Indian Farmer
Volume 8, Issue 05, 2021, Pp. 374-381.
Available online at: www.indianfarmer.net
ISSN: 2394-1227 (Online)

POLICY PAPER OPEN ACCESS

Genetically modified crops on human health

J. Prasoona[1], T. Supraja[2] and S. Sucharitha Devi[3]

[1]PhD Student, Post Graduate and Research Centre
[2]Associate Professor, [3]Associate Professor, Department of Foods and Nutrition,
College of Community Science, PJTSAU, Saifabad, Hyderabad -500004

**Corresponding Author : ajaykumar614303@gmail.com*

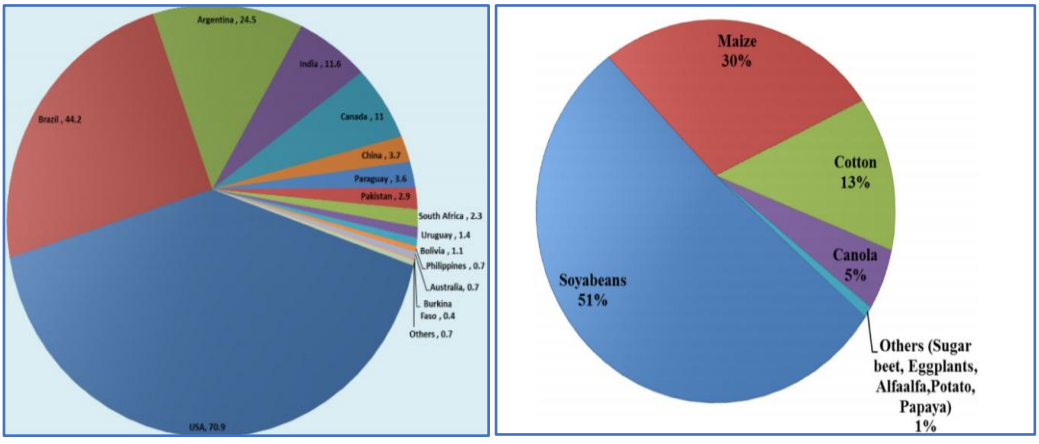
Article Received: *25 May 2021* ***Published:*** *27 May 2021*

Genetic modification is a biological technique that effects alterations in the genetic machinery of all kinds of living organisms. GMO is defined as follows by WHO (World Health Organization): "Organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination"."GM foods" refer to foods produced from genetically modified plants or animals.

History of GM foods

The genesis of DNA modification technology can be traced back to 1944, when scientists discovered that genetic material can be transferred between different species. The first genetically modified plants – antibiotic resistant tobacco and petunias were produced by three independent research groups in 1983.Scientists in China first commercialized genetically modified tobacco in early 1990s. GM foods that are available in the market include potatoes, eggplants, strawberries, carrots, and many more are in pipeline.

The global areas of production of GM crops:



