

# Use of GM crops and derivatives for animal feed: Status and opportunities

---

**Dr Vibha Ahuja, Chief General Manager,  
Biotech Consortium India Limited  
November 27, 2021**

# Biotech Consortium India Limited

---

**INCORPORATED :** 1990

**PROMOTER :** Department of Biotechnology, Government of India & All India Financial Institutions

Project  
Management

Consultancy

Technology Transfer

Certification  
Services

**Biosafety**

Information  
Services

IP Management

Human Resource  
Development

# Activities in biosafety

- ❑ Actively engaged in biosafety issues related to Genetically Modified Organisms (GMOs) and new gene technologies
- ❑ Working closely with the nodal ministries and other concerned agencies
- ❑ Capacity building activities for multiple stakeholders through organizing conferences, workshops, technical trainings, consultations, publications, e-learning courses.
- ❑ Assistance in preparation of guidelines, manuals and resource documents
- ❑ Assisting organizations in regulatory data generation and compliance
- ❑ Expertise in preparation of well researched publications in multiple languages, newsletters, e-learning courses and websites for creating awareness
- ❑ Implementation of capacity building projects



# Structure

---

1. What are GM crops?
2. Global and Indian status
3. Biosafety assessment and regulations
4. GM crops/derivatives used as animal feed
5. Myths/Facts
6. Way forward

# How the crops are improved?

- ❑ Trial and error selection for the first 9900 years
- ❑ Breeding on a more scientific basis for the past 100 years including use of chemicals/radiation for mutations
- ❑ Advances in molecular biology in the past 30 years now allow the production of plants (and animals) with specific gene insertions

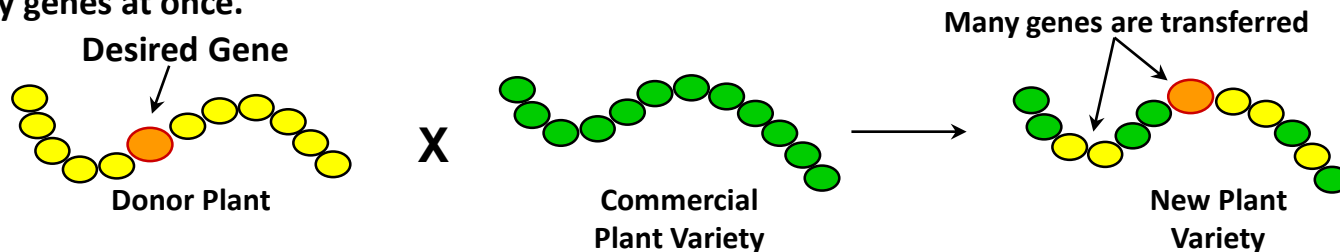


# What are GM crops?

- Genetically modified (GM) crops are the plants wherein the genetic material has been altered using genetic engineering. In most cases the aim is to introduce a new trait in the plant
- Also referred to as genetically engineered (GE) crops or transgenic crops

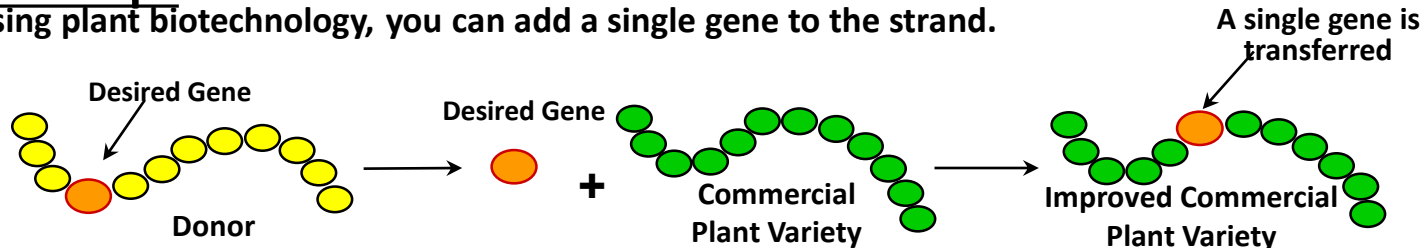
## Traditional plant breeding

DNA is a strand of genes, much like a strand of pearls. Traditional plant breeding combines many genes at once.



