



RAFI COMMUNIQUE

March/April, 1998

RURAL ADVANCEMENT FOUNDATION INTERNATIONAL

The Terminator Technology New Genetic Technology Aims to Prevent Farmers from Saving Seed

ISSUE: On March 3, 1998 the US Department of Agriculture (USDA) and an American cotton seed company, Delta & Pine Land Co., received a US patent on a technique that genetically alters seed so that it will not germinate if re-planted a second time. The technology aims to prevent farmers from saving seed from their harvest to re-plant the following season. Because it is a potentially "lethal" technology, RAFI has dubbed it the "Terminator Technology."

IMPACT: If commercially viable, the Terminator technology will have profound implications for agriculture. It is a global threat to farmers, biodiversity and food security. The seed-sterilizing technology threatens to eliminate the age-old right of farmers to save seed from their harvest and it jeopardizes the food security of 1.4 billion people – resource poor farmers in the South – who depend on farm-saved seed. The developers of the technology say that it will be targeted for use primarily in the South as a means of preventing farmers from saving proprietary seeds marketed by American seed corporations. Delta & Pine Land Co. 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 the world's food supply.

PARTICIPANTS: Although the USDA and Delta & Pine Land (D&PL) jointly hold the patent on the Terminator technology, Delta & Pine Land has exclusive licensing rights. D&PL is the largest cotton seed company in the world. With 1997 annual sales of \$183 million, D & PL holds 73% of the US cotton seed market and is a major soybean breeder. Monsanto (US-based agrochemical and seed giant) is a minor shareholder in D&PL; the two companies jointly own a cotton seed venture in China (D&M Intl. LLC).

POLICY IMPLICATIONS: RAFI and other NGOs are calling for a global ban on the use of the Terminator technology. Both the patent and the technology should be rejected on the basis of public morality. NGOs will call on the Consultative Group on International Agricultural Research (CGIAR) to publicly denounce the technology as a threat to food security in the South. The Fourth Conference of the Parties to the Convention on Biological Diversity will have an opportunity to address the issue when it meets May 4-15 in Bratislava, Slovakia. The FAO Commission on Genetic Resources for Food and Agriculture will meet in Rome, 8-12 June. NGOs will urge both intergovernmental bodies to pass resolutions condemning the Terminator technology as a threat to world food security and to Farmer's Rights. In the United States, farmers and farm advocacy groups are expected to protest USDA's anti-farmer research and urge immediate reforms of policies governing the department's research agenda.

Introduction

On March 3, 1998 Delta & Pine Land Co. (Mississippi, USA) and the United States Department of Agriculture (USDA) announced that they received a US patent on a new genetic technology designed to prevent unauthorized seed saving by farmers.¹ The patent is benignly titled, "Control of plant gene expression" (US patent no.

5,723,765). The patented technology enables a seed company to genetically alter seed so that it will not germinate if re-planted a second time. The patent is broad, applying to plants and seeds of all species, including both transgenic (genetically engineered) and conventionally-bred seeds. The developers of the new technology say that their technique to prohibit seed-saving is still in the product development stage, and is now being tested on

cotton and tobacco. They hope to have a product on the market sometime after the year 2000.

USDA researchers told RAFI that they have spent approximately (US) \$190,000 to support research on the Terminator technology over the past 4 years. D & PL, the seed industry collaborator, devoted (US) \$275,000 of in-house expenses and contributed an additional (US) \$255,000 to the joint research. USDA spokesman, Willard Phelps, told RAFI that Delta & Pine Land Co. has the option to exclusively license the patented technology that was jointly developed by USDA researchers and Delta & Pine Land.²

The USDA wants the technology to be "widely licensed and made expeditiously available to many seed companies," said USDA's Phelps. The goal is "to increase the value of proprietary seed owned by US seed companies and to open up new markets in Second and Third World countries," Phelps told RAFI.

