EAAE 2008 Congress- The Diffusion of Bt Cotton and the Economic Impact on Producers

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Abstract— **The objective is to present the economic impact of producers adopting Bt cotton and the rapid diffusion on the main producing countries: USA, China and India. The existing literature about this type of transgenic crop has been revised and the results of different research are presented. Bt cotton varieties have been quickly adopted by the countries in this study. Data show that this technology helps reduce production losses and significantly decrease the use of pesticides, thus saving their cost and the associated labour cost. But the total cost reduction is weak due to the high prices of the seeds incorporating this technology.**

Keywords— **Innovation diffusion, Bt cotton**

I. INTRODUCTION

Technical change has been acknowledged as a critical component of productivity and economic growth. Innovations reach the market in different forms and they contribute to a more efficient use of the production factors. The potential benefits from the generation of such innovations fall on the society that embraces them, and the speed at which they are implemented is determinant of the economic growth.

In agriculture, the development and trade of hybrid corn in the 30s is usually cited as an extraordinary example of the success of research and development in this sector. This has been only a little part of the long and profitable history of plant breeding of the main species: the yield increase of soy and wheat would arrive in the following decades [1]. At that time, consumers did not make a distinction between hybrid and ordinary crops, although there are genetic and qualitative differences these were considered "natural variations" [2].

During the sixties, the development of high-yielding varieties (HYVs) for less developed countries (LDCs) took place mostly for rice and wheat. In the so-called *green revolution* seeds had plant dwarfism genes that allowed plants to concentrate most of their energy to the production of grain and to devote little energy to the growth of leaves and stems. Yield increases were only obtained through combining HYVs with irrigation systems and the intensive use of fertilizers and pesticides. This technological package was quickly spread: the green revolution made HYV of rice and wheat, obtained through traditional plant breeding methods, available to millions of small producers. Technologies for wheat, rice and other grains breeding that allowed to obtain global benefits came from many sources: International agricultural research centres called as a group CGIAR (Consultative Group on International Agricultural Research) and the national research agencies of developing and less developed countries. The most important research was lead and funded by public institutions and the technologies and seeds used were not levied by intellectual property.

Despite the success of the green revolution in increasing the yield of food cultivars, this model of intensive input use has implied important environmental and water use drawbacks [3],[4].

The Genetically Modified Organisms (GMO) are a more environmentally respectful alternative offered by modern biotechnology for the use of inputs. Modern biotechnology applied to agriculture is based on biological processes rather than chemical ones. The potential uses in agriculture include increasing the yield while reducing the use of fertilizers, pesticides and weed killers; increase tolerance to alkaline earth metals, soil drought and salinity; increase the useful life and reduce the post-harvest losses; increase the nutrient content of the product; obtain products on industry demand to improve the output in the process of industrial transforming.

Nowadays only a few GMO can be sold at international food markets. They are: corn, soybean, canola and cotton with the characteristics of insect resistant (Bt) and/or herbicide resistant. Present in 23 countries, GMO is one of the most quickly widespread technologies. The high speed at which it was adopted since 1996 corresponds to the good economic, environmental and health results for both, big and small producers [5]. Table 1. In this technology, the seed makes the plant resistant to insects and/or herbicides.

Table 1. The adoption of transgenics, 1996-2006:by main countries (million hectares).

Country	Area	Biotech Crops
USA	57.7	Soybean, maize, cotton, canola
Argentina	19.1	Soybean, maize, cotton
Brazil	15.0	Soybean, cotton
Canada	7.0	Canola, maize, soybean
India	6.2	Cotton
China	3.8	Cotton
Paraguay	2.6	soybean
South Africa	1.8	Maize, soybean, cotton
Uruguay	0.5	Soybean, maize
Philippines	0.3	Maize

The insect resistant cotton, also called *Bt cotton*, has had a remarkably rate of diffusion: Table 2 shows how the three main cotton producing countries have adopted Bt cotton [5], [6], [7].

Table 2. Surface devoted to Bt cotton in percentage.

	1996	2002	2005	2007
USA	15%	42%	52%	60%
CHINA	10%	40%	65%	69%
INDIA		1%	60%	68%

II. OBJECTIVE

The objective is to present the economic impact of producers adopting Bt cotton on the main producing countries.

III. METHODOLOGY

Existing literature about this type of GMO has been revised and the results of different research are presented. This study has been focused on the main producing countries: USA, China and India, although Argentina has also been included for having shown a different behaviour to the rest of countries during the first years of adoption of this crop.

IV. RESULTS AND CONCLUSIONS

Bt varieties have been quickly adopted by the countries in this study. Table 3. Data show that this technology helps reduce production losses and significantly decrease the use of pesticides, thus saving their cost and the associated labour cost [5], [6], [7].

But the total cost reduction is weak due to the high prices of the seeds incorporating this technology, Table 4. This would explain the particular case of the weak diffusion in Argentina during the period 1996-2004, as the providing company was applying high prices; nevertheless, in 2004 the price went down over 30% and the seed has been finally adopted in this country [6], [8], [9], [10].

Table 3. Surface devoted to Bt cotton in percentage.

	1996	2002	2005	2007
USA	15%	42%	52%	60%
CHINA	10%	40%	65%	69%
INDIA	-	1%	60%	68%
ARGENT.	-	6%	27.5%	nd

Table 4. Economic impact of Bt cotton**.**

	USA (1996-06)	CHINA (1996-06)	INDIA (2002-06)	ARGENT (1998-06)
Yield increase	11%	19%	50%	30%
Cost ofTechnology ($/ha)	58 – 68	Nd	54	86 – 40
Average Cost Pesticide ($/ha)	4.8 - 5.9	194	31 – 42	Nd
Net Incr. Gros Marg. ($/ha)	100 – 108	330 – 305	138 – 260	33 – 93

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