Testimony of the Biotechnology Industry Organization
Subcommittee on Rural Development, Research, Biotechnology, and Foreign Agriculture
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The Biotechnology Industry Organization, or BIO, is the world's largest biotechnology organization, providing advocacy, business development and communications services for more than 1,100 members worldwide. BIO members are involved in the research and development of innovative healthcare, agricultural, industrial and environmental biotechnology products. Corporate members range from entrepreneurial companies developing a first product to Fortune 500 multinationals. The organization also represents state and regional biotech associations, service providers to the industry, and academic centers. The mission of BIO is to be the champion of biotechnology and the advocate for its member organizations - both large and small. As the subcommittee examines the benefits and opportunities of agricultural biotechnology, it is important for BIO to share its views.

Agricultural biotechnology is essential for American producers and producers around the world who seek to feed and fuel a rapidly growing population. Through years of research and successful use, biotechnology has revolutionized modern agriculture and forestry producing benefits to producers, the environment, consumers, animals, forests, and the agricultural economy, while enhancing food and energy security for the American people and our international neighbors.

Since the first crop developed through modern biotechnology was commercialized more than 15 years ago, U.S. producers have embraced the technology and grown increasing acres of biotech products. According to 2010 figures from USDA's Economic Research Service, 93 percent of soybean and cotton and 86 percent of corn grown in the U.S. were biotech varieties.[1].

Producers outside of the U.S. have also successfully utilized biotechnology: in 2010 more than 15 million farmers in 29 countries grew 365 million acres of biotech crops and trees. Nearly 50 percent of these crops and trees were grown by small producers in developing countries where rates of biotech adoption have been steeper than in industrialized nations. The expanding use of agricultural biotechnology throughout the world has made biotechnology the most rapidly adopted agricultural innovation in history.[2]

The message is clear: where producers have been allowed to choose biotech varieties, they have embraced the technology and stuck with it.

[1] The primary biotech crops grown today are insect-resistant and herbicide tolerant varieties of soybean, cotton, corn and canola.
[2] By way of comparison, 10% of the corn acres in the U.S. were planted in hybrid corn five years after its introduction; within five years, over 50% of the soybean and cotton acres in the U.S. were biotech varieties.

Proven Benefits of Biotechnology for Health, the Economy and the Environment

The rapid and persistent expansion of agricultural biotechnology can be explained, in part, by its outstanding safety record. Science has shown biotech crops, trees and animals to be as safe as conventional varieties. Through the years, there have been no documented adverse effects to human health or the environment from biotech crops.

Because science and experience have demonstrated biotech crops are as safe as conventional varieties, producer preference for these products must be related to differences in benefits seen on the land, including economic benefits. Scores of international studies have compared the economics of various biotech products with their conventional counterparts. The results show that producers switch from conventional to biotech varieties because of their economic benefits. The magnitude of the gain varies from study to study, crop to crop, and country to country, but the fundamental finding is that producers, like other business owners, act in their own best economic interest when determining what to plant in their fields.

For example, a 2010 National Academy of Sciences (NAS) study found that U.S. producers who grow biotech crops "are realizing substantial economic and environmental benefits…compared with conventional crops."[3] In their most recent study of global impacts, Graham Brookes and Peter Barfoot demonstrate substantial net economic benefits for producers of $10.8 billion in 2009 and $64.7 billion from 1996 to 2009, in spite of higher seed costs.[4] Interestingly, the shares of the global farm income gains, both in 2009 and cumulatively (1996-2009), have been split equally between farmers in developing and developed countries, but the economic gains to individual producers in developing countries exceed that for producers in developed countries. Carpenter's 2010 meta-analysis of 49 peer-reviewed studies on the economic benefits of biotech versus conventional varieties in 12 countries also demonstrated that the gains for small producers in developing countries exceed those for producers in industrialized countries.[5]

The gains that matter most to growers are not global figures, but the improved incomes they experience in their own operations. Studies have shown producer-level gains ranging from a few dollars per acre to significantly more than $200/acre depending on the product, year, current and previous pest levels and control practices, country and region.

