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Bt Brinjal in India: Fears, Myths and Facts

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Abstract

Brinjal is one of the important vegetable crops in India and its production is extensively affected by many insects in particular brinjal fruit and shoot borer. Large scale discriminate use of chemical insecticides not only damage environment but also affect human health. To minimize the use of insecticides and to get healthy brinjal fruit Bt Brinjal was developed employing transgenic technology. Bt brinjal could effectively control the target pests. When the insect feeds the plant and thereby ingests the delta cryo endotoxin in the insect gut, the protein binds to specific receptors on the insect midgut, inserts into the membrane and forms ion specific pores in gut lining and causes the death of the insect. The potential economic benefits of Bt brinjal hybrids in terms of yield gain, reduction in insecticide-use, and increase in net returns per hectare have been reported. Bt brinjal increases income of farmers, reduce its cost to consumers, improve food safety and reduce health hazards and environmental pollution.

Introduction

Agriculture is the most potent means to grow, nourish and sustain the planet. The food is essential for sustaining the life and underpinning of our culture and communities. The agriculture sector is one of the most significant contributors to our GDP and economic development of our country. Substantially the agriculture production has been increased in recent decades, but wistfully two billion people globally lack access to sufficient, nutritious and safe food. According to the national nutritional survey, millions of people are malnourished. From the last 4000 years, brinjal (eggplant) has been in cultivation in our country, also first domesticated here in our country. Brinjal is available in India in different shapes and colours and more than two thousand varieties of brinjal are found in the world. Odisha, West Bengal, Gujarat, Chhattisgarh, Tamil Nadu, Andhra Pradesh, Haryana and Karnataka are the major brinjal producing states. Pusa Hybrid-5, Arka Navneet, Hybrid-6, Pusa Ankur, ABH-1, Pusa Purple Long, ARBH-1, Pusa Purple Cluster, Utkal Tarini, Utkal Madhuri, Utkal Keshri and Ritu Raj are some of the popular varieties grown in India. India ranks second in brinjal production after China accounting to 26 percent of total production. Brinjal is a rich source of different minerals, vitamins, edible fibres and antioxidants and thereby help in reducing malnutrition. It has excellent medicinal properties ailing diabetes, obesity and hypertension. It is also known as poor man's vegetable and frequently used in dishes of every household they may be rich or poor.

Problems Related to Brinjal

Brinjal cultivation is challenged due to damage caused by shoot and fruit borer (*Leucinodes orbonalis*), a devastating pest found all over the world. It feeds

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almost solely on brinjal. Most of the insecticidal sprays were targeted against shoot and fruit borer. Indiscriminate and widespread use of toxic insecticides increases the cost of cultivation and also increases the health hazards of farmers and consumers level. The estimated yield loss caused by the Shoot & Fruit Borer in brinjal ranges from 60 to 70%. Besides the yield losses, it also deteriorates the quality of the fruit.

Need of Bt Brinjal in India

India is facing a huge increase in food demand as the population is increasing despite less availability of land, water and nutrients. To meet the sustainable development and to eradicate hunger, genetically modified crops developed through transgenic technology is the need of the hour. It is found that these crops are very safe and environment friendly. "Bt brinjal," a genetically engineered brinjal variety, can be successfully cultivated without being infested by the fruit and shoot borer (FSB) without the application of pesticides. Bt Brinjal hybrid is to provide many benefits to growers. Most desired one is the reduction in yield losses due to FSB infestation, other benefits include reduced production cost due to savings on pesticides, good quality fruits which will have better market acceptability and fetch an attractive remunerative price to the grower.

On the other hand, consumers will have access to better quality produce at a lower price. It does not pose any health hazards; also they will get it at a lower rate due to lowered cost of production and eventually they will have more access to the produce due to higher volume of its production. The performance of Bt hybrids over non-Bt and popular hybrids of brinjal was examined in terms of yield improvement and lowered pesticide-use, using data from large-scale trials.

