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Genetically modified food crops advantage in present and their future prospects: a review

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Abstract: Recently the world's population increases gradually and also increases their food requirement. The GM crops are otherwise called as transgenic crops which are genetically modified by transfer of beneficial genes into the crops. The GM crops has beneficial features such as insecticides resistance. But they have also harmful effects on environment as well as human health. The modern biotechnology or genetic engineering discovered a new technique to improve quality and quantity of food crops and increase food supply. It improves nutritional quality of food crops. But there are many hazardous impacts on environment as well as health. This paper will describe recent applications of GM Food crops and their prospects.

Keywords: *GM Plants; GM cotton; GM mustard*

The plants are grown from two types of method first is sexual propagation and second is asexual propagation. Plants produced by conventional methods takes thousands of years. This is a long process and taking more and more time (10 to 15 year). But in 21st century it is a possible too produced in a short time and high quantity or yield. The Genetic technology or genetic engineering in organisms and produce good quality and quantity for human welfare**).** By using genetic engineering, we can make plants which are referred as GM plants or transgenic plants. These are those type of plants which are genetically modified by using recombinant DNA technology **[1].** it provides resistance against biotic as well as abiotic stresses and It can be also used for improvement of their nutritional values. This type of plants can be used in medicines, industrial purpose etc. Thus, it can impact many aspects of the Society. But there are some issues of GM plants which affects human health and environment, so GM Food crops has been restricted. Some NGOs raised this concerns which related to GM plants **[2].** History of GM food crops could be represented in Table (1).

PROPERTIES OF GM FOOD CROPS

Herbicide resistance: Traditional herbicides are chemicals which impacts the plants growth and development. It also affects the environment. It decreases soil quality and also restricted the physiology of plants. These herbicides are chemical in nature and contaminated the environment. So new herbicides are developed which are safer and biodegradable. **[3].** It also restricted the photosynthesis and amino acid biosynthesis. Such as Atrazine(lasso) affects the photosystem and Bromoxynil (bucktail) inhibited photosynthesis, Glyphosate inhibited aromatic amino acid biosynthesis, Phosphinothricin inhibited the Glutamine biosynthesis etc. **[4-7].**

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Insect resistance: For protection of plants many pesticides and insecticides are utilized. These are chemically synthesized. So new insecticides are developed by using Bacillus thuringiensis (Bt). its spores are used as a biological insecticide which are depends on delta endotoxins(protein) during sporulation. These are toxin in nature but safe and very specific in their action **[8].**

Resistance against viral infection: The new technique developed viral resistance plants by the inoculation of susceptible strain of crop with a mild strain of crop it resists against viral infection this technique is called as Cross protection. It has been used to reduce yield losses in such crops Tomatoes against tomato mosaic virus (TMV), potato against potato spindle tuber viroid (PSV) and citrus against citrus tristeza virus (CTV). Disadvantage: Possibility of mutation, possibility of synergism Possibility of spread of unnecessary virus. Possibility of yield losses due to mild strain. **[9-12].** Following three kinds of genes have been used for this process: Gene for virus coat or capsid protein (CP) from positive strain RNA virus. Gene for nucleocapsid protein from tomato spotted wilt virus (TSWV) Satellite RNA for transformation as shown in Figure (1).

Figure 1. Genetically modified food crops and their technique.

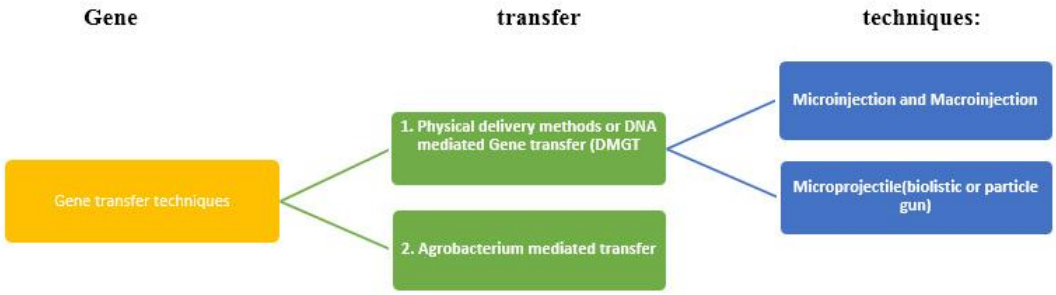

Table-1. Representation of discovery of GM crops.

	Contribution
1983	First GM plant (antibiotic resistance tobacco plant).
1992	China was the first country to allow commercialization of transgenic plants.
1994	US approved tomato for sale in US.
1995	Bt potato , Bt canola , Bt cotton was approved.
1996	First GM maize producing a Bt Cry protein was approved.
2000	The first two GM rice varieties both with herbicides resistance.
2000	Vitamin-A enriched Golden Rice was introduced.
2002	India was released Bt cotton.
2009	Insect resistance GM rice approved for food.

Significance of GM Plants:

(1) Resistant to biotic and abiotic stresses.

(2) Suitable for food processing **[11].**

Table-2. Some transgenic crops and their features.

