GENETICALLY MODIFIED CROPS AND ITS IMPACT ON ENVIRONMENT

Abstract

Genetically modified crops(GM crops) are the crops whose DNA have been modified. This modification is mainly to make the crop resistant to insecticides, herbicides or other such conditions. This is done by the technique of Genetic Engineering where the desired part of DNA is altered. Sometimes a piece of extra specific DNA can be added to the original one. This causes the desired gene to express the desired character and the plant become fit to survive or give the desired result as well. Plants that have been genetically engineered to possess certain desirable traits can strengthen resistance to pests, diseases or herbicides, improve nutritional content, and enhance ability to withstand harsh environmental conditions such as drought or salinity. But despite of all these characters there may be some negative impact also. Thus various researches are being conducted to ensure that the negative impact on environment should be reduced. They have found that Genetically Modified Crops are instead making the environment more healthy as it reduces many activities such as use of dangerous insecticides and herbicides. This can sometime leads to harm non - targeted species but it is negligible. The technique has also made large reductions in fuel use and tillage adjustments possible, which has significantly decreased the discharge of greenhouse gas emissions from the region where GM crops are grown. This article is a modest effort to understand GMO and its impact on the environment better.

Keywords: GM crops, GE crops ,GMO, Genetic engineering, Conventional Tillage (CT), GM IR crops, GM HT crops, Bt. Crops

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I. INTRODUCTION

With the growing demand for food supply and consumption, development in agriculture is also taking place simultaneously with the usage of various modern techniques with various objectives and intentions to increase yield, enhancing health aspect of crop, improving food quality and also the economic benefits associated with the farming. Keeping in mind all these objectives and also with the advent of biotechnology, various alterations in the crops are done. One such ambitious achievement is the Genetically Modified Crops. The crops whose genetic structures has been altered or modified for specific purpose are known as Genetically Modified (GM) Crops**.** With the help of Genetic Engineering; scientists are editing the DNA of organisms, transferring specific DNA of one organism to other and modifying the actual genetic construction of the organism (Shetty J Manjunath ,et.al;2018). Now-a-days we are very much familiar with such types of crops or any it's breed. The reason behind their high popularity in the market is primarily due to commercial benefits. We are well versed with the fact that genes are the blueprint of any organism which expresses variety of proteins and helps the organism to perform different functions. But why there is the need of Genetically Modified Organism (GMOs)? Due to the population explosion and reduction in cultivable land, there is a high demand of production. Providing the nutritional requirements , both quantitative as well as qualitative food supply to this huge population is time taking and tough process (Delaney 2005), and there the Genetically Modified Crops emerged as a revolutionary idea (Shetty J Manjunath ,et.al;2018). Sometimes the natural variety or indigenous variety fails to meet the required amount of products due to various factors which may be natural or anthropogenic. But if we can make them resistant to the changes in their environment, they will be able to meet their actual potential or even more. Here in this chapter, we are going to discuss not only about the productivity of genetically modified crops but their interactions and impacts on the environment. Genetically modified crops, also known as genetically modified organisms (GMOs), are plants that have been genetically engineered to possess certain desirable traits. These traits can strengthen a plant's resistance to pests, diseases, or herbicides, improve its nutritional value, or increase its ability to withstand environmental conditions like salinity or drought(Muhammad A. Nawaz et al ;2017). Despite of its exponential uses there is always a question arises whether these plants (GMOs) are beneficial for the environment, or they are affecting the other components of the environment.

II. IMPACTS OF GENETICALLY MODIFIED CROPS ON ENVIRONMENT

The commercial cultivation of genetically modified (GM) crops have been rising concerns worldwide about potential adverse effects on the environment due to the use of these crops(Sanvido et.al ;2007). Thus, before and throughout their commercial cultivation, the dangers of GM crops for the environment, particularly for biodiversity, have been thoroughly studied. The three GM crops now grown for commercial purposes—maize, oilseed rape, and soybean—that may be important for agriculture were the topic of this research. The two primary GM characteristics that are currently being sold commercially are herbicide tolerance (HT) and insect resistance (IR). Moreover, data relating to the interpretation of effects of GM crops on the environment are complex and are controversial(Sanvido et.al;2007). Study on modern techniques of agriculture illustrates the effect of GM crops on the environment.Modified Crops have remined as a topic of controversy also due to their potential impacts. Researchers have studied the effects of

genetically modified organisms, or GMOs, both on and off farms since the first ones were planted for consumer sale in the 1990s (How GMO Crops Impact Our World; FDA USA). Few key points are discussed below;

1. **Reduced Pesticide Use:** The ability to resist pests and diseases in genetically modified crops is leading to a reduction in pesticide use, asa result fewer chemical treatments are required. It can also minimize potential harm to environment and improve environmental health(B. Graham et.al;2018).Some crops such as Bt crops, are engineered to produce a toxin that is toxic to specific pests. Consequently, GMOs may be able to lessen the environmental damage caused by pesticide use; such as the contamination of soil, water, and non-target organisms. A permanent reduction in carbon dioxide emissions has been achieved by the fuel savings from using fewer spray runs on GM IR maize and cotton crops (compared to conventional crops) and the transition from conventional tillage (CT) to reduced tillage or no tillage (RT/NT) farming systems made possible by GM HT crops. A total of 2,456 million kg of carbon dioxide were saved in 2018 as a result of using 920 million fewer liters of gasoline. These savings would be equivalent to remove 1.63 million vehicles from the road for a year. (B. Graham et.al;2018).

