African Journal of Biotechnology Vol. 9 (52), pp. 8901-8904, 21 December, 2010
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 ©2010 Academic Journals

Review

Ethical issues in the use of the terminator seed technology

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Accepted 25 June, 2010

Biodiversity and food security especially in developing countries are under threat by a newly patented technique for preventing plants from producing viable seeds. The method dubbed "the suicide seeds" by critics was developed in a joint venture between the United State Department of Agriculture (USDA) and Mississippi based Delta and Pine Land Company, the largest cotton seed company in the world. Ethically, the technology will enslave farmers by making them dependent on multi-national seed companies for supply of seed inputs and other chemical inducers. The advocates of the new technology argue that for patents to be protected effectively, the technique has to be incorporated into seeds. However, multi-national seed companies, like Monsanto, control the supply of these seeds and farmers in developing countries will be hooked to these seeds. Critics argue that the technology endangers biodiversity and well-being of 1.4 billion rural people world wide, especially, in developing countries that normally depend on farm-saved seed.

Key words: Terminator seeds, food security, ethical issues, biodiversity.

INTRODUCTION

Transgenic crops have become a reality in present day Agriculture. About 28 million hectares of genetically engineered crops were grown in 1998 season with soybeans, maize, cotton, potato and canola/rapeseed being the five principal transgenic crops (Anonymous, 1999). Transgenic upland cotton was 79% up from 76% in the year 2004 in the United States of America (Anonymous, 2005). Biotechnology techniques are being applied to plants to produce plant materials with improved composition, functional characteristics or organoleptic properties. Genetic modifications have produced fruits that can ripen on the vine for better taste yet have a longer shelf life through delayed pectin degradation (Bennett et al., 1989; Gross, 1988) or altered responses to the plant hormone ethylene (Bleecker, 1989). Among the first commercially available whole food products was the flavr savr (Calgene, Inc) slow ripening tomato, which United States Food and Drug Administration (FDA) approved in May 1994. The gene for polygalacturonase the enzyme responsible for softening, is turned off in this, tomato (Henkel, 1995). There are obviously attendant controversies associated with these transgenic crops, for example, for many years; the Canadian public saw genetically modified rapeseed/canola as another potentially profitable, farm management strategy. But that was before Canada's international market for rapeseed collapsed amid years of genetically modified (GM) crops contamination and Monsanto took a farmer (Percy Schmeiser) to court (Anonymous, 2001). A recently patented method for preventing plants from producing viable seeds could have a serious implication for farming systems and even biodiversity and food security especially in developing countries.

The technique dubbed "terminator technology" by critics was developed in a joint venture between the United States Department of Agriculture (USDA) and Mississippi based Delta and Pine Land Company, the largest cotton seed company in the world. Delta and Pine Land Company was newly acquired by Monsanto, split-ting control over the patent between USDA and the biotechnology giant. Already a force in the pesticide market, Monsanto has been steadily buying up seed companies in recent years, thus consolidating its control over seed market.

The widely criticized terminator technology identified by Rural Advancement Foundation International (RAFI) in March, 1998 is a technique for altering plants genetically so that the seeds they produce are sterile. Farmers are

able to produce a crop normally using the new seeds but the second generation seeds will die before they mature. As a result, farmers will have to purchase new supply of seeds each year of any variety that incorporates this technology. So far, the technique has been shown to work in cotton and tobacco seed but Delta and pine Land Company believes it should be effective in other crops, including food crops of importance to developing countries.

This technology endangers agricultural biodiversity and the well being of 1.4 billion rural people world wide especially in developing countries that normally depend on farm saved seed and local plant breeding (Anonymous, 1999). Lured by the higher yield of the new varieties, farmers could quickly become dependent on them and abandon their traditional varieties. Once hooked, however, and with the traditional varieties gone, farmers will have no alternative but to continue to buy commercially bred “terminator seed” whether or not it is in their best interest to do so.

The new generation of terminator patent reveals that companies are developing terminator seeds whose genetic traits can be turned on and off by external chemical inducer. Mixed with the company’s patented agrochemical, there is also a possibility of applying the patent through the company’s propriety pesticide, fertilizer or herbicide. The latest version of Monsanto’s suicide seeds would not even germinate unless exposed to a special chemical.

This paper highlights the implication of the terminator seed technology on the farming community and examines a few ethical issues in the use of this technology.

THE TERMINATOR SEED TECHNOLOGY

The patent of terminator seed technology describes a set of interacting genetic elements that allow the controlled expression of value-added traits of seed viability in a crop plant. With this technology, it becomes possible to grow crops, which have seed that are viable when sold to the farmer, but of which seeds from subsequent harvest are sterile. As a result, farmers would be unable to maintain a commercial variety from their own seed stocks and would be forced to return to the seed provider.

