Genetically Modified Plants Panacea or Profit-makers?

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With the introduction of engineered crops, what does the future hold for Mexican corn?

Today, applied genetic engineering in agriculture deals mainly with genetically modified organisms, plants into which a single or several genes have been artificially incorporated. These techniques are unprecedented: previously, genetic crop improvement meant the cross-breeding of entire plants with their full genetic make-up, a process in which to induce a specific desired trait in a stable improved variety, a whole new generation had to grow, which could take up to 15 years.

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Genetically modified cotton grows well in Mexico because climatic conditions are similar to those of the U.S.

This has changed radically thanks to genetic engineering techniques that make it possible to induce new traits in plants with great precision and in a single step. By genetic engineering, we mean "the possibility of artificially creating new organisms through the combination of the genes of totally distinct species."[1] That is, the new combinations of genes would never have occurred in nature. The procedure does not always imply inserting alien genes; it sometimes means inducing changes in the genetic structure of the plant itself. What is new about this is that a gene with the particular information desired (for example, that of the bacteria *bacillus thuringiensis*, which contains the code for producing an insect-fighting toxin) is located and then inserted into the organism in question.

From this point of view the new technology saves a lot of time and makes for greater precision in agricultural improvement. But, at the same time, the risks of commercially cultivating these new plants have not yet been sufficiently studied.

The possibility of commercially appropriating agricultural and germoplasm[2] innovations has attracted large corporations to this branch of production. This is clear in their presence where genetically modified organisms are cultivated[3] and has determined that a large part of the research into the question is done along the lines of profitability.

The few products utilized in developing countries are those whose cultivation requirements coincide with those developed for industrialized countries. For example, in Mexico, cotton is the most widespread of these products because the varieties grown in the United States can be cultivated here without difficulty. But no products have been created specifically for the needs of developing countries.

The challenge for many of these countries, then, consists in developing their own scientific and technological capabilities, as well as the institutional means needed to introduce technology useful to the most vulnerable producers. They also must insert the technologies in production recognizing the market differentiation and segmentation and making the best possible use of the market niches that are of no interest to large corporations.

Table 1
Vavilov Centers of World Diversity

Region	Crops that Originated in the Region
• Central America	• Corn, the common bean, sweet potato
• Andes	• Potatoes, lima beans, peanuts
• Southern Brazil, Paraguay	• Cassava
• Mediterranean	• Oats, rape
• Southwest Asia	• Rye, barley, wheat, peas
• Abyssinia	• Barley, sorghum, millet
• Central Asia	• Wheat
• Indo-Burma	• Rice, dwarf wheat
• Southeast Asia	• Bananas, sugar cane, yams, rice
• China	• Fox-tail millet, soybeans, rice

Source: Germán Vélez and Mónica Rojas, "Definiciones y conceptos básicos sobre biodiversidad," *Biodiversidad, Sustento y Culturas,* Workbook I (Bogotá, Colombia: Programa Semillas, 1998).

In developing countries the maze of social and institutional networks for the dissemination of technology are incomplete or partial and the links needed to make it accessible to the poorest sectors of society are non-existent. This means that the potential risks and benefits of new technology must be carefully evaluated.

Corporations limit their discourse to saying that the new genetically modified plants contain the technology in their seeds themselves, but they do not take into account that the management of these new varieties requires greater specialization both on the part of producers and of public employees and officials who must deal with safely using agricultural biotechnology.

One of the most debated risks is the possible change in biodiversity. By biodiversity, we understand "the wealth, quantity and great variety of living beings in a specific area. It includes all the species and varieties in a territory, in the soil, in the water and seas; in the forests, on agricultural land and the different ethnic and cultural groups that live there."[4]

The possible health risks to anyone who consumes these new plants are also a polemical issue. Since this article will deal with environmental risks, let me just mention that, while it has not been conclusively proven that these new foods are harmful, neither has it been proven that they are harmless. What is clear is that more research is needed, just as some environmentalist organizations demand.

The Environmental Impact

The evaluation of possible environmental impacts on biodiversity of the new genetically modified plants is neither unique nor static, but rather place-specific and variable over time in different types of ecosystems. Countries with great biodiversity like Mexico should be particularly careful about today's products.

