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Genetically Engineered Crops and Foods

A PRIMER

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Gene Campaign

Genetically Engineered Crops and Foods:

A Primer

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Why this Primer?

Gene Campaign has brought out this primer as a simple guide to genetic engineering and the various issues related to it. The primer explains what genetic engineering is and how it is done. It addresses questions like whether it will solve hunger and poverty, who the major players are in this field, the issue of intellectual property rights and the cultural and religious reservations about food containing alien genes. It is hoped that this primer will give readers a basic knowledge about this technology and help them to participate in decision making on GE crops and foods.


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GENETIC ENGINEERING

Genetic engineering is a technology that can produce plants and animals that are not "natural" i.e. not possible in nature.

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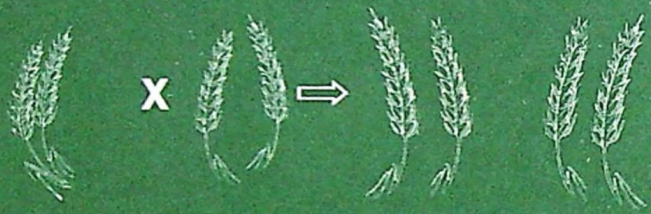

In natural reproduction, rice crosses with rice and pigs cross with pigs.

With genetic engineering, you can take the genes from a pig and put it into rice. You can cross rice with pigs, or fish with tomatoes.

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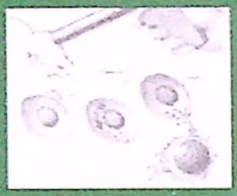

METHODS OF GENETIC ENGINEERING

Genetic engineering is done largely by two methods:

1. Using a Gene Gun
   - the gene construct is coated on gold beads and 'shot' into cells
2. Infecting with Agrobacterium
   - These bacteria 'infect' the cell of the host plant and transfer the gene construct through the infected part.

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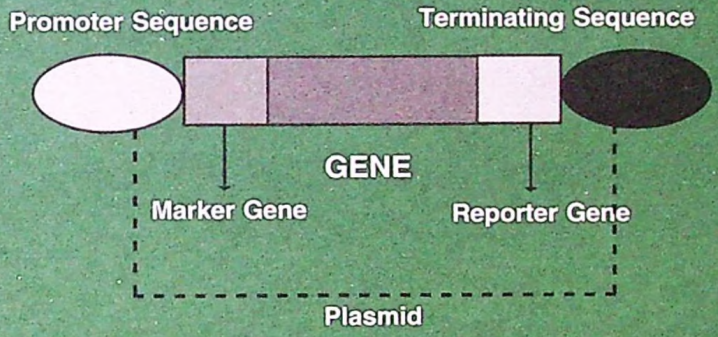
A TYPICAL GENE CONSTRUCT



During genetic engineering, it is not a single foreign gene that is put into a plant but a complex structure consisting of many genes. This gene construct is attached to a plasmid which is a kind of virus. The construct is then either 'shot' into the cell or 'infected' into it.

Genetic engineering is used in many sectors like pharmaceuticals, mining and environmental clean up. Its most controversial application is in agriculture because people are very sensitive about the food they eat and about how it is produced.

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IS THE GREEN REVOLUTION THE SAME AS THE GENE REVOLUTION?

No, it is not.

* During the Green Revolution - There were no patents, the seeds were freely accessible to farmers and they were affordable.

* In the Gene Revolution - Genes and seeds are patented by multinational corporations and are expensive.

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WHO OWNS THE SEED ?

- GE technology is controlled by six MNCs. They own the seeds. To use their technology you have to pay heavy license fees.
- In the Green Revolution, the farmer owned the seed. He sold seeds to other farmers so everyone shared the technology.

ARE GE CROPS NEEDED TO INCREASE FOOD PRODUCTION ?

At the moment, India produces enough food for itself. It is proved by the fact that it maintains buffer stocks. If more food were needed, it would be easily achieved by minimizing post harvest losses. Upto 30% of the food that is harvested perishes or is lost to rats in storage. Improving storage and building village roads to bring agricultural produce to the market quickly will minimize post harvest losses and increase the amount of food that is available.

Similarly, increased water for irrigation will very quickly increase food production in those areas that are at present dependent on the monsoon and can produce only one crop in a year. Availability of irrigation facilities will enable a second crop, allowing a big jump in food production. There is no evidence so far that GE crops can contribute anything to increase food production.

