



Biotechnologies, Products, Applications and Benefits

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Overview of Biotechnology and Regulations in the Philippines April 29, 2022



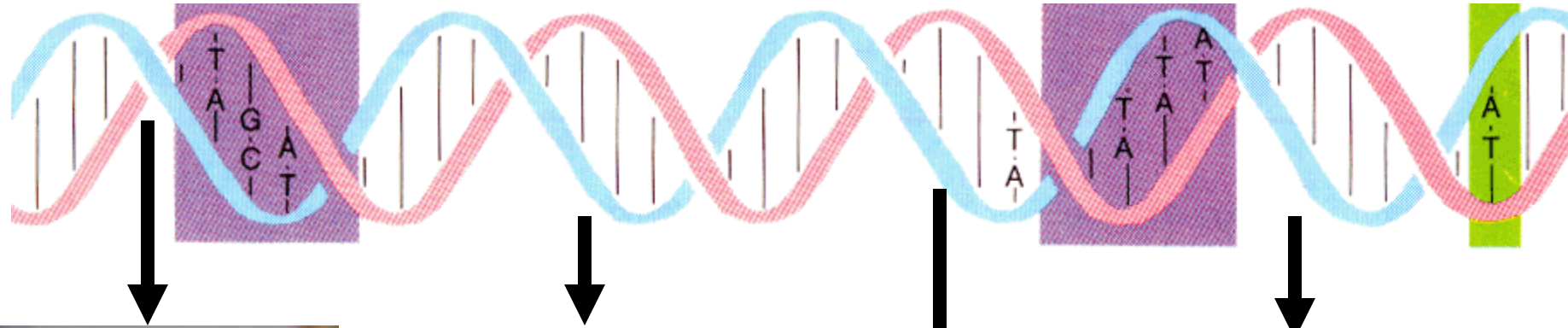
Why Biotech Crops?

- High global population (9.7 B in 2050, 10.7 B in 2100) needs 70% increase in food production
- Climate change heavily affecting food production with accompanying biotic and abiotic stresses
- 20% likelihood of severe food insecurity and undernutrition in low-income countries
- With more than 820 million still hungry, achieving SDG2 Goal of Zero hunger by 2030 will require biotechnology applications

HOW ARE CROPS GENETICALLY MODIFIED

Traditional Breeding	Mutagenesis	Transgenics	Gene Editing
<p data-bbox="428 501 708 575">Crossing plants and selecting offspring</p>  <p data-bbox="428 811 708 925">Desired gene(s) inserted with other genetic material</p> <p data-bbox="428 1001 708 1043">Almost all crops</p>	<p data-bbox="861 501 1174 575">Exposing seeds to chemicals or radiation</p>  <p data-bbox="881 811 1161 925">Random changes in genome, usually unpredictable</p> 	<p data-bbox="1263 494 1691 565">Inserting selected genes using recombinant DNA methods</p>  <p data-bbox="1289 822 1666 893">Only gene(s) inserted at desired locations selected</p> 	<p data-bbox="1735 494 2135 608">When used to delete genes using engineered nucleases (CRISPR, TALENs, ZFNs, etc.)</p>  <p data-bbox="1760 822 2104 893">Desired gene(s) deleted only at known locations</p> 
<p data-bbox="359 1129 774 1215">Number of genes affected: few genes to whole genomes</p>	<p data-bbox="927 1179 1118 1215">100s - 1,000s</p>	<p data-bbox="1442 1179 1505 1215">1 - 8</p>	<p data-bbox="1862 1179 2002 1215">1 or more</p>

