19AGE403 ENERGY CONSERVATION IN AGRO INDUSTRY

UNIT I

Key Highlights

- Introduction
- Types of GM Foods
- GM Food Process & Techniques
- Examples of Genetically Modified Foods
- Health and Safety Aspects of GM Foods
- GM Food Labelling
- Future Outlook and Conclusion

Russian Federation
Canada
United States of America
Mexico
Brazil
Bolivia
Argentina
Algeria
Libya
Egypt
Chad
Ethiopia
India
China
Mongolia
Japan
Indonesia
Australia
New Zealand
It costs as little as US 25 cents a day to feed a hungry child and change her life forever.
About 805 million people, or 1 in 9 of the world's population, go to bed hungry each night.
We can achieve Zero Hunger in our lifetimes. In the world today, we have the knowledge, tools and policies to feed everyone.
Hunger Map 2014
Prevalence of undernourishment in the population (percent) in 2012-14
35% and over
WFP
World Food Programme
wfp.org
ZERO HUNGER CHALLENGE

Introduction

- Advances in plant biotechnology have made it possible to identify and modify genes controlling specific characteristics.

- Nowadays, scientists can transfer genes from one organism to another unrelated organism, producing what is now known as "genetically modified organism" or "transgenic animal/ plant".

- Any food produced this way is called Genetically modified food i.e. foods obtained by added or deleted gene sequence.

- More technically, genetically engineered (GE) food are defined as foods produced from plants, animals and microbes that have had their genetic code modified by the selective introduction of specific DNA segments.

Introduction....Contd

- This process allows the organism to acquire a desirable trait such as pest protection, herbicide resistance or improved nutritional qualities.

- The enhancement of desired traits has traditionally been undertaken through breeding, but conventional plant breeding methods can be very time consuming and are often not very accurate.

- Peculiar features which could define GM foods are:
  - Food that contain an added gene sequence
  - Food that have a deleted gene sequence
  - Animal products from animals fed GM Feed.
  - Products produced by GM organisms.

History of GM foods

- In the 1960s, a lot of breakthroughs were recorded in the field of genetics. It was proven that this new knowledge had the potential to revolutionize food production, thus creating huge benefits for the world (Hammer, 2003).

- By 1972, another scientific breakthrough was recorded by Paul Berg, who joined together DNA from two different organisms, to create the first recombinant DNA molecule (Griffiths, 2006).

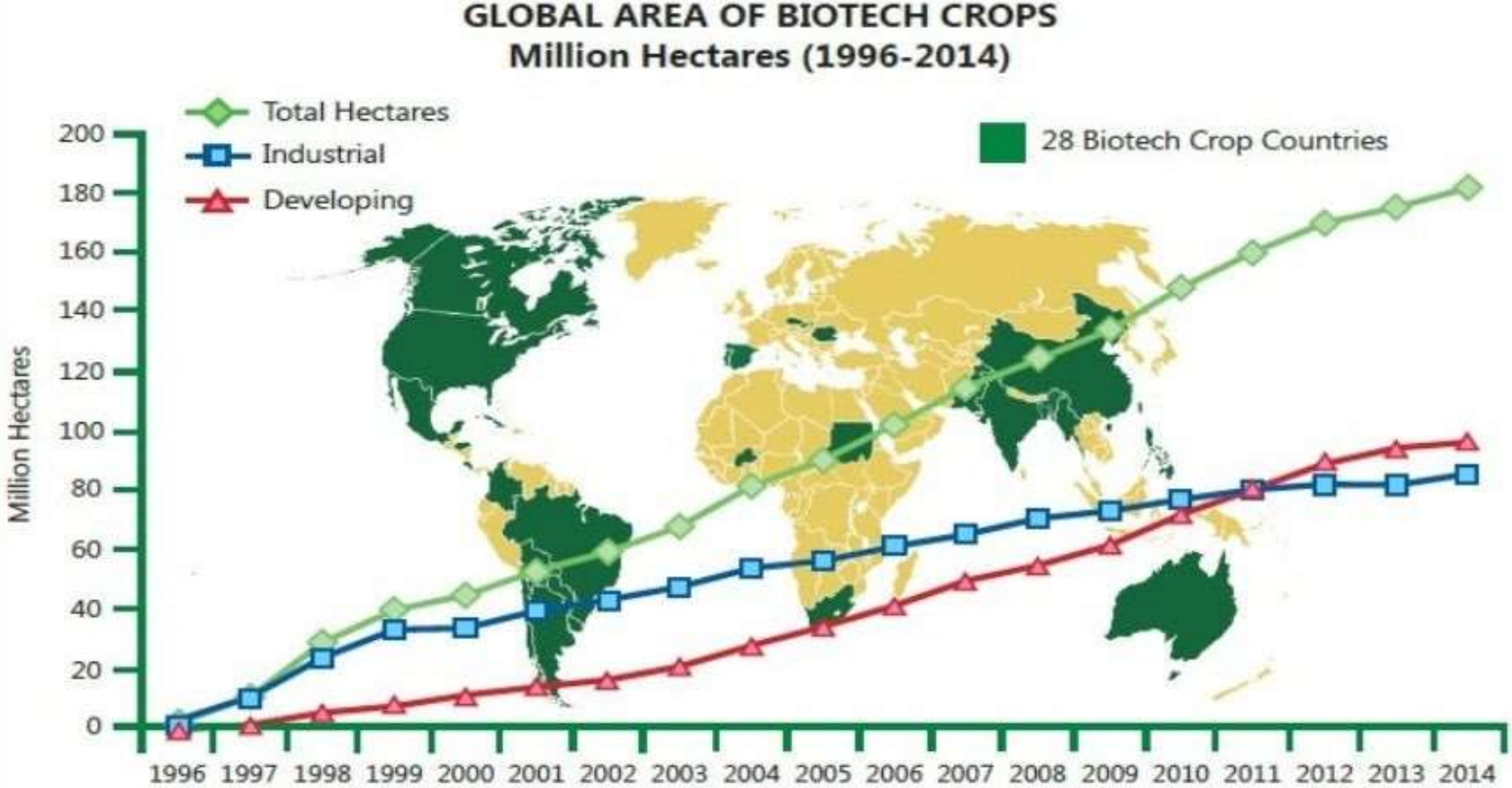
- This breakthrough was followed by a pioneer study in which Stanley Cohen and Robert Boyer inserted DNA from an African clawed toad into the *Escherichia coli* bacterium.

- Shortly, after then, some companies realized that this fledging technology could open up new highly profitable markets.

Some Revolutionary Period

1960-1970	Isolation of restriction enzymes and their use to analyse DNA structure.
1981-1982	First transgenic animals (*mice*) produced.
1983-1985	First transgenic plants produced.
1990-1992	First transgenic cereal plants (***maize and wheat***)
1992-1993	Regulations for deliberate release of genetically engineered organisms.
1994	Genetically engineered tomato marketed in USA.

Global Status of GM Foods



A record 18 million farmers, in 28 countries, planted 181.5 million hectares (448 million acres) in 2014, a sustained increase of 3 to 4% or 6.3 million hectares (~16 million acres) over 2013.

Source: Clive James, 2014.

