Federation of Seed Industry of India (FSII) and Alliance for Agri Innovation (AAI) has collaborated with Biotech Consortium India Limited (BCIL) to conduct Awareness Workshops on the potential of Gene Editing across India. Through these workshops we are enabling officials and scientists in States and Union Territories regarding the global scenario on gene editing research and regulations. We are also sensitizing the stakeholders on the potential of gene editing and sharing various research and innovations that are supported by gene editing to enhance the traits of crops.

Till now, FSII has conducted three workshops, in Hyderabad, Ludhiana and Bangalore respectively. In the workshop, experts from different institutes highlighted the advancements and potential of this technology. The workshop focused on sharing information, data on the research & commercialisation of gene editing products across the world and in India.

Agriculture experts shared that gene editing will prove to be a revolutionary tool to develop crops which are packed with nutrition, will be part of sustainable agriculture as it will help in feeding the global population as it does not require additional agricultural land. Gene editing in agriculture can help in arresting pests and diseases, increase productivity, increase income of farmers while ensuring food security. Since investment is very less, gene editing can be adopted by both small companies and start ups. This will help farmers in adopting niche crops, cash crops, staple crops with enhanced traits and get increased returns.

In India, good productivity of cereals, legumes and enhancing nutrition is a requirement and gene editing can help achieve it. Punjab Agricultural University presented their research on starch resistant in wheat and potato, less acrylamide content of wheat, tillering, haploid induction, increasing shelf life of tomato and biofuel production from sugarcane. National Institute of Plant Genome Research (NIPGR) presented their work on the manipulation of mustard oil through editing of glucosinolates in Indian oilseed mustard and National Agri-Food Biotechnology Institute (NABI) presented their work on increasing β-carotene content in banana and iron (Fe) content in wheat grains.

We believe that such a knowledge sharing initiative will bring together institutes and universities of states on one platform for using novel approaches such as gene editing for the

benefit of farmers and society and cultivate a positive perspective about the technology. Everybody has a responsibility to understand the science behind gene editing and enable others about the benefits and the need for adoption. Climate Change is posing a threat to our food security, it can be seen from the increasing events of crop failure due to drought and floods. In this scenario, gene editing is no more a 'want' but a 'need' for a successful agricultural ecosystem.

We have also covered news around several important developments on agriculture across India, globally and in the area of research in this newsletter. We hope you find it a good read!

Shivendra Bajaj
Executive Director
Federation of Seed Industry of India-Alliance for Agri Innovation

News from India and Around the World

Science activists urge National Biosafety Authority to approve GMO cowpea
(My Joy Online)
More than 100 science activists have in a letter to the National Biosafety Authority, urged it to approve Ghana's first genetically modified crop, GMO cowpea. The letter dated April 18, 2022, signed by 118 scientists and science activists said, "GMO crops, including the cowpea, have been confirmed by thousands of scientific and research organisations in Ghana and worldwide to be as safe as their non-GMO counterparts. There is no documented evidence that GMOs have caused any harm to any individual who consumed them. In neighbouring Nigeria, farmers have started growing it in their fields. They testify to the crop's positive benefits and also to its safety for both humans and animals and its overall good taste," the document said.

Ludhiana | 400 attend workshop on genome editing in agriculture at PAU
(Hindustan Times)
Around 400 people, including scientists, students, and research fellows from PAU and nearby institutions, attended the workshop, which aimed to highlight the application of genome editing in the crop breeding programmes and raise awareness among the key stakeholders viz scientists, students, agriculture officials and industry about the technology and its potential. Experts from different institutes highlighted the advancements, potential and applications of genome editing in two technical sessions.

GMO advocates uniting today for science campaign on Twitter
(AgDaily)
The #GMO hashtag has long been the pivot around which biotechnology discussions on Twitter have revolved. On May 5, advocates who support genetic engineering and modern sustainable farming practices are teaming up to correct misinformation around the technology and to help show that all approved GMOs are safe for consumption and are a key ingredient to feeding a growing global population. If you take to Twitter today, you'll likely see the #ScienceHug hashtag alongside of #GMO in posts from the scientific community. Award-winning land-grant researcher Kevin Folta from the

University of Florida called on people to counter anti-GMO messaging and "correct false information [about GMOs] kindly and with evidence" on what he referred to as Genetic Engineering Disinformation Day. Folta, who specializes in plant science and has long been an advocate of genetic engineering, encourages science-minded folks to share kind, thoughtful, evidence-based posts — a stark contrast when compared with the hate and hostility that often comes from GMO critics.

