

The early advent of summer and the weather cycle partially or completely missing spring has reiterated deleterious effects of climate change. The impact of climate change is being felt on agricultural productivity, animal behavior and migration patterns as well as resource availability and use. Global food systems account for one third of the greenhouse gas (GHG) emissions, these in turn also impact farm input use, water quality and soil health. The challenge of feeding the 8 billion global population is linked to our dietary choices, which leads to a discrepancy between land resource use and food production.

The latest IPCC report states that the agriculture and food systems also have a significant mitigation potential for climate change related deterioration. As a matter of fact, numerous solutions like GM crops, biosolutions, utilisation of biofertilisers, biopesticides and probiotic feed additives are ready and available for deployment. These measures are estimated to enable reduction of 8% of global GHG emissions by 2030.

The analysis of GM crops adoption on yield as well as GHG emissions clearly goes in favour of GM cultivation. Similar results are expected for gene edited crops with lower cost for commercialization. Obtaining higher amount of food and nutrition per acre with minimal resource use and carbon footprint is the only available path for agriculture and food system as a whole. We cannot afford the establishment of a natural balance for climate change over hundreds of years; therefore, technology intervention is imperative if need to save natural resources, produce enough food, mitigate climate change and conserve biodiversity.

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News from India and Around the World

Viewpoint: Why leftist GMO rejectionists should take notice of Cuba's emergence as biomedicine and ag-biotech innovator

Peremptorily banning GMOs or other biotech techniques is shooting ourselves in the foot — a “food and environmental suicide” — in times of tremendous challenges in food production, international conflicts and climate change. The famous Cuban poet José Martí wrote that “in revolution, the methods must be silent, and the purposes, public”; the GMO revolution in Cuban agriculture has perhaps gone unnoticed. It's time that its potential is promoted among the regulators and decision makers of other countries with similar left-leaning political ideologies. Without the use of GMOs and new biotech techniques, there will be no real “food sovereignty”, let alone the ability to feed vulnerable people in an environmentally sustainable way.

Viewpoint: Biotechnology can help address climate change fluctuations and deliver sustainable food and farming, says World Economic Forum

Biotechnology holds part of the key to enabling a transformation of our economy and our food systems. While in the past, we have mainly focused on offering farmers sustainable alternatives to chemical pesticides and food waste reduction, for instance by extending the shelf-life of products, the current innovative biotechnological solutions are offering society at large the possibility to shift to a more sustainable diet by providing plant-based proteins as an alternative to animal-based ones.

'Like turning on a light-switch': Gene-edited duckweed poised to revolutionize biofuel by eating up pollution and spitting out oil

Scientists have figured out how to coax copious amounts of oil from duckweed, one of nature's fastest-growing aquatic plants. Converting such plant oil into biodiesel for transportation and heating could be a big part of a more sustainable future. For a new study in the *Plant Biotechnology Journal*, researchers genetically engineered duckweed plants to produce seven times more oil per acre than soybeans—currently the most commonly used biodiesel-producing plant. Study lead author John Shanklin, a biochemist at the U.S. Department of Energy's Brookhaven National Laboratory, says further

research could double the engineered duckweed's oil output in the next few years.

Viewpoint: '40% of all crops grown are lost to pests and disease' — That's we need regulatory reform and automation to promote gene editing

With between 20 and 40% of all crops grown being lost to pests and diseases, the UK agriculture industry could hugely benefit from the prosperity that growing gene-edited crops will bring. The first challenge is around regulation, especially in cultured meat and plants. Currently, the EU's rules around gene editing focuses on legal interpretation rather than science – which has restricted the UK's agricultural research institutions from carrying out research.

Countries with clear gene editing regulations already reaping benefits

Through gene-editing, companies are not only diversifying crops but are also developing a variety of traits for biotic stress tolerance and modified composition, plant yield and abiotic stress tolerance, which was restricted to input-oriented traits in the case of GMOs. Traits are also being developed for bioenergy crops using gene-editing, and companies are also developing partnerships in the bioenergy space.