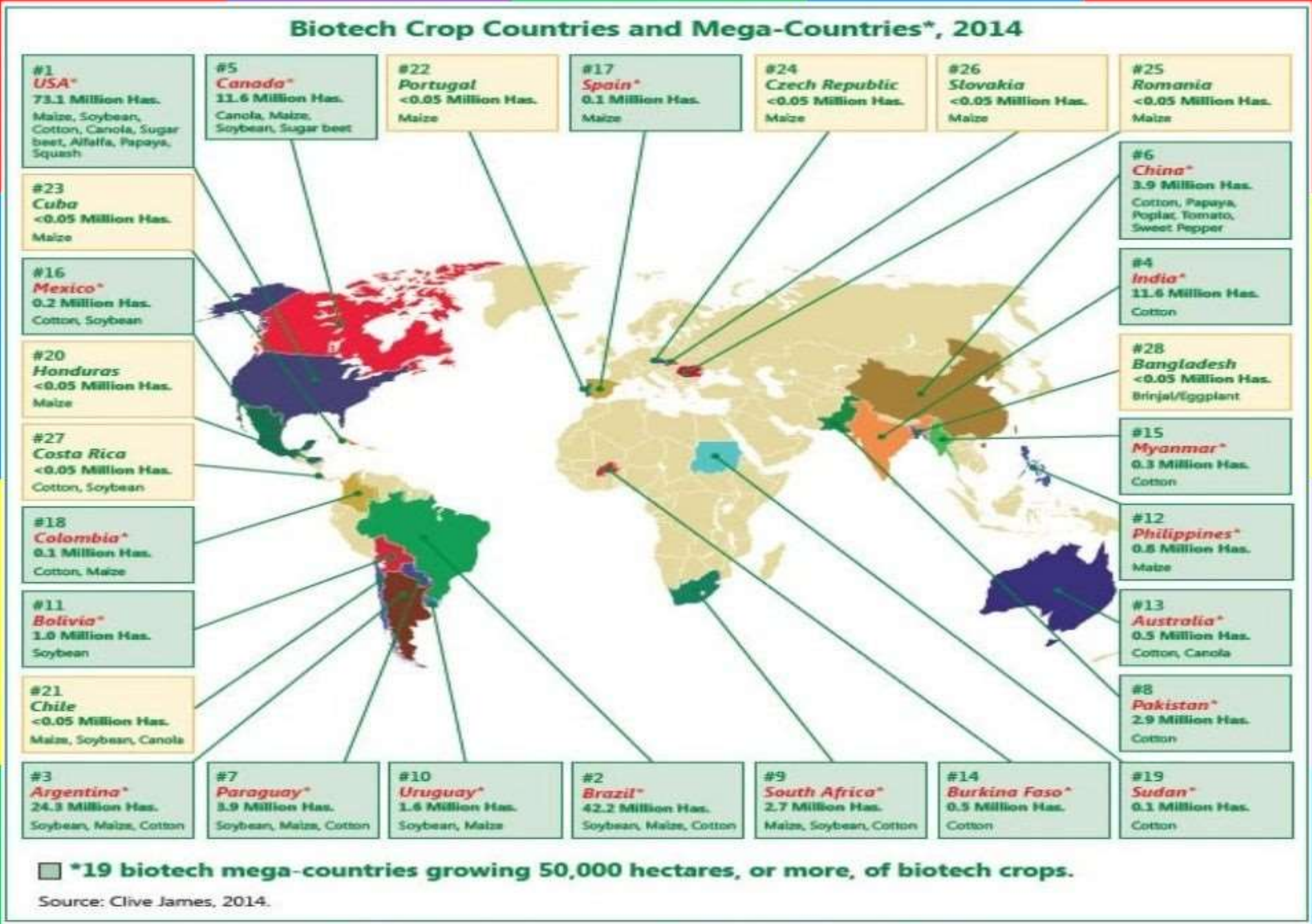


Figure 1. Global Map of Biotech Crop Countries and Mega-Countries in 2014

Rank	Country	Area (million hectares)	Biotech Crops
1	USA*	73.1	Maize, soybean, cotton, canola, sugar beet, alfalfa, papaya, squash
2	Brazil*	42.2	Soybean, maize, cotton
3	Argentina*	24.3	Soybean, maize, cotton
4	India*	11.6	Cotton
5	Canada*	11.6	Canola, maize, soybean, sugar beet
6	China*	3.9	Cotton, papaya, poplar, tomato, sweet pepper
7	Paraguay*	3.9	Soybean, maize cotton
8	Pakistan*	2.9	Cotton
9	South Africa*	2.7	Maize, soybean, cotton
10	Uruguay*	1.6	Soybean, maize
11	Bolivia*	1.0	Soybean
12	Philippines*	0.8	Maize
13	Australia*	0.5	Cotton, canola
14	Burkina Faso*	0.5	Cotton
15	Myanmar*	0.3	Cotton
16	Mexico*	0.2	Cotton, soybean
17	Spain*	0.1	Maize
18	Colombia*	0.1	Cotton, maize
19	Sudan*	0.1	Cotton
20	Honduras	<0.1	Maize
21	Chile	<0.1	Maize, soybean, canola
22	Portugal	<0.1	Maize
23	Cuba	<0.1	Maize
24	Czech Republic	<0.1	Maize
25	Romania	<0.1	Maize
26	Slovakia	<0.1	Maize
27	Costa Rica	<0.1	Cotton, soybean
28	Bangladesh	<0.1	Brinjal/Eggplant
	Total	**181.5**	

Types of GM Foods

1. First-generation crops

- They have enhanced input 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

- They have new traits to increase their benefits to consumers, such as increased levels of protein, modified or healthier fats, modified carbohydrates, increased flavor or increased micronutrients.
- Examples of such crops include 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

- These GM foods are in the research pipeline. These plants may have traits that can provide increased ability to resist abiotic stress such as drought, increased temperature or saline soils.

- Other traits may provide health benefits. Yet, another objective may be to create "pharmaplants" to help produce active pharmaceutical products.

- In February 2009, the U.S. Food and Drug Administration (FDA) approved the license for a recombinant anti-thrombin for prevention of blood clots in patients with hereditary anti-thrombin deficiency.

- Recombinant anti-thrombin is the first human biologic drug derived from the milk of goats that have been genetically engineered to produce human anti-thrombin in their milk.

GM Food Techniques

There are 3 main types of GM food technique:

1. Inserting genes (Gene Shifting):

- Genes are determined by different DNA sequences, when the isolated gene is inserted into a plant, it becomes part of the plant's gene and works with its own function .

- This method can increase or improve the plant such as resistance to insects, which increases the yield of food afterwards.

2. Removing genes (Gene Silencing):

•The function is reduced or stopped through genetic modification e.g. the function of virus which causes dried and spot of tomato is reduced by removing parts of the gene, thus the virus cannot be reproduced and tomato can grow healthily.

3. Changing the process of catabolism (Gene splicing):

- Food can be enhanced by changing the process of catabolism, such as controlling the percentage of starch of glutinous rice, and it also includes controlling the taste, mass, colour, and usefulness of food.

General GM Food Process

The Process for GM has 8 steps and begins with:

1. **Isolation of the gene(s) of interest-** A chromosome is used to identify the gene(s) responsible for the desired trait in the organism.

1. **Insertion of the gene(s) into a transfer vector-** The desired trait is put into the plasmid.

2. **Plant transformation-** The plasmid contained inside *Agrobacterium tumefaciens* cells transfers the plasmids and new gene into the plants chromosomes.

4. **Selection of the modified plant cells-** Selectable marker genes are used to favor the growth of the cells containing the trait as apposed to the non-transformed cells.

