



## Awareness on Genetically Modified Crops: A Case Study on GM crops in Kerala with Special Reference to BT Crops

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### ABSTRACT

**Purpose:** *The knowledge level, biosafety and even the awareness about genetically modified products available in the market are analysed in this case study. Most existing GM crops are developed with high yield capacity, which may help the common people. The perspective of common people on GM crops are different due to the lack of proper information about it. Lots of myths are shared among the population about the GM crops, which must be verified and cleared before the proper distribution in the market and make it available for the public. The primary goals of this study were to determine the level of understanding and view point on GM crops across different age groups and specialists, as well as to influence societal attitude towards new agricultural innovations.*

**Design/Methodology/Approach:** *The study was done by using a survey using questionnaires prepared to analyse the awareness level among common people. Both online and offline mode of survey was effectively utilized in this study. The responses for each question in the questionnaire was later analysed.*

**Findings/Result:** *It was observed to have more awareness about GM crops in age groups between 20-25 when compared to others. Despite the increasing use of GM crops over the last few decades, the majority of the general public is still unaware of it. And a few percentages of people still believe that GM crops have health effect even if it is clinically unproven yet. Those who have never heard of GM crops want to try growing and consuming them.*

**Originality/Value:** *This study gives us an outline about different perspectives on GM crops, with special reference to Bt crops, in the society based on the responses to the survey.*

**Keywords:** *Genetic Engineering, Bt crop, Awareness, GM crops, Bacillus thuringiensis.*

### 1. INTRODUCTION

For long years, human have used conventional ways of change plants and animals, such as selective breeding and cross breeding. Earlier, farmers developed many methods to grow corn with different color and size, but traditional methods might take a long time and it was difficult to make a specific or drastic change. After the advancement of Genetic engineering in 1970s, scientists were able to make wide range of changes to both plants and animals in much shorter period of time [1].

Genetically modified products that are manufactured artificially by introducing genetic material from an organism, e.g.: through the insertion of a gene from a different organism. This technology is often known as genetic engineering or recombinant DNA technology and the resultant product may knowns as Genetically modified or genetically engineered products or they may consider as transgenic products [2].

The first successfully produced and tested genetically modified plant was considered as a herbicide resistant tobacco plant in 1986 by France and the USA. It was first produced the first commercially farmed genetically modified entire food crop by a Californian Company, Calgene and it was a tomato which was genetically engineered to have a shorten ripening and softening when compared to wild type. It was then named as FlavrSavr tomato and Calgene was able to obtain the Food and Drug Administration (FDA) approval for its introduction to the market in 1994 [3].

According to a study done by ISAAA, about 26 countries are successfully growing GM crops and among them 19 countries were developing and others were industrial countries. We are growing mainly 5 different GM Crops World Wide and they are Herbicide and insect resistant corn, cotton, soybean, sugar beet and canola. In a recent study, India represented almost 6% of World total area growing GM crops [4].

## A TIMELINE OF GENETIC MODIFICATION IN MODERN AGRICULTURE

For thousands of years, people have worked to improve crops, livestock, and the foods we eat. In the 20th century, scientists found a way to modify food faster and more precisely by changing an organism's DNA. This process, called genetic engineering, produces genetically modified organisms (GMOs). This timeline highlights key dates in the development of GMO foods.

