conveying & Truck Loading System

- Z & Bucket Elevators
- Seed Conveying Systems
- Cob Conveying Systems
- Truck Loading Systems
- Remnant Conveyors

Our Vision & Footprint

VISION

To be "The Best Globally" in providing quality & cost-effective solutions in the operating segments with our range of Products, Solutions & After Sales to the Seed Segment and its allied sectors.

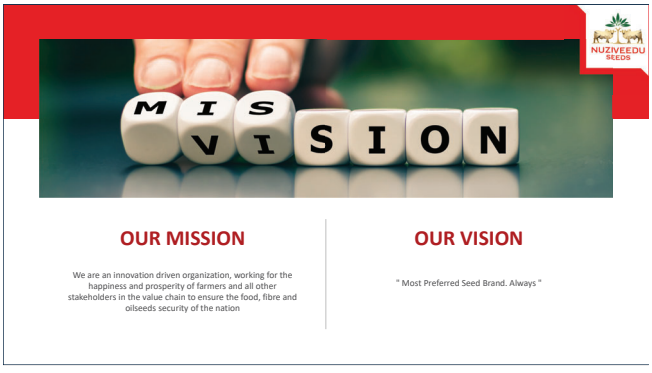
OUR FOOTPRINT

Captured 90% Market share in India

OUR Global Presence

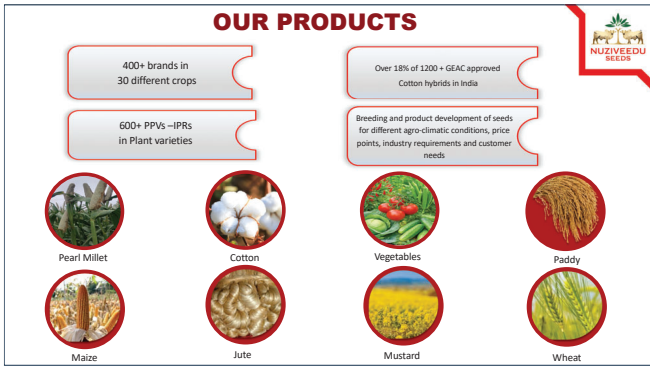
Expanded globally to 20+ Countries – providing cost-effective, highly automated, user-friendly machines to the Seed Segment

Presenter- Sudhir Singh Bhadauria, Head-Vegetable Seeds **(Nuziveedu Seeds Ltd)**

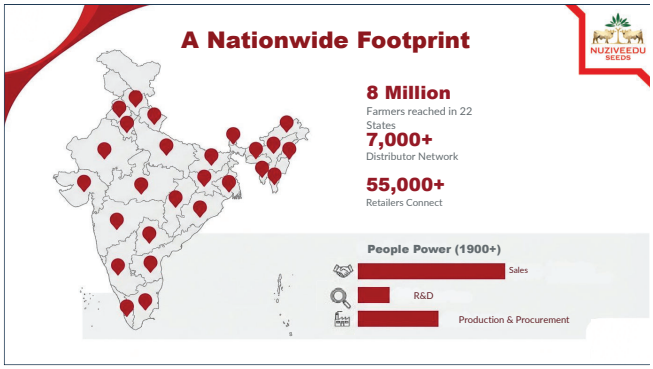


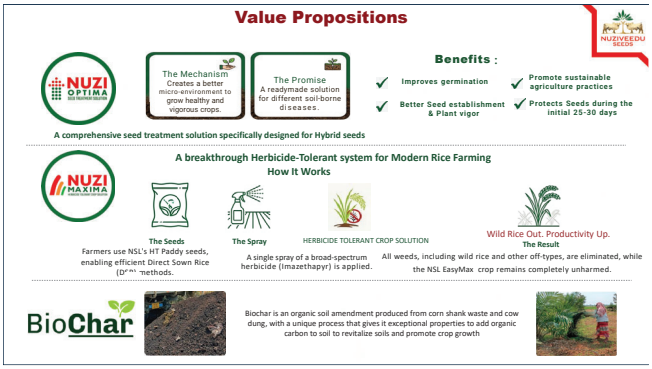

Specialized Excellence:
Seed Business Subsidiaries
NUZIVEEDU SEEDS
ASIAN AGRI GENETICS LIMITED
PRABHAT SEEDS
PRAVARDHAK
LAXMI SEEDS
ASHA AGRISCIENCES
FORTUNE HYBRID SEEDS LIMITED
Delivering targeted agricultural solutions through a network of specialized entities


Leadership Team
Our seasoned leaders combine scientific expertise and visionary foresight.
Dr. M. Prabhakar Rao, CMD
BHU Gold Medalist.
Visionary behind blockbuster hybrids 'Bunny' and 'Mallika'
Heads the 4,000-crore conglomerate
Mrs. Asha Priya, Director
University topper
20 years experience
Empowering rural women
Dr. Sateesh Kumar, Director
PhD in Agri-Genetics
38 years global research experience
Mr. M. Venkatram Chowdhary, Whole-time Director
Educated at UCSD & Amity
Finance and strategic operations expert
Mr. K. Venkat Rao, Whole-time Director
Veteran Leader with 40-years of experience
Pivotal in selling over one crore cotton seed packets in a single year


OUR PRODUCTS
400+ brands in 30 different crops
600+ PPVs –IPRs in Plant varieties
Over 18% of 1200 + GEAC approved Cotton hybrids in India
Breeding and product development of seeds for different agro-climatic conditions, price points, industry requirements and customer needs
Pearl Millet
Cotton
Vegetables
Paddy
Maize
Jute
Mustard
Wheat


