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GM Crops and Their Impact on Environment

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ABSTRACT

Though biotechnological advancement has laid to various benefactions in our day-to-day life, but still then the underling demerits are rarely acknowledged. The present paper is a short overview on the impact of genetic modification on the associated organisms.

INTRODUCTION

Food is the prime need of human beings. From the ancient, Human beings are trying to get more and more food in the limited field using various techniques. It is also the practices for food security. The ancient art was not technically advanced and does not belong to molecular level. They used to traditional techniques to get more and good food from a limited land. They had to use the natural products to fight against the pests and harmful stuffs for their agriculture. In modern era, the science is developed up to molecular level and they are playing with genetic materials to change the desirable character. The results of changing such characters with cultivated crops are GM crops or Genetically Modified crops. No doubt, they have resistance power against the diseases or abiotic factors like drought, salinity, and flood with desired level of nutrients and secondary metabolites. The aim of GM crops was to improve the quality, quantity or availability of food in the world.

The first GM crop plant was produced in 1982 (antibiotic resistant tobacco plant) and the first field trials occurred in France and USA

in 1986, when tobacco plant were engineered against herbicide. In the year of 1987, Pant Genetic System was the first company to get insect-resistant tobacco plant with the protein of *Bacillus thuringiensis* (Bt). China was the first country to allow commercialized GM plants in 1992 and first GM crop (FlavrSavr Tomato) approved for sale in the US in 1994.

In the same year, European Union approved GM tobacco for marketing in Europe. In 1995, Bt Potato was approved by the US Environmental Protection Agency and till mid 1996, a total 35 approval had been granted to grow commercially 8 GM crops. In 2000, Golden rice (Vitamin-A enriched) was developed but till now not for commercial production. Basically the GM crops are developed by adding or removing of genes using genetic engineering or biotechnological techniques like using Gene guns, Electroporation, Microinjection, Agrobacterium, CRISPR and TALEN. The most common technique is Agrobacterium tumefaciens-mediated transformation. Agrobacteria are natural plant parasites. This method is very common for potatoes, tomatoes and tobacco but not good for wheat and maize.

Even GM crops have many benefits, these have demerits too. Therefore, there is a scientific controversy whether it is good or having high disaster factors for human health and environment. In 2003, an article is published in the journal EMBO Reports that the Public Perceptions of Agricultural Biotechnologies in Europe project (PABE) found the public neither accepting nor rejecting GM crops. It found that public had "Key questions" about GM crops like "Why do we need? Who decided that they should be developed and how? etc. In 2012, a group called "Take the Flour Back" protested the GM crops. In India, Maharashtra government banned Bt cotton in 2012 but in 2009, Government of India cleared the Bt brinjal for commercialization. After opposition by some scientists, environmental groups, a moratorium was imposed on its release in 2010 and till now Bt brinjal is needed public trust and confidence.

For a growing population, global warming and loss of biodiversity have tremendous impacts on our environment. By the year 20150, the population will be about 9.5 billion. Feeding such huge mass is very difficult and further the population is responsible for all environmental problems. Therefore, future food should come without harming the environment. Hence, many scientists and researchers have screened the harmful impacts of GM crops on environment.

The screened impacts of GM crops on environment are following:

1. The GM crops will sexually hybridize with non-GM crops through the transfer of pollen.
2. GM crops may themselves become invasive weeds.
3. The conditions required to grow the GM crops will affect local wildlife populations.

4. Development of Super weeds or Superbugs as resistant weeds and insects
5. Difficulty of preserving the identity of non-GM crops
6. It harms the other beneficial organisms and breaks the chain of micro levels food chain in agricultural field.
7. Long term effects of GM crops are not certain.
8. Due to toxic of GM crops, soil is becoming dry and void of all nutrients.

Once a plant is introduced in an agricultural environment, it is reasonable to assume it will become part of a larger ecosystem, meaning the problem of environmental damage done by GMOs is much larger than simply potentially harming our health.

A Case study: impacts of GM crops on Environment

One of the most famous studies on the effect of GM crops on non-target organisms is the one on the monarch butterfly in the United States. In 1999, three entomologists from Cornell University in New York stated in the authoritative journal Nature that the pollen of insect-resistant Bt maize was harmful to the monarch butterfly. That article sparked considerable debate. It made front-page news and spread throughout the world. The monarch butterfly, just like the honey bee, is an insect that many people have a soft spot for. In North America, the monarch butterfly has symbolic meaning and is often referred to as "the Bambi of the insect world". They are not only incredibly beautiful, with their black-veined orange wings, but they also have a mysterious side to them. Every year, they set off on a heroic journey from Canada and the United States to the forests of Mexico, where they spend their winters. This annual migration of many millions of butterflies at the same time over remarkable distances is one of the most famed phenomena in nature. During their great journeys, monarch butterflies lay their eggs on a plant known as the butterfly flower (Asclepias syriaca), which comes from the periwinkle family common in North America and Mexico and is labeled a weed. The larvae only eat the leaves of the butterfly flower. The butterfly flower is therefore crucial to the existence of the monarch butterfly. The researchers involved in the 1999 Nature study fed leaves sprinkled with the pollen of insect-resistant Bt maize to monarch butterfly larvae.