EFSA Releases Assessments of GM Maize GA21 x T25 for Renewal and MON 87419 for Food and Feed Uses

The European Food Safety Authority (EFSA) GMO Panel has released its Scientific Opinion on the safety of genetically modified (GM) herbicide tolerant maize GA21 x T25 and MON 87419, for import, processing, and food and feed uses within the European Union (EU) and does not include cultivation.

Global Trends of Genome Editing Approaches

As the world continues to face challenges such as food security, climate change, and fatal diseases, scientists have turned to technological advancement to find ways to curb or eliminate them. One of these is genome editing, which has gained popularity over the last few years because of its precision and low cost. In a paper written by Masashi Tachikawa and Makiko Matsuo of the University of Tokyo in Japan, they examined how genome editing is regulated by different countries, and how these relate to the regulations of genetically modified organisms (GMOs).

Cotton breeders need some hurrahs

<https://www.farmprogress.com/commentary/cotton-breeders-need-some-hurrahs>

Breeders have made all of this possible. The people in the field need to get credit for long hours in the sun and rain, heat and cold, tweaking varieties that perform well in the wide range of growing conditions across the Cotton Belt. They are continually improving yield and lint quality. The new varieties of cotton that are presented in this issue are a result of hard work and a group of people who want to bring an advantage to growers with these product improvements. In my book they are seldom sung heroes of the industry.

The Rise of Agri-tech in India

<https://www.investindia.gov.in/team-india-blogs/rise-agri-tech-india>

India is referred to as a global agricultural powerhouse owing to its vast argo-ecological diversity. The agriculture industry in India contributes significantly to the country's economy, accounting for approximately 16 per cent of the GDP and employing 44 per cent of the national workforce. India is among the fifteen leading exporters of agricultural products in the world. Ernst & Young Report estimates that agri-tech startups in India offer an opportunity of \$ 24 billion, and the industry is still significantly untapped (with 1.5 per cent penetration).

Global cotton production to be 114.4 mn bales in CY 2022-23: US FAS

<https://www.fibre2fashion.com/news/cotton-news/global-cotton-production-to-be-114-4-mn-bales-in-cy-2022-23-us-fas-285709-newsdetails.htm>

Global cotton production is projected to be down by a million bales to 114.4 million bales in the 2022-23 cotton year (CY) and largely attributable to lower yields in the Franc Zone and India, according to the Foreign Agricultural Service (FAS) of the US department of agriculture (USDA). In addition to lower supplies in CY 2022-23, higher input costs for cotton lint and electricity are slowing consumption and suppressing profit margins, FAS noted. For major cotton-producing countries, cotton lint prices are down by more than 20 per cent compared with last CY. However, Pakistan's levels are up by more than 10 per cent.

The Next ESG Frontier Is Genetically Modified Food

<https://www.bloomberg.com/opinion/articles/2023-02-02/genetically-modified-food-is-the-next-esg-frontier-after-energy-and-defense#xj4y7vzkq>

The need to feed an expanding population while cutting agriculture's high greenhouse gas emissions means farming must become more efficient. The increased use of genetic technology in seed manufacture is one solution. Yet GMOs remain a bugbear for many ESG funds, which are wary of the unintended consequences of intervening in the food chain (the so-called precautionary principle).

Latin America: a biotech laboratory and world champion in GMOs

<https://allianceforscience.org/blog/2023/02/latin-america-a-biotech-laboratory-and-world-champion-in-gmos-and-gene-editing/>

Since the commercial release of GMOs began in the mid-1990s, Latin America has been a key region in the industry. Paraguay, Uruguay, and Bolivia are major producers of GM soybeans, and Chile maintains its position as the main GM counter-season seed nursery in the southern hemisphere. The region's seven countries — Argentina, Chile, Brazil, Paraguay, Colombia, Honduras, and Guatemala — are also leading the advance in regulations that allow the commercial release of gene-edited crops. Uruguay is likely to join soon.

