



# Agri Innovation Post

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The recently released gene edited mustard greens with moderate flavour is the second edited food with improved nutrition or flavour that has been commercialized. The mustard has been edited to be less bitter than the original plant. Mustard leaves are packed with vitamins and minerals and are much more nutritious than the usual salad greens like lettuce and iceberg lettuce. But they have a strong peppery flavour when eaten raw and hence are usually made palatable by cooking. The pungency of mustard has been reduced by editing. Like mustard that is the first edited food to hit the US market, GABA tomatoes were commercialized in Japan in 2021. GABA tomatoes contain high amounts of  $\gamma$ -aminobutyric acid, or GABA. A chemical messenger in the brain, that blocks impulses between nerve cells, aids in relaxation, helps relieve stress and lower blood pressure. Other consumer traits in crops that are being enhanced via gene editing include seedless blackberries and pit less cherries, vitamin A enhanced bananas and fruits and vegetables with longer shelf life. The speed and the precision of achieving the desired change in the plants using gene editing along with the reasonable science-based regulation, has resulted in the technology being avidly used for crops with smaller market size. The economics of bringing edited crops to market along with the associated timelines makes it a tool of choice for improving consumer traits that usually have niche markets. Gene editing is also being employed for de-novo domestication of wild relatives of domestic crops, which is bringing the much-required diversity in foods consumed by us and is also enhancing nutrition. The technology can contribute towards nutritional security as well as sustainability with consumers getting higher nutrition from the efficiently cultivated crops. In this edition of Agri innovation Post you can peruse the various articles that review the success of agricultural biotechnology in solving challenges of productivity and environment.



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### **News from India and Around the World**

#### **Are GMOs a solution to alleviate hunger?**

<https://alfayomega.es/son-los-transgenicos-una-solucion-para-paliar-el-hambre/>

For centuries man has cultivated plants and raised animals, and this has involved genetic modifications. 12,000 years ago a very basic genetics was used that crossed crops to try to improve products and crops. But during the 80s we learned how to be precise thanks to the magnificent Belgian scientists Marc Van Montagu and Jeff Schell, and to Mary Dell Chilton, in the United States, who dedicated their research to try to improve plants and achieve more success in the application of plant genetics. The most current forms of cultivation use a method called CRISPR, which was discovered a decade ago.

#### **Factory farming, GMOs, and corporate greed: Top 10 myths about agriculture: Debunked**

<https://www.aqdaily.com/insights/top-10-myths-about-agriculture-debunked/>

Modern agriculture practices have been in the hot seat for years, and it's no wonder why. With a growing global population of over 8 billion people and the pressure to feed everyone in a way that's sustainable for the planet, consumers are becoming increasingly more interested in how their food is being produced. Thankfully, farmers and ranchers have been at the forefront of implementing technologies aimed at ensuring each acre and animal is grown responsibly and sustainably. However, not everyone recognizes the innovations being made as beneficial, and many more twist the facts to spread fear and misinformation surrounding modern ag.

#### **[Banana appeal: Australia's first genetically modified fruit sent for approval](#)**

Scientists have submitted Australia's first genetically modified fruit – a Cavendish banana – to

regulators for approval, saying it has been engineered to withstand a deadly fungus that poses a threat to banana growers worldwide. The banana, known as QCAV-4, has been genetically modified to resist a fungus known as Panama disease tropical race 4 (TR4), which is threatening the multibillion-dollar Cavendish industry globally. If approved, the banana would become Australia's first GM fruit to be approved for cultivation and consumption, as well as the first GM banana to be approved worldwide.

#### **Leveraging agri-tech to decarbonise Indian agriculture**

<https://timesofindia.indiatimes.com/blogs/voices/leveraging-agri-tech-to-decarbonise-indian-agriculture/>

Just like hybrid seeds and increasing tractor penetration did not unilaterally usher in India's Green Revolution, the idea that technology alone holds the answers to India's grave and persistent agrarian crisis is wishful thinking. Nurturing policy support, central to the shift to modern Indian agriculture in the Sixties and Seventies, will be key once again in determining if agri-tech will be transformative or will merely contribute to the bottom lines of agri-tech companies.