The researchers identified that 44% of the larvae died and that those that survived were smaller than the larvae that ate the leaves without the Bt pollen. The fact that the larvae of butterflies were sensitive to some Bt proteins was in itself not surprising news. Monarch butterfly larvae and the moth larvae that Bt crops are designed to tackle both belong to the Lepidoptera order of insects after all. In addition, Bt proteins had already been used as an organic pesticide since the middle of the 20th century and it was already known that spraying affected the population of Lepidoptera.

However, the big question left unanswered in the Nature study was whether the larvae could also actually come into contact with Bt proteins in nature.

The above evidences indicate that there are an enormous number of variables that determine impact of GM crops on environment. All crops bred, whether obtained through "traditional" breeding techniques or through GM technology, can have an impact on the environment. From a regulatory standpoint, however, a great distinction is made between the two technologies. Whilst the products of traditional and mutation breeding are free to be placed on the European market, strict risk assessment is required in order to investigate the potential effects of GM crops on the environment. In this context, GM crops are compared with non-GM crops cultivated through conventional agricultural practices. Just like crops with specific traits, insect-resistant, drought-tolerant, and virus-resistant crops all have direct and indirect effects on the environment. These effects can be either positive or negative but in most cases they will have both positive and negative elements.

REFERENCES

1. Adamczyk Jr., J. J., Adams L. C. and Hardee D. D. (2001). Field efficacy and seasonal expression profiles for terminal leaves of single and double Bacillus thuringiensis toxin cotton genotypes. J. Econ. Entomol., 94, 1589-1593.
2. Adang, M .J., Brody, M.S., G. Cardineau, Petersen, L. J., Parker, G. B., McPherson J. S. A. Wyman, Love, S., Reed, G. Biever D. and Fischholf, D.A. (1993). The recontruction and expression of Bacillus thuringiensis cry III A gene in protoplants and potato plants. Plant Mol. Biol., 21, 1131-1145.
3. Alstad, D. N. and Andow, D. A. (1995). Managing the evolution of insect resistance to transgenic plants. Science 268, 1894-1896.
4. Armer, C.A., Berry, R.E. and Kogan, M. (2000). Longevity of phytophagous heteropteran predators feeding on transgenic Bt-potato plants. Entomol. Exp. Appl. 95: 329-333.
5. Arpaia, S. (1996). Ecological impact of Bt-transgenic plants: 1. Assessing possible effects of cryIIIB toxin on honey bee (Apis mellifera L.) colonies. J. Genet. Breed. 50: 315-319.
6. Atkins, E.L., Kellum, D. and Atkins, K.W. (1981). Reducing pesticide hazards to honey bees: mortality prediction techniques and integrated management strategies. Leaflet 2883, revised edition. Riverside, Division of Agriculture Sciences, University of California, pp. 24.
7. Baker H. G. (1974). The evolution of weeds. Annu. Rev. Ecol. Syst. 5: 1-24

8. Barton, K. A., Whiteley, R. H. and Yang, N. S. (1987). Bacillus thuringiensis d-entodoxin expressed in transgenic Nicotiana tabacum provides resistance to lepidopteran insects. Plant Physiol. 85: 1103-1109.
9. Bell, H. A., Fitches, E. C., Down, R. E., Ford, L., Marris, G. C., Edwards, J. P., Gatehouse, J. A. and Gatehouse, A. M. R. (2001). Effect of dietary cowpea trypsin inhibitor (CpTI) on the growth and development of the tomato moth Lacanobia oleracea (Lepidoptera: Noctuidae) and on the success of the gregarious ectoparasitoid Eulophus pennicornis (Hymenoptera: Eulophidae). Pest Manag. Sci., 57, 57-65.
10. Bhattacharya, R.C., Viswakarma, N., Bhat, S. R., Kirti, P. B. and Chopra, V. L. (2002). Development of insect-resistant transgenic cabbage plants expressing a synthetic cryIA(b) gene from Bacillus thuringiensis. Curr. Sci., 83, 146-150.
11. Birch, A. N. E., Geoghegan, I. E., Majerus, M. E. N., McNicol, J. W., Hackett, C., Gatehouse, A. M. R., and Gatehouse, J. A. (1999). Tri-trophic interactions involving pest aphids, predatory 2-spot ladybirds and transgenic potatoes expressing snowdrop lectin for aphid resistance. Mol. Breed., 5, 75-83.
12. Bourget, D., Chaufaux, J., Micoud, A., Delos, M., Naibo, B., Bombarde, F., Marque, G., Eychenne, N. and Pagliari, C. (2002). Ostrinia nubilalis parasitism and the field abundance of non-target insects in transgenic Bacillus thuringiensis corn (*Zea mays*). Environ. Biosafety Res., 1, 49-60.
13. Brasileiro, A. C. M. and de Carneiro, V. T. (1998). Manual de transformação genética de plantas. Embrapa SPI/Cenargen, Brasília, pp. 309.