Supply Chain & Production Excellence
Grower Network
Processing
Storage
Technology
95,000+ Growers across 100,000 Acres
Decentralized: 8 Plants for Field Crops, 4 for Cotton
43,000 MT Cold Storage Capacity
Integrated SAP/ERP Digital Tools


A Nationwide Footprint
8 Million
Farmers reached in 22 States
7,000+
Distributor Network
55,000+
Retailers Connect
People Power (1900+)
Sales
R&D
Production & Procurement


Value Propositions
NUZI OPTIMA
The Mechanism
Creates a better micro-environment to grow healthy and vigorous crops.
The Promise
A readymade solution for different soil-borne diseases.
Benefits :
Improves germination
Promote sustainable agriculture practices
Better Seed establishment & Plant vigor
Protects Seeds during the initial 25-30 days
A comprehensive seed treatment solution specifically designed for Hybrid seeds
NUZI MAXIMA
A breakthrough Herbicide-Tolerant system for Modern Rice Farming
How It Works
The Seeds
The Spray
HERBICIDE TOLERANT CROP SOLUTION
The Result
Wild Rice Out. Productivity Up.
Farmers use NSL's HT Paddy seeds, enabling efficient Direct Sown Rice (DSR) methods.
A single spray of a broad-spectrum herbicide (Imazethapyr) is applied.
All weeds, including wild rice and other off-types, are eliminated, while the NSL EasyMax crop remains completely unharmed.
BioChar
Biochar is an organic soil amendment produced from corn shank waste and cow dung, with a unique process that gives it exceptional properties to add organic carbon to soil to revitalize soils and promote crop growth


The Path Forward
Farmer Centric
Preferred Seed brand among farmers
Customer Approach
Shift from selling seeds to a solutions-based service model.
Operations
Reliable supplier at industry-leading costs and quality.
Responsibility
Socially and environmentally responsible corporate citizen.
Growth
Leverage multi-brand strategy for deeper market penetration.


Creating a Better Tomorrow
We consistently develop superior varieties and innovative solutions to enhance the farmer's income
NUZIVEEDU SEEDS
Most Preferred Seed Brand. Always.
www.nuziveeduseeds.com

Session-wise Key Observations

Day 1-Friday, February 27, 2026

Technical Session I

Research & Innovation- Driving Global Seed Competitiveness

Presentation on "Next-Generation Breeding Technologies for Global Markets"

Dr. Yunbi Xu, Senior Research Professor, Peking University, Institute of Advanced Agricultural Sciences, China

Highlights of the Presentation

- Rapid population growth and increasing food demand underscore the urgent need for advanced breeding technologies to accelerate the development of improved crop varieties and ensure global food security.
- Crop improvement is increasingly transitioning toward Breeding 4.0, which integrates genomics, biotechnology, speed breeding, artificial intelligence, and doubled haploid technology to accelerate genetic gain and facilitate the rapid development of completely homozygous lines, thereby significantly shortening breeding cycles.
- Advanced tools such as CRISPR/Cas9 genome editing and speed breeding under controlled environmental conditions enable precise modification of crop traits and substantially reduce generation time, thereby expediting the development of high-yielding and resilient crop varieties.
- The integration of genomics, phenomics, metagenomics, and enviromics with artificial intelligence and machine learning is fostering data-driven breeding through predictive modeling, trait analysis, and AI-based platforms such as BreedingGPT to support gene analysis, research insights, and informed breeding decisions.
- The future of crop breeding lies in the convergence of advanced breeding technologies, big data analytics, and AI-driven systems, which have the potential to transform crop improvement and enable the development of high-performing, climate-resilient varieties for global markets.

Presentation on "Public Private Partnership in Seed Innovation"

Dr. Sadawud Koonmanee, Executive Vice President, Charoen Pokphand Produce Co., Ltd., Thailand

Highlights of the Presentation

- Thailand has emerged as a prominent player in the global seed market, ranking among the leading seed-exporting nations, with field corn seed accounting for a significant share of exports valued at approximately USD 131 million.
- The country is strategically working toward establishing itself as a global hub for tropical seed production and trade by strengthening innovation, infrastructure, and international collaborations.
- Strong public–private partnerships involving government agencies, universities, and private seed companies have significantly driven innovation in Thailand's seed sector, particularly in germplasm development, hybrid evaluation programs, and enhanced seed production and quality systems.
- Multi-location trials conducted across 11 environments in Thailand assessed the performance of hybrid maize, with valuable germplasm contributions from Suwan Farm (Kasetsart University) and the Department of Agriculture (DOA) supporting hybrid development efforts.
- Thailand is reinforcing its seed ecosystem by enhancing seed production systems, processing facilities, quality assurance frameworks, and export and trade mechanisms to support the sustained growth of the seed industry.
- The country is actively promoting the adoption of modern breeding technologies, including conventional breeding, gene editing, genetic modification, and high-throughput screening techniques, to accelerate crop improvement and strengthen the competitiveness of its seed sector.
- In addition, Thailand is strengthening regulatory and quality assurance systems through the development of accreditation mechanisms for seed testing laboratories, field inspections, and seed health testing, while also initiating gene editing research and regulatory frameworks to advance next-generation breeding technologies.

