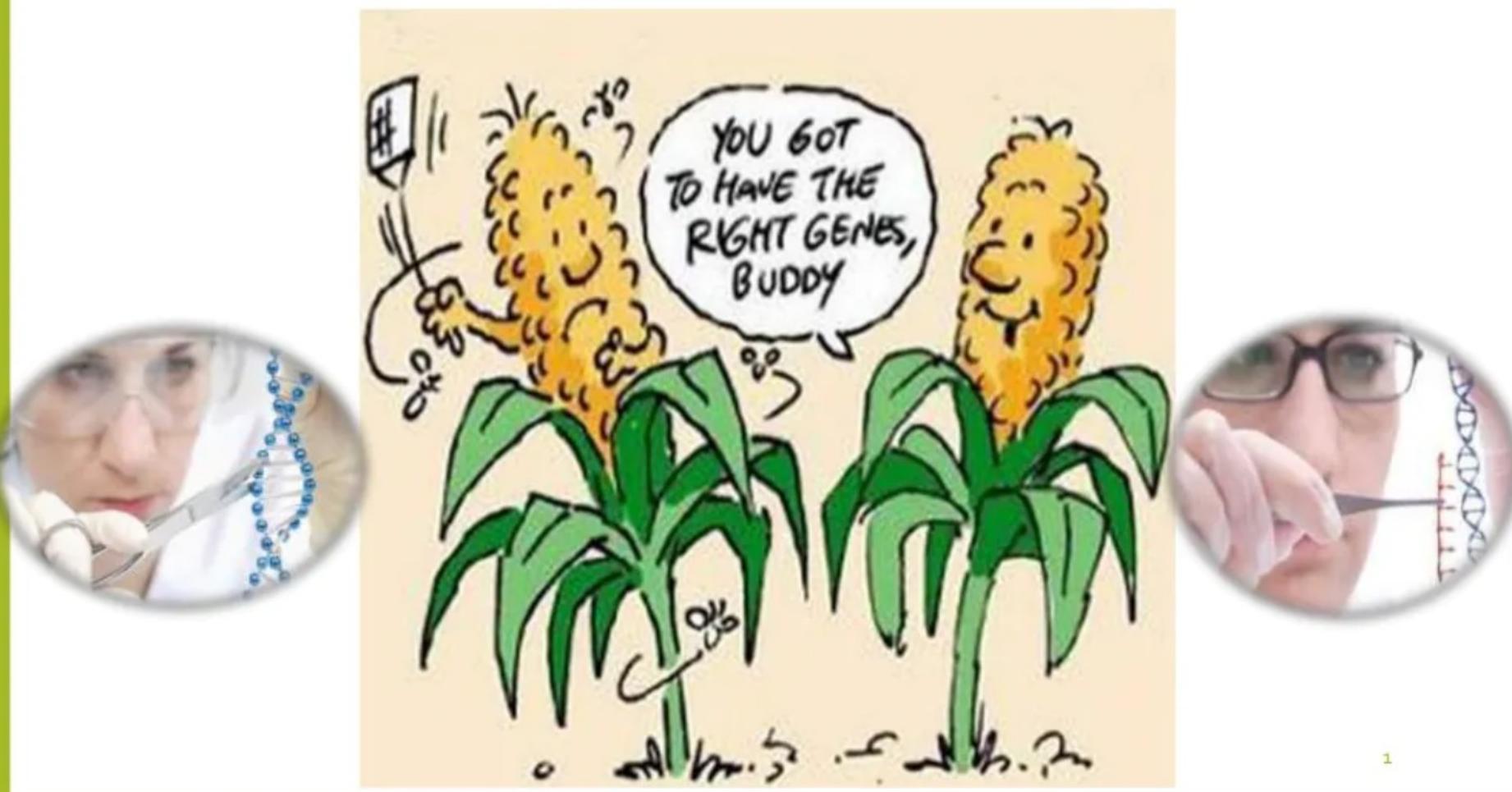


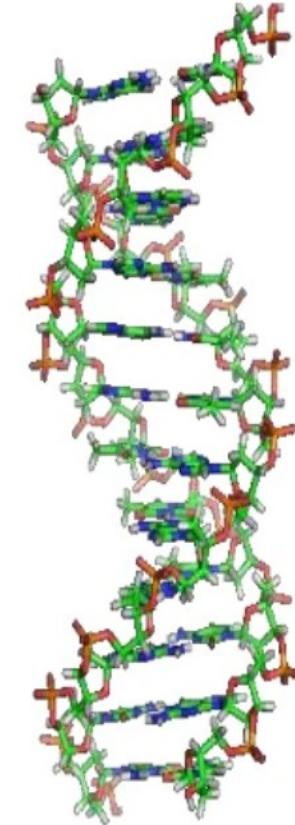
Genetically modified organism



Genetically modified organism

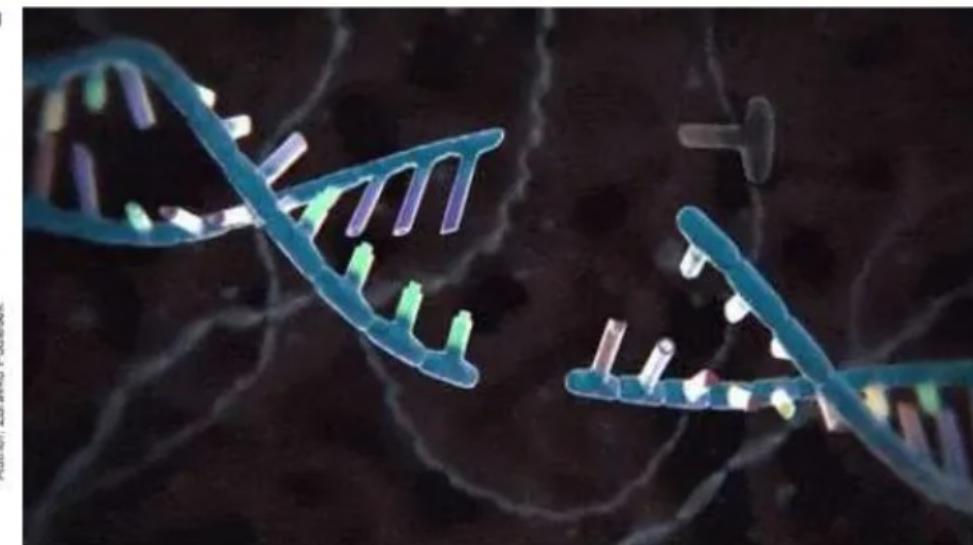
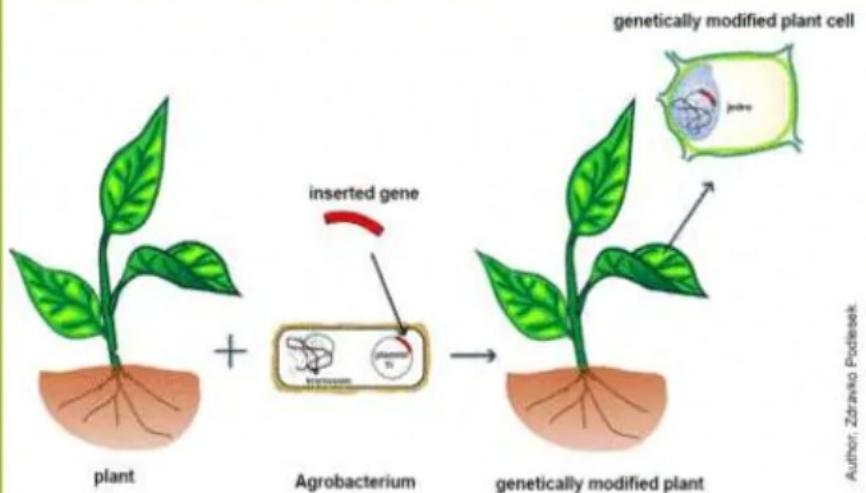
- A genetically modified organism is one whose genetic material has been altered using genetic engineering.
