Genetically Modified Organisms/Seeds - Is it the Answer to Global/National Food Crisis?

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In order to answer the above question, it is necessary to first be aware of all aspects related to the production and use of GM food in the world today and what is in store for the future.

Introduction

Several years ago, scientists in Indonesia discovered skeletal remains of one of our ancestors that were presumed to be around 10,000 to 12,000 years old. He was named as *Homo floresiensis*, a hunter-gatherer. During his time, he lived with nature and used the environment in order to find food and shelter, but did not harm it. At that time, they worshipped everything they could not find explanations for such as trees, the sun, human sex organs, etc. With the development of science and technology, as humans began to understand things around them, they started manipulating both the physical and biological environments for their benefit.

Today, with the development of technology, humans have 'evolved' to fly, our eyes have 'evolved' to observe organisms as small as viruses and stars in the far away 'heavens'. The physical environment has been manipulated to enable humans to travel at supersonic speed to reach the stars, to observe microorganisms, to communicate instantly with someone anywhere, to produce and use nanomaterial, to destroy each other from far away centres. Today, almost everything we use comes from factories. This is exosomatic evolution, the evolution outside our bodies, continuing in an identical manner to Darwin's somatic evolution.

In parallel to exosomatic evolution, somatic evolution has been speeded up, forced upon ourselves in the last couple of decades, using recombinant DNA technology (rDNA technology, modern biotechnology, gene technology, genetic engineering, gene cloning, etc.) where characters have been transferred across organisms, species and kingdoms, cutting across and overcoming all natural barriers. Genes (parts of the DNA molecule), which carry messages to produce proteins that contribute to development of characters, have been identified, isolated and transferred to other organisms in which they normally do not exist. Using this very powerful technology, scientists have transferred human genes into bacteria, bacterial genes into plants and animals, animal genes into plants, etc. Such organisms which carry 'foreign' genes are called Genetically Modified Organisms (GMO) and any food or feed obtained from them are called GM Food or GM Feed. Ingredients from GMOs can also be found in processed products. So, scientists have used rDNA technology to produce GMO/FFPs (genetically modified organisms, food, feed and processed products). Also, geneticists will tell you that not only the gene, but other fragments of DNA (such as the control system or promoter that switches genes on and off, other genes that help in selecting the successful transformants, etc.) are also transferred with the gene.

The Convention on Biological Diversity (CBD) too recognises modern biotechnology (rDNA technology) as having a great potential for the promotion of human well-being, particularly in meeting critical needs for food, agriculture and health care and recommends the use of modern biotechnology in the conservation and use of biological diversity (Artcle 16, para 1 and Article 19, paras 1 & 2).

Current Global Status

Some examples of GM organisms (also known as transgenic plants/animals) are given below:

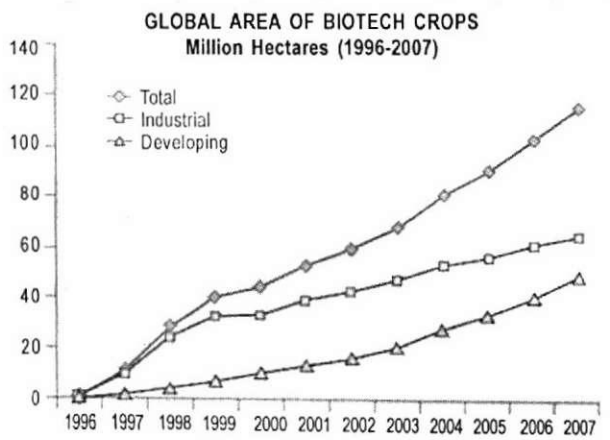
- Bt Corn and Bt Cotton - carry a gene from a bacterium (*Bacillus thuringiensis*, Bt) which produces an endo-toxin that kills lepidopteran insects which are pests of these two crops. Therefore, it is not necessary to spray chemical insecticides to control this pest, as the plant itself produces a toxin.

- Herbicide tolerant soybeans – carry a gene from a bacterium that makes the plant tolerant/ resistant to action of particular herbicide/ weedicide. Therefore, the application of an herbicide (even large doses) to kill weeds will not affect the soybean plants.

- Virus resistant papaya, tomatoes with delayed ripening, blue roses, 'golden' rice producing high levels of b-carotene, bananas, potatoes producing vaccines for several diseases (edible vaccines), better quality canola oil, cattle, sheep producing human milk proteins, fish carrying growth hormones, fluorescent ornamental fish, bacteria producing human insulin and a large number of other pharmaceuticals including blood factors, hirudin, tissue plasminogen activator, streptokinase, interferon, etc., ornamental plants carrying genes for increased vase life, dwarf growth habit, tolerance to diseases, etc. etc.

Figures 1 shows the global area covered by GM crops. Table 1 shows details of crops country-wise.

Figure 1
Global area of GM crops
(International Service for the Acquisition of Agri-biotech – 2007)



Increase of 12%, 12.3 million hectares (30 million acrest, between 2006 and 2007. Source : Clive James, 2007.