Day 1-Friday, February 27, 2026

Technical Session II

Disruptive Technologies in Seed Innovations and Quality Management

Presentation on "Smart Seed Technologies for Seed Quality Enhancement"

Mr. Johan Van Asbrouck, Ex-Chair, APSA Standing Committee for Seed Technology, Executive President, Rung Rueng Consulting Co., Ltd. (Rhino Research), Bangkok, Thailand

Highlights of the presentation

- The seed industry is increasingly transitioning from conventional seed testing methods based on average sample performance to single-seed analysis, enabling more precise evaluation and improved seed sorting techniques.
- Advanced light-based analytical technologies, including chlorophyll fluorescence, oxygen measurement, multispectral imaging, and NIR spectroscopy, are being widely adopted for comprehensive seed quality assessment.
- Artificial Intelligence (AI) is enhancing seed analysis by processing large datasets, recognizing patterns, and enabling rapid and accurate evaluation of seed quality traits.
- Chlorophyll fluorescence technology plays a crucial role in assessing seed maturity, vigor, germination potential, longevity, and aging, while also supporting harvest timing and warehouse management decisions.
- Single-seed oxygen consumption analysis provides valuable insights into seed vigor, germination speed, energy production, imbibition time, and the uniformity of seed lots.
- Multispectral imaging technologies, such as RhinoVision, enable detailed evaluation of seed morphology, germination and vigor, technical and genetic purity, seed coating quality, as well as the detection of diseases and insect damage.
- Advanced seed analysis technologies facilitate the transformation of large volumes of raw data into actionable insights, improving seed quality management and breeding decisions.

- Three key technologies highlighted for enhancing seed quality evaluation include chlorophyll fluorescence sensors (CF), oxygen-based respirometry systems (O_2 analysis), and multispectral imaging platforms such as RhinoVision (RVS).

Presentation on "Strengthening Seed Testing Laboratories and Quality Assurance for meeting Global Standards : A Strategic Roadmap for 2026"

Dr. Damrongvudhi Onwimol, Associate Professor, Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

Highlights of the Presentation

- The global seed sector is operating in a complex environment marked by economic slowdown, geopolitical fragmentation, and rising non-tariff barriers, requiring stronger compliance and trust in seed quality systems.
- Seed testing laboratories play a critical role in ensuring physical purity, genetic purity, and standardized testing, which are essential for maintaining seed quality and enabling international seed trade.
- Germination testing remains the regulatory requirement for market access, while seed vigor testing is increasingly important for assessing seed performance under stress conditions and gaining a competitive advantage in premium export markets.
- Adoption of advanced technologies such as multispectral imaging, hyperspectral imaging, drones, robotics, and AI-based analysis is transforming seed testing, improving accuracy in detecting seed purity, internal damage, and varietal identity.
- Precision technologies such as vision-guided robotics for detasseling in maize and drone-assisted pollination in hybrid rice production are improving efficiency and genetic purity in seed production systems.
- Hyperspectral imaging and AI-based models enable rapid detection of hidden seed defects, internal damages, and varietal differences without traditional grow-out tests.
- Post-harvest seed quality management is being strengthened through the Dry Chain concept, using controlled drying and hermetic storage to extend seed longevity and maintain physiological quality.
- The seed industry is evolving towards data-driven systems, where seeds are marketed as integrated products combining seed quality with digital traceability and data insights.

Day 2- Saturday, 28th February, 2026

Technical Session III

Policy and Regulatory Frameworks for Seed Trade

Presentation on "Strengthening India's Seed Policy Architecture and Opportunities for Global Alignment"

Mr. Ajeet Kumar Sahu, Joint Secretary (Seeds), GoI

Highlights of the Presentation

- India is strengthening its seed policy framework to build a transparent, technology-driven, and globally aligned seed ecosystem that supports agricultural productivity and food security.
- The SATHI (Seed Authentication, Traceability and Holistic Inventory) Portal has been introduced to digitize breeder seed indent, improve coordination among stakeholders, and enhance transparency in seed production and distribution.
- The proposed New Seed Bill aims to modernize India's seed legislation by strengthening seed quality regulation, improving certification systems, and promoting innovation in the seed sector with a greater role for the private sector.
- The concept of Seed Aadhaar is being explored to create a unique digital identity for seed varieties and seed lots, enabling better traceability and preventing the circulation of spurious seeds.
- India is focusing on digital governance and traceability systems to improve seed quality monitoring and ensure that farmers receive authentic and high-quality seeds.
- Harmonization of India's seed regulatory framework with international seed quality and testing standards is being emphasized to support global trade and expand India's seed export potential.
- Collaboration among government agencies, research institutions, and private seed companies is recognized as an essential approach for strengthening innovation and competitiveness in the seed sector.

- Adoption of modern technologies such as biotechnology, digital tools, and advanced breeding techniques is being encouraged to accelerate crop improvement and enhance agricultural resilience.
- India aims to build a farmer-centric and globally competitive seed sector that promotes innovation, ensures quality assurance, and contributes to global food security.

Presentation on "Global Regulatory Trends Shaping Seed Innovation, IPR & Trade"

Mr. Rajvir Rathi, Vice Chairman, Federation of Seed Industry of India

Highlights of the Presentation

- India's seed industry, valued at around USD 4 billion, is among the fastest growing globally, with private sector participation reaching about 65% in high value and hybrid crops.
- The seed sector plays a critical role in addressing challenges like biotic and abiotic stresses through high-yielding hybrids, pest-resistant varieties, and bio-treated seeds, supported by increasing investments in research and development.
- The global seed market is expanding rapidly and is projected to grow significantly, driven by demand for food, feed, fiber, and fuel, as well as modernization of agriculture and rising seed replacement rates.
- Despite strong domestic growth, India's seed export currently accounts for less than 2% of global seed trade, indicating significant opportunities to expand exports.
- Emerging technologies such as genomics, biotechnology, genome editing, digital agriculture, precision farming, remote sensing, and advanced seed technologies are transforming crop improvement and seed production systems.
- The global seed business operates within a complex regulatory landscape involving multiple international frameworks and standards, which influence seed production, germplasm exchange, and international trade.