Melvin J. Oliver, a USDA molecular biologist and the primary inventor of the technology, explains why the US government developed a technology that prohibits farmers from saving proprietary seed: "My main interest is the protection of American technology. Our mission is to protect US agriculture, and to make us competitive in the face of foreign competition. Without this, there is no way of protecting the technology [patented seed]," Oliver told RAFI.³

The USDA stands to earn royalties of about 5% of the net sales if a product is commercialized. "I think it will be profitable for USDA," Phelps told RAFI. The day after the patent was announced, Delta & Pine Land Company's stock rose sharply.⁴ **But USDA and seed industry profits will come at enormous cost to farmers and food security.**

USDA researchers interviewed by RAFI expressed a strong allegiance to the commercial seed industry, and an appalling lack of awareness about the potential impacts of the technology, especially in the South.

Impact in the South

A genetic technology designed to prevent farmers from saving seed would have enormous adverse impacts in the South – and that is precisely the market being targeted. Murray Robinson, the president of Delta & Pine Land, told RAFI, "We expect [the new technology] to have global implications, especially in markets or countries where patent laws are weak or non-existent."⁵ The company's 3 March 1998 press release claims that its new technology has "the prospect of opening

significant worldwide seed markets to the sale of transgenic technology for crops in which seed currently is saved and used in subsequent plantings."⁶

"This is an immoral technique that robs farming communities of their age-old right to save seed and their role as plant breeders. Farmers and governments everywhere should declare use of the technology as contrary to public order and national security. This is the neutron bomb of agriculture."

Camila Montecinos, CET
Centro de Educación y Tecnología, Chile

Up to 1.4 billion resource-poor farmers in the South depend on farm-saved seed and seeds exchanged with farm neighbours as their primary seed source.⁷ A technology that threatens to restrict farmer expertise in selecting seed and developing locally-adapted strains is a threat to food security and agricultural biodiversity, especially for the poor. The threat is real, especially considering that USDA and Delta & Pine Land have applied for patent protection in countries and regions throughout the South – from Madagascar to Mali, from Brazil to Benin, from China to Viet Nam (see list of designated states, p. 5).

If the Terminator technology is widely licensed, it could mean that the commercial seed industry will enter entirely new sectors of the seed market – especially in self-pollinating seeds such as wheat, rice, cotton, soybeans, oats and sorghum. Historically there has been little commercial interest in non-hybridized seeds such as wheat and rice because there was no way for seed companies to control reproduction. With the patent announcement, the world's two most critical food crops – rice and wheat – staple crops for three-quarters of the world's poor, potentially enter the realm of private monopoly. According to FAO, wheat is the world's most widely cultivated crop, covering 219 million harvested hectares in 1995. Rice was cultivated over a harvested area of 149 million hectares in 1995, and had the world's highest total production, 542 million tonnes.

"This patent is profoundly immoral. It will fundamentally change both the biology and economics of agriculture to the detriment of the poor. It must be stopped."

Farhad Mazhar, UBINIG
a Bangladeshi CSO and member of South Asian
Network for Food, Ecology and Culture

Bioserfdom Plus

In recent decades, the seed industry has attempted to prevent farmers from saving or re-selling proprietary seeds by using intellectual property laws (patents and plant breeders' rights) to restrict the farmer's right to re-use or sell proprietary seed (for reproductive purposes). It is only in the last decade that seed companies have begun to use industrial patents (also known as *utility* patents) to protect proprietary genes and traits. Under industrial patent law there is no exemption for farmers, and it thus becomes *illegal* for farmers to save or re-use patented seed. Monsanto, for example, requires that its customers sign a licensing agreement that strictly forbids the farmer from saving the company's patented, transgenic seed. (See *RAFI Communiqué* on "Bioserfdom," March/April, 1997.) According to a January, 1998 article by Greg Hillyer in the US-based *Progressive Farmer* magazine, Monsanto is aggressively enforcing its patents on transgenic soybean seeds, and has recently taken legal action against more than 100 soybean growers who have violated the licensing agreement.⁸ According to Hillyer, the company has even hired Pinkerton investigators (hired private police) to identify unauthorized seed-saving in the mid-western US.

If Delta and Pineland's new technology provides a genetic mechanism to prevent farmers from germinating a second generation of seed, then seed companies will gain the *biological control* over seeds that they have heretofore lacked in non-hybrid crops.