DNA contains the genetic code of life





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POTENTIALS OF BIOTECHNOLOGY



Fighting disease



Increasing yield



Environment-friendly



Safer crops



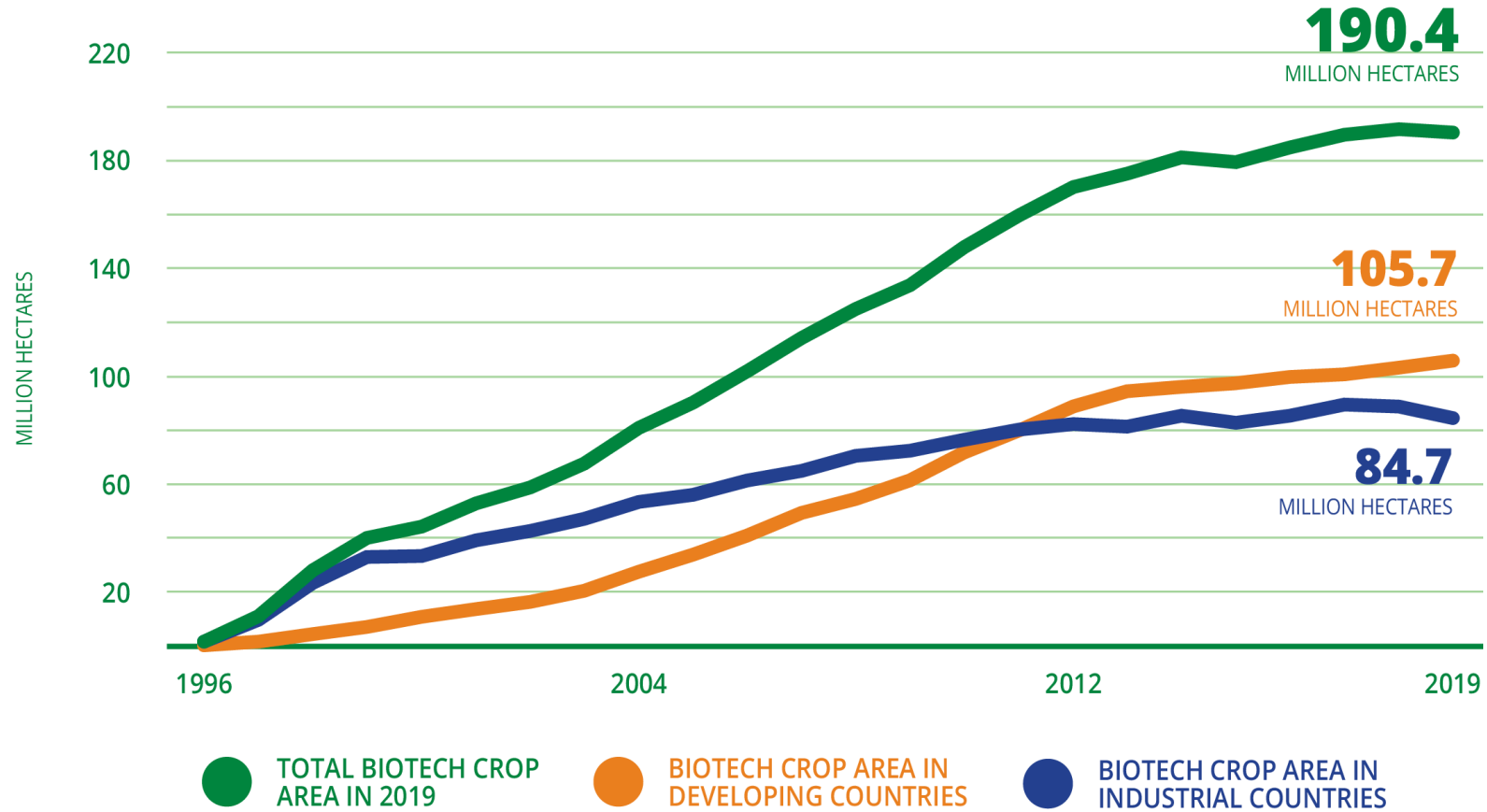
Nutritious food



Better industry



Global Area of Biotech Crops, 1996 to 2019: Industrial and Developing Countries



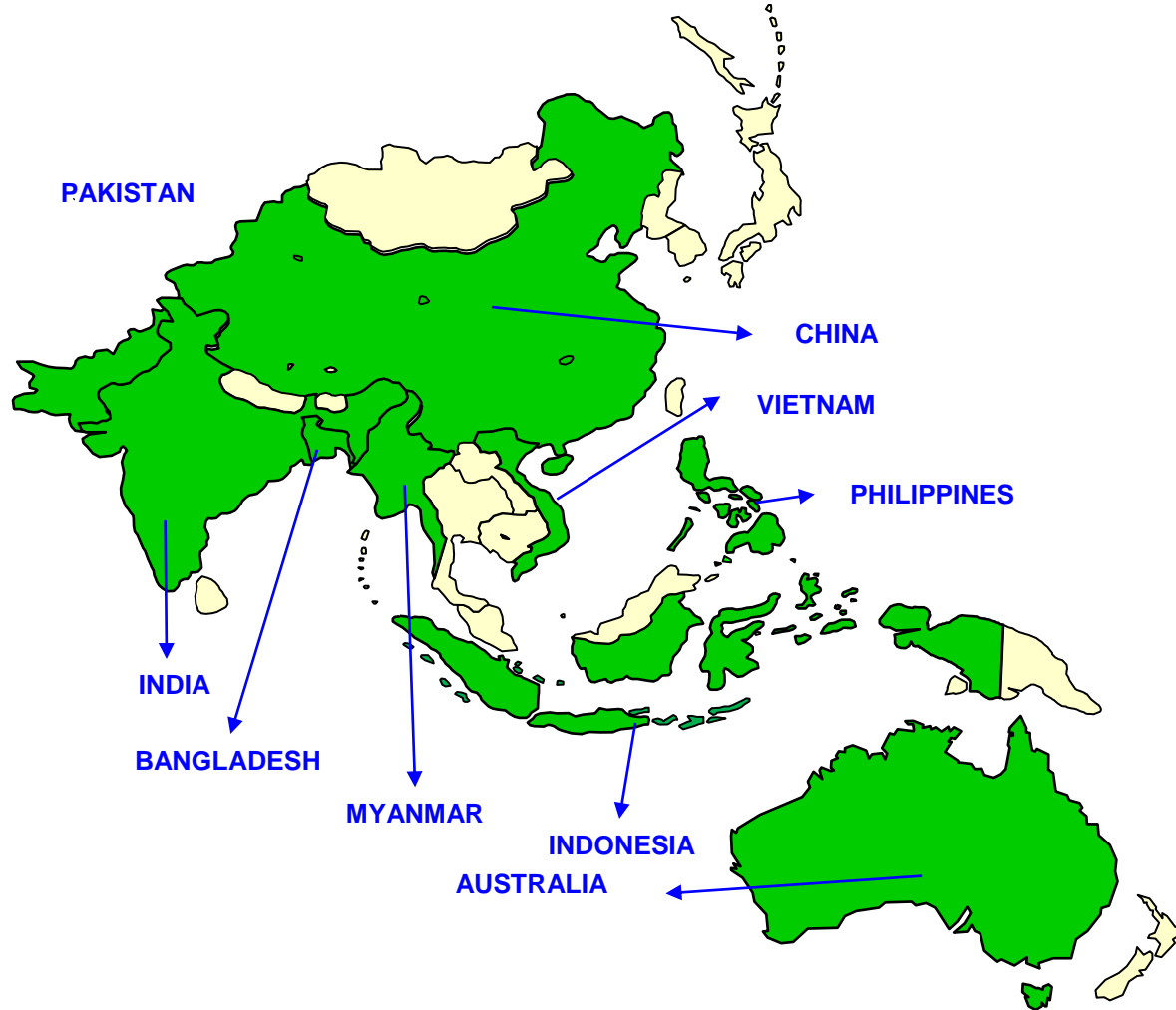
ISAAA, 2019

55.5% DEVELOPING COUNTRIES AND **44.5%** INDUSTRIAL COUNTRIES



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17 Countries/Regions Formally Adopting Biotech Crops in Asia-Pacific, 2019



8 Importing Countries/Regions:

- Japan
- Malaysia
- New Zealand
- Singapore
- South Korea
- Taiwan, China
- Thailand
- Turkey

9 Planting and 8 Importing countries



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Contribution of Biotech Crops to Food Security, Sustainability, and Climate Change