Presentation on "Building Sustainable Business Growth Ethically with Strong Adherence to IPR and Legal Compliance"

Dr. Kirtan Y. Patel, Director (Research), Moti Seeds Pvt Ltd.

Highlights of the Presentation

- Sustainable business growth in the seed sector is intrinsically linked to ethical practices, as companies that operate with transparency and responsibility build enduring trust with farmers, regulators, and global partners creating long-term competitive advantages over short-term gains.
- An ethically governed and well-regulated industry is more likely to receive government support, policy flexibility, and global recognition, which is crucial as India aspires to emerge as a global seed hub.
- As a leading industry body, the National Seed Association of India plays a pivotal role in setting benchmarks for ethical conduct, compliance, and governance, thereby influencing not only its members but also shaping the broader trajectory of the seed industry in India.
- The NSAI has developed the framework of a national level Ethics Committee which functions within a hybrid framework, integrating statutory provisions such as the Seeds Act, 1966 and the Protection of Plant Varieties and Farmers' Rights Act, 2001 with self-regulatory mechanisms established by National Seed Association of India to ensure ethical conduct, compliance, and industry credibility.
- The Committee has been entrusted with key obligations, including ensuring legal compliance, enforcing the Code of Ethics, promoting fair trade practices, safeguarding intellectual property rights, addressing disputes, and upholding transparency and trust across the seed sector.
- To promote awareness, the EC adopts a multi-pronged strategy, conducting training programs, workshops, and outreach initiatives through National Seed Association of India, while leveraging digital platforms, field demonstrations, and institutional collaborations to educate stakeholders on ethical practices and legal provisions such as the Seeds Act, 1966, Seeds (Control) Order, 1983, PPV&FRA, 2001.

- Dispute resolution is carried out through a structured and transparent mechanism, involving formal complaint submission, preliminary assessment, detailed investigation, hearings with concerned parties, and issuance of recommendations or disciplinary actions by the Ethics Committee under National Seed Association of India, ensuring fairness, accountability, adherence to legal frameworks and referring the matter to the government in case of proved serious offences.

Day 2- Saturday, 28th February, 2026

Technical Session IV

Global Opportunities, Investments & Future Growth of the Seed Sector

Presentation on "Global trends in Seed & Agri Biotech Innovations & Investments: What It Means for India"

Dr. G. Chaluvaraju, Asia Head- R&D-BASF NUNHEMS, India

Highlights of the Presentation

- The seed industry is rapidly transitioning into a strategic national infrastructure sector, playing a critical role in ensuring food security, climate resilience, and agricultural sustainability, much like energy or digital infrastructure in modern economies. The global seed market is projected to expand significantly—from around $70 billion to over $100 billion by the 2030s, driven by rising food demand, technological advancements, and the need for resilient crop varieties.
- Major row crops such as cereals and oilseeds continue to dominate the market, primarily due to their large cultivation area and the concentration of high R&D investments aimed at improving yield, stress tolerance, and productivity. At the same time, specialty crops such as vegetables and pulses are benefiting from rapid advancements in controlled environment, leading to enhanced productivity and improved production efficiency.
- Emerging technologies such as gene editing, artificial intelligence and predictive breeding, speed breeding and automation are redefining breeding efficiency, enabling faster development of superior varieties with precision and reduced time-to-market.
- Consequently, investment strategies are evolving, with greater emphasis on precision breeding, digital agriculture, and high-impact technologies that offer long-term competitive advantages.

- In this new landscape, competitive advantage is increasingly determined by access to capital, strength of intellectual property (IP), and alignment with supportive policy frameworks, rather than just operational efficiency.
- India possesses strong scientific expertise and research capabilities, but faces challenges in translating this potential into large-scale commercial success due to gaps in execution and investment.
- Private sector investment in R&D within India remains relatively low, limiting the pace of innovation and the ability to compete globally.
- Policy fragmentation and regulatory delays further hinder the commercialization of innovations, slowing down the transition from research to market deployment.
- These challenges collectively create a risk of India falling behind in the global agri-biotechnology race, especially as other countries accelerate their innovation ecosystems.
- Globally, leading seed companies invest approximately 9–14% of their revenue in research and development, reflecting a strong commitment to continuous innovation.

Presentation on "Structural Competitiveness and Strategic Trajectory of India's Seed Export Sector"

Dr. S. Rajendra Prasad, Ex-Vice Chancellor, University of Agricultural Sciences, Bengaluru

Highlights of the Presentation

- Global demand for seeds is steadily increasing, fueled by population growth, rising food security concerns, and the urgent need to develop crops that can withstand climate variability and resource constraints.
- Vegetable seeds constitute a particularly high-value and high-demand segment globally, owing to their intensive cultivation, higher returns, and increasing consumer preference for diverse and nutritious diets.
- India is the world's fifth-largest seed market and has one of the most thriving seed industries. Additionally, India's seed sector grew at a compound annual growth rate (CAGR) of 10.9%.