#### **[Philippines greenlights gene-edited banana that limits Panama disease and protects against browning](#)**

Panama disease, also called Panama disease Tropical Race 4 (TR4), is a serious banana disease and is one of the most severe threats facing the banana industry in the world today. There had been no known cure or varieties of bananas that were resistant to the disease until now. Tropic's 'non-browning' bananas have also received the go-ahead from the Philippines Department of Agriculture, which has a rigorous gene editing regulatory determination process, said the company in a statement.

#### **The First Crispr-Edited Salad Is Here**

<https://www.wired.com/story/wired30-crispr-edited-salad-greens/>

Mustard greens are packed with vitamins and minerals but have a strong peppery flavor when eaten raw. To make them more palatable, they're usually cooked. Pairwise wanted to retain the health benefits of mustard greens but make them tastier to the average shopper, so scientists at the company used the DNA-editing tool Crispr to remove a gene responsible for their pungency. The company hopes consumers will opt for its greens over less nutritious ones like iceberg and butter lettuce.

#### **What's the latest on GMOs and gene-edited foods – and what are the concerns? An expert explains**

<https://indianexpress.com/article/lifestyle/food-wine/gmos-gene-edited-foods-concerns-latest-8599325/>

Advances in genetic engineering have given rise to an era of foods – including genetically modified

organisms (GMOs) and gene-edited foods – that promise to revolutionise the way we eat. Critics argue these **foods** could pose risks to human health and the environment. Proponents point to their potential for enhancing yields, reducing food waste, and even combating climate change.

#### **How space-based technologies are transforming Indian agriculture**

<https://www.thehindubusinessline.com/economy/agri-business/how-space-based-technologies-are-transforming-indian-agriculture/article66900062.ece>

Enhancing precision agriculture Space based technologies leverage Global Navigation Satellite Systems (GNSS) to enable precision agriculture and provide accurate positioning data. This allows farmers to precisely map their fields, identify potential areas for cultivation, and optimise resource allocation. Farmers are empowered to not only adopt site specific nutrient management and precise irrigation techniques but also plan crops optimally and improve yields and resource efficiency.

#### **EPA Finalizes Rule to Accelerate Use of Plant-Incorporated Biotechnologies to Protect Against Pests**

<https://www.epa.gov/pesticides/epa-finalizes-rule-accelerate-use-plant-incorporated-biotechnologies-protect-against>

Today, the U.S. Environmental Protection Agency (EPA) released a final rule exempting a class of plant-incorporated protectants (PIPs) created using genetic engineering from registration requirements under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and from the food or feed residue tolerance requirements under the Federal Food, Drug, and Cosmetic Act (FFDCA). This rule ensures that public health and the environment are protected while reducing costs for the regulated community, consistent with Executive Order 14081 on advancing biotechnology. The rule may also result in increased research and development activities, commercialization of new pest control options for farmers (particularly in minor crops such as grapes and cucumbers), and reduced use of conventional pesticides.

#### **[Paper Highlights Public Acceptance of Gene-edited Foods](#)**

Most public engagements of researchers and academics on gene editing are focused on its relevance in agriculture. Scientific literature, patent publications, and market reports have shown a sharp increase on its usage during the past decade. Since it is still a new technology, understanding public views and stakeholders' perspectives about gene editing is vital in projecting future applications.

#### **Genomic Innovation in Rice: Transforming Black, Brown, and Red Varieties With CRISPR**

<https://scitechdaily.com/genomic-innovation-in-rice-transforming-black-brown-and-red-varieties-with-crispr/>

KAUST researchers are working to improve the agronomic traits of pigmented rice varieties using genomic studies and CRISPR technology. Their focus is on improving nutrient-rich varieties like the

black Indonesian rice Cempo Ireng, transforming it into a shorter, earlier maturing variety to enhance its appeal to farmers. Their next project is to enhance the productivity of Hassawi rice, a culturally significant red rice variety native to Saudi Arabia.