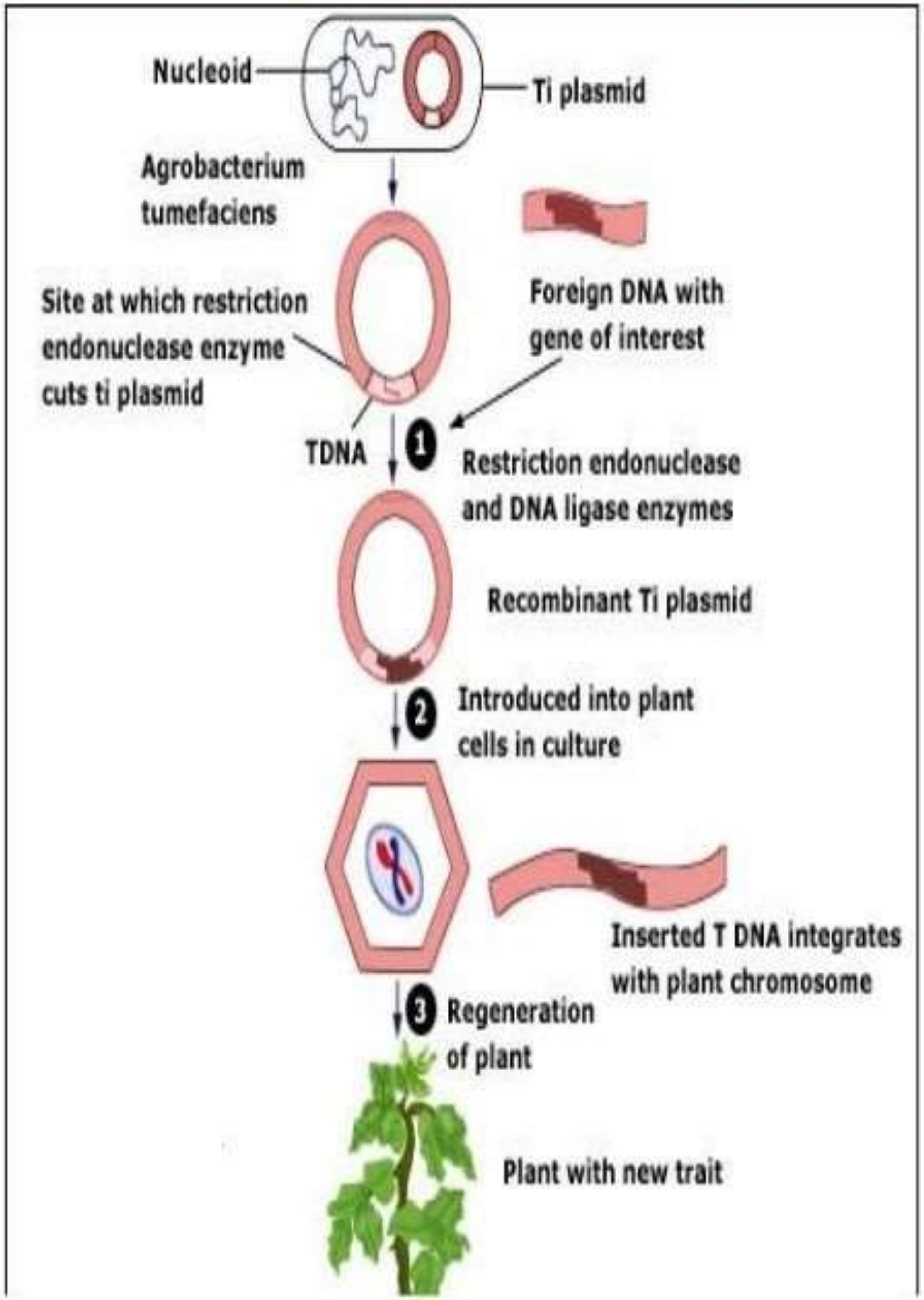
Contd…..

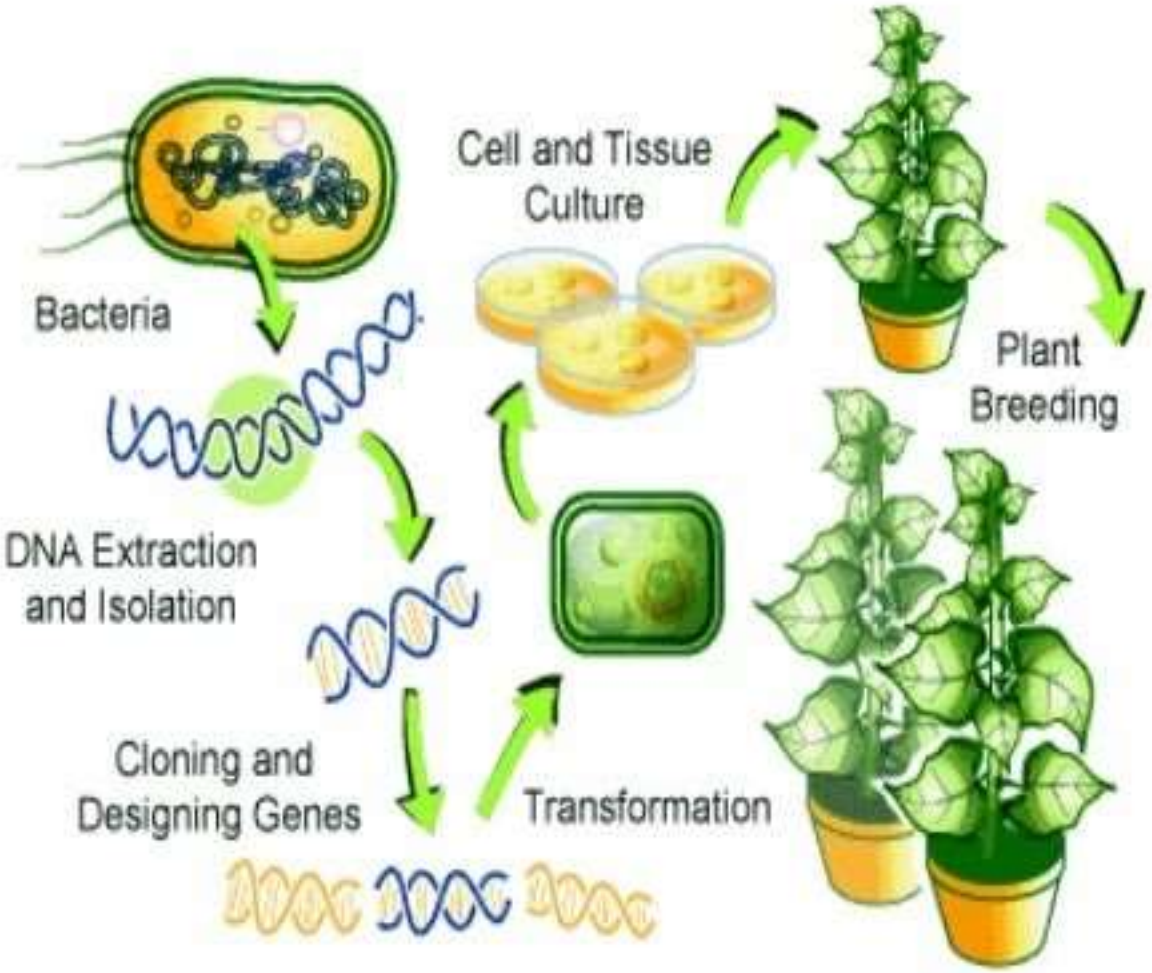
5. Regeneration into whole plants via tissue culture- In this step they take explants (plants/cells) onto media containing nutrients that spark development of cells that form plantlets that once rooted are put in pots controlled in environmental conditions.

6. Verification of transformation and characterization of the inserted DNA fragment- Tests are done to determine the number of copies, if intact, and doesn't interfere with other genes. These tests are done to see if the gene is functional.

7. Testing of the plant performance- Here we see or test and see if the resulted plant grown in a greenhouse has acquired the favored traits and if it has any unwanted characteristics.

8. Safety assessment- Now more test carried out to see plants performance. Environmental safety assessments and other Safety assessments.


Nucleoid
Ti plasmid
Agrobacterium tumefaciens
Site at which restriction endonuclease enzyme cuts ti plasmid
Foreign DNA with gene of interest
TDNA
1
Restriction endonuclease and DNA ligase enzymes
Recombinant Ti plasmid
2
Introduced into plant cells in culture
Inserted T DNA integrates with plant chromosome
3
Regeneration of plant
Plant with new trait


Bacteria
Cell and Tissue Culture
Plant Breeding
DNA Extraction and Isolation
Cloning and Designing Genes
Transformation

Common genetically modified foods

- **Soybean, Corn & sugar-beet:-** resistant to glyphosate by inserting herbicide resistant gene.
- **Cottonseed oil:-** by inserting pest resistant Bt crystal protein gene.
- **Tomato:-** by removing the gene that codes for polygalacturonase, responsible for softening of fruits after harvesting.
- **Potatoes:-** Amylopectin rich variety by switching off of GBSS (granule bound starch synthase) gene, responsible for amylose production.
- **Rapeseed (canola):-** with high oleic acid content by adding new gene.
- **Rice:-** with high Vitamin A by inserting gene from daffodils .