Economic gains producers enjoy result from higher yields, lower input costs, or both. The 2010 NAS study cites these as the sources of economic gain: "lower production costs, fewer pest problems, reduced use of pesticides and better yields." In terms of specific numbers, since 1996 biotech traits have:

- Increased yields by 83.5 million tons for soybeans; 130.5 million tons for corn; 10.5 million tons for cotton lint; 5.5 million tons for canola (Brookes and Barfoot, 2011). Increased yields accounted for 57 percent ($36.6 billion) of the $64.7 billion economic gain observed from 1996 to 2009.
- Reduced use of pesticides spraying by 865 million pounds. This and other lower production costs contributed $28.1 billion to the global ag economy.

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[3] National Research Council. 2010. *The Impact of Genetically Engineered Crops on Farm Sustainability in the United States.* http://www.nap.edu

[4] Brookes, G. and P. Barfoot. 2011. GM crops: global socioeconomic and environmental impacts 1996-2009. PG Economics. United Kingdom. PG Economics has published a series of similar studies. www.pgeconomics.co.uk

[5] Carpenter, J. 2010. www.guardian.co.uk/commentisfree/cif-green/2010/apr/21/gm-crops-benefit-farmers

For a single year (2009) James[6] found approximately 25 percent of global producer-level income increase ($2.7 billion) was due to reduced production costs (lower fuel costs, less pesticides used, lower labor costs), and the remainder to yield gains for biotech varieties: 9 million tons of soybeans, 29 million tons of maize, 2 million tons of cotton lint and .67 million tons of canola. This doesn't account for animal biotechnology, forest crops or fruit and nut trees, like the papaya.

The follow-on environmental benefits of growing biotech products are substantial and include preservation of biodiversity[7] and topsoil[8], while reducing greenhouse gas emissions, fuel use and water loss from soil.

- Without biotech crops, the 2009 production increases would have required clearing 31 million acres of land for crop production and, as a result, decrease biodiversity.
- Herbicide tolerant biotech crops have facilitated the adoption of no/reduced tillage production systems in many regions, which reduces soil erosion and improves soil moisture levels.
- In 2009 alone, less fuel use and additional soil carbon storage from reduced tillage reduced greenhouse gas emissions by an amount equivalent to removing 17.7 billion kg of carbon dioxide from the atmosphere or removing 7.8 million cars from the road for one year.
- The development of disease resistant trees, salvaged the Hawaiian papaya industry and may resurrect significant species like the American Chestnut Tree.
- Improved growth rates and processing through biotechnology may significantly contribute to U.S. biomass harvests and domestic production of renewable fuels and chemicals, making energy independence a realizable goal and reducing the need for harsh chemicals to process tree fiber into economically valuable pulp and fiber for paper, fuel and energy.

Doing More with Less, Sustainably

Throughout history, as human population growth increased the demand for food, animal feed, fuel and fiber, our agricultural and forest production systems kept pace. In the mid-20th century, fears of a population-driven food crisis, primarily in the developing world, led to research and investment to intensify crop production there. From 1960 to 2000, the Green Revolution increased food production in developing countries by nearly 200 percent from 800 million tons to 2.2 billion tons and global food production by 150 percent from 1.8 billion tons to 4.6 billion tons through the use of high yielding varieties that could resist herbicides and disease, irrigation, insecticides and fertilizers. As a result, the Green Revolution 1) saved one billion from famine; 2) halved the global percentage of undernourished people; 3) improved rural economies; and 4) protected approximately 2.2 – 3.8 billion acres of land from being cleared for crop production.

We still face the relentless challenge of feeding and fueling an ever-expanding population, which will reach 9 billion by 2050 and require at least a 70 percent increase in food, feed and fuel production. However, this time the challenge of increasing per acre productivity is exacerbated by a confluence of interacting pressures in addition to population growth: increased competition for water and land; rising energy prices; a dietary shift from cereals to animal products; diminishing supplies of fossil fuels – the source of most agrochemicals; resources degraded from past activities; and the global effects of climate change.

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[6] James, C. 2010 Global status of commercialised biotech/GM crops: 2010, ISAAA brief No 42. www.isaaa.org
[7] Carpenter, J. 2011. Impacts of GM crops on biodiversity. *GM Crops:*2:1-17.
[8] http://www.ctic.purdue.edu/resourcedisplay/293/; http://www.ctic.purdue.edu/resourcedisplay/281/

The Green Revolution allowed us to produce more with more inputs, most of which are derived from nonrenewable resources. Our current challenge is to produce more with less and to do so in a sustainable fashion. Biotechnology provides a set of precise yet flexible tools for meeting that challenge.