Nobody knows exactly how many farmers in industrialized countries save seed from their harvest each year. By some estimates, 20% to 30% of all soybean fields in the US mid-west are typically planted with saved seeds; up to 50% of soybeans in the South are planted with farmer-saved seed. Most North American wheat farmers typically rely on farm-saved seeds and return to the commercial market once every four or five years. Wheat grown on the Canadian prairies is almost all produced in the communities in which it is grown. The same is true for lentils and peas.

More Options for Farmers?

Proponents of the Terminator technology are quick to point out that farmers will not buy seed that does not bring them benefits. Farmers are not stupid, they make rational choices. We agree. But market choices must be examined in the context of privatization of plant breeding and rapid consolidation in the global seed industry. The top 10 seed corporations control approximately 40% of the commercial seed market.⁹ Given that maize seed industry giant, Dekalb Plant

Genetics (USA), is now on the auction block, further consolidation is expected in a matter of months. Current trends in seed industry consolidation, coupled with rapid declines in public sector breeding, mean that farmers are increasingly vulnerable and have far fewer options in the marketplace.

A new technology that is designed to give the seed industry greater control over seeds will ultimately weaken the role of public breeders and reinforce corporate consolidation in the global seed industry.

"I was concerned and angry when I read about a new technology that will make it impossible for farmers to save seed from their own crops. This technology will once again bias research to those crops covered by the technology. To remain competitive internationally, farmers will be compelled to work with improved varieties covered by this "Terminator" technology. The technology will ensure that most of the gains from research will accrue to companies owning the varieties and not to farmers."

Ian McCreary, farmer,
Saskatchewan, Canada

Advocates of the Terminator technology claim that it will be an incentive to plant breeding investment, and a boon to food production in the South because seed companies will have an incentive to invest in crops that have long been ignored by the commercial seed industry. RAFI rejects that claim. Private companies are not interested in developing plant varieties for poor farmers because they know the farmers can't pay. Even national public breeding programmes tend to focus on high-yielding, irrigated lands leaving resource-poor farmers to fend for themselves. Proponents of the Terminator maintain that poor, seed-saving farmers will be unaffected by the technology while more affluent farmers will have the choice of buying Terminator seed or sticking with standard varieties. They point out that farmers will still be able to choose between Terminator seed and open-pollinated varieties developed by the public sector.

RAFI envisions a very different scenario. Even public breeders will be pressured by cash-starved institutes to adopt the Terminator technique in order to prevent "unauthorized" seed saving and recoup their research investment. After all, it was a publicly-funded institution, the USDA, that developed this anti-farmer technology. It is likely that public breeders wanting access to patented genes and traits controlled by the private sector will be forced to adopt the Terminator as a licensing requirement. In

the long run, it is cheaper for the world's ten dominant seed companies (with 40% of the commercial market) to simply put pressure on seed regulatory systems and public breeders to adopt the Terminator technology in order to eliminate competition from open-pollinated varieties. This is precisely what happened in Europe in the 1980's with the creation of the European Common Catalogue.

"We work with farmers who may buy a commercial variety but its breeder wouldn't recognize it five years later. Women select the best seeds every year and, over time, the rice molds itself to the farm's own ecosystem. Women also cross the commercial variety with other rice strains to breed their own locally-adapted seeds. The Terminator technology could put an end to all of this and increase crop uniformity and vulnerability. It poses a threat to the culture of seed sharing and exchange that is led primarily by women farmers."

Neth Daño, SEARICE
Philippines-based South East Asian Regional
Institute for Community Education

Far from improving plant breeding, the Terminator could drive hundreds of millions of farmers out of plant breeding and, since no one else will breed for their needs, out of agriculture altogether. This represents an enormous threat to world food security. Half the world's farmers are poor and can't afford to buy seed every growing season, yet poor farmers grow 15 to 20% of the world's food and they directly feed at least 1.4 billion people - 100 million in Latin America, 300 million in Africa, and 1 billion in Asia.¹⁰ These farmers depend upon saved seed and their own breeding skills in adapting other varieties for use on their (often marginal) lands.