2. **Herbicide-Tolerant Crops:** Some genetically modified crops have been engineered to tolerate specific herbicides, allowing them for more effective weed controls. However, using herbicide-tolerant crops can lead to an increased reliance on herbicides, potentially resulting in the evolution of weeds resistant to herbicides (Roger H.,et.al; 2021). This can be detrimental to biodiversity and requires the development of new weed management strategies. Introduction of herbicide-tolerant crops have made it possible to reduce the amount of tillage because they offer better and more adaptable weed management. The introduction of herbicide-tolerant soybean has resulted in significant tillage reductions in both the United States and Argentina. In the US, cotton that is herbicide-tolerant has had similar results. Reduced tillage has several positive effects on the environment, including lowering of soil erosion and runoff, maintaining soil fertility, and fostering in-field biodiversity (Roger H.,et.al;2021).

3. **Gene Flow and Biodiversity:** There has been a matter of concern expressed regarding the possibility of gene transfer from genetically engineered crops to nearby non-GMO wild relatives or crops. This could result in the transfer of transgenes to related species, potentially impacting biodiversity and natural ecosystems. Strategies such as buffer zones and isolation distances can be implemented to minimize gene flow and maintain the genetic integrity of non-GMO crops. Weeds with herbicide-resistant crops may be able to acquire the trait of herbicide tolerance, although this would only be advantageous when the herbicide was present (ICSU, GM Science Review Panel). Transgenic features like pest or disease resistance may give organisms a fitness advantage but there isn't much proof that they have any detrimental effects on environment. (ICSU, GM Science Review Panel). The development of genetics and management techniques to reduce the possibility of gene flow are in process.

4. **Non-Target Organisms:** It has been demonstrated that the GMOs that produce insecticidal proteins, like *Bacillus thuringiensis* (Bt) crops minimize insect pest damage. However, there is a concern that these proteins could also affect non-target organisms, including beneficial insects like bees and butterflies. Extensive testing and regulation are

typically implemented to assess the potential risks to non-target organisms before genetically modified crops are approved for commercial use. To assess the non-target effect on transgenic Bt crops that produce the insecticidal proteins of a common bacteria, Bacillus thuringiensis, significant laboratory and field research has been conducted (Naranjo Steven E.;2014). From meta-analyses of quantitative and qualitative data syntheses obtained and other data compilations ,usually point to the absence of any negative effects of Bt crops on invertebrates(arthropods) that are not their intended targets. The statistics also clearly show that using Bt crops to manage the pest that the Bt proteins are intended to target; causes considerably less harm to non-target animals. There have been some indirect impacts on arthropod natural enemies linked to decreased quantity or quality of Bt target herbivores, but it is unclear what these effects mean (Steven E. Naranjo ;2014).

5. **Biodiversity:** Utilising GM crops can have complicated implications on biodiversity (Peter H. Raven;2010). While the reduction in pesticide use may benefit certain organisms. Because we are completely dependent on biodiversity and economy services now and in the future, protecting them should be a top priority and be taken into account in all human actions. It is important to understand that the ecological issues associated with the growth of GM crops are not fundamentally different from the ecological issues associated with agriculture in general, with the exception that they typically involve less application of chemical supplement and tend to leave the environment in and around where they are grown in better condition than do the conventional ones (Peter H. Raven;2010).

III. CONCLUSION

Crop genetic engineering may result in unintended consequences. There is a need for thorough testing and evaluation to ensure that genetically modified crops do not exert unintended negative impacts on the environment. Long-term research is also essential to assess the sustainability of GMO production and potential ecological impacts. After reviewing the various research works done earlier it can be seen that the environmental benefits of genetically modified crops outweigh any potential drawbacks. It is significant to highlight that depending on the particular crop, trait, and agricultural techniques used, the effects of genetically modified crops on the environment might differ.To ensure safety and minimize potential environmental risks before cultivation regulatory bodies in different countries conduct extensive assessments of genetically modified crops. It focuses on the effects of GM crops on the environment including changes in pesticide use and greenhouse gas emissions since those crops were first widely used for commercial purposes before 22 years. The environmental effect of using herbicides and insecticides on these crops has lessened as a result of the introduction of GM insect resistant and herbicide tolerant varieties. This technology has also made it possible to reduce fuel use and tillage adjustments, which has again significantly decreased the discharge of greenhouse gas from the region where GM crops are grown. In 2018, this was equivalent to removing 15.27 million cars from the roads (B. Graham et.al;2018).

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ABBREVIATIONS

GMO- Genetically Modified Organism
GE crops- Genetically Engineered Crops
GMIR- Genetically Modified Insecticide Resistant
GMHT-Genetically Modified Herbicide Tolerant
Bt- *Bacillus thuringiensis*

