Evaluating the Production and Price Impacts of Biotechnology Application in Crop Markets

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Introduction: Biotechnology crop traits have been applied on a widespread commercial global basis since 1996, making it the most rapidly adopted crop technology in agriculture. The primary biotechnologies used have included technology delivering herbicide tolerance and insect resistance for crops, such as corn, soybeans, cotton, and canola. This technology has provided farmers with productivity improvements through a combination of yield improvements and cost reductions. Thus, this technology has had an impact on prices of cereals and oilseeds (and their derivatives) both in countries where biotech traits were applied and in the global market.

Objective: Realizing the surging significance of biotechnology application in global crop markets, this study

- summarizes the productivity impacts of biotech crops on production (see maps for select countries);
- aims to quantify the impact of the use of biotech traits on production, utilization and prices of corn, soybeans, and canola as well as other crops where the biotechnology is not utilized.

Methodology: Part of a partial-equilibrium, multi-commodity, multi-country modelling system of production, use, and trade in key agricultural commodities is employed. The models cover major temperate crops, sugar, and biofuels for major producing and consuming countries. Extensive market linkages exist in these models, reflecting competition for land in production, and consumer substitution possibilities for close substitutes. The models provide 10-year (2008-2017) projections of production, use, trade and prices.

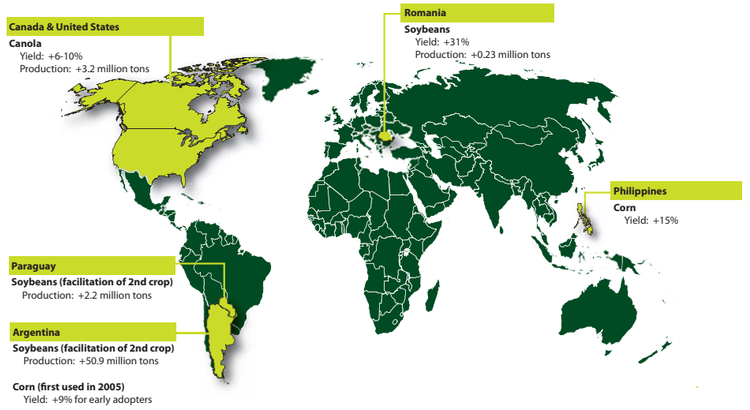
To analyze the impact of yield improvements due to biotechnology, first a baseline is established (representing the current status quo) with trend growth rate in yields. Then, a scenario is run where the biotech traits are no longer available, i.e., the yields are effectively lower than the baseline levels over the 10-year projection period for corn, soybeans, and canola. The difference between the baseline and scenario represents the impact of no longer using the available biotechnology for these crops.

The production and yield change assumptions used are derived from Brookes and Barfoot (2008), where the production and yield impacts are converted into national-level yield equivalents (see table below). These yield change assumptions are introduced into the models to identify impacts of withdrawing the biotechnology from production systems.

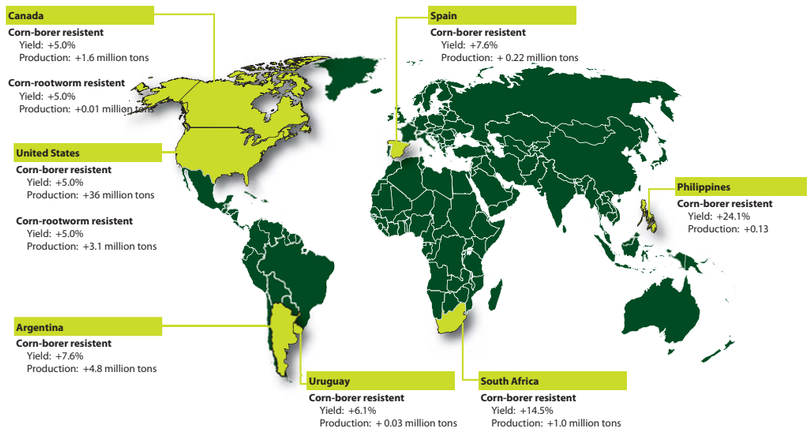
Yield impact assumptions--to lower average yields for countries/crops assuming no biotech traits used from 2008 onwards