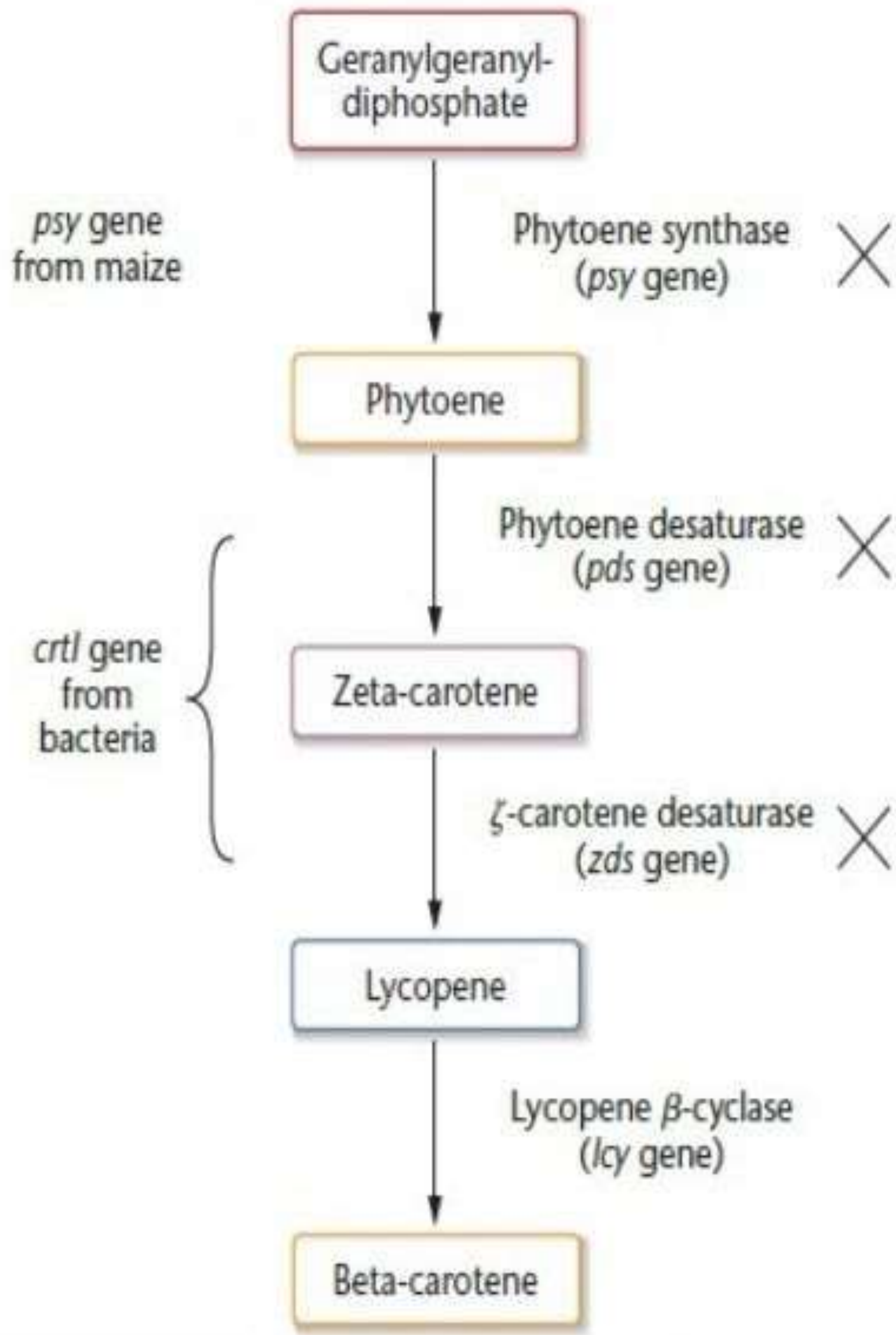
More Specific examples of GM foods

1) **Golden rice**

- It was created by Ingo Potrykus. Golden rice is a variety of rice produced through genetic modification to biosynthesize the precursors of beta-carotene (pro-vitamin A) in the edible parts of rice (endosperm).

- More than 120 million children in the world suffer from vitamin A deficiency. Golden rice has the potential to help prevent the 1 to 2 million deaths each year caused by a deficiency in this vitamin.

- Golden rice was created by incorporating rice with two beta carotene biosynthesis genes:
  - Psy (Phytoene synthase)
  - Lyc (lycopene cyclase)



Beta-carotene pathway in Golden Rice

2. Cold tolerant tomatoes

- Scientists have created a frost resistant tomato plant by adding an antifreeze gene from a cold water fish to it. The antifreeze genes come from the cold water flounder, a fish that can survive in very cold conditions.

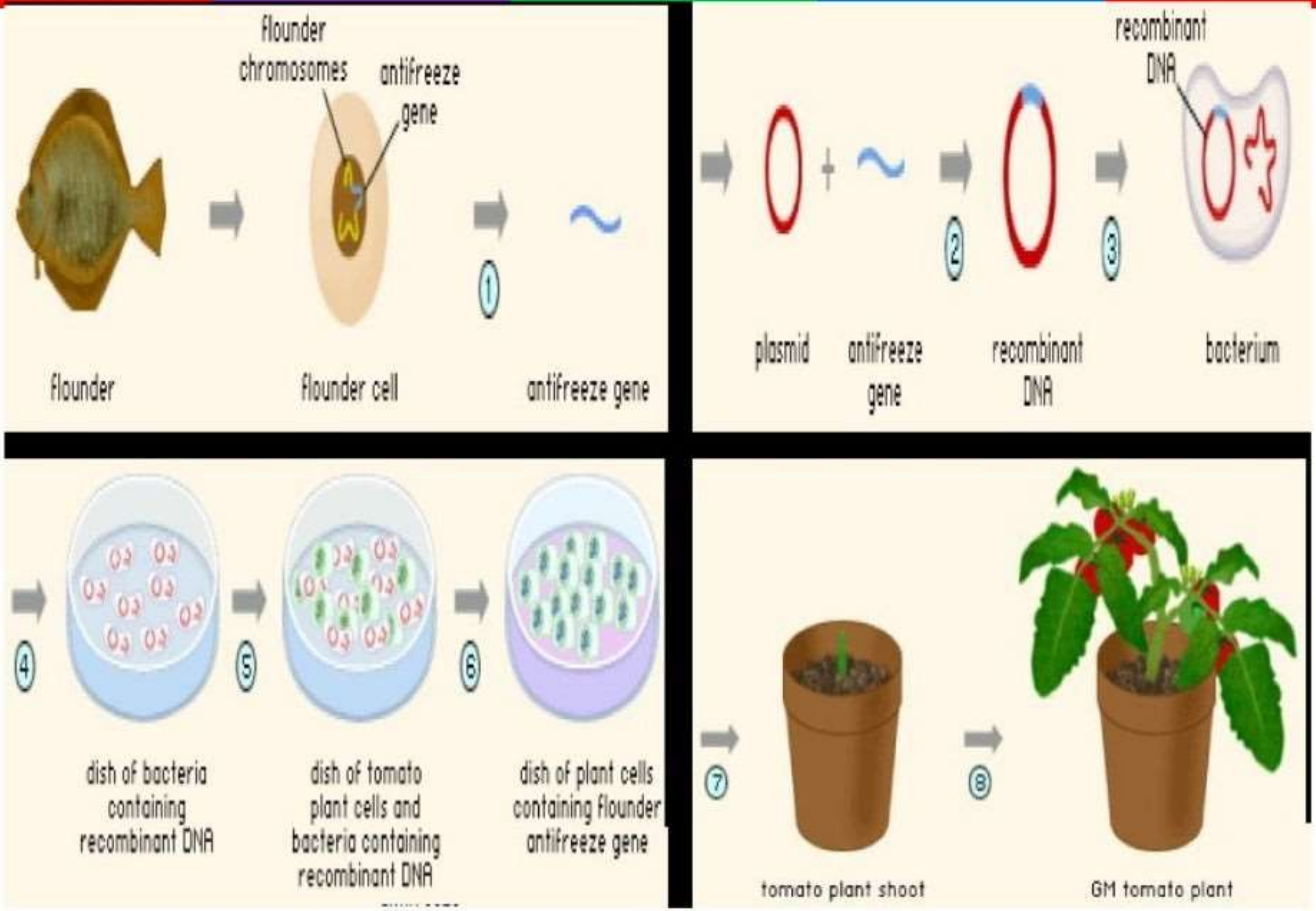
- The flounder has a gene to make chemical antifreeze. This is removed from the antifreeze DNA and is joined onto a piece of DNA called a plasmid. This hybrid DNA, which is a combination of DNA from two different sources, is known as recombinant DNA.