- Genetically modified organisms or GMOs, are commonly used in foods and medicines. This has led to concern about the dangers they might cause to the environment and to human health.

BIOTECHNOLOGY: GENETIC MODIFICATION OF CROPS



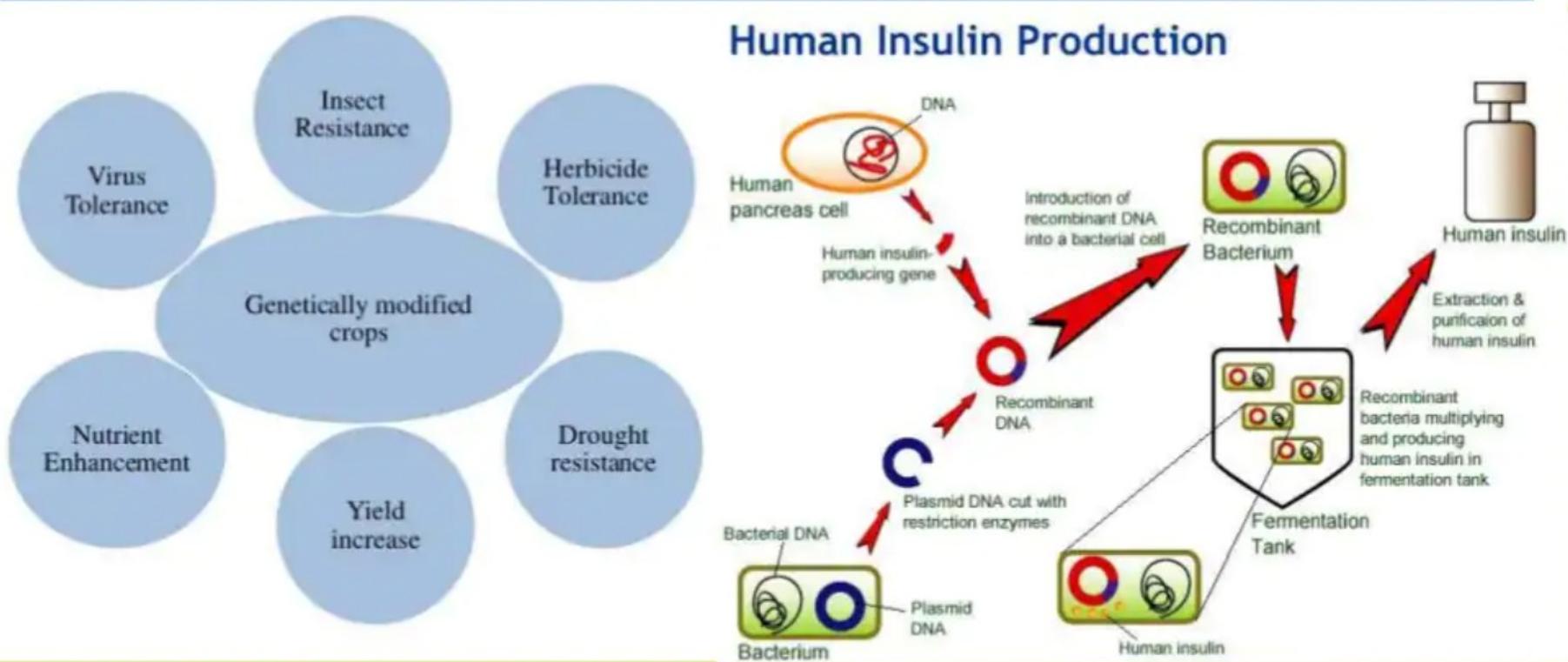
How it modified?