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WILL GE CROPS SOLVE HUNGER ?

It is difficult to see the connection between GE crops and hunger. People are hungry either because they do not have productive assets like land to produce food or because they do not have incomes to buy the food that they need. Even when our buffer stocks have stored 60 million tons, people are still hungry because they do not have the money to buy food. Realizing the importance of generating incomes, the Indian government has recently enacted the Employment Guarantee Act, which should provide employment to the poor.

It would be better to empower the poor to produce their own food or to buy food. Our efforts should be focused on land reforms as also on investing in education and skill generation in large parts of the country. Investing in literacy and skill development is definitely going to equip people to get employment or generate incomes, thus empowering them to become more food secure. It is uncertain what GE technology could contribute.

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ARE GE CROPS THE ANSWER TO MALNUTRITION?

Not really. Although Golden Rice is being presented as the answer to vitamin A deficiency, there are several natural high vitamin A, high iron and high mineral crop varieties in all the major staple crops. ICRISAT released conventionally bred Golden Millet some years ago and there are several natural varieties of golden cassava, golden sweet potato and a number of varieties of high nutrition rice.

Rice and other staples, rich in vitamins and minerals are available and only need to be selected from existing germplasm collections and multiplied. As against all these options that are already available, Golden Rice is still an uncertain product in the laboratory. Also, the question must be asked: 'Is it wise to promote a single point technical fix to malnutrition, should one not promote instead natural balanced diets containing cereals, legumes and leafy greens?' These are easily available to farming families.

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IS AGRICULTURAL BIOTECHNOLOGY BEING IMPLEMENTED PROPERLY IN INDIA?

- There is no policy on agricultural biotechnology or GE crops in India.
- The agenda for GE crops is framed by a small coterie without any discussions with the scientific community or the National Academy of Agricultural Sciences.
- GE crops are being introduced without consultations with farmers or civil societies.

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WHICH GE CROPS ARE AVAILABLE IN INDIA?

At present, only Bt cotton is grown commercially in India. Research is being carried out on rice, chickpea, potato, tobacco, rapeseed, mustard, tomato, brinjal, cauliflower, chilli, bell pepper, banana, cabbage, muskmelon, blackgram, coffee, pigeonpea, wheat, citrus fruits and groundnut.

DO WE HAVE GE FOODS IN INDIA?

Officially, India does not have GE food crops in cultivation. However, it is possible that some food crops like papaya are being cultivated illegally. The government has now begun to give permission for the cultivation of GE foods like GE brinjal, GE okra, and GE potato. Other food crops are in the pipeline. Many food products, especially those prepared from imported corn and soybean, are likely to contain GE ingredients. Imported foods like tofu, soya nuggets, soya milk, corn chips, sweet corn, tomato puree etc. may have GE ingredients.

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WRONG GE RESEARCH IN INDIA

- India is researching on Bt cabbage, Bt cauliflower, Bt chilli, Bt brinjal, Bt tobacco even Bt rice, why?
- Why is there no research to produce toxin free Lathyrus (Khesari dal)?
- Or, to improve the nutrition of fodder grasses?

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GENETIC ENGINEERING IS A VERY EXPENSIVE TECHNOLOGY

* Conventional varieties cost
  - Approx. US$ 1 million
* GE varieties cost
  - Approx.US$ 10 - 25 million
* Cost of Bt cotton (seeds)
  - Rs. 1800/- 450 gm bag
* Cost of good Indian cotton varieties
  - Rs. 300-400/- 450 gm bag

WHAT ARE THE MAIN PROPERTIES OF GE CROPS?

Just two traits dominate GE technology. Globally, GE crops are either insect resistant and carry the Bt gene from *Bacillus thuringiensis* to provide resistance to insect pests or they are herbicide tolerant, which means they carry a gene that can survive the application of herbicides. A very small proportion of crops have been bred for virus resistance.

WHAT IS A HERBICIDE TOLERANT PLANT?

A Herbicide Tolerant (HT) plant is a genetically engineered plant that contains genes that enable it to resist chemicals that are sprayed to destroy weeds. For example, Roundup Ready corn is a herbicide tolerant maize variety that will survive the application of a herbicide called Roundup, when all other plants will die after its application.