Cold water fish

+

Tomato

= **Frost resistant tomato**



Pathway for cold tolerant tomatoes using antifreeze gene

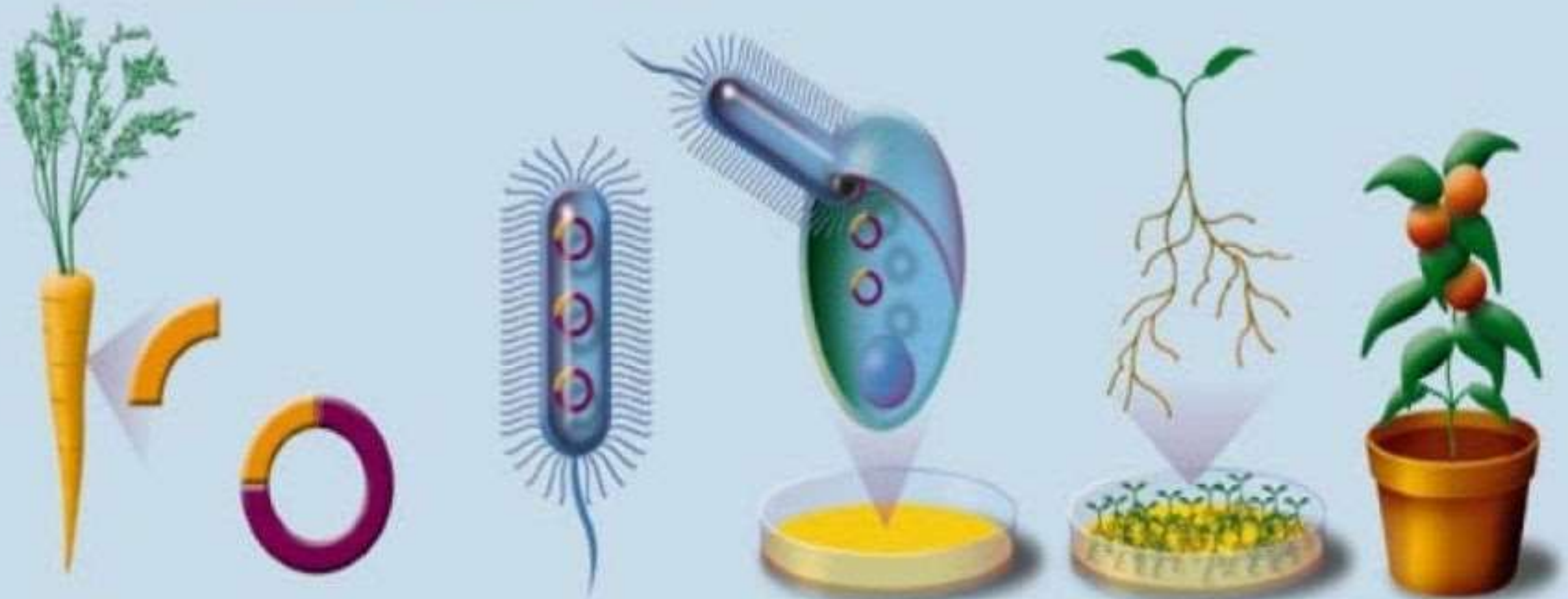
3. Vitamin rich tomatoes

- The *Agrobacterium* naturally infects plants by causing various diseases. By replacing that gene with desirable ones, results into the new genetic makeup with advantageous traits.

- The bright orange color of carrots comes from beta-carotene, which works as the precursor for the synthesis of vitamin A in our body. So by inserting this color gene into the tomato, enhance its appearance as well as its vitamin A level to the desired level.

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.*

4) Protein enriched potatoes for NASA

- Potato is a non-cereal food crop limited in the amount of lysine, tyrosine, methionine and cysteine.

- To provide sufficient protein and amino acids to astronauts with their complete nutritional requirements, a tuber-specific protein amaranth seed albumin (AmA1) has been used to transform potatoes.

- The AmA1 protein has a well-balanced amino acid profile. In fact its amino acid composition exceeds values recommended by the W.H.O. for a nutritionally rich protein.

- This protein was used due to its non-allergenicity in its purified form. When the AmA1 gene was inserted into a potato, 2.5 to 4 fold increases in lysine, tyrosine, methionine and cysteine content and 35 to 45% increases in total protein content was reported in transgenic tubers.

5) **Bt Soyabean**

- The two target insects for insect-resistant, transgenic soybeans are the velvet bean caterpillar and the soybean looper.

- These pests feed on the leaves of the soybean plant and can severely limit yield. Velvet bean caterpillar populations can reach damaging levels rapidly. Many producers in areas where velvet bean caterpillar is a significant problem apply a preventive treatment of Dimilin when plants are in full bloom.

- Scientist have incorporated *Bacillus thuringiensis* gene into soybean which has insecticidal protein that maintains the yield of the crop. *Bacillus thuringiensis*, a ubiquitous soil bacterium is the source of the gene for insect resistance.

Infestation of a transgenic Bt soybean with velvet bean caterpillar. The non transgenic control on the right shows extensive defoliation.

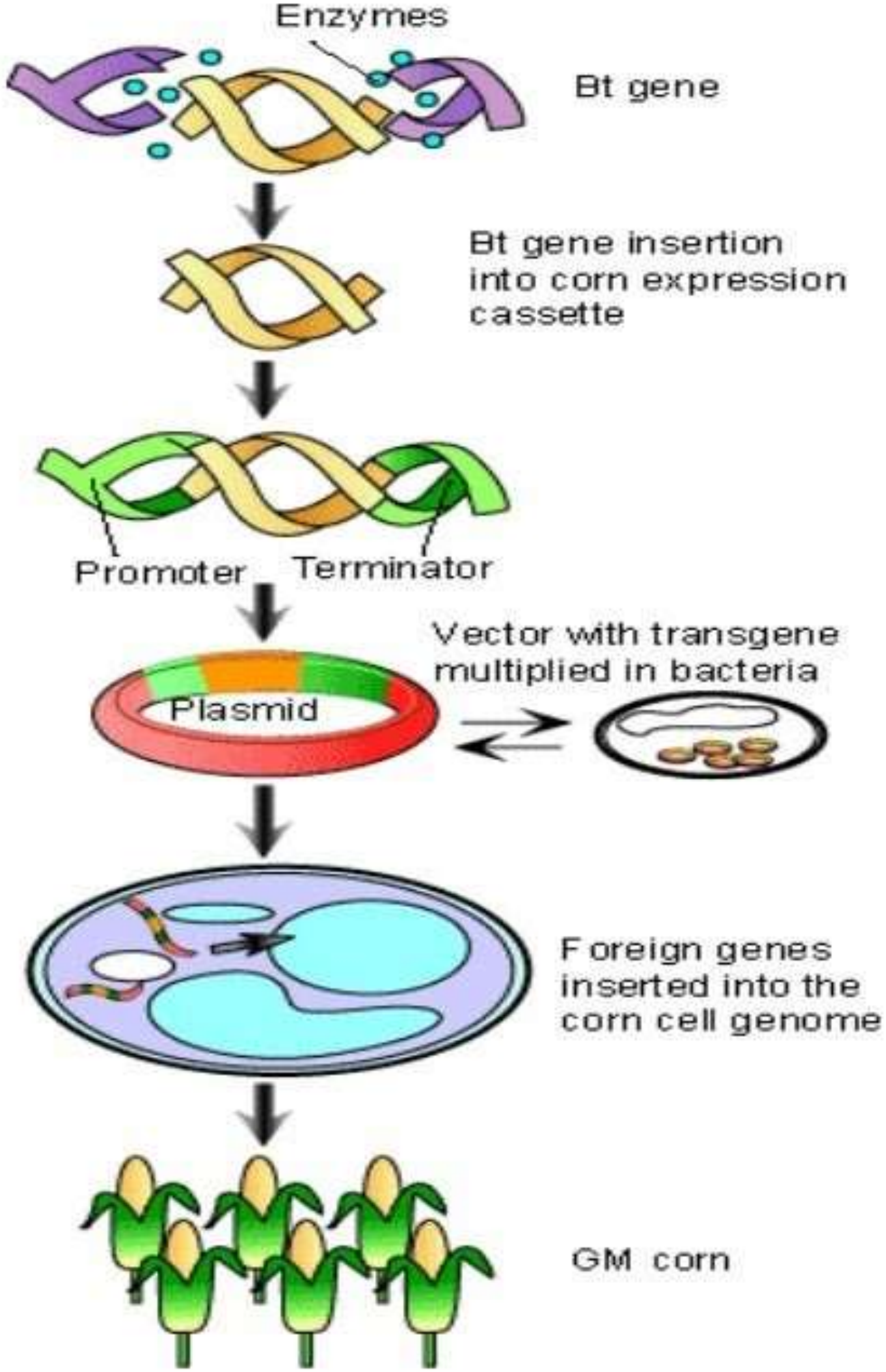
6) **Genetically modified corn**

- Corn has been deliberately genetically modified (GM) to have agronomically desirable traits.