## GM crops

Using plant biotechnology, you can add a single gene to the strand.



# GM crops: What is Unique?

A GM crop carries new gene(s)

New gene(s) can be Introduced into a plant from any source  
-bacteria, virus, fungi, animals -  
thus overcoming taxonomic or reproductive barrier

A Big Breakthrough!  
Novel Products

# Example: Insect resistant GM crops

- ❑ *Bacillus thuringiensis* (Bt) produces a protein that is toxic to plant pests
- ❑ GM plants contain the gene for the Bt toxin and have a built-in defense against these plant pests
- ❑ Examples include cotton, corn and brinjal





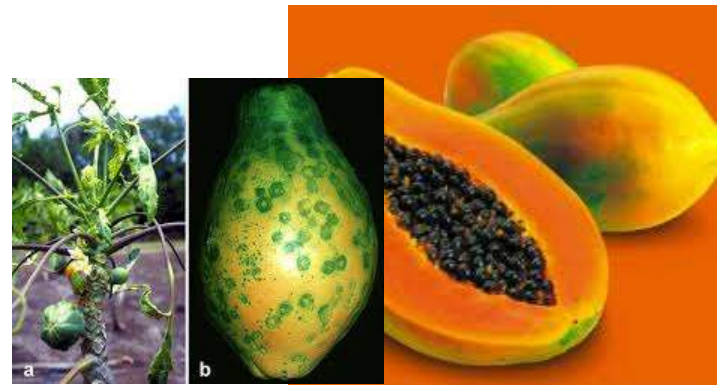
# Example: Herbicide tolerant GM crops

- ❑ Herbicides used to kill weeds, but they also kill the plants
- ❑ Herbicides such as GLYPHOSATE (Round-up Ready) widely used to control weeds
- ❑ Herbicide tolerant (HT) crops contains a gene that provides resistance to selective herbicides, thereby providing better weed control and improves farm efficiency
- ❑ Examples include soybean, corn and cotton



# Disease resistance (Example GM Papaya)

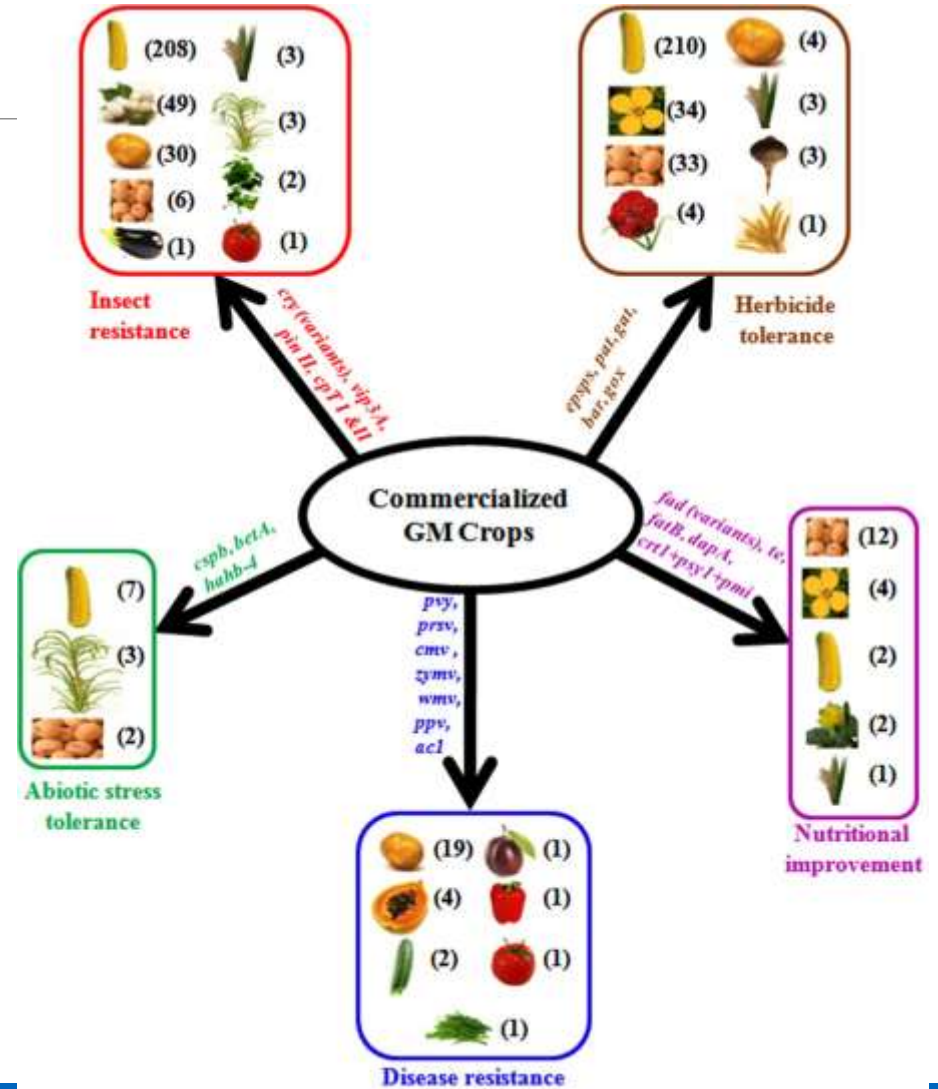
- ❑ GM papaya contains a viral gene that encodes for the coat protein of papaya ringspot virus (PRSV).
- ❑ This protein provides the papaya plant built-in protection against PRSV.



