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# AGRICULTURE TODAY

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**ISTA**  
**100 YEARS**

A CENTURY OF PROGRESS IN SEED QUALITY ASSURANCE





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## TRIBUTE TO 100 YEARS OF ISTA

2024 marks the 100th anniversary of International Seed Testing Association (ISTA). Envisioned to ensure uniformity in seed quality evaluation worldwide, ISTA has stood the test of time, and today has more than 130 accredited member laboratories in its fold. A non-profit collaboration of over 400 competent and energetic seed scientists and analysts worldwide, ISTA works in developing standard seed testing methods, facilitates the trade of quality seeds and makes a valuable contribution to food security.

Seeds are integral part to food security. With the looming threat of climate change, burgeoning human population and the challenges that comes along with it, agriculture sector needs to be reassessed for its sustainability and productivity. Seeds offer a starting point to these discussions. Fortunately, there are research efforts afoot worldwide, to develop high yielding varieties with attributes specifically directed towards addressing a challenge. Nonetheless, if we are unable to ensure quality and uniformity in these seeds, these efforts would be in vain. Especially with flourishing seed trades between countries, it becomes a necessity to develop uniform standards. ISTA has been playing a pivotal role in developing standard procedures for seed sampling and testing, and in promoting uniform application of these procedures for evaluating seeds moving in international trade.

Agriculture Today group which very recently celebrated its 25th anniversary, understands the trials and tribulations of being steadfast and dedicated to a cause. Collaborating with ISTA in its centenary celebration in bringing out a Seeds Special Issue was a reaffirmation of our vision, that stories of resilience and steadfast leadership should be shared.

I am delighted that this issue has been able to unite different stakeholders in seed sector, and has transformed into a platform to discuss, highlight and share views. We are happy that ISTA chose to partner with us for this special edition and we wish them all the success in their future endeavours. Here is to next hundred and many more!





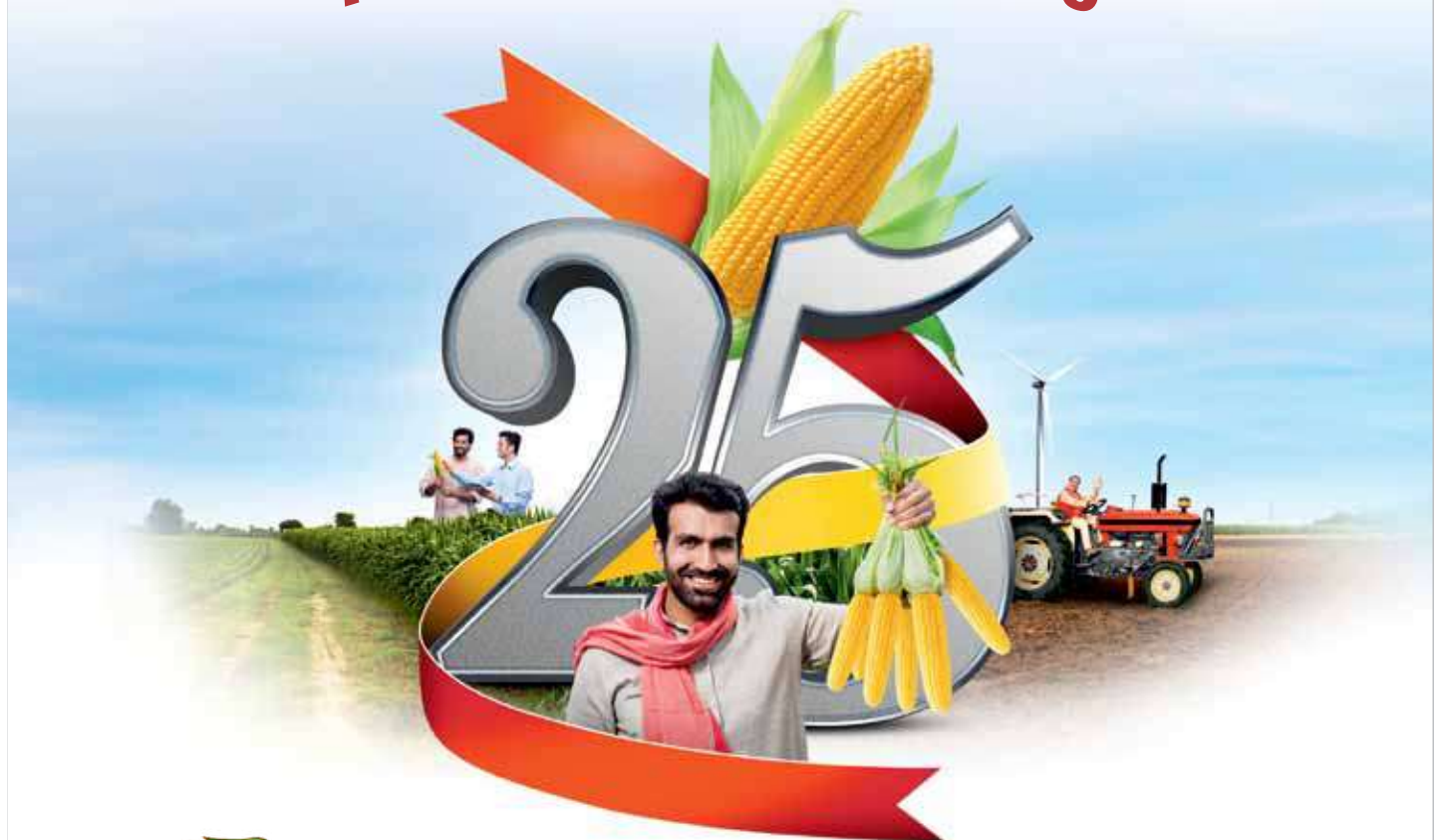


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## Green and Prosperous fields A tradition of 25 years



DEKALB is proud to celebrate 25 years of service to the corn farmers. A farmer's key requirement is a Trusted brand or product that stands for Innovation, Performance and Customer connection. DEKALB with its presence across the world brings Global-Germplasm expertise to serve the smallholder farmer. These hybrids have been extensively tested by DEKALB scientists along with farmers in their fields, local management and climatic conditions.

Health for All, Hunger for None



# A CENTURY OF PROGRESS IN SEED QUALITY ASSURANCE

**F**ounded in 1924 in Cambridge, England, the International Seed Testing Association (ISTA) is inextricably linked with the history of seed testing. With Member Laboratories and Sampling Entities, Personal Members and Associate Members, from over 80 countries worldwide, ISTA remains as an authority in developing global standards.

## Develop, Adopt and Publish

The ISTA's main purpose is to develop, adopt and publish standard procedures for seed sampling and testing, and to promote uniform application of these procedures for evaluating seeds moving in international trade.

The secondary purposes of the Association are to actively promote research in all areas of seed science and technology, including sampling, testing, storing, processing and distributing seeds, to encourage variety (cultivar) certification, to participate in conferences and training courses aimed at furthering these objectives, and to establish and maintain liaison with other organisations having common or related interests in seed.

The ISTA Rules are referenced in a number of seed laws worldwide as the standard for seed testing and are part of the standard contract of the member of the International Seed Federation (ISF) for arbitration.

## Major Achievements

As an authority in seed science and technology, ISTA continues its role as the developer of seed testing methods. Its major achievements to date are briefly the following:

- The **ISTA International Rules for Seed Testing**, provides annually updated and worldwide uniform seed testing



methods.

- The **ISTA Accreditation Programme** includes the Accreditation Standard, Proficiency Testing and Auditing, guaranteeing worldwide harmonised seed testing results.
- The **ISTA International Seed Analysis Certificates** issued exclusively by ISTA Accredited Laboratories, truly reflecting the quality of each seed lot.
- The **promotion of research, training, publishing and information** in all areas

ISTA VALUES	
<p><b>Vision</b> Uniformity in seed quality evaluation worldwide.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>• To develop, adopt and publish internationally agreed standard procedures (Rules) for sampling and testing seeds.</li> <li>• To promote uniform application of standard procedures for evaluation of seeds involved in international trade.</li> <li>• To award accreditation to laboratories.</li> <li>• To actively promote research and dissemination of knowledge in seed science and technology, for the sampling, testing, storing, processing and distribution of seeds.</li> <li>• To provide international seed analysis certificates and training courses.</li> <li>• To encourage variety (cultivar) certification.</li> </ul>
<p><b>Mission</b> Our Association produces internationally agreed rules for seed sampling and testing, accredits laboratories, promotes research, provides international seed analysis certificates and training, and disseminates knowledge in seed science and technology. This facilitates seed trading nationally and internationally, and also contributes to food security.</p>	

of seed science and technology and co-operation with related organisations.

## The ISTA International Rules for Seed Testing (ISTA Rules)

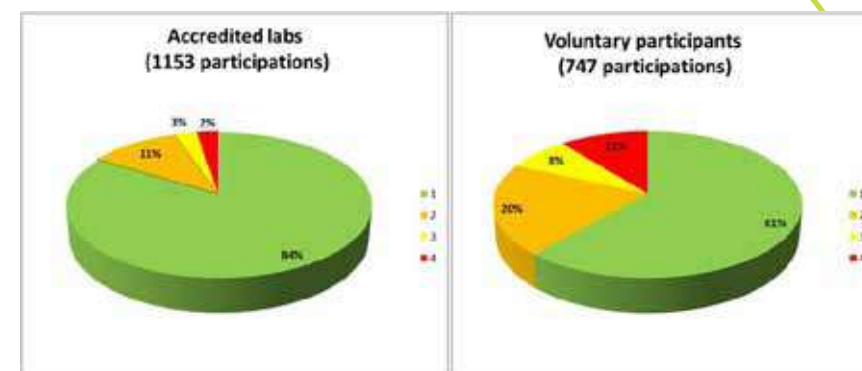
ISTA's primary instrument in promoting uniformity in seed testing is the ISTA International Rules for Seed Testing, which lays down standard methods and procedures for seed sampling and testing. The International Rules for Seed Testing are designed for many agricultural crops, flowers, trees, shrubs, medicinal and herbage species.

The International Rules for Seed Testing are approved and amended at ISTA Ordinary Meetings based on advice tendered by the ISTA Technical Committees. The ISTA Rules are referenced in a number of seed laws worldwide as the standard for seed testing and are part of the standard contract of the member of the International Seed Federation (ISF) for arbitration.

## ISTA Accreditation

The aim of the ISTA Accreditation Programme is to verify if a seed testing laboratory is technically competent to carry out seed testing procedures in accordance with the ISTA International Rules for Seed Testing.

Accredited laboratories must show that they run a quality assurance system fulfilling the requirements of the ISTA Accreditation Standard. Only laboratories accredited by ISTA are authorised to issue ISTA International Seed Analysis Certificates. By reporting seed test results on ISTA International Orange Seed



Comparison of ratings of ISTA Proficiency Tests in 2023 by ISTA accredited (left) and non-accredited laboratories (right) – A Rating (1), B-Rating (2), C-Rating (3) and Below Minimum Performance (4).

**By reporting seed test results on ISTA International Orange Seed Analysis Certificates, the issuing laboratory assures that the sampling and testing has been carried out in accordance with the ISTA Rules.**

Analysis Certificates, the issuing laboratory assures that the sampling and testing has been carried out in accordance with the ISTA Rules.

## ISTA Certificates

ISTA International Seed Analyst Certificates are accepted by many authorities and consumers as assuring reproducible and true results representing the quality

of seed. There are two types of ISTA certificates.

The Orange International Seed Lot Certificate refers to a seed lot, and sampling and testing are carried out under the responsibility of an ISTA Accredited Seed Testing Laboratory. The Blue International Seed Sample Certificates, are laboratory reports test results referring to a seed sample as it was submitted by the applicant.

The use of the Orange International Seed Lot and Blue International Seed Sample Certificates had a constant growth rate over the years of about 2.5% annually, demonstrating the growing importance of uniform seed testing.

For the new century, ISTA will introduce an electronic Certificate system (eCertificates). This will enable third parties not only to receive the as originals much quicker, but also to verify online. The system will be operated first in parallel to the paper Certificates on a voluntary basis, and start after the ISTA

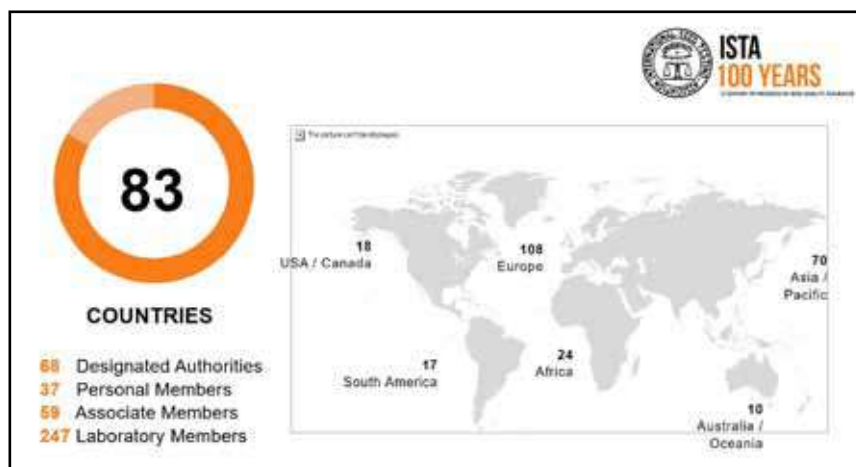


14 Years Growth rate of ISTA Certificate Usage



23 Year Growth Rate of ISTA accredited laboratories





Distribution of ISTA Membership

Centenary Annual Meeting if approved by the Ordinary General Meeting. Countries wishing only to receive eCertificates should notify the importers of this in advance.

**Proficiency Test Programme**

Only Member Laboratories of ISTA may become accredited. Prior to accreditation, applicants have to demonstrate their ability to carry out seed testing in accordance with the ISTA Rules through participation in the Proficiency Test Programme (PT). There are three PT

rounds per year, covering at least four crop groups and different tests. ISTA accredited laboratories in most cases perform better than the non-accredited laboratories. This demonstrates that the ISTA accreditation system is assuring uniformity and quality in seed testing globally.

All ISTA Member Laboratories are eligible to participate in all test rounds of the ISTA Proficiency Test Programme. It is mandatory for ISTA Accredited Member Laboratories and voluntary for non-accredited laboratories who want to benchmark themselves with accredited laboratories and prepare themselves for accreditation.

Three times a year, seed samples are dispatched to laboratories participating in the ISTA Proficiency Test Programme, the goal of which is to identify that all laboratories meet the minimum standard of performance that is reasonable to be expected from an ISTA Accredited Laboratory.

**Stringent Quality Assurance**

ISTA Member candidates for accreditation are required to establish a quality assurance system which complies with ISTA's requirements. Criteria for becoming accredited are formulated in the ISTA Accreditation Standard. Part of the accreditation is the on-site assessment. An experienced audit team verifies the laboratory's compliance with relevant criteria. Accredited laboratories

are re-audited in regular intervals to examine if they continuously abide to the ISTA accreditation requirements. Once the laboratory is accredited, it is authorised to issue ISTA Certificates for methods and species covered by its scope of accreditation. The growth rate of ISTA accredited laboratories is about 2% annually over the last 23 years. This is a little less than the growth rate for the ISTA Certificates, which is about 2.5% annually. Nonetheless, the number is increasing especially in the last two years after Covid-19.

**ISTA Membership  
ISTA Technical Committees**

The principal objective of ISTA Technical Committees is to develop, standardise and validate methods for sampling and testing of seed quality, using the best scientific knowledge available.

These tasks are subject focused in Technical Committees and Task Forces where scientists, technicians and specialists from all over the world work closely together for the enhancement of seed testing methodologies. The Technical Committees perform comparative studies and surveys in different research fields. They develop and enhance the ISTA International Rules for Seed Testing and ISTA Handbooks on seed methods including sampling, testing and processing seeds, and are responsible for the organisation of Symposia, Seminars and Workshops.

ISTA Technical Committees regularly hold workshops which provide a platform for the exchange of information, experience and ideas.

**Who can become an ISTA TCOM Member?**

Seed scientists and technicians of different research fields of seed science, and specialists in seed testing from seed testing laboratories, universities, research institutes and companies from all over the world are welcome to actively participate in the ISTA Technical Committees:

Advanced Technologies Committee;

Bulking and Sampling Committee; Flower Seed Testing Committee; Forest Tree and Shrub Seed Committee; Germination Committee; Moisture Committee; Nomenclature Committee; Proficiency Test Committee; Purity Committee; Rules Committee; Seed Science Advisory Group; Seed Health Committee; Statistics Committee; Seed Storage Committee; Tetrazolium Committee; Variety Committee; Vigour Committee; GMO Committee; Wild Species Working Group; Editorial Board of Seed Science and Technology.

**Use of New Technologies**

For methods in the ISTA Rules where technologies can be used that are equivalent to the human seed analysts the technology does not need to be re-validated, but it must be verified for the seed analyst that the technology (equipment) is competent to undertake the analysis. Technology includes any piece of equipment that enables the analysis to be achieved and any operating systems (algorithms, software etc.) that enable the technology to perform its function and, in some cases, may provide the final result. Interpretation of the data is still performed by a human analyst.

**Research and Knowledge Dissemination**

One of the important pillars assuring the uniform application of seed testing methods is the aspect of training and education. For this purpose, on-site workshops as well as online webinars, held on various aspects of seed testing, in which ISTA has experience of several decades, are considered an excellent tool.

Experts within ISTA are sources of competence and additionally offer workshops on different aspects of seed testing for training purposes. The lecturers are experienced seed scientists and technicians actively involved within ISTA and considered as experts in their fields.

**Seed Testing International (STI)**

The ISTA News Bulletin, Seed Testing

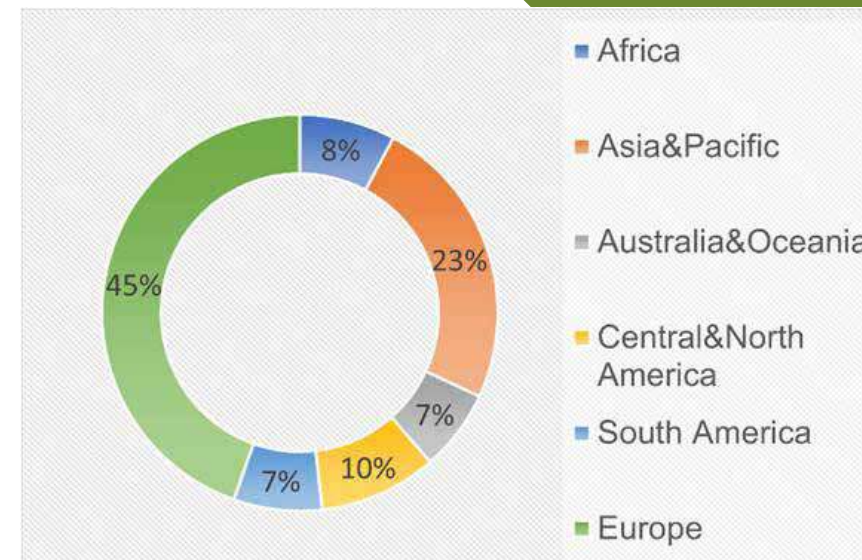


Fig 5: Global Distribution of ISTA accredited laboratories

International, is not only read by ISTA Members, but is distributed to over 1700 subscribers worldwide. It includes reports from ISTA President, Technical Committees, and Secretariat. It also includes articles addressing issues of Common Technical Interest and Accreditation, Reports from various Meetings and Congresses.

**Handbooks**

ISTA provides a wide range of handbooks including detailed techniques on all relevant topics in seed sampling and testing methodology. The handbooks are elaborated by ISTA Technical Committees and are excellent tools to improve knowledge and train laboratory staff in different technical areas and facilitate the daily technical work in seed sampling and testing.