- Traits that have been engineered into corn include resistance to herbicides and resistance to insect pests, the latter being achieved by incorporation of a gene that codes for the *Bacillus thuringiensis* (Bt) toxin.

- Corn varieties resistant to glyphosate herbicides (Liberty and Roundup) have been produced. Pioneer Hi-Bred has marketed corn hybrids with tolerance to imidazoline herbicides under the trademark “Clearfield”.

Figure 12: Genetically modified maize (corn).



Flow chart for production of Bt Corn

7) Roundup Ready Soyabean

- The Roundup Ready soybean is a transgenic soybean that has been immunized to the Roundup herbicide. Since the soybean's natural trypsin inhibitors provide protection against pests, the only major problem in soybean farming was weeds, thus making soybean revolutionary.

- The glyphosate in the herbicide would inhibit the soybean plant's ESPSP gene, which is involved in the maintenance of the "biosynthesis of aromatic metabolites," and cause the plant to die along with the weeds for which the herbicide was meant.

- A plasmid which was transferred to the soybean cells through the cauliflower mosaic virus was soon developed to provide immunity to glyphosate-containing herbicides, and, after this process was perfected, the Roundup Ready soybean was ready, first hitting the US market in 1996 (Neil *et al.*, 2000).

8. Canola oil

- Rapeseed oil had a distinctive taste and a disagreeable greenish color due to the presence of chlorophyll. It also contains a high concentration of erucic acid.

- Experiments on animals have pointed to the possibility that erucic acid, consumed in large quantities, may cause heart damage.

- A known toxin, the cultivar used to produce commercial food-grade canola oil was bred to contain less than 2% erucic acid, levels that are not believed to cause harm in humans and no ill health effects has been associated with consumption by humans of the genetically modified oil (Harvey and Downey, 2003).

9. Papaya

- Papaya cultivation is threatened by papaya ring spot virus, a disease that sharply lowers the fruit yield.

- The University of Hawaii developed a ring spot virus disease resistant papaya. To do this, certain viral genes encoding capsid proteins were transferred to the papaya genome.

- These viral capsid proteins elicit something similar to an "immune response" from the papaya plant. The first resistant papaya varieties were grown commercially in 1999 in Hawaii. These genetically modified papayas are approved for consumption both in US and in Canada (Nap *et al.,* 2003).

Food Companies Using Monsanto's Products: (In Alphabetic Order...)

Aunt Jemima
Aurora Foods
Banquet
Best foods
Betty Crocker
Bisquick
Cadbury
Campbell's
Capri-sun
Carnation
Chef Boyardee
Coca Cola
ConAgra
Cool-aid
Delicious brand cookies
Famous Amos
Flowers industries
Frito-lay
General Mills
Green Giant
Healthy Choice
Heinz
Hellmans

Holsum
Hormel
Hungry Jack
Hunts
Interstate Bakeries
Jiffy
KC Masterpiece
Keebler Industries
Kellogs
Kid Cuisine
Knorr
Kraft
Lean Cuisine
Lipton
Loma Linda
Marie Callenders
Minute Made
Morningstar
Ms. Butterworths
Nabisco
Nature Valley
Ocean Spray
Ore-Ida

Orville Redenbacher
Pasta-roni
Peppridge farms
Pepsi
Phillip Morris
Pop Secret
Post Cereals
Power Bar Brand
Prego Pasta Sauce
Pringles
Procter & Gamble
Quaker
Ragu sauce
Rice-a-roni
Smart Ones
Stouffers
Sweppes
Tombstone Pizza
Totinos
Uncle Ben's
Unilever
V-8

#MAM


BOYCOTT
KELLOGG'S
Sign the petition
asking them to
remove GMOs!
GMO FREE USA
GMO FREE CANADA
Kellogg's Corn Pops
All-Bran
Crispix
Apple Jacks
Carr's
Fruity Snacks
Chips Deluxe
Mother's
Müeslix
Austin
Since 1932
Famous Amos
Kellogg's Cracklin' Oat Bran
MorningStar
Corn Flakes
Crunch Mania
Kashi
Gardenburger
Special K
Pringles
Keebler
Kellogg's Crunchy Nut
Murray Sugar Free
Cheez-It
Kellogg's Eggo
Pop-Tarts
Kellogg's Cinnabon
Product 19
Kellogg's Froot Loops
Smart Start Cereal
Town House
Kellogg's Rice Krispies
Worthington
Smorz
Kellogg's Raisin Bran
FiberPlus
Kellogg's Frosted Flakes
Honey Smacks
Kellogg's Krave
Kellogg's Low Fat Granola Original
FiberPlus Antioxidants
Nutri-Grain

Health and Safety Concerns of GM Foods for Human Consumption

The WHO has identified the following issues of concern for human health with respect to genetically modified foods:

1)Allergenicity:

•GM foods have the potential to cause allergic reactions in general; this risk is comparable to the risks associated with traditionally grown foods.

•However, the proteins produced by any newly introduced genes have the potential to cause an additional allergic response (USDA, 2013).

•To prevent such allergenicity, the transfer of genes from commonly allergenic foods is discouraged unless it can be proven that the protein produced by the introduced gene will not be allergenic (WHO, 2013).

•Another potential risk is the introduction of an entirely new protein that did not previously exist in the food chain.

Contd….

2) Gene Transfer

- Another potential concern arising from GE foods is the transfer of genetic material from GE foods to the cells of the human body or the bacteria in the intestinal tract.

- DNA from ingested food is not completely degraded by digestion and small fragments of DNA from GM foods, have been found in different parts of the gastrointestinal tract.

- This could result in horizontal gene transfer due to absorption of DNA fragments by gut microflora or somatic cells lining the intestinal cells.

- Scientists however, have postulated that uptake of GM DNA into the cells of the gastrointestinal tract will not have any biological consequences because this DNA will be degraded in the cells.

Contd….

3) Increase in Anti-nutrients

- Anti-nutrients are substances that interfere with the utilization of nutrients.

- The insertion of a new gene may lead to an increase in the existing levels of anti-nutrients.

- For example, glyphosate resistant Roundup Ready soybean has been shown to increase anti-nutrients.

- In sheep and cattle, heat-stable anti-nutrients such as phytoestrogens, glucinins, and phytic acid have been found to cause infertility, allergic reactions, and decreased availability of phosphorus and zinc, respectively (Dona and Arvanitoyannis, 2009).

Contd….

4) Use of Viral DNA in Plants

- Most GM crops utilize the Cauliflower Mosaic Virus 35S promoter (CaMV35S) to switch on the introduced gene.

- There is controversy as to whether CaMV35S could be horizontally transferred and cause disease via carcinogenesis, mutagenesis, reactivation of dormant viruses, or generation of new viruses.

- Some scientists believe that CaMV found in foods is not infectious and cannot be absorbed by mammals.

