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Winter 2017

The biotech story: as told in the scientific literature

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Available at: https://works.bepress.com/matt_bogard/35/
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February 21, 2017

Summary

Has biotechnology lived up to its promises? What were the ‘promises’ of biotechnology? Does genetic engineering present food safety risks greater than conventional plant breeding methods? These are controversial questions. There is one version of the story that indicates that biotechnology has not lived up to so called promises expressed by critics and creates risks to the environment and consumers. However the story that we find in the scientific literature tells us that biotechnology in crop production and applications in the livestock industry is just as safe or safer than traditional technologies, promotes biodiversity, reduces the levels and toxicity of herbicides and pesticides used in row crop production, improves food safety, and reduces our carbon footprint. This annotated review of key scientific papers from sources including The Proceedings of the National Academy of Sciences, Science, Nature Biotechnology, Crop Science, Ecological Economics, and others tells this story.

Safety/Genomic Disruptions


- the above all indicate that molecular breeding techniques (recombinant DNA technology/ transgenic/genetic engineering) have less impact on plant genomes compared to conventional breeding methods which include mutagenesis.

Biodiversity


"Cumulative benefits over 14 years are an estimated $3.2 billion for maize growers in Illinois, Minnesota, and Wisconsin, with more than $2.4 billion of this total accruing to non-Bt maize growers."


"Bt corn planted near non-Bt corn can provide the unmodified plants with indirect protection from pests"


- Improved diversity of crops planted


- Improved diversity of crops planted


- Reduced impact on biodiversity


- Improved diversity of crops planted

Reduced Toxicity/Safety and Health Improvements

Genetically Engineered Crops: Has Adoption Reduced Pesticide Use? Agricultural Outlook ERS/USDA Aug 2000

- Environmental benefits and reduced pesticide use of biotech crops/substitution away from more toxic chemistries


- Health and environmental benefits of biotechnology

-Improved safety and reduced carcinogens in biotech crops


-Improved safety and reduced carcinogens in biotech crops


-Bt cotton has reduced pesticide applications by 50%, with the largest reductions of 70% occurring in the most toxic types of chemicals...Bt cotton now helps to avoid several million cases of pesticide poisoning in India every year, which also entails sizeable health cost savings.


-GM cotton used two-thirds less insecticide and produced higher yields than conventional cotton while reducing farm labor allocated to spraying.

Carbon Footprint

Greenhouse gas mitigation by agricultural intensification Jennifer A. Burneya, Steven J. Davisc, and David B. Lobella. PNAS June 29, 2010 vol. 107 no. 26 12052-12057

-Industrial agriculture’ aka family farms utilizing modern production technology have a mitigating effect on climate change


-reduced pollution, improved safety, reduced carbon footprint
greenhouse gas reductions associated with biotechnology were equivalent to removing 7.8 million cars from the road note: only 600,000 hybrid cars in the U.S. (2009)

Organic Food

-20% lower yields in non-biotech organic foods

Association of farm management practices with risk of Escherichia coli contamination in pre-harvest produce grown in Minnesota and Wisconsin. *International Journal of Food Microbiology Volume 120, Issue 3, 15 December 2007, Pages 296-302

-comparison of E.Coli risks and modern vs. organic food production methods, odds of contamination are 13x greater for organic production

**Animal Science**


-reduced carbon footprint in dairy production

Clearing the Air: Livestock's Contribution to Climate Change Maurice E. Pitesky*, Kimberly R. Stackhouse† and Frank M. Mitloehner Advances in Agronomy Volume 103, 2009, Pages 1-40

-transportation accounts for at least 26% of total anthropogenic GHG emissions compared to roughly 5.8% for all of agriculture & less than 3% associated with livestock production vs. 18% wrongly attributed to livestock by the FAO report 'Livestock's Long Shadow' Conclusion: intensified 'modern' livestock production is consistent with a long term sustainable production strategy


-rBST supplemented cattle lead to an 8% reduction in cattle requirements vs a 25% increase in organic cattle numbers to produce equivalent amounts of milk. For every 1 million cows, the reduction in GWP from rBST supplemented cows is equivalent to removing 400K cars from the roadways or planting 300 million trees