**Seed Science and Technology**

Seed Science and Technology publishes original papers in all areas of seed quality and physiology. The journal is an important tool to promote research in seed science and technology and is a prime source of information for seed scientists and technologists involved in the improvement of seed quality and seed quality control.

The journal was launched in 1973 as a replacement of the Proceedings of the

International Seed Testing Association, which was first issued in 1921.

SST is edited by the ISTA Editorial Board, and published by ISTA in three issues per volume and year and is available as open access.

**Young@ISTA**

Young@ISTA is a special programme initiated by ISTA to attract talented professionals and researchers passionate about seed science and technology. This program aims to ensure the continuity of ISTA's legacy by engaging individuals who can contribute to the Association's mission, benefiting their home countries, organisations, and personal career development. Through this programme, ISTA seeks to expand its reach and share its knowledge with a wider audience globally.

**ISTA Membership**

The ISTA Membership consists of personal members, associate members, and over 240 member laboratories. The membership is a collaboration of seed scientists and seed analysts from universities, research centers and governmental, private and company seed testing laboratories around the world. ISTA values and promotes the diversity of membership, this being the basis for its independence from economic and po-



**1876**: 26 countries participated in the meeting held in Cambridge, and the International Seed Testing Association was founded.

**1924**: Friederich Nobbe published his famous Handbook of Seed Science and the Motto of the meeting held in Hamburg that year was "uniformity in seed testing", later becoming the ISTA logo.

**1931**: At the request of FIS (ISF), ISTA adopted the first "International Rules of Seed Testing", as well as establishing the ISTA Certificates Scheme.

**1950**: During the ISTA Congress held in Washington D.C., the first outside Europe, and demonstrated that, after 13 years of interruption by World War II, ISTA was indispensable to seed business.

**1995**: During the ISTA Congress held in Copenhagen, ISTA Membership was opened to private laboratories and private seed companies.

**1996**: To ensure harmonized seed testing worldwide, ISTA initiated the Quality Assurance Programme to accredit seed testing laboratories. The first ISTA member Laboratory was audited under the new set-up in this year.

**2004**: During the ISTA Congress held in Budapest, it was agreed to consider accreditation as a purely technical task, and the responsibility to give authorization to issue ISTA International seed Analysis Certificates was given to the ISTA Executive Committee.

**2024**: Machine vision testing policy approved and use of Artificial Intelligence (AI) systems being discussed.

**2024**: QA well-established; some laboratories having their 9<sup>th</sup> or 10<sup>th</sup> ISTA audit.

**ISTA eCertificates soon!**

**Brief history of seed testing**  
litical influence.

**Benefits of the ISTA Membership**

- **Receive the International Rules for Seed Testing Updates free of charge.** The Rules contain standardised methods and techniques to be used in seed testing, which are internationally harmonised and constantly reviewed by the ISTA Technical Committees.
- **Participate in the ISTA Proficiency Test Programme** ISTA Members Laboratories are eligible to participate in the ISTA Proficiency Test Programme at no additional cost. The Proficiency Test provides an opportunity for ISTA members to assess their technical performance and to benchmark themselves with the worldwide ISTA seed testing laboratory community.
- **Participate in the ISTA decision making process.** ISTA Personal Members may be appointed as Designated Members and obtain authorisation to vote at ISTA Ordinary Meetings on behalf of the government concerned.

- **Get valuable information through ISTA Publications.** ISTA regularly publishes a range of technical Handbooks, the scientific open-access journal 'Seed Science and Technology' (SST), the news bulletin 'Seed Testing International' (STI) as well as different proceedings from the ISTA events. ISTA Members get a 50% discount on all purchased ISTA publications.
- **Be involved in the seed testing methodology development.** ISTA Members are part of an international network of seed professionals and represent the expertise in seed science and technology. ISTA Members can become directly involved in ISTA Technical Committee work, having contact with leading seed experts worldwide.
- **Become accredited and issue ISTA International Certificates.** Members Laboratories can become accredited by ISTA. Accredited laboratories have proven their technical competence in carrying out seed testing in accordance with the ISTA Rules and operate an effective quality management system. They are authorised to

- issue ISTA International Seed Analysis Certificates.
- **Participate in ISTA Events.** Special reduced prices for all ISTA Events and prioritised registration to any ISTA Event of interest.

**Expansion of Membership**

During the last three Trienniums the ISTA Strategy was concentrating on growing membership especially in regions, where ISTA accredited laboratories were not sufficiently available to the ISTA stakeholders. These areas were mainly Asia, Africa and South America. The special focus was first on Asia, which was very successful in India. There are currently 34 member laboratories, of which nine are accredited. The area is still the quickest growing area in ISTA. All regions mentioned above are still strategic growths areas for ISTA to grow in future.



**ISTA 100 YEARS**  
**ISTA EXECUTIVE COMMITTEE 2022 - 2025**



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# 'UNIFORMITY IN SEED QUALITY EVALUATION WORLDWIDE'

## How would you assess the 100-year history of ISTA?

The International Seed Testing Association (ISTA), established in 1924 in Zurich, Switzerland, is a globally recognized inter-governmental organization dedicated to seed science and technology. With a mission of "Uniformity in Seed Quality Evaluation Worldwide," ISTA has played a pivotal role in developing, adopting, and disseminating standard procedures for seed sampling and testing. Over the past century, ISTA's impact has been remarkable, reaching 83 countries in 2024, from initial 24 countries in 1924.

Throughout its history, ISTA has adapted to the evolving needs and challenges of the global seed industry and agriculture sector. The 100-year history of ISTA is marked by significant milestones and accomplishments that have greatly impacted growth of global seed industry, seed trade, both at national and international levels, agriculture development and food security worldwide.

## What were the important milestones accomplished by ISTA in the past 100 years?

Key milestones include the introduction of standardized rules for seed sampling and testing in 1931, which have been continually updated to incorporate advancements and new scientific research as per the needs of the seed industry; the launch of the ISTA Accreditation Programme in 1993, opening ISTA membership to private laboratories and seed companies, broadening its reach in the seed industry in 1995; initiation of the Global Quality Assurance Programme to accredit seed testing laboratories, ensuring consistent and reliable testing across laboratories worldwide in 1996; embracing digital



Throughout its history, ISTA has adapted to the evolving needs and challenges of the global seed industry and agriculture sector.

technologies and data-driven approaches to enhance the precision and efficiency of seed testing in the 2000s; addition of numerous new species to the ISTA Rules, especially tropical and subtropical; remote audits and virtual meetings in response to the COVID-19 pandemic in 2020; enhanced partnerships and collaborations with other affiliated international organizations, regional seed associations, and the seed industry to enhance seed testing capacity and capabilities; the Young@ISTA initiative, launched in 2022, for attracting the younger generation to ISTA activities, ensuring the organization remains vibrant and forward-thinking; introduction of "eCertificates" to streamline processes and improve the efficiency of seed testing labs in communicating the test results; the increase in the number of technical committees to 20, the continued evolution of the ISTA Rules and their translation into Spanish, workshops and seminars/symposia, growth in the number of ISTA-accredited laboratories, open access to Seed Science and Technology, online training programs, integration of new technologies into seed testing, enabling the use of new technologies such as imaging technologies, that have equivalence to human analysts for seed analysis, and

so on. These changes have been made to address the ever-changing needs of members, the seed industry, and the farming community worldwide.

## You are the first Indian to assume the position of President of ISTA. From a global stage, how does India appear in terms of maintaining quality standards, and participating in global trade?

Yes, it gives me immense pleasure to be on ISTA Executive Committee as the President, that too as a first person from the Asian continent. Of course, it is also a great opportunity to learn, interact and contribute to the global cause of achieving food security and improved nutrition through sustainable agriculture.

The Indian seed industry, as a sub-sector of the agri-inputs industry and has been the most vibrant in terms of innovation and growth over the past few decades. I am pleased to mention that the Indian seed industry has emerged as one of the most advanced in the world, with both public and private seed companies boasting strong research and development, effective supply chain management, and quality assurance systems. As a result, India has carved out a special niche in the global seed market. The Indian seed market reached approximately USD 5.5 billion in 2023 (Rs. 40,000 crores), and is expected to grow to USD 11.3 billion by 2027.

India is having a robust regulatory framework that ensures minimum required level of seed quality assurance. The Indian Seeds Act of 1966, Seeds Control Order of 1983, coupled with other legislative measures, national seed policy and the Protection of Plant Varieties and Farmers' Rights Act of 2001, have estab-

lished a comprehensive system for regulating seed quality. In addition, India adopted ISTA standards for seed sampling and testing, AOSCA rules for domestic seed certification, and the OECD seed schemes for international seed certification to promote seed exports. Therefore, from a global stage, India stands out as a committed and influential player in maintaining seed quality standards and a major player in the global seed trade.

## Does it mean that India has leveraged the benefits of quality seeds?

Despite India's vibrant seed industry, many farmers across the country have not yet fully benefited from the advantages of using quality seeds due to bottlenecks in the seed value chain and distribution channels, inadequate post-harvest handling, and poor awareness of seed quality assurance among stakeholders. For example, while India has a sufficient number of seed testing laboratories (over 170), some laboratories need major improvements in competence and facilities to effectively implement seed legislation. Only 9 laboratories have ISTA accreditation out of 28 ISTA member labs. Additionally, seed health testing and its impact on sustainable crop production have not received due importance. Strengthening the phytosanitary certification system in accordance with international standards is necessary. Furthermore, although India has adopted OECD seed schemes to boost export potential, policy issues have hindered the ability to fully harness this opportunity. Improving competency, global

**Dr. Keshavulu Kunusoth, is the President, ISTA, Zurich, Switzerland and Director, Telangana State Seed & Organic Certification Authority, Hyderabad, India.**





cooperation, and networking is essential to expanding the niche for Indian seeds in the global market.

Thus, there is a need to further strengthen and empower the seed industry through globally aligned enabling policies, appropriate revisions in regulations, seed control and quality assurance, enhanced phytosanitary certification, global cooperation, networking, and increased seed exports.

### What are the challenges in global seed trade?

Global seed trade relies heavily on national and international regulatory frameworks, involving numerous stakeholders and organizations. The OECD and AOS-CA provide seed certification schemes, while ISTA and AOSA standardize seed testing methods. The IPPC, WTO-SPS, and NPPO manage phytosanitary measures, and the ITPGR governs plant genetic resources laws. UPOV guidelines address plant variety protection and intellectual property rights. Effective synergy among these entities is crucial for seamless seed movement and sector development.

Major challenges include diverse regulatory frameworks across countries. This regulatory diversity increases operational costs and complexity, often discouraging smaller companies from participating in the global seed trade due to high compliance costs. Additionally, there is no universal standard for seed quality, which encompasses factors like germination, purity, health, and vigor. The lack of harmonized standards can lead to disputes and mistrust between trading partners. Customs procedures can be lengthy and complex, often causing delays in seed shipments. Since seeds are highly time-sensitive, these delays can adversely affect their viability and value. Efficient and predictable customs processes are crucial for maintaining seed quality during transit.

Other challenges include varied seed system development, inconsistent policies and IPR laws, non-tariff trade barriers, country-specific varietal registration protocols, and non-uniform phytosanitary



“  
Global seed trade relies heavily on national and international regulatory frameworks, involving numerous stakeholders and organizations.”

### In order to facilitate the global seed trade, which policies that need to be aligned?

Addressing the challenges in global seed trade requires coordinated efforts among international organizations, national governments, and industry stakeholders. Harmonizing seed policies, regulations, and standards at a global level is not practically feasible. Therefore, harmonizing seed regulatory frameworks at regional levels is essential. Recent efforts have focused on adopting harmonized regulations and standards, with successful examples like the EU's unified seed certification system and regional systems in Africa (SADC, UEMOA, ECOWAS). These initiatives improve seed trade by standardizing procedures, reducing trade barriers, increasing transparency, and lowering transaction costs. Aligning policies and regulations at the regional level will make the seed trade more efficient, resilient, and equitable, contributing to global food security and agricultural sustainability. Through collaboration and regional harmonization, the seed trade can overcome existing barriers and foster a more integrated global seed market.

### What is the future strategy of ISTA?

The International Seed Testing Association (ISTA) has made significant progress in seed science, technology, sampling, and testing over the past century. It has become a key organization for ensuring

The strategic initiatives of ISTA in the second century will revolve around key objectives that guarantee the continuous progress and significance of seed sampling and testing. Some of them are:

- (i) The development and validation of scientifically robust rules and methods for seed sampling and testing, aimed at meeting the evolving needs of the seed industry.
- (ii) Incorporation of new or emerging technologies into our current methods and also new species into the rules.
- (iii) Enhancing the accessibility to the ISTA Rules by promoting their translation into additional languages.
- (iv) Focusing on partnerships and collaborations to enhance global seed testing capacity and capability, ensuring consistency and reliability in seed quality assessments.
- (v) Enhancing and broadening the accreditation system to cater to the needs of ISTA members and other global stakeholders.
- (vi) Increasing the number of outreach programs aimed at enhancing communication with designated authorities and member laboratories, strengthening their roles through consultation and active engagement, and expanding collaboration with various affiliated organisations and stakeholders in the seed sector.
- (vii) Focusing on strengthening seed health quality assessment capacity and capability through laboratory and method development with organisations such as IPPC and RPPO's and NPPO's at the regional and national levels respectively.
- (viii) Facilitating the appointment of regionally based and balanced ISTA representatives in various parts of the world.
- (ix) Expanding partnerships with other international organisations and the seed industry to enhance seed capacity and capabilities.

the seed quality worldwide, contributing to global seed and food security. As we anticipate the ISTA Annual Meeting and its Centennial Celebration in Cambridge, United Kingdom, from July 1–4, excitement is high. ISTA is poised to enter its second century, having completed a remarkable 100 years. The event will bring together stakeholders from the global seed industry, including representatives from agricultural ministries, policymakers, researchers, seed experts, and laboratories from over 60 countries.

As ISTA enters its second century, there are several key priorities with a blend of wisdom, foresight, and strategic commitment to ensure that ISTA continues to play a pivotal role in global seed and food security for generations to come. ISTA, as a seed science and technology authority, will continue to evolve and adapt to the changing landscape of the global seed sector and agriculture world-

wide. ISTA's position at the interface between research, industry and regulation will continue to facilitate the identification of needs for new methods or changes in existing methods.

### What is your message to the seed



### industry all over the world?

Quality seed is the foundation of agriculture, providing the basis for sustainable and resilient food systems. Investing in quality seeds is essential for achieving agricultural sustainability, economic prosperity, and food security for present and future generations.

To ensure quality seed access for farmers in both domestic and international markets, consistent quality checks are required at all stages of the supply chain. Seed testing has become more important than ever before due to the increased focus on precision farming and maximizing yield per unit area. Moreover, the methods of seed testing are constantly evolving in accordance with the development of the modern seed industry. Therefore, regular reviews and updates on the latest seed testing technologies and standardized operating procedures are prerequisites for seed quality assurance programs in general, and seed testing in particular.

Strengthening seed testing infrastructure is essential for ensuring the supply of high-quality seeds, which requires well-equipped laboratories that adhere to global (ISTA) best practices, guidelines, and standards. In addition, regular capacity-building programs are necessary to ensure that seed testing remains a highly technical and systematic process, enhancing the quality and reliability of seeds delivered to farmers and supporting the international seed trade.



“  
To ensure quality seed access for farmers in both domestic and international markets, consistent quality checks are required at all stages of the supply chain.”

# ‘ISTA RULES ARE THE GLOBAL STANDARD’

**Dr. Andrea Wais,  
Secretary General,  
ISTA**

**Seed quality assurance has become an important parameter in the global seed trade. Do you think that the establishment of ISTA has led to an increase in the seed trade?**

It may not have directly led to an increase in international seed trade. On the other hand, seed trade has definitely increased over the last 100 years. New countries have started production of seed. Some of them are new players and specialised in different crops. Further, the seed sector did grow and change, especially with regards to the Seed Schemes of the Organisation for Economic Co-Operation and Development (OECD). This forced a further demand for seed testing in a uniform way. Uniformity is important as results obtained for purity, germination and other quality parameters should be the same no matter where the seed was tested. Common rules for seed sampling and testing also are needed, when disputes on quality may occur. Here the ISTA Rules are the global standard. The increase in testing may be seen not only by a growing number in ISTA accredited laboratories (annual growth rate of more than 2 % over the last 23 years), but also by the increasing number of ISTA Certificates issued (annual growth rate of more than 2.5 % over the last 14 years).

**Today, technologies have been developing at an accelerated pace. How does an organisation that has withstood the test of time keep pace with changing technologies?**

The ISTA Executive Committee (ECOM) was established a number of years ago to look more deep into the development of new technologies. They established an Advanced Technology Committee and a Seed Science Advisory Group. One works directly for the implementation of new technologies and the other is advising the ECOM on the scientific development in the area of seed testing. For methods in the ISTA Rules



where technologies can be used that are equivalent to the human seed analysts, the technology does not need to be re-validated, but it must be verified for the seed analyst that the technology (equipment) is competent to undertake the analysis and, in some cases, may provide the final result.

**How has ISTA planned to bring more seed laboratories into its fold?**

The ISTA Strategy clearly states that ISTA would like to grow in regions, where ISTA is not fully represented. This started especially in Asia, where ISTA did essentially grow in membership over the last years. This is now introduced into other regions like Africa and South America. ISTA cooperates here with local, regional and international partners

“  
ISTA also enhances innovation by funding research through the 20 ISTA Technical Committees as well as funding young people inside the seed sector in their development through the Young@ISTA Programme”

either through Seminars or Workshops to help building capacities. One point to be mentioned here is probably the World Seed Partnership consisting of 5 participating organisations, where ISTA is a founding member ([www.worldseed-partnership.org](http://www.worldseed-partnership.org)).

**What are the benefits of being ISTA member and Accredited member?**

The membership benefits are clearly that each member laboratory received all ISTA publications including the ISTA Rules, which are updated annually, for free, as well as a free participation in the ISTA proficiency programme. Further, participation in ISTA events is at a reduced membership price. These events include Annual Meetings, Congresses, Symposia, Workshops. The accreditation would also allow member laboratories issuing ISTA Certificates, which are seen as seed passports.

**Besides accreditation, does ISTA work on encouraging research on innovation?**

Tasks beside accreditation is clearly dissemination of knowledge this is supported by ISTA's scientific journal - Seed Science and Technology, which has been available as open-source publication for the last 7 years. Here another membership benefit is, that member publish free of charge. ISTA also enhances innovation by funding research through the 20 ISTA Technical Committees as well as funding young people inside the seed sector in their development through the Young@ISTA Programme.



# The History of THE ISTA RULES

“I first started as a user of the International Rules for Seed Testing (ISTA Rules), then became Chair of the ISTA Rules Committee (2000-2018). My involvement with ISTA in 1989 began by being part of the ISTA Forestry Tour organised by Peter Gosling after the ISTA congress in Edinburgh. I then became more active in ISTA as the ISTA Rules Chair from 2000, while working at the National Institute of Agricultural Botany (NIAB) in the UK. I had the opportunity to move to Canada in 2008 and continued with ISTA supported by the Canadian Food and Inspection Agency (CFIA) and had the privilege to representing both the UK and Canada on the Executive Committee of ISTA. I became ISTA President in 2019, and although now retired, I am still active as the Immediate Past President of ISTA”.

ISTA was formed at the Fourth International Seed Congress held in 1924 in Cambridge, UK but before that many countries across the world understood the necessity to test seed. Seed testing started in Europe in the 1870s.