- Eliminating, modifying or adding copies of specific genes often from other organisms through modern molecular biology techniques.
- Other names: Recombinant DNA (rDNA)
Genetic engineering
Gene splicing



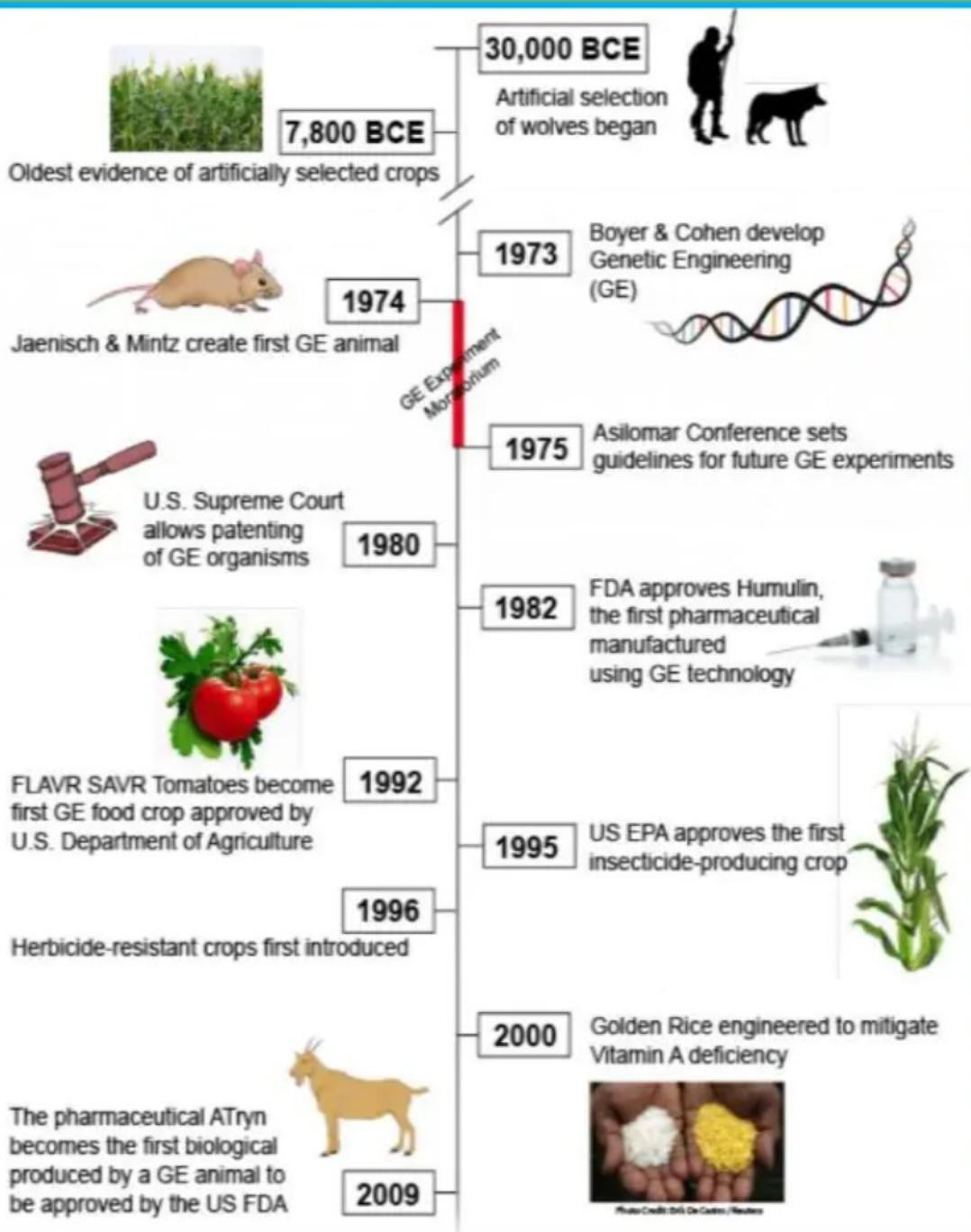
Where it use?

