JUST AGRICULTURE
multidisciplinary e-Newsletter

Genetically modified crops (GM crops)

Karishma Behera[1], R. G. Vyshnavi[2], Pushplata Dawar[3]

1- Department of Plant Breeding and Genetics

2- Department of Plant Physiology

3- Department of Entomology

Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur-482004

ARTICLE ID: 37

Abstract

Arable land for the cultivation of crops on the earth's surface is limited but the population is rising day by day. Under such circumstances, in order to fulfill the food requirement of ever growing population, modern biotechnological tool like genetic engineering emerged as a powerful tool which not only enhanced the productivity of the crop globally but also reduced the herbicide and pesticide consumption. Although GM crops have several advantages but in addition to that several risks and controversies are also associated with it. In order to overcome the limitations of GM crops several new strategies are being introduced such as Zinc Finger Nucleases (ZFNs), Transcriptor Activator Like Effector Nucleases (TALENs) and Clustered Regularly Interspaced Palindromic Sequences (CRISPR/Cas) which facilitates modifying the crop genome with unprecedented ease, accuracy and precision.

Introduction

Plant breeding was started with domestication nearly 9,000-10,000 years ago. In 1900s, Mendel's study on trait inheritance in pea came into recognition and it solved the mystery behind linkage, crossing over, pleiotropy of genes. Plant breeding is normally based on combining desirable characters from the parents for getting the new varieties. Several plant breeding techniques such as pure line selection, mass selection, clonal selection, backcross selection, mutation breeding is used for the improvement and development of varieties. Later on, GM technology is evolved in 1990s which provided new opportunities to the researchers for the introduction of new genes from one species into completely different species without much effort and shorter period of time. The use of GM technology in agriculture increased the crop yield, enhanced nutrient composition and food quality, reduced the use of pesticide,

JUST AGRICULTURE
multidisciplinary e-Newsletter

developed resistance against the diseases and pests and ultimately provided the food security to the overgrowing population of the world.

Definition of GM Crops

"GM crops are the crops which are generated through genetic engineering methods involving cloning of genes, splicing of DNA segments and inserting the genes into cells of the crops."

Scenario of GM crops in the world

GM crops are commercially grown in nearly 33 countries. Almost 10% arable land of world is under cultivation of GM crops. USA, India, Brazil, Argentina and Canada are several other countries cultivating GM crops (Kumar *et al.* 2020). The first GM crop was developed in Tobacco for antibiotic resistance in 1982. Some of the major examples of transgenic crop are glyphosate resistance soybean, Bt maize, Bt cotton, Bt potato, modified oil composition in canola and bromoxynil herbicide resistance cotton (Phillips, 2008). In 1994, a transgenic tomato named Flavr Savr is released by Calagene Company which has the property of longer shelf life and delayed ripening. Rainbow Papaya is another prominent GM crop which developed resistance against ring spot virus in Hawaii papaya industry. The adoption of GM crops has enhanced the crop yield by 22% and farmers profit by 68%.

Risks and controversies associated with GM crops

The utilization of GM technology to the crops increases the yield up to several folds, reduced the CO_2 emission and increased the farmer's income. However, widespread adoption of this technology is limited because of several risks and controversies are also associated with it which is described below (Shetty *et al*. 2018) (Fig.1).

1. Biosafety issues: The consumption of GM crops develops potential toxicity and allergenicity to human being. It occurs due to the addition of proteins that were not indigenous to the human being and causes allergy.

2. Not 100% environment friendly: The cultivation of GM crop is not 100% environment friendly. They release certain substances which are not yet proved as environment friendly.

JUST AGRICULTURE
multidisciplinary e-Newsletter

3. Lowering the diversity: The introduction of the GM crops sometimes harms the ecosystem of other organism. When we are developing insect resistance crops then we are developing a mechanism that causes harm to the insect and remove it from the chain of ecosystem. Ultimately, it leads to lowering the level of diversity in an ecosystem.

4. Not safe for consumption: GM crops contain additional substances that develop several diseases and even cause death of organisms.

5. Decrease antibiotic efficiency: Sometimes GM crops contain antibiotic features that make them resistance to viruses and diseases. Regular consumption of these will decrease the antibiotic efficiency.

6. Cross pollination: Cross pollination of GM crops covers large distance and contamination of non GM crop occurs by the GM crop. This poses difficulty in labeling the GM products from the non GM products. Strict labeling and prevent the mixing of GM products with the non GM products is very much essential for its adoption by people.

7. Gene flow: In GM crops there is always risk of transfer of gene flow from one organism to other organism and there might be possibility of conversion of cultivable species into wild species by transferring resistance gene from the herbicide resistance cultivar to the weed and ultimately lead to conversion of weed to a super weed which would be impossible to kill at the later stages (Maghari and Ardekani, 2011).

From the above we can conclude that there are lots of risks are associated for the cultivation of GM crops. Therefore, government performs the risk assessment test before the commercialization of the GM crops in order to estimate the risk associated with the crop and consequences after the use of the crop.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Fig.1. Schematic representation of risk associated with GM crops

Conclusion

Although risks are associated with the commercialization of GM crops but it can be overcome with adequate research by the scientists. GM crops have greater potential for nutritional enhancement, disease resistance, insect resistance, biofuel efficiency and remediation of polluted sites. Ultimately, it will help the farmer for maximizing the yield by reducing the losses due to biotic and abiotic (temperature, drought, salinity, and frost) stresses in a cost effective way. Several new technologies such as Zinc Finger Nucleases (ZFNs), Transcriptor Activator Like Effector Nucleases (TALENs) and Clustered Regularly

JUST AGRICULTURE
multidisciplinary e-Newsletter

Interspaced Palindromic Sequences (CRISPR/Cas) has evolved which not only addressed the regulatory issues of GM crops but also enabled modifying the crop genome with unprecedented ease, accuracy and precision. This started a new era in plant breeding and genetics by developing varieties through targeted mutagenesis and precise genome editing.

References

1. Kumar, K., Gambhir, G., Dass A., Tripathi, A. K., Singh A., Jha, A. K. 2020. Genetically modified crops: current status and future prospects. Springer. 251:1-27
2. Maghari, B. M., and Ardekani, A. M. 2011. Genetically modified foods and social concerns. Avicenna Journal of Medical Biotechnology. 3(3): 109-117
3. Phillips, T. 2008. Genetically modified organisms: Transgenic crops and recombinant DNA technology. Nature education. 1(1): 213
4. Shetty, M. J., Chandan, K., Krishna, H. C., and Aparna, G. S. 2018. Genetically modified crops: An overview. Journal of pharmacognosy and phytochemistry. 7(1): 2405-2410