Agri Innovation Post - Edition 49 - January 2023

Alliance for Agri Innovation wishes its readers a very Happy and Innovative 2023. We begin the new year with multiple positive developments on the use of technology in agriculture and its acceptance.

This was very well elucidated in a scientific review article in the New Zealand Journal of Agricultural Research that evaluated more than 800 studies and concluded that GM-bred crops contribute significantly to food security. The study inferred that after 25 years there have been no human health problems from the consumption of GM crops, and the technology is bringing significant environmental and economic benefits to farmers around the world. On an average, the use of GM crops has led to 37% lower use of pesticides, a 22% increase in crop yields and a 68% increase in farmer profits, with the greater adoption and impact in developing countries compared to the developed countries. It has been estimated that, in 2018, GM crops were cultivated in 192 million hectares worldwide, including 32 different crop species with over 2,000 GM foods approved in 43 countries, including New Zealand. Economic studies showed that between 1998 and 2018 the technology has returned US$225 billion to 17 million farmers, 95% of whom are in developing countries. On average, crop yields have increased by 34% in cotton, 12% in corn and 5% in soybeans.

Around 75% of the gains came from GM crop production improvements and 25% from reduction in associated cost due to less tillage and pesticide/herbicide use. The environmental benefits of the GM crop cultivation have been sustainable and long term with 620 million kg fewer crops being sprayed with chemicals between 1995 and 2015. This led to 23% lower environmental impact for GM crop cultivation than the conventional ones. At the social level, increased yields of GM crops contributed to a 50% increase in the profits of small farmers, that allowed them to spend on their nutrition, education, and health. The review article, concluded that GM technology is a valuable option for generating positive

environmental and economic outcomes to the extent that can and have been well monitored, quantified, and mitigated.

Such an open acknowledgment from NZ that has traditionally not been very accepting of GM crops is a very positive step when globally experts have reiterated the need to sustainably produce more nutritious food in higher volumes from diverse sources with lower use of resources and farm inputs. The solution can only be provided by science and technology in various aspects of food production, storage and movement so that the food production is efficient with minimal wastage or loss.

We hope that review article and other news in this newsletter will give you an overview of the progress in crop biotechnology. We also hope it is informative enough and gives you enough fodder in support of technology and its potential in the newsletter.

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A special interest group of Federation of Seed Industry of India

News from India and Around the World

Science lets us grow more with less, putting us closer to ending hunger

https://www.theparliamentmagazine.eu/news/article/science-technology-food-more-with-less-fao

The world needs to produce more with less, with more quantity, higher quality and more food diversity, but with less inputs and less impacts on the environment. The only solution is science and innovation, enabling policies and increased investment. Precision agriculture covers a range of technologies that generate and analyse data to help farmers understand how much water and fertiliser they need and when. Using algorithms that combine information from satellite imagery, drone footage, weather forecasts and data from sensors in the soil, farmers can understand day by day and field by field how their crops are doing and what inputs they need and when.

European Academies Form Task Force on Intellectual Property System for NGTs
https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19944

The All European Academies (ALLEA) announced the establishment of a task force that will look into the protection of intellectual property rights on new genomic techniques (NGTs) in support of a more equitable system. The task force's goal is to ensure that European researchers, small and traditional breeders, and farmers will be able to avoid the unintentional patent infringement but still be able to receive the benefits of NGTs.

'Their joy knows no bounds': Nigerian farmers welcome first harvest of disease-resistant genetically modified potatoes as a possible end to the 'nightmare' of late-blight potato disease
The harvest from the first round of confined field trials planting shows that the biotech potatoes have a yield advantage of 300 percent, when compared to the conventional varieties which have severely suffered from blight infestation. The Feed the Future Global Biotech Potato Partnership project is implemented in four countries – Kenya, Bangladesh, Indonesia and Nigeria.