BioSafety Concerns

The Terminator seed technology could pose a biosafety hazard. Molecular biologists who have studied the patent have mixed views on the potential ecological hazards of the sterility trait. The concern is that the sterility trait from first generation seed will "infect" (via pollen) neighbouring fields of open-pollinated crops and/or wild relatives growing nearby. Some biologists believe that pollen will not escape, and if it does, it would not pose a threat. With certain applications of the Terminator technology, however, even if the sterility gene does not last long in the environment, it could still pose a threat to nearby crop fields or wild relatives of the plant.¹¹ Given that the technology is new and

untested on a large scale, biosafety issues remain a valid and extremely important concern.

BioSafety vs. Food Security?

The seed industry is expected to defend the Terminator technology by arguing that it will increase the safety of using genetically-engineered crops. Since the seed carries the sterility trait, say proponents, it is less likely that transgenic material will escape from one crop into related species and wild crop relatives. The seed industry is expected to argue that this built-in safety feature will speed up biotech advances in agriculture and increase productivity. Based on this reasoning, it is likely that the industry will enlist government regulators and environmental organizations in backing the Terminator. In RAFI's view, biosafety at the expense of food security is no solution. Both must be considered, but human safety through food security must be our primary concern.

How does the Terminator Technology work?

The new technique described in US patent no. 5,723,765 to genetically "sterilize" seed is technically complex, involving both bacterial and plant genes. One molecular biologist who studied the patent said that he "looked at the patent and very quickly got a headache." He also indicated that the technology described in the patent is "neat and elegant from a technical standpoint." What follows is an excerpt from Dr. David Culley's explanation of the technology, as gleaned from the patent. David E. Culley, Ph.D., is a molecular biologist in the department of plant pathology, Washington State University.¹²

"To protect their variety from "seed savers" they are making the embryos in the F2 inviable. To do this they take the coding sequence for a gene that's toxic to the plant and put it behind a promoter that restricts expression to the embryo and, specifically, to late stages of embryo development. (from the Late Embryogenesis Abundant (LEA) genes. Therefore, during late embryogenesis this protein "kills" the embryo. Plant the seed and it just sits there feeling sad.

To allow them to produce seed, they control expression of the toxic protein by putting a spacer between the promoter and the toxic gene to keep it from expressing. On either side of this spacer they placed sequences that are specifically recognized by an enzyme (a recombinase) that can excise the spacer (very precisely). This excision brings the promoter and toxic gene back together so that the toxic protein is produced late in embryo development. Without the recombinase, the spacer stays in place and the gene construct is silent. This is a good thing.

To allow the spacer excision to be controlled, the recombinase gene is placed behind a promoter that is normally expressed during early seed germination. Therefore, the recombinase protein is expressed during germination and that protein goes over and excises the spacer from the toxic protein gene construct. Then later, during late embryogenesis at the end of seed development, that toxic protein is produced and you have a dead embryo. This is a bad thing if you are planning on growing that seed."

- David E. Cully, Ph.D.

Patents on the Terminator Technology

Delta & Pine Land Company and the USDA have received a patent on the Terminator technology in the United States (US 5,723,765).¹³ Applications are pending in Canada (CA 2196410), Australia (AU 9532050) the European Patent Office (EP 775212), and South Africa. The patent, "Control of Plant Gene Expression," has also been published at the World Intellectual Property Office (WO 9604393). The inventors have designated the following states for patent application either through WIPO or the European Patent Office.

Patent Applications Pending on the Terminator: Designated States

Armenia	Estonia	Liechtenstein	Senegal
Austria	Finland	Lithuania	Singapore
Australia	France	Luxembourg	Slovakia
Belarus	Gabon	Macedonia	Slovenia
Belgium	Georgia	Madagascar	Spain
Benin	Germany	Malawi	Sri Lanka
Bulgaria	Greece	Mali	Sudan
Brazil	Guinea	Mauritania	Swaziland
Burkina Faso	Hungary	Mexico	Sweden
Cameroon	Iceland	Moldova	Switzerland
Canada	Ireland	Monaco	Tajikistan
Central African Republic	Italy	Mongolia	Togo
Chad	Japan	Netherlands	Trinidad & Tobago
China	Kazakhstan	New Zealand	Uganda
Congo	Kenya	Norway	Ukraine
Cote d'Ivoire	Korea, DPR	Niger	Uzbekistan
Cyprus	Korea, Rep	Poland	United Kingdom
Czechoslovakia	Kyrgyzstan	Portugal	Vietnam
Denmark	Latvia	Romania	
	Liberia	Russia	

The Terminator Must be Terminated

A genetic technology that aims to sterilize seed threatens to extinguish the right of farmers to save seed and breed new crop varieties, and threatens the food security of 1.4 billion people. The Terminator must be banned.