Table 1
Global Area of Biotech Crops in 2007: by Country (Million Hectares)

Rank	Country	Area (million hectares)	Crop/s
1	USA *	57.7	Soybean, Maize, Cotton, Canola, Squash, Papaya, Alfalfa
2	Argentina *	19.1	Soybean, Maize, Cotton
3	Brazil *	15.0	Soybean, Cotton
4	Canada *	7.0	Canola, Maize, Soybean
5	India *	6.2	Cotton
6	China *	3.8	Cotton, Tomato, Poplar, Petunia, Papaya, Sweet Pepper
7	Paraguay *	2.6	Soybean
8	South Africa *	1.8	Maize, Soybean, Cotton
9	Uruguay *	0.5	Soybean, Maize
10	Philippines *	0.3	Maize
11	Australia *	0.1	Cotton
12	Spain *	0.1	Maize
13	Mexico *	0.1	Cotton, Soybean
14	Colombia	0.1	Cotton, Carnation
15	Chile	0.1	Maize, Soybean, Canola
16	France	0.1	Maize
17	Honduras	0.1	Maize
18	Czech Republic	0.1	Maize
19	Portugal	0.1	Maize
20	Germany	0.1	Maize
21	Slovakia	0.1	Maize
22	Romania	0.1	Maize
23	Poland	0.1	Maize

** 13 biotech mega-countries growing 50,000 hectares, or more, of biotech crops*
Source: ISAAA - 2007

Risks, Concerns and Biosafety

Biosafety is one of the issues addressed by the CBD which refers to the need to protect human health and the environment from the possible adverse effects of the products of modern biotechnology. Article 8(g) and 19, paragraph 3, recommends the development of appropriate procedures to reduce all potential threats to biological diversity, taking also into account the risks to human health. Article 8(g) deals with measures that Parties should take at national level, while Article 19, para 3, gives the basis for the development of an international legally binding instrument to address the issue of biosafety.

The Cartagena protocol on Biosafety is a result of the meeting of an Ad Hoc Working Group on Biosafety appointed by the CBD resulting in a draft protocol on biosafety known as the Cartagena Protocol on Biosafety. This focuses specially on Tran boundary movement of any GMO that may have adverse effects on the conservation and sustainable use of biological diversity.

What are the risks & concerns?

1. Risks to human health

The risks posed by consumption of GM food to human health include the following:

(i) toxicity (ii) allergenicity (iii) movement of antibiotic resistant genes (iv) effect of strong promoter and (v) changes in nutritional aspects of novel food.

The consumption of food obtained from, for example transgenic crops having Bt gene (e.g. Bt corn), can cause a situation where the new protein (the endo-toxin) can be toxic to human health; the new proteins from Bt crops, and herbicide resistant crops, for example, can cause allergenic reactions in humans; the antibiotic resistant genes in transgenic food can move into other disease-causing organisms in the gut of humans and thus enable them to be resistant to antibiotics; the possibility of strong promoters (e.g. CaMV) switching other genes on/off; although corn is consumed in western communities as corn flakes, in Sri Lanka it is consumed as boiled corn and/or cooked in local curries. Will the foreign protein behave the same as in corn flakes.

2. Risks to Biodiversity and Environment

Once a transgenic crop is introduced to the environment, several risks are encountered as indicated below:

(i) GMO can become invasive as it is a novel organism. The existing races of pests and disease-causing organisms may not be able to harm it. Moreover, if the GMO has herbicide resistance gene, it can become a weed in another crop field or with several genes, a superweed.

(ii) The transgene can move naturally to another crop of the same kind or to a close relative and/or if grown close to a centre of origin, to a wild relative and thus disturb/change the natural biodiversity.

(iii) Although transgenic crops are developed to get resistance to known pests (for example Bt endotoxin harms only lepidopteran insects), when they are grown in Sri Lanka, will the toxin be harmful to other non-target organisms which are numerous in Sri Lanka such as parrots, crows, butterflies, moths, ladybird beetles, soil organisms, etc. No experiments have been carried out to find such effects.

(iv) There is concern about the persistence of the transgene and its stability in subsequent generations.

(v) With the introduction of GMOs by wealthy transnationals, the economic vulnerability of local farmers who have been growing local varieties will have to be seriously considered.

(vi) Other concerns include patenting of genes and other DNA fragments, biotheft & biopiracy and the concern of vegetarians when transgenic vegetables/fruits contain animal genes.

Answer to National Food Crisis

Recombinant DNA technology has up to now produced on a commercial scale only a limited number of crops which are of interest to those who fund such research. They include soybean, corn, canola, tomato, cotton, squash, papaya and alalfa. Varying reports of success/ failure are available on the Internet regarding the cultivation of these crops worldwide.

There is no doubt or debate regarding the fantastic possibilities of producing novel organisms in a very short period of time using this technology. This scientific marvel should be included in the curricula of our schools, universities and other institutes. But the billion rupee question is whether they could be used to solve the 'burning' problems in the agriculture sector!

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The high cost of labour, high cost of chemicals as fertilizer, pesticides and herbicides and hence high cost of production, and lack of available water at the appropriate time, cultivating crops in difficult environments are major components that beg for quick solutions.

The decision-makers have to decide which crop/animal requires this technology and which character needs to be transferred, on a priority basis. The high cost of chemical fertiliser can be reduced by using biofertiliser to some extent, but herbicide resistant transgenic crops will increase the use of herbicides and hence the cost of production. We have to consider the requirements crop-wise. Do we need 'golden' rice? Scientists working with rice need to decide what type of GM rice is urgently required by us. If we have an urgent pest problem can we produce a GM rice plant to overcome it? From where do we get the necessary gene? Do we require a saline/drought resistant rice plant urgently? Can we use this technology and produce transgenic rice for these characters?

These same questions apply to all crops and animals. Until those responsible answer these questions, we cannot agree that GM technology alone can solve our food problems.

Even if we do decide to produce GM plants or animals, we need to have the biosafety regulations in place well in advance. We cannot produce GM organisms and then look for biosafety regulations in a 'cart-before-the-horse' fashion. The Ministry of Health has already established regulations regarding GM food. But what about GM plants? GM animals? GM feed? Processed products having GM ingredients? All of them require relevant regulations in place before any GM organism is introduced to the environment.

The National Biosafety Framework of Sri Lanka and the National Biosafety Policy clearly indicates this.

This is an era of high technology, no doubt, but not any technology for anything. We need to decide soon before we miss this bus too!!!

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