Carbon-neutral farming policies will fail without a science based approach, new report warns
The development and application of agricultural technologies must become a priority for the UK government if the farming sector is to achieve net zero, new research warns. The government has put forward the ambitious plan of delivering net-zero carbon emissions by 2050, while at the same time increasing the quality and quantity of agricultural production.

Togo launches 2022-23 cotton commercialisation campaign
https://www.fibre2fashion.com/news/cotton-news/togo-launches-2022-23-cotton-commercialisation-campaign-284707-newsdetails.htm

Togo launched the 2022-23 cotton commercialisation campaign last week in Korbongou in Savanes region. The Nouvelle Société Cotonière du Togo (NSCT), which will mobilise the logistics required to ensure efficient collection from and rapid payment to cotton farmers, has projected sales of 52,000 tonnes of cotton, mostly produced in the 2021-22 season.

GMO regulation: lessons from across the globe

The subject of soybean cargoes halted at Karachi port for nearly six weeks has attracted a lot of media scrutiny. The cargo was stopped from offloading after Customs Intelligence flagged the shipments containing genetically modified organisms. These shipments had originated from various exporting origins, including USA, Brazil and Argentina. According to Pakistan's existing regulatory framework, the approval for import of any commodity derived from genetically engineered products requires

approval from National Biosafety Committee (NBC), an inter-ministerial body headed by the Environmental Protection Agency (EPA), an autonomous agency under the federal ministry of climate change (MoCC).

What is a genetically modified crop and why is it important to India
https://www.business-standard.com/podcast/current-affairs/what-is-a-genetically-modified-crop-and-why-is-it-important-to-india-122122000440_1.html
The government recently cleared the environmental release of a genetically modified variety of mustard The move has triggered a debate around it It has been challenged in the Supreme Court too Environmental activists and several groups representing farmers are bent against Environmental activists and several groups representing farmers are bent against (GM crops).

FAO Publishes Issue Paper on Gene Editing and Agrifood Systems
https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=19958
The Food and Agriculture Organization of the United Nations (FAO) has released *Gene Editing and Agrifood Systems*, a science- and evidence-based *Issue Paper* that presents a balanced discussion of the key aspects of gene editing, including the consequences for human hunger, human health, food safety, effects on the environment, animal welfare, socioeconomic impact and distribution of benefits.

EFSA Releases Scientific Opinions for Renewal of Authorization of 3 GM Soybeans
https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=19948
The European Food Safety Authority (EFSA) GMO Panel has released its Scientific Opinion on data submitted for the renewal of authorization applications for three genetically modified (GM) soybeans, including insect-resistant soybean MON 87701, insect-resistant and herbicide-tolerant soybean MON 87701 × MON 89788, and herbicide-tolerant 40-3-2 for food and feed uses, excluding cultivation within the European Union.

Australia's Gene Regulator OGTR Invites Comments on Field Trial of GM Perennial Ryegrass
https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=19916
The Australian Office of the Gene Technology Regulator (OGTR) invites comments from the public to assess an application from Grasslanz Technology Australia Pty. Limited to conduct a field trial of perennial ryegrass genetically modified for increased metabolizable energy content. GM perennial ryegrass grown in this field trial would not be used for human food or commercial animal feed.

UK Plant Breeders Express Support for Precision Breeding Techniques

https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19919

The British Society of Plant Breeders (BSPB) has expressed its full support for the Genetic Technology (Precision Breeding) Bill and its objective to provide greater access to more precise new breeding methods with the potential to accelerate progress in crop-related innovation at a time when it is increasingly and urgently needed.

Agriculture Startup to Grow Rice in the Ocean Using CRISPR

https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19910

An ocean agriculture startup, is trying to activate dormant genes from seagrasses to use in terrestrial crops such as rice, wheat, and corn. In a press release, the group stated that if these genes could be activated, those crops could be grown in brackish water—or even directly in the ocean. Using CRISPR tools, the start-up is piloting an effort to grow rice plants on land in salty waters. Their plan is to move growing rice on floating platforms off the coasts of African and Asian countries. According to Luke Young, a particular pattern of eight genes, in seagrasses and mangroves, work together to allow the plant to not only defend itself against the saline environment, but actually use it to its own benefit as a way to power growth.