GM crops	Features	Gene
Corn	Weed control Insect resistance	EPSP Synthase Bt Ceyl A(c)
Rice	Pro vit A	Pro vit A synthesis gene
Papaya	Virus resistance	Coat protein
Potatoes	Insect resistance	Bt Cryl 2A
Tomatoes	Insect resistance	Bt Cryl A(b)

BENEFITS OF GM FOOD CROP'S: These are following benefits of GM Food crops:

1. Increased Nutritional Content

In many nations, only a single staple food crop is the reliable source for intake of energy. GMO plants having more nutritional value than the wild varieties of the same crop, hence provide a solution to malnutrition. For instance, Golden Rice. It has the ability to carry out metabolic steps required for the synthesis of the precursor for Vitamin A, i.e. beta carotene. There is a worldwide deficiency of vitamin A which leads to deaths and also proves to be a cause behind blindness in the survivors. Golden rice has thus reached us as a health solution against the deficiency **[9].**

2.Resistance development against biotic stresses

Biotic stresses against plants include a variety of pathogens (bacteria, fungi, viruses) and insects that cause diseases and badly affect the productivity and quality of the crops. In order to provide resistance against pathogens, genes like glucanase, chitinase, defensin and osmotin are used to create disease resistant crops. Genes like lectins, inhibitors of protease, inhibitors of trypsin, etc. are used to from insect-pest resistant plants. For example, Bt Tomato plant - it was created by using cry gene present in a bacterium, namely *Agrobacterium tumifaciens*. This gene codes for protein that provides resistance to the plant against pests like *Heliothis virescens* and *Spodoptera litura*. Transgenic Persimmon is another fruit tree which has been transformed by cryI gene and is thus resistant to *Monema falvescens* and *Plodia interpunctata* **[13-15].**

3.Resistance development against abiotic stresses

Various abiotic factors like heat, drought, salinity, chilling, oxidative stress severely affect the crops. There are a large number of genes known to code for proteins against these stresses and these are used in GM technology to provide resistant crops. For instance, a bacterial gene namely mannitol-1-phosphate is used to create transgenic tomato plants. Experiments have showed that the transformed plants showed a higher level of resistance against drought and salinity than the non-transformed ones. Another GM plant is transgenic sweet potato, Sushu-2 which contains gene called betaine aldehyde dehydrogenase (SoBADH). It is present in *Spinacia oleracea* and is responsible for an increased produce of glycine betaine in cells of the plant which improves its tolerance for low temperature, salinity and oxidative stress **[16-20].**

4.Increased shelf-life

Excessive softening of the tissues of fruits and vegetables is an important factor that limits their shelf life. Hence, a variety of ways are used to delay the ripening. Activity of cell wall enzymes like polygalacturonases which are responsible for ripening is altered. In many other fruits and vegetables, the biosynthesis pathway for fruit ripening hormone, ethylene is blocked. Many improved varieties of tomato have been developed over time with increased shelf-life. In these plants, synthesis of ethylene precursors like ACC oxidase or ACC synthase has been stopped or reduced through antisense RNA inhibition **[21].**

5.Commercial advantages

Other than providing as a food, GM technology also allows various crops to be used for commercial purposes. For eg. Glyphosphate tolerant crops. Being safe and rapidly degrading, these crops are a good alternative to more toxic and costly herbicides. Also, they are beneficial in reduction of soil erosion and ground water loss as they allow farmers to go for no-till agriculture in which the field is left undisturbed for a specific period of time **[19-20].**

APPLICATION OF GENETICALLY MODIFIED FOOD

1. GM crops are more nutritious and tastier food and are potentially more commercial friendly.

2. GM plants reduce the dependence on harmful pesticide. Many are disease and drought resistant plant that require fewer environmental resource such as water and fertilizer.

3. Genetic engineering were developed in 1973 and now it is widely accepted. Even many countries used GM food commercially. In 2009, 10% of Earth arable land were used for GM food production.

4. It increased supply of food with reduced cost and longer self-life. Plants and animal used in genetic engineering are of superior quality.

5. First generation GM crops have improved quality with special trait. for example, herbicide resistant soybean and corn can be 'weeded' with effective, less toxic and cheaper herbicide. Cotton and corn plant are modified with Bt gene which protect them from larval pest.

6. There are many environmental benefits like due to use of chemical fertilizer which have highly toxic effect on water system while farm runoff, are controlled by GM plants. Reduced mechanical breeding help prevent the loss of topsoil.

7. There are many health benefits result from reduced use of chemical pesticide exposure for farmer and rural labourer and lower pesticide residue for consumer.

8. When developing countries grow GM crops more people get employment because more worker are needed to harvest significantly higher yield.

9. GM soybean and corn are widely grown in North and South America and Africa produced combinedly 55 billion per year at global level.

10. Huge benefits are also projected for future GM crops that are more tolerant to draught and have more nutrient content.

11. Second generation GM crops have enhanced quality trait like higher nutrient content more tolerating power and good disease resistant. for example: "golden rice" are biofortified for Vit A content, other biofortified projects include corn, sorghum, cassava and banana with increased minerals and vitamin content.

