Vol. 1, No. 1 August 2022

### DECODING BIOTECH STRAND BY STRAND

How to genetically engineer a plant?

**News Briefs** 

Biotech crops in the Philippines

Biotech corn – the first biotech crop in the Philippines

Where are biotech crops grown in the world?

Who plants biotech corn in the Philippines?

Science activities



### DOUB HELLS DECODING BIOTECH STRAND BY STRAND

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# Welcome!

Dear Teachers and Students, welcome to the first-ever issue of the *Double Helix*, the only magazine supplement on agricultural biotechnology for senior high school students in the Philippines!

The world is facing major challenges to food production as the global population increases and climate change affects agriculture. Agricultural biotechnology, or agbiotech, a field of science that uses modern tools and techniques to improve crops and livestock, helps address the challenges of feeding and clothing the global population of 9.8 billion by 2050.

This maiden issue of the *Double Helix* presents the process of developing a biotech crop, the countries where biotech crops are grown, biotech crops in the Philippines, farmers, news briefs, and some fun science activities and exercises for all of you to enjoy.

Through the *Double Helix*, we hope to impart to you how biotech crops are developed and the immense benefits that consumers, farmers, their families, and communities enjoy from planting biotech crops. If there are topics that you want to be covered in the *Double Helix*,

send us a message at doublehelix@isaaa.org. Please share the *Double Helix* with your family and friends!

— Double Helix Editorial Team

### **NEWS BRIEFS**

### PHILIPPINES PREPARES FOR GOLDEN RICE SEED DEPLOYMENT



The Philippine Rice Research Institute (PhilRice) is getting ready for the distribution of Golden Rice to farmers by increasing its seed production operations.

Department of Agriculture Secretary William Dar gave Golden Rice seeds to seed growers and producers during a ceremony held at the PhilRice Central Experiment Station in Nueva Ecija on May 6, 2022. The seed workers and producers will participate in the expanded Golden Rice seed production, together with researchers from Ilocos Norte and Isabela.

#### MIT SCIENTISTS TO DEVELOP SELF-FERTILIZING CROPS

Massachusetts Institute of Technology researchers are working together to reduce agriculturedriven emissions, combat

climate change, and produce healthier crops. This multidisciplinary project titled "Revolutionizing agriculture with lowemissions, resilient crops" is one of the five flagship winners in the Climate Grand Challenges competition. The project includes finding ways to transfer legumes' self-fertilizing ability to cereal crops to revolutionize the sustainability of food production.

#### EGYPTIAN RESEARCHERS DEVELOP GM WHEAT WITH RESISTANCE TO SALINITY AND WATER SCARCITY



Researchers at the Egyptian Atomic Energy Authority (EAEA) have started harvesting genetically modified (GM) wheat at the authority's site in Inshas City. The GM wheat has several improved characteristics such as high yielding, tolerance to saline soils, and resistance to

water scarcity. The GM wheat can produce almost 1 ton higher than the cultivated Egyptian wheat varieties. It is projected that it can increase the country's local wheat production by 33 percent and decrease the need for imported wheat.

#### NIGERIA STARTS TRIALS FOR DROUGHT TOLERANT AND INSECT RESISTANT MAIZE

Nigeria will start the national performance trials for drought tolerant and insect resistant maize known as TELA. TELA maize, which exhibits resistance to fall armyworm, stem borers, and tolerates moderate drought, was developed by researchers at the Institute for Agricultural Research, Ahmadu Bello University. The national performance trials will involve 180 farmers from 10 states with varied agro-ecological conditions. The results of the trials will also be used in the application for commercial approval of TELA maize.

#### DEVELOPERS APPLY FOR COMMERCIAL RELEASE OF GM CHRYSANTHEMUM IN AUSTRALIA



The Australian Office of the Gene Technology Regulator has received a license application from the International Flower Developments for the

commercial release of genetically modified (GM) chrysanthemum with altered flower color. The application is for the commercial import and distribution of cut flowers of GM chrysanthemum intended for ornamental use and would not be used for human food or animal feed.

#### GM LETTUCE HELPS PROTECT ASTRONAUTS' BONES IN LONG SPACEFLIGHTS

University of California, Davis developed a GM lettuce that produces a drug which protects against bone density loss. Astronauts lose bone mass when in



space due to the disturbance of balance of their bone growth and resorption under microgravity. The GM lettuce produces a fusion protein combining parathyroid hormone (PTH), a hormone to bring back the balance of bone growth and resorption, with part of a human antibody protein. The astronauts will then be able to plant and extract the drug during their time in space, instead of bringing injectable PTH.