CRISPR Plant Market Accelerating in Latin America

The plant breeding and CRISPR plant market in Latin America is projected to attain a market increase in the forecast period of 2021 to 2028, with a compound annual growth rate (CAGR) of 12.7 %, and is expected to reach USD 11.1 million by 2028. These figures are based on the market report of Data Bridge Market Research.

Review of more than 800 studies concludes that GM-bred crops contribute significantly to food security

https://www.simfruit.cl/revision-de-mas-de-800-estudios-concluye-que-los-cultivos-mejorados-con-transgenia-contribuyen-significativamente-a-la-seguridad-alimentaria/

On average, the use of GM crops has led to a 37% lower use of pesticides, a 22% increase in crop yields and a 68% increase in farmer profits, with the greatest emphasis in developing countries. A major review of more than 800 scientific investigations regarding genetically modified crops confirmed that after 25 years there have been no human health problems from the consumption of GM crops, and the technology is bringing significant environmental and economic benefits to farmers around the world.

Open to gene scissors

https://www.fr.de/wirtschaft/gastwirtschaft/offen-fuer-die-gen-schere-91996773.html

The EU Commission wants to decide in the spring how strictly crops that have been produced using

new genetic engineering methods such as the CRISPR/Cas genetic scissors must be tested. Here, the genome of plants is manipulated in order to enhance certain characteristics, such as resistance to drought. In contrast to the “old” genetic engineering, no alien genetic material is inserted, as has been done with corn or cotton plants for about 25 years: Bacteria are built into them, making them resistant to insect pests.

Tilak Raj Sharma writes: On GM, follow the science
https://indianexpress.com/article/opinion/columns/on-gm-follow-the-science-8341304/
GM is a disruptive technology because it can bring about targeted changes in crop varieties that cannot be achieved through normal breeding of plant lines. The crops bred through this technique have to, of course, be safe for humans, animals and the environment. In the case of DMH-11, the objective of genetic modification was to make the mustard crop amenable to hybridisation. Why hybrids? Hybrid plants that result from the crossing of genetically diverse parents generally demonstrate higher yields and wider adaptation. This is a phenomenon known as heterosis or hybrid vigour, which has been widely exploited in crops such as maize, pearl millet, rice, sunflower and many vegetables. Hybrids typically show 20-25 per cent yield increases over conventional-bred varieties across crops.

Biotech chestnut tree poised to restore lost ecosystems and biodiversity — But it needs your help
https://geneticliteracyproject.org/2022/12/22/biotech-chestnut-tree-poised-to-restore-lost-ecosystems-and-biodiversity-but-it-needs-your-help/
Over the last several decades, conservation-minded scientists developed a biotechnology-based solution that would return this tree to this critical ecosystem. Tested, validated and poised for deployment, the fate of this effort balances in the uncertain hands of regulators Your voice may be instrumental in their decision.

Centre launches National Genome Editing & Training Centre at Mohali, Punjab
Dr Jitendra Singh, Union Minister of State (Independent Charge) Science & Technology; Minister of State (Independent Charge) Earth Sciences; MoS PMO, Personnel, Public Grievances, Pensions, Atomic Energy and Space, inaugurated “National Genome Editing & Training Centre” at National Agri-food Biotechnology Institute (NABI) Mohali, Punjab. National Genome Editing & Training Centre” (NGETC) is a one-roof state-of-the-art facility that will serve as a national platform to cater to the regional needs to adapt different genome editing methods, including CRISPR-Cas mediated genome modification. It will also empower young researchers by providing them with training and guidance about its know-how and application in crops.