RAFI and other NGOs are calling for a global ban on the use of the Terminator technology. Both the patent and the technology should be rejected on the basis of public morality.

NGOs will call on the Consultative Group on International Agricultural Research (CGIAR) to publicly denounce the technology as a threat to food security in the South.

The Fourth Conference of the Parties to the Convention on Biological Diversity will have an opportunity to address the issue when it meets May 4-15 in Bratislava, Slovakia. The FAO's Commission on Genetic Resources for Food and Agriculture will meet in Rome, 8-12 June. NGOs will urge both intergovernmental bodies to pass resolutions condemning the Terminator technology as a threat to world food security and to Farmer's Rights. In the United States, farmer organizations and farm advocacy groups are expected to protest USDA involvement and urge immediate reforms of US government policy governing the department's research agenda. (At press time, farmers' organizations worldwide were just beginning to learn about the Terminator Technology.)

Companies mentioned in this RAFI Communiqué

* **Delta & Pine Land Co.** (Scott, Mississippi) is the largest cottonseed company in the world, with 1997 annual sales of \$183 million. D & PL holds almost three-quarters of the US cottonseed market. Monsanto is a minor shareholder in Delta & Pineland; the two companies have a joint cotton seed venture in China (D&M Intl. LLC).

* **Monsanto** (St. Louis, Missouri) is a major life industry corporation, and the world's second ranking agrochemical corporation. Monsanto's investments and acquisitions in seeds and agrochemicals over the past 24 months exceeded (US) \$2 billion. Monsanto's total 1996 revenues were (US) \$9.26 billion.

A note about RAFI:

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¹ Delta and Pine Land Company, "Delta and Pine Land Company and the USDA Announce Receipt of Varietal Crop Protection System Patent," March 3, 1998. On the internet: http://biz.yahoo.com/prnews/980303/ms_delta_p_1.html

² RAFI interviewed Willard Phelps by phone on March 10, 1998.

³ RAFI interviewed Melvin Oliver, USDA molecular biologist, by phone on March 10 and March 12.

⁴ Anonymous, "Delta & Pine stock up after patent awarded," March 4, 1998. Reuters wire story. On the internet:

http://biz.yahoo.com/finance/980304/delta_pine_2.html

⁵ RAFI interviewed Murray Robinson, President of Delta & Pine Land Co., by phone.

⁶ Delta and Pine Land Company, "Delta and Pine Land Company and the USDA Announce Receipt of Varietal Crop Protection System Patent," March 3, 1998. On the internet:

http://biz.yahoo.com/prnews/980303/ms_delta_p_1.html

⁷ Food and Agriculture Organization of the United Nations, "The State of the World's Plant Genetic Resources for Food and Agriculture," (Background Documentation prepared for the International Technical Conference on Plant Genetic Resources, Leipzig, Germany 17-23 June, 1996), Rome, 1996.

⁸ Hillyer, Greg, "Saved-Seed Busters", *Progressive Farmer*, January, 1998. On the internet:

<http://www.progressivefarmer.com/today/pffile/savedseed.html>

⁹ RAFI Communiqué, "The Life Industry," November/December, 1997. On the internet:

<http://www.rafi.ca/communiqué/19976.html>

¹⁰ FAO, "The State of the World's Plant Genetic Resources for Food and Agriculture," FAO, Rome, 1996.

¹¹ Doreen Stabinsky, Ph.D., Sacramento State University. Personal communication with RAFI.

¹² Excerpts from David Culley's comments are used with his permission. The original comments were posted of a tissue culture discussion group, the archives of which can be accessed through: <http://www.agro.agri.umn.edu/plant-tc/>

The complete text of David Culley's comments are found there.

¹³ Users of the World Wide Web can find the text of the patent on the IBM patent server:

http://www.patents.ibm.com/details?patent_number=5723765.

RAFI obtained information on patent applications pending in other jurisdictions by conducting a database search.