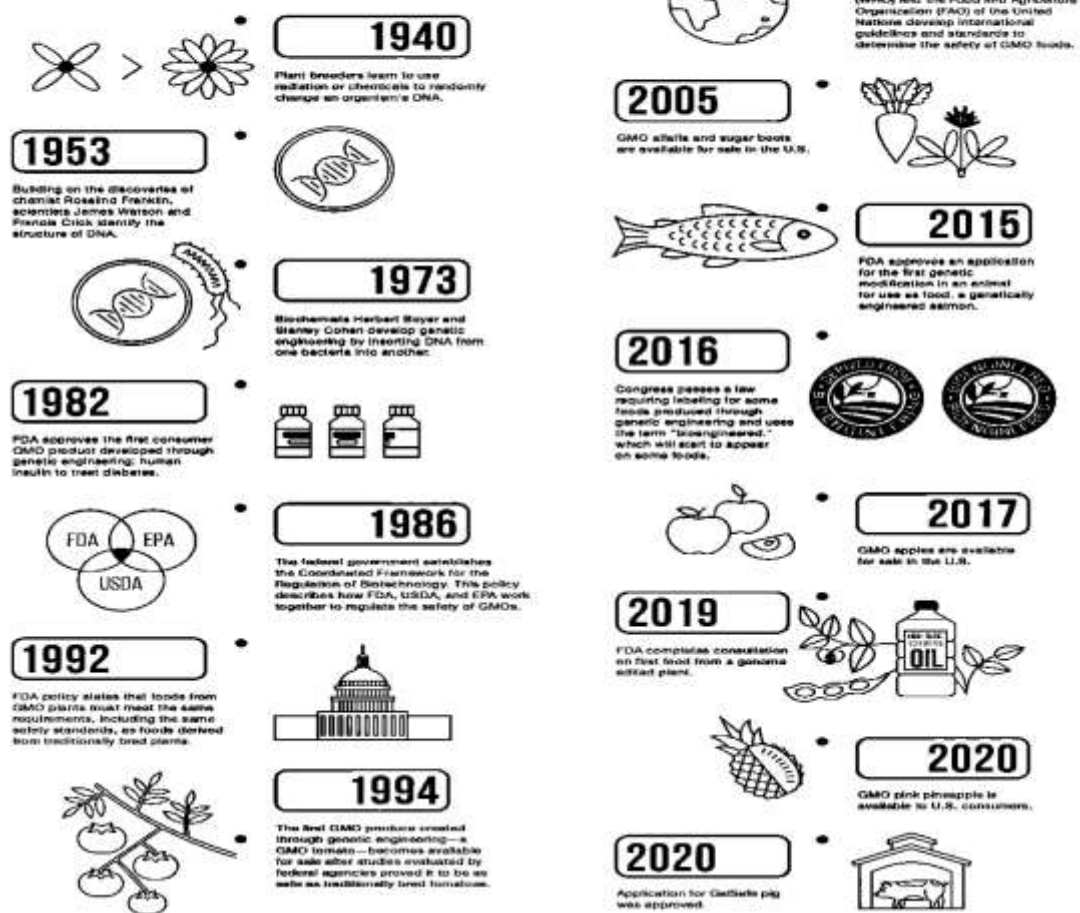


Fig. 1: A timeline of genetic modification in modern agriculture [1]

GM crops are produced by:

- Identification and location of the gene of interest
- Designing gene of interest for the insertion to a suitable vector
- Insertion of gene of interest to vector and transformation to host
- Screening for the selection of successful transforms
- Multiplication of transformed host in controlled environment.

As the global population is increasing day by day, food remains the scariest resource. GM crops are much essential in this condition, as they are having a better yield, high nutritional value and lot more features like: resistance to insects, virus, herbicides, pest and diseases, tolerance to harsh soil conditions like drought, acidity, alkalinity and salt, reduced environmental impacts [5].

Bt crops:

Bt crops are genetically modified or engineered to contain the endospore or crystal of Bt toxin, which make it resistant to insect pests. The first Bt crop was successfully produced by Plant Genetic System, a company in Belgium and the plant produced was Bt tobacco in 1985. The approval for production and distribution of Bt crops like tobacco, Potato, cotton, and corn was given by Protection agency (EPA) in the USA [6].

The mode of action of Bt spores is that it has to be ingested by the organism to cause its death. The Cry toxin become active in the presence of proteolytic enzymes in the alkaline gut juice of insect. The activated toxin then passes through the peritrophic membrane and binds to apical microvillar brush border membrane receptor of midgut epithelial cells. This creates pores through which the toxins penetrate to the cells and become swollen which leads to the

cellular lysis. The alkaline gut juice thus leaks and enters to the hemocoel causes the rise in pH of hemolymph and leads to paralysis and death of the insect [7].

