

Genetically Modified Organisms

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Recent reports have brought to public attention concerns about Bt corn and genetically modified organisms (GMO) in general. The timing, it seems, is most appropriate considering two related developments early this year: the final approval of the Cartagena Protocol on Biosafety in Montreal on January 29, 2001, and the OECD Edinburgh Conference on GM food safety last February 28- March 1, 2001.

The protocol makes clear that GMOs include all living modified organisms (LMO) defined as “any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology”. This includes seeds, live fish, and other organisms intentionally obtained for release to the environment. It would seem that the common understanding about GMOs as referring to farm-to-table products is perforce expanded to embrace genetically modified farm animals and aquatic resources. Being a trade agreement, the Montreal accord primarily deals with the safety issues related to the transboundary movement of LMOs around the globe.

The OECD conference on the other hand, called for an international body “to address all sides of the GM debate” in response to the public outcry, particularly in Western Europe, regarding the risks the new products pose to human health and the environment. Some points of contention, which remain unresolved, include issues such as whether countries should be allowed to develop their own GM food based on their needs, and whether a global moratorium on GMOs and mandatory labeling should be enforced worldwide.

BT CORN

The U.S., Canada, and France are the leading producers of GM crops. Brazil, Argentina, West Africa, Japan, Australia, and New Zealand have also adopted this form of agrobiotechnology. Recently, Japan announced its plans to double its investment in biotechnology while Taiwan is engaging U.S. expertise to enable it to become the biotechnology center in this part of the world.

Genetically engineered corn or maize is one of at least thirty-six GM food products available in the world market. Soybean, cotton, canola, potato, and squash are the other top modified crops in terms of land area planted to them. In 1998 the total area planted to GM crops is 27.8 million hectares, 23.3 million hectares or 84 percent of which are in the U.S. and Canada. Compared to the 1997 figures (11 and 9.4 million hectares, for U.S. and Canada respectively), the increase in total land area is about 153 percent.

GMOs are derived from traditional organisms or crops using the techniques of recombinant DNA technology. A genetic package, consisting of a gene which encodes the protein that produces the desired characteristics in the modified organism, a promoter and a marker gene, are introduced into the DNA of the parent organism. The promoter regulates the amount and distribution of the trait-determining gene in the new organism while the marker provides a means to test for successful transformations or events. For agricultural products, the desirable characteristics or outcomes include, for example, resistance to either pest or herbicide or both, protection against plant viruses, and the introduction of

micronutrients in plants. Quite controversial is the use of the technology to produce sterile seeds, also called terminator seeds, which compels farmers to purchase new seeds for every planting season.

Protein crystals produced by the bacterium *Bacillus thuringiensis* (Bt) had been used for more than thirty-five years as the active component of biological pesticides, which are commercially available in various formulations: liquid concentrates, powders and ready-to-use dust and granules. Organic growers generally prefer these insecticides over their chemical counterparts since the bacteria are naturally occurring organisms commonly found in soils. The obsolescence of this agricultural practice, brought about by the development of resistance to the genetically engineered Bt toxin by the target insects, is precisely one of the more important reasons cited against the use of the technology.

The gene of interest in modified corn is obtained from the bacterium, thus, the name Bt corn or Bt maize. Its distribution in the plant varies among the different corn hybrids. KnockOut (Novartis Seeds) and NatureGard (Mycogen Seeds), for example, have these genes only in the green tissues and pollen; YieldGard (Monsanto and Northrup King/Novartis Seeds) has genes distributed throughout the entire plant.

The Bt protein is toxic primarily to corn borers. When the insect feeds on the plant, the protein becomes activated by the enzyme in the insect's gut, eventually killing it within two to three days. The modified corn in effect acquires a built-in pesticide. In the U.S., the target pests are the European corn borers which are responsible for losses amounting to as much as one billion dollars annually. In the Philippines, the losses brought about by Asian corn borers are estimated to be about 20 to 30 percent of the annual potential yield.