**INCREASE
CROP PRODUCTIVITY**
US\$225 BILLION
FARM INCOME GAINS IN 1996-2018
GENERATED GLOBALLY BY
BIOTECH CROPS



**CONSERVE
BIODIVERSITY**
IN 1996-2018, PRODUCTIVITY GAINED
THROUGH BIOTECHNOLOGY SAVED
231 MILLION HECTARES
OF LAND FROM PLOWING AND CULTIVATION



**PROVIDE A BETTER
ENVIRONMENT**
DECREASED USE OF CROP
PROTECTION PRODUCTS BY
776 MILLION KGS
A GLOBAL REDUCTION
OF 8.6% IN 1996-2018



REDUCE CO2 EMISSIONS
SAVED **23 BILLION KGS CO2**
EQUIVALENT TO REMOVING
15.3 MILLION CARS
OFF THE ROAD FOR 1 YEAR



HELP ALLEVIATE POVERTY AND HUNGER
BIOTECH CROPS UPLIFTED THE LIVES OF
17 MILLION FARMERS
AND THEIR FAMILIES TOTALING
>65 MILLION PEOPLE



Source: Graham Brookes, 2020

Philippine Biotech Status

- Crops approved for import (food, feed and processing): alfalfa, canola, cotton, eggplant, maize, potato, rice, soybean, sugarbeets

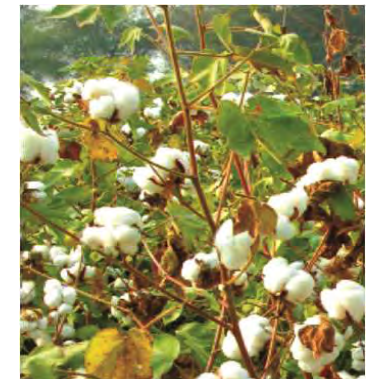
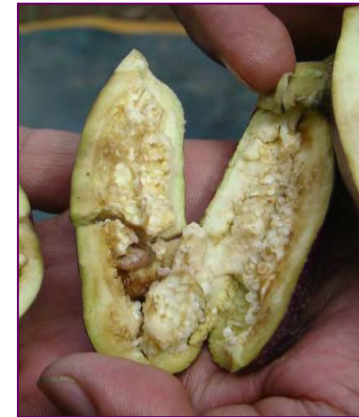