- Exports of seeds, particularly fruits and vegetables, have crossed ₹1,222 crore, indicating a strong and growing presence of India in international markets.
- Key export destinations include countries such as the United States, Netherlands, Bangladesh, United Arab Emirates, and Thailand, reflecting a diversified global footprint.
- The growth in global demand is further driven by shifts toward better nutrition, increasing adoption of biotechnology, and the widespread use of hybrid seeds that offer higher productivity and uniformity.
- India benefits from rich germplasm diversity and strong breeding expertise, enabling the development of a wide range of varieties suited to different agro-climatic conditions globally.
- Advancements in seed processing, packaging, and traceability systems are improving export quality and building global trust, which is essential for long-term market expansion.
- The regulatory ecosystem governing seed exports includes APEDA licensing, phytosanitary certifications, and approvals related to genetically modified organisms (GMOs), ensuring compliance with international standards.
- Recent policy initiatives, including BioE3 and efforts to streamline patent timelines, are strengthening India's export competitiveness, especially in biotechnology-driven seed segments.
- The proposed Draft Seed Bill 2025 aims to modernize the regulatory framework by simplifying seed registration, certification, and traceability, thereby facilitating smoother domestic and export operations.
- The strongest export opportunities for India lie in regions such as the Middle East, Africa, South Asia, and Southeast Asia, where demand for affordable and adaptable seed varieties is rapidly increasing.
- However, success in seed exports critically depends on efficient logistics, robust certification systems, and stringent quality assurance mechanisms, which are key to maintaining competitiveness.

Presentation on "The role of National/Regional Associations in Exploring Global Opportunities for the Seed Sector to Achieve Sustainable Growth"

Ms. Francine Sayoc, Executive Director, APSA

Highlights of the Presentation

- **Seed associations play a pivotal role in enabling global growth of the seed sector**, acting as key facilitators that connect industry stakeholders, promote best practices, and support the expansion of seed trade across international markets.
- APSA **actively promote sustainable agriculture by encouraging the production and distribution of high-quality seeds**, which are essential for improving productivity, ensuring food security, and addressing environmental challenges.
- The **membership base of most seed associations primarily comprises seed enterprises with strong research and development capabilities**, making them important drivers of innovation and technological advancement in the sector.
- Overall, the **growth of the seed industry is increasingly driven by innovation, international trade, and collaborative efforts**, all of which are strengthened through the active involvement of associations.
- However, the industry faces **significant barriers such as** technical barriers to trade **and fragmented regulatory frameworks across countries**, which complicate the smooth movement of seeds globally. The **lack of structured knowledge exchange and professional development opportunities also slows industry progress**, reducing the ability of stakeholders to adopt new practices and technologies effectively. Furthermore, **low levels of trust, industry isolation, and weak collective action can hinder coordinated growth**, making it difficult to address common challenges at scale.
- In this context, **seed associations act as a crucial bridge between industry, government, and markets**, facilitating dialogue, coordination, and alignment among stakeholders.
- Associations play a key role in **policy advocacy and regulatory**

harmonization, ensuring that industry concerns are effectively represented and that policies support innovation and trade. They also **promote public–private partnerships**, which are essential for accelerating innovation, scaling technologies, and addressing complex agricultural challenges.

- Associations also **support intellectual property protection and plant variety rights frameworks**, encouraging innovation by safeguarding breeders' interests. They **facilitate access to genetic resources and emerging technologies**, enabling members to remain competitive in a rapidly evolving global landscape.
- Ultimately, seed associations **play a vital role in building trust, fostering collaboration, and strengthening the overall ecosystem**, thereby driving sustainable and inclusive growth in the global seed industry.

Presentation on "Artificial Intelligence for Agricultural Development and Farmer's Prosperity with Special Reference to Seed Supply Chain"

Dr. Kavya Dashora, Associate Professor, Centre for Rural Development and Technology, Yardi School of Artificial Intelligence, IIT Delhi

Highlights of the Presentation

- **Artificial Intelligence (AI) is emerging as a transformative enabler of efficiency and precision in agriculture**, reshaping how decisions are made across the value chain, from research and breeding to production and distribution.
- The **seed industry stands to benefit immensely from data-driven decision-making**, as AI enables the analysis of vast and complex datasets to improve accuracy, reduce uncertainty, and optimize outcomes.
- One of the most significant applications of AI is in **predictive breeding**, where advanced algorithms can forecast desirable traits and accelerate the selection process, thereby shortening breeding cycles.
- The **integration of AI with genomics is further enhancing the precision of crop improvement**, enabling breeders to identify gene–trait associations more accurately and develop superior varieties with targeted characteristics.
- Beyond breeding, **AI plays a crucial role in precision agriculture**, supporting

optimized use of inputs such as water, fertilizers, and pesticides, which improves efficiency while reducing environmental impact.

- AI-driven tools also **enhance yield prediction and crop performance forecasting**, allowing farmers and companies to make proactive and informed decisions under varying climatic and market conditions.
- The adoption of **digital technologies is enabling real-time monitoring across the entire seed lifecycle**, from seed production and processing to distribution and on-field performance tracking.
- **Traceability systems play a critical role in guaranteeing seed quality, authenticity, and compliance**, helping to eliminate counterfeit or substandard seeds from the market.
- Technologies such as **blockchain and digital tracking systems are enhancing end-to-end supply chain visibility**, enabling stakeholders to track seed movement and performance across multiple stages and geographies.
- In India, the **adoption of AI in the seed and agriculture sector is still at a nascent stage but is growing rapidly**, driven by increasing digitalization and policy support.

