

India a staple food,
cannot be used as



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India has lagged much behind in commercializing the GM crops.

In May 2002, three cotton hybrids have been cleared by Genetic Engineering Approval Committee (GEAC). The increase in yield is to the extent of 10-15% with IPM and a considerable saving in pesticides. India has identified 12 major field crops (Rice, Wheat, Maize, Sorghum, Cotton, Pigeon pea, Chick pea, Mung and Urad bean, Potato, Mustard, Soybean and Pearl millet) which need transformation for specific diseases like bacterial blight, rust, wilt, downy mildew and viruses and pests like shoot fly, pod borer and American boll worm. Nutritional and food security are of utmost importance for country like India. There is no compelling scientific argument to demonstrate that GM crops are innately different from non-GM crops. But some novel GM crops may pose elevated risk to environment. Hence all cases of GM crops including novel genetic changes must be assessed on case-by-basis. GM rice varieties tolerant to drought, submergence, salinity and rich in micronutrients need to be commercialized.

But gene can also be introduced for pest resistance. Golden rice in vitamin A is a major step towards nutritional security. It is worthy of note that rice, being a staple food, cannot be used as a bioreactor to produce drugs and pharmaceuticals. Tomato, with its small genome, is an ideal crop for transformation. The increase in polyamine levels such as spermidine and spermine is associated with significant increase in concentration of antioxidant-lycopene with improvement in quality of juice and shelf life. Over expression (Antisense RNA technology) of S.

adenosyl methionine decarboxylase gene (*ySAMdc*) increased the levels of polyamines during ripening. Thus ripening involves differentiation of chloroplasts to Chromoplasts which results in accumulation of beneficial nutrients such as P-carotene, vitamin E and lycopene. Biopharming: Field crops such as corn and tobacco are programmed with recombinant DNA Technology to produce high-value-added pharmaceuticals.

Biopharmed corn is modified to produce a vaccine against *Escherichia coli* (produces diarrhoea) Similarly, tomato and musk melon are addressed with r-DNA technology to produce edible vaccines. This is termed as biopharming where plants act as bioreactors and harvested to produce drugs and then purified. The potential of this technology is the economy of the process.

It is much cheaper to produce the drugs from the plants. Nevertheless, the biopharmed crops should be distinct from food crops so that food security is not threatened. Gene Flow: This phenomenon is universal. Crops and weeds have exchanged genes for centuries.

But genetic engineering raised additional concerns due to introduction of novel genes. The fear is that the gene may lead to 'supra weeds' which may develop resistance to insects, diseases, herbicides and harsh growing conditions. The risks of transgenic crops are: (a) Cross pollination of GM crops with conventional varieties. (b) Germination of volunteer GM seeds. (c) Cross pollination of GM crops with crop cultivar distant for non GM crop or organic niche markets. Now strategies are available for gene containment or gene flow. Refugia of 20% for cotton is already practised. Other strategies

for containing gene flow are: (a) Restricting flower opening and floral development (cleistogamy) in GM crops.

(A) Male sterility approach as in mustard. (c) Seed sterility and apomixes (vegetative propagation). (d) Destruction of volunteer seeds by chemical/physical means.

(e) Specific excision of transgene. Recombinant systems have emerged as valuable tools for efficiently regulating the excision of transgene when their expression is no longer required. Environmental risks: The fear is that GM crops might indirectly impact the environment. This might be associated with recombinant and novel combination of DNA passing into the environment.

Terminator Gene Technology:

Definition: The technology that terminates the viability/ fertility of seed after a given time is known as terminator technology and the gene involved is popularly known as terminator gene.

The Terminator System in Cotton has Three Components: 1. A gene for a toxin that will kill the seed late in development, but that will not kill any other part of the plant. 2.

A method for allowing a plant breeder to grow several generations of cotton plants, already genetically-engineered to contain the seed-specific toxin gene, without any seeds dying. This is required to produce enough seeds to sell for farmers to plant. 3. A method for activating the engineered seed-specific toxin gene after the farmer plants the seeds, so that the farmer's second generation will be killed. These three tasks are accomplished by

engineering a series of genes, which are all transferred permanently to the plant, so that they are passed on via the normal reproduction of the plant.