How biotechnology over-regulation harms farmers, boosts food costs and fuels inflation

Recent months have been hellish for many American farmers and consumers who buy the food they produce. Many farms have suffered frost damage to crops, and poultry farms have experienced the worst avian flu epidemic on record. As all Americans who shop for food know only too well, the result has been skyrocketing prices at the supermarket, especially for poultry, eggs, and certain fruits and vegetables.

Using cost-benefit analysis: Crop biotechnology offers sizable yield and sustainability benefits when compared to non-GM farming

What are the costs of not adopting the best food producing technologies? The ability to quantify a choice that is not made is not an easy thing to do, especially when the choices are government decisions that are not made. For many policy decisions, a cost-benefit analysis is performed to compare and sum the benefits to the costs based on a particular decision. For this analysis, some decisions are easier to make, such as having the choice to invest \$1,000 in one of two investment options. We can always compare the return of the alternative option to determine if our decision was the one that provided the higher return. However, if a person had two job offers, it isn't easy to determine what the outcome could have been from the alternative option.

Opinion on new genomic technologies applied to plants

<https://www.academie-technologies.fr/publications/avis-sur-les-nouvelles-technologies-genomiques-appliquees-aux-plantes/>

<https://www.lopinion.fr/economie/selection-genetique-vegetale-lacademie-des-technologies-prone-le-progres-raisonne>

This opinion from the Academy of Technologies presents a set of analysis and recommendations to support the development and use of new genomic technologies, also called genome rewriting technologies, for the creation of new plant varieties. It recalls the major stages and the socio-economic

context of the emergence of biotechnologies, in particular genetically modified organisms (GMOs), the context within which the NTGs emerged.

Happy Valentine's Day! Learn How USDA is Using Biotechnology to Produce High Quality Chocolate with Cacao for Peace in Colombia

<https://www.usda.gov/media/blog/2023/02/14/happy-valentines-day-learn-how-usda-using-biotechnology-produce-high-quality>

The USDA Economic Research Service notes that imports of chocolate and edible cocoa products to the United States reached almost \$2.8 billion per year between 2017–21. One challenge facing cacao producers all over the world is cadmium in soils where cacao trees are grown. The cadmium is taken up by cacao trees from the soil where they grow. Changing the soil can be difficult, so scientists are turning to biotechnology to help solve the problem. Through support from Cacao for Peace, scientists are using genome editing to make minor changes to the cacao gene responsible for cadmium absorption from the soil. The resulting genome-edited plants would absorb less cadmium, resulting in chocolate with lower levels of cadmium.

Report Projects the Future of CRISPR-Cas Market

The global CRISPR-Cas gene editing market is valued at ~US\$ 830.7 Mn in 2022 and is projected to achieve a compound annual growth rate of 22.8% from 2023 to 2030. This forecast is according to the report released by Coherent Market Insights. CRISPR, an abbreviation for clustered regularly interspaced short palindromic repeats, is a simple but powerful tool for editing genomes. It enables researchers to easily modify DNA sequences and change their function. It has numerous applications in healthcare, food, and agriculture. The other similar gene editing techniques include ZFNs (Zinc Finger Nucleases) and TALENs (Transcription Activator-Like Effector Nucleases).

India's DBT to Enhance Genome Editing Capacity of Scientists Through Research Grants

The Indian government through the Department of Biotechnology (DBT) will provide support for innovative, interdisciplinary, and collaborative research approaches for agricultural improvements by Indian scientists. This is an attempt to maximize the potential of cutting-edge tools of modern biotechnology, including genome editing, to foster research and innovation focusing on translational research.