## 2. OBJECTIVES OF THE CASE STUDY

- To analyze the level of knowledge about GM crops in the society.
- To understand the key issue of society on acceptance of GM crops.
- To study the acceptance of a new product in the public.
- To analyze the market value of Bt crops.
- To compare the level of knowledge among different age groups

## 3. RELATED WORKS

It has been many years farmers are trying to modify the agriculture sector for a better income and yield. With the help of scientist, they could reach their goal using genetic engineering as the key tool. Even if we are currently producing much better crops than before, scientists are still trying hard to make modifications in crops. As a part of it we are having variety of crops in the market with desired traits. Bt crops are widely accepted crops because of its resistance to a variety of insects, which are the main enemy to the farmers.

**Table 1:** Review on GM crop and Bt crops

Sl. No.	Work	Focus	Reference
1	Awareness on GM proliferation in Saudi Arabia: A case study of Makkah city	GM Food domination in Saudi Market	Shori Amal Baker et al. (2013) [8]
2	Consumers awareness towards genetically modifies (GM) food	Awareness on GM food in Klang Valley	Erni Tanius et al. (2015) [9]
3	Genetically engineered (modified) crops (Bacillus turingiensis crop) and the world controversy on their safety	Controversy on the use of GM crops	Abbas M.S.T (2018) [10]
4	Genetically modified crops in India: Experiments with Bt cotton to explore the road ahead	Study on conventional and modified cotton	Amanpreet Kaur (2020) [11]
5	On risk and regulation: Bt crops in India	Possible risk and regulations on GM crops	Herring R.J (2014) [12]
6	Assessment of knowledge and attitude on Genetically modified food among students studying Life Science	Awareness on GM crops among life science students using survey method	Rathod. D et al. (2022) [13]
7	An analysis of the GM crop debate in India	Acceptance of GM crops in India	Egorova et al. (2015) [14]
8	The impact of genetically modified crops in modern agriculture: A review	GM crops in modern agriculture	Raman R. (2017) [15]
9	Are Bt crops safe?	Study on safety of Bt crops	Mendelsohn, M. et al. (2003) [16]
10	The food and environmental safety of Bt crops	Food safety	Michael S koch et al. (2015) [17]
11	The impact of Bt crops in the developing world	Growth percentage on Bt crops in developing countries	Huesing et al. (2004) [18]

## 4. METHODOLOGY

This study was conducted among 100 selected common people in Kerala, which includes students of various backgrounds, working people, home makers etc. The main aim of the study was to analyze the level of understanding about GM and Bt crops in different age groups and different background people. The study was done in an online mode by sharing the questionnaire to the selected candidates. The survey report is then analyzed.

### 4.1 Preparation of Questionnaire for the Survey

The questionnaire was prepared as 3 sessions and a total of 27 questions were added in it. In the first session candidates were provided with an introduction of the survey and they were asked to enter the contact information. In the second session, personal information of the candidate is collected which includes their age, gender, qualification, working status etc. in the third session, candidates were provided with 19 questions about GM and Bt crops to know the level of understanding and attitude towards it.

#### 4.2 Selection of candidates

The candidates were selected according to three criteria, they are age, qualification and working status. The candidates in age between 15-25 is selected more because they are considered as the future generation to establish more GM and Bt crops in to the world.

**Table 2:** Age of the candidates

Sl. No.	Age limit	n (%)
1	15-20	25%
2	20-25	40%
3	25-30	15%
4	30-35	10%
5	35-40	10%

The candidates with a post-graduation are more considered as they are the sources of further development in the field of agricultural biotechnology. The study is more concentrating on the upcoming generation to grow the Genetic engineering to the next level for the betterment of society but the understanding about GM and Bt crops among past generation should also be analyzed, so that the candidates with an age above 30 and less qualification is also considered in the study. People with least qualification and not a working person is also found to be aware of GM crops so far.