#### [Paper Highlights Public Acceptance of Gene-edited Foods](#)

Ghent University researchers and partners provided a global overview of public acceptance and stakeholder views of gene-edited foods. Their paper is published in *Trends in Biotechnology*.

#### **New Research**

#### [The resurrection of Plant Disease Resistance Proteins via Helper NLR Bioengineering](#)

Parasites counteract host immunity by suppressing helper nucleotide binding and leucine-rich repeat (NLR) proteins that function as central nodes in immune receptor networks. Understanding the mechanisms of immunosuppression can lead to strategies for bioengineering disease resistance. Here, we show that a cyst nematode virulence effector binds and inhibits oligomerization of the helper NLR protein NRC2 by physically preventing intramolecular rearrangements required for activation.

#### [The dream of self-cloning crops](#)

[https://www.science.org/content/article/game-changer-scientists-are-genetically-engineering-crops-clone-themselves?utm\\_source=Nature+Briefing&utm\\_campaign=91a93ef166-briefing-dy-20230523&utm\\_medium=email&utm\\_term=0\\_c9dfd39373-91a93ef166-43919645](https://www.science.org/content/article/game-changer-scientists-are-genetically-engineering-crops-clone-themselves?utm_source=Nature+Briefing&utm_campaign=91a93ef166-briefing-dy-20230523&utm_medium=email&utm_term=0_c9dfd39373-91a93ef166-43919645)

**I**n 2019, the first self-cloning rice plants brought a palpable “sense of excitement” to plant science, says molecular biologist Mary Gehring. More than 400 plant species, including common ones such as dandelions, naturally reproduce through cloning — a process that scientists are now starting to copy over to staple crops. Self-cloning hybrid crops could preserve their unique genetics, a long-sought goal for plant breeders. Hybrid crops, made by crossing strains of inbred parents, are remarkably (and mysteriously) robust and high-yielding. But producing hybrid crops is labour-intensive, and the process must be repeated for each batch of seeds. Otherwise, genetic reshuffling during normal sexual reproduction means that the offspring will lose their parents’ favourable traits.

#### [Proprietary CRISPR Technology Accelerates Innovation in Agriculture Products, Supply Chains, and Production Systems](#)

A new technology called FULCRUM™ Platform has been launched by the agricultural company Pairwise. FULCRUM Platform is built on proprietary CRISPR technology and other gene editing tools, allowing Pairwise to make changes to crops quickly and successfully. This platform was used in

Pairwise Conscious™ Foods products and the specialty and commodity crop products of its business partners.

#### [CRISPR Used to Increase Glucoraphanin Content in Chinese Kale](#)

Plant secondary metabolite glucoraphanin (GRA) generates a hydrolysis product that has potent anticancer activity. GRA is available in Chinese kale but only in trace amounts. To improve the GRA content of Chinese kale, three copies of the ALKENYL HYDROXALKYL PRODUCING 2 (AOP2) gene were isolated and edited using the CRISPR–Cas9 system. This led to *boaaop2* mutants with increased levels of GRA. It was also observed that the expression of upstream genes of glucosinolate biosynthesis was decreased in the mutants.

#### **Microbial carbon use efficiency promotes global soil carbon storage**

[https://www.nature.com/articles/s41586-023-06042-3?utm\\_source=substack&utm\\_medium=email](https://www.nature.com/articles/s41586-023-06042-3?utm_source=substack&utm_medium=email)

This study provides evidence from global–scale observations that microbial CUE plays a pivotal role in determining SOC storage. On the basis of information retrieved from global vertical soil profiles using the PRODA approach, we found that microbial CUE is at least four times as important in determining SOC storage at the global scale as any of the other six components evaluated: plant carbon inputs, carbon input allocation, non–microbial carbon transfer, substrate decomposability, environmental modifications and vertical transport.