For the first time, genetically modified trees have been planted in a US forest

<https://indianexpress.com/article/world/climate-change/united-states-genetically-modified-trees-living-carbon-8452692/>

Written by Gabriel Popkin on Monday, in a low-lying tract of southern Georgia's pine belt, a half-dozen workers planted row upon row of twiglike poplar trees. These weren't just any trees, though: Some of the seedlings being nestled into the soggy soil had been genetically engineered to grow wood at turbocharged rates while slurping up carbon dioxide from the air.

Australia Allows Import and Distribution of GM Chrysanthemum <https://www.ogtr.gov.au/gmo-dealings/dealings-involving-intentional-release/dir-191>

Australia's Gene Technology Regulator (OGTR) has issued license DIR 191 to International Flower Developments Pty. Ltd., authorizing the commercial import and distribution of chrysanthemums genetically modified (GM) for altered flower color.

AI Robots Sustainable Solutions for Agriculture in India <https://timestech.in/ai-robots-sustainable-solutions-for-agriculture-in-india/>

Agriculture is pivotal to the Indian economy with a 17% contribution to national GDP. Further, it is the primary source of livelihood for 58% of the population. There is a dire need to increase agricultural output sustainably. This is necessary to not just feed an ever-growing population but also to make it an economically viable profession. AgRobots have the potential to truly disrupt agriculture for the better. It can make laborious farming tasks exponentially easier by reducing input time, effort, and costs. 2023 is a paramount year for Agtech as a whole. In turn farmers are beginning to develop trust and have realistic expectations about AgTech. Further, AgTech companies that embrace a farmer-first approach will lead agriculture into its new era of super-efficient and sustainable farming.

You are Myth Taken: GMOs <https://european-seed.com/2023/02/you-are-myth-taken-gmos/>

The aim of the *European Seed* series on Myths, Fake News, Misinformation and Disinformation is to dive deeper, taking a closer look at a variety of seed-related topics. This article looks at the myths surrounding GMOs.

SARI Submits 2 New Applications <https://nba.gov.gh/sari-submits-2-new-applications/>

Researchers with Ghana's Savanna Agricultural Research Institute have submitted applications for two new cowpea traits. One application is for a breeding cultivar containing the Cry2ab protein, which the agency hopes to combine with the already approved cowpea-expressing Cry1Ab protein. Another application is for confined field trials of a cowpea resistant to Bruchid beetles. The first GM cowpea approved by biosafety regulators is still awaiting clearance from the country's National Varietal Release

and

Registration

Committee.

Cost of strict risk-based regulations for GM and CRISPR crops should be balanced by their environmental benefits

Genetically modified organisms (GMOs) are created by moving a gene into a crop or animal. With this added gene, a new protein enhances the plant or animal. For instance, Bt corn has an added gene that produces a protein that is a deterrent to certain insects. A newer procedure using CRISPR-Cas9 allows for more precise editing of genes within the organism and does not require the insertion of a gene from another species. Whether we are referring to crops or livestock modified using transgenic methods (moving a gene from one species to another, i.e., GMOs) or genome-editing, the safety record of agricultural biotechnology is unblemished. Not a single illness has been attributed to the consumption of biotech food (eaten by billions of people around the planet) due to how it was enhanced.

Gene-edited or genetically modified food? The impacts of risk and ambiguity on Chinese consumers' willingness to pay

<https://onlinelibrary.wiley.com/doi/abs/10.1111/agec.12767>

This study investigates consumer preferences for newly introduced gene-edited (GE) food. We focus on how risk and ambiguity aversion affect consumers' willingness to pay (WTP) to avoid genetically modified (GM) food or GE food and whether the impacts of risk and ambiguity aversion differ between GM and GE food.

NEMA gives a go ahead for research on GMO cassava

<https://www.the-star.co.ke/news/star-farmer/2023-02-22-nema-gives-a-go-ahead-for-research-on-gmo-cassava/>

The National Environment Management Authority has given a green light for the National Performance Trials on GMO cassava. National Performance Trials are designed to test the performance of new plant varieties compared to varieties that are currently in the market.