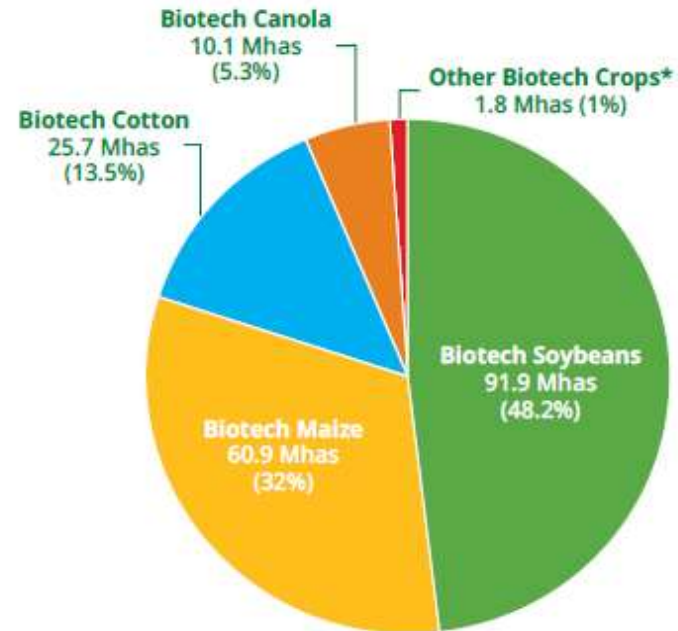
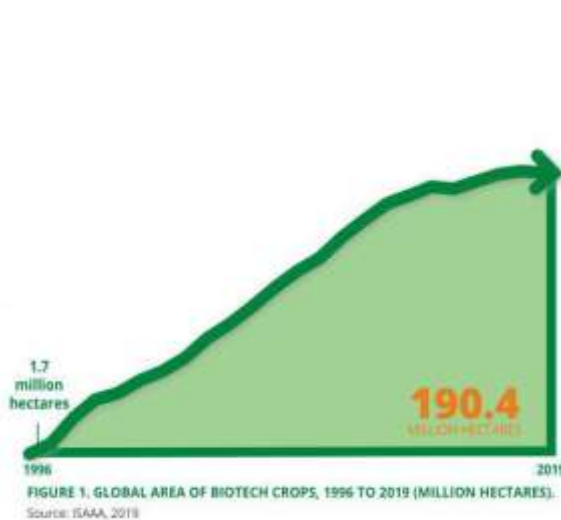
# GM Crops grown worldwide



Kumar K. (2020) Genetically modified crops: current status and future prospects. *Planta* 251:91



# Biotech crops in 2019 (area and adoption rate)



\* Biotech sugar beets, potatoes, apples, squash, papaya, and brinjal/eggplant.