Terminator Technology: The success of Terminator depends on its ability to make a lot of a toxin that will kill cells, and to confine that toxin to seeds.

To accomplish this, in the case of cotton, the plan is to take the promoter from a gene normally activated late in seed development in cotton, and to fuse that promoter to the coding sequence for a protein that will kill an embryo going through the last stages of development. Problems with use of Terminator: It is likely that terminator will kill the seeds of neighbouring plants of the same species, under certain conditions. In any case, dead seeds, where they occur, would be a serious problem for the farmer whose fields are close to the Terminator crop. How many seeds die will depend on the degree of cross-pollination, and that is influenced by the species of plant, the variety of crop, weather conditions, how close the fields are to each other, and so on. They will contain the toxin and any other proteins engineered into the Terminator-protected variety. These new 'components' may make the seed unusable for certain purposes.

Ò Cotton:

India, the world's third largest cotton producer, where the traders say Indian cotton yield is just 300 kg/ha less than half the global average of about 650 kg/ha whereas, India has the world's largest area under cotton cultivation covering nearly 9 million hectares.

Due to some reasons Indians are starving from low productivity of cotton viz., low productivity of land, low and miscellaneous use of manures and

fertilizers, applications of NPK, plant population, lack of irrigation, insects pests menaces, management practices and vagaries of monsoons etc.

Among these, the production loss due to insects is quite high. About 21 species of insects possess enmity against cotton of which 12 are so egregious. These insects are classified into two groups: 1. 'Sucking insects' viz., termites, aphids, whiteflies, hariquin bugs etc.

affect flowering stage (40-50 days after sowing). 2. 'Bollworm complex' viz. , spotted bollworm, green bollworm, pink bollworm etc., decrease 30-40% yield. India spends nearly Rs. 2800 crores per year on pesticides to control the damage.

Among which cotton uses more pesticides i. e., Rs. 1600 crores than any other crop. Only 5% of the total cultivated area is occupied under cotton, which requires 55% of insecticides and pesticides per year.

Obviously, it affects environment too. This also increases selection pressure in insect population, which influences the evolution of new resistant biotypes. It is an urgent necessity to control this attack by developing new resistant host plants having resistant genes. This had not been developed earlier, but recently the biotechnology genes produce insecticidal crystal proteins from micro-organisms which are being transferred to the cultivated varieties of cotton. This cotton is known, as 'Transgenic Cotton'. In India, the research for developing transgenic cotton has been going on in Central Institute of Cotton Research at Nagpur (CICR), at the International Crops Research Institute for Semi-Arid Tropics (ICRIS AT); several candidate genes are being evaluated for their biological efficacy against the sorghum shoot

fly (*Atherigone soccata*), spotted stem borer (*Chilio partellus*), cotton bollworm which are the major crop pests in semi-arid tropics. Since last 4-5 years some work is in progress in different private sector companies too. Fact behind Cotton: Bt is short for 'Bacillus thuringensis' a gram positive, aerobic, sporulating omnipresent bacterium, first discovered in 1902, one of the most successful agent of biological control, synthesizes crystalline proteins coded by the Cry genes during sporulation.

This BT gene (Cry 1AC) encodes a special type of toxin commonly known as 'Delta endo toxin'. Delta toxin kills bollworm only without any deleterious effect on living creatures. The effort was made towards transferring this gene in cultivars of cotton to produce transgenic cotton plants showing resistance against bollworm. There are several genes with different functions in various organisms. When we transfer a gene in a cultivated variety, it induces resistance against the insect in the similar fashion, like a child vaccinated against Polio. However, Bt was already known for the control of Bollworms.