'Golden Rice' harvest reaches 100 tons

The Philippines harvested over 100 tons of genetically modified "Golden" or "Malusog" Rice in 17 pioneer production sites across the country, the Philippine Rice Research Institute (PhilRice) said. PhilRice said Malusog Rice is expected to be fully commercialized at the latter part of 2024 once more seed supply becomes available. According to the agency, the first harvest will be milled for distribution in target households with pre-school children identified at-risk for vitamin A deficiency (VAD) and undernutrition, as well as pregnant and lactating mothers.

Science leaders discuss India's path toward a knowledge intense economy

https://pib.gov.in/PressReleasePage.aspx?PRID=1888529

Leaders of scientific departments of the Government of India chalked out the framework for making India a knowledge intense economy and deliberated on the challenges and opportunities in the path at the first plenary session of the Indian science congress at Nagpur. Principal Scientific Adviser to the Government of India, Professor A K Sood underlined that while India has emerged as the third largest ecosystem for start-ups globally and the deep tech startup landscape in India has seen rapid growth, there is still space to boost it up specifically in areas like consumer technology, automotive, media and entertainment, agritech, energy utilities, and cyber security.

New Researc

Experts Share Genetic Transformation Resource for Cassava

https://currentprotocols.onlinelibrary.wiley.com/doi/10.1002/cpz1.620

Three basic protocols with two alternate protocols were published by researchers from the United States and Brazil for the root crop, cassava. Sharing the protocols with fellow researchers and scientists will help advance genetic improvement of the crop to meet the required needs of farmers and consumers.

Low-cadmium Rice Developed Using CRISPR-Cas9

China Agricultural University scientists successfully generated low-cadmium rice germplasms using CRISPR-Cas9 gene editing. The results of their study are published in the *Journal of Environmental Sciences*. Cadmium is a highly toxic heavy metal that affects living organisms. Human activities such as industrial production and agriculture have led to cadmium pollution in soils, which is a serious problem globally. Cadmium is not required for rice plants, as well as in human nutrition, and

may even lead to diseases. Thus, the reduction of cadmium contamination in rice plants is vital to protect human health.

Study Reveals Role of Wild Soybean Protein Kinase in Abiotic Resistance of Plants

Researchers from Northeast Agricultural University in China and partners reported the functional characteristics of wild soybean (*Glycine soja*) GsSnRK1.1 protein kinase in plant resistance to abiotic stresses. Their findings are published in the *Journal of Plant Physiology.* Protein kinases are vital in regulating plant resistance to various stresses. In the study, *GsSnRK1.1* gene that codes for a protein kinase was found to be actively involved in responding to abiotic stresses in wild soybean. Analysis showed the protein kinase activity, which showed that it could significantly promote resistance to salt-alkaline stresses in yeast and in transgenic Arabidopsis plants.

CIMMYT Study Says Breeding New Crops Must Adapt to Climate Change

https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=19920

Research conducted by the International Maize and Wheat Improvement Center (CIMMYT) has determined that climate change is affecting current plant breeding objectives, efficiency, and genetic gains, causing limitations to the breeding approach of the next generation. The goals for breeding and developing new crops have been changed by the rising demands for climate-ready crops, originating from the urgent need to adapt to climate change. The study found that climate change requires a faster breeding cycle and must drive changes in breeding objectives by putting climate resilience as the top priority.

Simplified Heat Stress Assay Increases Mutagenesis Efficiency in CRISPR

https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19922

Scientists from Ghent University were able to increase the mutagenesis efficiency of the gene editing tool CRISPR by alternating heat shocks and recovery. The method was found to be useful for Cas9 and LbCas12a systems. CRISPR is a popular gene editing tool known for its precision and low-cost. Scientists continually try to improve the tool systems to achieve optimal results. Applying heat stress is one of the ways to increase CRISPR mutagenesis efficiency, but this usually requires a dedicated climate chamber that not all researchers have.