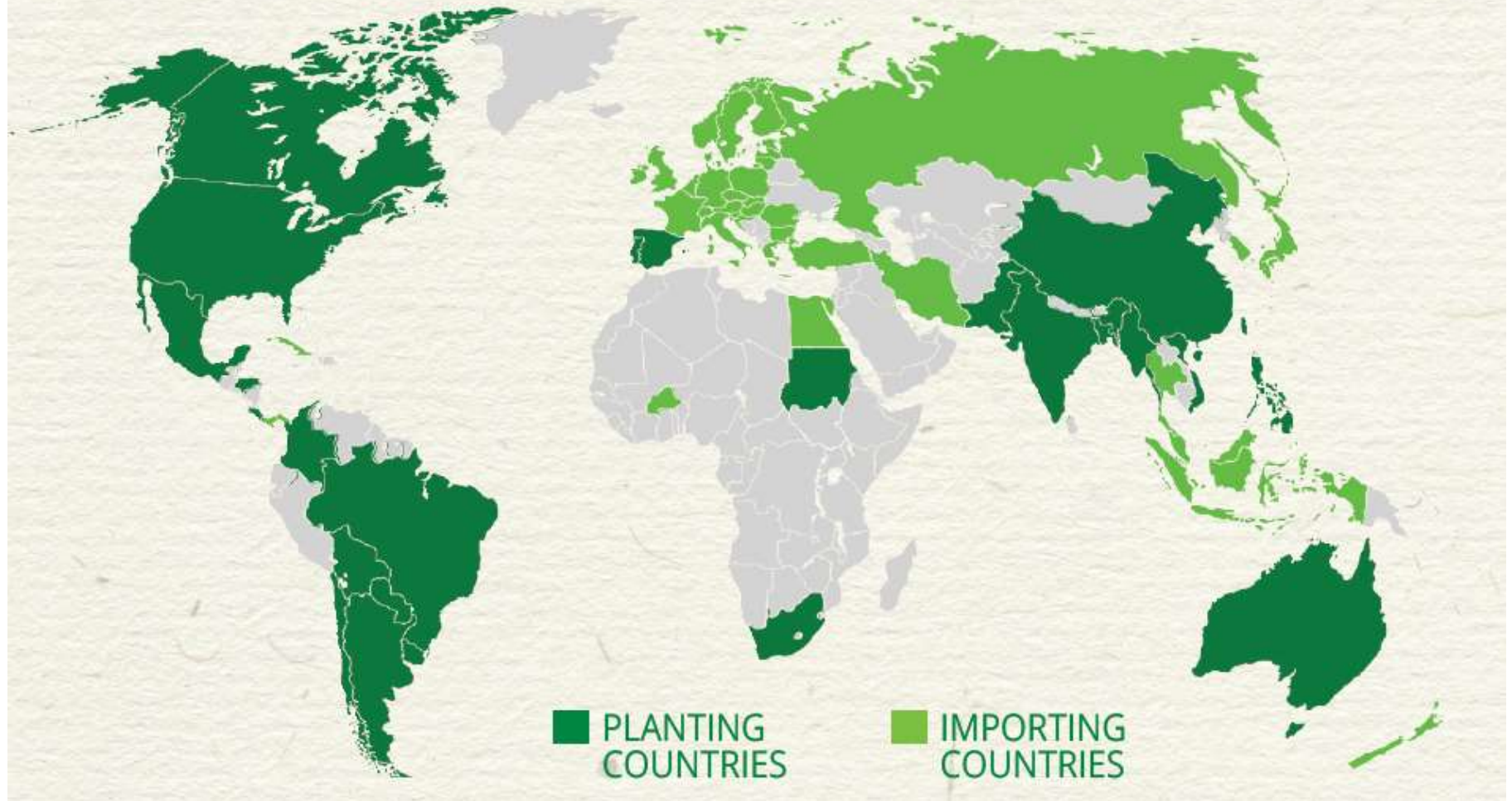
## BIOTECH CROPS IN 2019 (AREA AND ADOPTION RATE)