From the field to the dinner table, AI in agriculture can create a resilient food system
(The European Sting)
Gene editing technology CRISPR — another innovation developed in a different industry — could help to design more resilient, high-yield seeds. Companies are applying AI to improve its speed and efficacy. Because many crops are so genetically complex — corn has 32,000 genes compared to 20,000 in humans — AI is invaluable in helping researchers understand the effects of editing multiple genes. Companies like Inari and Cibus are using these technologies to bump up crop yields while requiring less water and other inputs. Increasing yields of staple crops like corn, soy and wheat is critical as the global population grows and natural disasters like droughts, exacerbated by climate change, make farming more difficult.

How crop gene editing increases nutrition and sustainability
(GLP)
Breeding new plant varieties is not a simple, or rapid process, with development times of 12–15 years common. One estimate identifies that the application of genome editing technologies could shorten this time requirement to as few as 2–3 years (Friedrichs et al., 2019). One challenge of older plant breeding technologies was the accuracy of the resulting genetic changes. Mutagenic technologies introduce changes throughout the plant genome, affecting many genes, thus requiring substantial testing and breeding cycles to determine which changes proved advantageous. The advent of GM technologies allowed for improved breeding accuracy, with scientists able to introduce specific genetic traits with greater testability, such as herbicide tolerance or insect resistance. In the short time period of use, genome editing technologies offer further enhanced predictability and accuracy of modifying or deleting specific endogenous genes by making targeted genetic changes (or targeted mutations), as well as the ability to introduce new genes. This article examines the potential contributions with the wide-scale adoption of current applications of genome editing technologies in plant breeding towards achievement of the first three Sustainable Development Goals (SDGs).

Durham University Launches New Degree In Plant Biotechnology And Enterprise
(Indian Education Diary)
Durham University has launched a new MSc in Plant Biotechnology and Enterprise designed to provide the fundamental knowledge and skills to produce future scientists specialising in plant biotechnology. Students' will gain the technical and scientific skills needed to support increased agricultural productivity and the development of new biotechnological innovations whilst also delivering a commercial approach through the business-related enterprise element of the course. Alongside taught modules and practical lab-based experience offering one to one mentoring, this programme will enable students to develop their own research project, access vital training in business development and create links with leading biotech industries whilst developing essential skills for the employment market.

Sustainable GM farming innovation: How Argentina's drought-tolerant genetically engineered wheat reduces greenhouse gas emissions and increases yields
(GLP)
In October 2020, Argentina approved the world's first genetically engineered wheat for cultivation and consumption. Production expanded dramatically in 2021, and will continue to expand in 2022, after Argentina received regulatory approval in late 2021 for exports to Brazil, a major consumer of Argentina's wheat. The lessons from Argentina's experience are important as other countries decide whether they want to follow suit. Argentina's genetically engineered, drought-tolerant wheat — named HB4 — could have large environmental benefits, but other countries' choices will determine their scale. Argentina is increasingly struggling with drought and saw an opportunity for HB4 wheat to help stabilize production and revenue. Yields have been steadily decreasing since 2017, partially due

to drought, with the 2020/21 season yields the second lowest in ten years. Yields in the 2021/22 season bounced back thanks to sufficient rainfall at critical times. HB4 wheat, genetically engineered to be drought resistant, can help protect against such variability by maintaining high yields even under drought conditions. HB4's drought resistance gene comes from sunflowers, so it qualifies as transgenic — containing genes from a different species — and therefore as bioengineered, genetically modified, or a GMO.

Are all crops that we eat genetically improved?
(National Academies)
Almost all crops today have been changed from their original form. Since people have been farming for such a long time, nearly all crops grown today have been genetically improved, whether through domestication, selective breeding, hybridization, radiation or chemicals, or changes made directly to plant genes by humans. Scientists and growers continue to improve methods for making crops with certain traits. For example, people are working to create crops that can better withstand droughts, which are becoming more common as the climate changes.

Nigeria, Ghana commence consumption GMO crops
(Farmers Review Africa)
Nigeria and Ghana have commenced the consumption of first genetically modified BT cowpea with a view to enhancing scientific bilateral collaboration to boost food security in the West African sub-region. Both countries said that biotechnology is a cutting-edge tool of the 21st Century that has proven to raise productivity, reduce drudgery and increase yields that bring about economic growth and development through agriculture. At a joint press briefing on cowpea in Abuja, the Director-General, the National Biotechnology Development Agency (NABDA), Prof. Abdullahi Mustapha, said the journey began 21 years ago to promote, coordinate and develop research in science and technology.