Summary of Key Recommendations

Technical Session I- Research & Innovation- Driving Global Seed Competitiveness

Chair: Dr. A. K. Singh, Emeritus Professor, Division of Genetics, ICAR-IARI
Moderator: Dr. Sanjay Kumar, Advisor, Beej Anusandhan Kendra, IFFCO, Gandhinagar

Key Speakers:
Dr. Yunbi Xu, Senior Research Professor, Peking University, Institute of Advanced Agricultural Sciences, China

Dr. Sadawud Koonmanee, Executive Vice President, Charoen Pokphand Produce Co., Ltd., Thailand

- The integration of speed breeding with CRISPR-based genome editing enables precise and rapid development of climate-resilient, high-yielding, and nutritionally improved crops, significantly accelerating progress toward sustainable global food security.
- Strengthen data-driven and molecular breeding approaches through the integration of multi-omics (genomics, phenomics, enviromics, metagenomics) and molecular design strategies to enhance selection accuracy and develop superior varieties.
- Develop smart breeding and research infrastructure including controlled environments, high-throughput phenotyping platforms, advanced computational systems, and modern seed production and processing facilities.
- Accelerate the development of climate-resilient and high-quality crop varieties by prioritizing traits related to abiotic and biotic stress tolerance, productivity, and nutritional value.
- Strengthen seed quality, certification, and phytosanitary systems through accredited testing laboratories, robust inspection frameworks, and global standard compliance to support quality assurance and trade.
- Promote strong policy support and public–private partnerships to drive innovation, technology transfer, and the growth of biotechnology and smart agriculture.
- Enhance collaboration and knowledge transfer among research institutions, academia, and the seed industry for sharing technologies, germplasm exchange, and best global practices.

Technical Session II - Disruptive Technologies in Seed Innovations and Quality Management

Chair: Dr. P.K. Singh, Agriculture Commissioner, DAFW, MoA&FW, GoI
Moderator: Dr. S. Rajendra Prasad, Former Vice-Chancellor, University of Agricultural Sciences, Bengaluru

Key Speakers:
Mr. Johan Van Asbrouck, Ex-Chair, APSA Standing Committee for Seed Technology, Executive President, Rung Rueng Consulting Co., Ltd. (Rhino Research), Bangkok, Thailand

Dr. Damrongvudhi Onwimol, Associate Professor, Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

- **Adopt advanced and precise seed quality assessment approaches** by moving towards single-seed analysis and early detection of parameters such as vigor, dormancy, and seed health within quality control systems.
- **Leverage AI, automation, and digital analytics in seed testing** to transform data into actionable insights, improving accuracy, efficiency, and decision-making.
- **Invest in advanced analytical and imaging technologies** including chlorophyll sensors, oxygen respirometers, and multispectral/hyperspectral imaging for rapid and precise seed quality evaluation.
- **Utilize analytical tools for end-to-end seed management** to support critical decisions on harvest timing, storage management, and seed lot optimization.
- **Digitize and modernize seed testing laboratories** by integrating automation, AI, and digital data systems to enhance traceability and operational efficiency.
- **Align seed testing protocols with international standards** such as ISTA to ensure global acceptance and facilitate international trade.
- **Implement robust seed storage and handling systems** including the Dry Chain approach to maintain quality during storage, transport, and distribution.
- **Strengthen global collaboration and leadership in seed testing** particularly for tropical crops to ensure uniform standards and harmonized practices.
- **Enhance supply chain resilience and export readiness** by diversifying markets and addressing geopolitical risks and emerging trade barriers.

Technical Session III - Policy and Regulatory Frameworks for Seed Trade

Chair: Dr. Ravi Khetarpal, Executive Director, APAARI
Moderator: Mrs. K.K. Tara, Head IP & Regulatory Affairs, NSL, Hyderabad

Key Speakers:
Mr. Ajeet Kumar Sahu, Joint Secretary (Seeds), GoI

Mr. Rajvir Rathi, Vice Chairman, Federation of Seed Industry of India

Dr. Kirtan Y. Patel, Director (Research), Moti Seeds Pvt Ltd.

- **Strengthen digital governance and traceability systems** by expanding platforms like SATHI and leveraging digital tools to improve transparency, coordination, and accountability across the seed value chain.
- **Modernize and harmonize regulatory frameworks** by accelerating the release and implementation of New Seed Bill, aligning with global standards, and adopting science-based, data-driven policies to support innovation and trade.
- **Promote advanced breeding and innovation ecosystems** by encouraging biotechnology, genomics, genome editing, and supporting agri-startups and digital agriculture solutions.
- **Enhance seed quality assurance systems** by strengthening certification, testing, and monitoring frameworks to ensure availability of high-quality seeds to farmers.
- **Foster strong multi-stakeholder collaboration** among government, research institutions, private sector, and startups to accelerate innovation and strengthen the seed value chain.
- **Develop balanced and enabling policy frameworks** that protect farmer interests while promoting industry growth, innovation, and global competitiveness.
- **Institutionalize ethics, transparency, and accountability** across the sector through clear codes of conduct, responsible business practices, and trust-building measures.

- **Strengthen governance and the role of NSAI** by empowering it to lead in setting standards, ensuring compliance, and promoting industry-wide ethical practices.
- **Adopt a hybrid regulatory approach** integrating statutory provisions with strong self-regulatory mechanisms for effective compliance and governance.
- **Enhance the effectiveness of the Ethics Committee** to oversee compliance, enforce ethical standards, protect IPR, and ensure fair trade practices.
- **Build capacity and awareness across stakeholders** through training programs, workshops, digital outreach, and field-level engagement.
- **Establish robust dispute resolution and enforcement systems** with transparent procedures, clear accountability, and defined penalties for non-compliance.

