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Seeds of Hope, Growth and Prosperity for the Amrit Kaal

In India, where agriculture serves as the backbone of the economy, the seed industry plays an irrefutable role in ensuring food and nutritional security for the 1.4 Billion. With continued emphasis on breeding, research and seed improvement programs since Green Revolution in both the public and private seed sectors, Indian seed industry gained international recognition. Government of India has taken several proactive measures to foster the industry's development and think tanks like NITI Aayog strongly reinforce the need for enhanced synergy between public and private sectors particularly, for R&D. Several initiatives have been implemented to facilitate access to high-quality seeds at affordable prices, empowering farmers with the essential inputs for maximizing agricultural productivity. These efforts have resulted in remarkable growth, aligning the industry with the evolving needs of farmers.

The socio-economic impacts of the seed sector extend beyond agricultural boundaries, generating employment opportunities, fostering entrepreneurship, and contributing to overall economic prosperity, sustainable practices, climate resilience. Use of quality seeds has proven to be a game-changer, boosting crop yields by an astounding 20-30%, leading to higher incomes for farmers and contributing to poverty reduction.

The industry's growth, in the past 2 decades, has been driven by innovations in biotechnology, genomics, and precision agriculture, addressing challenges such as drought tolerance, pest & disease resistance, and improved nutrition content etc. However, widespread awareness about these innovations remains limited, leading to unfounded fears and negative perceptions. Bridging this knowledge gap is crucial to dispel myths and ensure science-based and unbiased policymaking.

Hence, targeted outreach and communication efforts by the seed industry are to be stepped up to engage stakeholders across the food value chain, including farmers, researchers, policymakers, and the public. By highlighting the transformative potential of innovative technologies, the industry can foster enthusiasm and drive their widespread adoption, ultimately propelling Indian agriculture forward.

To maximize its impact, the seed industry needs to be supported with science-based policies, predictable regulatory frameworks, sustained investments in R&D, and harmonization with global best practices. These ingredients create an enabling environment for innovation and pave the way for a sustainable agricultural research ecosystem. With cutting-edge technologies and strategic collaborations, the seed sector becomes a vital catalyst for progress and prosperity.

In the Amrit Kaal, India's seed industry is all set to seize the opportunity to drive positive socio-economic transformation. By embracing science, fostering innovation, and communicating its socio-economic benefits, the sector can lay the foundation for sustainable food production and rural development. With a steadfast commitment to shaping science-based policies and proactive outreach, the seed industry strives to navigate the path towards a prosperous future for Indian agriculture.

Raghavan Sampathkumar

Executive Director

Federation of Seed Industry of India and Alliance for Agri Innovation

raghavan.sampath@fsii.in

News from India and Around the World

How soon will gene edited seeds become the agricultural norm?

https://www.feednavigator.com/Article/2023/05/26/raboresearch-high-adoption-of-gene-edited-crop-seeds-expected-in-the-next-five-to-ten-years

Rabobank sees that expectations for gene edited crops are high, and significant growth in their adoption is projected in the years ahead. At least five factors that will determine if a GE crop can achieve a high adoption rate: 1) product performance, such as quality, yield, and consistency in

performance; 2) possible long-term risks, such as allergic and toxic reactions; 3) disruption to trade flows due to export bans on GE crops; 4) the marketing power, selling strategy, and distribution network of the input company; and 5) access to technology.

The status of transgenic crops in India

https://www.veetrack.com/showarticles.aspx?UName=496465616C6D65646961&id=323439303330 3336

The process of developing transgenic crops is an elaborate one as inserting transgenic genes into plants to elicit a sustained, protective response is a mix of both science and chance. There are multiple safety assessments done by committees before they are cleared for further tests in open plots of lands, which are located at either agricultural universities or are plots controlled by the Indian Council for Agricultural Research (ICAR).

