

ETHICAL CONCERNS IN PLANT BIOTECHNOLOGICAL RESEARCH

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Introduction

Plant biotechnology is a growing industry promising to offer remarkable economic, social and environmental advantages in the future. The figure below shows that in one decade, the worldwide grown area of transgenic or genetically modified (GM)¹ crops has grown to 12.3 million hectares. Like other waves of change, biotechnology has evoked both praise and adverse reaction leading to a global debate over its potential for good or ill. The reactions whether good or otherwise are bound to be strong because the contents of discussion include food.² Sustaining the revolution in

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¹GM crops: When scientists want plants to show a certain expression, they transfer the genetic code responsible for that expression from another organism. This biotechnological approach allows genes to be introduced into a plant genome from any source resulting in the potential transfer of a wide range of genetic resources between unrelated species. These crops are referred to as genetically modified (GM), genetically engineered, or transgenic crops.

²C. Ford Runge and Ryan Barry, "The Economic Status and Performance of Plant Biotechnology in 2003," Adoption, Research and Development in the United States,"

plant biotechnology will require continued research on and careful thought about, the emerging ethical issues in this field.³

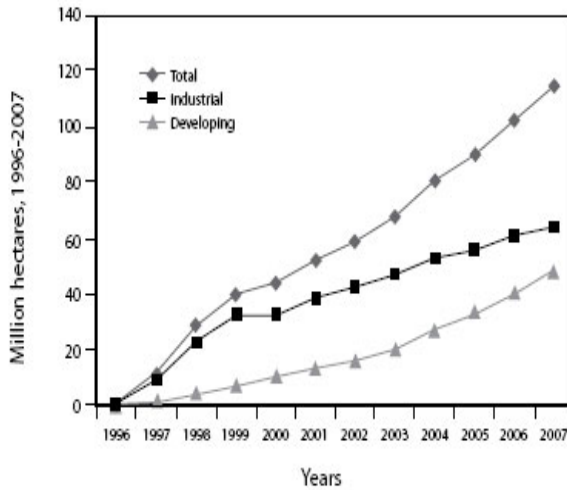


Figure 1. Worldwide grown area of transgenic crops between 1996 and 2007. Increase of 12%, 12.3 million hectares (30 million acres) between 2006 and 2007.

Researchers are aware of the numerous benefits and possibilities of plant biotechnological research.⁴ In this paper however, the potential ethical concerns are emphasised. Some of the enlisted concerns might seem unreasonable and some may have been proven as mere myths. Nonetheless, researchers should be aware and have the accountability to try and understand the fears of the society in the adoption of technologies. Researchers need to weigh each possible concern vis-a-vis desired outcomes of a scientific study. Awareness building in the society about ethical conduct of research is also the responsibility of the scientific community.

December 11, 2003, A Study Prepared for the Council for Biotechnology Information (CBI), Washington, D.C.

³The figure given below is from Andrés R. Schwember, "An update on genetically modified crops," *Ciencia e Investigación Agraria* 35, 3 (2008) 231-250.

⁴N.M. Anishetty, I. Buddenhagen, J.T. Esquinas-Alcázar, E. Wagner, "Plant Biotechnology in Agricultural Research Systems," FAO approach, in Y. Demarly, ed., *Place et rôles des biotechnologies dans les systèmes de recherche agronomique des pays méditerranéens*, Zaragoza: CIHEAM, 1991, 163-168.

1. Ethical Concerns in Plant Biotechnological Research

1.1. Intellectual Property Rights (IPRs)

It is assumed that the agricultural and health fields will see the greatest impact of the changes in biotechnological intellectual property in respect of the bio economy of 2030. To address concerns of climate change and impact on food security as well as the increasing convergence of agricultural and health biotechnologies, pressure will increase on finding collaborative mechanisms to manage intellectual property.⁵

When we talk of IPRs the issues of farmers' rights and benefit sharing come in, which is briefly discussed below. Other issues which emerge in the discussion on IPRs are power imbalances, conflicts of interests,⁶ vulnerability⁷ and other socio-economic issues which are discussed later in this paper. In order to highlight these ethical issues and the relatively greater concern that it poses for developing countries like ours, the famous Schmeiser case study from Canada has been included in the paper.