**Table 3:** Qualification of the Candidates

Sl. No.	Qualification	n (%)
1	Above PG	20%
2	Post-graduation	40%
3	Graduation	30%
4	Below Graduation	10%

**Table 4:** Working status of the candidates

Sl. No.	Working status	n (%)
1	Employee	30%
2	Unemployed	20%
3	Student	50%

#### 4.3 Collection of data

The questionnaire was designed in google forms and it was shared to selected candidates in online mode. Both WhatsApp and Email were used as a medium for the successful sharing. The confidentiality of candidate's personal information was strictly maintained throughout the study.

#### 4.4 Analysis of data

The responses were recorded in the mail and it was statistically analyzed.

## 5. ANALYSIS OF RESPONSES

### 5.1 Analysis of response to optional questions

A total of 100 candidates were participated in the survey and all of them responded to all the questions without skipping. The response was recorded and analyzed to create table for better and easy understanding.

**Table 5:** Analysis of Response to Optional questions

Question	Yes n (%)	No n (%)	Neutral n (%)
Have you heard of GM products, especially crops?	74	26	
Do you have any idea about Bt crops like Bt brinjal, Bt cotton, Bt maize etc.?	76	24	
Have you ever used any GM crops/ products?	44	32	24
Do you feel any difference in GM crop used from regular crop?	53	47	
If you have not used any GM crops yet, do you like to try any of them?	72	28	
Do you believe GM crops will cause health issues like allergies?	32	68	
Do you think the production cost of GM crop will be lesser than regular crops?	29	31	40
Do you like to grow GM crops your own?	79	21	
Have you ever cultivated any GM crops	12	70	18
Will you encourage others in cultivating and using GM crops?	61	26	13
Do you agree GM crops will reduce poverty in our country?	53	15	42
Do you believe GM crop can be a solution for malnutrition?	67	13	30
Do you think the future generation will choose GM crop over traditional crops?	58	12	40
Do you think an awareness about GM crop among common people is necessary?	70	12	18

### 5.2 Analysis of response to descriptive questions

Question: If you like to develop a new GM crop, what it will be?

Lots of candidates have respond to create new GM crop with variety of traits and most common response are Crop with high nutrition value, disease curing factors, high disease resistance, factors for improving immune system, accelerate metabolism, less harvesting period, anti-cancer property and even tear less onions and fluorescent fruits.

Question: Now we have different GM crops with advanced specifications like high yield, disease resistance, high nutrition value, long shelf life etc. what will be the next trait you would like to develop and in which crop?

Most of the candidates respond to have new fruits varieties with wide range of features. A large number of responders are interested to create more tasty fruits which are easy to eat. The strangest responses were development of seedless mangoes and rambutan, colorful grapes. It was found to have more serious responses from candidates with higher qualifications like crops resistant to environmental issue, crops which produce the drugs to treat diseases and deficiencies, crops with infant nutrition etc.

Question: If you completely support GM crops then mention the reasons?

The most commonly found reasons were: high yield, disease resistance, high nutritional value, eradicate poverty, support farmers, long shelf life, economic stability, improve the market supplies, high profit, less expensive cultivation etc.

Question: If you are completely against GM crops then mention the reasons?

It was found to have a very few candidates to be against GM crops. Almost 80% of the candidates were completely supporting GM crops. The rest of them were worried about the cost of seeds, chance of having health issues, ethical matters, trigger allergic reaction and even thinks to have a gene alteration in us.

## 6. CONCLUSION

Based on the survey conducted among selected candidates with different parameters, we have reached the following conclusions:

- Majority of society supports GM and Bt crops.
- People very rarely oppose the introduction of a new product in the market.
- Teenagers have more better understanding about GM and Bt crops when compared to those who are 30+.
- More farmers have started using modified seeds for better result.
- The minority people in the society who completely oppose GM or Bt crops should have an awareness session because they are lacking enough knowledge about its advantages.
- Farmers must get enough supplies of seeds and seedling with proper subsidy from Government to Government approved agencies.
- People should have proper communication option to clear their doubts of having risk in using modified crops.