- Biotech maize planted by 673,000 farmers in 875,000 hectares (2019)

Benefits

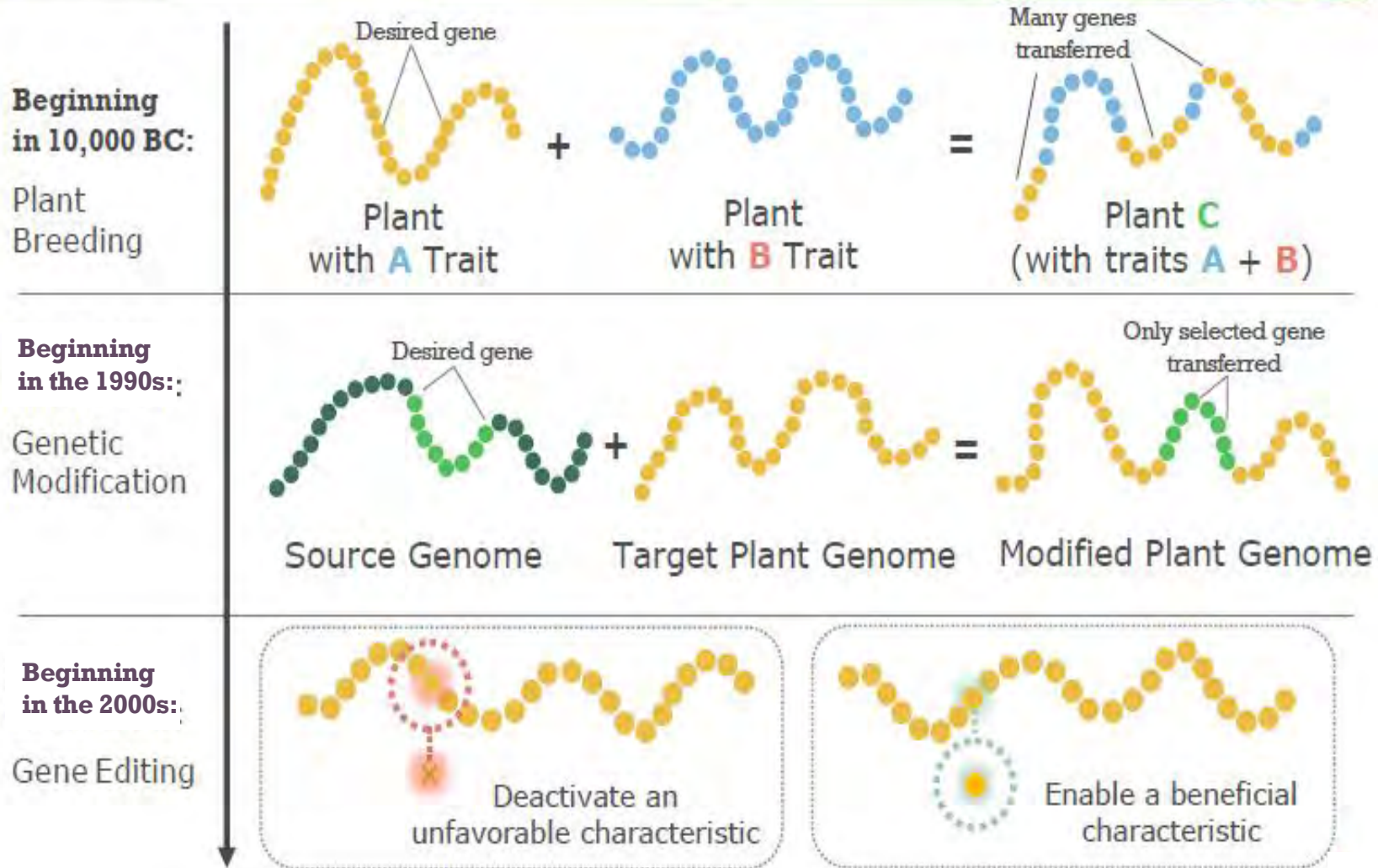
- From 2003-2018 \$872.6 million
- For 2018 alone \$87.7 million

Upcoming Pinoy Biotech Products



PLANT SCIENCE IS CONSTANTLY EVOLVING

The efficiency and accuracy with which plant traits can be improved is increasing