Govt Approves Imports of Extra 5.5 Lakh Tonnes of GM Soymeal
(Krishi Jagran)
India has approved the import of an additional 5,50,000 tonnes of genetically modified (GM) soymeal to aid the poultry industry, which is suffering from a spike in local prices of the important animal feed. According to the government order, the shipments must be imported before September 30. After animal feed prices tripled in a year to a record high, the government relaxed import rules in August 2021 to allow the first shipments of 1.2 million tonnes of GM soymeal to help the poultry industry. Before the deadline for overseas purchases expired on October 31, 2021, traders were able to sign deals for only about 6,50,000 tonnes of soymeal, compared to the allowed 1.2 million. The government has now approved the importation of the remaining 5,50,000 tonnes of GM soymeal. All India Poultry Breeders Association had requested that the government allow imports of 5,50,000 tonnes of feedstuff in 2021.

China to approve first GMO corn traits developed by Syngenta
(Successful Farming)
China plans to approve GMO corn traits developed by Syngenta Group for the first time, the agriculture ministry said. The two traits developed by the Swiss agrichemical giant and to be approved, were Bt11×MIR162×GA21 and Bt11×GA21, both insect and herbicide tolerant, the Ministry of Agriculture and Rural Affairs said in a note posted on its website. Beijing has given safety approval to a few other domestic GMO corn traits already, and proposed overhaul of the country's seed rules to pave the way for GMO crop approvals as part of an effort to prepare for commercial cultivation of the grain.

Can GM crops jump-start Africa's agriculture?
(Africa News)
Africa faces a race against time to increase food production. As climate change, population growth, and conflict constrain agricultural productivity, Genetically Modified (GM) crops as being touted as the solution to ensuring food security. Supporters of crop biotechnology argue that transgenic crops will aid farmers in reducing the burden of pests, drought and improve yields and quality with limited

cost and effort. The number of countries planting biotech crops has grown from three in 2016 to over 10 in 2022, according to the International Service for the Acquisition of Agri-biotech Applications (ISAAA). South Africa, Sudan, Egypt, and Burkina Faso lead in the commercialization of GM crops.

Cotton: the ideal crop for reducing carbon emissions and poverty

(Farmers Weekly)

The detrimental impact of cotton on the climate has been greatly exaggerated. The common narrative is that cotton is drenched in chemicals and uses all the water resources in a region. In fact, 55% of the world's cotton is dryland only, and that which is under irrigation uses only 230mm per year [on average]. Furthermore, since the introduction of genetically modified (GM) cotton, crop-protection chemical applications have been reduced from between eight and 10 sprays per season to just one or two, and most farmers don't need to spray at all. Considering that 80% of the global cotton crop is GM, the impact on the environment from chemicals is minor. Cotton is also a carbon-neutral crop. In other words, the processes necessary to cultivate cotton don't create more carbon than what is sequestered by the plant, so there's no carbon footprint in the cultivation of cotton.

Does crop genetic engineering promote monoculture, as anti-GMO activists claim?

(GLP)

First of all, important for classification: mixed cultures (i.e. the opposite of pure cultures) make up only a minimal percentage of current agriculture because the cultivation of different plants in one field entails numerous challenges (see above). However, this applies both to genetically modified plants and to plants bred using other methods. Theoretically, genetically modified organisms (GMOs) such as GM carrots and GM onions could also be planted in alternating rows in a field and the cultivation and harvesting would not be (even) more complicated than with conventional carrots and onions in mixed cultures. Despite all the advantages of mixed cultivation, it is simply challenging to sow, fertilize, protect and harvest two different types of plants in the same place while working economically. In Germany, for example, no genetically modified plants are grown, and yet you usually only see plants of one type in a field.

New Research

Gene-editing breakthrough could cut ruminant methane

(Farmers Weekly)

Scientists have successfully switched on a plant gene in feed crops that could help reduce methane emissions from cattle and sheep. Studies have indicated ruminant methane emissions can be cut by 5% for each 1% increase in dietary lipid content, and Rothamsted Research scientists have been investigating ways to increase it in grazing or feed crop plants. Using a model plant species called Arabidopsis, the scientists snipped out a section of genetic material and then joined the two exposed ends together. This fused a "dormant" gene that is capable of stimulating lipid production with a non-essential gene that is switched on. The non-essential gene acts as an on-switch and, once the genes were joined, the plant leaves accumulated vegetable oil.