- Students must be properly informed about both the risks and benefits about modified crops so that they can be a source to common people for better understanding.
- Unqualified and un employed people should also have enough resources to know about the current development in at least their nation.
- Seeds should be made available for those who want to experience the change in modified crops and traditional crops.
- The myths about GM and Bt crops should be made clear to make more people trust in the global development.
- Any demerits in modification should be cleared before it is commercialized.

## 7. REFERENCE

- [1] U.S Food and Drug Administration. (2022). "Science and history of GMOs and other food modification processes", *FDA Agriculture Biotechnology*, 1-3.[Google Scholar](#)<sup>↗</sup>
- [2] World Health Organisation. "Health topics- Food, Genetically Modified", *WHO Official website*. Tab 1.[Google Scholar](#)<sup>↗</sup>
- [3] Belinda Martineau (2001), "First fruit: the creation of the FlavrSavr tomato and the birth of biotech foods", *New York: McGraw-Hill*, 10 (6-7), 245-258.[Google Scholar](#)<sup>↗</sup>
- [4] Clive James (2016), "Global status of commercialized Biotech/GM crops", *The International service for the acquisition of Agri-Biotech Applications (ISAAA)*, Brief No: 52.[Google Scholar](#)<sup>↗</sup>
- [5] S. Jhansi Rani & R. Usha (2013), "Transgenic plants: types, benefits, public concerns and future" *Journal for Pharmacy Research*, 6 (8), 879-883.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [6] Vaeck, M., Reynaerts, A., Hofte, H. et al. (1987), "Transgenic plants protection from insect attack", *Nature* 328, 33-37.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [7] Soberon M, Pardo L, Monoz C, Sanchez J, Gomez I, Porta H (2010), "Pore formation by Cry toxins", *Landes Bioscience and Springer science, New York*, 127-142.[Google Scholar](#)<sup>↗</sup>
- [8] Shori Amal Bakr & Olorogun Lukman Ayinde (2013), "Awareness of GM food proliferation in Saudi Arabia: A case study on Makkah City". *Journal of association of Arab Universities for basic and applied sciences*, 13(1), 8-13.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [9] Erni Tanius & Sam Wae Seng (2015), "Consumers awareness towards genetically modified (GM) food", *International Journal of Business, Economics and Law*, 6 (2), 17-21.[Google Scholar](#)<sup>↗</sup>
- [10] Abbas M.S.T (2018), "Genetically engineered (modified) crop (Bacillus turingiensis crop) and the world controversy on their safety", *Egyptian Journal of Biological pest control* , 28, 52-58. [Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [11] Amanpreet Kaur (2020), "Geetically modified crops in India: Experiments with Bt cotton to explore the road ahead", *Open Agriculture*, 5(1), 386-394.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [12] Herring R.J (20014), "On risk and regulation: Bt crops in India", *GM crops & foods*, 5 (3), 204-209.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [13] Rathod .D & Hedao R.P (2022), "Assessment of knowledge and attitude on Genetically Modified food among students studying life", *Cureus*, 14(12), e 32744. [Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [14] Egorova, Yulia & Raina, Rajeswari & Mantuong, K. (2015). "An analysis of GM crop debate in India", *Government Agricultural Sustainability: Global lessons from GM crops*, 105-135.[Google Scholar](#)<sup>↗</sup>
- [15] Raman R. (2015)," The impact of genetically modified crops in modern agriculture: A review", *GM crops & foods* , 8 (4), 195-208.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [16] Mendelsohn, M., Kough, J., Vaituzis, Z. et al. (2003), "Are Bt crops safe?", *Nature Biotechnology*, 21, 1003-1009.[Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [17] Michael S Koch. et al. (2015), "The food and environmental safety of Bt crops", *Frontiers in Plant science* , 6. [Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>
- [18] Huesing et al. (2004), "The impact of Bt crops in developing world", *AgBio forum*, 7, 1-3. [Google Scholar](#)<sup>↗</sup> [Cross reference/DOI](#)<sup>↗</sup>