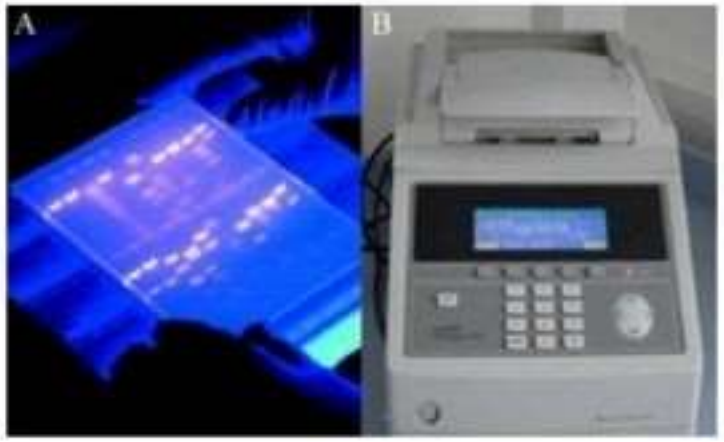
- Some scientists also point out that humans have been ingesting CaMV and its 35S promoter in high amounts and it has never caused any disease or recombined with other viruses (Dona and Arvanitoyannis, 2009).

Testing of Genetically modified foods

- GM products contain an additional trait encoded by an introduced gene(s), which generally produce an additional protein(s) that confers the trait of interest.

- Raw material (e.g. grains) and processed products (e.g. foods) derived from GM crops might thus be identified by testing for the presence of introduced DNA or by detecting expressed novel proteins encoded by the genetic material.

- Laboratories carrying out these assays must be proficient in performing them.



Detection Techniques

- Legislation enacted worldwide to regulate the presence of genetically modified organisms (GMOs) in crops, foods and ingredients, necessitated the development of reliable and sensitive methods for GMO detection.

- Protein- and DNA-based methods employing western blots, enzyme-linked immunosorbant assay, lateral flow strips, Southern blots and limiting dilution-PCR methods, have been employed.

- New approaches, such as near-infrared spectrometry, might tackle the problem of detection of non-approved genetically modified (GM) foods.

- The efficiency of screening, identification and confirmation strategies needs to be examined with respect to disappearance of marker genes, increased use of specific regulator sequences and the increasing number of GM foods.

GM Food Labelling: An International Approach

- Internationally, the Codex Alimentarius Commission (www.codexalimentarius.net), an international standards setting body for food, has a Committee on Food Labeling.

- Since 1990, Codex has sought to develop guidelines for labeling biotech foods. So far, however, there is no agreement on the international standards. In all likelihood, a final Codex standard on the labeling of biotech foods will not occur for many years.

- The approaches taken in different countries towards GM food labeling differ greatly as shown on Table below. The EU has very strict GM labeling guidelines.

- In contrast are the United States, Argentina, and Canada, the three big producers, whose governments do not believe in mandatory labeling. Japan, South Korea, China, and other countries are in-between the EU and the United States on this issue.

Sample of International Guidelines for labeling GM Foods

	Labeling Scheme	% Threshold for Unintended GM Material	Are Some Biotech Foods and Processes Exempt?
Canada	Voluntary	5%[c]	N/A
United States	Voluntary	N/A	N/A
Argentina	Voluntary	N/A	N/A
Australia & New Zealand	Mandatory	1%	Yes
European Union	Mandatory	0.9%[a]	Yes
Japan	Mandatory	5%[b]	Yes
S. Korea	Mandatory	3% [b]	Yes
Indonesia	Mandatory	5%[c]	Yes

N/A means not applicable. Proposed threshold in the EU, lowered from 1%.
Top 3 ingredients in Japan and top 5 ingredients in S. Korea.
Not yet operational.

Current Labelling Policies in the US

The U.S. Food & Drug Administration announces the policy for labeling of GM/GE foods. Examples:

- We do not use ingredients produced using biotechnology.
- Genetically engineered.
- This oil is made from soybeans that were not genetically engineered.
- This product contains cornmeal, produced using biotechnology.

- High oleic acid soybean oil developed using biotechnology to decrease the amount of saturated fat in soybeans.

Governments and GM Foods

- **Europe:** Anti-GM protests (Austria, France, Hungary)
- **Japan:** GM testing is mandatory. Customers for organic
- **USA:** FDA → GM foods are substantially equivalent to natural food, so not subject to FDA regulations

  GRAS → Generally Recognized As Safe
- **India:** No policy yet → for GM → ↓ poverty
- **Brazil:** Some states have banned GM crops

  Smuggle to compete with grain-exporting countries.
- **Africa:** EU opposes the use of GM in Africa

  S. Africa, Sudan, Zimbabwe have GM laws; Kenya Act → 2009
- **Argentina:** Very pro-GM
- **New Zealand:** NO GM Foods grown here!

Current Status of GM Food in India

- India is a signatory to the Cartagena Protocol on Biosafety (CPB) since 2003.

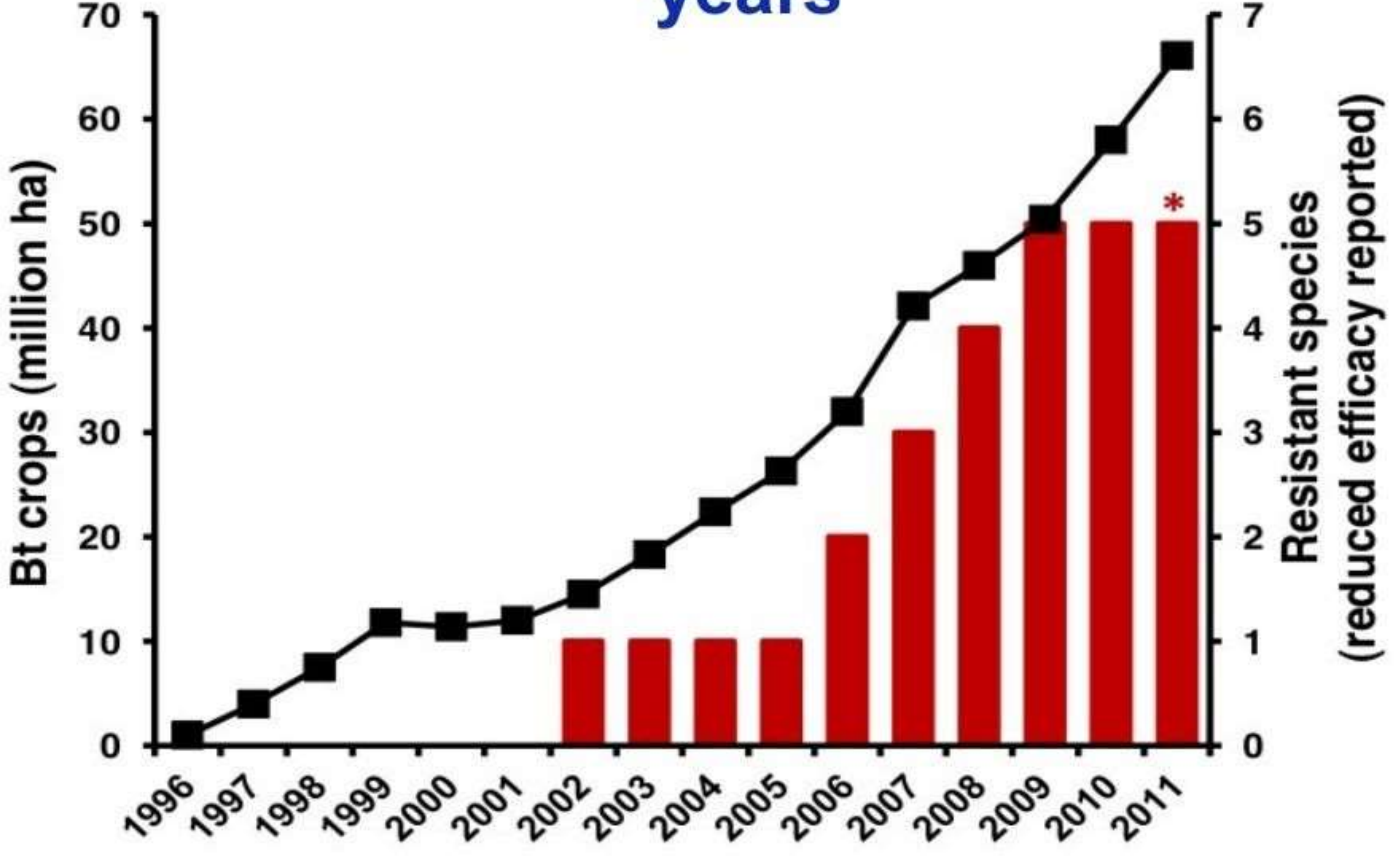
- India's apex biotech regulatory committee, the Genetic Engineering Approval Committee (GEAC) that functions as a statutory body under the Environment Protection Act 1986 of the Ministry of Environment & Forests (MoEF), has been changed to Genetic Engineering Appraisal Committee in July 22, 2010.