Novel biological means can be used to gain corporate control over the first link in the food chain-the seed. New biotechnologies controlled by corporations allow the engineering of crops that kill their own seed in the second generation, making it impossible for farmers to save and replant. The Rural Advancement Foundation International (RAFI) has dubbed this genetic sterilization invention “Terminator Technology” and has analyzed its serious social, economic and environmental implications (Anonymous, 1998). Companies are now working on controlling several important genetic traits with a number of external chemical catalysts. The six, transnational agro industrial firms that control almost 100% of the biotechnology transgenic seed market will dominate these new technologies, their ability to insert and externally manipulate vital DNA sequences within crops threatens the sovereignty of nations over their agriculture and biological resources.

Three different genes present in a plant are involved in terminator technology and act in the following stages:

A gene produces a toxin at the time when the seed matures and kills the seed. This gene is usually not active and the seeds are normal until the seed matures.
A gene that activates the toxin-producing gene to become active to produce the toxin. This gene is also not normally active until the seed matures.
A gene that activates, switches on gene (b).

In normal situation, all the three genes are inactive and the seed germinates and grows normally and produces viable seed for the next generation. However, when a certain chemical is applied to seeds containing these three genes, gene number (c) is switched on, which then produces a special protein that enables gene number (b) to turn on the toxin producing gene number (a). The plant grows normally because the toxin is only produced as the next generation of seed matures. However, as it does mature, so it is killed.

IMPACT OF THE TERMINATOR SEED TECHNOLOGY ON THE FARMING COMMUNITY

The greatest concern about terminator technology especially as it affects poor farmers is that they would be unable to maintain commercial varieties from their own seed stock and would be forced to return to the seed provider. This will translate into non availability or lack of seed inputs to the farmers. This will greatly affect the level of agricultural production and the farmer’s income thus, undermining food and social security. This will tantamount to a technology imprisoning target users which is an issue of social concern.

For quite long, farmers in developing countries have the culture of seed sharing and exchange among themselves with the traditional landraces and available crop varieties. However, with terminator seeds, this is not possible and it will greatly hamper this beneficial and sustainable culture of the local farmers who mostly practice subsistence agricultural production. Also, courtesy of this culture traditional landraces possessing desirable characteristics and adaptability to the local environment such as disease and pest resistance, drought tolerance, etc acquired over time compared to modern varieties are exchanged among farmers and this cycle of seed exchange will be impaired by terminator technology. More complicating is the fact that Intellectual Properties Rights prohibits farmers from saving seed and undertaking their own breeding programs and prohibit plant breeders from using the material to create new generation of varieties adapted to specific regions of growing conditions

(Guebert, 2001). The regulatory process, in fact, may not answer most questions about the environmental and human health risks of commercial production of transgenic crops (Anonymous, 2003).

ETHICAL

Ethical issues involved in the use of terminator seed technology includes: violation of natural organisms' intrinsic values, tampering with nature by mixing genes among species and domination of food production by a few companies. The most critical issue concerning this technology is of ethics and bioethics. An important part of bioethics is risk assessment, the analysis and prediction of risks. Risk assessment is the use of scientific data to estimate the effects of exposure to crops that have been altered genetically by changing their genetic constitution using genetic engineering methods or gene breeding. There are several risks of genetic engineering some of which are: (i) the risk of unintentionally changing the genes of an organism, (ii) the risks of harming that organism, (iii) the risk of changing the ecosystem, and (vi) the risk of change or harm to any other organism of that species or others including human beings who may even be the target of change. The extent to which a change is judged to be a subjective harm depends on human values, whether nature should be intransient or modified. This relates to the fears that technology is unnatural.

With the advent of terminator seed technology, the genetic constitution of the seed would be altered and the more common concerns are interference with nature or general fear of a more intangible kind (Macor, 1994). Taking into cognisance the role of subsistence farmers in developing countries as the major stakeholders in agricultural production, poverty will increase among these poor resource farmers, leading to greater social imbalance. This is because with terminator technology, they are perpetually dependent on multinational seed corporations for the supply of the vital input – the seed. Bruhn (1992) reported that consumer concerns are about genetic engineering related to perceived unpredictability, risks to the environment, alterations in the ecosystems and moral and social questions. An ethical issue of great concern about new technologies altering nature as reported by Epstein (1998) is that "At a time when an estimated 50,000 species are already expected to become extinct every year, any further interference with the natural balance of ecosystems could cause havoc. Genetically, engineered organisms, with their completely new and unnatural combinations of genes, have a unique power to disrupt our environment. Since they are living, they are capable of producing, mutating and moving within the environment. As these new life forms move into existing habitats, they could destroy nature as we know it, causing long term and irreversible changes to our natural world." This is a violation of the balance of natural ecosystem.

