Dr. Cathie Martin, a plant biologist at the John Innes Centre in Norwich, United Kingdom was obsessed with colours. This obsession motivated her to understand how plants produce and regulate their flower pigments. She than began investigating anthocyanins — the pigments that give plants their characteristic red, purple and blue colors. She observed that purple colors were posed to be healthier.

This observation led the team to identify the key genes that synthesize and regulate anthocyanin biosynthesis in plants, using the genetic model of snapdragon plant (Antirrhinum majus). This gene was then introduced into the tomato causing them to accumulate anthocyanins in the fruits, making them turn purple. The purple pigment is the result of the transfer of a gene from the snapdragon plant (snapdragon plant is an edible plant).

The purple tomato contains higher levels of anthocyanins — an antioxidant compound with the potential to help prevent cardiovascular diseases and fight cancer. Anthocyanins also slow down the fruit's rotting process and doubles its shelf life. Anti-inflammatory properties are another benefit of this purple tomato. Experts are of the view that with the health benefits that purple tomato could provide, consumers will see the value of modern biotechnology and GMOs.

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

Scientists in second GMO maize approval bid

(Business Daily Africa)

The approval for commercialisation of genetically modified maize now lies with the Cabinet after scientists concluded field trials and handed the report to the Kenya Plant Health Inspectorate Service (Kephis) for registration. The acting chief executive officer of the National Biosafety Authority (NBA), Roy Mugiira said a Cabinet memo was prepared early this year and is now awaiting approval. Dr Mugiira said the final decision will be made by the Cabinet given that the 2012 moratorium on importation and growing of GMO products is still in place. The new request comes four years after former Health Cabinet secretary Cleopa Mailu turned down another request by the researchers to have the GM maize commercialised in the country. So far Kenya has commercialised planting of GMO cotton, which is now running for the second year while the field trials for cassava have also been approved. "The fate of commercialisation of the GMO maize now lies with the cabinet, which has to give concurrence on whether to approve or not," said Dr Mugiira.

CRISPR Genome Editing: Into the Second Decade

(Libert Pub)

2022 marks 10 years since the initial publications characterizing Cas9 as a programmable RNA-guided endonuclease. These findings have led to the emergence of powerful CRISPR-based platforms enabling gene disruption, insertion, correction, and deletion. Even as the first wave of programs moves forward through clinical studies, the technology side continues to advance at a rapid clip, with advances in activity, specificity, and the incorporation of novel functions positioned to further expand the "CRISPR toolbox" and the reach of therapeutic genome editing. Although various open questions remain regarding safety and activity, the outlook for the field is excellent. CRISPR technology is on track to become a pillar of cell and gene therapies in the coming decades.

Future bakery trends: what does the next 75 years look like?

(Bakery Info)

Novel ingredients, genetically edited grains and artificial intelligence could play an integral role in the future of the baking industry, according to British Bakels. To celebrate its 75th anniversary, the Bicester-headquartered business has teamed up with food futurologist Lyndon Gee to see what the next 75 years could have in store for the industry. Climate change will greatly impact food production, notes the report, meaning staples such as grains may need to be gene edited to survive on very little water. Gene editing may also extend growing seasons, give higher crop yields, and make them less susceptible to drought or flooding.

CSIR requests approval for environmental release of Ghana's first GMO crop

(Myjoyonline)

The Council for Scientific and Industrial Research (CSIR) has submitted an application to the National Biosafety Authority (NBA) requesting for permission to release Ghana's first GMO crop (PRB cowpea) into the environment. The request to the NBA which is a government agency under the Ministry of Environment, Science and Technology will allow for the CSIR to also place the pod borer resistant (PBR) cowpea or beans on the Ghanaian market. According to a public notice published in the Ghana Gazette on 18th February 2022, the application is currently undergoing review process by the NBA, together with relevant regulatory agencies and independent experts.

What are the barriers limiting Africa from adopting genetically engineered and hybrid-improved seeds?

(GLP)

Among farmers that do plant improved maize, a study in Kenya found that farmers that grow hybrids are wealthier than farmers that grow OPVs, and that a measure of wealth (soil preparation technique, either tractor, oxen, or manual) is one of the two most important determinants of which farmers grow.

Along with wealth, the other variable with the largest impact was farmer preferences for characteristics present in different varieties, which is an important factor to consider in genetically engineered variety development. As studies have shown for adoption of OPV and hybrid seed, cost is likely a barrier to adoption of genetically engineered seeds as well. Desired genetically engineered traits can be bred into either hybrids or OPVs and breeding them into OPVs can keep costs down and thereby make them accessible to more farmers; however, the trade-off is that OPVs have lower yields than hybrids. Since lack of wealth is a barrier to adoption of hybrid seed, a genetically engineered trait in an OPV could be cheaper and more accessible, and potentially better include smallholder farmers in the benefits.