The majority of the world's most important centers of biological origins and diversity are in the tropics and sub-tropics, where the plants originated and the most developed agriculture was practiced in ancient times. According to the Vavilov classifications,[5] the world has 10 main centers of biodiversity (see Table 1).

All the components, structure and functions in agroecosystems relevant for agricultural production are vital for future generations' food security.

The mega-diverse countries located in these Vavilov regions are Mexico, Colombia, Brazil, Zaire, Madagascar, India and Indonesia. The rapid deterioration of this biological wealth is clear in Mexico: in 1998 the public was already being warned that if the current process of deforestation and depredation continued, in less than a decade 96 species of birds, mammals, reptiles, fish and amphibians and 66 species of plants and fungus would disappear.[6]

A great deal of discussion has been generated by biotechnology's making it possible to own living organisms. Although the world's biological wealth has for many decades been the source of different substances for pharmaceutical companies that have made endless use of them with no limitations whatsoever, today, this becomes even more critical.

Agrobiodiversity —defined as "the total of components, structure and functions in agro-ecosystems relevant for agricultural production"—[7] is vitally important for the food security of future generations. It can be used to combat new plagues and diseases, to resist climatic change, to face the challenges posed by the growing human population, to deal with changes in consumption habits and to make production more sustainable.

In general, in modern agriculture, since the Green Revolution technological model came on the scene in the 1940s and was widely applied in the 1950s, agrobiodiversity has been paid scant attention. Genetic diversity has been considered a function of improvement, such as in the case of the new form of producing food based on the cultivation of "super-plants," capable of producing their own insecticides and of tolerating drought and which have a series of other favorable traits. However, the negative effects that the constant quest for high yields has had on genetic diversity have been ignored.

Nevertheless, genetically modified organisms are not dangerous per se. The problems arise when the new traits —or a combination of them— produce undesired effects on the environment. These plants cause different kinds of problems depending on the new genes they contain, the characteristics of the mother crop and the surroundings in which they grow.

Concern in Academic Circles

Because the crops and genes are so many and varied, the identification and classification of the potential risks of genetically modified crops is a real challenge.[8] For Jane Rissler and Margaret Mellon of the Union of Concerned Scientists of the United States, putting to one side for the moment the health risks to those who eat these new foods, two kinds of dangers exist on the environmental level: those stemming from the transformed plants themselves and those linked to the transference of genes to other plants.[9]

The first risk implies that the new characteristics of the modified plants would allow them to become weeds in agricultural ecosystems or propagate outside the fields being cultivated, disturbing non-modified ecosystems.[10]

The second kind of risk involves the relocation of transferred genes to the crop's parent plant. This could happen when the genetically modified variety is planted near related vegetation growing wild; this could give rise to new weeds and/or alter the gene pool of the predecessors of a crop. This concern has been voiced with regard to corn in Mexico, the place where it originated and where two of its wild relatives still exist: *teocintle* and *tripsacum*.[11] A similar case is that of the potato in Peru.

A risk derived from this is the possibility that the gene added to the modified organism could be part of a virus. In that case, new viruses could be created that would cause unknown diseases.[12]

Field tests of engineered crops, carried out under controlled conditions to prevent the flow of pollen from the plants to their surroundings, do not necessarily imply that their biosecurity is satisfactory on a commercial level. The ecological risks of these new crops depend on random events caused by the interaction of the modified plants with a specific environment. The absence of such events under controlled conditions in field tests does not mean that they could not arise in normal use.

Other studies conclude that biotechnology in general and genetic engineering in particular can also have a positive effect on the environment, helping to maintain genetic diversity through conserving germoplasm in different ways, using biodiversity to increase efficiency in improvement techniques and reducing the use of pesticides by increasing resistance to blight.[13]

However, the fact that a tolerance to herbicides is the first characteristic of genetic modification speaks to the fact that genetic engineering's contribution to improving the environment is not the main concern of biotechnological multinational corporations. These new plants resist greater quantities of herbicides —often produced by the same firms— such as Roundup, made by Monsanto (whose patent ran out in 2000), which also produces many genetically modified organisms resistent to it.