12. Many foods are also developed for medicinal purpose which could be used for vaccines and medicines

FUTURE PROSPECTS OF GENETICALLY MODIFIED FOOD CROPS

Nowadays genetics is the most frequently used branch of science in daily aspects. Genetically modification techniques is used in agricultural field in which gene is modified using genetic engineering methods. By this method we add or remove the interested gene using Genetic engineering techniques including gene gun, electroporation, micro injection and agrobacterium Some examples of GM crops:

1. ***Corn:*** GM corn is created to resist insect pests or tolerate herbicides. Bt corn produce protein, which is toxic to some insects, by this it reduces the need for spraying insecticides.

2. ***GM soy:*** It is used predominantly as animal food, which contains high nutrients.

3. ***GM cotton:*** I.e Bt cotton was created to be resistant to bollworms, which is important for textiles, cottonseed oil and some food for animals.

4. ***GM potato:*** It is developed to resist insect pests and disease like bruising and browning which occur when potatoes are packed, stored and transported.

5. ***GM papaya:*** It named Rainbow papaya was created to resist ring port virus.

6. ***GM Summer squash:*** It is resistant to some plant viruses.

7. ***GM Canola:*** It is used mostly to make cooking oil and margarine, which is resistant to herbicides and helps farmers to more easily control weeds in their fields.

8. ***GM Apple:*** A few varieties of GM apples used to resist brown after being cut. These are the crops which have a major role in the development of food production and reduction of malnutrition. If we use these techniques in large amount, we can resolve the nutritional problems**. [11-15].**

GM FOOD CROPS IN INDIA

According to the International Service for the Acquisition of Agri-Biotech Applications (ISAAA), India currently has the world's fourth largest GM crop acreage, surpassing China's 3.0 million hectares (mh) while equaling Canada's 11.6 mh, based primarily on GM Cotton, the country's only genetically modified crop allowed. Farmers in India planted 11.6 million hectares of transgenic crops in 2014, leaving Argentina (24.3 million hectares), Brazil (42.2 million hectares), and the United States to take the top three rankings (73.1 mh). Last year, Bt cotton made up the entirety of India's 11.57 million hectare GM crop acreage, with Bt hybrids covering the majority of it (approximately 96 percent). While Bt cotton dominates GM crop

acreage in India, with much of it based on Monsanto's proprietary "Bollgard" technology, this is not the situation in other major countries. Brazil's 42.2 mh, for example, includes 29.1 mh, 12.5 mh, and 0.6 mh for soyabean, maize, and cotton, respectively. In addition, maize, soyabean, and cotton accounted for 34.5 mh, 32.3 mh, and 4.3 mh of the US's 73.1 mh GM crop area, respectively. Bt cotton covers the majority of China's 3.9 million hectares of GM planted land. However, the government has approved the commercial growing of seven other crops: papaya, rice, maize, petunia, tomato, and sweet pepper. (Kari, et al., 2004) GM MUSTARD After Bt Cotton and a brief debut of Bt Brinjal, India has seen no new entrants in the GM-based crop variety field.

Many GM cultivars are thought to be in various stages of development but have yet to be officially released. GM Mustard is the newest GM crop on the block, and it has been approved by the Genetic Engineering Approval Committee (GEAC), India's biotech authority, which is part of the Ministry of Environment and Forests, with no biosafety or public health issues. India imports over $12 billion worth of vegetable oil each year. Agri-experts have suggested that GM mustard could be a solution to the country's edible oil shortage because it yields up to 30% more than conventional types.

The Dhara Mustard Hybrid-11 or DMH-11 variety was created by a team of scientists from Delhi University lead by former Vice-Chancellor Deepak Pental by genetically altering the mustard variety “Varuna” and crossing it with an Eastern European line. Bt cotton, which has been engineered to create an insecticide that can kill any invading pest, is not the same as GM mustard, which has been modified to make the breeding process easier. It employs a system of genes derived from a soil bacterium that allows mustard to self-pollinate, making it more adaptable to hybridization than the present gene pool of India. As a result, the current status of yet another GM crop is determined by public opinion rather than scientific reports. Although commercial production of GM food has not been permitted by any State government in India until now, field trials for 21 GM food crops, including GM vegetables and grains, have been approved by the government **[23].**

CONCLUSION

It is concluded that The GM crops have beneficial as well as harmful effects. There are many applications of GM food crops because these are safe from viral infection, insect disease. They have good nutritional quality and prevents biotic as well as abiotic stresses. They have also great role in environment because they reduce soil erosion. Genetic modification of food and feed related plant is developing rapidly, it become one of the fastest growing industry profiting growers as well consumer and increasing major country economies. GMO have potential to improve sustainability of agriculture but apparently lack of information about long term use make it risky to use it blindly. There are many ‘pro’ and ‘con’ of using genetically modified food on human being we cannot answer in simple yes or no. With un Hamlet-like indeciveness we suggest use of GMO with keen toward all good and bad signs.

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