### How to genetically engineer a plant?

By Kristine Grace N. Tome

Genetic engineering enables direct transfer of gene/s of interest between closely or distantly related organisms. For example, a gene from a soil bacterium is inserted into the eggplant DNA to make it resistant from pest attacks. This will help farmer lessen the use of insecticide sprays.

Two of the most common tools used by scientists in genetic engineering are the gene gun and the microorganism known as *Agrobacterium*.



### Using a gene gun



The gene of interest is copied out of the DNA extracted from an organism.

Gold/tungsten microparticles are coated with the cloned DNA.

Target plant cells fired are with the coated DNA.



From these cells, plants are regrown and checked for the presence of new genetic material.

### Using Agrobacterium



Design a plasmid containing the gene of interest.

The plasmid is inserted into the *Agrobacterium*.

Cells from target plants will be infected by *Agrobacterium*.

Transformed plants are regrown and checked for the presence of new genetic material.



After the transformation is confirmed, the plants will be tested further in the laboratory, in the greenhouse, in a confined field, then in different locations. Safety tests and public consultations will be conducted before the genetically engineered plant becomes available in the market.

### Learn new biotech words!



**Bacterium** a single cell organism

**Clone** a cell that is genetically the same as the original cell from which it is derived



**DNA** deoxyribonucleic acid; the hereditary material of living organisms

**Gene of interest** basic unit of inheritance that carries information to express a certain trait



**Plasmid** a strand or loop of DNA used to carry a gene/s to be inserted into a bacterium

Transformation another term for genetic engineering







### **Biotech crops in the Philippines**

### **By Clement Dionglay**

In 1996, six countries—the USA, China, Argentina, Canada, Australia, and Mexico—planted biotech crops on a total of 1.7 million hectares. Soon, more countries joined these six "founder countries" including the Philippines, which planted Bt corn, its first biotech crop, in 2003. Since then, the Philippines has become a model for science-based and thorough regulatory policy in the region.

### **Biotech corn**

The Philippines is the first country in Southeast Asia to approve and grow Bt corn, a major biotech feed crop. Since 2003, the adoption of biotech corn in the Philippines increased consistently year after year, reflecting the significant benefits that 673,000 smallholder Filipino corn farmers, their families, and communities continue to enjoy.

In 2019, the Philippines ranked 12th among the 29 countries that planted biotech crops with a total area of 875,000 hectares planted to biotech corn, retaining the biotech mega-country status it held since 2004 for planting 50,000 hectares, or more, of biotech crops.



Filipino corn farmers and their families enjoy the benefits of planting biotech corn.

### **Golden Rice**



Golden Rice seeds has been distributed for pilot planting.

Golden Rice, a biotech rice biofortified with provitamin A (beta carotene) was developed by the Philippine Rice Research Institute (PhilRice) and the International Rice Research Institute to help in the fight against vitamin A deficiency (VAD). VAD is a serious public health problem affecting millions of children and pregnant women globally.

In July 2021, the Philippines became the first country in the world to approve Golden Rice for commercial planting. In May 2022, PhilRice distributed the seeds for pilot planting in selected provinces during the 2022 wet season.

### Bt eggplant or Bt talong



Bt eggplant is as safe as a conventional eggplant.

Bt eggplant is an insect-resistant eggplant developed by the Institute of Plant Breeding at the University of the Philippines Los Baños. It contains a natural protein from the soil bacterium *Bacillus thuringiensis* which makes it resistant to eggplant fruit and shoot borer (FSB), the most destructive pest of eggplant. The Bt protein in Bt eggplant only affects FSB and is safe for humans, farm animals, and other insects in the field.

In July 2021, the Philippine Department of Agriculture-Bureau of Plant Industry approved Bt eggplant for direct use as food, feed, or for processing, and is found to be as safe as a conventional eggplant. Aside from eggplant, the following crops are also approved for food/feed in the Philippines: alfalfa, canola, cotton, corn, potato, rice, soybeans, and sugar beets.



# Biotech corn — the first biotech crop in the Philippines

By Zabrina J. Bugnosen



A Filipino farmer tends to drying harvested corn in General Santos City. Biotech corn has been grown in the country since 2003.