ISTA and the seed industry have moved a long way since the 1800s. The seed industry (now represented by International Seed Federation, ISF) was also founded in 1924. Over the years the atmosphere of trust, assurance and cooperation to deliver quality seed to the end users has been the aim of these and other similar organisations across the world. Reliable ways to sample and test seeds is critical in achieving this, and ISTA helped meet that need.

## Genesis of ISTA

It was 26 governmental seed testing laboratories that came together to form ISTA in 1924. Both the UK and Canada were founding members. Although not an official delegate in 1924, the USA had experts from the Association of Official Seed Analysts (AOSA, formed in 1908) and the Society of Commercial Seed Technologists (SCST, formed in

**ISTA methods in sampling and testing have become an integral part of what is the largely unknown quality assurance system that is seed certification.**



### About the AUTHOR

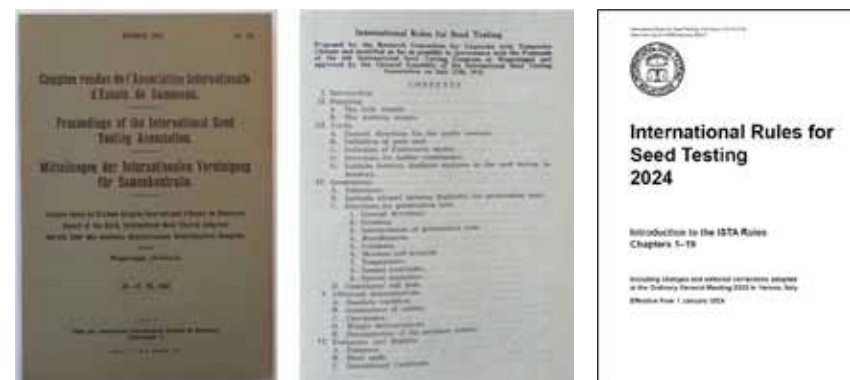
Steve Jones, PhD, MRSB, Past President, ISTA

1922) working with ISTA both then and now.

The first edition of the ISTA Rules was approved by the ISTA membership during the Sixth International Seed Congress in 1931 held in Wageningen, The Netherlands. At the same meeting the first versions of the blank Orange and Blue International Certificates were also approved, i.e., the International Seed Lot Certificate (Orange International Certificate, OIC) and the International Seed Sample Certificate (Blue International Certificate, BIC). The decision to have a uniform way of reporting was a key point for ISTA.

## ISTA Standards

ISTA methods in sampling and testing have become an integral part of what is the largely unknown quality assurance system that is seed certification. ISTA provides methods to sample and test for seed lot quality, e.g., moisture for storage, thousand seed weight to set sowing rates in combination with percentage normal germination. The ISTA Rules started with 41 agricultural species and over the years tree, shrub, flower and other species were added.



Front covers of the 1931 versions of the ISTA Rules

Front cover of the 2024 edition of the ISTA Rules

ISTA as an association has always been about collaboration. A recent survey of ISTA members in North America provides me with a suitable quote from a private sector seed laboratory in Canada that for me sums up ISTA very well: “...100 years of ISTA is an incredible accomplishment, the organisation continues to thrive and evolve as industry changes. This would not be possible without the dedication of all of its members and volunteers who are committed to its success. It is quite incredible....”

Today there are over 860 species in the ISTA Rules with test methods for sampling, analytical purity, other seed determination, germination, viability, and moisture as well as other methods like seed health, varietal purity, vigour and GMO presence. ISTA members mainly work with agriculture/vegetable species, but there are also ISTA members working in forestry, reforestation, conservation and replanting of land, all using internationally agreed standard methods supported by sound science: the ISTA Rules.



1931 versions of the OIC and BIC



Current versions of the OIC and BIC

**The ISTA accreditation system is very robust and includes compulsory on-site audits and Proficiency Testing (PTs) to maintain accreditation status.**

From the start ISTA, sampling was always considered as critical and included in the ISTA Rules. During many ISTA workshops, it was often stated “...the quality of the test result is only as good as the quality of the sample...” or “...it all starts with a representative seed sample...”. ISTA’s OIC uses this principle: one seed lot, one sampling operation and the results on the one OIC. This idea of traceability and integrity came from the start for ISTA, and both improvements to sampling and testing methods have been worked on by the ISTA Technical Committees over the last 100 years.

## Accreditation for Uniformity

Although ISTA was formed by the governmental seed testing laboratories, it has embraced the skills and knowledge from the private sector, helped by the move to a uniform laboratory and sampling accreditation system in the 1980s. Now regardless of whether it is a government or private sector laboratory, if it can meet the requirements of being an ISTA accredited laboratory/sampling entity, it can issue test results on an ISTA International Certificate (OIC or BIC). The ISTA accreditation system is very robust and includes compulsory on-site audits and Proficiency Testing (PTs) to maintain accreditation status. This is just another way ISTA has evolved to help ensure the ISTA Rules are applied correctly, and “uniformity in seed testing”, ISTA’s main aim is achieved.

To conclude I would like to thank all the past, present and current people who have worked and continue to work collaboratively to help ISTA achieve its goals. I also thank in advance, all those that I hope will still see value in a career in seed science, technology, breeding, sampling, analysis and certification. It is a cliché but the future rests with the young and hopefully the young will continue to ensure quality seed reach the people that need it for the future harvest.



# SEED TESTING

## Why it is a cornerstone for food and nutritional security?

The world's population is growing annually and is projected to continue to grow at least for the first half of the twenty-first century if not for the entire century. The United Nations Sustainable Development Goal number 2 includes “ensuring access to safe, nutritious and sufficient food” for all. Achieving sustainable food

**Provision of high-quality seed will enhance the yields to farmers who are the end users of the seed for sowing and establishment of crops.**

and nutritional security are on-going challenges, nationally and internationally. A multilayered approach will be needed to achieve food and nutritional security globally. The availability of high-quality seed when it is required is a critical component of achieving food security. This needs to be coupled with the availability of suitable varieties to achieve nutritional security.

### Retention of Seed Quality is Needed

Formal seed systems, which are a linked set of activities from varietal development and multiplication, seed production, quality control, harvesting, processing, storage, and distribution, will ensure that seed of high varietal purity and physiological quality is

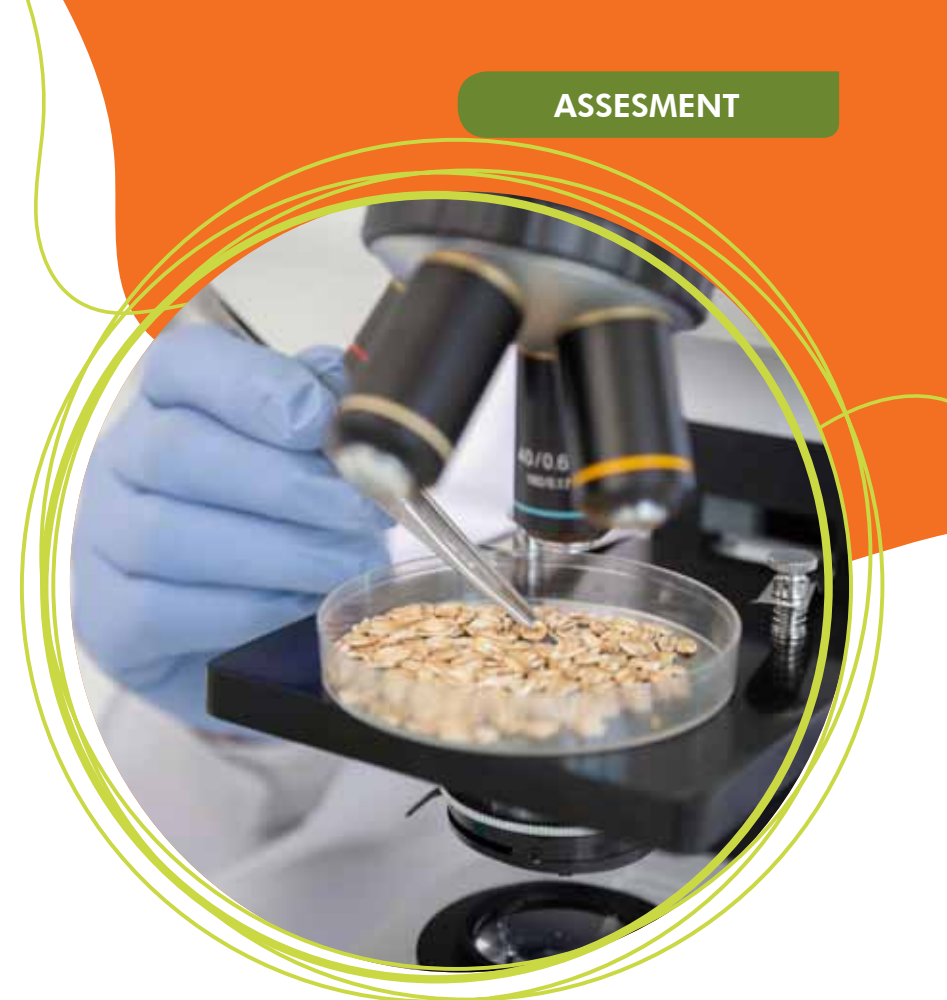
produced, and quality is retained until subsequent sowing. In a formal seed system the different activities are under the control of separate specialist operators. The formal seed systems operate at the international level through organisations such as the Organisation for Economic Cooperation and Development (OECD Seed Schemes), the International Union for the Protection of New Varieties of Plants (UPOV), the International Seed Testing Association (ISTA), the Association of Official Seed Analysts (AOSA) and the International Seed Federation (ISF). In considering how food and nutritional security will be achieved globally, there also needs to be recognition that for many areas of the world informal seed systems - “farmer-saved seed”- where all or most activities are managed by the farmer, continue to be the main source of seed for sowing. Irrespective of the system operating, production of high-quality seed, and retention of that quality for sowing is needed.

Provision of high-quality seed will enhance the yields to farmers who are the end users of the seed for sowing and establishment of crops. Poor seed quality leads to poor or no crop establishment which is a cost to farmers not only for the seed, but the other farm

### About the AUTHOR

**Craig McGill, Massey, Senior Research Officer, Seed Science and Technology, School of Agriculture & Environment, Massey University, New Zealand and Member, ISTA Executive Committee, Former President, ISTA (2016-2019).**

**Key drivers for the improvement and retention of seed quality in seed production systems are suitable production practices, harvesting and post harvesting seed infrastructure and technologies, and appropriate storage facilities combined with skilled farmers and skilled public and private operators. These best practices need to be coupled with a reliable and accurate seed testing service that can assess the quality of the seed produced and distributed; and drive change in seed systems where quality standards are not being met, and where quality is not being retained. The seed testing service must be able to verify seed quality at all points in the seed system.**



inputs needed for establishment of the crop. Reduced income from poor quality seed not only impacts farmers but also the wider community with reduced income meaning reduced spending in the community and reduced supply of food for both human and livestock consumption.

### Consistency Across Seed Testing Services

To provide confidence to seed producers and end users to the quality of the seed being distributed or purchased, there should be consistency across seed testing services. It is also needed for the movement of seed - both nationally and internationally. This is to allow the seed to move in trade by giving regulatory authorities confidence that seed being traded will not introduce unwanted weeds or disease.

### ISTA - For Accreditation

Provision of a reliable and accurate seed testing service requires investment in staff, infrastructure and information technology. There are international

**ISTA both accredits laboratories for seed testing and develops and publishes standard methods for seed quality assessment.**

systems that will verify the capability and competence of seed testing laboratories through accreditation systems. The leading international accreditation system is the International Seed Testing Association (ISTA) accreditation system (<https://www.seedtest.org/en/accreditation.html>). ISTA both accredits laboratories for seed testing, and develops and publishes standard methods for seed quality assessment. ISTA-accredited laboratories provide seed testing results on ISTA seed analysis certificates. The ISTA accreditation system includes competence in sampling which when combined with the competence in seed testing provides the confidence needed in the assessment of the quality of the seed and will enable informed decisions to be made on the sale and

purchase of the seed, and movement of seed including by regulatory authorities.

While ISTA operates within the formal seed system testing undertaken by ISTA-accredited laboratories, it can also be utilised for verification of the physical purity (presence of weed seed or other crop species), germination and health and other quality components of seed being produced in informal seed systems. Informal seed systems are by their nature less controlled, and here it could be argued that an accurate and reliable seed testing service is even more critical for ensuring that poor quality seed is not sown where it could result in crop failure and reduced food and nutritional security, and driving improvements in these systems.

A reliable and accurate seed testing service cannot alone “ensure access to safe, nutritious and sufficient food”. But without seed testing laboratories, the task of achieving global food and nutritional security will be much harder and longer.



# Celebrating 25 Years of ISTA Accreditation

**F**ounded during the 4th International Seed Testing Congress in Cambridge, UK, in 1924, the International Seed Testing Association (ISTA) embarked on a century-long mission to standardise seed testing globally. ISTA, now spanning 83 member countries and partnering with over 400 seed scientists and 244 laboratories worldwide, has been pivotal in advancing seed quality assurance through rigorous standards and innovative practices.

## About ISTA

ISTA (International Seed Testing Association) was founded 100 years ago; with the participation of 26 founding countries, and its mission has been to develop and publish seed sampling and testing standards. Over the past century, ISTA has been recognized as a

leader in seed quality assurance, innovation, and excellence in seed science and technology.

Today, ISTA has 150+ accredited labs/sampling entities, and also partners with governments, organisations, and the seed industry to enhance knowledge exchange, capacity building, accreditation, technical competency,

**INDAM, with support from ISTA's Technical Committee Chairs and subject experts, has been hosting ISTA workshops in India.**



## About the AUTHOR

**Arthur Santhosh Attavar,**  
President, International Seed Federation;  
Chairman & Managing Director, Indo-American Hybrid  
Seeds (India) Pvt. Ltd



Key drivers for the improvement and retention of seed quality in seed production systems are suitable production practices, harvesting and post harvesting seed infrastructure and technologies, and appropriate storage facilities combined with skilled farmers and skilled public and private operators. These best practices need to be coupled with a reliable and accurate seed testing service that can assess the quality of the seed produced and distributed; and drive change in seed systems where quality standards are not being met, and where quality is not being retained. The seed testing service must be able to verify seed quality at all points in the seed system.

and best practices in seed testing and quality assurance.

## ISTA Accreditation of Indo-American Hybrid Seeds

The Seed Testing Laboratory at Indo-American Hybrid Seeds was set up in 1999 by Dr. Manmohan Attavar (Founder & Chairman) with a state-of-the-art seed facility for quality testing to deliver high-quality seeds for export. The lab was prepared for ISTA accreditation in 2000, and was officially accredited in October 2002.

The scope in 2002 included sampling, physical purity analysis, other seed determination, germination test, tetrazolium test, determination of moisture content, and weight determination. It extended to additional tests in 2017 for verification of species and variety, seed health, and vigor tests.

Demonstrating its commitment to maintaining high standards, the Seed Testing Lab successfully underwent re-accreditation in 2023, reaffirming its role as a leader in seed quality assurance and testing.

## Key Milestones

INDAM, with support from ISTA's Technical Committee Chairs and subject experts, has been hosting ISTA workshops in India. Since 2008, Indo-American Hybrid Seeds has organised ten ISTA training sessions in collaboration with ISTA. These workshops have trained

**With twenty-five years of contributions from the Seed Laboratory (IN07), our seed testing services and training programs for the seed industry stand as key achievements in fulfilling ISTA's objective of "Uniformity in seed testing."**

over 300 seed managers and scientists from 35 countries and over 70 public and private organisations. Participants have come from all corners of the globe,



including New Zealand, the USA, Japan, and Brazil.

ISTA Lab experts have also provided training to members of both national and multinational seed companies in India. These sessions cover various aspects of seed quality assurance, such as seed sampling, purity testing, germination, and moisture testing for accreditation and seed quality assurance purposes.

The Seed Testing Lab (IN07) offers services to seed companies for seed sampling and testing. This includes issuing Orange International Seed Lot Certificates (OIC), Blue International Seed Sample Certificates (BIC), and Seed Analysis Reports. Both OIC and BIC serve as essential documents for international seed trading, acting as visas for seed lots.

## Leadership Role

With twenty-five years of contributions from the Seed Laboratory (IN07), our seed testing services and training programs for the seed industry stand as key achievements in fulfilling ISTA's objective of "Uniformity in seed testing." These efforts have empowered farmers with access to high-quality seeds for sustainable crop production. We commemorate this significant milestone during ISTA's Centenary year, celebrating not only our achievements but also the enduring partnerships with our key stakeholders.



# ISTA

## SUPPORTING FARMERS & ENHANCING FOOD PRODUCTION SYSTEMS

The International Seed Testing Association (ISTA) accreditation is highly regarded within the agricultural and seed industries. It sets the benchmark for quality assurance in seed testing, and provides numerous benefits for companies and stakeholders. ISTA accreditation ensures that seed quality is maintained at the highest standards, contributing to agricultural productivity, trade facilitation, and global food security.

East-West seed company is one of the leaders in tropical vegetable seeds in the world. Our mission is to provide innovative seeds and services that help improve the livelihood of tropical vegetable farmers, and promote sustainable farming and business practices. Thus, high-quality seeds are fundamental to agricultural productivity and food security which eventually helps us to achieve our mission. Our seed quality testing laboratories of East-West seed company in Thailand have been accredited since 2009, followed by our quality testing laboratory in India which has been accredited in 2023. The scope of our accreditation covers sampling from the lot, purity and identification of other seeds, germination and vigor.

ISTA accreditation helps us to ensure that our seeds meet stringent quality standards, leading to better crop performance and resilience. This contributes

to sustainable agricultural practices and helps in addressing global food security challenges. By providing reliable seed quality assurance, our ISTA accredited laboratory plays a vital role in supporting farmers and enhancing food production systems worldwide.

### Enhanced Seed Quality Assurance System

ISTA accreditation guarantees that seed testing laboratories adhere to rigorous international standards. The lab conducts tests using standardized methods, ensuring accuracy and reliability in seed quality assessments. This consistency is crucial for identifying seed viability and purity, ultimately leading to higher quality seeds being supplied to farmers. Improved seed quality translates to better crop yields, enhancing food production and agricultural sustainability.

### Improved Operational Efficiency

The process of obtaining ISTA accreditation involves thorough evaluations and audits of a laboratory's processes, equipment, and staff qualifications. This rigorous assessment often leads to improvements in operational efficiency and laboratory practices. The lab is required to maintain high standards, leading to better resource management, reduced errors, and

Holding ISTA accreditation enhances a company's reputation within the seed industry.



### About the AUTHORS

Dr. Kanokwan Chodchoey, Group Head, Public Affairs, East-West Seed Ltd. and Saruttaya Lapuk, Country Quality Assurance Manager, East-West Seed Thailand Ltd.

increased productivity. These operational efficiencies can result in cost savings and higher profitability for seed companies. Moreover, the process can be implemented to all seed quality testing laboratories in our company to ensure that the protocols are benchmarked and our staff are competent to deliver consistent results though the seeds are being tested in a different laboratory.

### Facilitation of International Trade and Increased Market Credibility

For East-West Seed company, international trade is the core of the business. So, ISTA accreditation is a significant advantage. Many countries or customers require ISTA certificates for seed imports, as they trust the testing standards. This accreditation helps in reducing trade barriers and streamlining the import-export process.

Holding ISTA accreditation enhances a company's reputation within the seed industry. It signals to clients, partners, and regulatory bodies that the company is committed to maintaining high standards in seed testing and quality control. This credibility can lead to increased business opportunities, as customers are more likely to trust and prefer doing business with accredited companies. It can also help in establishing long-term partnerships and collaborations with other industry leaders.