Among the objections raised against the use of Bt corn are (a) the possibility of allergic reactions in humans; (b) the development of resistance by the insects against the toxin; (c) Bt toxin leakage through the root system to the soil, hence the possibility of gene transfer to other soil bacteria; and (d) outcrossing with other corn varieties.

Proponents of the technology enumerate as advantages the desirable characteristics and nutrient transfers mentioned above, and the enhanced ability to increase world food production. In the case of cereals, according to Nobel Laureate Norman Borlaug, the production should be raised by eighty percent over the 1990 average by the year 2025. Management strategies to contain the development of resistance against the Bt toxin are incorporated in integrated pest management systems. Moreover, strict registration requirements and regulations ensure safety against possible harm to humans and the environment.

GMO CONTROVERSY

In Switzerland the national debate from 1996 to 1998 on the so-called "excesses" of recombinant DNA technology led to a final vote on the Gene Protection Initiative which sought to outlaw, if not severely curtail, some activities, GMOs included, in biotechnology in the country. What became a difficult battle for scientists and advocates of the technology ended up in their favor, with two out of three voters expressing support for their cause.

Shortly after the Swiss settled their GMO issue, public concern for food safety in the U. K. was brought to greater heights after a British scientist announced on television that rats fed with genetically modified potatoes suffered from stunted growth and a damaged immune system. His research data were promptly reviewed by various groups, including one panel, convened by the British Royal Society, which dismissed his findings as "flawed". The journal *Lancet*, which published his research results, was later criticized as "irresponsible" by the U.K. Biotechnology and Biological Research Council. The controversy continued with Prince Charles siding with the scientist who chose to retire after an indefinite suspension was served upon him, and after his laboratory was unceremoniously padlocked by the institute director.

Although not as intense as in the British situation, the American public appears to be entertaining some reasons for alarm regarding the risks to which GMOs expose consumers and the environment. This was

prompted by a 1999 report in *Nature* by an American entomologist about his studies on monarch butterflies. He reported that larvae fed with leaves dusted with Bt corn pollen died within four days. The mortality rate was 44%. The scientists however noted that their data are laboratory results which need to be validated in field experiments.

To date only two laboratory studies, the potato and monarch butterfly experiments, which bear upon the GMO controversy appear to have been undertaken by independent groups. This may be surprising considering that the first Bt corn was approved for commercial distribution as early as 1996 by the U. S. Environmental Protection Agency.

Government response to protests against GMOs in other countries has taken various forms: heightened public information campaigns about the new product, ban or moratorium on importation, stricter regulations such as separate storage and labeling, and regional monitoring and cooperation. International organizations continue to address the issues surrounding the GMOs, but in many instances representatives from developing countries end up not entirely pleased with the final versions of legally binding agreements, that is, when these are the expected outputs of international negotiations.

New concepts dealing with modified organisms have also evolved. Substantial equivalence, for example, refers to the determination of the safety of the new product for human consumption. The procedures appear to be quite cumbersome, but they seem to have gained international acceptance in spite of criticisms that the concept is “pseudo-scientific”. Precautionary principle, a concept which traces its origin to international agreements concerning the environment, has found its place in the Cartagena Protocol, the trade agreement referred to earlier. Under this principle, a country may choose, as appropriate, not to trade in LMOs even in the absence of “scientific certainty” that the organisms are harmful to human health or the environment. What constitutes “scientific certainty”, however, is far from clear as the Bt corn issue in General Santos City, South Cotabato, is likely to demonstrate.

THE GENERAL SANTOS CITY BT CORN ISSUE

The actions taken by the community and the local government of General Santos City are not any different from the public response to GMOs in other parts of the world. The fact that the issue has been brought to the courts is not difficult to appreciate at a time when modified genetic resources are fast becoming the newly discovered items of international commerce. Through their collective decision, the community asserts in concrete terms their fundamental rights to health and to a balanced and healthful ecology as provided for in the 1987 Constitution (Art. II, Secs. 15 and 16). No less than the Supreme Court has underscored the primordial importance of these rights when it noted, in *Juan Antonio v. Fulgencio Factoran* (G. R. No.101083, July 30, 1993), that their advancement “may even be said to predate all governments and constitutions. As a matter of fact, these basic rights need not even be written in the Constitution for they are assumed to exist from the inception of mankind.”