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 the years



Bt Brinjal was placed on a 2 year moratorium because consumers opposed it!

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.

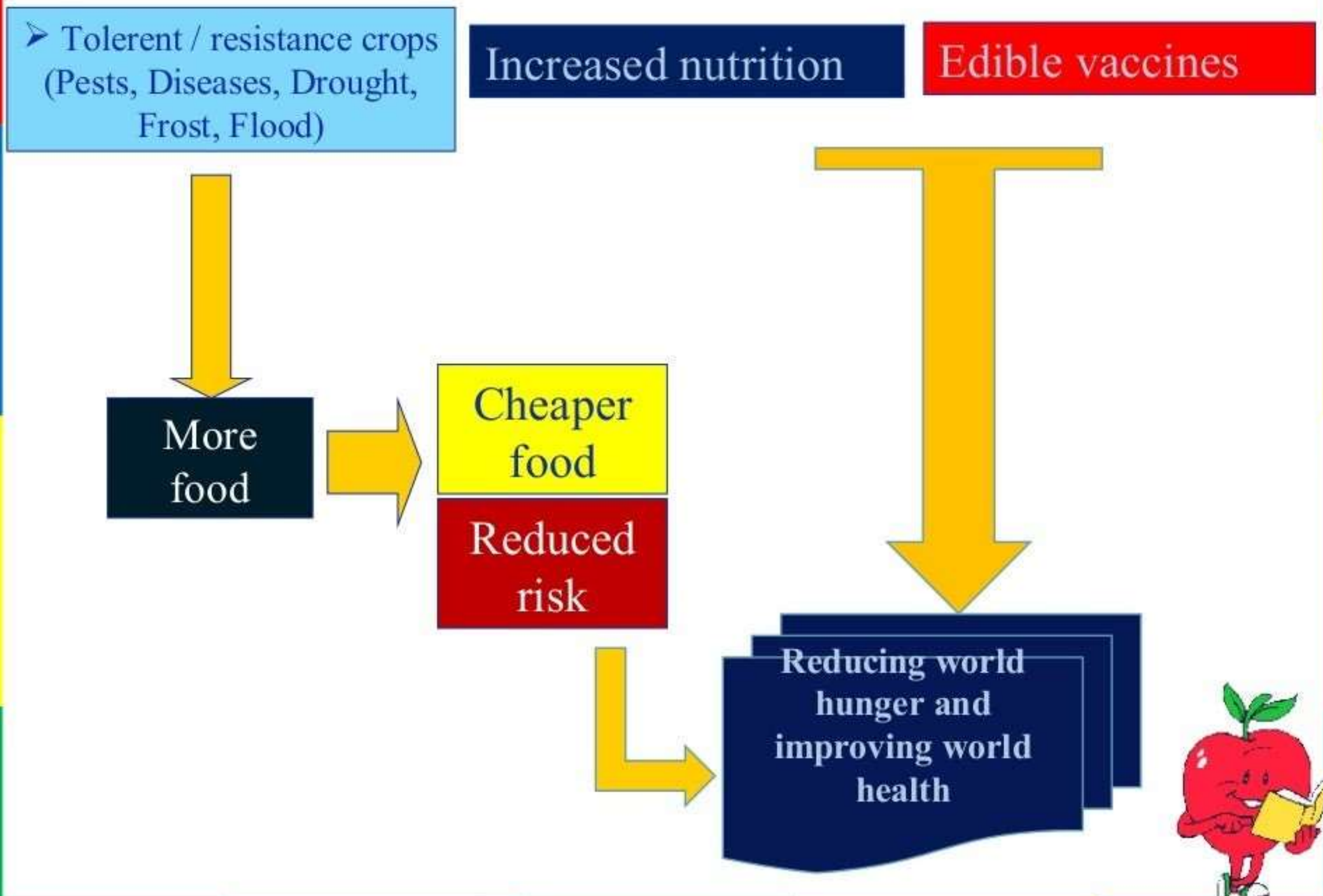
In India, labeling is NOT possible since most

Consumers might lose their Right of Choice

In Andhra Pradesh,
3000 villages with 6 lakh farmers have adopted ORGANIC farming and have said
NO to Pesticides and NO to GM

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
More food
Cheaper food
Reduced risk
Reducing world hunger and improving world health

Why Produce GM Food?

- Traditionally, combining the desirable genes in one plant is a tough task that utilizes longer time and so much attention, involving crossing one plant to another plant of the same species or related species.

- From economical and agricultural standpoints, it is advantageous to grow crops that have higher yield or improved quality, pest or disease resistance, or tolerance to heat, cold and drought.

- Desirable genes may provide means for plants to combat these conditions.

- The development of transgenic technology allows useful genes from various living sources to be brought together in a relatively simple manner.

Trait	Advantage	Sample Product
Pest-Resistance	Less damage by insect, virus, bacteria, etc.	Corn
Herbicide-Resistance	Hebicides 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

Criticism of GM Organism/Foods

Critism of GM Foods

1) Environmental hazards

- Unintended harm to other organism
  - Difficult to design toxin → kills crop-damaging pests, not other insects
- Reduced effectiveness of pesticides
  - Develops resistance → DDT
- Gene transfer to non-target species
  - Cross-breeding
  - Transfer of herbicide resistance from crops to weeds
  - The "superweeds" will then have herbicide tolerance as well

•**Solution**

– Create buffer zone

2) Human health risks

- Allergenicity: We already have allergies to peanuts and other foods. Introducing gene may create more allergies.

- Unknown effects on human health

- However, proposal to introduce a gene from Brazil nuts into Soyabeans was abandoned.

On the whole, with the exception of possible allergenicity, scientists believe that GM foods do not present a risk to human health!

3) Economic concerns

- Lengthy and costly process

- May be patented
  - Monsanto, Novartis, Dow, DuPont hold patents for GM crops
  - Make substantial profit by exporting it to Ems'.

- Farmers from developing countries/EM cannot afford.

- More gap between rich and poor

4) Other invention → discouraged/stopped

- Suicide gene technology
  - Only one growing per season
  - Next time would produce sterile seeds that do not germinate.

Future of GM Foods

- GM advocates are confident that the next generation of GM foods will show even more promising prospects—and may also address many of the problems.

- Australian scientists are adding genes to bananas that will not only provide resistance to Panama disease, a serious fungal disease that can destroy crops but also increase the levels of beta-carotene and other nutrients, including iron.

- Other GM crops in the pipeline include plants engineered to resist drought, high salinity, nitrogen starvation, and low temperatures.

- The current techniques that researchers use to introduce genes into plant cells result in random insertions into the genome. New techniques are being devised that will allow genes to be inserted into precise locations in the genome, avoiding some of the potential unknown effects of disrupting a plant's normal genome with random integrations.

Contd….

- In the future, GM foods will likely include additional GM animals e.g. a transgenic Atlantic salmon variety is likely to receive marketing approval in the near future.
- In another project, scientists have introduced a DNA sequence into chickens that protects the birds from spreading avian influenza.
- Although these and other GM foods show promise for increasing agricultural productivity and decreasing disease, the political pressure from anti-GM critics remains a powerful force.
- An understanding of the science behind these technologies will help us all to evaluate the future of GM foods.

Conclusion

- Genetically modified food is still a new concern in few countries and its acceptance restricted mainly due to the mis and myth conceptions ignoring valuable benefits.
- India is the second most populated country, so to feed the large hungry and malnourished population is also a challenge.
- GM crop propagation proves to be a good alternate for revenue generation in the form of high yield, nutritious grain with less reliance on pesticides and herbicide which has no threat to our agriculture and environment.
- Despite all these positive attributes this technology still lies in its embryonic stage. Awareness programmes at village level for farmers to adopt newest technologies in field farming viz. crop rotation, organic farming and genetic modification results in increase in production per area with healthy crop.

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