New regulation of CRISPR/Cas & Co: No more genetic engineering in many countries

<https://www.transgen.de/aktuell/2853.genome-editing-pflanzen-regulierung-weltweit.html>

The EU is still sticking to it: New breeding methods such as the gene scissors CRISPR/Cas are also genetic engineering – without exception. This is about to change. Political consultations will begin in Brussels in mid-2023. What will come out of it in the end is not foreseeable. But numerous countries on all continents have already shown the way and relaxed the requirements for simple genome-edited plants or even released them altogether. The European neighbours Great Britain and Switzerland also

want to remove such plants from the current genetic engineering law. (With a country overview of (de-)regulation of genome-edited plants).

Argentina's GDM prepares launch of new GMO soy seeds in South Africa

<https://www.reuters.com/markets/commodities/argentinas-gdm-prepares-launch-new-gmo-soy-seeds-south-africa-2023-02-27/>

Argentina based plant genetics company GDM has applied for registration in South Africa of 13 soybean varieties after the country approved the use of a new GMO seed technology, according to company executives. It is expected that three of the 13 soybean varieties will be pre-launched this year, as the firm hopes to bolster its South African business and prepare incursions throughout the region.

Here's how Kenya is inching its way into the biotechnology revolution in agriculture

The biotech research community in Kenya heaved with relief when the government lifted a decade-old ban on genetically modified organisms (GMOs) in October last year. This would face headwinds immediately when court cases stopped the regulator, the National Biosafety Authority (NBA), from facilitating the distribution, importation, transactions and growth of GMOs.

New

Research

Researchers Discover Reason Behind Switchgrass' Summer Photosynthesis Shutdown

Researchers at Michigan State University led by Assistant Professor Berkley Walker have solved a puzzle that could unlock the full potential of switchgrass as a low-cost and sustainable biofuel crop. In a paper in the journal *Frontiers in Plant Science*, Walker's team revealed why switchgrass stops performing photosynthesis during its growing season in the middle of the summer, limiting its biofuel yields.

OsLPR3 Mutation Improves Tolerance to Phosphate Starvation in Rice

Researchers from Nanjing Agricultural University and partners reported that mutation of *OsLPR3* improves tolerance to phosphate starvation in rice. Their findings are reported in the *International Journal of Molecular Sciences*.

Genome Sequence and Analysis of *Nicotiana benthamiana*, the Model Plant for Interactions between Organisms

<https://academic.oup.com/pcp/advance-article/doi/10.1093/pcp/pcac168/7031347?login=false>

Nicotiana benthamiana, colloquially known as benth or benthii, is one of the most widely used experimental models in plant science. Now that its complex genome has been almost completely

mapped out, plant science research is expected to steeply improve along with the rapid development of more effective experimental methods for the plant.

Researchers Construct Pan-3D Genome of Soybean

https://english.cas.cn/newsroom/research_news/life/202302/t20230207_326712.shtml

A research group at the Chinese Academy of Sciences (CAS) led by Prof. TIAN Zhixi from the Institute of Genetics and Developmental Biology has constructed a pan-3D genome of soybean, revealing the internal relationships among soybean genome, 3D genome, and gene expression. Published in *Genome Biology*, the study obtained high-quality 3D genome data by performing high-throughput chromatin conformation capture experiments on 27 soybean germplasm materials that were de novo assembled in a previous study.

CRISPR-Cas9-mediated Editing of BADH2 for Better Rice Aroma

One of the most essential characteristics considered in rice breeding is fragrance. A key fragrance compound known as 2-acetyl-1-pyrroline (2-AP) is just one of the over 200 substances present in fragrant rice. Other plants also contain such substances that provides fragrant aroma, and they exhibit low levels of BETAINE ALDEHYDE DEHYDROGENASE 2 (BADH2).