"Latin America's embrace of gene editing positions Americas to become big in agricultural innovation"

(Hortidaily)

There are countries with restrictive regulatory frameworks regarding GMOs that even today make their adoption unlikely—such as in Peru, Ecuador, and Mexico. In contrast, Brazil and Argentina have taken a totally different approach allowing, deliberately, and fervently embracing biotech innovation, and transforming South America into a global leader in GM crop production. These same countries are now embracing advancing the latest cutting-edge genetic engineering tools, CRISPR, and other forms of gene editing. All signs point to gene editing crops having a less bumpy road through the regulatory thickets as the genetic engineering process does not involve the transfer of so-called 'foreign genes', a key issue that regulators used to block approval of GMOs.

Benefits of gene editing plants

(Henley Standard)

GM uses DNA material from other species to make changes to the plants. Gene editing manipulates the coding within the same species, in this case a plant. Take wheat, for example, that you might want to make more resilient to drought. Rather than introducing new DNA from an external source such as a cactus, you could use gene editing. This involves a group of technologies that make changes within the plant's own DNA by moving, adding or deleting precise pieces of genetic material. In this case, it could be the gene responsible for the control of water loss in the plant. Humans have been using various techniques for plant breeding for centuries. The original wheat plants were cultivated in the Middle East more than 10,000 years ago and were introduced into this country about 5,000 years ago. These original plants were nothing like the modern varieties that are now grown to produce flour to provide us with all sorts of foods, notably bread. To start with, they were more than 1.6m tall, nearly twice as high as today's plants.

Europe Must Embrace New Genomic Technologies (NGT) to Safeguard its Food Sovereignty

(European Seed)

France and Europe, which have intervened at the regulatory level to limit waste at the distribution and consumption stage, must now urgently adapt the regulations in force to allow new genomic technologies (NGT) to make their contribution to limiting production losses at the crop level. The future resilience of our agriculture and thus the safeguarding of our production potential are at stake. This adaptation of the European regulation on GMOs is therefore a strategic issue: ensuring food security for Europeans, one of the founding principles of the EU and the CAP. The EU cannot, without risking the loss of its food sovereignty and therefore also its economic sovereignty, refuse to allow farmers to benefit from these new biotechnologies.

University of Chittagong establishes greenhouse to develop climate-tolerant crops

(The Financial Express)

University of Chittagong (CU) has initiated a process to establish a greenhouse to develop climate-tolerant crop varieties. The Genetic Engineering and Biotechnology Department of the university is constructing the greenhouse under a project with an estimated cost of Tk 60 million. Bangladesh Climate Change Trust Fund (BCCTF) is providing financial support for the project, reports BSS. Officials said they have completed about 80 per cent of the project and it can be inaugurated within this year. Dr Laila said, once the project is implemented, it would be possible to innovate flood-, salinity- and

drought-tolerant crop varieties applying modern biotechnologies through the installation of the greenhouse.

China's agriculture ministry says to facilitate commercialisation of GM soybeans, corn

(Today)

China's agriculture ministry said that it will facilitate the commercialisation of genetically modified soybeans, corn and cotton crops. China will improve management of GM varieties of the crops, the Ministry of Agriculture and Rural Affairs also said in its 2022 work plan of regulation on GM crops. Beijing has in recent years approved several domestically designed GMO crops as safe, in a renewed push towards commercial planting of GMO crops in the country. It has also planned overhaul of regulatory rules to pave the way for seed makers to get approval for GMO crops.

Origin Agritech Files for Approval for Gene Edited Corn Traits that Increase Yields

(PR Newswire)

Origin Agritechs Ltd. together with its partner China Agricultural University, has submitted applications for biosafety certificates for six newly developed gene edited traits that significantly increase the yield of corn crops. The new traits include change of the leaf angle and improvement in drought tolerance of corn. Changing the leaf angle and plant types will improve the photosynthesis efficiency and increase the planting population, which in turn increases yields. The new traits will also improve the water use efficiency and drought tolerance for corn plants. Origin is currently integrating these traits into its commercial hybrid corns, including the company's nutritionally enhanced corn.

New Research

RNA vaccines for plants?

(GLP)

The threat of COVID-19 spurred innovation at unprecedented rates. Moderna and Pfizer's RNA vaccines were approved in about a year. The impact? Hundreds of thousands of saved lives. Similar innovations have been occurring in agricultural research — albeit much more slowly. For the last 10 years, a niche group of plant scientists has worked towards a similar goal: delivering RNA into cells to temporarily shift their activity. Although the impacts on human health aren't as obvious, these technologies could enhance nutrition, protect the environment and decrease the cost of food. But without a threat like a global pandemic, will RNA-based plant applications ever reach the field? Funding for plant research is hard to come by, and biotech innovations in agriculture face steep regulatory obstacles. Still, a recent study from Kyoto University made strides towards field-ready RNA-based technologies. Scientists in the space are hopeful that, like the vaccines, this approach will follow an accelerated path towards approval.