### Regulatory Compliance

ISTA accreditation ensures compliance with national and international regulations regarding seed testing and certification. We can stay updated with the latest ISTA rules and methodologies, ensuring that we operate within legal and regulatory frameworks. This compliance is crucial for avoiding legal issues and penalties associated with non-compliance, providing freedom to operate for our company and stakeholders.

### Access to ISTA's Global Network

ISTA accreditation provides access to a global network of seed testing laboratories and industry experts. This network



On the occasion that ISTA is celebrating their 100 years anniversary, we would like to extend our heartfelt congratulations to ISTA on reaching the remarkable milestone in seed quality assurance. We are looking forward to the next 100 years with ISTA to continue delivering trust and improve the livelihoods of farmers through high quality seeds.

ISTA accreditation provides access to a global network of seed testing laboratories and industry experts.

facilitates knowledge sharing, collaboration, and professional development opportunities. We can participate in ISTA workshops, conferences, and training programs, keeping us at the forefront of advancements in seed testing technologies and methodologies. Being part of

this global community also fosters innovation and continuous improvement within our company and seed industry.

In conclusion, ISTA accreditation offers numerous benefits, including enhanced seed quality assurance, facilitation of international trade, increased market credibility, regulatory compliance, improved operational efficiency, access to a global network, contribution to food security, and heightened customer confidence. For seed companies, achieving ISTA accreditation is a strategic investment that yields significant returns in terms of market access, reputation, and operational excellence.



# ROLE OF ISTA FOR UNIFORMITY IN GLOBAL SEED QUALITY TESTING

Quality seed production and timely distribution to farmers play a crucial role in the development of the agriculture sector and in ensuring food security for any nation. Seeds, as fundamental propagating material, must exhibit essential quality attributes to foster the development of healthy and vigorous seedlings and ensure optimum crop yields. This involves maintaining high genetic and physical purity, optimal germination rates, and freedom from diseases and pests. To accurately assess the quality of seeds, it is imperative to conduct a series of meticulously recommended tests. These tests evaluate various parameters such as moisture content, viability, germination capacity, and seed health.

## Foundational Practices

Accuracy, reliability, and reproducibility in seed testing are not merely technical requirements but foundational practices that determine the viability and potential success of agricultural endeavors. They provide critical information about seed lots, enabling farmers to make informed decisions and mitigate the risk of crop failure. Consequently, all stakeholders involved in the seed production and



**ISTA operates with the vision of ensuring “uniformity in seed quality evaluation worldwide” and the mission of developing internationally agreed rules for seed sampling and testing.**

handling process, including seed companies, certification bodies, and regulatory authorities, must prioritize quality testing. This commitment to quality must align with international standards set forth by organizations such as the

International Seed Testing Association (ISTA).

Adhering to these standards is essential to prevent future losses, which can significantly impact farmers, institutions, and society at large. Poor seed quality can lead to reduced crop yields, economic losses, and food insecurity, highlighting the importance of rigorous seed quality assessments. Furthermore, by ensuring that seeds meet international standards, seed producers can enhance their competitiveness in the global market, fostering trade and economic growth. Therefore, the precise testing of seeds according to international norms is a pivotal practice in the seed industry. It ensures that seeds have the necessary attributes to develop into robust seedlings, thus supporting agricultural productivity and sustainability. All par-

ties involved in the seed sector must uphold these standards to safeguard the interests of farmers, institutions, and society, thereby contributing to the overall advancement of agricultural practices and food security.

## International Seed Testing Association (ISTA): Overview

The International Seed Testing Association (ISTA) is an inter-governmental organization founded in 1924 in Zurich, Switzerland. It is a non-profit association of seed testing laboratories and seed professionals from around the globe, operating under the governments of its member countries or distinct economies. ISTA rules have been adopted worldwide to ensure the supply of quality seeds to the farming community.

ISTA operates with the vision of ensuring “uniformity in seed quality evaluation worldwide” and the mission of developing internationally agreed rules for seed sampling and testing. It accredits laboratories, promotes research, provides international seed analysis certificates and training, and disseminates knowledge in seed science and technology. By doing so, ISTA facilitates seed trade both nationally and internationally, supports global agriculture, and contributes to worldwide food security.

ISTA also organizes workshops, seminars, training courses, annual meetings, and triennial congresses worldwide, open to both ISTA members and non-members, to exchange experiences and expertise.

## ISTA Membership

Currently, ISTA’s membership includes approximately 226 member seed testing laboratories, personal and associate members from 83 countries. India has been a designated member of ISTA since 1961, having adopted ISTA rules for seed sampling and testing in its quality control program. India has 26 ISTA member laboratories, of which nine are accredited. These nine seed testing laboratories in India are authorized by ISTA to handle seed sampling, germination,

## ISTA’s main objectives are:

- Developing, adopting, and publishing internationally agreed standard procedures (Rules) for sampling and testing seeds.
- Promoting the uniform application of these standard procedures for evaluating seeds involved in international trade.
- Actively promoting research and disseminating knowledge in seed science and technology for the sampling, testing, storing, processing, and distribution of seeds.
- Accrediting seed testing laboratories and conducting regular training and capacity-building courses.

**As an authority in seed science and testing, ISTA aids the seed industry and agricultural development worldwide by providing internationally agreed rules and procedures that promote and facilitate cross-border seed trade.**

moisture, and purity testing, and to issue Orange International Seed Lot Certificates. These laboratories are among the 150 globally approved accredited laboratories from 83 countries or distinct economies. Therefore, it is crucial for all seed testing laboratories to carry out testing and issue certificates according to ISTA Rules for Seed Testing, ensuring that the results are uniform, repeatable, and reproducible.

**With the upcoming ISTA 100 Centenary year in Cambridge, UK, under the leadership of Dr. Keshavulu as President, it is gratifying to see more Indian and Asian seed laboratories, both private and public, becoming ISTA member laboratories and achieving accreditation to issue ISTA certificates. This development is crucial for fostering global seed trade and for upgrading and maintaining quality seed testing standards.**

## Ensuring Supply of Quality Seeds

As an authority in seed science and testing, ISTA aids the seed industry and agricultural development worldwide by providing internationally agreed rules and procedures that promote and facilitate cross-border seed trade. Its accreditation program improves the technical competency of laboratories. International seed analysis certificates act as passports for seeds in the international market. ISTA also helps build human resources in seed testing capacity and capability through regular workshops, training sessions, seminars, webinars, and global networking of seed professionals. This ultimately assists member countries in ensuring the supply of quality seeds to the farming community and supports global agriculture and food security.

In conclusion, the production and distribution of high-quality seeds are fundamental to the development of the agriculture sector and the assurance of food security. Adherence to international standards, such as those set by the International Seed Testing Association (ISTA), ensures the reliability and effectiveness of seed quality assessments. ISTA’s role in establishing uniform testing procedures, accrediting laboratories, and promoting global seed trade is invaluable. As we approach ISTA’s 100th centenary, the continued commitment to these standards and the expansion of accredited laboratories, particularly in regions like India, will further enhance agricultural productivity, support global food security, and facilitate international seed trade.

## About the AUTHORS



◀ **Dr. G.V. Jagadish, Advisor and former Head, QA, Indo American Hybrid Seeds, Bangalore. Member of ISTA TCOM on Vigour and APSA Seed Technology Committee Member.**

**Dr. Keshavulu Kunusoth, President, ISTA and Director, Telangana State Seed & Organic Certification Authority, Hyderabad.** ▶





# SEED AND SEED QUALITY

## FROM PRODUCTION FIELD TO FARMER'S FIELD

**W**ith the global population projected to exceed 9 billion by 2050, it is estimated that the demand for food will rise by 70 to 100 percent. Therefore, it is imperative that all parties, including academics, agricultural industries, policymakers, and seed associations come together to develop a strategy to mitigate this challenge. Being a seed physiologist at the largest agricultural company, Bayer Crop Science, I strongly believe that we can play a significant role in improving crop productivity and addressing global challenges on a large scale. Innovative cropping systems and high-quality seeds with relevant traits are key to improving crop productivity. Seeds are the foundation of agriculture, and with the arrival of modern farming, it serves as a vehicle to deliver specific and defined technology to the field with direct and expected benefits to our farmers. Therefore, it is critically important that we deliver high-quality and high-performing seeds that maximize yield potential and farmers' profits.

### Seed Production

Successful seed production requires establishing quality metrics during pre- and post-harvest operations. The environment during seed production significantly impacts the quality of progeny seeds. For instance, in annual plants, prevalence of extreme weather during the life cycle of the mother plant can affect the germination rate of progeny due to altered seed physiology and dormancy responses. Furthermore, climate change can impose additional threats to seed quality in the future. Therefore, production of high-quality seeds



**Seed quality encompasses a range of attributes including genetic purity, physical purity, viability, vigor, and health.**

starts with the selection of seed production sites, which include soil type, water availability, and weather conditions appropriate to a given crop. The most criti-

cal factor is to ensure optimum pollination to maximize seed setting and minimize cross-contamination. Furthermore, harvesting the crops at optimal physiological maturity, which determines viability and vigor, is essential for ensuring high-quality seeds.

### Seed Processing

Seed processing involves post-harvest seed conditioning using appropriate methods and technologies to ensure

quality upgradation. Proper attention should be given during both pre and post-harvest phases of seed production, regarding all attributes of seed quality. One of the most critical steps during post-harvest is seed drying. Drying seeds reduces their moisture content to levels appropriate for storage. However, care needs to be taken in the temperatures applied and drying duration to avoid damage to the seeds. Damage during drying will result in the seeds being more susceptible to abiotic and biotic stressors in commercial growing conditions. Therefore, studies should be conducted to establish an appropriate drying process and optimum seed moisture level for maintaining maximum seed longevity. Furthermore, genetic purity is primarily linked with the production or pre-harvest phase, whereas physical purity is primarily achieved in the post-harvest phase. The harvested raw seed mass consists of various materials other than seed, and these impurities often attract pest infestation, which can further cause seed loss both in terms of quality and quantity.

### Seed Storage

Proper storage of processed and clean seeds is another essential component of seed production programs. Following the drying step, the most critical processes for maintaining seed quality are storage and handling. Cold storage at 10°C and 50% RH is most widely recommended for most crop species. In handling, the type of packaging material and the storage environment will significantly impact seed shelf life. Packaging material should be capable of protecting seeds from pest damage, controlled with the principle of oxygen depletion. In vegetable crops, it has been demonstrated that storing seeds at depleted oxygen levels can significantly prolong seed longevity and can substitute the cold storage requirement. Further research is however needed to investigate the impact of locally available packaging materials, newly produced polypropylene bags, and hermetic bags, on seed qual-

**For over a century, ISTA has played a leadership role in setting seed quality testing rules and ensuring global harmonization of methodologies.**

ity. Hermetic storage systems are used around the world to reduce stored product losses. Scavenging residual oxygen in hermetic containers can further enhance their effectiveness in minimizing stored commodity losses in storage at warehouses, dealers, and during transportation.

### Seed Quality

Seed quality encompasses a range of attributes including genetic purity, physical purity, viability, vigor, and health. High-quality seeds are true to type, meaning they faithfully reproduce the desired characteristics of the parent plants. They also exhibit high germination rates and vigor, ensuring that a sizable proportion of the seeds will sprout and grow into healthy plants. Additionally, good quality seeds are free from diseases, pests, and other contaminants that could hinder plant development.

### Seed Planting

The ultimate test of seed quality is measured in terms of germination and stand establishment in commercial growing conditions. This involves three important aspects: seed quality, intrinsic stress tolerance of the germplasm, and most importantly, selection of the optimum planting window. The optimum planting window can be characterized as appropriate soil moisture and temperature. If stress levels are beyond the crop's intrinsic tolerance levels, due to extreme conditions like dry, wet, and low or high temperatures, these can impact germination and emergence even if the seed is of high quality. Therefore, selecting an optimum planting window is necessary for maximizing plantstand. Farmers can

use weather forecast data to determine an optimum planting window in each geography.

### Role of ISTA

For over a century, ISTA has played a leadership role in setting seed quality testing rules and ensuring global harmonization of methodologies. Two reasons in the current global situation are creating the need for an evolution of the concept of seed testing and harmonization. Firstly, there has been multiple regulatory requirements at a global level. This is due to the deployment of genetically modified plants. The different regulations require different testing approaches, which are difficult to harmonize in one unique testing method. Secondly, is the emergence of innovative technologies in seed testing. For example, imaging technologies combined with machine learning algorithms are offering diverse opportunities to measure seed quality features in physiology, purity, or seed health. Similarly, seed quality assessment may not be related exclusively to laboratory testing anymore. New data-driven approaches combining predictive modeling and/or in-process control with sensor technology during the seed production process are coming into play. Since the deployment of these new tools will not happen overnight, the coexistence of multiple approaches must be considered. The role of ISTA in accreditation processes leading to seamless implementation, and enabling in issuing ISTA certificate will be imperative.

In summary, seed quality, technologies, and performance in the commercial growing fields are important for each function along the seed's journey. Focus on the current state of quality considerations, measures, and monitors that need to be followed to understand the quality attributes of seeds from production fields to farmers' fields is important. Furthermore, identifying synergies between current processes, methods, and accommodating new technologies are important to mitigate the global challenge of demand for more food.

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# ISTA: THE GUIDE TO RELIABLE SEED TESTING

Big congratulations to ISTA for centenary celebrations. Advanta is very much thankful to ISTA for all the learning experiences we had. Advanta has been associated with ISTA almost for the past 2 decades.

Quality seed is a basic input of agriculture, and it can enhance predicted yield with the help of other resources. ISTA gives seed testing member laboratories strong wings with the right methodology to check the seed quality. Competency and confidence in seed testing is enhanced by participating in the regular proficiency tests organized by ISTA in various crop groups. We learned and implemented all applicable seed-testing procedures in our laboratories as per ISTA rules and handbooks. ISTA rules and Handbooks are very much helpful in deciding usage of the suitable substrate and resources for seed testing for efficient test results analysis. Validation and calibration of all the testing equipment as per ISTA guidelines improves the confidence in seed testing and thereby reliable results. Apart from this, ISTA publications such as bulletins, webinars, and workshops enhance the skills and knowledge of professionals in the seed industry and help them remain up to date. ISTA also supports research in seed science and technology, fostering innovation and improvements in seed testing and new methods validations.

## Accreditation from ISTA

Obtaining accreditation from the International Seed Testing Association is a great milestone in seed industry. ISTA accreditation is not only a matter of hon-

Competency and confidence in seed testing is enhanced by participating in the regular proficiency tests organized by ISTA in various crop groups.

our but also helps in giving competitive advantage in global seed marketplace in promoting international trade through reliable seed analysis certificates (OIC/BIC). We at Advanta very much benefited during the processes of acquiring ISTA accreditation right from becoming laboratory member in 2022 and becoming accredited (IN 47) in early 2024. It



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was a very good learning experience at each stage from participation in the proficiency testing (PT) rounds to the getting of ISTA accreditation during these two years. Participation in every PT gave new insights in learning testing requirements of new species unknown to us, other seeds determination (OSD) exercises really helped in exploring the criticalities in identifying the uncommon seed species and facilitated building the collection of herbariums. Apart from the technical front, documentation improved a lot while preparing ourselves for system audit complementing the strong quality management system. Dealing with non-conformities during ISTA accreditation audit is again a great experience in working towards continuous improvement while complying to the system requirements.

Apart from physiological and physical parameters testing knowledge, ISTA rules also help the seed industry in assessing the varietal purity through biochemical protein-based methods and DNA based techniques. Seed health testing methodologies against detection of various pathogens is another area where seed industry is benefitted by ISTA. In a modern era of ever-changing technological innovations, ISTA is also promoting the various non-conventional testing methodologies like AI based image analytical tools. The contribution of various technical committees of ISTA is immense in adding new standardized methods and new crops in seed rules. In total, ISTA's efforts safeguard that the seed industry can produce, test, and trade seeds with confidence in their quality and performance, helping the mankind in food security and global agriculture.

# PUBLIC PRIVATE PARTNERSHIP CRITICAL FOR THE FUTURE OF GLOBAL SEED INDUSTRY

The ISTA Annual Congress is the world event that attracts the key role industry players. But what do we need to know about the seed sector globally? The seed system and product market are critical factors for the sector transformation. For starters, the countries boast of a robust Public Private Partnership which has been critical in developing the future of global seed industry with inputs and support from the Government, the Private Sector and others major Role-players.

## Public Private Partnership – Key to Success

For Rwanda as example of success of Public Private Partnership, the Government has taken various initiatives to improve the enabling regulatory environment for seed trade, such as the policies and regulations that govern varietal development, and seed marketing as a drive to increase uptake of improved seeds in farming community, which has resulted in a noticeable change in the use of improved seed varieties by small-scale farmers, according to data from the National Institute of Statistics of Rwanda.

## These efforts include

- (i) Permitting private seed companies to sell seeds directly to farmers, rather than selling seeds through government entities
- (ii) The creation of the seed certification agency, the Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA)
- (iii) Increased access to finance and fund for public research to develop the improved varieties of key staple food crops
- (iv) The creation of a government sub-

The 2<sup>nd</sup> NSAR Congress to be held on 29<sup>th</sup>-30<sup>th</sup> July 2024 under the theme “Rwanda Seed industry Modernization” will serve as a catalyst for change, uniting industry leaders, both local and international seed companies, policymakers and experts to address the challenges facing the seed sector in Rwanda and across Africa. Through insightful discussions and shared expertise, the congress will contribute to the laid foundation for a new era of progress and collaboration, where the discussions will be around topics related to seed production and trade systems, recent technologies in Crop genetic improvement for food security, Strategic Policies and Systems to catalyze seed systems sessions. Join us at the congress to first hand meet the local role-players, observe the various investment opportunities and be part of the development of the new and vibrant seed industry of Rwanda.

sidy program that increases farmers' access to improved seed. In this process, the Public Private Partnership has been critical in develop-

ing the future of the seed industry with inputs and support from Government, Private Sector and others major Role-players.

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## Committed Private Sector

The private sector remains committed to support the government's vision to enhance agriculture in Rwanda and support a well-coordinated effort to implement such a plan on all levels.

We would like to make sure that all role players do this in an effective coordinated effort to achieve our common goal with an effective business enabling environment and regulatory framework. That is why any investment right from variety development research to seed production, requires an intact regulatory framework to guide the whole process.

In essence, the roadmap to the seed industry in Rwanda not only envisions a prosperous future for the agriculture sector but also aligns with the broader sustainable development goals of the country. By investing in seed research, production, and distribution, Rwanda can become the hub for seeds business and position itself in the regional and global agricultural market, create job opportunities and improve the overall well-being of its citizens.



# BLUEPRINT FOR INDIA'S ASCENDANCE AS THE GLOBAL SEED HUB

The Indian seed industry, already the fifth largest globally, stands on the precipice of remarkable growth. With an estimated market size of \$3.61 billion in 2024, projected to reach \$5.01 billion by 2030, India's seed sector has the potential to become a major player on the world stage. However, a robust policy framework and strategic investments are needed to enhance the industry's global competitiveness and ensure sustainable growth.

## Boosting the Seed Industry's Global Market Edge

One of the foremost recommendations is establishing a national accreditation system for seed research companies. This system will differentiate firms based on their investment in advanced technologies and long-term research capabilities. Accredited companies, recognized for their comprehensive facilities, including research, product testing, seed production, and quality control, will drive inno-

**Restoring the 200% deduction is crucial for encouraging more substantial investment in seed R&D, which is both capital and knowledge-intensive.**

Through this system, the government can track seed research work and incentivize research in high priority areas for the country through this system. Clear criteria - covering infrastructure,

manpower, skills, and processes - will be established, with renewals based on audits every five years. The new Seed Bill's mandatory registration of varieties will benefit from accredited companies' data generation capabilities, streamlining regulatory compliance.