Europe's First Gene-edited Wheat Field Trial a Success

Rothamsted Research reported the completion of the field trial of the United Kingdom's gene-edited wheat. Researchers are now a step closer to bringing the wheat variety with lower asparagine levels to farmers and consumers. The field trial exhibited that the gene-edited wheat's asparagine level was 50% lower than Cadenza, the variety used as control during the study. Asparagine in wheat grains are converted to acrylamide, a potential carcinogen that can cause cancer, when cooked. Flour made from the gene-edited wheat showed a reduction of acrylamide level by up to 45%. The field trial data supports the results previously gathered during the contained trial.

Copying nature to resist viruses

<https://www.inrae.fr/en/news/copying-nature-resist-viruses>

For thousands of years, crops have been shaped by domestication processes. Farmers cross-breed and select new varieties, adapted to constantly changing environments. Although efficient, this process is time consuming. Moreover, the desired trait must be present somewhere within the diversity of the species to be improved. Copying a mechanism from one species into a species of agronomic interest thus becomes a new challenge. Among the technologies available, new plant genome editing techniques have been available since 2012. Often compared to molecular scissors, the CRISPR-Cas9 technique

makes it possible to modify a region of the plant's DNA in a targeted and precise manner.

IIRR develops high-yield variety of Samba Masuri

<https://www.newindianexpress.com/states/telangana/2023/feb/20/iirr-develops-high-yield-variety-of-samba-masuri-2548992.html>

Over the years it has been a great challenge for researchers to enhance the yield potential of the fine-grain Samba Masuri – a fine-grain elite mega-rice cultivar having a significant rice export contribution, while retaining the original grain and cooking qualities. A ICAR-Indian Institute of Rice Research (IIRR) team started working on rice improvement and in 2018, received funding from National Agricultural Science Fund (NASF) to carry out research in the area of genome editing.

Researchers Use Epigenetic Editing Technique to Fight Cassava Bacterial Blight

<https://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=20040>

Pioneering research led by Rebecca Bart from Donald Danforth Plant Science Center and her collaborators at the University of California Los Angeles and the University of Hawaii at Manoa shows that epigenome editing can reduce cassava bacterial blight (CBB) symptoms in cassava plants while maintaining normal growth and development.

Japanese scientists look to create vegetables with anti-inflammatory properties using plant pigments

<https://www.foodnavigator.com/Article/2023/02/22/japanese-scientists-look-to-create-vegetables-with-anti-inflammatory-properties-using-plant-pigments>

A team at the Tokyo University of Science and Iwate Biotechnology Research Center have successfully genetically engineered tomatoes to produce the plant pigment betalain with significant anti-inflammatory effects. Betalains are a class of plant pigments responsible for the characteristic red-violet or yellow colour of certain fruits and vegetables. These naturally occurring, water-soluble, and nitrogen-containing pigments are commonly used as food colouring agents.

Ancient emmer roots using gene tools from today

<https://www.greenprophet.com/2023/02/emmer-wheat-long-roots/>

<https://www.nature.com/articles/s41467-023-36248-y>

In a recent study the group used gene editing and hydroponics to pinpoint which genes are responsible for long roots. Long-rooted wheat can search for water and minerals better in the wild and is a more ideal gene trait if seed bank researchers want to produce seeds from wild varieties that are climate resilient. There is an established theory that farming started with the emmer wheat in the area around Israel, Jordan and Lebanon fifteen thousand years ago. As seed banks start to proliferate around the

Middle East, and younger generations turn to farming, new ideas are formulating.

Study Reveals Role of Activator Gene in Tomato Growth and Ripening

<https://link.springer.com/article/10.1007/s11248-023-00337-x>

A team of researchers from Ain Shams University and other institutions conducted a study to characterize the transgenic Micro-Tom plants and revealed new insights into tomato fruit ripening. Auxin is a plant hormone that controls several growth and development traits. The researchers described the characteristics of a new transcriptional activator *SIARR* which functions as a two-component response regulator and belongs to the subfamily of type-B response regulators in the cytokinin signaling pathway.