Gene Editing Strategies for Reducing Phytic Acid in Crops

Removal of anti-nutrients in cereals may lead to healthier grains. Thus, researchers have used various techniques to reduce anti-nutrients in plants. These techniques include gene editing tools such as TALEN, ZFN, and CRISPR-Cas9. In a review article, researchers from India's Council of Scientific and Industrial Research presents potential applications of TALENs and other gene editing tools to knock out the desired genes, and RNAi for their silencing.

Update on GMOs and Health: Thirty years on, there is even more evidence that GMO food are safe

https://sciencebasedmedicine.org/update-on-gmos-and-health/

The first GMO food was approved in 1994 (a GMO tomato that is no longer on the market), so we are getting close to 30 years of GMOs. Opponents of GMOs falsely claim that they have not been studied enough (there is more evidence for their safety than other food products) and that there may be long term unknown risks. They were wrong 30 years ago, but it was at least true that GMO introduction into the food market and animal feed was new.

Multi-country effort helps develop gene-edited rice that both boosts yield and resists disease

Researchers from the University of California, Davis, and an international team of scientists used the genome-editing tool CRISPR-Cas to create disease resistant rice plants, according to a new study published in the journal Nature. Small-scale field trials in China showed that the newly created rice variety, developed through genome editing of a newly discovered gene, exhibited both high yields and resistance to the fungus that causes a serious disease called rice blast. Rice is an essential crop that

feeds half of the world's population.

Latest CRISPR food innovation: South Korea develops tomato with enhanced levels of provitamin D3. Will it go to market?

n humans, ProVitD3 is a precursor for the synthesis of biologically active vitamin D_3 and serves as a protective agent against ultraviolet radiation on the skin. Circulatory vitamin D often falls below desirable levels, particularly among individuals with limited exposure to sunlight. While dietary supplements help address this deficiency, natural vitamin D sources are restricted to a few animal-derived sources, such as fish, egg yolks, and beef liver, as fruits and vegetables have historically shown limited capacity for ProVitD3 production.

Mexican researchers investigating genetic engineering to produce drought-tolerant crops

https://www.excelsior.com.mx/nacional/ante-la-sequia-en-mexico-ug-investiga-sobre-cultivos-resistentes/1596175

Researchers from the University of Guanajuato -UG- review which crops are tolerant to drought, which with climate change are becoming more and more necessary, since they reduce food production around the world. Given the drought that Guanajuato is suffering, which has reduced up to 25 percent of the capacity of its bodies of water, teachers and students are looking for options to avoid a food collapse.

Multiplex Gene Editing Changes How Plants Grow

Technological and scientific advancements have improved in the past two decades. Today, the combination of genomics, gene editing, and artificial intelligence is propelling the next wave of breeding advancements.

enetic Information Unleashes Gene Editing Potential of Grass Pea

New genome sequence information of grass peas revealed key biochemical steps on how the plant produces toxins. The data can aid researchers in potentially applying genome editing tools on grass pea to make it less or non-toxic and become an alternative crop with natural resilience to flood and drought for farmers.

Viewpoint: 'Even if it seems like breaking a taboo, CRISPR gene editing techniques and organic farming are an excellent match'

https://geneticliteracyproject.org/2023/07/11/viewpoint-even-if-it-seems-like- breaking-a-taboo-crispr-gene-editing-techniques-and-organic-farming-are-an-excellent-match/?mc_cid=dcfc175aaf&mc_eid=b993433273

People don't like pesticides. They are even less fond of genetic engineering. But they don't want to convert natural areas into new farmland either. How are we going to feed ten billion people in the near

future? Austrian science journalist Alwin Schönberger makes a plea to embrace the latest methods of crop genetic improvement.