- Food - Canola, Soya bean, Golden rice and corn Etc.
- Medicine - Insulin, hormones and vaccine Etc.
- Genetically modified medicines can be produced cheaper and easier.



History

- 1972 – 1st rDNA molecule produced
- 1977 – Genetech use rDNA to make insulin
- 1982 – Monsanto bovine growth hormones use in cow increase milk production
- 1987 – 1st outdoor field test of GMO “Frostban” bacteria
- 1987 – national academy of science concluded transferring genes between species no serious environment hazard
- 1992 – USDA approves “flavravr” tomatoes - calgene
- 1996 – Monsanto introduce roundup ready soybeans



GM crops

1. Rice
2. Wheat
3. Corn
4. sunflower
5. Canola
6. Soy
7. Sugar beet
8. Papaya
9. Squash
10. Potato
11. Tomato
12. Brinjal
13. Alfa alfa

Types of GM Foods

1. First-generation crops

- Traits such as herbicide tolerance, better insect resistance and better tolerance to environmental stress.

- The ensuing crops are not significantly different from the traditionally grown crops in terms of appearance, taste and nutrition.

- Examples of such crops are herbicide resistant soybean, insect-resistant maize, and herbicide and insect-resistant potato.

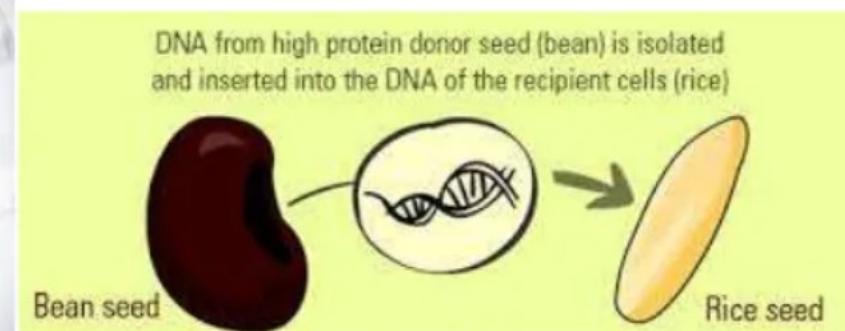
2. Second-generation crops

- Increased levels of protein, modified or healthier fats, modified carbohydrates, increased flavor or increased micronutrients.

- Examples rice with a higher level of beta-carotene,
- tomatoes with higher levels of carotenoids,
- maize with increased vitamin C,
- soybean with improved amino acid composition, and potatoes with higher calcium content.