Defra approves field trials of genetically modified barley

(Farmers Weekly)

Defra has approved field trials of genetically modified barley that scientists say could reduce the need for synthetic fertilisers. The trial, run by researchers at the Crop Science Centre in Cambridge, will evaluate whether improved crop interaction with naturally occurring soil fungi can result in more sustainable food production. The barley variety has been genetically modified to boost expression levels of the NSP2 gene. This gene is naturally present in barley and boosting its expression enhances the crop's capacity to engage with mycorrhizal fungi. Professor Giles Oldroyd is leading the trial and said there was an urgent need to satisfy the demands of a growing population, while respecting limits on natural resources. "We believe biotechnology can be a valuable tool for expanding the options available to farmers around the world," he said. The trial will also test varieties of barley that have been gene-edited to suppress their interaction with arbuscular mycorrhizal fungi (AMF). Prof Oldroyd said: "The ultimate goal is to understand whether this same approach can be used to enhance the

capacity of other food crops to interact with soil fungi in ways that boost productivity without the need for synthetic fertilisers."

Base edit your way to better crops
(Nature)
Is there anything better than a perfectly sweet summer strawberry? Alas, many commercial berries look better than they taste. But molecular biologist Caixia Gao and her colleagues at the Institute of Genetics and Developmental Biology in Beijing have devised a way to tune the sweetness of strawberries using a few simple genetic tweaks1. "We could increase the total sugar content from 20 to 41 milligrams per gram," she says. "And there are so many different levels, you could choose what you like." Gao's is one of a growing number of research groups turning to strategies known as base editing and prime editing to improve the yield, robustness and consumer appeal of commercial cereals, fruit and vegetables. The methods are adaptations of the widely used CRISPR–Cas9 system, which can be used to introduce specific changes at defined places in the DNA. They allow scientists to tweak the amino-acid sequence of a protein of interest, for instance, or alter sequences that control how strongly a gene is expressed.

Plant microbiome: Key to weaning agriculture off chemical inputs?
(Alliance for Science)
Plants need a host of nutrients to grow and thrive. The ones that are usually limited are nitrogen and phosphorous. As a result, our food system relies on nitrogen and phosphorous fertilizers to get the most food out of the least amount of land. Some plants need more fertilizers than others. So-called "nitrogen fixers" do not require nitrogen fertilizer. These plants, which include beans, peas and alfalfa, produce specialized root nodules where beneficial bacteria live. The bacteria convert the nitrogen that is naturally present in the soil into a format that is digestible by plants. Similarly, many plants use fungi in the soil to take up phosphorous. These root-associated fungi, called mycorrhizae, solubilize phosphorous for the plant in exchange for carbohydrates (sugars). While most plants naturally form mycorrhizal relationships, several major crops do not, including sugar beets, broccoli and canola. In addition to these well-characterized examples, several other plant-microbe relationships are poorly understood. The plant microbiome can play a role in uptake of several additional nutrients like iron and potassium, regulation of plant growth and response to insects and disease.

Creating the "smart plants" of the future
(Cosmos)
My personal research is about understanding the communication networks within plants –specifically, how the chloroplast communicates with the genes to bring about changes to deal with the sun and shade, drought and heat – it's about how the chloroplast acts as an environmental sensor for the plant, and then how the plant responds according to the signals it receives. What are the languages the plant is using to communicate with itself? How does it respond to its environment in a way that's best suited to its survival? To understand those things you get down to the cellular level. Once you understand the components of the system, you go back to the plant, change the components, and see what happens to the network of signals.

Egypt agriculture scientists at Atomic Energy Authority produces new strain of wheat resistant to salinity, water scarcity
(Egypt Today)
The Egyptian Atomic Energy Authority, headed by Dr. Amr El-Hajj, announced that the agricultural research scientists in the authority have started harvesting the production of new strain of genetically-modified wheat at the authority's site in Inshas city, Bilbeis, Sharqia Governorate. This strain has high-productivity with distinct characteristics such as being resistant to cultivation in saline lands, and water shortage, the authority said in a statement. The rate of production exceeds 4 tons per acre, with an increase of almost a ton over the currently cultivated Egyptian varieties, the statement said, adding that this variety cultivation takes only 140 days, the statement continued.

Higher wheat yields and protein content on the horizon
(Science Daily)

A team of international researchers has discovered a way to produce higher quality wheat. The scientists from the University of Adelaide and the UK's John Innes Centre have identified a genetic driver that improves yield traits in wheat, which unexpectedly can also lead to increasing protein content by up to 25 per cent. "Little is known about the mechanism behind drivers of yields and protein content in wheat production," said the University of Adelaide's Dr Scott Boden, School of Agriculture, Food and Wine who led the research. "Discovering a gene that controls these two factors has the potential to help generate new wheat varieties that produce higher quality grain.

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