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IS HERBICIDE TOLERANCE A SUITABLE TRAIT FOR INDIA?

No !

- 90% of all GE Crops have the Herbicide Tolerance and Bt genes.
- HT was developed for weed control in the West, where there are large land holdings and no agriculture labour.
- Weeds in monoculture farming are a nuisance and have no use.

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* Weeds have many uses in India, destroying them with chemical herbicides will deprive rural communities of valuable resources.
* In India, Herbicide Tolerant crops will displace labour that does the weeding
* India is a labour surplus country
* HT technology will not allow the practice of mixed cropping.

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*Weeding is an income source for agriculture labour, specially women.

*Weeds gathered from fields are:

- nutritious leafy greens (saag) - like *chaulai and bathua*
- supplementary fodder for livestock
- medicinal plants for local health and veterinary care

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ARE GENETICALLY ENGINEERED 'EDIBLE" VACCINES SAFE?

- Melons and tomatoes are being genetically engineered to produce vaccines against cholera and rabies.
- These 'cholera melons' or 'rabies tomatoes' are supposed to vaccinate those who eat these fruits.
- Can they be effective as vaccine delivery mechanisms?

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- What if the vaccine and normal fruit get mixed up, what happens if children eat a lot of fruit with rabies vaccine?
- How does one regulate dosage of vaccine in fruit?
  - What happens to the dosage when the fruit is raw?
  - What is the dosage with overripe fruit?
- 'Edible Vaccines' seems to be a dangerous approach to vaccination

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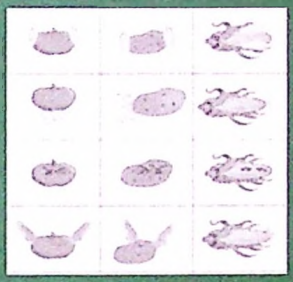
ARE GE FOODS SUPERIOR TO CONVENTIONAL FOODS?

No. GE food products do not have any advantage over conventional foods. They do not taste better, look better nor are they more nutritious or cheaper than conventionally grown crops and foods in the market. It cannot be said that GE technology has increased the choice or the quality of food available. In fact, GE food crops could be a risk to human health and also the environment.



ARE GE CROPS PATENTED IN INDIA?

The US Government allows crops to be patented but the Indian law does not allow patents on plants or plant parts like cells or genes. An Indian law, called the Protection of Plant Varieties and Farmer's Rights Act, grants Plant Breeder's Rights to the developer of a new plant variety, including a GE variety. The Indian law acknowledges both Farmer's and Breeder's Rights. Patents on plants or genes would harm the interest of farmers and national food security. We must be vigilant that our laws do not allow plants and seeds to be patented.

WILL GE CROPS REDUCE THE USE OF TOXIC CHEMICALS ?

This does not appear to be the case. On the contrary, we can expect higher toxic chemical residues. The majority of GE crops are engineered to be grown using herbicides manufactured by the same companies selling the seeds. Monsanto's Roundup Ready soybean can only use Monsanto's herbicide Roundup. The United States Department of Agriculture (USDA) data show that in the US, use of herbicides actually increased upto 22%, not decreased, in the cultivation of Herbicide Tolerant GE soybean.

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CONCERNS ABOUT GE CROPS/FOODS

- Farmer Concerns - expensive, risky technology
- Consumer Concerns - food safety
- Trade Concerns - are there markets for GE crops?

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CONCERNS...

- No liability laws exist to force the company to pay compensation if a GE crop 'escapes' or contaminates non-GE /organic food .

- Labeling of GE crops cannot be done realistically under Indian conditions.

ENVIRONMENTAL IMPACT

* Foreign gene flow to related species
  - can result in pernicious weeds by gene transfer to wild relatives
  - Foreign genes can contaminate native biodivesity
* Major concern about genetic contamination in centers of origin.

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GLOBAL POLICY ON GE CROPS IN THEIR CENTERS OF ORIGIN

Centers of Origin

- Mexico - Corn - Ban
- China - Soybean - Ban
- Peru - Potato - Ban
- India - Rice - GE Rice being developed.

  Is this sound ?

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HEALTH IMPACT OF GE FOODS

* Potential for allergic reaction
  (Brazil nut soya, Starlink corn)
* Potential for toxicity (GE Tryptophan)
* Safety of 'edible' vaccines
  (Rabies, Cholera in bananas and melons)
  - fruit gets mixed up in food chain
  - dosage in raw fruit, overripe fruit?