POTENTIAL BENEFITS IN AGRICULTURE

Gene-editing tools hold great promise for farmers, consumers and our planet



Farmers

Another tool that improves the pace and scope of innovation to deliver better seed products



Consumers

An agriculture system that meets society's needs — like food variety and supply — while minimizing environmental impact



The Planet

Farming solutions that allow for smarter use of inputs like pesticides, and natural resources like water, energy and land

Potential Applications

Weed Management



Disease Resistance



Drought Tolerance

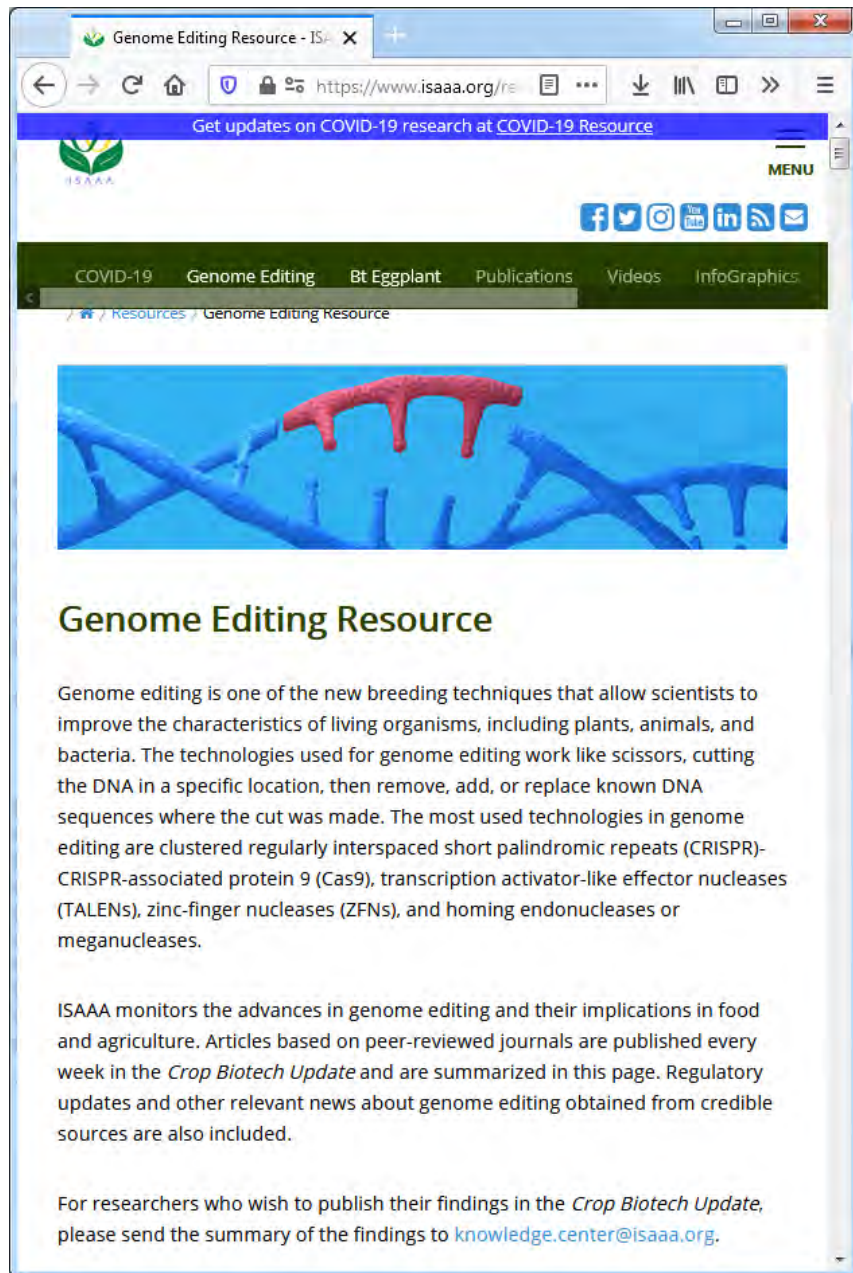


Quality Improvements



Enhanced Nutrition






Genome Editing Resource - ISAAA

Get updates on COVID-19 research at COVID-19 Resource

COVID-19 Genome Editing Bt Eggplant Publications Videos InfoGraphics

Resources / Genome Editing Resource



Genome Editing Resource

Genome editing is one of the new breeding techniques that allow scientists to improve the characteristics of living organisms, including plants, animals, and bacteria. The technologies used for genome editing work like scissors, cutting the DNA in a specific location, then remove, add, or replace known DNA sequences where the cut was made. The most used technologies in genome editing are clustered regularly interspaced short palindromic repeats (CRISPR)-CRISPR-associated protein 9 (Cas9), transcription activator-like effector nucleases (TALENs), zinc-finger nucleases (ZFNs), and homing endonucleases or Meganucleases.