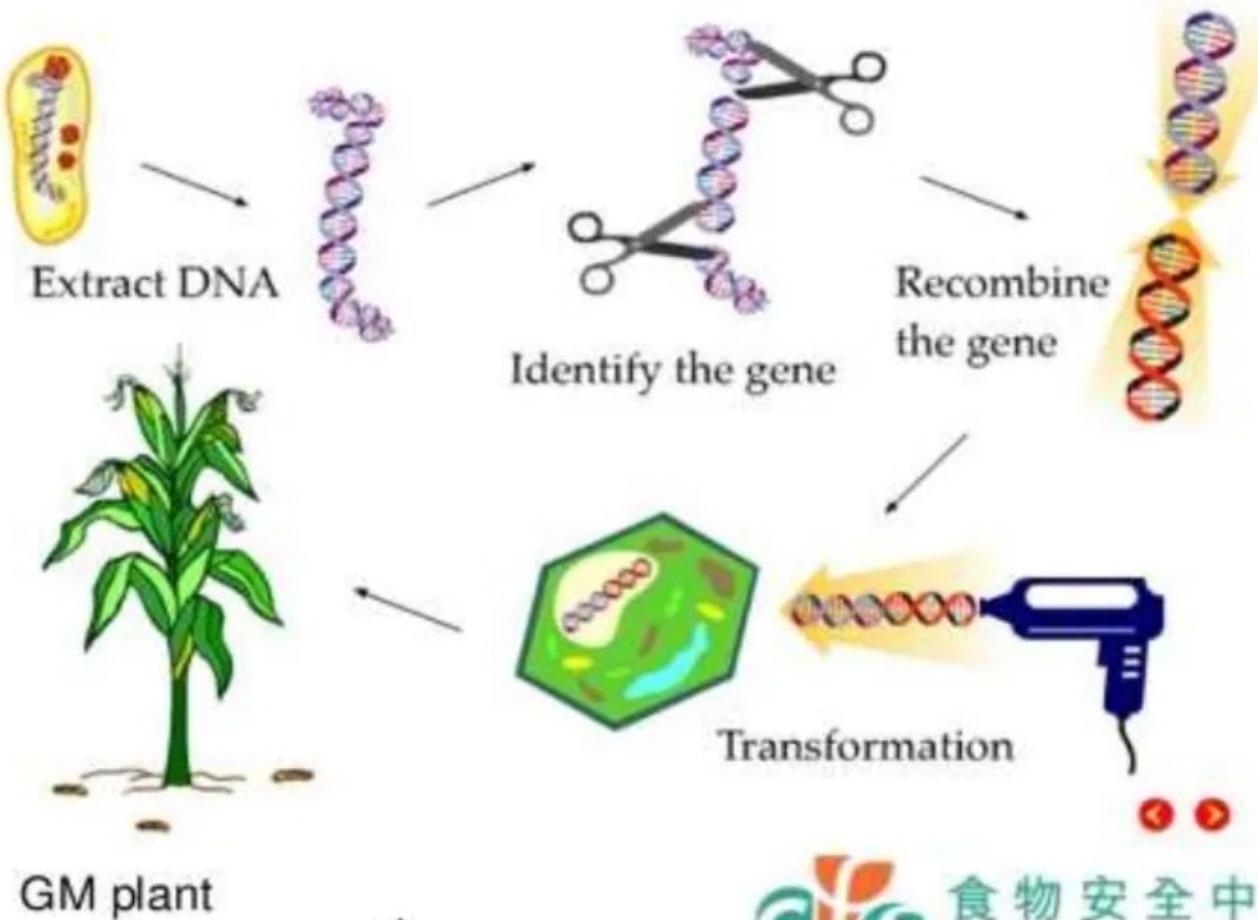
3. Third Generation

- Increased ability to resist abiotic stress
- Create “pharma plants” to help produce active pharmaceutical products.
- In Feb 2009, the U.S. Food and Drug Administration (FDA) approved recombinant anti-thrombin prevention of blood clots, hereditary anti-thrombin deficiency.
- This is 1st human biologic drug derived from the milk of goats that have been genetically engineered to produce human anti-thrombin in their milk.



Genetic Modification

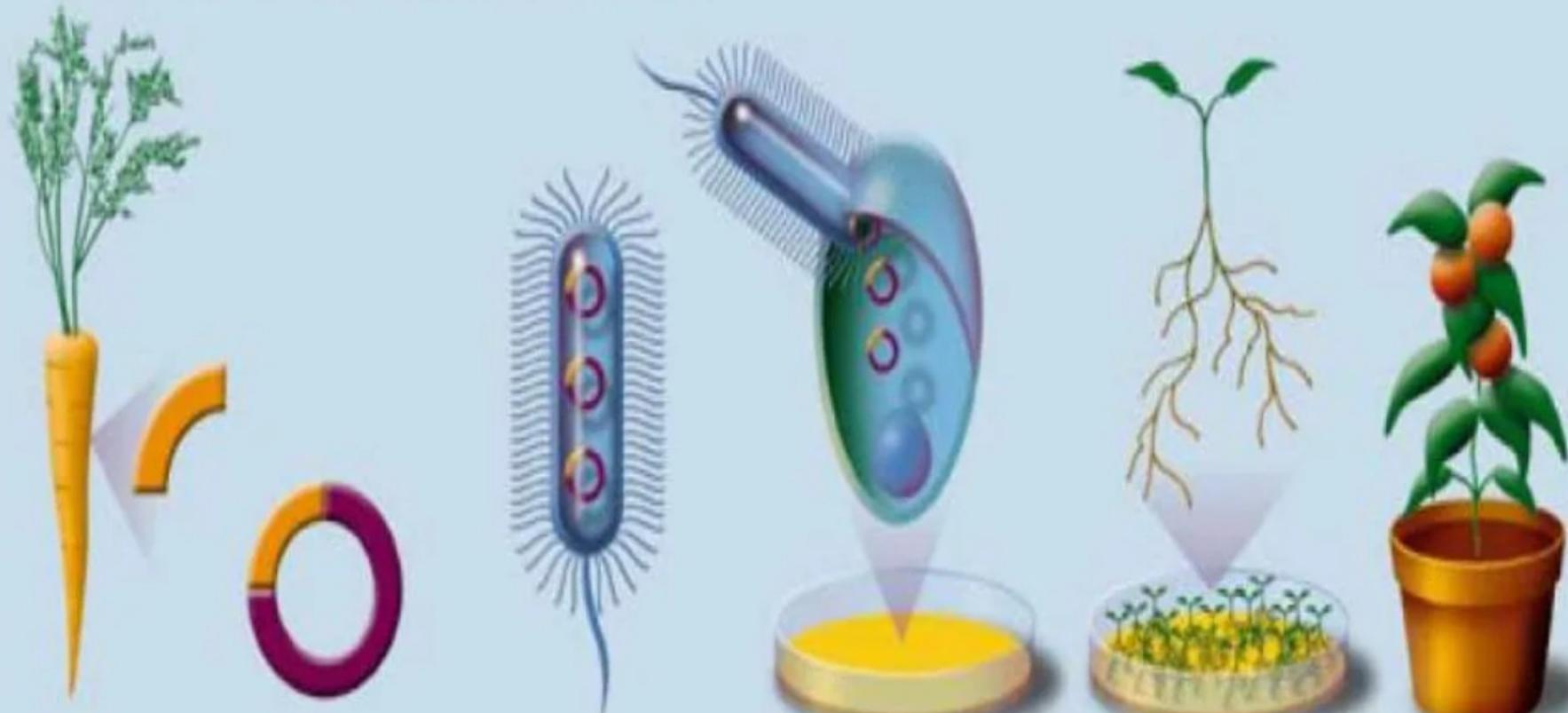
Bt protein
(natural pesticide)
produced by a
bacterium



Modified **plant**
can produce the
Bt protein

Creating a Vitamin-Rich Tomato with a Carrot Gene

The bacterium Agrobacterium naturally infects plants. It carries some genes on a circular piece of DNA called a plasmid and inserts those genes into plant cells. Scientists are now able to remove the bacterium's genes that cause plant disease and add a gene for a desirable trait.