Source: ISAAA, 2019

Source: ISAAA, 2019

# 67 COUNTRIES ADOPTED BIOTECH CROPS SINCE 1996

24 COUNTRIES PLANTING • 43 IMPORTING BIOTECH CROPS



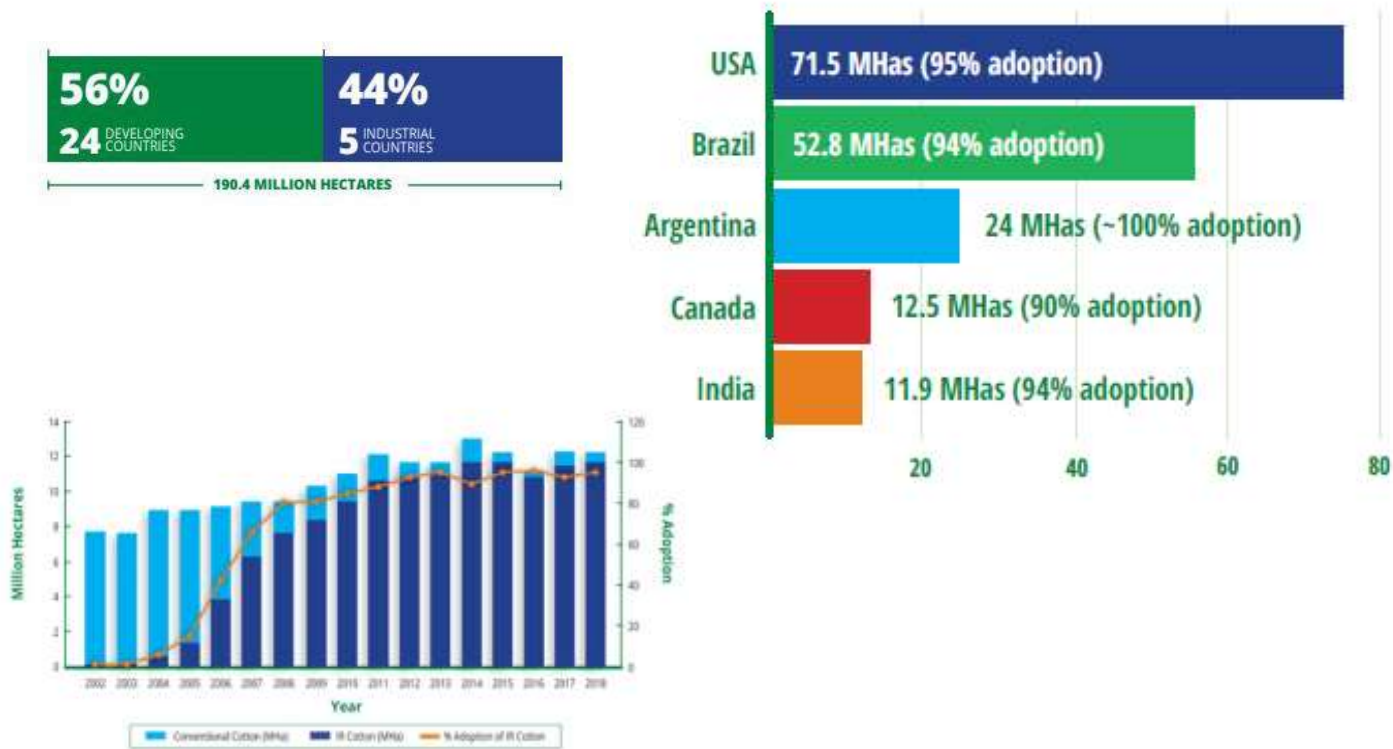
Source: ISAAA, 2019

# Top ten countries which granted food, feed and cultivation / environment approvals

Rank	Country	Number of Approvals			
		Food	Feed	Cultivation	Total
1	USA**	183	178	178	539
2	Japan*	186	177	130***	493
3	Canada	147	138	144	429
4	Brazil	111	111	106	328
5	South Korea	157	148	0	305
6	Philippines	116	114	14	244
7	Mexico	188	29	14	231
8	Argentina	77	69	75	221
9	European Union	100	101	4	205
10	Australia	118	18	39	175
	Others	732	431	152	1,315
	<b>Total</b>	<b>2,115</b>	<b>1,514</b>	<b>856</b>	<b>4,485</b>