#### [New Gene Editing Method Can Reveal Roles and Properties of Duplicated Plant Genes](#)

Researchers at Tel Aviv University (TAU) have developed a genome–scale technology that makes it possible to reveal the role of genes and traits in plants that may have been hidden by functional redundancy. This technology is expected to revolutionize the development of agricultural crops and how they are improved, as it can be applied to most crops and agricultural traits, such as increased yield and resistance to drought or pests.

#### [IGI Scientists Make Strides in Protecting Rice from Drought](#)

Brian Staskawicz, Director of Innovative Genomics Institute (IGI) Sustainable Agriculture, together with his research team have used CRISPR to open a new path towards developing drought tolerant rice. The gene STOMAGEN (short for “stomata generator”) is crucial for the development of stomata. Researchers have previously reduced the number of stomata by disabling or “knocking out” the STOMAGEN gene in rice, leading to an ~80% reduction in the number of stomata. EPFL10 promotes the development of stomata in rice leaves and knocking out EPFL10 reduces the number of stomata, but less dramatically than knocking out STOMAGEN.

#### **Purdue biology innovation allows the introduction of valuable traits in plants without creating**

## **transgenic plants**

<https://www.purdue.edu/newsroom/releases/2023/Q2/purdue-biology-innovation-allows-the-introduction-of-valuable-traits-in-plants-without-creating-transgenic-plants.html>

The VirD2 mutant *Agrobacterium* strains can carry T-DNA that delivers and expresses genome engineering reagents, such as CRISPR-Cas. Although the plant genome may be altered, no transgenic plant is created. T-DNA delivered by Purdue-created *Agrobacterium* strains disappears from the plant nucleus because it is eventually destroyed by nucleases – naturally existing enzymes that degrade DNA – or it is ‘diluted’ out of the plant nuclei as the cells divide.

## **Will Crispr ‘genetic scissors’ revolutionize agriculture?**

<https://www.slate.fr/story/247775/ciseaux-genetiques-crispr-cas9-solution-miracle-revolutionner-agriculture-futur-manipulation-cultures-ogm-ethique>

Sustainable agriculture, robust in the face of current and future diseases and climatic upheavals. Such is the promise made realizable with Crispr (“Short grouped and evenly spaced palindromic repetitions” in French). The so-called Crispr-Cas9 technique, discovered in 2012 and for which Emmanuelle Charpentier and Jennifer Doudna received the Nobel Prize in Chemistry in 2020, consists of manipulating the DNA of a living being and is already used in agriculture in many countries, and soon in Europe.

## **Whole genome of highly adaptable foxtail millet sequenced**

<https://www.newsdrum.in/national/whole-genome-of-highly-adaptable-foxtail-millet-sequenced>

In a new research, scientists have mapped the complete genome of an important cereal crop, *Setaria* or foxtail millet, advancing our understanding of its domestication and evolution, along with a genetic explanation for its agricultural traits.

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## **[EFSA: Six-Event Stack Maize and 30 Subcombinations as Safe as Non-GM Maize](#)**

The European Food Safety Authority (EFSA) Panel on Genetically Modified Organisms (GMO Panel) has published its assessment on the safety of the six-event stack genetically modified (GM) herbicide-tolerant and insect-resistant maize Bt11 × MIR162 × MIR604 × MON 89034 × 5307 × GA21. The Scientific Opinion is published based on the application EFSA-GMO-DE-2018-149 under Regulation

(EC) No. 1829/2003 received from Syngenta Crop Protection NV/SA.

**University of Tokyo, 30% more rice harvest with less fertilizer Genome editing**

<https://www.nikkei.com/article/DGXZQOUC084N30Y3A600C2000000/>

Professor Tsuyoshi Izawa of the University of Tokyo, Kyoto University, and others have developed rice that can increase yields even in environments with little fertilizer by using “genome editing,” a technology that enables efficient gene modification. In the experiment, the yield increased by about 30% compared to before the improvement. It is expected that this will lead to the realization of agriculture with a low environmental impact that uses less fertilizer.