1) Scientists copy a
carrot gene that
converts a pigment to
beta-carotene.

2) They insert the carrot
gene into a plasmid.

3) The plasmid is
reintroduced into the
Agrobacterium.

4) The Agrobacterium
transfers the carrot
gene to the cells of
tomato leaves in a
petri dish.

5) The tomato cells grow
and divide in a culture
with hormones that
encourage the cells to
become new shoots
and roots.

6) As the tiny new plants
grow, the carrot gene
converts the tomato's
pigment into beta-
carotene, creating an
enhanced tomato.

GMO Foods

Tomato



Tomatoes have been genetically modified, but they are not being grown commercially at this time

Alfalfa



GMO alfalfa is contaminating non-GMO alfalfa crops at a rapid rate

Cotton



At least half of cotton grown in the world is GMO

Rice



GMO rice has been approved but is not yet being used commercially

Sweet Corn



More than 70 percent of corn grown in the United States has been genetically engineered

Summer Squash



Farmers don't like GMO squash but some experts say GM squash have blended with wild squash

Salmon



GMO salmon has not been approved by the FDA, but it will be very soon

Wheat



Unapproved GMO has contaminated wheat fields, and we don't yet know the extent of it

Sugar Beets



90% of Sugar Beets (used to make 50% of our sugar) are GMO

Soy



More than 93% of soybeans the United States produces are genetically modified

For more information go to
olmag.co/gmo-foods

Canola Oil



87% of canola grown commercially, and 80% of wild canola is GMO

Yeast



GMO yeast for wine has been approved

Hawaiian Papaya



Most Hawaiian papaya is GMO, even many organic crops are contaminated

organic lifestyle
MAGAZINE

GMO status at world level

	Country	Area (millions of hectares)	% of global GM hectares	Crops			
1	USA	73.10	40.3%	Corn, soybean, cotton, canola, sugar beet, alfalfa, papaya, squash		77%	90%
2	Brazil	42.20	23.3%	Soybean, corn, cotton			
3	Argentina	24.30	13.4%	Soybean, corn, cotton			
4	India	11.60	6.4%	Cotton			
5	Canada	11.60	6.4%	Canola, corn, soybean, sugarbeet			
6	China	3.90	2.1%	Cotton, papaya			
7	Paraguay	3.90	2.1%	Soybean, corn, cotton			
8	South Africa	2.70	1.5%	Corn, soybean, cotton			
9	Pakistan	2.85	1.6%	Cotton			
10	Uruguay	1.64	0.9%	Soybean, corn			
11	Bolivia	1.00	0.6%	Soybean			

98%
OF GLOBAL
GM
HECTARES

Global Status of Commercialized Biotech/GM Crops: 2014. ISAAA brief No. 49 Agri-biotech Applications (ISAAA): Ithaca, NY.

Institutional framework

- 1) Ministry of Agriculture;**
- 2) Ministry of Environment and Forests**
- 3) Department of Biotechnology, Ministry of Science and Technology**

- The legislative framework on agro biotechnology rests mainly with the Ministry of Environment and Forests, Government of India.
- The Environment (Protection) Act, 1986, the Ministry of Environment and Forests has notified the Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro Organisms/ Genetically Engineered Organisms or Cells, 1989, or in short, the Rules, 1989.

rDNA Advisory committee



Institutional Biosafety Committees (IBSC) Department of Biotechnology, Ministry of Science and Technology.



Review Committee on Genetic Manipulation (RCGM) Department of Biotechnology



Genetic Engineering Approval Committee (GEAC) under the Ministry of Environment and Forests



State Biotechnology Coordination Committee (SBCC)



District Level Committee (DLC) in the districts

Conti....

- Recombinant DNA Safety Guidelines, 1990 by Department of Biotechnology covering research in biotechnology, field trials and commercial applications;
- Revised Guidelines for Research in Transgenic Plants, 1998 by Department of Biotechnology;
- Protocols for Food and Feed Safety Assessment of GE Crops, 2008 by Department of Biotechnology;
- Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants, 2008 by Indian Council of Medical Research (ICMR);
- Guidelines and Standard Operating Procedures (SOPs) for Confined Field Trials of Regulated, Genetically Engineered (GE) Plants, 2008 by Department of Biotechnology and Ministry of Environment and Forests.

Current Status of GM Food in India

- India is a signatory to the Cartagena Protocol on Biosafety (CPB) since 2003.
- India's apex biotech regulatory committee, the Genetic Engineering Approval Committee (GEAC) that functions as a statutory body under the Environment Protection Act 1986 of the Ministry of Environment & Forests (MoEF), has been changed to Genetic Engineering Appraisal Committee in July 22, 2010.