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RISK-BENEFIT ANALYSIS OF GE FOODS

- **Benefits *Not Visible***
  * GE foods are not cheaper, better tasting or more nutritious
- **Risks *Visible***
  * Food safety can be compromised
  * New allergens can be formed as in Brazil nut soya, Starlink corn
  * New toxins can be created as in GE Tryptophan, which resulted in 37 deaths.
  * Feeding mice and rats with GE corn, potato and tomato has resulted in organ damage, collapsed immunity, even death.

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ARE GE FOODS TESTED PROPERLY?

Nobody knows whether they are tested properly or how they are tested since the government and regulatory bodies in India like the Genetic Engineering Approval Committee (GEAC) refuse to share any information with the public or answer any questions regarding biosafety and testing procedures.

IS GE FOOD SAFE ?

- There is growing scientific evidence that GE food may not be safe to eat. A recent study from CSIRO, Australia showed that when a gene for pest resistance was genetically engineered into peas, the GE peas provoked inflammation of the lung tissue and allergic reactions in mice.
- A secret study conducted by Monsanto showed that rats fed on a diet of GE corn showed severe organ damage.
- Rats fed with GE potatoes showed similar organ malformations and altered immune response.

There are numerous other reports of stomach lesions in rats, false pregnancies in cows, uncontrolled cell growth and damage to animal immune system following feeding studies conducted with GE foods. Experts think that because of genetic engineering and the shuffling of foreign genes into natural crops, the genetically engineered plants may start producing new products in their cells. These new products could be poisonous, produce allergies or damage the tissue to create lesions or destroy the immune system.

When the first genetically altered tomato "Flavr Savr" was fed to rodents in the labs in 1994, they refused to eat the GE tomatoes. Data revealed that many of the rats that ate the GE tomato developed lesions in their stomachs, seven of the forty rats died within two weeks.

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HOW CAN ONE AVOID GE FOODS?

Do not buy imported foods that contain corn, soybean, potato or tomato. These foods are likely to be genetically engineered. There is no way of knowing for sure if the imported food contains GE ingredients since most companies do not provide this information on the label. Therefore, the safest route is to avoid such foods. Tell your families, friends and colleagues about the risks of GE food. Ask the government to make the food safety data public. Ask to be involved in taking decisions on whether GE crops and foods should be allowed in India.

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ETHICAL / RELIGIOUS CONCERNS ABOUT FOOD

* Muslims and Jews object to pig genes in food
* Hindus object to cow genes
* Vegetarians object to animal genes
* Several people have found the presence of human genes in GE food revolting since they associate it with cannibalism.

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GE FOODS OR ORGANIC FOODS? WHAT IS INDIA'S USP ?

* Low external input agriculture, specially in dry land areas, can more easily turn to organic agriculture than GE agriculture.
* 70% agriculture in India is in dryland areas.
* Resource-poor farmers can easily turn organic since it is cost effective. GE crops are expensive.

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GE CROPS AND ORGANIC CROPS CAN NOT COEXIST IN INDIA

* India will have to choose one.
* Segregation of GE - non GE organic is impossible in small land holdings
* All crops will be contaminated with GE
  - -leaving farmers with no choice
  - - no choice for consumer
* Organic agriculture is a poverty-reducing tool
  - - organic markets are growing
  - - India has competitive advantage in organic

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SO, GE OR ORGANIC ?

GE Crops	Organic Crops
·Alien technology ·Farmers dependent on external sources for problem solving · Expensive · Global markets diminishing ↓ · 158 countries/states/ regions have declared themselves to be GE free	Familiar technology Farmers do their own problem solving Affordable Global markets increasing ↑

About Gene Campaign

Gene Campaign is a research and advocacy organization working for food and livelihood security for rural and tribal communities. It led the efforts to get Farmers' Rights incorporated into the Indian legislation and is striving for the recognition of indigenous knowledge as the intellectual property of rural communities. Gene Campaign fights against biopiracy and works to protect indigenous products like Basmati rice and turmeric.

Gene Campaign holds the view that decisions on GE crops must be taken with stakeholder inputs. These crops should be subjected to stringent cost and risk benefit analyses and adopted only if they are proven safe and superior to available alternatives.

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