CRISPR Apple Exhibits Less Phloridzin and Normal Growth

https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19899

Experts from the Research and Innovation Centre of Edmund Mach Foundation and partners used CRISPR-Cas9 to *MdPGT1* in apples, which led to reduced foliar phloridzin without impacting plant

growth. The results are published in *The Plant Journal*. The researchers simultaneously assessed the effects of targeting MdPGT1 by conventional transgenesis and CRISPR-Cas9 genome editing. Knockdown lines showed signs of plant growth and leaf morphology disruption, while the genome-edited lines exhibited normal growth despite reduced foliar phloridzin.

OsNramp4 Involved in Cadmium Accumulation in Rice Grains

https://www.isaaa.org/kc/cropbiotechupdate/ged/article/default.asp?ID=19925

Researchers from the Hunan University of Arts and Science and Hunan Normal University in China reported that *OsNramp4* aluminum transporter is involved in cadmium accumulation in rice grains. Their findings are published in the *Reproduction and Breeding* journal. Cadmium toxicity impacts several crops. Members of the *OsNramp* (*Natural resistance-associated macrophage protein*) gene family are vital in transporting specific cations in rice. The results showed that the net cadmium ion flux was significantly lower than the wild-type. The loss-of-function *OsNramp4* mutation reduced root cell sap cadmium ion content, resulting in substantially lower cadmium concentrations in shoots and grains.

Striga Smart Sorghum for Africa Project Launched in Kenya and Ethiopia

https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=19960

A new public-private partnership project, Feed the Future *Striga* Smart Sorghum for Africa (SSSfA), has been launched in Kenya and Ethiopia. SSSfA is a project that utilizes CRISPR genome editing technology to develop new sorghum varieties resistant to *Striga. Striga* is a parasitic weed responsible for up to 100 percent yield loss in Africa's staple cereals, thus posing a great danger to the livelihoods of millions of smallholder farmers on the continent.

Flexible CRISPR-Combo System Used to Edit Genomes in Plants

Researchers from the Amrita School of Biotechnology in India created a flexible CRISPR-Combo platform for simultaneous genome editing and gene activation in plants. The results of their study are summarized in *Science Open*. The florigen gene in Arabidopsis was activated, and then CRISPR-Combo was applied to shorten the plant life cycle and decrease the process for screening transgene-free genome-edited plants. Activation of morphogenic genes in poplar was done to exhibit how genome-edited plants are able to regenerate and reproduce faster. Furthermore, CRISPR-Combo was used to achieve rice generation without using exogenous plant hormones.

Alternative _Agrobacterium_ Method Bypasses Tissue Culture to Multiply Sweet Potato Cultivars

Chinese scientists were able to multiply sweet potatoes by utilizing both *Agrobacterium rhizogenes* and

the crop's natural transgenic trait. Their method skips the need for tissue culture to obtain genetically modified sweet potato plants.

Enhanced Prime Editing Leads to Heritable Mutations in Maize

The *Journal of Integrative Plant Biology* released a breakthrough report that optimized prime editing can efficiently generate heritable mutations in maize. Researchers from China Agricultural University and Henan University conducted the study.

Ultra-low gossypol cottonseed could reduce world hunger

https://www.farmprogress.com/cotton/ultra-low-gossypol-cottonseed-could-reduce-world-hunger

Ultra-low gossypol cottonseed (ULGCS) represents a biotechnology product that can help address protein malnutrition in most cotton-growing countries. Research has shown that cottonseed as a protein source is useful not only for non-ruminants but also directly to improve human nutrition, says Professor Keerti Rathore, Texas A&M AgriLife Crop Sciences.