Bt Cotton is the only GM crop grown in India

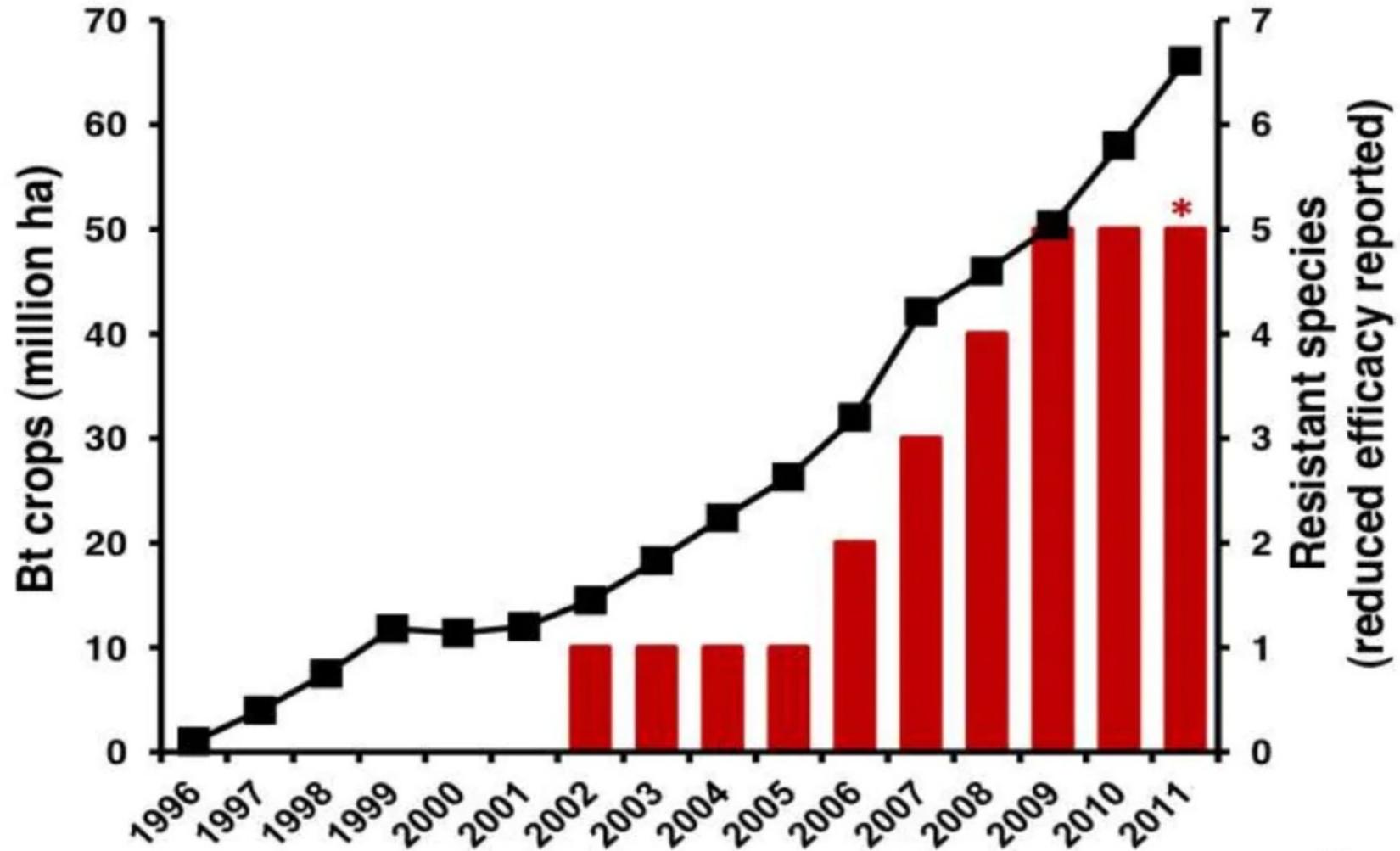


Cultivation of Bt Cotton was allowed in 2002.

- ▶ India has become a net exporter of Cotton in the last one decade.
- ▶ 90% of total cotton cultivation area is covered by Bt Cotton.
- ▶ Yield is more than 80% compared to non-Bt Cotton.
- ▶ More than 600 hybrid seeds are in circulation now