ISAAA monitors the advances in genome editing and their implications in food and agriculture. Articles based on peer-reviewed journals are published every week in the *Crop Biotech Update* and are summarized in this page. Regulatory updates and other relevant news about genome editing obtained from credible sources are also included.

For researchers who wish to publish their findings in the *Crop Biotech Update*, please send the summary of the findings to knowledge.center@isaaa.org.



CROP BIOTECH UPDATE

A weekly summary of world developments in agri-biotech, produced by the ISAAA Global Knowledge Center on Crop Biotechnology direct to your inbox.

December 9, 2021

ISAAA to Release Primer on Genome Editing

LAUNCH OF ISAAA PUBLICATION

Breaking Barriers with Breeding: A Primer on New Breeding Innovations for Food Security

**Monday
13 December 2021
10AM Philippines
via Zoom**

Keynote Speaker:
 **Dr. Paul S. Teng**
Board Chair, ISAAA

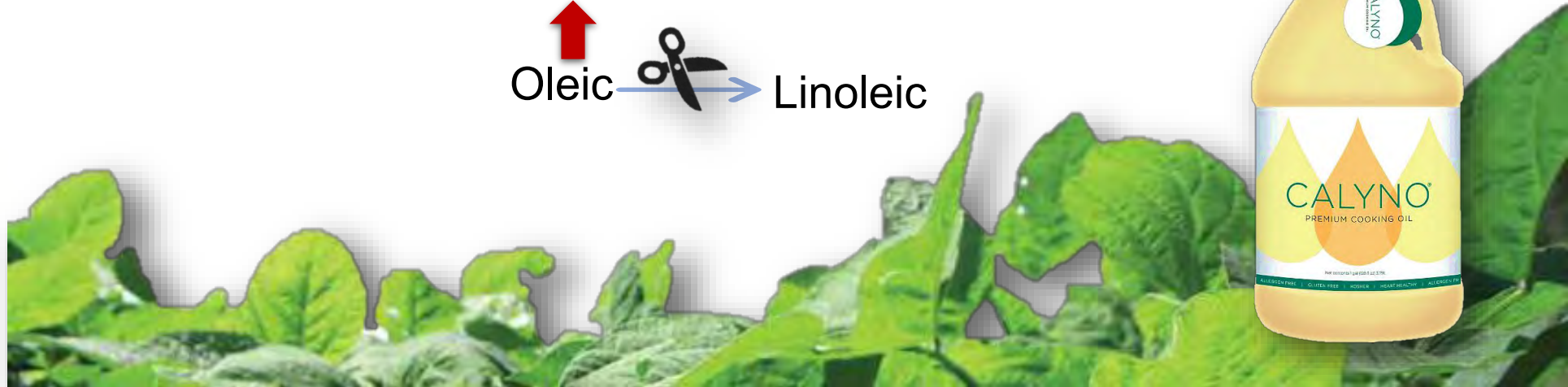
Register for free at bit.ly/ISAAABrief56Launch

ISAAA, in partnership with the Philippine Department of Agriculture Biotechnology Program Office and Biotech Coalition of the Philippines, will be launching its latest publication titled *Breaking Barriers with Breeding: A Primer on New Breeding Innovations for Food Security* on December 13, 2021 at 10 AM GMT+8 via Zoom.

[READ MORE](#)

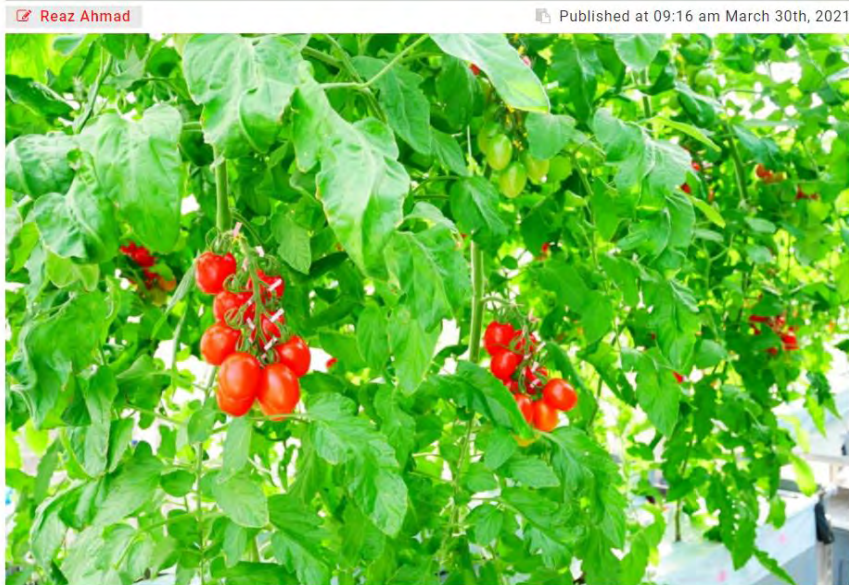
First edited product on the market

calyno™ by **calyxt**™ *Now Available*



GABA tomato approved for commercialization in Japan

Japan launches world's first gene-edited tomato



The Sicilian Rogue High GABA tomato, developed by Japan's Sanatech Seed, is said to help lower blood pressure