In stemming the preponderance of terminator technology in agriculture, various governments have very important roles to play. These technologies will soon be available commercially with their attendant adverse consequences on farmers, food security and agro-biodiversity. By genetically engineering plant so that their seeds lose their viability unless sprayed with patented formulae, most of which turn out to have antibiotics as their primary ingredient, it seems to be, therefore, that the idea is to keep farmers from keeping stock of genetically engineered seeds, thus forcing them to buy it every year, making them dependent on profit – oriented multinational corporations for their production. The corporations involved are unconcerned about the gene escaping into the wild, with obvious disastrous results, even though that is a clear scientific possibility (Epstein, 1998), which is clearly an ethical issue of utmost concern.

The developers of this technology Delta and Pineland Company and USDA have applied for patents on the terminator technology in at least 78 countries. If the terminator technology is widely utilized, it will give the multinational seed and agrochemical industry an unprecedented and extremely dangerous capacity to control and dominate the world's food supply (Anonymous, 1999).

ENVIRONMENTAL

The environmental danger of terminator seed technology which bounds on ethical concern as reported by geneticist Joseph Cummings in 1998 is "pollen escaping from the terminator crop is sterile and cannot spread to weeds or other crops. Pollen escaping from the tetracycline treated seed-producing crop can spread the terminator blocking genes. When a weed is fertilized, for example, with the terminator pollen, the new generation of seeds will bear plants, with fertile pollen. In the next generation, only 25% of the terminator plants will produce fertile genes, since the sterile pollen cannot spread the terminator genes, the spread of terminator genes will always be in the population. The situation is similar to lethal genetic diseases in human. Terminator does not threaten plant populations if it is spread only by normal sexual processes. However, spread of terminator by other means is more intimidating. Spreading terminator genes by virus could easily cause a wide array of weeds and crops to be rendered sterile and genetic recombination eliminate the reversing action of tetracycline. The terminator virus could have a profound influence on crop production. Such genes are potentially able to create chromosomes mutation leading to genetic erosion and untold changes in gene regulation and expression. They are very highly mobile and once introduced into higher plants and animal are likely to spread and not meant to leave ever."

The crucial issue of concern as related to both moral and ethical values concerning terminator seed technology is that the proprietors of the technology seem to be

"playing God" and are creating new life forms as well as tampering with nature. Chemically dependant seeds, the aim of terminator technology, will hold farmers to ransom and therefore, food security especially in developing countries is threatened; Multinational corporations will thus control the supply of these seeds and therefore National Agricultural production could become wholly dependent upon foreign exports of critical chemical inducers. Is it a fair deal to the subsistent farmers in developing countries as well as their national economies? Thus, genetic trait control technology could become a biological weapon used for agro-terrorism. In the words of Geri Guidetti of the ARK Institute, "Never before has man created such an insidiously dangerous, far reaching and potentially perfect plan to control the livelihoods, food supply and even survival of all humans on the planet" (Anonymous, 1998).

There has also been a mounting opposition to terminator seed technology among environmental NGOs based in Britain. "Terminator Technology amounts to a complete block on crop breeding" said Owain Williams of the London based Gaia Foundation. Its only purpose is to protect profits. After a meeting of the commission on genetic resources, 23 African delegates issued a statement which said "we will not accept the use of terminator technology on African soil because it will kill the capacity of the seed to germinate which we believe is a fundamental crime against nature and humanity.

The most important questions to ask concerning terminator seed technology which have moral bearing are:

Is it not a crime against nature and humanity to kill seeds in order to establish a monopoly market by any firm or government or individual?
Can any responsible government encourage a technology that imprisons and enslaves her citizenry?
These are serious ethical issues of concern with use of the terminator technology.

CONCLUSION

Terminator seed technology will have adverse consequences on on-farm conservation and development of plant genetic resources. Traditional landraces may disappear or become genetically contaminated. The technology tinkers with nature, the environment and natural ecosystem by altering them. It is imperative, whatever we do as Scientists, Politicians or Business men, that we have a moral duty to ensure that the planet is not left in a worst condition than we inherited it and that we conserve the legacy of the past so that future generations might have access to it. Supportive documents to the precautionary principle necessary to do this as articulated by international conventions include (i) Rio Declaration on Environment and Development (1992), (ii) The Earth charter (2000), (iii) The Convention on Biological Diversity (1992), (iv) The Cartagena Protocol on Biosafety (2000) and (v) International undertaking on Plant Genetic Resources (1998) which was signed by about 110 countries. For example, eighty six countries and the European Union agreed on implementation steps for the United Nations Cartagena Protocol on Biosafety which came into force in September 2003 (Anonymous, 2004). There is the need for governments of developing countries to formulate and enact appropriate policies against the influx and proliferation of terminator seeds and asso-ciated products under whatever guise into their agricultural and farming system, sensitization of farmers and agroinputs importers about terminator technology can also have an impact.

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