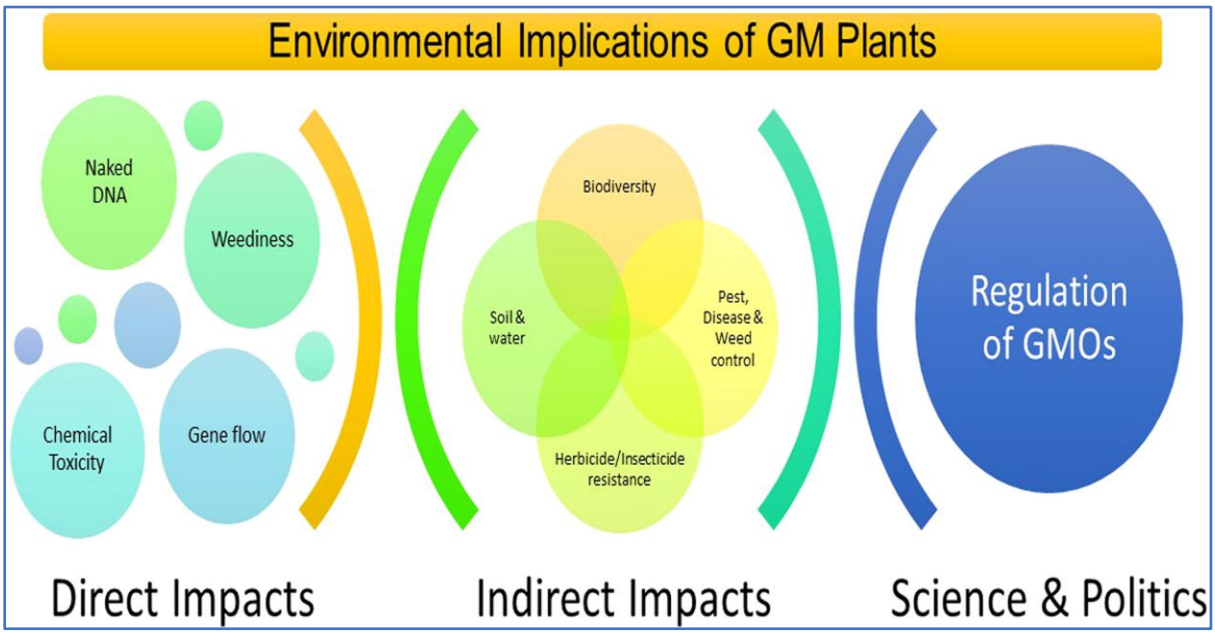
Gm plants and the environment

Any adverse effects on the environment through the large-scale growth of GM plants may indirectly affect human health. The following concerns have been expressed with regard to GM plants and the environment:

1.That GM plants will sexually hybridize with non-GM plants through the transfer of pollen

2.That GM plants may themselves become invasive weeds

3.That the conditions required to grow GM plants will affect local wildlife populations.



Advantages of GM foods

Pest resistance:

Farmers typically use many tons of chemical pesticides annually. Consumers do not wish to eat food that has been treated with pesticides because of potential health hazards, and run-off of agricultural wastes from excessive use of pesticides and fertilizers can poison the water supply and cause harm to the environment. Growing GM foods such as B.t. corn can help to eliminate the application of chemical pesticides and reduce the cost of bringing a crop to market.

Herbicide tolerance: Crop plants genetically-engineered to be resistant to one very powerful herbicide could help to prevent environmental damage by reducing the amount of herbicides needed.

Disease resistance:

There are many viruses, fungi and bacteria that cause plant diseases. Plant biologists are working to create plants with genetically-engineered resistance to these diseases.

Cold tolerance:

An antifreeze gene from cold water fish has been introduced into plants such as tobacco and potato. With this antifreeze gene, these plants are able to tolerate cold temperatures that normally would kill unmodified seedlings.

Drought tolerance/salinity tolerance:

As the world population grows and more land is utilized for housing instead of food production, farmers will need to grow crops in locations previously unsuited for plant cultivation. Creating plants that can withstand long periods of drought or high salt content in soil and groundwater will help people to grow crops in formerly inhospitable places.

Nutrition:

Malnutrition is common in third world countries where impoverished peoples rely on a single crop such as rice for the main staple of their diet. However, rice does not contain adequate amounts of all necessary nutrients to prevent malnutrition. If rice could be genetically engineered to contain additional vitamins and minerals, nutrient deficiencies could be alleviated. For example, blindness due to vitamin A deficiency is a common problem in third world countries. Researchers at the Swiss Federal Institute of Technology Institute for Plant Sciences have created a strain of "golden" rice containing an unusually high content of beta-carotene (vitamin A). Plans were underway to develop golden rice that also has increased iron content. Pharmaceuticals Medicines and vaccines often are costly to produce and sometimes require special storage conditions. Researchers are working to develop edible vaccines in tomatoes and potatoes. These vaccines will be much easier to ship, store and administer than traditional injectable vaccines.

Phytoremediation:

Plants such as poplar trees have been genetically engineered to clean up heavy metal pollution from contaminated soil.

Stronger Crops:

GM technology is believed to bring about is that crops can be engineered to withstand weather extremes and fluctuations, which means that there will be good quality and sufficient yields even under a poor or severe weather condition. As populations across the world grow and more lands are being utilized for housing instead of food production, farmers are prompted to grow crops in locations that are originally not suitable for plant cultivation, and culturing plants that can withstand high salt content in soil and groundwater, not to mention long periods of drought, will help them grow healthy crops. Also, animals and plants that have been genetically modified can become more resistant to unexpected disease problems.

Larger Production:

It has been easier to raise crops that are classified as genetically modified because all of their examples have the stronger ability to resist pests. This attribute helps farmers with producing greater amounts of crops or foods.

More Nutritious Foods:

According to the Food and Agricultural Organization of the United Nations, some GM foods have been engineered to become more nutritious in terms of vitamin or mineral content. This not only helps people get the nutrients they need, but also plays a significant role in fighting against malnutrition in third-world countries. In fact, the United Nations recommends that rice that is enhanced with vitamin A can help with reducing deficiencies of such nutrient around the world.