The resolution of the case now belongs to the courts. As it appears, the issues could be fairly complicated and may require the assistance of expert testimony. Hopefully, the equivalent Daubert standard (*Daubert v. Merrell Dow Pharmaceuticals*, 509 U. S. 579 (1993)), not the Frye test of general acceptance (*Frye v. United States*, 54 App. D. C. 46, 293 F. 1013 (1923)), which Daubert set aside after seventy years, will be made to apply in the instant case. In this manner, the rigorous requirements of scientific evidence and scholarship demanded by Daubert will help pave the way for a reasoned settlement of the Bt corn controversy.

As in other courts confronted with scientific issues, the likely outcome of the litigation may depend on the trial judge’s attitude toward law on one hand and science on the other. Those who are confident that the law can deal with situations where science fails to serve public interest can be one of two types: a full believer of science or entirely the opposite. In the former case, the risk is a decision based on blind faith; in the latter, a decision based on caution. Among those who feel that current legislation is inadequate—an example, it seems, is DNA profiling in sex assault cases—the judge, while

maintaining faith in science, can opt to be restrictive in allowing it to proceed with its course. Another possibility refers to a situation where mistrust for science leads to skepticism on the part of the judge and, hence, inaction or a delay in judicial decision. In any case, the goal is the pursuit of balance among competing considerations. A true disaster is when science and technology is severely curtailed in a manner that is reminiscent of the Luddites of 19th century England who professed that technology is harmful to society.

REMARKS

Bt technology is still a relatively new field. It may very well be labeled as a first generation technology. As novel and useful organisms are discovered and new transformations are successfully carried out in the laboratory, second generation technology capable of producing “smart proteins” is a possibility in the near future. Coupled with the new knowledge that will be available when the ongoing genome projects on major crops—rice, corn, and cassava presently—are completed three to five years from now, the implications for improved world food production and nutrition can be far-reaching indeed.

Biotechnology goes beyond its applications in agricultural products. It has gone into the realm of animal science producing improved livestock and important pharmaceuticals, such as insulin to treat diabetes, from animals modified through the introduction of human genes into the animal’s DNA. Xenotransplantation, the use of animal tissues or organs for transplantation to humans, is another area of application which is actively being pursued in various laboratories. A significant breakthrough was the cloning of a sheep in 1996 in Scotland. Dolly, the cloned offspring, came into being with the use of a procedure referred to as somatic nuclear cell transfer. Alarmed that this development has made the cloning of humans a not too distant reality, governments have responded by restricting research on human embryos, as well as passed legislation which expressly prohibit human cloning. Gene therapy, screening for genetic disorders like breast cancer, and reproductive technologies to address fertility problems are some of the more common applications of biomedicine to humans. Human stem cell research

appears to be both promising and controversial. Laboratories are now looking into the possibility of “instructing” these pluripotent cells to develop into human tissues for xenotransplantation work, thereby overcoming acute rejections which presently limit animal to human transplantation efforts. In 2003, the human genome project is expected to be completed and, like the developments which followed the elucidation of the DNA structure in 1953, this could lead to great advances never before imagined in medical research and practice.

Nobel Laureates James D. Watson, co-discoverer of the DNA structure, and Robert F. Curl both said that the 21st century will be the era of the life sciences—genetics, biology and their related disciplines. The above discussion suggests why.

Like any other scientific discipline, biotechnology has its own package of benefits for society. Like the others, it is also not immune from causing possible harm brought about by the negligent or irresponsible use of knowledge it acquires through research and development.

Indeed, the Bt corn controversy is far more than interesting. It has become a national issue where public policy, political will, community concerns, scientific evidence, and judicial wisdom will all come into play.

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