## Tax Incentives for R&D

In 2010-2011, a 200% weighted deduction under Section 35(2AB) of the Income Tax Act, 1961, was available to biotechnology companies. However, this deduction was reduced to 150% in 2017 and further to 100% in 2020. Restoring the 200% deduction is crucial for encouraging more substantial investment in seed R&D, which is both capital and knowledge-intensive.

Customs duties on scientific and technical equipment, consumables, prototypes, and similar items should be restored to the previous

concessional rate of 5% for all nationally accredited companies. This would ensure that Indian laboratories have access to the cutting-edge tools necessary for world-class research.

While seeds for sowing are exempt from GST, most of the associated expenses, such as production, processing, storage, and transportation, incur GST. Seed companies can't utilize this as input tax credit since their primary output is GST-exempt, increasing seed costs and burdening farmers. For instance, GST on seed transportation by Goods Transport Agencies (GTA) must be paid either by the GTA or through Reverse Charge Mechanism (RCM) at 5% without input tax credit or at 12% with input tax credit. This unrecoverable GST on inputs adds to the company's costs. By exempting inputs and services related to seed production and distribution from GST, the overall cost of seeds can be reduced, ultimately benefiting farmers.

## PLI Scheme & Research Linked Schemes

India's current global seed export share is just 1%. With a supportive policy environment, this can increase to 10% of the \$14 billion global seed trade or INR 10,000 crore by 2028.

To achieve this, India needs seed export zones with greenhouses, processing and packing facilities, dry ports near production centers, and ISTA/NABL accredited seed health testing facilities. Developing these infrastructure will position India as the "Seed Valley" of the world, boosting foreign exchange earnings and creating jobs for rural youth and women.

The Ministry of Agriculture should commission a feasibility study for a PLI Scheme specifically for the seed industry. Additionally, a "National Seed Production & Trade Policy" should be formulated to encourage seed exports, involving private sector engagement or PPP models. Creating a "National Seed Export Promotion Council" will ensure compliance with international standards and foster global collaborations,

Currently, India's R&D expenditure in seeds averages 3% of revenue, far below the global standard of 10-12%. Enhanced incentives would boost this investment, helping farmers tackle climate change, pest and disease challenges, and yield stagnation. This is vital for making Indian agriculture competitive globally. Eligibility for the 200% tax benefit would be limited to companies accredited through a rigorous national process, ensuring they have a strong track record in research and product development. Accreditation would last for five years, with renewals based on performance reviews. Companies would need to report their research activities annually, with labor and product testing expenses included in the research costs.

## The Ministry of Agriculture should commission a feasibility study for a PLI Scheme specifically for the seed industry

enhancing India's competitiveness in the seed industry.

The RLI scheme (complementing the PLI scheme) will provide incentives for research and development in the seed industry, which will lead to the development of new and innovative products. The RLI scheme will also help to attract foreign investment particularly in R&D in the seed industry, which will create job opportunities and boost economic growth. This would help to propel India as a "R&D hub" for seeds globally by encouraging more investment in research. High capital-intensive research is essential for the seed industry. This is because it is necessary to develop new and improved seed varieties that can meet the challenges of climate change, pests and diseases, and low productivity. This is why a research-linked incentive scheme (RLIS) is necessary to provide financial support to these companies.

## A Single Window System for National Registrations

The seed industry's growth is hindered by procedural complexities and inconsistent state policies. Some states issue notifications that conflict with national seed laws, complicating operations.

To address this, a uniform and clear set of guidelines is essential.

These guidelines will reduce confusion and provide a stable regulatory environment for seed companies and farmers, encouraging investments in research, development, innovation, and infrastructure. Harmonized regulations will simplify compliance, reduce administrative burdens, and lower costs, promoting a more predictable business climate.

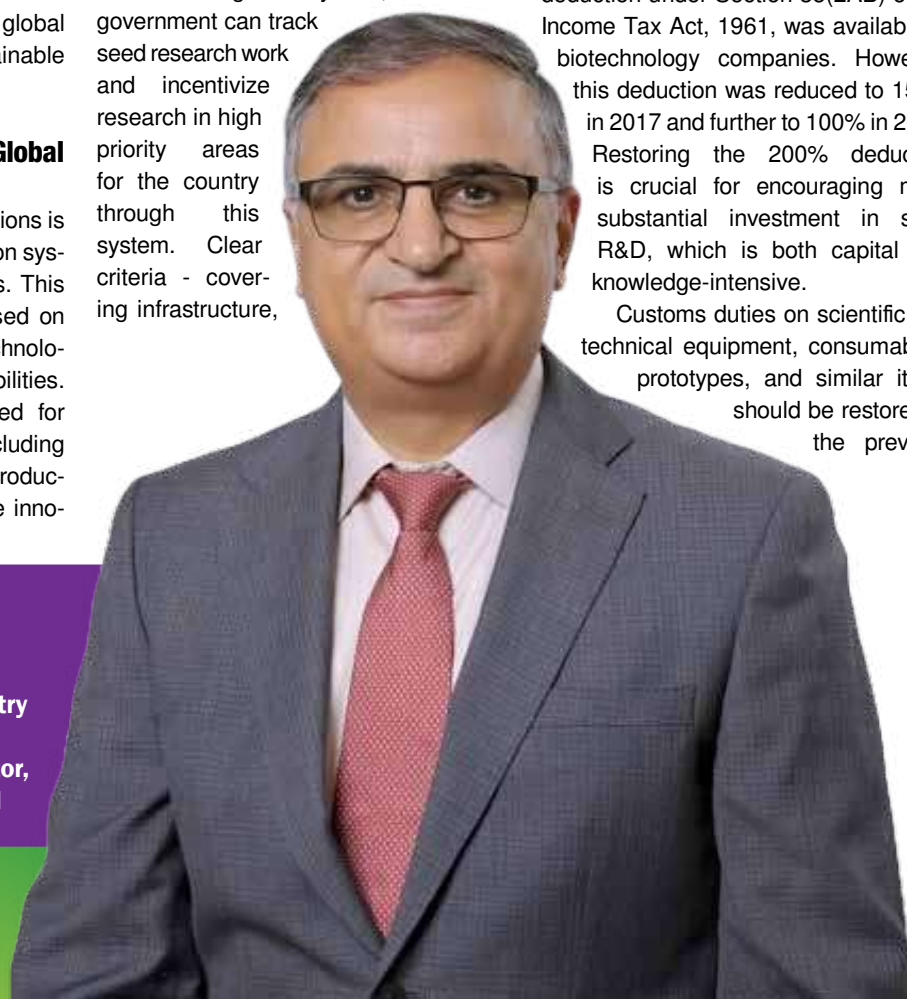
A national-level registration system is proposed to ease business operations and research efforts. Implementing a "Single Window System" for all necessary approvals and creating a national registration directory for seed licenses under the "One Nation One License" policy will streamline operations across states and minimize disruptions.

Additionally, harmonizing regulations between the Central and State governments is crucial. The Union Ministry of Agriculture and Farmers' Welfare (MoAFW) should work with State agriculture departments to ensure a consistent approach to interpreting and implementing national seed regulations. Revisiting and streamlining the regulatory approval process will reduce bureaucratic delays, facilitating the faster introduction of new technologies to the market.

The Indian seed industry is at a critical juncture. With the right policies and strategic investments, it can transform into a global leader, significantly enhancing its market share. Implementing these recommendations will strengthen the seed industry, ensure food security, promote economic growth, and improve the livelihoods of farmers. The time to act is now, to realize the vision of India as the "Seed Valley of the World."

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# INDIAN SEED INDUSTRY PREPAREDNESS FOR AMRITKAAL

The Government of India has launched an ambitious vision for AmritKaal, spanning from 2023 to 2047, which marks the centenary of Indian independence. This vision aims to transform India into a technology-driven, knowledge-based economy, aspiring to become the world's second or third-largest economy. Currently, India ranks as the fifth-largest economy with a GDP of USD 3.9 trillion. By 2034, India aims to achieve a GDP of USD 10 trillion, with the agricultural sector growing from USD 550 billion to USD 1 trillion.

## Crucial Role of the Indian Seed Industry

The Indian Seed Industry is pivotal in driving the economic growth of the agricultural sector. As the primary agricultural input, seeds embody the superior genetics of improved plant varieties, resulting from intensive R&D in plant breeding. The seed industry is responsible for supplying seeds that meet genetic and physical purity standards as per the Seed Act of 1966.

Today, the global seed industry has grown from USD 52 billion in 2014 to USD 70 billion in 2023-24, with India ranking fifth at USD 4.25 billion. However, India's seed exports are minimal at USD 150 million, compared to the leading export-

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ers like the Netherlands (USD 3.2 billion), France (USD 2.3 billion), USA (USD 1.8 billion), and Germany (USD 1.1 billion).

## Growth of the Indian Seed Industry

From 2004 to 2014, the Indian seed industry grew from USD 1.5 billion to USD 2.75 billion, driven by hybridization in maize, rice, vegetables, millets, and GM traits in cotton. Between 2014 and 2023, the industry continued its growth, reaching USD 4.25 billion due to improved Seed Replacement Rates (SRR) and Varietal Replacement Rates (VRR) in crops like rice, wheat, and soybean,

as well as hybridization in mustard and the adoption of improved varieties in the vegetable seed sector.

Looking ahead, as the Indian economy aims for USD 10 trillion by 2034, the seed industry must strive to reach USD 10 billion, including USD 500 million in seed exports. Key drivers of this growth include:

- **Improvement in SRR/VRR:** Increasing these rates in rice, wheat, pulses, oilseeds, and expanding hybridization in cotton, millets, rice, maize, and vegetables.
- **Innovative Breeding and Improved Varieties:** Focusing on cereals, vegetables, and commercial crops like cotton and maize.
- **Development of Novel Traits:** Utilizing biotechnologies such as transgenics and gene editing for traits like insect and herbicide tolerance.
- **Robust Seed Production Systems:** Supported by a skilled workforce and technically trained seed growers.
- **Enhanced Agronomic Practices:** Incorporating mechanization and digital tools to realize the yield potential of different plant varieties.
- **Upgradation of scientific and testing infrastructure and technical audit of the Seed Testing Laboratories (STL):** Improving the STL infrastructure for accurate performance of the facilities from time to time for effective implementation of seed quality regulation across the country.
- **Innovative Value Chain Models:** Creating demand-driven models that align product quality with customer and industry needs. Examples include premium fiber quality cotton for the textile in-

dustry and high-protein maize for various industrial uses.

## India as a Seed Production Hub

India has the potential to emerge as a seed production hub for Asian and African countries with similar climatic conditions. To meet the ambitious target of a USD 10 billion seed industry and USD 500 million in exports, a concerted effort between the private and public sectors is required. Key areas of focus include:

## Research and Development

- **Establishment of Seed Parks:** Setting up seed parks in different agro-climatic zones with common infrastructure to support small and medium companies in deploying new biotechnologies and plant breeding technologies.
- **Leveraging Public Sector Research:** Commercializing public sector research outputs through joint projects and consortia with private seed companies.
- **Innovative Agronomic Practices:** Implementing practices like Direct Sown Rice (DSR), zero tillage maize, and mechanization-friendly cotton hybrids.
- **Accelerated Molecular Breeding:** Utilizing speed breeding for stress tolerance and shortening breeding cycles.
- **Seed coating Technologies:** Adopting technologies like apomixis-based seeds for genetic purity and novel seed treatment technologies using microbiological consortia and nanomaterials.

## Convergence Technologies

- **Policy Implementation and Regulation:** Using technology for harmonizing regulations, enforcement, and traceability.
- **Integration of Advanced Technologies:** Incorporating AI, IoT, robotics, and UAVs in seed production operations.
- **Precision Agriculture:** Linking seed production to precision agriculture for

**India has the potential to emerge as a seed production hub for Asian and African countries with similar climatic conditions.**

high-value vegetable seeds.

- **Fintech Applications:** Developing fintech solutions for seed production farmers and distribution channels

## Sustainability and Climate Action

- **Regenerative and Sustainable Agriculture:** Promoting practices like DSR and High-Density Planting Systems (HDPS) while committing to "Net Zero" emission targets.
- **Soil Health Improvement:** Setting frameworks for soil health enhancement and carbon neutrality.
- **Biologicals and Microbiome Approaches:** Incorporating biologicals and microbes into agronomic practices for improved soil health.
- **Micro/Drip Irrigation:** Promoting precision irrigation techniques to reduce the ecological footprint.

## National Seed Association of India (NSAI)

The National Seed Association of India (NSAI) is at the forefront of policy advocacy for the seed industry, ensuring profitability for farmers and aligning with sustainable development goals. To turn the vision of AmritKaal into reality, NSAI will focus on:

- **Harmonizing the Seed Regulatory Regime:** Developing a favourable ecosystem for implementing the New Seed Act, uniform licensing, varietal testing, and IPR protection.
- **Collaboration with Downstream Industry Players:** Working with sectors like feedstock, food, fuel, and dairy to create value-enhancing business models.
- **Prioritizing R&D and Government Support:** Focusing on oilseed crops

and pulses to save foreign exchange and investing in forage and feedstock crops to meet emerging industry needs.

- **IPR Understanding and Compliance:** Ensuring members align their business practices with India's IPR regime.
  - **Reviewing Export Potential:** Developing an action plan to promote high-value vegetable seed and forage seed exports, aiming at USD 250-350 million.
  - **Addressing Labour Scarcity and Mechanization:** Improving production efficiency through crop-specific mechanization.
  - **Promoting Regenerative Agriculture:** Ensuring compliance with SDG and ESG goals to meet climate change challenges and government Net Zero targets.
  - **Steering Tax Reforms to facilitate Growth of Indian Seed Industry:** Consultations with the Finance Ministry to bring out new Income Tax policy towards "Rule Based Taxation System" for seed as in case of tea, rubber and coffee industry, and continuance of GST exemption on inputs/input services used by the seed production industry.
  - **Capacity creation with NGOs/Societies managed by Technocrats towards Seed Testing:** Capacity creation in seed quality testing by NGOs/Societies managed by technocrats without conflict of interest, which are subject to monitoring by a Central agency. This helps the MSME sector and even the farmers for testing the seed easily and thereby enhancing the seed quality in the country.
- By focusing on these strategic initiatives and operational measures, the Indian seed sector can achieve its vision and goals during AmritKaal. This collaborative effort between public and private sectors, leveraging advanced technologies and sustainable practices, will pave the way for India to become a global leader in seed production, ensuring food security and economic prosperity for the nation.

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# SEED QUALITY TESTING

## KEY TO SUCCESSFUL AGRICULTURE

**A**griculture contributes to ~17% to the gross domestic product in India, engaging more than 40% of the workforce. It has registered a substantial growth in the last 50 years, not only transforming it from a food deficit to food surplus nation, but actually making available 2.3 times more food per capita to its population which grew by almost 4 times. This could be possible by raising food production by 8.83 times (R. Chand & J. Singh, NITI Working Paper 02/2023) without any significant increase in the area of cultivation. Quality seed of high yielding plant varieties and hybrids played a key role in this transformation. It started with the introduction of high yielding varieties in the 60s during the period of Green Revolution and subsequently supported by the public research programmes as well as government policies.

### Quality Seeds for Quality Production

It is well documented that the use of good quality seed of a superior variety under favourable cultivation conditions can result in 15 – 20% gain in production. Thus, preparations for successful agriculture starts with procuring quality seed of a suitable plant variety having

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desired attributes. It is now well recognised that the planting value of the seed is as important as its genetics. Erratic weather patterns, a consequence of overall climate change, are evidenced worldwide. Therefore, crop improvement programmes aim at developing such varieties which have desirable quality traits, and/or have the ability to perform well under a wide range of fluctuating growing conditions exhibiting fair degrees of resilience against major prevailing biotic and abiotic stresses.



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The basic objectives of seed technological processes ensure that the seed is:

- true to type – genetically pure
- does not contain undesirable substances – physically pure
- free from seed borne pathogens and pests - healthy
- have high germination and vigour and – physiologically superior
- retain quality during the period of storage –good storability

To achieve, this utmost care is taken during raising the seed crop; harvesting and post-harvest handling of the seed; seed sampling; accuracy in seed quality evaluation; and seed storage till it is used for sowing. The newer technological interventions also add value through applied technologies for sustainability under less favourable/unfavourable conditions.

Major factors favouring the Indian seed industry in the global market are attributed to:

- Competence in Plant Breeding and development of many improved crop varieties.
- Trained manpower to manage seed production, processing and testing.
- Varied agro-climates favouring seed production of a wide variety of tropical and temperate crops.
- National and international training programmes organised from time to time helped competence building in Seed Quality Assurance.
- With 28 ISTA Labs, India is well equipped to handle testing of a large number of seed samples for quality assurance as per international norms.
- There is a growing awareness among seed industry men and seed analysts about the precision in seed quality.
- India is also working towards acquiring European Equivalence (EU) in seed quality.

Thus, three major components of seed technological interventions and innovations comprise of variety improvement, quality seed production and accurate testing, and quality enhancement.

### Robust Infrastructure

The public sector in India is fully equipped to meet the requirements of crop variety development as per consumers' preferences and adaptability to diverse agro-climatic conditions, and seed production and marketing. There are 65 crop institutes under Indian Council of Agricultural Research (ICAR), 3 Central Agricultural Universities (CAUs), 48 State Agricultural Universities (SAUs), National Seeds Corporation Ltd (NSC), and 15 State Seed Corporations (SSCs) which are engaged in variety development and seed production, respectively. In addition, more than 550 private seed companies also contribute equally to the seed supply system in India. These are participating actively to the national seed system, of which nearly 15% have in-house R&D programmes.

### Seed Certification

Though Seed Certification is not compulsory in India, the quality assurance is achieved through compulsory labelling. The monitoring of Breeder Seed is done by especially constituted crop specific

**Starting with the first two ISTA member laboratories in the early 70s, which were established in Indian Agricultural Research Institute (IARI) and the National Seeds Corporation (NSC), presently, there are 28 ISTA member labs, highest in any country in the world.**

Monitoring Teams, and certification of Foundation and Certified seeds (FS & CS) is done by 25 State Seed Certification Agencies (SSCAs). Testing of CS, TL as well as farm-saved seeds samples are performed in 145 Notified Seed Testing Laboratories (STLs), accredited labs, or ISTA laboratories. Starting with the first two ISTA member laboratories in the early 70s, which were established in Indian Agricultural Research Institute (IARI) and the National Seeds Corporation (NSC), presently, there are 28 ISTA member labs, highest in any country in the world. Of these 8 (6 in the private sector and 2 in the public sector) are ac-

credited for seed testing and issuance of ISTA Certificate, some more are expected to get ISTA accreditation soon.

### Burgeoning Seed Trade

Considering the universality of seed programmes, where seeds could be produced in one country and traded and used in others, accurate and uniform procedures in Seed Testing must be followed to obtain the best reproducible results in seed testing. India has great potential both in imports and exports of seeds of field crops, vegetables and flowers. Though its share in the global market is still small, its volume and value are increasing steadily during the last 10 years, making India a net seed exporter since 2019 with highest margin in flower seeds (Vijay et al, 2023). While the import of seeds increased from <20,000 t in 2013 to >39,000 t in 2020, the export rose from <30,000 t to >85,000 t during the same period (ISF estimates, 2022). Though the field crops occupy the largest share in terms of quantity, the value of the vegetable seeds is the highest in terms of value.