New Research

CRISPR/Cas9-Based Gene Drive Could Suppress Agricultural Pests

https://news.ncsu.edu/2023/06/crispr-gene-drive-could-suppress-ag-pests/

Researchers have developed a "homing gene drive system" based on CRISPR/Cas9 that could be used to suppress populations of *Drosophila suzukii* vinegar flies – so-called "spotted-wing *Drosophila*" that devastate soft-skinned fruit in North America, Europe and parts of South America – according to new research from North Carolina State University.

Could Gene Editing Create More Disease-Resistant Grape Varieties?

https://daily.sevenfifty.com/could-gene-editing-create-more-disease-resistant-grape-varieties/

Using gene-editing technologies like CRISPR, researchers are fighting back against one of the wine industry's biggest problems—powdery mildew disease

Breakthrough in fight against devastating potato disease

https://www.wur.nl/en/research-results/research-institutes/plant-research/show-wpr/breakthrough-in-fight-against-devastating-potato-disease.htm

Potato is the third most important food crop in the world after rice and wheat in terms of human consumption. But potato world production is threatened by potato late blight, one of the most devastating potato diseases which causes globally 3-10 billion euros in yield loss and management costs annually. WUR researchers made a breakthrough in fighting the disease. With the gene editing technology CRISPR/Cas, they made potato plants resistant to late blight disease caused by Phytophthora infestans.

New approach 'stacks' genes for faster plant transformation

https://www.ornl.gov/news/new-approach-stacks-genes-faster-plant-transformation

Scientists from the Oak Ridge National Laboratory (ORNL) successfully inserted multiple genes into plants using only a single step. The technique, known as gene stacking, replaces the laborious way of individually inserting genes into a targeted plant's DNA. Each transformation also requires its own

confirmation test to determine if the gene is in the right spot and orientation to exhibit the intended desired trait. Gene stacking allows scientists to do multiple gene insertions and confirmation tests in just one transformation. The new delivery method uses *intein* protein segments, which can naturally split off from larger proteins then splice back together to create new proteins.

Gene Editing Produces Non-Browning Avocado

Researchers from the California-based GreenVenus LLC biotechnology company successfully modified a crucial gene associated in the browning of avocado flesh. The new trait is expected to extend the shelf life of the gene-edited avocado thereby reducing food waste without sacrificing good taste and nutritional content.

CABBI Team Achieves Gene Editing in Miscanthus

The Center for Advanced Bioenergy and Bioproducts Innovation (CABBI) announced that its researchers successfully conducted gene editing on miscanthus. The plant, also called silvergrass, is known to be a potential as a source of novel bioproducts like oils and high-value chemicals.

Editing Cacao Gene to Make High Quality Chocolate

Scientists from the Alliance of Bioversity International and the International Center for Tropical Agriculture are using gene editing on cacao to reduce its absorption of cadmium from soil. This research aims to lower cadmium levels in chocolate. Cadmium is a heavy metal that may cause negative health effects when consumed in certain amounts. One of the problems in cacao production is the presence of cadmium in the soil where cacao trees are grown, and the trees absorb it. It will be difficult to change the soil, so the scientists decided to use biotech tools such as gene editing to address the issue.

Corteva's Proprietary Gene Editing Tool Precisely Co-locates Traits in Corn's Genome

Corteva Agriscience has published its research confirming the natural movement of disease resistance genes within a corn plant's genome. The results reveal that gene editing tools such as CRISPR can mimic this naturally occurring process, which could unlock the ability to relocate multiple disease resistance genes, speed up plant breeding progress, and deliver enhanced high-performing products to farmers.

Experts Decode Genome of Destructive Asian Soybean Rust Fungus

Researchers from the Centre for Research in Agricultural Economics (CRAG) led by Núria Sánchez-Coll

have discovered the exclusive location of AtMC3 protein in the plant vascular system and its role in drought tolerance in the model plant *Arabidopsis thaliana*. AtMC3 is a protein of the metacaspase family. The research team discovered that increased levels of AtMC3 confer enhanced tolerance to severe water scarcity without affecting plant yield.