Source: ISAAA, 2019

# Top 5 countries that planted biotech crops in 2019 (area and adoption rate)



Source: ISAAA, 2019

# GM crops in India

- ❑ Only one GM crop, Bt cotton – Approved in 2002
- ❑ High adoption rates, >95% under Bt-cotton cultivation.
- ❑ Benefits include:
  - ✓ Tripled Cotton production (13 million bales in 2003 to 37.1 million bales in 2021, **Yield gain-31%**)
  - ✓ Reduced Insecticide sprays (**Usage decreased by 39%**)
  - ✓ Increased production of Cotton seed, and its byproducts -oil and meal (**0.46 million tons in 2002-03 to 1.5 million tons in 2014-15**)





# Current use of GM crop ingredients in livestock feed

---

- Soybean meal
- Canola meal
- Cottonseed meal
- Corn gluten meal/feed
- Dried distillers grains soluble (DDGS)

**All these products do not contain Living Modified Organisms (LMOs) and are considered a non-LMO's in the Cartagena Protocol on Biosafety and hence exempted from biosafety regulations in most countries.**

# GM soybean meal

---

- ❑ Top GM crop grown in the world is soybean
- ❑ Soybean meal is by-product of the extraction of soybean oil.
- ❑ used in food and animal feeds, principally as a protein supplement, but also as a source of metabolizable energy.
- ❑ Globally, about 98 percent of soybean meal is used as animal feed



# Dried Distillers Grains Solubles (DDGS):

---

- ❑ A by-product of GM corn, high in nitrogen and phosphorus
- ❑ Currently imported by over 50 countries, including China, Japan, Korea, Turkey, Canada, Ireland, Spain, Bangladesh, Sri Lanka, Vietnam, Philippines and New Zealand etc.
- ❑ Being used globally for poultry feed



# Cottonseed meal

---

- ❑ By-product of oil extraction from cotton seeds.
- ❑ Protein-rich feed
- ❑ Livestock sector in India has been using domestically produced GE cottonseed meal for feed – currently estimated at around 4 MMT annually
- ❑ Exported to other countries as well namely Bangladesh, Taiwan, Germany, Japan, Korea, New Zealand, Oman, Saudi Arabia, South Africa, Sri Lanka, Thailand etc.
- ❑ Importing countries have treated Cotton Seed cake/Meal as a non-LMO as well.



# Global trends in use of animal feed from GM crops

---

- ❑ **USA:** More than 95% of animals used for meat and dairy in the United States eat GM crop. Most of GM corn is used to feed livestock and poultry. GM soy grown in USA is used for food for animals, predominantly poultry and livestock and in soybean oil.
- ❑ **United Kingdom:** feed industry imports more than 70% of its maize, soya and rapeseed requirements each year. Significant quantities of maize, in the form of DDGS and corn gluten feed, are imported from the USA (majorly GM maize).
- ❑ **Australia:** Soybean meal has been regularly imported into country. In 2017-18 769,000 tonnes of soymeal were brought into Australia for the livestock sector.
- ❑ **European Union:** Restrictions for cultivation, but continue to import GM crop derivatives for use as animal feed.

## Use in India

---

- ❑ Cottonseed meal extensively used in animal feed; limited quantities also exported
- ❑ GM soybean meal recently permitted in limited quantity
- ❑ Application for canola meal and DDGS are pending



# Biosafety concerns

---

- ❑ As the genes are derived from various organisms, concerns raised regarding safety of such organisms since the advent of technology in 1975 and guidelines/regulations put in place
- ❑ First GMO derived product **Insulin approved in 1982** and first GM crop (tomato) approved in 1996 in USA
- ❑ Applications in healthcare widely accepted, however biosafety concerns in use of GM crops in agriculture
- ❑ These include food safety issues and environmental safety issues



# Concerns by stakeholders

---

## ➤ Scientific

- Potential harm to human health; Risk of introducing toxins, allergens and other anti-nutrition factors in foods.
- Potential damage to the environment;