### ISTA – Uniformity in Seed Testing

ISTA plays an important role in Seed Quality Evaluation, It develops rigorously validated precise protocols, adopts, and publishes internationally agreed standard procedures for sampling and testing the quality of seeds with a vision to attain 'Uniformity in Seed Testing'. In majority of the countries, including India, the National Seed Testing Rules are adopted on ISTA Rules, with some modifications, as necessary. The Rules are published annually, incorporating changes if required, and adopting new advanced protocols, such as molecular technologies for greater precision. Newer species are also being added over the years to widen the utility of these protocols. By organising many specific Training Workshops on Sampling, and Testing Purity, Germination, Seed Health, Vigour etc, ISTA contributes in building competence of Seed Analysts in India and strengthening its seed programmes.



# UTMOST EMPHASIS ON SEED QUALITY

Syngenta is one of the world's largest developers and producers of innovative seeds and traits across grain, oilseeds, vegetables, fruits and flowers. One of the first companies to breed vegetable varieties more than 150 years ago, Syngenta today operates in more than 60 countries. In an interaction with Anjana Nair, Group Editor, Agriculture Today, Mr. Sanjay Singh who heads the South Asia Business, Vegetable Seeds in Syngenta discussed the existing seed scenario in India, while addressing the challenges of the sector. Mr. Singh with 25 years of experience in Seed industry in different roles across the world, also touched upon the aspect of seed quality and its relevance in food security.

Excerpts from the interview.

## What is the size of India's vegetable seed market?

Vegetable Seed sector in India is not a very organized segment. Having said that, there is no clear database, that can assign a value. I would put the number somewhere between 650 and 700 Million USD.

## Is there any gap between demand and supply of vegetable seeds in India?

Yes. There is always going to be a demand and supply gap. Seed production is dependent on many variable factors such as climate, pest, diseases etc. With erratic climate, we may sometimes confront yield losses creating a gap in demand and supply. Emergence of new pest and diseases is another important factor affecting the production. For instance, quite recently, black thrips in Pepper and Tomato brown rugose fruit virus have emerged as important threats to the standing crops in the field. It was Fall Army Worm (FAW) in sweet corn 3-4 years ago. As far as the production is linked to uncertain factors, there will

always be a gap in demand and supply.

## In terms of quality of vegetable seeds, where does India stand when compared to the rest of the world, especially when there are reports of spurious seeds?

Be it the MNCs or the Indian private players, good quality standards in seeds are always maintained. For example, the minimum germination standard prescribed by the Indian government is 70%, while Syngenta maintains it at 80-85%. On the other side, there are local players who give scant regard to quality. They steal hybrid seeds/parental

lines from the production areas, produce and/or pack and sell them in the market. Sometimes, there is no clarity on what variety of seeds they are selling. But over the last 10 years, I have seen a remarkable change among the organized players. Earlier seed production was in the open fields, but today many good players have shifted to net house

**Syngenta ensures quality seeds production and places utmost significance on seed quality.**



cultivation for key crops. This has been beneficial to the growers as the quality and yields will be much higher.

## How does Syngenta address Seed quality?

Syngenta ensures quality seeds production, and places utmost significance on seed quality. Our newly established global standard Seed Health Lab in Hyderabad is testament to our commitment to quality. The state-of-the-art lab is one of the most advanced seed testing facilities in the world and delivers India's first dedicated seed health lab, which will serve growers in India, across the Asia Pacific region. The lab is part of Syngenta's global network of vegetable seed Quality Control labs, including centres of excellence in the United States and the Netherlands. The 6,500-square-foot modern facility is currently capable of processing 12,000 virus/bacterial tests per year with capacity to expand with future growth. The facility is compliant with seed health test regulations in India and is ISTA approved.

## What are the challenges of the seed industry in India?

**Infringement / copy seeds:** The biggest challenge is the infringement of Plant Breeder's Rights. In India, IP protection needs to be strengthened / implemented strongly. The government and industry should work towards its proper implementation. Today anybody can steal parental lines from the field production, cross it with any hybrids/varieties and release them as new ones. This way, we cannot guarantee quality to the grower.

**Climate change:** Extreme weather conditions and rising temperatures are affecting yields adversely. This will only get worsened further in the coming decades.

**New pests and diseases:** Emergence of new pests and diseases is threatening many crops in India.

## In terms of traits, which are the sought-after traits in India?

tête-à-tête with *Anjana*



Traits vary from crop to crop. Resistance is a much sought-after trait. Viral diseases in plants are incurable and the only protection that can be offered is through inbuilt resistance or by controlling vectors. Without resistance, disease incidence leads to maximum losses to the farmers. The intensity of disease depends on two factors- climate and variety tolerance, a combination of which will be a lethal one to the farmer. ToBRFV (Tomato brown rugose fruit virus) is another important virus that is present globally, but it is yet to make its presence in India. It can be categorised as a future threat for India. It is better to be prepared. Syngenta has already identified resistant genes for this. Innovations form the key to stay ahead. The much sought after traits keep changing with crops, climate, geographies and time.

## Is India's research system attuned to this demand, and how well are we delivering?

Now many MNCs are working in India and thanks to the Indian Government that has allowed foreign companies to invest. This has resulted in many global innovations to make way to India. Many hybrids that are sold in India have arrived as global germplasm. All the MNCs have global access to germplasm for developing new hybrids/varieties. Even the Indian companies can gain access through different institutions. We also can collaborate to create new varieties utilizing indigenous germplasm. NBPGR, Vegetable Research Institutes also maintain a good collection of germplasm. Except for a few crops like Spin-

ach, pumpkin etc., Indian companies can access germplasm from abroad.

## How is the policy environment in India for seed sector?

New Draft Seed Bill is a promising development that the industry is keenly looking forward to. The new draft seed bill will bring all three different laws (The Seed Act, 1966, The Seeds Order and The Essential commodity Act, together for end to end seed business. The ease of hybrid registration policy in the bill will facilitate faster release/registration of new varieties across the country. Another notable change would be the ease of export and import of inbred lines. This will be helpful when the existing infrastructure in India is inadequate for any of the process in seed production. We can then use the facilities elsewhere to perform those functions and send the varieties back. In future too, I am expecting a lot of policy changes which will help in ease of doing business and for bringing innovation.

## What are Syngenta's new varieties that are in focus currently?

We are very strong in tomato, Brassica & Peppers segment. Our Tomato 'Baaho' variety is of very good keeping quality and produces firm fruits. It has a sour taste. Saaho, a variety that was released four years ago is our leading hybrid in India. It has been accepted across India due to its fruit quality & wider adaptability. Recently we launched green fresh Hot Pepper Jyestha, HPH-2042 & hot pepper 'Rangeen' in red dry segment with high color value.



# INDIAN SEED SECTOR

## JOURNEY TOWARDS EXCELLENCE

The Indian seed sector is one of the most dynamic seed sectors globally, where both public and private sectors play a significant role towards the availability of quality seed to the farming community. The presence of self-certifications, independent quality assurance systems, and quality regulation in marketing makes the Indian system exceptional. The successful implementation of the sui generis plant variety protection in India, which includes both farmers' and breeders' rights, establishes it as a paradigmatic system. The remarkable transformation of the Indian seed sector from a predominantly public sector to an equitable public and private industry, all through guaranteeing farmers' rights and without compromising on the quality, establishes it as an astute and valuable seed system. Nonetheless, it is essential for the seed system to make necessary adjustments in order to accommodate the dynamic changes taking place in the seed sector.

### Present Status

The Indian seed market is valued at more than US\$ 6 billion and is the fifth largest in the world presently. Open-pollinated varieties play a significant role in this endeavour. On the other hand, the private sector exhibits a stronger inclination towards commercial and vegetable crops, with hybrids dominating the majority of sales. The Indian seed sector comprises one National Seeds

**The Indian seed market is valued at more than US\$ 6 billion and is the fifth largest in the world presently.**

Corporation, fifteen state seed corporations under the public sector, and approximately seven hundred small and big seed companies in the private sector.

### Role of Public and Private Sector

The public and private sectors are supported by the National Agricultural Research System (NARS), comprising 50 ICAR research institutes of crop science and horticulture and 46 State Agricultural and Horticultural Universities for providing

source seed (Breeder seed) for further multiplication. The NARS system shouldered the responsibility of producing enough breeder seed through AICRP on Seeds from 1979-80. The breeder seed production witnessed a significant increase by 2022-23, reaching 25 times the initial quantity of 3914 quintals produced in 1981-82. Over the past decade, the NARS system has supplied a total of 11 lakh quintals of breeder seed for subsequent multiplication by the public and private seed sectors. Apart from breeder seed, during 2023, the NARS system pumped 1.1 lakh quintals of foundation seed, 1.4 lakh quintals of certified seed and 1.08 lakh quintals of truthfully labelled seed into the seed system of the country. During this period, the private sector's contribution to quality seed supply has increased steadily and significantly. The share of the public sector in quality seed supply reduced from 49.1 per cent

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Food crops account for the highest percentage of exported seeds (74.08%), followed by vegetables (25.86%) and flowers (0.06%). However, the export volume of food crop seeds witnessed a mere 55% growth in the past decade, while flower seed exports surged by 360% and vegetable seed exports by 400% during the same period. Vegetable seeds account for 66% of the total value of seed exports, while flower seeds account for 7% and food crops account for 27%. This indicates the significance of exporting vegetable seeds because of their substantial value.

in 2012-13 to 33.2 per cent in 2021-22. Whereas the share of the private sector grew from 50.9 per cent to 66.8 per cent during the same period, highlighting the increasing role of private seed companies in India's seed sector. These statistics do not include vegetable seeds, where the private sector is the major player because of hybrids.

### Increasing SRR and VRR

The efforts of both public and private seed sectors have resulted in an increased utilization of quality seeds, which was indicated by the seed replacement rate (SRR). The average SRR risen from 38.1 per cent to 42.6 per cent in the last decade. A 25-33 per cent increase was observed in crops like maize, lentil, and red gram. While at the same time, in crops like barley, rape seed and mustard and soybean, it was reduced by 20-30 per cent. Crops like paddy, mung bean and ground nut showed almost no change (1-2%) in their SRR during the last decade. This shows the variation in the adaptability of quality seeds in various crops.

Besides SRR, the varietal replacement rate (VRR) is another important indicator of adoption of new varieties. In crops like wheat, pigeon pea, chickpea, mung bean, urd bean and lentil, the share of less than ten-year-old varieties is more than 90 per cent in breeder seed indents. Similarly, in groundnut, rape seed and mustard, lentil, urd bean, pigeon pea, and wheat, the share of less than five-year-old varieties is more than 50 per cent.

Another landmark output showing the vibrance of the seed sector is the registration of new varieties under the PPVFR Act, 2001. In 2009, when the first plant variety protection certificates were issued, only

**In order to promote seed export and increase its impact on international seed trade, it is crucial to harmonize rules and regulations with international laws**

two new varieties were registered by Maharashtra Hybrid Seeds Company Limited. Presently (15 May 2024), a total of 1069 new varieties have been registered, with 84 per cent originating from the private sector. Of the 24 different crops whose varieties were registered by the private sector, 64.5 per cent are food crops, 21.1 per cent are commercial crops, and only 14.3 per cent are vegetable crops. While 76% of newly registered varieties by the public sector pertain to food crops, vegetables make up a mere two per cent. This shows that the public and private sectors are developing more food crop varieties.

### Prospective Changes

The Seeds Act of 1966, being one of the country's oldest acts, requires immediate replacement to address the changes that have occurred over the past fifty years. Despite being introduced to parliament in 2004 for the first time, the new seed bill has yet to be enacted. The 2019 seed bill, despite being recently introduced, necessitates specific modifications to align it with the provisions of the PPVFR Act, 2001. In order to promote seed export and increase its impact on international seed trade, it is crucial to harmonize rules and regulations with international laws. Despite India's enrolment in the OECD seed

scheme in 2008, our efforts to enhance seed exports have yielded limited results. We need to re-orient our export strategy to concentrate mainly on vegetables and flower seeds as they are highly remunerative and easy to handle because of their low-volume nature. Government initiatives for dual varietal release systems in Asian and African countries boost seed exports as these regions have climatic conditions similar to those in India. There is a need to foster the notification of new public and private varieties under OECD seed schemes and extend them to other crop groups. The government should limit itself to monitoring and licensing private certification units while new initiatives are needed for recognized third-party certification.

The breeder seed supply system requires a definitive policy decision due to the concurrent operation of non-exclusive MOUs for varietal multiplication with research institutes and the national indenting system, leading to confusion. The research institutes' seed production units shall be restructured as autonomous, self-sustaining organizations, separate from the NARS system, to boost the availability of quality seed and reduce the influence of the unorganized seed sector. It is necessary to restrict the release of both public and private sector varieties and encourage varietal de-notification to have limited and targeted products for various identified crop segments. The establishment of a national varietal register can facilitate this process. The newly initiated SAATHI portal must be reinforced to establish the traceability of domestically produced seeds. The private seed sector shall also be brought into its ambit in the later stages of implementation for more transparency in the seed production and supply system. The implementation of mandatory registration for all varieties, following a thorough evaluation of their value for cultivation and use through an independent and rigorous system, along with third-party certification from licensed private agencies that are independent of seed production, greatly supports the seed trade and improves the accessibility of high-quality seeds for the farming community.



# R&D FOR SUSTAINABLE SEED INNOVATION

**W**ith a burgeoning population straining food security and climate change threatening agricultural resilience, safeguarding sustainable food production systems has become an urgent global imperative. According to the latest United Nations projections, India's population has reached 1.4 billion people and with its ever increasing population growth, stands at the forefront of the global agricultural landscape. However, its agrarian economy's foundation is under threat by the vagaries of climate change. Increasingly erratic weather patterns, exacerbated by phenomena like El Niño, pose existential challenges to farmers, disrupting traditional agricultural practices and jeopardizing food security. The once-in-a-century heatwaves now forecasted every five years serve as a stark reminder of the urgent need to address the impact of climate change on crop production and protection.

With all this, our farmers face the challenge of ensuring that production systems are efficient, environmentally friendly, and above all, optimizing the output to ensure the supply meets the demand. Climate change is impacting the livelihoods and income of small-scale food producers and those engaged in production systems and their value chains. According to a 2023 PIB survey, in absence of adoption of adaptation measures, by 2050, rainfed rice yields in India are projected to reduce by 20% while, irrigated rice yields and wheat yields by 3.5% and 19.3% respectively.

## Multifaceted Benefits of Sustainable Seed Innovation

Against this backdrop, the need for deep



**In India, investments in new seed technologies, such as high yielding hybrid seeds like mustard and associated seed applied technology, will help in increasing the output substantially.**

research and development (R&D) in sustainable seed innovation emerges, offering a pathway to adaptability, productivity, and sustainability in the face of climate uncertainty. Sustainable and science-based seed technologies offer a lifeline for farmers, equipping them with the tools to adapt to changing environmental conditions while maximizing yields and minimizing resource inputs.

Research initiatives have demonstrat-

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**Introducing proactive policies towards incentivizing the farmers who contribute to environmental health (through DSR/Zero Till etc. practices) such as agricultural carbon credits will go a long way in augmenting the needed investments into seed R&D.**

ed that sustainable seed technologies not only enhance crop resilience but also contribute to environmental sustainability by reducing the reliance on chemical inputs and mitigating the impacts of climate variability. For instance, studies conducted by the Drought Tolerant Maize for Africa project of CIMMYT clearly established that adoption of drought tolerant maize hybrids by farmers increased yields by 15% and reduced the probability of crop failure by 30%. Furthermore, as temperature rises, invasive pests and diseases such as the fall armyworm and Maize Lethal Necrosis in Corn, Brown Plant Hopper (BPH) and False Smut in Rice etc. pose a growing menace to global food security. Strategic investments in seed and Crop Protection (CP) R&D, including biologicals can yield breakthroughs in biotic stress resistant cultivars as well as sustainable CP solutions, offering farmers a potent array of defensive tools against climate-driven pest outbreaks.

Moreover, access to improved seed varieties can significantly improve farm incomes and livelihoods, particularly in vulnerable regions prone to climate extremes and foster a socio-economic development by empowering smallholder farmers and enhancing their adaptive capacity. In India, investments in new seed technologies, such as high yielding hybrid seeds like mustard and associated seed applied technology, will help in increasing the output substantially. For example - Of the 8 million plus ha of mustard being cultivated in India fifty percent of the farmers still grow varieties where the yield levels are less than half of hybrids. Transitioning these farmers to high yielding hybrid

technologies will significantly increase the mustard productivity and production in India. By bringing the existing mustard acres in India to global yield levels of ~ 2 t/ha, we can reduce edible oil imports by a good 15% and hybrid seeds will play a key role in reversing the balance of trade.

Another area where investments in sustainable seed solutions is yielding big dividends is with respect to developing and deploying direct seeded compatible rice cultivars that reduce 30-40% green house gas (GHG) emissions, thereby enabling environment-friendly rice farming, which has huge potential over more than 100 million rice hectares across the Asian region.

## Challenges In Seed Innovation

In the pursuit of sustainable seed innovation, R&D emerges as the cornerstone of progress. Despite the pivotal role of R&D in driving agricultural innovation, limited financial resources often impede the scale and scope of research initiatives. In addition to funding constraints, Complex regulatory frameworks governing seed technology approval processes can hinder the timely commercialization of innovative seed varieties, delaying their deployment in the field. Additionally, introducing proactive policies towards incentivizing the farmers who contribute to environmental health (through DSR/Zero Till etc. practices) such as agricultural carbon credits will go a long way in augmenting the needed investments into seed R&D. Strengthening the Plant Variety Protection and Farmers Rights Act and its strict implementation will encourage innovators to invest more aggressively in agricultur-

al R&D, thereby benefiting small holder farming communities in the long run.

Moreover, the inherently interdisciplinary nature of seed innovation requires collaboration and knowledge sharing across diverse stakeholders, including researchers, policymakers, farmers, and industry partners. However, siloed approaches and fragmented communication channels often hinders collaboration and the translation of scientific discoveries into practical solutions for farmers. Nevertheless, the potential benefits of increased investment in R&D are manifold, promising not only enhanced agricultural productivity and resilience but also economic growth and environmental sustainability.

## Policy-Led Growth For Collaboration

At the ground level, addressing the complex challenges of climate change and food security requires collaboration among various stakeholders. Public-private partnerships offer fertile ground for collaboration, leveraging the strengths of academia, industry, and government to drive innovation and ensure equitable access to technological advancements. A robust policy framework also plays a pivotal role in incentivizing investment in R&D and fostering a conducive regulatory environment for seed innovation.

By fostering dialogue and engagement among stakeholders, policymakers can address concerns related to technology safety, ethical considerations, and equitable distribution of benefits to the farmers. For instance, Corteva collaborates with local farming cooperatives to exchange research findings, implement best practices, and co-create innovative solutions tailored to regional climate challenges. Through these collaborative efforts, stakeholders collectively develop strategies to effectively mitigate the impact of climate change and ensure long-term food security. This approach not only empowers farmers with access to the latest advancements in crop protection technologies and techniques but also allows Corteva to contribute to the sustainability of agriculture on a global scale.



# SATHI

## ENHANCING THE DIGITAL ECOSYSTEM FOR SEED

Delivering seeds with genetic integrity and physical/physiological quality in compliance with enacted seed laws is paramount for India. The comprehensive seed regulations in India, including The Seeds Act (1966), Seeds Rules (1968), The Seed (Control) Order (1983), New Policy on Seed Development (1988), National Seed Policy 2002, Protection of Plant Varieties and Farmers' Rights Act (2001) and Biological Diversity Act (2002), have been instrumental in shaping the seed regulatory regime.