In December 2002, the Philippines was the first country in Asia to approve the commercial planting of genetically modified (GM) corn. In its first year of planting, Bt corn was planted on 10,000 hectares of land. In 2019, the area planted to biotech corn reached a whopping 875,000 hectares. What makes the Bt corn so special that Filipino farmers have continuously and increasingly planted it?

Let's start with the first Bt corn that was approved for planting – MON810. MON810 is resistant to the Asiatic corn borer (ACB), a pest that eats its way into a corn ear, destroys the tassels, and eats other parts of the plant as a larva. An ACB infestation in the field can cause up to 80% yield loss, leaving farmers with very little income after each planting season. MON810 changed all that. After planting MON810, farmers realized the benefits of Bt corn. They harvested more corn and did not have to buy chemical pesticides to control the pest. Bt corn was also beneficial to the environment because other insects were not harmed and there was less pesticide residue in the soil. Moreover, the farmers and their families did not have to be exposed to chemical pesticides that they used to spray in the corn farm.

The Philippines has come a long way from the first Bt corn event in 2002. There are now 64 biotech corn events approved in the country, and all of them were evaluated for safety before the seeds were released to farmers. Some of them are resistant to insect pests like MON810, while others are tolerant to herbicides to help farmers manage weeds in their farms better. Some have additional traits known as "stacked events," like additional GM corn varieties that can be insect resistant and herbicide tolerant at the same time.

Bt corn remains an important part of Philippine agriculture. Not only does it bring more harvests of good quality corn, it has also benefited the Filipino farmers' livelihood, income, and health while being friendly to the environment. The experiences from planting biotech corn is truly an extraordinary success story of a GM crop that resonates not only in the Philippines but the entire world.



To learn more about biotech crops in the Philippines, visit: bit.ly/BiotechCropsPH



### Where are biotech crops grown in the world?

More than 30 countries have planted biotech crops since 1996. The top four biotech crops are soybeans, corn, cotton, and canola. See where they are currently grown.





### Who plants biotech corn in the Philippines?

*Since 2003, 673,000 Filipino corn farmers and their families benefited from planting biotech corn. Read below as Filipino farmers share their experience in planting biotech corn.* 



Delzon Sonza Sara, Iloilo

"The adoption of biotech corn uplifted our lives as farmers."

"It gave us income far higher than income from conventional corn."



**Rosalie Ellasus** San Jacinto, Pangasinan

"We no longer need to visit our corn field everyday."

"This gives us peace of mind."



**Ryan Lising** Magalang, Pampanga

"I was able to buy my own farm machines."

"My steady income allowed me to explore other business opportunities."



Aurea Raso San Jacinto, Pangasinan

"Adopting biotech corn indeed helped my family."

"When harvesting comes, we are confident that we have a sure earning."



Pablito Lobendino Naguillan, Isabela

"When we were not yet planting biotech seeds, there was barely money left."

"When we planted Bt corn, we earned a decent profit."



Corazon Cabasag Iguig, Cagayan

"Even if the seed's price is high, Bt's outcome is far better."

> "Because of Bt corn, we were able to buy a big thresher."





# SCIENCE ACTIVITY

Developing biotech crops requires experts' skills and knowledge about genetic engineering. Scientists continuously learn to get updates on the latest trends and techniques in biotech. Just like your parents, they also care about our future. They also want us to have enough and better food to eat.

Ask your parents to help you find a scientist who works on plants. Schedule an interview with him/ her which could be face-to-face, through a phone call, or e-mail. Use this questionnaire for your interview.

#### Send your answers to

double.helix@isaaa.org with the subject "Scientist Appreciation Activity" and get a gift from us! Don't forget to include your name, age, address, and mobile number.

•	Scientist Appreciation Activity
	INTERVIEW QUESTIONNAIRE
	Name of Scientist:
	Specialization:
	Organization:
	Email address:
	QUESTIONS:
	1. Why do you love being a scientist?
	2. Why is biotechnology important?
	3. What is your advice to kids who would like to be scientists
	in the future?
5	

## Which countries are planting biotech crops?

29 countries planted biotech crops in 2019. The top 10 countries with the largest land area planted to biotech crops are: USA, Brazil, Argentina, Canada, India, Paraguay, China, South Africa, Pakistan, and Bolivia. Find those countries in this puzzle.

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# Are biotech crops safe for the environment?

Because farmers planted biotech crops in 2019, carbon dioxide emissions were reduced by 23 billion kg, equivalent to taking 15.3 million cars off the road for 1 year, according to PG Economics.

