11-29-2006

The Market Acceptance and Welfare Impacts of 'Terminator' Technology

Marianna Khachaturyan
University of Nebraska-Lincoln, mkhachaturyan2@unl.edu

Amalia Yiannaka
University of Nebraska-Lincoln, ayiannaka2@unl.edu

CORNHUSKER ECONOMICS

University of Nebraska–Lincoln Extension

November 29, 2006

Institute of Agriculture & Natural Resources
Department of Agricultural Economics
http://www.agecon.unl.edu/Cornhuskereconomics.html

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Market Report	Yr Ago	4 Wks Ago	11/24/06
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight	$91.15	$89.16	$87.64
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb	134.78	116.85	117.70
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb	119.87	108.79	105.73
Choice Boxed Beef, 600-750 lb. Carcass	151.02	147.66	141.76
Western Corn Belt Base Hog Price Carcass, Negotiated	55.61	61.09	61.49
Feeder Pigs, National Direct 45 lbs, FOB	56.40	54.01	57.72
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean	66.30	66.45	66.51
Slaughter Lambs, Ch. & Pr., 90-160 lbs., Shorn, Midwest	86.00	*	*
National Carcass Lamb Cutout, FOB	246.78	250.77	252.36
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu	*	4.84	4.74
Corn, No. 2, Yellow Omaha, bu	1.71	3.07	3.44
Soybeans, No. 1, Yellow Omaha, bu	5.20	6.14	6.56
Grain Sorghum, No. 2, Yellow Columbus, cwt	2.16	4.91	5.57
Oats, No. 2, Heavy Minneapolis, MN , bu	2.00	2.53	2.71
Hay			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton	117.50	135.00	135.00
Alfalfa, Large Rounds, Good Platte Valley, ton	37.50	87.50	87.50
Grass Hay, Large Rounds, Good Northeast Nebraska, ton	52.50	82.50	82.50

* No market.

An Intellectual Property Rights (IPRs) system is effective when infringers can be identified, successfully sued for damages and deterred from further infringement. The effectiveness of IPRs in plant varieties is limited due to high detection costs of unauthorized use of seed that embodies intellectual property (e.g., genetically modified (GM) seed) and high enforcement costs. Seed companies have traditionally performed limited research and development (R&D) in self-pollinating plants mainly because seed saving limits their ability to recoup their investment.[1]

Genetic Use Restriction Technologies (V-GURTs), commonly referred to as 'terminator' technologies, are a biological way of restricting the unauthorized use of newly developed plant varieties through interference with reproduction that results in the production of sterile seeds. It has been argued that the introduction of 'terminator' technologies will encourage innovating firms to invest more in R&D, and could result in increased agricultural productivity through an increased degree of accuracy in production (precision agriculture) as well as in crops with better agro-ecological characteristics, as these technologies could also be used as a tool that prevents the escape of horizontal gene flow into neighboring crops or wild species, limiting the potential negative environmental effects of GM crops.

At the same time, a number of countries (e.g., India, Brazil), consumer groups and non-governmental

[1] Globally, the largest quantity of seed is produced by farmers; more than 75 percent of farmers, mainly in developing countries, depend on saved seed as their primary seed source. Given that farmers are spread all over and seed reproduces naturally, monitoring the unauthorized use of seed by farmers becomes very costly for seed providers.

organizations oppose the introduction of 'terminator' technologies, with the main criticism being that they are unethical technologies that would deprive farmers of their traditional right to save, use and exchange seeds, and would jeopardize the independence and food security of poor and small farmers.[2] An additional criticism of 'terminator' technologies is that they would restrict access to genetic resources and hinder the efforts of public institutions and farmers to make new discoveries through breeding, and would, therefore, foster the formation of perpetual monopolies leading to an unequal distribution of economic rents between farmers, seed companies and consumers. Opposition also stems from concerns about the environmental effects of gene flow from crops which are sterilized and, according to the critics of the technology, could in turn sterilize other plants and have serious effects on the ecosystem.

A recent study conducted in the Department of Agricultural Economics at the University of Nebraska–Lincoln tries to shed light on the potential market and welfare effects of the introduction of 'terminator' technologies. Specifically, the study examines how the agronomic characteristics of a 'terminator' seed, consumer perceptions and preferences regarding GM technology, and producer cost structures and dependence on saved seed affect the adoption of 'terminator' technology by producers, its market acceptance by consumers and, consequently, the incentives of the biotech sector to introduce the new technology. The analysis examines the market effects of the introduction of 'terminator' technology in the U.S. market under the current No-Labeling regime of GMPs.

The results show that the market and welfare effects of the introduction of 'terminator' technology depend on (1) the level of consumer aversion to the GM technology, (2) the shares of GM and 'terminator' technology (TT) products in the total production of the non-labeled product, (3) the price of the GM seed after the TT product is introduced, (4) the price of 'terminator' seed, (5) the agronomic characteristics of the 'terminator' seed relative to GM and conventional seeds, and (6) the expected penalty producers face when they cheat on their GM licensing agreements.

Specifically, the study shows that the greater the agronomic benefits of the TT crop and/or the lower the price of 'terminator' seed, the more likely it is that producers with relatively low dependency on saving seed will find it optimal to switch their production from the conventional and the GM crop to the TT crop, and thus, the more likely it is that the producers with both low and high dependency on saving seed will experience welfare gains. In addition, the lower the consumer aversion to genetic modification and the lower the expected penalty producers face when they cheat on their GM licensing agreements, the greater the incentive of the biotech sector to introduce 'terminator' technology (as the greater are the profits that can be captured).

The analysis shows that, in most cases, the introduction of 'terminator' technology results in both winners and losers. For instance, when the price of the non-labeled product decreases due to the introduction of 'terminator' technology (this case emerges when the TT and the GM product shares in the total production of the non-labeled product either stay the same or increase compared to the GM share under the *status quo*), consumers with low levels of aversion to genetic modification experience welfare gains, while consumers with high levels of aversion to genetic modification experience welfare losses. Similarly, producers with low dependency on saving seed, (who are more likely to adopt the new technology), experience welfare gains despite the decrease in the price of the non-labeled product, while producers with high dependency on saving seed experience welfare losses.

While in many cases the introduction of 'terminator' technology creates winners and losers, there are certain conditions under which all interest groups involved may experience welfare gains. In particular, when consumer aversion to 'terminator' technology is relatively low, the agronomic benefits of the TT crop are high, and the expected penalty producers face when they cheat on their GM licensing agreements is low, the introduction of 'terminator' technology may be welfare-enhancing for consumers, producers and the agricultural biotechnology sector.

Note: This article is based on Marianna Khachaturyan's M.Sc. thesis "The Market Acceptance and Welfare Impacts of Genetic Use Restriction Technologies (GURTs)" conducted in the Department of Agricultural Economics at the University of Nebraska–Lincoln.

Marianna Khachaturyan, (402) 472-7865
Ph.D. Student of Agricultural Economics
University of Nebraska-Lincoln
mariannakhach@yahoo.com

Amalia (Emie) Yiannaka, (402) 472-2047
Assistant Professor
Dept. of Agricultural Economics
University of Nebraska-Lincoln
yiannaka2@unl.edu

[2] The United Nations Convention on Biological Diversity adopted a *de facto* moratorium on Terminator seeds in 2000, the Food and Agriculture Organization of the United Nations is against the use of terminator technology while the Consultative Group on International Agricultural Research (CGIAR) pledged never to use any kind of terminator technology seeds. See http://www.banterminator.org/takeaction/nationalcampaigns for countries with a national ban on terminator technology.