Nanocarrier Spray Silences Genes In Plants Without Gene Modification

(Bio Scription)

The use of bioactive molecules has shown the capability to infiltrate into plant leaves and into the cells themselves with genetic components like small interfering RNAs (siRNAs) being used to interfere with the expression of selected genes. This is done by using cell-penetrating peptides (CPPs) that can passively ferry the biomolecules through the cell wall and combined with organelle-targeting peptides, can further take the biomolecules to the genomic material that is being targeted. The research team in today's study wanted to broaden this capability and create a platform that would allow for nanocarrier genetic silencing to be done to multiple plants all at once in the form of a leaf spray. This would allow for both natural and synthesized CPPs to be used on particular plants on a larger scale.

Defective molecular signalling in plants helps them survive in a salty medium

(Phys Org)

Genetic mutations that almost completely disrupt a natural molecular signalling system in plants can confer the surprising benefit of making the plants more tolerant to high salt levels, a RIKEN-led team has found. This discovery could help to develop new strategies for enabling crop plants to thrive in regions of high salinity, which is a growing problem in many places in the world. "Salinity is a major threat to modern agriculture," says Mostafa Abdelrahman of the RIKEN Center for Sustainable

Resource Science (CSRS). "It is now estimated to affect somewhere between 20 and 50% of irrigated agricultural land worldwide as a result of irrigation with brackish water, inefficient drainage systems and global climatic changes."

Researchers hope to make wheat more efficient
(Western Producer)
"We're aiming to identify naturally occurring gene variants that are found in wheat grown in Canada. We want to find gene variants that cause specific traits in wheat. For example, we're looking for variants that cause wheat to have a larger and finer root system," said Lyzenga. "Wheat with larger and finer root systems have more surface area, and therefore make more contact with the soil and are better able to absorb nitrogen and phosphorus," she said. Kochian added that these genes have always been in natural wheat populations but can have different versions of the gene in some of the different cultivars. One of the genes the researchers will be looking at was discovered in rice and subsequently identified in sorghum, which is not a Canadian crop, but is an important crop in Africa and in the United States for animal feed. "We're going to be taking that information and looking for variants of that gene in wheat," she said. The cutting-edge tools used at GIFS, including easier techniques for gene editing, has resulted in the recent sequencing of 15 wheat genomes.

The Power of Purple: GMO tomato could help fight cancer
(Alliance for Science)
The purple tomato contains higher levels of anthocyanins — an antioxidant compound with the potential to help prevent cardiovascular diseases and fight cancer. Anthocyanins also slow down the fruit's rotting process and doubles its shelf life. "If we can reduce the amount of food waste, we will make a huge impact on feeding the world and reducing the carbon footprint from agriculture," Pumplin added. Anti-inflammatory properties are yet another benefit of the colourful fruit. Through a mouse feeding study, Martin and team found that the purple tomato can increase the lifespan of cancer-susceptible mice by 30 percent.

Scientists Decoded Highly Complex Potato Genome Facilitating Breeding of New Varieties
(Krishi Jagran)
Scientists at Ludwig-Maximilians-Universitat Munchen and the Max Planck Institute for Plant Breeding Research in Cologne have decoded the highly complex genome of the potato for the first time, more than 20 years after the first release of the human genome. This technically demanding study lays the biotechnological groundwork for faster breeding of more robust varieties, a long-term goal in plant breeding and an important step toward global food security.

Chinese researchers develop fragrant sorghum with gene editing
(ECNS)
Chinese researchers have successfully cultivated fragrant sorghum using CRISPR/Cas9 gene-editing technology. Aroma is an important quality in food. Jasmine rice, for instance, is popular with consumers for its aroma and, and it fetches a higher price accordingly. Previous studies have found that a volatile aroma compound named 2-AP contributes to the fragrance of rice. A gene called BADH2 can regulate the accumulation of 2-AP, generating odor in crops. Researchers from the Institute of Genetics and Developmental Biology of the Chinese Academy of Sciences used CRISPR/Cas9 gene-editing technology to knock out the SbBADH2 gene in sorghum, the BADH2 variant regulating the sorghum aroma. According to the study published in the Journal of Integrative Plant Biology, the seeds and leaves of gene-edited sorghum have a significantly higher accumulation of 2-AP and smell floral and sweet.

***