γ -aminobutyric acid (GABA)

- Enhances blood pressure lowering
- Glutamate decarboxylase (GAD)- key enzyme
- Deleting C-term of 2 GAD genes expressed in tomato development through CRISPR/Cas 9 technology
- Increases GAD activity and GABA accumulation 7-15 fold

Gene edited GABA tomato was commercially released in Sept 2021; launched in May 2021 in seedling gardening kits.

Source: <https://www.nature.com/articles/s41598-017-06400-y>



Gene edited Crops in the Pipeline For Improved Yield

Camelina – 55% increase in oil US and
Canada, not regulated in Argentina



Canola =

- shorter (to minimize lodging),
- highly branched canola variety: more pods,
- easier to harvest: Canada



Gene-edited Crops in the Pipeline For Disease Resistance



Pepper

- Resistance to pepper veinal mottle virus
- Partially resistant to strain 1C but susceptible to PVY: France



Wheat

- Resistant to Powdery mildew : China



Gene-edited Crop in the Pipeline For Tolerance to Abiotic Stresses

Maize:

- drought resistant
- with lower lignin content for better digestibility as silage: Netherlands



Barley:

- delayed germination, prevents pre harvest sprouting due to unexpected rains affecting marketable yield: Japan



Gene-edited Crop in the Pipeline For Consumer Traits



Sorghum: fragrant for food,
liquor and vinegar brewing:
China



Potato:

- decreased cold-induced sweetening and acrylamide formation in fried potatoes (promotes health)
- prevents food wastage and:
Australia

Gene-edited Crops in the Pipeline For Consumer Traits

Tomato: increased sugar content by 30%
with no effect on fruit size: Japan

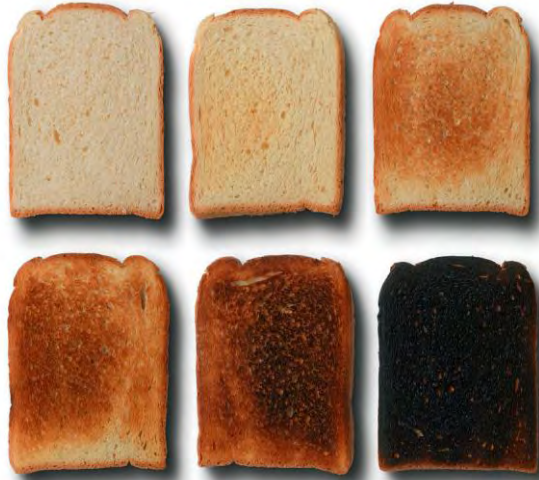


Chicory, the source of natural sweetener inulin

- no longer contains bitter compounds, making the processing cheaper, easier, more sustainable: Netherlands



Gene-edited Crops in the Pipeline For Consumer Traits



Wheat with reduced asparagine and eventually the carcinogenic acrylamide during baking and toasting: UK



Canola: resistant to white mold: USA

Philippine Research on Genome editing



- High lycopene tomato
- Low phytate corn



- Optimal amylose content (soft grains) rice



- Bacterial blight resistant rice
- Tungro resistance
- Improved yield

Commercialized GnEd fishes: Japan

Sea bream with myostatin protein knocked –out increased growth rate



Puffer fish with disrupted leptin gene gained appetite and weight



GnEd Animals in the pipeline



Intentional genomic alteration(IGA)
Slick hair coat = to better regulate their internal body temperature with an increased capacity for sweating.

USDA announced the low risk determination for the marketing of products derived from GnEd beef cattle



A typical horned dairy cow (left) and a genome-edited cow without horns (right) that contains a DNA sequence found in hornless cattle. *(Photo courtesy of Alison L. Van Eenennaam, Department of Animal Science at University of California, Davis.)*

GnEd in Healthcare

Production of complex antibiotics to re-program pathways to future medicines urgently needed to fight antimicrobial resistance, treat neglected diseases and tackle future pandemics: UK



Global regulatory landscape for SDN1 gene-edited products



Blue: products are likely to be regulated as conventional new varieties after recent regulatory policy updates.