### An Inaccessible Seed Cycle

Making quality seed available at an adept time to the seed stakeholders is the crux of the seed multiplication chain, for which elaborate planning and forecasting is done where Indian Council of Agriculture Research (ICAR) institutes and State Agriculture Universities (SAUs) proceed for breeder seed production based on seed demand for various crops, three years in advance received with the Ministry of Agriculture and Farmers Welfare (MoA & FW) from concerned line agencies, i.e. state agriculture departments. Breeder seed produced from the originating/ sponsored institute is further multiplied to foundation and certified seed by National Seeds Corporation (NSC), State Seeds Corporation (SSCs), SDAs, Co-operatives, Farmer Producer Organizations (FPOs), private sector companies etc. before it reaches the farmers. However, the holistic mechanism to access complete seed life cycle over multiple seed generations starting from nucleus to breeder seed, breeder to foundation



seed, foundation seed to certified seed, and further distribution through licensed dealers, which are necessary to ascertain the supply of quality planting material to farmers, was missing.

### Genesis of SATHI portal

The lack of robust traceability mechanisms has often resulted in challenges such as counterfeit seeds, adulteration, and inefficiencies in supply chains. To



At its core, the SATHI portal harnesses the transformative power of technology to instill transparency, accountability and trust in the seed ecosystem.

address this longstanding challenge, the MoA & FW in collaboration with ICAR and National Informatics Centre (NIC) developed Seed Authentication, Traceability and Holistic Inventory (SATHI) portal and mobile application. At its core, the SATHI portal harnesses the transformative power of technology to instill transparency, accountability and trust in the seed ecosystem. Leveraging cutting-edge innovations such as blockchain, QR code and data analytics, the portal provides a comprehensive platform for stakeholders to seamlessly track, authenticate, and manage seeds at every stage of their journey.

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### Salient features of SATHI portal

**Seed Traceability:** Each seed batch is assigned a unique identifier, enabling stakeholders to track its movement across different nodes of the supply chain. By scanning the QR codes, users can access detailed information regarding the seed's provenance, quality parameters, and distribution channels.

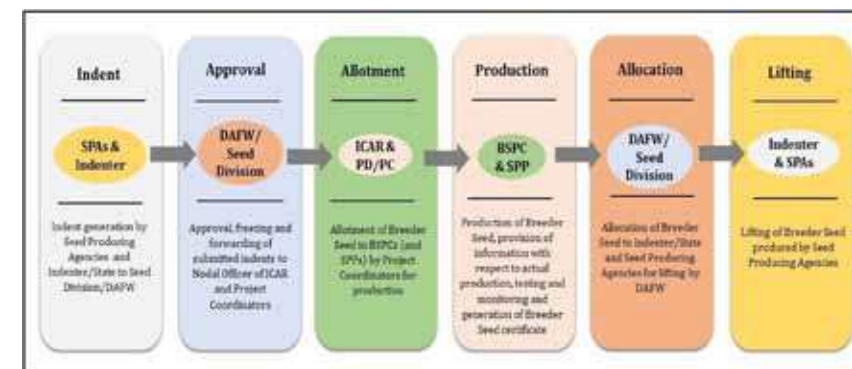
**Quality Assurance:** The SATHI portal integrates robust quality assurance mechanisms, encompassing seed quality parameters through real-time monitoring and data analytics, stakeholders can ascertain the quality of seeds, thereby fostering confidence and reliability in agricultural inputs.

**Authentication Mechanisms:** To combat counterfeiting, the SATHI portal employs sophisticated authentication techniques, including cryptographic hashing and digital signatures. By verifying the authenticity of seed packets and certificates, stakeholders can mitigate the risks associated with spurious seeds.

**Data Management and Analytics:** The SATHI portal serves as a centralized repository for seed-related data, encompassing parameters such as indents, production volumes and sales transactions. Through advanced analytics, stakeholders can derive actionable insights and optimize resource allocation in seed chain.

**Regulatory Compliance and Reporting:** The SATHI portal facilitates seamless compliance with regulatory requirements by automating documentation. By maintaining comprehensive records of seed transactions and certification, stakeholders can demonstrate adherence to statutory norms and facilitate regulatory inspections with ease.

The generation of GIS reports of seed production plots based on Bharat Map Interface, offline-friendly and device-agnostic mobile application, Quality inspection module for the quality check of the inspection process, system-generated sample slips on processed verification data, online forwarding of the samples to the seed testing laboratory



Process flow for nucleus to breeder seed module

The SATHI portal facilitates seamless compliance with regulatory requirements by automating documentation

and issuing of tag certificates based on digital tag registers are some of the salient features of SATHI portal.

### Modules in the SATHI portal

#### Nucleus to breeder seed management

This module is pertinent to NARES (ICAR institutes and SAUs) which are basically involved in production and supply of breeder seed. The breeder seed indent generation to ICAR, SAU, and breeder seed production centre, registration of breeder seed production centre, allocation of breeder seed through programmed functionality by PC/PDs, monitoring and reporting, issue of breeder seed tags and lifting of allocated breeder seed by indenters are integrated into the system.



#### Breeder to certified seed management

The above module is pertinent to seed producing agencies for production of other seed classes (F/S, C/S & TFL). Online registration of seed growers, SPAs (Seed Producing Agencies) and SPPs (Seed Processing Plants), verification of seed source, class, and other requirements of the seed used for raising the seed crop through the mobile application, field inspections to verify seed to the prescribed field standards using an offline mobile app, sampling, testing, billing and accounts management modules, permission modules to allow SPAs/ SPPs for interstate permission, small-size bag allocation, venturing with other marketing firms, applying unique and distinct tags to the lots with the help of the tag register, etc. are some major features of this module.

The SATHI, with its intensive, accurate, and up-to-date record makes tracking and dispatching of inventory secure and easier. SATHI aims to make the seed supply chain more efficient and accessible. It saves time and resources, improve traceability, while guaranteeing uncompromised seed quality and purity. It makes the working of seed production chain uncomplicated for everyone involved in the process. As the agricultural sector embraces digital transformation and innovation, SATHI emerges as a beacon of progress, resilience, and sustainability in the journey towards food security and rural prosperity.



# DIGITIZATION IN SEED MANAGEMENT

The food journey begins with seeds, and it plays a fundamental role in the entire food ecosystem – by supporting the livelihoods of farmers and rural communities, improving food security and nutrition, contributing to sustainable use of agri-input resources, and mitigating climate change.

According to industry estimates, the Global Seed Market stood at USD 67.02 billion in 2022 and is projected to register a Compound Annual Growth Rate (CAGR) of 4.21% to reach USD 85.81 billion in 2028.

## Challenges and Opportunities

Key findings from the internal desk research for the Seed Production Segment conducted by Cropin highlights the following Challenges

- Transparency across the business value chain (62%)
  - Reducing costs and/or growing revenue (57%)
    - Demand forecasting (52%)
    - Collecting accurate data across the business value chain (42%)
      - Traceability in agriculture (41%)

The majority of respondents cited transparency across the business value chain as the top business challenge in seed production. That is because transparency ensures ac-

**To ensure transparency, it is vital for seed producers to adopt solutions that enable geotagging of plots, setting pest and weather alerts, predicting accurate demand, end-to-end traceability in agriculture of the seeds and much more.**

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countability and traceability from farm-to-fork that serves as proof for seed certification and improves brand loyalty as well as the company's performance. To ensure transparency, it is vital for seed producers to adopt solutions that enable geotagging of plots, setting pest and weather alerts, predicting accurate demand, end-to-end traceability in agriculture of the seeds and much more.

## Improvement of Financial Metrics

Seed germination companies can drive transparency and increase revenues by accelerating the pace of digitalization in agriculture. It will eliminate fraud and ensure food safety, while also helping to optimize costs and increase revenue. In the next two years, 83% of seed companies aim to digitize their business value chain, as against 47% now. The industry expects 12% increase in revenue and 16% decrease in costs. Further, every business segment, i.e., research and development, operations, sales, and marketing, is set for digital transformation.

## Intelligent Seed Companies

Data collated by deploying technology can be a dead end if it is not mined, refined, and distributed across the business value chain. Turning data into valuable insights will help businesses make well-informed decisions to mitigate risk and improve performance. The projected shift towards digitalization can be seen as 48% of the data collected was digitized in 2022 and 85% of the data collected will be digitized in 2024.

Seed production companies can leverage predictive intelligence to analyze trillions of datasets collated through various devices at the farm level. Remote end-to-end monitoring can help with informed decision-making to optimize the usage of agri-input resources, maximize yield sustainably and reduce operational costs. It democratizes data, provides business intelligence to enterprises, and triggers timely interventions at every crop stage from sowing to harvest to improve agricultural productivity.



**Agriculture technologies such as Artificial Intelligence (AI), automation, and IoT in agriculture, make technology truly intelligent, enabling it to predict accurate demand and supply, provide valuable insights, and efficient decision-making capabilities.**



## Master New Tools to Unlock New Growth

Agriculture technologies such as Artificial Intelligence (AI), automation, and IoT in agriculture, make technology truly intelligent, enabling it to predict accurate demand and supply, provide valuable insights, and efficient decision-making capabilities. However, research shows that most seed companies have not started with automation, IoT and AI in agriculture. Getting started with the right tools is key to tapping into the potential of technology.

## Farmer Engagement Practices Need to be Revamped

Building farmer trust and credibility with continuous communication has not been practiced extensively by seed companies. Of the respondents 90% agreed farmer engagement practices must be overhauled and 54% identified building farmer trust and credibility as the key benefits of digitalization. With farm digitization, companies can provide contract farmers with real-time yield estimation and help plan the harvest and procurement by remotely detecting farms ready for harvest.

The seed production industry must drive digital transformation to solve the challenges of further growth.



# MICROPROPAGATION TECHNOLOGY PARK

## A UNIQUE FACILITY FOR QUALITY PLANTING MATERIAL

**M**icropropagation is in vitro mass multiplication of genetically identical plants of superior genotype, ensuring uniformity and disease-free planting material in a short period of time. Tissue culture offers several advantages over conventional methods of seed production to improve seed/planting material quality to enhance crop production and productivity. Tissue culture helps to produce genetically identical plants and consistency in quality planting material. Through tissue culture, pathogens and diseases can be eliminated or minimised from parent plants, resulting in healthier material and improved yield.

By harnessing the capabilities of tissue culture for seed / elite planting material, production can be significantly enhanced with improved quality, quantity, and diversity of seeds. This would contribute to improved agricultural productivity and sustainability. By taking advantage of plant tissue culture technique, TERI is a pioneer in developing a tissue culture unit for mass multiplication of economically important plant

Tissue culture techniques like somatic embryogenesis and protoplast fusion enable the development of genetically modified seeds with desirable traits such as disease resistance, increased yield, or improved nutritional content. Tissue culture allows for the conservation and propagation of rare or endangered plant varieties, thereby safeguarding genetic diversity and enhancing seed quality for future production.

species, particularly horticultural crops like bananas and potatoes.

### Micropropagation Technology Park (MTP)

TERI has one of the oldest and the most unique plant micropropagation facility called Micropropagation Technology Park (MTP) at its campus in Gual Pahari, Gurugram. This facility was developed with support from the Department of Biotechnology, Government of India in the year 1989 to produce disease-free and superior quality planting materials with a production capacity of 2 million plants annually. This facility is ISO 9001 certified and accredited under the National Certification System for Tissue Culture Raised Plants (NCP-TCP) Department of Biotechnology, Government of India and is managed by dedicated research scientists and production staff. Through mass production of certain horticultural, medicinal and aromatic plants etc. that give economically higher return along with proactive market linkage and business development efforts, livelihoods of small and marginal farmers have been enhanced.

### Production Protocols

The development of commercial micropropagation protocols has enabled large-

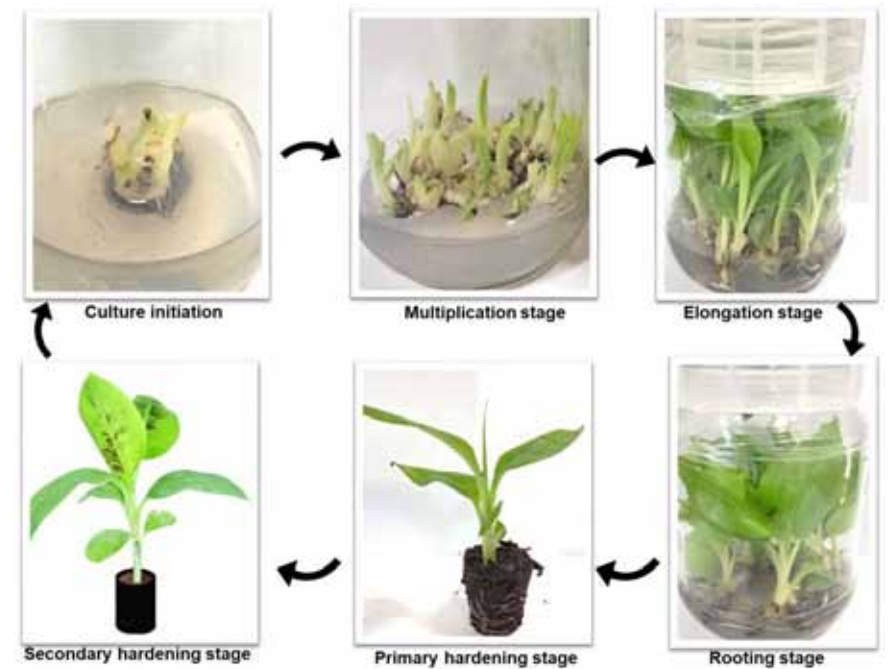
TERI has one of the oldest and the most unique plant micropropagation facility called Micropropagation Technology Park (MTP) at its campus in Gual Pahari, Gurugram.

scale production of superior quality planting material and the MTP has protocols of over 70 horticultural, forestry medicinal herbs and ornamental plant species.

MTP has developed a commercial micropropagation protocol for potato microplants generation for mini-tuber/seed production. Potato seed production is largely being done by conventional seed production system which involves clonal multiplication and the use of potatoes eyes cutting. It has several drawbacks as it often involves manual processes such as planting tubers or seeds in fields, which limits the rate at which seeds can be multiplied. This can lead to insufficient seed quantities for large-scale production or distribution. The conventional system is susceptible to the spread of viruses and other pathogens, which can rapidly deteriorate seed tubers and compromise their quality. This poses a significant risk to crop yield and overall agricultural productivity. On the other hand, high-tech seed production system involves in vitro multiplication of disease free micro-plants and micro-tuber followed by mini-tuber production in insect net houses.

In brief, tissue culture offers several advantages in terms of genetic and phenotypic uniformity, pathogen-free planting material, genetic modification, rapid multiplication, and conservation of rare varieties as compared to the conventional system of seed/planting material production. However, both methods have their respective strengths and applications depending on the specific requirements of seed producers and the desired traits of the resulting planting material.

### Diagrammatic representation of different stages of plant micropropagation



TERI performs virus indexing of all tissue culture raised plants before dispatching to the clients. So far, over 50 million tissue-cultured plants from the MTP have been supplied to various state forest departments, horticulture departments, Spices Board, NGOs, agro-based companies, entrepreneurs, and progressive farmers for field demonstrations and routine plantations. Additionally, the MTP undertakes several activities to disseminate information and capacity development. It organises workshops, seminars, and training programmes for a wide array of professionals including researchers, foresters, horticulturists, government officials, private entrepreneurs, farmers and students. Besides producing disease free planting material, MTP conducts research/production of plants based on choice of clients and provides training to start-up entrepreneurs and technical workforce for industry.



### About the AUTHORS

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(TERI) and **Dr Shyam  
Sunder Sharma**



# KHARIF SEASON IN INDIA CHANGING DYNAMICS AND EMERGING PERSPECTIVES

India, being a sub-continent, has long relied on the predictable rhythm of El Niño for its seasonal rainfall. However, this reliable pattern has been disrupted by shifting weather dynamics caused by climate change. Erratic weather conditions cast a shadow of uncertainty over Kharif crops, leaving farmers vulnerable. Yet, amidst this situation and changing dynamics, there are a few emerging opportunities which should ensure to minimise impact of climate change and ensure food security.

Every state in our country has a different Kharif season, which typically lasts from June to September. The crop is planted in June, right at the start of the monsoon season and harvesting is done in September or October. Kharif crops include rice, maize, cotton, soybeans, groundnuts and bajra. In their final area coverage report for Kharif crops, dated September 29, 2023, the Department of Agriculture and Farmers Welfare, Government of India, stated that, aside from key crops like rice, the area sown for crops like pulses, oilseeds, cotton and jute declined in 2023 compared to 2022.

## Impacting Sowing Patterns

The decline in the area cultivated for vital Kharif crops reflects the impact of climate change. This phenomenon extends beyond India, illustrating challenges posed to global food security by erratic rainfall, heightened droughts and soaring temperatures. Indeed, the shift in Indian monsoon patterns, primarily attributed to the El Niño effect in recent years, has not only led to drought-like conditions but also disrupted sowing patterns in numerous states.

Data from the Drought Early Warning System (DEWS), India's inaugural real-time drought-monitoring platform managed by IIT Gandhinagar, depicts a concerning picture. As of the first week of September 2023, approximately 30% of India's land area grappled with varying degrees of drought. This worsened the already precarious situation for farmers reeling under crop failure and amplified their concerns regarding food security. At least, 11.5% of the land faced severe, extreme dry conditions, while 18.9% experienced abnormal to moderate dryness.

**Harnessing technology in agriculture is pivotal for sustaining production levels, fortifying food security and bolstering resilient agricultural practices.**

Farmers are facing more difficulties as a result of such drought stress. Firstly, they had to postpone planting in June and July due to insufficient rainfall. Secondly, they had to deal with crop failures and lower crop yields, particularly during the vegetative and reproductive stage when rainfall is either low or excess in some regions. For example, the area under the Kharif crop has decreased margin-

ally by 2.72 lakh hectares in Maharashtra alone. 137.50 lakh hectares of land were sown in 2023–24, compared to 140.22 lakh hectares over the same period in the previous year.

## Decline in Productivity

In addition to the decrease in area under Kharif cultivation, the productivity of food grains has also decreased, directly



## About the AUTHOR

**Mr Ankur Aggarwal,  
Managing Director,  
Crystal Crop Protection  
Limited**

Presently, the only states with more than half of their net cultivable area using micro-irrigation systems are Sikkim, Andhra Pradesh, Karnataka and Maharashtra. By comparison, 27 states in India have less than 30% of their area covered by micro-irrigation, with 23 of them having less than 15% of the total. Interestingly, just 1.5% of the land in Uttar Pradesh, the state that produces the most water-intensive sugarcane, is covered by micro-irrigation; Punjab, another major agricultural region, falls even farther behind with just 1.2%. So there is ample scope to enhance micro-irrigation and the good news here is that by focusing on micro-irrigation we can slowly turn the tables on climate change.



impacting the income of farmers. The Deccan zone has witnessed a surge in drought frequency since 1986 and there has been a substantial monsoon rainfall deficit of approximately 21.25% during the critical June to September period, coinciding with the tillering and grand growth stage of sugarcane. This imposed drought during crucial growth phases emerges as a significant obstacle in achieving optimal cane productivity in sugarcane-growing states. Such statistics underscore the urgent need for proactive measures to mitigate the impact of drought on agricultural productivity and ensure the stability of food supplies in the face of increasingly erratic climatic patterns.

## The Good News

Harnessing technology in agriculture is pivotal for sustaining production levels, fortifying food security and bolstering resilient agricultural practices. A prime example is the micro-irrigation sector in India, poised to be a game-changer in mitigating the adverse impacts of unpredictable Indian monsoons. Despite a total sown area of 140.13 million hectares, only 68.38 million hectares benefit from irrigation, leaving a substantial 71.74 million hectares dependent on rain-fed agriculture. The adoption of micro-irrigation stands at a mere 19%, significantly lagging behind many other nations. This underscores the urgent need to accelerate the adoption of innovative irrigation technologies to optimize water usage, enhance crop yields and safeguard agricultural livelihoods in the face of climatic uncertainties.