Some criticisms and disadvantages of GM foods:

GM foods fall into three categories:

Environmental hazards, Human health risks, and Economic concerns

ENVIRONMENTAL HAZARDS:

Unintended harm to other organisms: pollen from B.t. corn caused high mortality rates in monarch butterfly caterpillars. Monarch caterpillars consume milkweed plants, not corn, but the fear is that if pollen from B.t. corn is blown by the wind onto milkweed plants in neighbouring fields, the caterpillars could eat the pollen and perish. B.t. toxins kill many species of insect larvae. Reduced effectiveness of pesticides just as some populations of mosquitoes developed resistance to the now-banned pesticide DDT; many people are concerned that insects will become resistant to B.t. or other crops that have been genetically modified to produce their own pesticides. Gene transfer to non-target species is another concern that crop plants engineered for herbicide tolerance and weeds will cross-breed, resulting in the transfer of the herbicide resistance genes from the crops into the weeds. These "superweeds" would then be herbicide tolerant as well.

HUMAN HEALTH RISKS:

Allergenicity Many children in the US and Europe have developed life-threatening allergies to peanuts and other foods. There is a possibility that introducing a gene into a plant may create a new allergen or cause an allergic reaction in susceptible individuals. A proposal to incorporate a gene from Brazil nuts into soybeans was abandoned because of the fear of causing unexpected allergic reactions. Unknown effects on human health: A recent article published in Lancet examined the effects of GM potatoes on the digestive tract in rats. Moreover, the gene introduced into the potatoes was a snowdrop flower lectin, a substance known to be toxic to mammals.

ECONOMIC CONCERNS:

Bringing a GM food to market is a lengthy and costly process. Yet consumer advocates are worried that patenting these new plant varieties will raise the price of seeds so high that small farmers and third world countries will not be able to afford seeds for GM

crops, Patent enforcement may also be difficult, as the contention of the farmers that they involuntarily grew Monsanto-engineered strains. One way to combat possible patent infringement is to introduce a "suicide gene" into GM plants. These plants would be viable for only one growing season and would produce sterile seeds that do not germinate. Farmers would need to buy a fresh supply of seeds each year. However, this would be financially disastrous for farmers.

Decreased Antibiotic Efficacy:

According to the Iowa State University, some genetically modified foods have antibiotic features that are built into them, making them resistant or immune to viruses or diseases or viruses. And when we eat them, these antibiotic markers will persist in the body and will render actual antibiotic medications less effective.

Unusual Taste

Genetically modified foods are observed to have unnatural tastes compared with the ordinary foods that are sold on the market. This could be the result of the substances that were added to their composition.

Not Totally Safe to Eat:

It is proven by scientific studies that GMO foods contain substances that may cause diseases and even death to several kinds of species in this world, including us humans. For instance, mice and butterflies cannot survive with these foods.

New Diseases:

Genetically modified foods can create new diseases. Considering that they are modified using viruses and bacteria, there is a fear that this will certainly happen. This threat to human health is a worrisome aspect that has received a great deal of debate.

Food Supply at Risk:

GMO seeds are patented products and, in order to purchase them, customers have to sign certain agreements for use with the supplier or creator. As the reliance on these seeds expands around the world, concerns about food supply and safety also continue to arise. Furthermore, these seeds structurally identical, and if a problem affects one of them, a major crop failure can occur.

APPLICATION OF TRANSGENIC PLANTS IN HUMAN NUTRITION:

Genetically modified foods are classified into three categories according to their usage and legal regulations.

1. Food is genetically modified (potato, tomato, soya, maize, sunflowers, rice, pumpkins, melons, rape, etc.)
2. Food contains components of genetically modified plants (starch, oil, sugar, aminoacids, vitamins, etc.)
3. Food contains genetically modified organisms (yoghurt contains transgenic microorganisms).

Gene technology enables higher yields in plants, resistance to pests and frost, as well as mechanical properties of fruits, etc. We can also modify physical and chemical

composition in order to improve nutritional and physiological value of foods. Transgenic plants also enable production of healthier food (more unsaturated fatty acids, transfer of proteins from legumes into wheat, increased content of essential amino acids, transfer of proteins from sunflowers into maize, etc.). Thus, dangers of heart diseases, allergies are diminished and malignancy prevented.

LOWERING CANCER INCIDENCES:

Mycotoxins are both toxic and carcinogenic to humans and animals and are considerably more concerning in developing economy food systems where access to food safety toxicity tests is less prevalent. Fumonisins are correlated to being the cause of higher rates of neural tube defects in high maize-based diets.With food security challenges existing in many developing countries, corn containing mycotoxins are consumed as part of the household diet due to the lack of any other option.