How's Bt Brinjal Developed?

Bt Brinjal is a genetically modified brinjal developed by adding a gene *cry1Ac* from a soil bacterium named *Bacillus thuringiensis* through *Agrobacterium* mediated gene transfer method. The *cry1Ac* gene which codes an insecticidal protein, which is derived from common soil bacterium *Bacillus thuringiensis* (Bt) subsp. *kurstaki* to produce the insecticidal protein. *The cry1Ac* gene is driven by a cauliflower mosaic virus (CaMV) 35S promoter along with the *nptII* gene (antibiotic resistance marker) and neomycin phosphotransferase-II. The Bt transgene (*cry1Ac* gene) in the Bt brinjal behaves as a single gene, dominant Mendelian factor and is stably integrated in the plant genome. The *cry1Ac* gene, along with two other supporting genes, namely *nptII* and *aad* genes, work in tandem to produce an insecticidal protein that is toxic to the targeted insect (fruit and shoot borer). This protein is expressed in brinjal so that it can control brinjal fruit and shoot borer. The insects (lepidopterans insects: brinjal fruit and shoot borer; fruit borer) that feed on the Bt brinjal plants and thereby ingested this protein. In the insect gut, the protein binds to specific receptors on the insect midgut, inserts into the membrane and forms ion specific pores in gut lining. These events disrupt digestive processes, paralysis and subsequent death if the feeding larvae and insects. But the *Cry1Ac* protein produced in Bt brinjal is non-toxic to non-lepidopteran insects, birds, fish and mammals as these species lack receptors for the proteins on the surface of their gut cells. Also the acidic medium in gut of these organisms also makes *Cry1Ac* protein inactive.

Controversies Regarding Bt Brinjal in India

The usage of Bt crops gradually decreased the pesticide consumption. However, it increases in secondary pest infestation and shown increase tolerance of insects against that crop. No proper long term field trials have been conducted regarding the impact of *Cry1Ac* protein over soil biodiversity. According to some perceptions as brinjal is originated in our country so genetically modified Bt brinjal should not be cultivated here as it can alter the characteristics of our wild varieties due to transgenic cross-pollination. The endotoxins present in Bt brinjal can be carcinogenic. So in 2009, the Genetic Engineering Appraisal Committee (GEAC) approved the cultivation of Bt brinjal in India, but due to above controversies, Ministry of environment and forest passed a moratorium against it in 2010.

Figure 1: Bt brinjal

Potential Benefits of Bt Brinjal

The extensive volume of pesticides used in brinjal mainly to control brinjal fruit and shoot borers can be decreased and the cost born by farmers for the pest control can be reduced (Figure 1). Even the use of insecticides is not very useful because the larvas generally hide inside, so it is not possible to control them by spraying. However, it can be achieved through Bt brinjal. As per the present report, the *Cry1Ac* endotoxins only affect on the guts of particular insect directly leading to its death and it has no side effects on animals or human beings or to the soil. It has been proven that

it does not increase the susceptibility towards other pests and has no hazard towards our conventional varieties. Bt brinjal remarkably increases marketable yields fetching remunerative prices for farmers.

Conclusion

Bt brinjal has more benefits for both farmers and consumers. According to studies, Bt brinjal efficient control against fruit and shoot borer, and will lower the insecticide use. Bt brinjal is better over conventional and hybrid varieties. The outstanding success of Bt cotton in India has proven that biotechnology in the field of agriculture can help in reducing poverty, hunger and evict the food insecurity and it will surely help in creating a new healthy world. Bt brinjal will help in reducing soil and environmental pollution & also help in maintaining soil microflora. It will bring food security and availability. The only solution is to conduct more and more field and toxicological trials in different regions so that the questions and doubts arising in the mind of people regarding Bt brinjal can be clarified so that both farmers and consumers will be able to accept Bt brinjal happily.

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