We were using same insecticides based on Bt such as Delfin, Dipeal-E, etc. Mechanism of action of BT toxin: The mechanism of action of Bt cry proteins involves solubilization of crystal in the insect midgut protease, binding of the cry toxin to midgut receptors and insertion of the cry toxin in to the apical membrane to create ion channels or pores, disturbing cellular osmotic balance and causing the cell to swell and lyse through a process that has been termed 'colloid-osmotic lysis', which results in death of insect. History of Commercialized BT: Although Bt was described by Berliner in 1915 from the province of Thuringia in Germany, the earliest description was actually <https://assignbuster.com/india-a-staple-food-cannot-be-used-as/>

that of Ishiwata in 1902, from Japan. The name "Bacillus Scotto" was given to the bacteria which caused a disease of silkworms, the name "Scotto" meaning limp. Berliner's isolation was from a disease Mediterranean flour moth, *Ephesia kubniella*, and he was able to show that the bacterium was toxic when the spores were fed to insects.

Interest in Bt was rekindled by Mattes in 1927 who was able to re-isolate a strain of Bt from *Ephestia* and subsequent field tests by Husz in 1928; with this isolate on the European corn borer gave promising results. This work eventually led to the first commercial product, Sporeine, which was first produced in France in 1938. BT in plant protection: (i) BT as a biopesticide: Bt is now the most widely used biologically produced pest control agent. The use of biological pesticides in agriculture remains significantly behind that of synthetic chemical pesticides, several environmental and safety considerations favour the development of Bt Cry proteins that have been studied; they are not pathogenic to mammals, birds, amphibians, but very specific to the groups of insects pests against which they have activity.

Since the Bt is not genetically engineered, there is no need to obtain specific biosafety permits to market Bt based products. It proves the possibilities of resistance development in insects, strategies to prevent such resistance and the need for providing an umbrella of integrated pest management (IPM) over the transgenic crops. (ii) Novel BT biopesticide: Bt has evolved to produce large quantities of crystal proteins, making it a logical host for developing improved cry biopesticides. Natural isolates of Bt can produce target specified. On the other hand, certain combinations of cry proteins have been shown to exhibit synergise offers. (iii) BT-transgenic plants:

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Delivery of Bt process through spray formulations, engineered Bt any other bacteria has certain limitations.

The chemical sprays suffer from short life, mechanical method and inability to reach burrowing insects. Engineered bacteria vary after proliferating at a rate and quality not sufficient to kill the target insects. These disadvantages can be overcome if the cry proteins are expressed in the plant cells at levels sufficient enough to kill the larvae. The first transgenic plants using cry genes in crop plants like cotton, and potato conferred considerable protection against lepidopteran and coleopteran pests, respectively.

Other crop species carrying various cry genes include Soybean, peanut, alfalfa, apple, white clover, broccoli, walnut, pear and sugarcane. Some landmark events in the production of transgenic BT Cotton: March 10, 1995: Department of Biotechnology (DBT) of the Government of India permits import of 100 gms of transgenic Cocker-312 variety of cotton seed cultivated in the United States by Mahyco. This variety contained the 'Cry 1 AC' gene from bacterium 'Bacillus thuringensis'. April 1998: Monsanto tie up. Gave permission for small trials of Bt cotton 100 gms per trial by Department of Biotechnology (DBT). July 2000: Mahyco allowed conducting large scale field trials including seed production at 40 sites in 6 States. The DBT set up committee to "independently" monitor and evaluate large scale yield trials. July 18, 2001: An open dialogue held between Monsanto and Ministry of Environment representatives and farmers to discuss Bt cotton with scientists, June 19, 2001: Genetic Engineering Approval Committee (GEAC) extends field trials of Bt cotton by another year.

Mahyco conducts large-scale trial on 100 hectares in seven States. Jan 23, 2002: Dr. Manju Sharma, Secretary of DBT, declares that the round of Bt cotton trials was satisfactory and that is up to the GEAC and the Ministry of Environment to decide on a date of commercial release. April, 5, 2002: Mahyco had received approval from India's Genetic Engineering Approval Committee (GEAC) of the Environment and Forest Ministry for commercial cultivation of BT Cotton.