Technical Session IV - Global Opportunities, Investments & Future Growth of the Seed Sector

Chair: Dr. M. Prabhakar Rao, President, NSAI & **Dr. Jai Singh**, GS, NSAI
Moderator: Mr. Chetan Joshi, Managing Director, BBSSL

Key Speakers:
Dr. G. Chaluvaraju, Asia Head- R&D-BASF NUNHEMS, India

Dr. S. Rajendra Prasad, Ex-Vice Chancellor, University of Agricultural Sciences, Bengaluru

Ms. Francine Sayoc, Executive Director, APSA

Dr. Kavya Dashora, Associate Professor, Centre for Rural Development and Technology, Yardi School of Artificial Intelligence, IIT Delhi

- Strengthen R&D and innovation ecosystem through supportive policies for increasing private investment (8–12% of revenue), developing shared infrastructure, adopting global best practices, and aligning capital, policy, and science.
- India should invest at least 2–3% of its GDP in Research & Development (R&D) to strengthen innovation capacity, enhance technological self-reliance, and accelerate advancements in critical sectors.
- Build global competitiveness in seed exports through focus on high-value

horticulture crops, phased export strategies, market diversification, and expansion into emerging regions.

- Enhance quality, certification, and compliance systems by leveraging OECD standards, ensuring phytosanitary compliance, strengthening IP protection, and establishing dedicated regulatory mechanisms.
- Develop robust supply chain, logistics, and traceability systems including temperature-controlled infrastructure, digital tracking (QR/blockchain), and end-to-end transparency.
- Leverage policy support and risk management tools by utilizing government incentives, export financing, regulatory harmonization, and financial instruments like hedging and insurance.
- Enhance market intelligence and industry coordination by developing data-driven systems, improving decision-making, and fostering trust, transparency, and a unified industry voice.
- Accelerate adoption of AI and digital technologies in breeding, genomics, phenotyping, and supply chain systems to improve precision and efficiency.

List of Delegates

S.No.	Delegate Name	Designation	Organisation	State	Country	Mobile	Email
1	Aakula Ganesh	Proprietor	A N Laxmi Seeds	AP/Telangana	India	9885274124	anlaxmiseeds41@gmail.com
2	Yanamadab Ravi Chandra	Director	Aadhyaa Seeds Pvt. Ltd.	AP/Telangana	India	9642395999	aadhyaaseeds@gmail.com
3	Mandalapu Sandeep Kumar	Director	Aadhyaa Seeds Pvt. Ltd.	AP/Telangana	India	9000222233	aadhyaaseeds@gmail.com
4	MNR Baig	Director	Aasma Seeds India pvt Ltd	Karnataka	India	9513366900	mnrbaig@aasmaseeds.in
5	Steven Roelandts	General Manager SEA	Acviss Technologies Pvt Ltd	Karnataka	India	0+66961287469	steven.r@acviss.com
6	Ishwar S Jadav	MD	Agricell Crop Life Pvt Ltd	Gujarat	India	9712995945	agricellcroplife@gmail.com
7	Amit Ramlal	Director	Agrius India Private Limited	Madhya Pradesh	India	9825070016	amit.mishra@agriusindia.com
8	Max Eftimov		AgroTech Robotics	Balkans	Bulgaria	885788989	maxeftimov@gmail.com
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Annexures

Indian Seed Congress 2026

CEO Conclave

Thursday, 26th February, 2026

Programme Schedule of the CEO Conclave

Time (PM)	Speakers	Topic
2:00 - 3.00		Registration
3:00 - 3.05		Lamp Lighting
3:05 - 3:10	Mr. Satish Kagliwal	Welcome of the Guests
3:10 - 3.20	Dr. M. Prabhakar Rao	Opening Remarks
3:20 - 3.35	RMG Mileage	Leadership Alignment
3:35 - 5:15	RMG Mileage	Leadership Bytes
5:15 – 5:30	**Break**	
5:30 - 6:00	Mr. Ram Kaundinya Partner, AgVaya	Building a World Class Seed and Biotech Industry in India
6:00 - 7:30	RMG Mileage	The Winning Bid IPL Style Auction Game
7:30 - 7:45	RMG Mileage	Integrated Leadership Synthesis
7:45		Vote of Thanks
8:00	**Dinner**	

Indian Seed Congress 2026

Seed Innovations - Reaching Global

Programme Schedule of the Technical Sessions

Day 1-Friday, 27th February, 2026

Time	Event
8:30 AM-9:30 AM	**Registration**
9:30 AM-10:15 AM	**Opening Session and Inauguration of Trading Table/Exhibition Hall**
10:15 AM-10:45 AM	**Tea Break**

Technical Session I: Research & Innovation- Driving Global Seed Competitiveness
Time: 10:45 AM – 1:00 PM
Chair: Dr. A. K. Singh, Emeritus Professor, Division of Genetics, ICAR-IARI
Moderator: Dr. Sanjay Kumar, Advisor, Beej Anusandhan Kendra, IFFCO, Gandhinagar

10:45 AM – 10:55 AM		**Opening Remarks by Moderator**	
SN	**Duration**	**Topic**	**Speaker**
1.	**10:55 AM – 11:25 AM**	Next-Generation Breeding Technologies for Global Markets	**Dr. Yunbi Xu** Senior Research Professor, Peking University Institute of Advanced Agricultural Sciences, China
2.	**11:25 AM – 11:55 AM**	Preparing for Future: Advancements in Product Evaluation	**Dr. Taweesak Pulam** Managing Director, Thai Seed Research Company Limited
3.	**11:55 AM – 12:25 PM**	Public Private Partnership in Seed Innovation	**Dr. Sadawud Koonmanee** Executive Vice President, Charoen Pokphand Produce Co., Ltd., Thailand
4.	**12:25 PM – 12:40 PM**	Interaction of Moderator with Panelists on Key Industry Issues	
12:40 PM – 1:00 PM		Q&A and closing remarks of the Chair	
Lunch: 1:00 PM – 2:30 PM			