BT COTTON PRODUCTION IN INDIA OVER



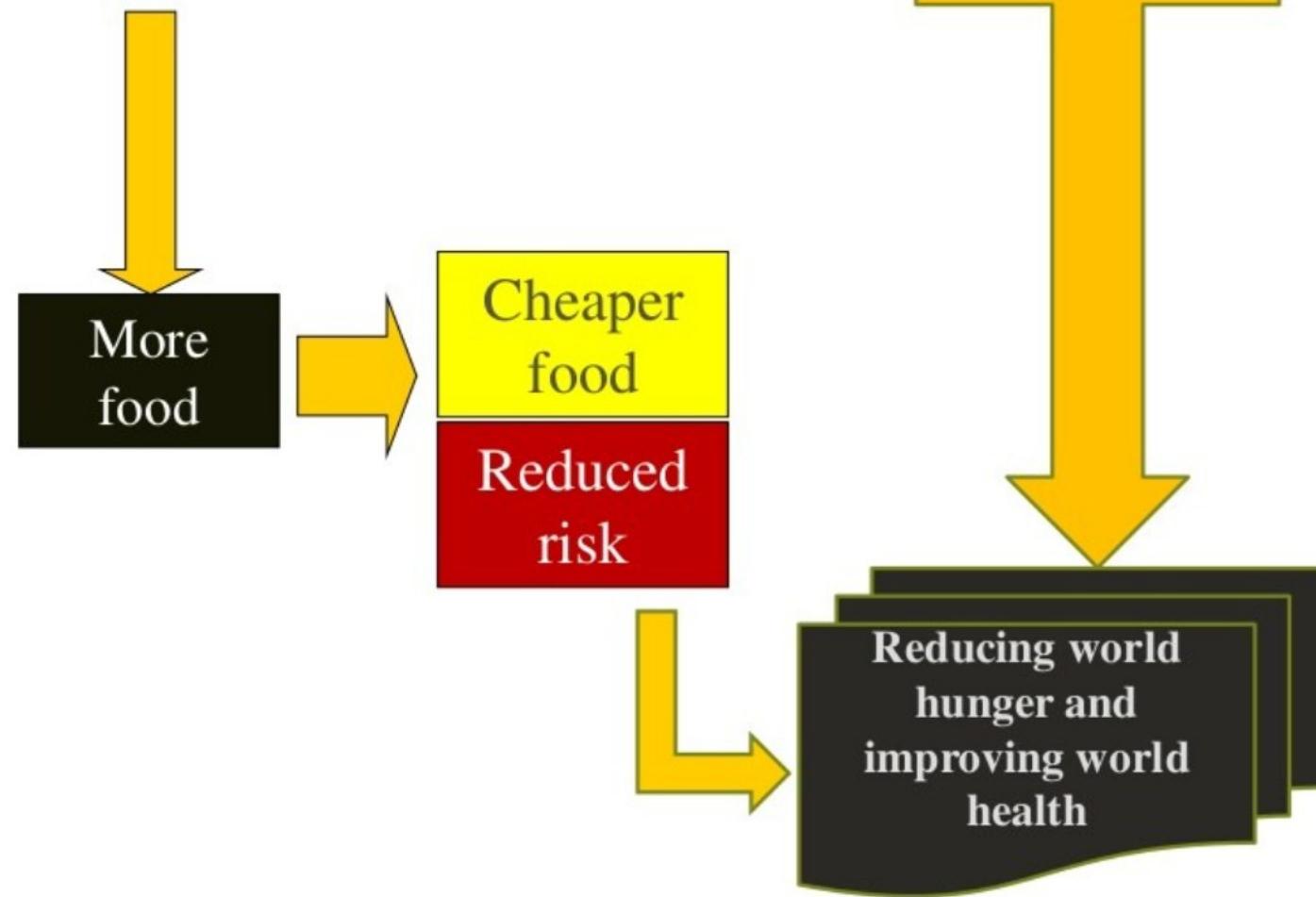
Pros of genetically modified foods ?

- ❖ Improved yield
- ❖ More resistant to disease
- ❖ Less likely to be damaged by insect
- ❖ Tolerance to herbicides
- ❖ Better nutritional value
- ❖ Increased shelf life
- ❖ Improvement in health and environment
- ❖ Better climatic survival by increasing tolerance to draught, flood or frosty conditions to allow the use of previously inhospitable land
- ❖ Higher crop yields
- ❖ Reduced farm costs
- ❖ Increased farm profit

- Tolerent / resistance crops
(Pests, Diseases, Drought, Frost, Flood)

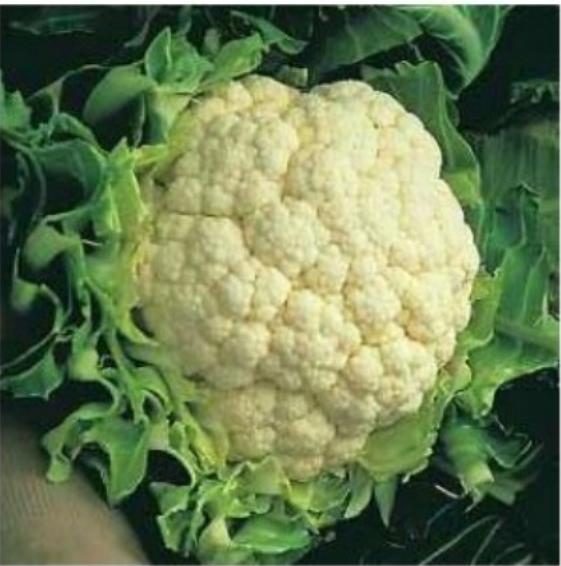
Increased nutrition

Edible vaccines



Trait	Advantage	Sample Product
Pest-Resistance	Less damage by insect, virus, bacteria, etc.	Corn
Herbicide-Resistance	Herbicides will kill only weeds, not crops	Cotton
Delayed Ripening	Can be shipped with less damage	Tomato
Miniature Size	Improved eating quality	Watermelon
Improved Sweetness	Better tasting	Sweet peas
Cold-Resistance	Withstands freezing and thawing	Strawberries
High Starch	Absorbs less oil when fried	Potato
Polyester Gene Added	Better fiber properties	Cotton
Growth Hormone Added	Faster growth	Salmon
Hepatitis B Virus Protein Added	May provide immunity to Hepatitis	Banana

There are 55 crops in the pipeline for clearance..



The proposed Biotechnology Regulatory Authority of India (BRAI) Bill



This Bill will allow quick clearance of GM crops by just a handful of people.

In India, labeling is NOT possible since most foods are not packaged.



Consumers might lose their Right of Choice