Lactoferrin and its role in biotechnological strategies for plant defense against pathogens

https://link.springer.com/article/10.1007/s11248-022-00331-9

Experts from the National Academy of Sciences of Ukraine reviewed the general principles of plant protection against pathogens and the role of iron and antimicrobial peptide metabolism in plant immunity. The review paper is released in *Transgenic Research.* Crops are prone to many diseases due to pathogens like viruses, bacteria, and fungi. The article shows the antibacterial, fungicidal, and antiviral action principles of lactoferrin, a mammalian secretory glycoprotein, and lactoferrin peptides and their role in protecting plants from phytopathogens.

Transgenic Hairy Root System of Field Mustard Helps Decrease Cadmium Pollution in Soil

https://www.tandfonline.com/doi/full/10.1080/15226514.2022.2164247

Cadmium (Cd) is the main heavy metal pollutant in soil. The combination of genetic engineering technology and *Rizobium rhizogenes* mediated technology can effectively improve the enrichment efficiency of heavy metals in super accumulators and reduce soil heavy metal pollution. An overexpression of the *IRT1* gene allowed researchers from the Beijing Jiaotong University in China to enhance the hair root structure of field mustard to cope against Cadmium stress.

APHIS: GE Soybean and GE Chrysanthemum Unlikely to Pose Increased Plant Pest Risk

https://www.aphis.usda.gov/aphis/newsroom/stakeholder-info/sa_by_date/sa-2022/rsr-soybean-chrys

The U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) reviewed a soybean plant and a chrysanthemum plant that were modified using genetic engineering (GE) to determine whether they present an increased pest risk as compared to unmodified plants. The review found that GE plants are unlikely to pose an increased plant pest risk compared to other cultivated soybean and chrysanthemum plants.

Epigenome Editing Enhances Resistance Against CBB

A novel method published by scientists from the United States describes an epigenetic modification they successfully developed to increase resistance against the cassava bacterial blight (CBB) disease. The approach also has the potential to be effective in other crop species. A plant becomes affected by CBB when its causal agent, *Xanthomonas phaseoli* pv. *manihotis*, affects the plant's S gene called *MeSWEET10a* by activating the transcription activator like 20 (TAL20). Based on this, the scientists investigated the effects of the direct methylation to the TAL20 effector binding element within the *MeSWEET10a* promoter using a zinc finger DNA binding domain combined with a component of the RNA-directed DNA methylation pathway.

***Seed Shattering 11* Controls Seed Shattering in African Rice**

Scientists from China Agricultural University reported that MYB transcription factor *Seed Shattering 11* (*SH11*) controls seed shattering by repressing lignin synthesis in African rice. The results are published in *Plant Biotechnology Journal.* One of the major challenges in African cultivated rice production is seed shattering, which leads to extensive grain losses during harvest. On the other hand, Asian cultivated rice exhibits better resistance to seed shattering, which leads to more grains. Therefore, a better understanding of the regulation of seed shattering would help enhance harvesting efficiency in African cultivated rice.

Grafting and Mobile CRISPR Overcomes Limitations of Genome Editing in Plants

Scientists from the Max Planck Institute of Molecular Plant Physiology use a ground-breaking twist to the CRISPR tool to edit plant genomes. The discovery, signaling a methodology change, could simplify and speed up the development of novel, genetically stable commercial crop varieties by combining grafting with a 'mobile' CRISPR tool. An unmodified shoot is grafted onto roots that contain a mobile CRISPR-Cas9, allowing the genetic scissor to move from the root into the shoot. It then edits the plant DNA but leaves no trace of itself in the next generation of plants. This breakthrough will save time and money and circumvent current limitations in plant breeding and contribute to sustainable food solutions across multiple crops.

Researchers Resurrect CRISPR's 2.6 Billion-Year-Old Ancestors

For the first time, an international research group has reconstructed the ancestors of the well-known CRISPR-Cas system dating back 2.6 billion years and studied their evolution over time. Led by Ikerbasque research professor Rául Pérez-Jiménez of CIC nanoGUNE, the researchers find that the revitalized systems not only work but are more versatile than current versions.