Technical Session II: Disruptive Technologies in Seed Innovations and Quality Management **Time: 2:30 PM – 4:30 PM** **Chair:** Dr. P. K. Singh, Agriculture Commissioner, DAFW, MoAFW, GoI **Moderator:** Dr. S. Rajendra Prasad, Ex Vice Chancellor, UASB			
2:30 PM – 2:40 PM		**Opening Remarks by Chair/Co-chair**	
SN	**Duration**	**Topic**	**Speaker**
1.	**2:40 PM – 3:10 PM**	Smart Seed Technologies for Seed Quality Enhancement	**Mr. Johan Van Asbrouck** (Ex-Chair, APSA Standing Committee for Seed Technology), Executive President, Rung Rueng Consulting Co., Ltd. (Rhino Research), Bangkok, Thailand
2.	**3:10 PM – 3:40 PM**	Strengthening Seed Testing Laboratories and Quality Assurance for meeting Global Standards : A Strategic Roadmap for 2026	**Dr. Damrongvudhi Onwimol** Associate Professor, Department of Agronomy, Faculty of Agriculture Kasetsart University, Bangkok, Thailand
3.	**3:40 PM – 4:10 PM**	Interaction of Moderator with Panelists on Key Industry Issues	
4:10 PM – 4:30 PM		**Q&A and Closing Remarks by Chair**	
Tea Break: 4:30 PM – 05:00 PM			
4:30 PM – 5:30 PM		Close group meeting with Taiwan Seed Trade Association/ Industry Representatives (On Registration Basis)	
5:30 PM – 7:00 PM		Trading/Business Activities	
7:00 PM Onwards		Cultural Program & Welcome Dinner	

Day 2- Saturday, 28th February, 2026

9:30 AM – 11:00 AM	Industry Business Showcase
Tea Break- 11:00 AM-11:30 AM	

Technical Session III: Policy and Regulatory Frameworks for Seed Trade
11:30 AM – 1:15 PM
Chair: Dr. Ravi Khetarpal, Executive Director, APAARI
Moderator: Mrs. K. K. Tara, Head IP & Regulatory Affairs, NSL Hyderabad

11:30 AM – 11:40 AM		**Opening Remarks by Moderator**	
SN	**Duration**	**Topic**	**Speaker**
1.	**11:40 AM – 12:00 Noon**	Strengthening India's Seed Policy Architecture and Opportunities for Global Alignment	**Mr. Ajeet Kumar Sahu** Joint Secretary (Seeds), GoI
2.	**12:00 Noon – 12:20 PM**	Global Regulatory Trends Shaping Seed Innovation, IPR & Trade	**Mr. Rajvir Rathi** Vice Chairman, Federation of Seed Industry of India
3.	**12:20 PM – 12:40 PM**	Building Sustainable Business Growth Ethically, with Strong Adherence to IPR and Legal Compliance	**Dr. Kirtan Y. Patel** Director (Research), Moti Seeds Pvt Ltd.
4.	**12:40 PM – 12:55 PM**	Interaction of Moderator with Panelists on Key Industry Issues	
12:55 AM – 1:15 PM		**Q&A and Closing Remarks by Chair**	
Lunch: 1:15 PM – 2:30 PM			

Technical Session IV: Global Opportunities, Investments & Future Growth of the Seed Sector
Time: 2:30 PM – 4:15 PM
Chair: Dr. M. Prabhakar Rao, President, NSAI & Dr. Jai Singh, GS, NSAI
Moderator: Mr. Chetan Joshi, Managing Director, BBSSL

2:30 PM – 2:40 PM		**Opening Remarks by Moderator**	
SN	**Duration**	**Topic**	**Speaker**
1.	**2:40 PM – 2:55 PM**	Global trends in Seed & Agri Biotech Innovations & Investments: What It Means for India	**Dr. G. Chaluvaraju** Asia Head- R&D-BASF NUNHEMS, India
2.	**2:55 PM – 3:10 PM**	Structural Competitiveness and Strategic Trajectory of India's Seed Export Sector	**Dr. S. Rajendra Prasad** Ex-Vice Chancellor, University of Agricultural Sciences, Bengaluru

3.	**3:10 PM – 3:25 PM**	The role of National/Regional Associations in Exploring Global Opportunities for the Seed Sector to Achieve Sustainable Growth	**Ms. Francine Sayoc** Executive Director, APSA
4.	**3:25 PM – 3:40 PM**	Artificial Intelligence for Agricultural Development and Farmers' Prosperity with Special Reference to Seed Supply Chain	**Dr. Kavya Dashora** Associate Professor, Centre for Rural Development and Technology, Yardi School of Artificial Intelligence, IIT, Delhi
3:40 PM – 3:55 PM		Interaction of Moderator with Panelists on Key Industry Issues	
3:55 PM – 4:15 PM		**Q&A and Closing Remarks by Chair**	
Tea Break: 4:15 PM – 4:45 PM			
4:15 PM – 5:15 PM		Close group meeting with Bangladesh Seed Association (BSA)/ Industry Representatives (On Registration Basis)	
5:15 PM – 6:15 PM		**Valedictory Session and Awards Ceremony**	
7:00 PM Onwards		**Cultural Program & Gala Dinner**	

Notes

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