NUTRITIONAL BENEFITS:

Genetically modified crops have made significant contributions to address the United Nations Sustainable Development Goals, in particular goals 1 (reducing poverty) and 2 (reducing hunger). While increased yields have contributed to higher household incomes, which reduce poverty, the increased yields have also enhanced household food security. Biofortified GM crops have been adopted, increasing micronutrient availability. Nutritionally enhanced foods improve an individual's nutrient intake, preventing and/or treating leading causes of death such as cancer, diabetes, cardiovascular disease and hypertension. Improving the nutritional content of daily food consumption certainly has day-to-day effects, but of significant importance are the long-term effects that extend for decades over the course of an individual's lifetime. In many instances, improving macronutrients (proteins, carbohydrates, lipids, fibre) and micronutrients (vitamins, minerals, functional metabolites) has significant childhood health improvements, such as reducing blindness due to the lack of vitamin availability. Improved food nutrient content, especially the increase in mineral availability, contributes to improved immunity systems and reduces stunting.

In many developing countries, plant-based nutrient intake accounts for one hundred per cent of an individual's nutrient diet, further highlighting the importance of nutritionally enhanced crop-derived foods. As the later in life benefits from improved childhood nutrition are better understood, the full value of nutritionally enhanced GM crops and foods may not be realized for several decades.

GMO Vitamins and Crop Biofortification

Genetically modified microorganisms are used to create some of our most essential vitamins. Examples of vitamins created through genetic modification are vitamin A, vitamin B-2, vitamin B-12 (riboflavin), vitamin C (ascorbic acid), and vitamin D.

There are several ways that genetically modified microorganisms are used to create vitamins, including utilizing a natural bacteria (*Bacillus subtilis*), while others are derived from GM crops, such as corn, soy, and sugar beets. GMO vitamins can be found in supplements and in food.

Biofortification is the process by which the nutritional quality of staple food crops is improved through genetic engineering. These crops could help to solve important global health challenges in developing countries. While no biofortified crops are available to the public yet, current public-private research involving biofortification include:

- Iron-biofortification of rice, beans, sweet potato, cassava and legumes;
- Zinc-biofortification of wheat, rice, beans, sweet potato and maize;
- Provitamin A carotenoid-biofortification of bananas, sweet potato, maize and cassava; and
- Amino acid and protein-biofortification of sorghum and cassava.

FOOD APPLICATIONS FOR GM PLANTS:

In the developing world, 840 million people are chronically undernourished, surviving on fewer than 8000 kJ/day (2000 Kcal/day). Approximately 1.3 billion people are living on less than US$1/day and do not have secure access to food. Many of these are also rural farmers in developing countries, depending entirely on small-scale agriculture for their own subsistence and to make their living.

They generally cannot afford to irrigate their crops or purchase herbicides or pesticides, leading to a vicious circle of poor crop growth, falling yields and pest susceptibility. In addition, theworld's population is predicted to double over the next 40 years, with over 95% of individuals being born in developing countries. It is estimated that to meet these increased demands, food production must increase by at least 40% in the face of decreasing fertile lands and water resources. GM plant technologies are one of a number of different approaches that are being developed to combat these problems. Specifically, studies are under way to genetically modify plants to increase crop yields, or to directly improve nutritional content.

Benefits of GMOs	Risks of GMOs
Nutritional value of foods could be improved (e.g. by introducing proteins, vitamins or vaccines)	New traits could cause adverse health reactions (e.g. new proteins may cause allergic responses)
Crops can be produced that lack known allergens	Removal of traits could have unknown effects
Crops can grow in arid conditions for better yield (e.g. by introducing drought resistant genes)	Crops may limit biodiversity of local environment (increased competition with native species)
GM crops can produce herbicides to kill pests	Cross pollination could lead to 'super weeds'
Improve food supply / agriculture in poor countries (GM crops can be engineered for improved yields)	Patents restrict farmers from accessing GM seeds (biotech companies hold monopolies over crop use)
GM crops may have longer shelf lives (less spoil)	Foods with GM components may not be labeled
Reduces economic costs and carbon footprint – less need for land clearing and pesticide usage	Different governments may have conflicting regulatory standards concerning safe usage

GM crops can mitigate several current challenges in commercial agriculture. Current market trends project them as one of the fastest growing and innovative global industries, which not only benefit growers but also consumers and major country

economies. However, it is imperative that the agricultural industry and science community invest in better science communication and regulation to tackle unethical research and misinformation. Imperfections and major GM technology can also be combated by stricter regulation, monitoring and implementation by government agriculture bodies, a globally improved risk mitigation strategy and communication with growers, therefore ensuring greater acceptance. With key innovation in precision gene integration technologies and emerging research in biofortification and stress tolerance, GM crops are forecast to bring productivity and profitability in commercial agriculture for smoother progress in the future.