## ➤ Non Scientific

- Monopolisation by MNCs
- Impact on exports
- Increase in prices etc.
- Regulations not strict

# Addressing concerns

## ➤ Scientific

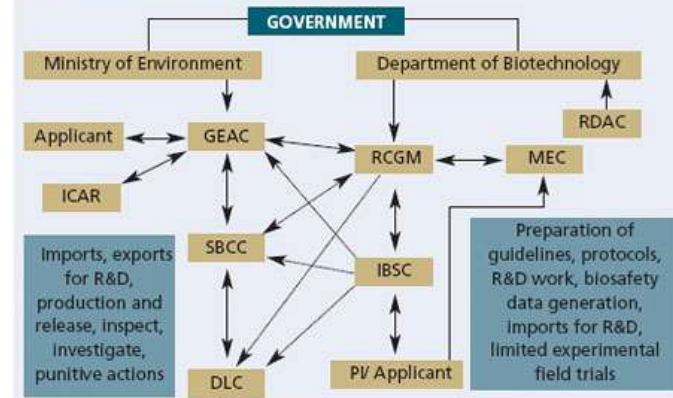
- ❑ Internationally accepted safety assessment methodologies for GM crops
- ❑ Rigorous data requirements for pre-market safety assessment
- ❑ Review of data by experts and regulators

## ➤ Non-Scientific

- ❑ Based on apprehensions
- ❑ Not unique to GM crops but applicable to agriculture in general

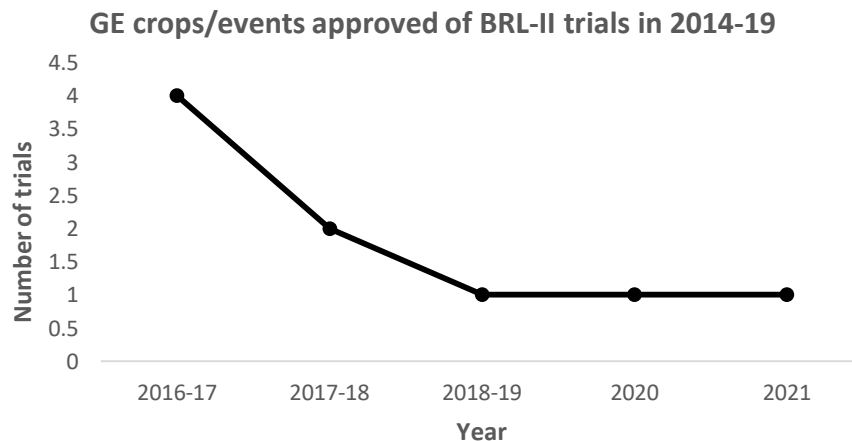


### How biosafety works in India



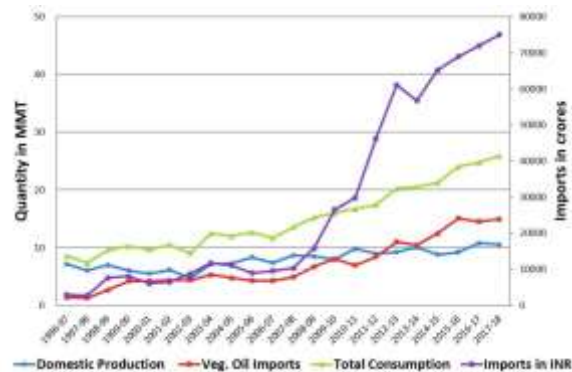
# Impact of polarized debates: Delay in approval of GM crops

- ❑ Despite highly successful experience, **no further approvals**
- ❑ Bt brinjal moratorium, but being grown and consumed in Bangladesh
- ❑ GM mustard on hold despite urgent need to increase productivity
- ❑ Illegal cultivation of HT cotton in large acreage being reported
- ❑ Number of trials significantly reduced
- ❑ Research activities reduced significantly