Crop	Average yield/production effect on biotech area 2006	% of crop to trait (2006)	Yield impact of technology related to average yield on total crop if biotech traits no longer used
Corn			
US	+5%	49%	-2.45%
Canada	+5%	50%	-2.45%
Argentina	+7.6%	73%	- 5.55%
Philippines	+24.1%	4%	-0.97%
South Africa	+14.5%	35%	-5.1%
EU 27	+6.1% (Spain)	15% of Spain 3.3 % of EU-27 area	-0.2% on EU-27 average yield
Soybeans			
EU-27	+31% (Romania)	26% of EU-27 area	-8.1%
Paraguay	+7.5% second crop	7.5%	-7.5%
Argentina	+20% second crop	20%	-20%
Canola			
US	+6.0%	98%	-5.9%
Canada	+3.7%	84%	-3.1%

Herbicide-Tolerant crops



Insect-Resistent Crops



Yield and Production Impact of Biotechnology, 1996-2006, for Select Countries

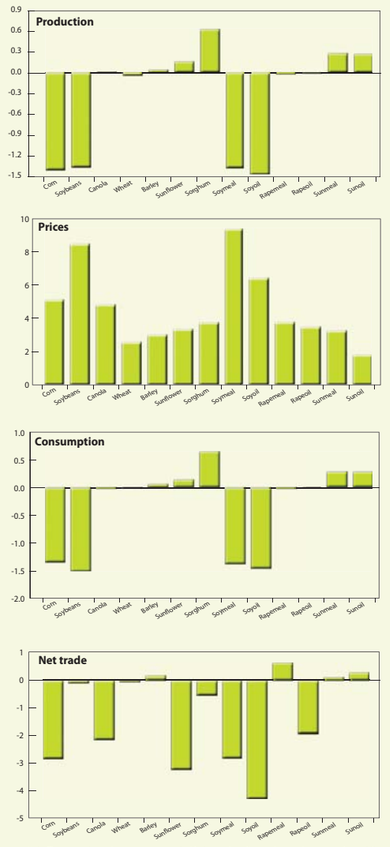
Results: The chart (right) summarizes the effect of removing the current widely used biotech traits in corn, soybeans, and canola in select countries on the global supply of these crops and their derivatives.

Scenario results show the following:

- Despite some likely 'compensating' additional plantings of the three crops (of 3 million hectares), reduction in average global yields for corn, soybeans and canola cause a net fall in global production of the three crops and their derivatives of 17 million tons.
- World prices of corn, soybeans, canola and their derivatives are higher than the baseline levels.
- The prices of other cereals and oilseeds also increase due to land reallocation and consumer substitution between all crops.
- As a result of changes in supply availability and increase in prices, global trade falls by 7 million tons and global consumption declines by 14 million tons for the three biotech crops and their derivatives.

Conclusions:

- Adoption of biotechnology has significant impacts not only on the individual country that adopts it, but also on the global agricultural markets.
- Through crop price changes and area reallocation, biotechnology adoption in one crop will also impact the supply and utilization of other crops.
- Although productivity-enhancing technology reduces world prices, which represents a loss to farmers' incomes, this loss is more than offset by income gains from the adoption of the technology
- When discussing the impact of biotechnology in terms of food security, biodiversity, and agricultural environmental footprint, a GLOBAL perspective needs to be employed.



Note: The percentage changes are computed between baseline and scenario averaged over 10 years

Potential change to global prices, trade, production, and consumption if biotech traits are no longer used (average of annual changes 2008-2017)

Reference

Brookes, G. and Barfoot, P. (2008) "GM crops: global socio-economic and environmental impacts 1996-2006." AgBioForum, 11(1):21-38.