The engineered crops resistent to herbicides are by far the largest group. In Argentina, Brazil and Uruguay, 60 percent of the field tests centered on this resistance, particularly a tolerance for two: Monsanto's glyphosate (the base compound of its famous Roundup herbicide) and AgrEvo's gluphosinate. Although the companies' argument is that the genetically modified plant's resistance to these compounds will mean using less of them, thus improving the environment, Monsanto is increasing its production capacity for glyphosate in Argentina and Brazil by U.S.$135 million and U.S.$410 respectively. This increase in herbicide sales is due to the growing cultivation of Roundup Ready soy beans, particularly in Argentina, where its commercialization has already been authorized and cultivation has expanded spectacularly: in 1998, two million hectares were planted with it, half of all the country's cultivated land.[14]

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In 1999, of all the land planted with engineered crops, the herbicide resistent ones accounted for the majority (71 percent). The second place was occupied by those resistent to insects (22 percent) and third place, those resistent to both (7 percent). The two latter categories which include resistance to insects are called biopesticides.

Making use of the benefits these crops offer and minimizing their risks require a change in agricultural practices, including implementing programs that would stave off insects' developing a resistance to the toxins the plant is now producing. These programs are called resistance management. In addition, the strategies proposed must be monitored to see if they actually work and to remain alert to possible unexpected effects arising from the interaction of the genetically modified crops with the environment and their cultural and productive surroundings.

This implies the capacity to manage engineered crops. In a country with the enormous contrasts of Mexico, where highly technically advanced producers work side by side with subsistence farmers, the requirements that these crops pose may shunt to the side producers with less training and access to technical assistance. In addition, the lack of appropriate governmental supervision may not only put the usefulness of the technology at risk, but also make some of its potential negative effects a reality. VM

NOTES

1 Humberto Tomasino, "Los cultivos transgénicos ¿los trans...qué?" in *Biodiversidad, Sustento y Culturas*, Workbook 3 (Montevideo: Redes-AT, 1999).

2 Germoplasm is all living things that can be stored, particularly seeds, plant sprouts and micro-organisms.

3 This comes to 39.9 million hectares in the world, an area that has increased steadily since 1996. The largest areas commercially planted with these kinds of crops are in the United States, China and Argentina.

4 Germán Vélez and Mónica Rojas, "Definiciones y conceptos básicos sobre biodiversidad," *Biodiversidad, Sustento y Culturas*, Workbook 1 (Bogotá, Colombia: Programa Semillas, 1998).

5 The Russian biologist Nicolai Vavilov identified these centers of world biodiversity.

6 "En menos de diez años desaparecerían 96 especies animales," *La Jornada* (Mexico City), 29 June 1998, p. 43.

7 Bert Visser, "Effects of biotechnology on agrobiodiversity," *Biotechnology and Development Monitor* 35 (Amsterdam) June 1998, p. 2.

8 Since 1991 Mexican academic circles have been voicing concern about the negative impact of agricultural biotechnology on the environment.

9 Jane Rissler and Margaret Mellon, *The Ecological Risks of Engineered Crops* (Cambridge, Mass. and London: The MIT Press, 1996), p. 22.

10 The history of the introduction of kudzu hay into the United States is illustrative. This grass was introduced at the end of the nineteenth century as an ornamental plant in gardens in the South. In the early 1900s it was promoted as fodder and to reduce soil erosion. After 1930, kudzu spread out of control and now infests 28.3 million hectares of the U.S. Southeast, despite repeated efforts to eradicate it.

11 José Antonio Serratos, "El maíz transgénico en México," in "Los vegetales transgénicos, el ambiente y la salud," *La Jornada Ecológica*, supplement (Mexico City) 31 August 1998, p. 4.

12 Jan Rissler and Margaret Mellon, op. cit., p. 24.

13 Bert Visser, op. cit., p. 5.

14 Genetic Resources Action International (GRAIN), "Los cultivos transgénicos invaden el Sur," *Biodiversidad, Sustento y Culturas* 18 (Barcelona/Montevideo: GRAIN/Redes-AT, 1998), pp. 6-7.

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