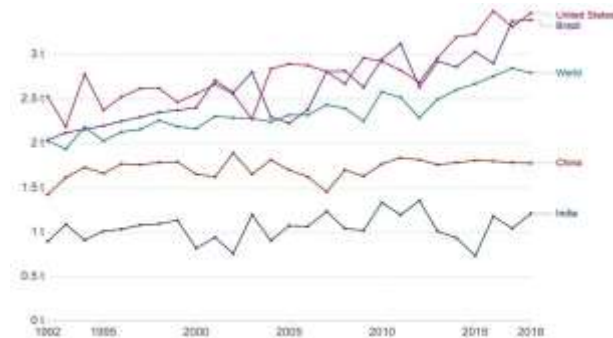


# Stagnation in production and increase in prices

- ❑ Stagnation in production
- ❑ Increase in prices
- ❑ Increase in Imports



Domestic production and imports of vegetable oils



Soybean yields (tonnes/ hectare), 1961-2018



Rapeseed/Mustard yields (tonnes/ hectare), 1961-2018

# Concern: GM crops and the food derived from them are not safe

---

- Different GM crops include different genes inserted in different ways.
- No general statements; case by case assessment.
- Permitted only after safety assessments and confirmation that are not likely to pose risks for human health and environment.
- Statement by National Academy of Sciences (USA), World Health Organization, food and agriculture organisation, the American Medical Association and the Royal Society of Medicine (UK) along with major science academies in India.
- Evaluation by scientific bodies and regulatory agencies

# Concern: If livestock consume GM crops, there are chances of presence of transgenes in food product (meat, milk and eggs) derived from them

---

- Genes are part of all living organisms including conventionally bred plants and animals. Human or animals eat genes whenever they eat any kind of food.
- **Transgenic genes** or **expressed novel proteins** present in GM crops are broken down during the digestion in the same way as other genes or proteins.

# Concern: GM crops contain antibiotic resistance genes that can affect human health

---

- Antibiotic resistance genes may be used as markers for identification of cells into which the desired gene has been successfully introduced.
- Concerns about the possibility of transferring these genes from GM crops/foods to bacteria that is normally present in the human gut and resulting in the development of antibiotic resistance in these bacteria.

**Numerous scientific studies concluded that the likelihood of antibiotic resistance gene moving from GM crops to any other organism is extremely remote (< 10<sup>-14</sup> to 10<sup>-27</sup>) or virtually zero.**

# Concern: Food with GM crops contain fewer nutrients

---

- Detailed compositional analysis an essential part of the safety evaluation process.
- Prior to approval, it is necessary to demonstrate that GM crops being cultivated are as nutritious as food from comparable traditionally bred plants.
- Nutritionally enhanced GM crops are also being developed with an objective to increase levels of specific nutrients for e.g. Golden Rice with increased Vitamin A, biofortified Maize, etc.



# Concern: Long-term health effects of food from GM crops

---

- The only difference between a GM crop as compared to its non-GM counterpart is the inserted gene and its expressed protein.
- Safety is already established

**Substantial equivalence confirmed that the GM crop/food is similar to corresponding non-GM which has been used/consumed traditionally for generations and hence no long-term effects are expected to be seen based on the history of safe human use.**

# Concern: GM crops not responsible for yield increase

---

- Developed for specific traits such as insect resistance, disease resistance and herbicide tolerance. These are not responsible for yield increase per se, but indirectly they do, as there is a significant reduction in losses due to pests, diseases and weeds. Savings from such losses have significantly contributed to increase in production.
- As a result there has been a continuous increase in adoption of GM crops in many countries.
- GM crops are also being developed to address challenges such as drought, salt, improved nutritional quality etc. and are expected to contribute to food security.

# Way forward for GM Crops

---

- ❑ GM crops commercially cultivated and traded across the world
- ❑ Area under cultivation of GM crops has been increasing steadily since 1996, from 1.7 million hectares to more than 90 million hectares in 2019.
- ❑ In addition large number of countries are importing these crops and their products for food, feed and processing
- ❑ Systematic regulations in place to ensure safe use of GM crops
- ❑ Need to increase research efforts and field testing/cultivation
- ❑ Urgent need for streamlining the approval procedures in India
- ❑ Consideration of processed products as non-LMOs

# Thank You!