Water conservation is also an impor-

**To combat climate change, the government must tackle erratic monsoons and incentivize private participation to increase the adoption of water conservation technologies.**

tant element in this fight against climate change. The government has been proactive in launching various schemes like Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Jal Shakti Abhiyan (JSA) and Atal Bhujal Yojana (ATAL JAL) to enhance water access, improve efficiency and promote sustainable practices. To combat climate change, the government must tackle erratic monsoons and incentivize private participation to increase the adoption of water conservation technologies.

The cultivation of the 4 Ms - Millets, Maize, Mustard and Moong - is crucial for mitigating climate change due to their resilience to rising temperatures, heat-waves and dry spells, as well as their water efficiency and adaptability to various agro-climatic conditions, ensuring food security in the face of climate change.

## Threats to Agricultural Sustainability

The Council on Energy, Environment, and Water (CEEW) analysed monsoon trends at the sub-divisional (tehsil) level from 1982-2022. They found that ap-

proximately 11% of India's 4,400 tehsils witnessed a decrease in rainfall. Within these tehsils, about 68% experienced reduced rainfall throughout all four monsoon months, while 87% observed a decline during June and July, crucial for Kharif crop sowing. The majority of these affected tehsils are located in the Indo-Gangetic plains, North-eastern India, and the Indian Himalayan region, regions that collectively contribute to over half of India's agricultural production.

Factors like seasonality, management practices and climate change could severely compromise crop production. Another aspect is that the indirect consequences of Climate Change, such as uncertain rainfall, droughts, floods, irrigation changes, soil alterations, crop-pest competition and coastal submergence, pose greater threats to agricultural sustainability than direct effects on crop growth. Simulation studies suggest that immediate impacts on Indian agriculture may be manageable if nutrition level of the soil is maintained and biotic and abiotic stress is monitored and controlled by adopting integrated pest management solutions.

Long-term impacts of global climate change may take decades to unfold, but other drivers such as shifting demands, markets and agricultural technologies are poised to rapidly transform Indian agriculture in the near future. The pace of these changes is expected to escalate over the next decade or two, reshaping the agricultural landscape significantly. Therefore, it is crucial to embrace latest practices and deploy advanced technologies amidst climatic uncertainties to sustain production and ensure food security goals for the nation.



# OIL CAKES - FOOD, FEED, FERTILIZER AND FUEL

Oilseeds are a prized commodity since civilizations began. The early settlers understood their importance as food, fodder, fertilizer, fuel and even as medicine for humans and animals. Though they never served as staple food, they had their prime importance as taste enhancers and nutritious snack items. Their importance as fodder to milch animals to obtain more milk was recognized long time back. Apart from identifying the products, namely, oil and deoiled cake, the value of the other plant parts like leaves, stem, roots and flowers etc. has also been evaluated and utilized. Plant residues have since long been utilized as manure and fuel.

## Oil Cakes/Meals

Oil cakes/oil meals are by-products obtained after oil extraction from the seeds. Oil cakes are of two types, edible and non-edible. Edible oil cakes have a high nutritional value with protein content ranging from 15% to 50%. Due to their rich protein content, they are used as animal feed, especially for ruminants and fish. Upto 75% of the available oil cakes are utilized as animal feed. Another 10 to 15% is utilized as manure. Only limited quantity of the oilcakes is utilized for food purposes. Mostly soybean, groundnut, sesame and coconut cakes find use as food. Non-edible oil cakes such as castor cake, karanja cake, neem cake are used as organic nitrogenous fertilizers, due to their N P K content. Some of these oil cakes are found to increase the nitrogen uptake of the plant, as they retard the nitrification

Globally, a wide variety of oilseeds are cultivated. Important oilseed crops being cultivated are mustard/rapeseed, soybean, sesame, groundnut, sunflower, niger, castor, linseed and safflower. Except the oils derived from castor and linseed, the other oilseeds serve as edible oil sources. The four important edible oils of tree origin are palm, olive, coconut and avocado. In addition, we have a few byproduct oils which also significantly contribute to the world edible oils kitty. The germ tissues of the grains of rice and maize (corn) are rich sources of oil, which are produced worldwide in large quantities. These two oils are considered byproduct oils. Similarly, cotton seed oil is another byproduct oil as cotton lint is the main product utilized by the textile industry.



**India exports oilseeds worth Rs.9600 crores and 36.8 lakh tonnes of oil meal worth Rs. 8015 crores.**

of soil. They also protect the plants from soil nematodes, insects, and parasites; thereby offering great resistance to infection.

## Edible Oilcakes

Groundnut, Sesame, Niger, Soyabean,

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Olive and Coconut oilcakes, can be safely consumed by humans and animals. They are protein rich and hence have utility in energy rich foods, biscuits etc. They are used as processed ingredients (hydrolysate, protein concentrate and protein isolate) or as substrate (in the production of amino acids, flavors, bioactive compounds, pigments, antibiotics, surfactants, enzymes and vitamins). Protein isolates and protein concentrates, dairy and meat analogues can be prepared from the edible grade oil cakes.

## Export Value

The positive strength of the oilseeds is that they have high export value. The top exporter of oilcake in the world is India with 52,257 shipments followed by Nepal with 8,194 and China at the 3rd spot with 5,401 shipments. India exports oilseeds worth Rs.9600 crores and 36.8 lakh tonnes of oil meal worth Rs. 8015 crores. Castor oil, its products and other oil exports earn around Rs.14,710 crores. Export of value added oil and oilseed products fetch around Rs.206 crores. All these add up to Rs. 32,531 crores. Value addition naturally will increase the value with higher export earnings.

## Alleviating Malnutrition

Hygienically processed flours can be used for edible purposes. Their use in preparation of multipurpose flours, biscuits, dairy and meat analogues etc. will enhance their value. Other cakes from rapeseed, sunflower, safflower, niger and linseed, being richer in fibre content, can go as poultry, cattle, and fish feed. Groundnut oilcakes improves the animal's overall body functioning. They are packed with carbohydrates, fats and protein. Castor cake and other non-edible (unhygienic) cakes can serve as organic manure and will help us in increasing the yields of crop plants.

The oilseed cakes are rich in protein, nitrogenous compounds, and minerals. Considering the exponentially increasing human population and escalating



**Edible oil cakes have a high nutritional value with protein content ranging from 15% to 50%.**

food prices, these protein rich oilseed cakes can be used to extract protein. The quality and functional properties of extracted oilseed cake proteins not only supplement the existing protein sources for the human consumption but also solve the problem of disposal of oilseed cakes along with additional income to the oilseed crop producers/farmers and processors. Production of proteins for human consumption from oil seed cakes may also reduce the carbon and water footprints while producing animal protein.

## Low- Fat, High Protein Products

Very often, the proteins present in pristine conditions, get partially or fully denatured due to the drastic processing conditions. This results in a tremendous drain of high-quality proteins, but can be well preserved if suitable care is taken. The development of low fat- high protein oilseeds is one route through which the quality of oilseeds can be maintained for food uses. The dehulled oil cake powder can be used in the recipes like chapatti, baked items, and pakodi. Groundnut, soyabean, sesame and dehulled sunflower cake have lot of scope and potential for utilization in various food products.

## Oilcakes in Agriculture

Oilcakes are rich in NPK and its use as a fertilizer can improve soil health and crop yield. By adding organic matter to the soil, oilcakes can improve soil structure, and fertility and help in reducing soil erosion, increasing water retention, and encouraging healthy root growth. Natural compounds like oilcakes can act as a repellent to pests, reducing the need for chemical pesticides. Nitrogen fixing bacteria can be found in soybean and groundnut oilcakes, thereby increasing soil nitrogen contents. Organic fertilizer can convert chemical nitrogen fertilizer into a less soluble form which is highly advantageous.

## Future Prospects

Oilseed cakes are rich in nutrient content such as fiber, protein, and energy. Also, they are attractive due to their availability and being relatively cheaper. The cakes contain up to 60% protein and the edible cakes of soyabean, groundnut, sesame, coconut and dehulled sunflower have prime potential in utilization as food. Simultaneously, protein concentrates and protein isolates can also be prepared from the cakes and utilized as baby and convalescent foods. They also can be added to cereal foods to improve their nutritional value. The cattle feed rate is increasing every year because of the insufficiency of farm lands to grow the feed. Thus, the cattle feed production from oilseed cakes appears feasible and beneficial. The utilization of oil processing factory waste as biomass and to generate beneficial products is helpful, efficient, and cost-effective.



# QUALITY FIRST: THE ROAD AHEAD FOR THE INDIAN SPICES INDUSTRY

Recently, established Indian spices brands MDH and Everest found themselves in the eye of an international storm as authorities in the US, Hong Kong, and Singapore raised red flags over the quality of their products. Both brands have vehemently denied any wrongdoing and have reassured consumers of their commitment to stringent health and safety standards, both domestically and internationally.

The controversy stems from a series of findings indicating discrepancies in the standards of these spices giants, prompting a closer examination of the Indian spices industry's practices at large. According to an article by NDTV, an extensive analysis of over 1.23 lakh food samples conducted between 2023 and 2024 revealed alarming results. Out of these samples, a staggering 24,794 failed to meet the required standards set by FSSAI. Among the samples scrutinized were 38,661 spice samples, the brands of which were undisclosed.

The controversy underscores a broader issue within the spice industry - the need for stringent regulations and quality control measures. The lax oversight of farming practices, including the indiscriminate use of pesticides by farmers desperate for crop growth, poses a significant risk to consumer health. Additionally, the reliance on carcinogenic chemicals like ethylene oxide for spice sterilization further compounds these risks.

Given these advancements, one of our investee companies Azad Agro, sets a precedent for responsible and ethical practices in the spice trade, by directly sourcing agricultural produce from registered farmers and prioritizing



At the heart of this controversy lies the use of ethylene oxide, a chemical banned by European authorities due to its carcinogenic properties. Ethylene oxide is used as a fumigant in the sterilization process of various foods, including spices. Despite its ban in many regions, the US Environmental Protection Agency (EPA) has set tolerances for ethylene oxide residues in various food items, indicating its potential presence in imported products. For example, 7 ppm on herbs and spices, liquorice roots, dried peppermint tops, sesame seeds, dried spearmint tops, and dried vegetables.

**Many spice brands are mere marketing agencies that have made hardly any investment in forging quality backward linkages and quality processing infrastructure.**

#### About the AUTHOR

**Ritwik Bahuguna, Director of Farlense Group & Founder- Roots Foundation. & Prashasti Yadav, Manager Communications, Farlense Group**



education and empowerment at the grassroots level.

#### The Way Ahead

It should not come as a surprise if the quality of ingredients (resulting end products) for most spices' brands being sold in India is found wanting (read inferior) by regulatory authorities. A constant struggle to retain or increase margins in a very price-sensitive market is a major reason for this phenomenon. Many spice brands are mere marketing agencies that have made hardly any investment in forging quality backward linkages and quality processing infrastructure.

As the next step, the food regulator must test the products of all major brands selling in India and come out with the results in public. At another level, the food regulator must also benchmark the parameters it has laid down for Indian brands against those set by their counterparts in developed countries. Government and consumer pressure will force brands to rethink their business models. In parallel, brands must invest in farmers to improve the POPs and technical know-how. Quality raw material is the

#### Azad Agro's (AA) Holistic Approach – A Successful Case Study

Azad Agro, based out of Kota in Rajasthan, is a leader in supplying IPM coriander and cumin to various brands and B2B buyers. Its team of experts has complete control over the entire value chain of these spices with SOPs based on the following principles –

- Development of an internationally acceptable package of practices (regularly updated).
- Education of registered farmers on best practices in crop cultivation.
- Complete handholding, training, and supervision of farmers during the entire cropping cycle, including testing for banned molecules.
- Development of requisite infrastructure for procurement, logistics, processing & packaging, including steam sterilization, a more natural way of processing that aligns with international regulatory standards and ensures minimal distortion in taste as far as consumption is concerned.
- Strong forward linkages, primarily catering to MNCs.
- Appropriate use of technology in the entire chain (Source Trace App etc.)

**Quality raw material is the first step in the supply chain.**

first step in the supply chain. They must also invest in quality processing and packaging infrastructure. Ample central and provincial government funds are available as incentives for infrastruc-

ture creation in food processing. There is a global phenomenon of more aware consumers demanding better quality products, more accurate labelling, and environment-friendly packaging. The Indian spices industry has no option but to fall in line and follow ethical and sustainable practices to manufacture quality products. Our investee company Azad Agro's success shows that profitability and quality can go hand in hand.



# Industry Speaks.....

India's new government under the leadership Shri Narendra Modi assumed office on 9<sup>th</sup> June 2024. Narendra Modi is the first person after Jawaharlal Nehru to be elected as PM for the third consecutive term. After assuming office, the first file that he signed was the file authorising the release of the 17th instalment of PM Kisan Nidhi, which will benefit 9.3 crore farmers and distribute around Rs 20,000 crore. "Ours is a government fully committed to Kisan Kalyan. It is, therefore, fitting that the first file signed on taking charge is related to farmer welfare. We want to keep working even more for the farmers and the agriculture sector in the coming times," PM Modi said after signing the file.

The continuity in the government has kept the hopes of industry buoyant and PM's keen interest in farmers' welfare has become evident by induction of Shri Shivraj Singh Chouhan as the Minister of Agriculture and Farmers' Welfare, who has turned around the fortunes of Madhya Pradesh during his reign as the Chief Minister. Here is a collation of industry's views and expectation from the new government



## Raju Kapoor, Director- Corporate Affairs, FMC Corporation



"The new council of ministers showcases a commendable balance between continuity and innovation. The inclusion of both seasoned veterans and fresh faces ensures that the government can leverage the strengths of both. While it would have been ideal to see more representation from women, the overall composition is still a positive step forward.

I am particularly pleased to see Mr. Shivraj Chauhan at the helm of the Agriculture and Rural Development Ministry. His extensive experience, leadership skills, and grassroots understanding make him an excellent choice for this critical portfolio. At FMC, we are committed to supporting initiatives that promote sustainable agriculture and rural development, and we look forward to collaborating with Mr. Chauhan and his team to leverage our expertise in crop protection and precision agriculture to help farmers achieve higher yields, while minimizing

environmental impact".

## Dr. KC Ravi, Chief Sustainability Officer, Syngenta India Pvt. Ltd & Chairman CropLife India



"At Syngenta we extend our heartfelt thanks to Prime Minister for his unwavering commitment to the welfare of our farmers. His dedication in keeping the interests of farmers at the forefront has been evident throughout the first two terms and it is truly commendable to see the focus continue in the third term.

Authorizing the release of the 17th installment of the PM Kisan Nidhi, highlights the steadfast commitment to *Kisan Kalyan*. Over the past ten years, under PM's leadership we have witnessed a series of transformational measures to take agriculture to a higher growth trajectory. The agriculture sector will get a further boost with the induction of Shri Shivraj Singh Chouhan, Shri Bhagirath Choudhary and Shri Ramnath Thakur and I am confident that the focus will

continue to be on financial support, sustainable practices, market access, technological integration, and women empowerment. The government has ensured that Indian agriculture remains resilient, productive, and sustainable. Under PM's visionary leadership, we are confident that the agriculture sector will continue to flourish, and our farmers will thrive".

## Mr Ajai Rana, Business Head, Asia Pacific, RiceTec & Chairman, FSII



"India's agriculture sector is thriving with opportunities and positive interventions will go a long way in propelling this sector ahead.

The government has always showcased its unbridled commitment towards this sector. Coupled with enabling policies, this will go a long way in benefitting the country's agrarian community.

Agriculture is a cornerstone of economic development and we remain eager to work closely with the new administration to drive forward its initiatives."

## T. R. Keshavan, President:Corporate Relations & Alliances at Tractors & Farm Equipment Ltd.



"Modi 3.0 clearly demonstrated the confidence reposed by countrymen on progress led/ oriented governance. Focus on continuity and stability in reform process by the new cabinet across sectors like infrastructure and skills & education is now expected. Going forward, thrust on rural development and targeted reforms on agriculture & allied sectors that can augment farmer's retained income, are much needed."

## Ajay S Shriram, Chairman & Sr Managing Director, DCM Shriram Ltd



"We look forward to significant interventions by the new government to provide support to the Agriculture sector. As agriculture falls within the ambit

of both central government and state governments, it is important to build consensus on major policy issues as well as the reforms required.

I hope an institutional mechanism can be created to play a coordinating role, a GST Council type body should be set an "Agriculture Council". Such a framework can bring about substantial "ease of doing agriculture", which will eventually help in increasing farmer incomes."

## Simon-Thorsten Wiebusch, President, Bayer South Asia.

"Under the leadership of the honourable Prime Minister Shri Narendra Modi, we are pleased that an experienced leader like Shri Shivraj Singh Chouhan has been appointed as the Union Agriculture and Farmers' Welfare Minister. We sup-



port his focus on doubling farmers' incomes by improving the farm economy and increasing agricultural production through the availability of high-quality seeds and fertilizers. Moreover, the approval of the 17th installment of PM Kisan right after the cabinet formation demonstrates the government's continued commitment to securing farmers' incomes. In line with the Prime Minister's initiatives, India has introduced new varieties of Direct Seeded Rice, which will help increase paddy production and reduce water usage for this crop. We hope that the new government continues the commendable work done by the previous minister, with a special focus on enhancing the accessibility of modern technologies, quality inputs, and digital advancements such as the use of drones in agriculture. Additionally, the sustained push to make India self-sufficient in edible oil and pulses would be a positive step."

## Dr. RS Sodhi, President, Indian Dairy Association and Chairperson, NIFTEM - T



"We believe the Ministry of Agriculture and Minister of Commerce and Industry should not yield to the industry's demand to reduce import duty. The prosperity of farmers and the reduction of urban and rural disparity will only come about, if rural produce prices are remunerative. Rural economy will only improve, if flow of money into villages increases. That can happen with better pricing as productivity growth is only 1.5-2%.

To reduce the impact of higher food prices on lower class, minimum wages

should be increased. But it will impact the profitability of Industry or corporate world. So in a nutshell food inflation is being controlled so wages can be lowered and industry profits can be increased. Farmers are paying for India's prosperity."

## Dr MJ Khan, President of Indian Chambers of Food and Agriculture



"I must congratulate the PM for selecting the best Cabinet, and entrusting the portfolios to the right persons. While continuity of the S4, CCS Minis-

ters- Defence, Home, Finance and Foreign, ensures larger social and economic stability, the new Ministers at the key ministries of food and agriculture, animal husbandry and dairy, fertilisers and food processing and water resources, will provide fresh perspective and growth impetus. Selection of the Agriculture Minister, Shivraj Singh Chouhan, in particular, is great hope. He is seasoned politician to deal with the complex farmers issues and challenges, and a performing minister to deliver to the expectations of the agriculture sector. As chief minister of Madhya Pradesh, under his vision and leadership the state registered double digit growth in agriculture for almost a decade. The Agriculture Today Group recognized the State by Agriculture Leadership Awards three times in the ten years time, including conferring the policy leadership award upon him in the year 2016. The sector has great hopes from him, and expects the ministry to focus on key challenges and opportunity areas, ranging from climate resilient agriculture system to nutrition smart crops, and greater thrust to digital technologies and precision farming to post harvest infrastructure and farm level processing by FPOs to promoting crop diversification and eco-agriculture to undertaking the market reforms and boosting Startups to agribusinesses."



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