Farmer's rights (FRs) refer to the rights that farmers deserve for their contribution in conserving, improving and making available plant genetic resources for development of new plant varieties. A farmer will also be able to register a variety developed by him provided it conforms to the 4 criteria (novelty, distinctiveness, uniformity and stability). The Nagoya protocol is a global document which encourages access to genetic resources and the fair and equitable sharing of benefits arising from their utilization. **Benefit sharing** refers to the fact that the community owns traditional knowledge and shall get benefits if it gets commercialized. Even if there are legislations in place to ensure FRs, the need of the hour is to make farmers aware of the same. Besides, ethics has to become an integral part of the work culture of research and bureaucracy.

⁵Intellectual Property: Intellectual property (IP) is a term referring to a number of distinct types of creations of the mind for which a set of *exclusive rights* are recognized known as IPRs.

⁶Conflict of interest (COI) occurs when an *individual* or *organization* is involved in multiple interests, one of which could possibly *corrupt* the motivation for an act in the other interest.

⁷Vulnerability refers to the susceptibility of a person, group, society or system to physical or emotional injury. The term also refers to a person's state of being liable to succumb to *manipulation*, *persuasion* and *temptation*.

1.2. Environmental and Bio Safety Issues

The various environmental and bio safety issues which arise as a result of the increasing plant biotechnological research and the wide adoption of GM crops are:

- a. Genetic erosion and biodiversity loss
- b. Potential introgression
- c. Contamination
- d. Resistance emergence
- e. Harm to other organisms
- f. Resistance to antibiotics

a. **Plant Genetic erosion⁸ and biodiversity⁹ loss:** As mentioned earlier, while some see biotechnology as of great benefit, others see it as an interference with the laws of nature. There are reports that the wide adaptability of GM crops has contributed to plant genetic erosion and has decreased the biodiversity of plants and even animals. Wide adoption of GM crops, accompanied by clean cultivation practices have contributed to plant genetic erosion.

b. **Potential introgression:**¹⁰ or unintended gene flow is a major environmental concern when discussing GM crops. Transferred genes may escape and produce transgressive segregants in the form of super weeds (giant weeds) or unwanted or unintended plant types.

c. **Contamination:** or genetic pollution of indigenous varieties due to GM crops is another concern. The potential appearance of giant weedy relatives resistant to herbicides might cross pollinate GM crops or indigenous crops, polluting them. It is also believed that new diseases have emerged due to transgenic contamination.

d. **Resistance emergence:** There are additional worries about the sustainability and durability of pest resistance as a result of the increasing and uninterrupted use for more than one decade of

⁸Plant Genetic erosion is defined as the gradual loss of plant genetic diversity and plant genetic variation from the population.

⁹Biodiversity refers to the quantity of species and the variety of environments in which species or genes are present.

¹⁰Potential introgression is the infiltration of the genes of one species into the gene pool of another during hybridization.

modified *Bacillus thuringiensis* toxins (Bt),¹¹ which confer insect-resistance to GM crops; in other words there are concerns about the potential for resistance to evolve in the target organism.

e. **Harm to other organisms:** Non-targeted species may be inadvertently harmed by a genetically modified plant producing endo-toxins intended for a specific pest. The Bt endo toxin is widely used by organic and conventional farmers because it is a relatively harmless, natural pesticide. However, genetically modified plants such as Bt corn, cotton, potatoes, rice, and tomatoes constantly produce the Bt endo toxin, and may speed up the spread of Bt resistance among pests that feed on these.

f. **Resistance to antibiotics:** As part of the genetic modification of organisms, marker genes¹² are used to determine if the desired gene has been successfully embedded. Marker genes typically provide resistance to antibiotics. Even though marker genes are genetically scrambled before use to reduce the potential for this danger, their use could contribute to the growing problem of antibiotic resistance.

