**GENETICALLY MODIFIED CROPS**

Pratyush Priyadarshan Pradhan, Rupesh Kar, Priyanshu Prasad Nath, Abhijit Anant Dehury, Goutam Nag, Avni Naik, Manash Ranjan Das, Abhilash Nayak, Barsa Rani Sahu, Ankita Ashok Kumar Nayak, Himansu Sekhar Nayak, Suprita Mohanty, Sushree Subarna Nayak

**Corresponding author:** [pratyush2002pradhan@gmail.com](mailto:pratyush2002pradhan@gmail.com)

C.V. Raman Global University, Mahura, Janla, Odisha-752054

**Abstract:**

Despite there being more people in the world, there is actually less land available for farming. As worldwide rivalry and globalization increase, as do consumer demands for enhanced food quality, safety, health enhancement, and convenience, food and agricultural systems must adapt to a number of new circumstances. The application of rDNA technology and genetic engineering in modern biotechnology has emerged as a potent tool for enhancing both the amount and quality of available food. Globally accessible with the potential to increase crop yields, reduce the use of harmful pesticides and other chemicals, alter the plants' natural characteristics, boost their nutritional content, and lengthen their storage life. There are worries that they could have a negative effect on people's health, the environment, and species diversity.

**Keywords:** genetic engineering, shelf life, anti-sense, manipulation, Bacillus thuringiensis (Bt)

**Introduction:**

Modern biotechnology has resulted in genetically modified crops (GMCs), sometimes known as genetically engineered crops, in which plant DNA has been modified to include desirable characteristics. Since their widespread introduction to the market in the mid-1990s, GMCs have been the subject of heated discussion. The advantages, disadvantages, and future ramifications of genetically modified crops are discussed in detail.

The practice of genetic engineering or modification has provided numerous advantages:

Mass manufacture of human insulin, vaccines, growth hormones, and other medications based on GM technology has considerably increased their accessibility and availability.

• The use of animal-based rennet in cheese production has been largely phased out in favor of chymosin, an enzyme created by genetically modified microbes, in 80-90% of the world.

History:

Around 10,000 years ago, people started employing selective breeding to create domesticated animals. Plant hybridization was first practiced in the 1700s by farmers and scientists. In order to breed plants with desirable characteristics, scientists in the 1980s developed more accurate and controllable methods of genetic engineering. In 1982, scientists created the first genetically modified crop plant: a strain of tobacco that could withstand antibiotics.

Antibiotic-resistant tobacco was the first GM crop to be developed back in 1982.

Herbicide-resistant tobacco plants were first tested in the wild in 1986, with the first field trials taking place in France and the United States.

The FlavrSavr tomato was the first GMO crop to be commercially released in the United States.

Tobacco that had been genetically modified to be resistant to the pesticide bromoxynil was the first GM crop sold commercially in Europe.

Bt maize (Ciba-Geigy), bromoxynil-resistant cotton (Calgene), Bt cotton (Monsanto), glyphosate-resistant soybeans (Monsanto), virus-resistant squash (Asgrow), and further delayed ripening tomatoes (DNAP, Zeneca/Peto, and Monsanto) were all given the green light in 1995.

Golden rice, which is higher in vitamin A, was created in the year 2000.

Genetically Modified Crops and Their Scientific Foundations.

Instead of using controlled pollination to get the desired results, GM technology resorts to direct manipulation of DNA. Crop improvement strategies, including genetic manipulation, often include either adding desirable genes or eliminating unwanted genes in order to create superior kinds. Selecting and crossing superior varieties through artificial pollination is a staple of conventional crop improvement.

Location and Manufacturing:

In 2013, 27 countries cultivated genetically modified (GM) crops, 19 of which were developing nations. Around 90% of the 18 million farmers who cultivated GM crops were subsistence farmers in poor nations. Global GM crop cultivation expanded from 17,000 km2 (4.2 million acres) in 1996 to 1,797,000 km2 (444 million acres) in 2015, an increase of a hundredfold. In 2010, ten percent of the world's farmland was used to grow genetically modified crops. By 2014, genetically modified soy, cotton, and corn accounted for 94%, 96%, and 93% of total US sowing area, respectively. 28 countries cultivated 181.5 million acres of genetically modified crops in 2014. It is projected that these crops have a global market value of $15.7 billion.

creating genetically modified crops:

The first step in creating genetically modified crops is extracting the gene of interest from the host organism. The gene is introduced into the crop plant's DNA using either a gene gun or an agrobacterium in a controlled laboratory setting. The effectiveness of the genetically modified crop is evaluated in both lab and field settings.

Methods:

"Shoot" (direct high-energy particles or radiations) target genes into plant cells using gene guns (Biolistics). It's the standard approach. High-pressure shots of DNA-coated gold or tungsten particles are fired into plant tissue or individual cells. The sped-up particles can get through the cell membranes and the cell walls. After detaching from the metal, the DNA enters the plant's nucleus and fuses with its own DNA. Many cultivated crops, especially monocots like wheat or maize, for which Agrobacterium tumefaciens transformation has been less successful, have benefited from this technique. The main drawback is that it can cause severe damage to biological tissue.

• Agrobacterium-mediated transformation: the bacterium Agrobacterium tumefaciens transfers a piece of its DNA (T-DNA) to plant cells in a natural process, leading to tumorous growths in the plants. In order to transfer genes from Agrobacterium into plant cells, scientists harness this natural process to insert genes into Agrobacterium's T-DNA. For dicot plants, this technique is standard practice.