Red: products should be treated as GMO based on old regulations.

Yellow: where there are noticeable policymaking discussions over proposals to treat SDN1 as conventional new varieties.



Regulation of Gene-edited Crops

- China: Preliminary guidelines Jan 24, 2022...shortened approval process for biosafety certificate for GnEd crops to 1-2 years (from 6 years), skip fields, lab and small scale trials suffice for biosafety
- Nigeria Released National Guidelines: Biotech products that do not fall within the purview of GMOs need not be given a vigorous review process.
- UK moving towards more liberal biotech regulations
- Japan's new framework: If there is no foreign DNA = non GMO, until proven for the presence of foreign gene and considered a GMO.
- Canada: GE/GM plants that contain foreign DNA will continue to be subject to regulatory oversight, while GnEd organisms that do not have foreign DNA will be exempted from safety evaluation

Acceptance of G_nEd crops

Consumer's Preferences: knowing more about CRISPR tomatoes impacted German consumers. **Majority of the 32 survey participants** (mostly non scientists) **increased willingness to buy CRISPR tomatoes**



835 Chinese consumers were more accepting of G_nEd food products than GM. **A reduction in consumers' fear of novel food technologies** can substantially increase consumer valuation and market acceptance of bioengineered food products.

Acceptance of GnEd crops

200 Koreans, 20-50 years old prefers GnEd products over GM, **responds better to novel technologies based on their scientific knowledge.**

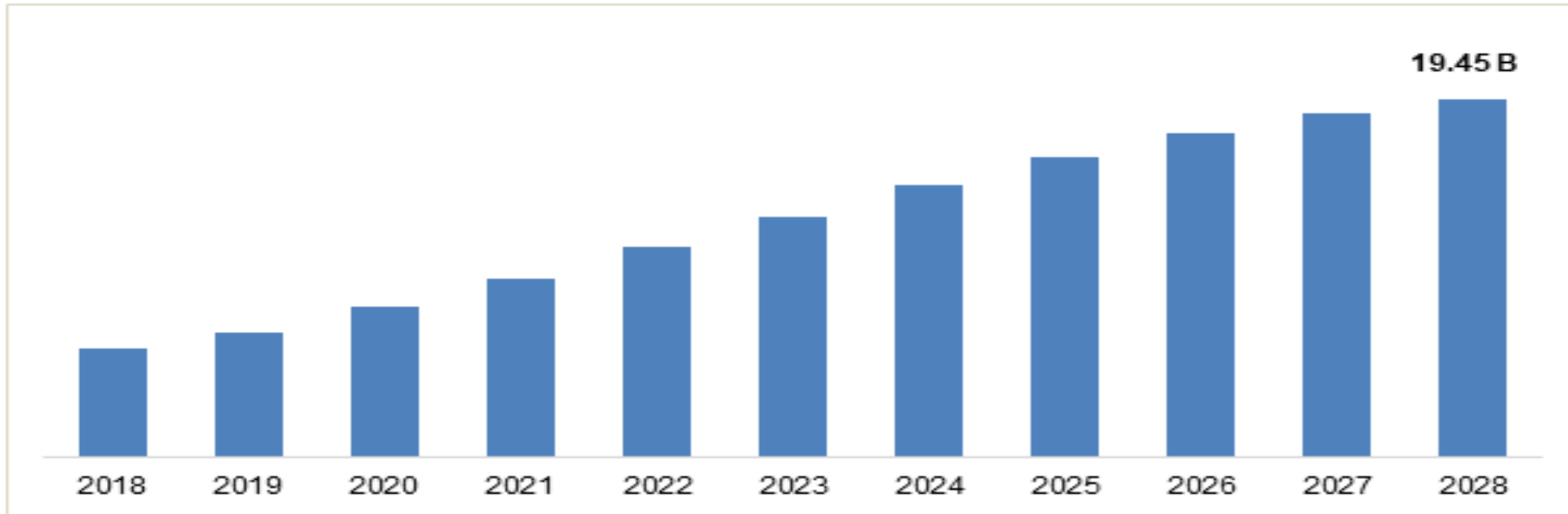


Needs:

- a. Objective information about GnEd must be provided at the government and private levels when actively introducing the novel technology to consumers
- b. Cite that a process of education and promotion about the differences between GM and GnEd are necessary.
- c. Importance of appropriate risk communication and dissemination of scientific information in the private and public domain.

Gene Editing Market Projections

Global Gene Editing Market 2018-2028 (USD Billion)



Source: Adroit Market Research © 2021

Adroit Market Research: 2028 gene editing market projected to go beyond US\$19.45 billion by 2028, with applications to various organisms and healthcare

Improvement in Crop Yield through Biotech

Corn example