1.3. Human Health Issues

The various human health issues which arise as a result of the increasing plant biotechnological research and the wide adoption of GM crops are:

a. Toxicity potential and allergies

b. Damage to food quality and nutrition

a. **Toxicity potential and allergies:** Crops engineered to produce Bt, do so in very large quantities. It is produced by every cell in the plant including roots, stems, leaves and flowers. It is also present in the pollen of these plants. The amount of Bt in these plants is enough to trigger allergies in some people, and irritate the skin and eyes of farmers who handle the crops.

In India, when sheep were used to clear a field of left over Bt cotton, several sheep died after eating it. Reports also say that genes might transfer from GM corn to turn human intestinal bacteria into

¹¹Bt (*Bacillus thuringiensis*) is a ubiquitous soil bacterium that synthesizes proteins called crystal (Cry) proteins. Bt crystal proteins are ingested by insects, subsequently resulting in a protoxin and then an activated toxin which eventually kills the insect by osmotic lysis.

¹²A marker gene is a gene used in nuclear biology to determine if a nucleic acid sequence has been successfully inserted into an organism's DNA.

living pesticide factories. British scientific researchers have demonstrated that genetically modified DNA¹³ material from crops is finding way into human gut bacteria, raising potentially serious health questions.

b. Damage to food quality and nutrition

A 1999 study by Dr Marc Lappe published in the *Journal of Medicinal Food* found that concentrations of beneficial phytoestrogen compounds, thought to have protective effects against heart diseases and cancer were lower in genetically modified soybeans than in traditional strains. These and other studies, including Dr. Pusztai's, indicate that genetically engineering food might result in foods lower in quality and nutrition.

1.4. Socio Economic Issues

The various socio-economic issues which arise as a result of the increasing plant biotechnological research and the wide adoption of GM crops are:

- a. Religious beliefs
- b. Difference in views across areas/cultures
- c. Labelling and autonomy
- d. Power imbalances and vulnerability

a. Religious beliefs: In many orthodox, closed societies with vegetarian populations, people fear that the Bt of GM crops, for example Bt rice, would pollute their traditional rice varieties and make it non-vegetarian. They feel that the production of GM crops is against the laws of nature. Although this issue might not seem genuine but is an issue nevertheless as far as the social impact of the technology is concerned.

b. Difference in views across areas/cultures: Cultural beliefs and socio economic conditions shape the views of people. Therefore, transgenics which have been widely accepted in one society might not be so well received in other societies. Africa has so far blocked easy entry of GM crops into the continent. It is important to

¹³DNA(Deoxyribonucleic acid) is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses.

understand the effect of cultural relativism¹⁴ when pushing GM crops into certain societies.

c. **Labelling and autonomy:**¹⁵ In most countries, GM foods are not labelled. According to the Institute of Food Technologists, genetically modified foods should not be labelled because “labels are likely to mislead consumers by implying a warning...” However, this deprives people of their basic right to decide what to purchase. People for whom GM or natural makes a difference due to religious and cultural beliefs, not labelling, is definitely an infringement upon their autonomy.

d. **Power imbalances and vulnerability:** Multi-national Company (MNC) monopoly and domination leaves very less choice for farmers. Poor economic conditions and illiteracy are probable factors which make the farming communities vulnerable. Their vulnerability forces them to buy and sow GM seeds although it might be unaffordable for them. In case of crop failures, power imbalances prevent them from fighting the MNCs and there are instances when farmers have gone to the extent of committing suicides.

In the long run, there might be danger that indigenous farmers will be driven off the land and consumers’ food choices will be dictated by a league of multinational companies. Hundreds of millions of farmers and agricultural workers worldwide might lose their livelihoods and rural communities might be devastated.