• Gene editing methods: cutting-edge gene editing tools like CRISPR-Cas9 enable targeted alterations to a plant's DNA. In order to inhibit or replace certain genes, CRISPR-Cas9 can be used. Compared to older methods of genetic manipulation, this one allows for pinpoint precision and specificity.

• RNA interference (RNAi): RNAi is a technique in which particular genes can be silenced or regulated by employing tiny RNA molecules. Scientists can manipulate the expression of specific genes in plants, leading to the development of desirable features or resistance to pests and diseases, by introducing specific RNA molecules.

Some viruses can be engineered to transport specific genes into plant cells, a process known as virus-mediated gene transfer. The plant is infected with the virus, which inserts the desired genes into the plant's DNA. Some virus-resistant crops were developed using this technique.

In order to determine whether plants have been successfully transformed, researchers frequently insert "marker genes" alongside the target genes. Some antibiotics and pesticides can be bypassed thanks to these indicators. Only the successfully altered plants will be able to withstand the effects of the antibiotic or herbicide.

Developments in Transgenic Plants:

The necessity to combat issues like rising population, unpredictable weather, and pests and diseases in farming inspired the creation of GMCs. Through the use of genetic engineering, scientists are able to give crops desirable traits like resistance to pests, enhanced nutritional value, and the ability to withstand environmental challenges like drought and high temperatures. Therefore, genetically modified crops (GMCs) have shown superior yields and nutritional characteristics compared to conventional crops in various situations.

Regulatory Agencies for Genetically Modified Crops:

The Recombinant DNA Advisory Committee (RDAC) keeps tabs on the state of biotechnology on a global scale.

The Institutional Biosafety Committee (IBSC) gives the green light to low-risk experiments and oversees compliance with safety regulations. It is the responsibility of the Review Committee on Genetic Manipulation (RCGM) to approve potentially dangerous experiments.

The RCGM, or Review Committee on Genetic Manipulation, evaluates all active studies that pose a significant risk to the general public and all controlled field experiments. grants permission to collect data on genetically modified plants.

Large-scale research and production utilizing GMOs require approval from the Genetic Engineering Appraisal Committee (GEAC).

The State Biotechnology Coordination Committee (SBCC) examines the precautions taken to ensure the security of GMOs by various organizations. Responsible for coordinating response efforts in the event of a GMO release and determining the extent of damage.

The SBCC or GEAC receives information on compliance or non-compliance with regulatory requirements from the DLC, which conducts inspections and investigations. Responsible for coordinating response efforts in the event of a GMO release and determining the extent of any resulting damage at the District level.

GMO Crops Have Their Advantages

Greater pest and disease resistance in GMCs typically results with higher agricultural yields. The increased output from farming helps alleviate food shortages and satisfy the expanding worldwide need for nourishment.

Crops can be fortified with beneficial substances like vitamins and minerals thanks to genetic engineering. Malnutrition and nutritional inadequacies are something that this biofortification can help with.

Because GMCs may need less chemical pesticides and herbicides thanks to the incorporation of characteristics that guard against pests and diseases, their environmental impact may be lessened.

Genetically modified crops with enhanced drought and heat tolerance may help maintain consistent food supply in the face of increasingly harsh weather brought on by climate change.

Genetically modified crops have been the subject of heated debate.

• Health and safety issues One of the most common complaints about GMCs is that they may have negative effects on people. Even while regulatory agencies have undertaken rigorous safety analyses, some people still worry that eating genetically modified foods could cause health problems down the road.

• Risks to the Environment: Critics are worried about the ecological fallout that could result from introducing GMOs. Hybridization between genetically modified (GM) crops and their wild relatives has the potential to reduce plant diversity.

Patenting GMO crops and the consolidation of seed firms raise serious concerns about intellectual property and corporate control. This can lead to monopolization of the seed market by a small number of corporations, making farmers dependent on annual seed purchases.

Because of the complicated connections between genes in a genome, there is a chance that genetic change will have unintended repercussions that won't be immediately obvious.

GMOs and the Future of Food Production:

The controversy surrounding GMCs is not going away anytime soon. Biotechnology has progressed to the point that gene editing tools like CRISPR can be used to precisely alter plant genomes. Striking a balance between the benefits and threats to human health, the environment, and society at large will be crucial as the technology develops.

Priorities in agriculture development should inform the direction of genetic engineering research.

Enhancing Capabilities in Genetically Modified Research, Development, and Regulation

Educating the public about genetically modified crops and foods by using scientific evidence

• Regulations based on sound science and applied consistently

• Streamlined modules for risk analysis and administration

Conclusion:

There are several hopeful answers to the world's food problems that have been made possible by genetically modified crops, which have changed modern agriculture. But the ongoing discussion over their safety, environmental impact, and potential economic ramifications calls for cautious assessment and well-considered choices. To fully utilize the promise of genetically modified crops for sustainable and fair agricultural growth, it is crucial to strike the correct balance between advancements and potential hazards. If agriculture and food security are to thrive into the future, society as a whole will need to chart a course for making the most of this potent tool as science and technology advance. Compared to agronomic crops, horticulture crops have seen much less commercial use of genetically modified technology. Since most efforts and resources have been put into goods with market value, this is to be expected. However, many of the most exciting uses for consumer and quality attributes will be in horticulture crops (Clark et al., 2004).

**DECLARATIONS:**

**Author contribution statement:**

All the authors listed have significantly contributed to the development and the writing of this article.

**Data Availability Statement:**

No data was used for the research described in the article.

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