CRAG Researchers Discover Protein that Confers Drought Tolerance to Plants

Decoding a genome provides information about how an organism functions. In the case of the Asian soybean rust fungus (*Phakopsora pachyrhizi)*, the scientists understood why it is highly variable and how this severe soybean disease can be managed to prevent production losses to farmers worldwide. Members of the International Asian Soybean Rust Genome Consortium were able to sequence and assemble the genome of three samples of the fungus *P. pachyrhizi* that causes Asian soybean rust disease.

22% yield increase: How non-photochemical quenching, or NPQ, could dramatically boost corn production

The researchers found that the speed and magnitude of NPQ responses varied widely among the lines, a fact that helped ease the search for any new genes potentially driving that variation in corn. A comparison of the lines' genetic code, cross-referenced against the differences in NPQ performance, eventually revealed six promising gene candidates. Several of those candidates were already familiar to the team. Others were not including one called PSI3, which introduced more of that variation than any other candidate.

Targeted Mutagenesis by CRISPR Improves Grain Quality and Heat Resilience in Rice

Researchers at the University of Arkansas System Division of Agriculture (UADA) showed that by suppressing the activity of a grain-specific vacuolar H+ translocating pyrophosphatase (VPP5), chalk content of the grain could be reduced.

New CRISPR-Like System Could Revolutionize Genome Editing

A team of experts led by Feng Zhang at the Massachusetts Institute of Technology (MIT) reported the first programmable RNA-guided system in eukaryotic organisms, including plants, animals, and fungi. Their findings are published in *Nature*.

Norway Approves Plant-derived Omega-3 Oil for Aquafeed

The Norwegian Food Safety Authority (NFSA) granted approval for Aquaterra® Omega-3 oil for use in

fish feed applications according to a statement released on June 28, 2023. It is said to be a more sustainable source of omega-3 oil as it reduces utilization of the world's marine resources while enhancing aquaculture growth.

'Jumping Genes' Help Plants Become More Resilient in Extreme Temperatures and Pathogen Attacks

Researchers from the Okinawa Institute of Science and Technology (OIST) and the Center for Sustainable Resource Science, RIKEN found that the model plant *Arabidopsis thaliana* expresses thousands of transcripts between regular genes and jumping genes. The researchers report that the plant alters the expression of these hybrid genes in response to extreme temperatures or pathogens.

APHIS Issues Review for Bayer's Short-Stature Corn

Bayer's genetically engineered shorter-stature corn known as Smart Corn System has received safety approval from the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS). The shorter corn plants are modified to be 30% smaller with the same yields as other corn plants.

New Zealand Expands Research on GM Grasses

AgResearch, a scientific research center in New Zealand, is expanding research and development initiatives on genetically modified and gene-edited grasses. The center has included clover and endophytes to its research efforts, which initially focused on High Metabolizable Energy (HME) ryegrass. HME ryegrass has completed field trials in the US, but was temporarily withdrawn in Australia because of the complex requirements of the regulators.

Researchers Pinpoint Gene that Could Help Cucumbers Survive Climate Change

A study published in *Transgenic Research* reported that a gene called *CsUBL5* could be used to enhance cucumbers' resilience to climate change. CsUBL5 is a promoter gene; thus it controls the expression of other genes. In this study, researchers found that the *CsUBL5* promoter could be used to drive the expression of genes that make cucumbers more resistant to pests, diseases, and drought.

JRC Policy Report Discusses the Impacts of Gene-Edited, Low-Gluten, Celiac-Safe Wheat

The Spanish National Research Council (CSIC) and Wageningen University & Research (WUR) used NGT-CRISPR-Cas targeted mutation to produce low-gluten, celiac-safe wheat that will help individuals with gluten intolerance. The policy report shared the advantages of this product when it becomes available in the market.

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Alliance for Agri Innovation

10A, 10th Floor, Vandhana Building, Tolstoy Marg, Janpath

Delhi, 110001

India

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