2. Case Study

The case: Imagine that a storm blows across your garden — and that now, without your knowledge and without your consent, foreign and genetically — manipulated seeds are in your vegetable patch which you have nourished and maintained for many years. A few days later, representatives of a multi-national corporate group pay you a visit at home, demand that you surrender your vegetables and file a criminal complaint against you. What would be your response?

Case discussion: This is a real case of Monsanto Canada Inc. v.¹⁶ The ethical issues that come up in the case include,

¹⁴Cultural relativism is the principle that an individual’s beliefs and activities should be understood in terms of his or her own culture and the principle beliefs that there are no universally acceptable standards.

¹⁵Autonomy is the right to self determination and the right to make informed decisions.

¹⁶Monsanto Canada Inc. v. Schmeiser, 1 S.C.R. 902, 2004 SCC 34 239 D.L.R. (4th) 271, 31 C.P.R. (4th), 2004, 161, Claudio Chiarolla, *Intellectual Property, Agriculture and Global Food Security*, Edward Elgar Publications, 2011, 87, footnote 41.

- MNCs monopolize/dominate market
- Conflict of interest
- Resource constraints and vulnerability
- Patents and Power imbalances-human rights issues
- False claims (deception) — Contrary to biotech industry propaganda, recent studies have found that US farmers growing GE crops are using just as many toxic pesticides and herbicides as required by conventional crops, and in some cases are using more. There have been similar observations all over the world.

Percy Schmeiser was a farmer from Bruno, Saskatchewan Canada whose Canola fields were contaminated with Monsanto's Round-Up Ready Canola. Monsanto's position was that it didn't matter whether Schmeiser knew or not that his canola field was contaminated with the Roundup Ready gene, or whether or not he took advantage of the technology (he didn't); that he must pay Monsanto their Technology fee of \$15/acre.

According to court ruling, the Monsanto appeal was allowed in part but agreed with Schmeiser, ruling that he didn't have to pay Monsanto anything. The seed saved and developed by Schmeiser was destroyed by Monsanto. In an out of court settlement finalized on March 19, 2008, Percy Schmeiser has settled his lawsuit with Monsanto. Monsanto has agreed to pay all the clean-up costs of the Roundup Ready canola that contaminated Schmeiser's fields.

The Schmeisers, while standing up for their rights, felt that it was impossible for an individual to stand up against a large MNC. When this was what they felt, such a step cannot be imagined from a probably illiterate farmer from a developing country.

Indeed, "the complexity of the interaction between society environment and technology makes predicting the precise course of the future (of plant biotechnology) very difficult."¹⁷

There is a need for guidelines for research and marketing of GM crops which should be strictly adhered to. It should address safety assessment, appropriate cultivation practices to avoid unintended gene flow (potential introgression), patenting issues and

¹⁷Henry Petroski, *The Evolution of Useful Things*, New York: Vintage Books, A Division of Random House inc, 1992.

compensation to farmers in cases of crop failure. Clear definitions of Farmers' Rights, Plant Breeders' Rights and Benefit sharing and IPRs as they apply to plant variety protection, need to be established in many countries to preserve traditional farming systems. Enforcing labelling of GM foods, which is related to informed decision making of the people, needs a thought too.

At least a minimum level of knowledge of bioethics is desirable for a plant researcher for carrying out responsible research. Researchers and agricultural development workers need to be aware of current policies and guidelines that can fairly address concerns about farmer's rights, agro biodiversity, public research, and private sector profit. Other stakeholders like the farmers should also be involved in the ethical assessment of genetically modified crops. Ethics education and sensitization of the society in general and plant researchers in particular, in order to instil in them critical reflection and ethical responsibility is the need of the hour.

(Undoubtedly, in view of the benefits that technology provides in plant improvement), "it is a powerful tool that will complement traditional plant breeding. (However, the use of plant biotechnology) should be critically analyzed case by case due to the complexity of the biological issues and to avoid irreversible damage to ecosystems."¹⁸

¹⁸Henry Petroski, *The Evolution of Useful Things*.