As described above, biotech crops and trees have already provided more with less, sustainably, by improving yields without clearing new land, while conserving soil, saving water, using less fossil fuel, both directly and indirectly, and enhancing biodiversity. In addition to environmental sustainability, biotechnology has contributed to sustainability by improving land-based incomes and both preserving and creating jobs in rural communities.

However, the past achievements of biotech crops pale in comparison to what agricultural biotechnology could provide in light of the necessity of doing more with less.

The "less" we have already experienced with the existing agricultural biotechnology – less fuel, land, pesticides, soil erosion – could be extended to many more crops, including orphan crops essential to subsistence agriculture in developing countries. For example, genes for the insect-resistance trait developed for corn and cotton, which come from a naturally occurring microbe found in soils worldwide, *Bacillus thuringiensis* or Bt, have been donated to African institutions for use in cowpea, a staple crop in West Africa. This flexibility is one of biotechnology's greatest untapped potentials: a genetic innovation developed for commodity crops grown in affluent countries can be used in any crop, because all plants know how to translate and use the genetic information.

The tools of biotechnology are also being used to develop new crops that use less of other essential resources: water and fertilizers. Drought tolerant corn varieties developed through biotechnology are awaiting approval in the U.S. and other countries, and drought tolerant genes have been incorporated into African corn varieties. A number of crops with the NUE trait (nitrogen utilization efficiency) are also in the pipeline.

In addition to improving crop plants, the ability to use biotechnology to improve the productivity of animal agriculture, including aquaculture, is enormous. Existing technologies include fish that are 15 percent more efficient in feed utilization and pigs that are better able to use the phosphorous in plants (50 to 75 percent more efficient). Both will allow us to meet the growing demand for animal protein with fewer inputs.

Many of the foods we enjoy today come from overseas. Food transportation is energy demanding, and 97 percent of the farmed salmon we consume is produced overseas. Biotechnology gives us the tools to grow the salmon here in the U.S., which not only would conserve fuels, but would also improve food security and ensure a safer food supply. Imported seafood does not receive the same level of inspection as domestic production. Only one-tenth of one percent of imported seafood is inspected for drug residues.[9]

Biotechnology also can improve the processing capability of various industrial processes, unlocking cellulose for conversion to fuels or chemicals, or to paper using fewer environmentally harsh chemicals. A recent study by the National Renewable Energy Lab has discovered the altering the amount of lignin in

[9] A recent GAO report documented several instances of farmed salmon from Chile using non-approved drugs for treatment of fish

trees, which may unlock higher degrees of cellulose for use in producing fuel. [10] The Environmental Protection Agency has also stated that biotechnology is key to achieving the goals of the federal Renewable Fuel Standard by enabling the conversion of cellulosic biomass to fuels and other chemicals.

"Less" means not only lower amounts of agricultural inputs, but also less severe environmental impacts. The pest control traits of current biotech varieties have had less severe environmental impacts than their predecessors, and therefore less of an impact on biodiversity. The Bt gene is toxic only to a handful of insects, and in order to exert its effect, the insect must eat the crop. As a result, insects that are not crop pests or are beneficial, such as bees and ladybird beetles, are not harmed. The herbicide tolerance traits added to biotech crops have allowed producers to switch to herbicides with fewer environmental and health impacts. This same thinking could be applied to crops to control disease, such as those caused by fungi and virus. There has long existed the technology to create many virus-resistant crop varieties, but the economics of product development, primarily the costs of regulatory approval, make it unlikely that these will be developed for any but the largest commodity crops.

Just as "less" means more than less inputs, the "more" provided by past and future advances in biotechnology encompasses more than just "more" product. More land-based income, with its concomitant impacts on rural economic development, could be provided to many more producers, including those growing small acreage crops in the U.S., if existing biotech traits can incorporated into additional crops.

The "more" provided by biotechnology also entails more nutritious, thus enhancing agricultural biotechnology's contribution to public health. A few crop varieties, nutritionally-enhanced through biotechnology, have been commercialized in the U.S. and could help to address the obesity epidemic by shifting the proportion of various oils to healthier types. Similar work is being done with animal food products in which the levels of omega-3 fatty acids, which have many health benefits, in meat and milk are increased. However, much more could be done to improve the vitamin and mineral content, as well as local availability of fruits, vegetables and other crops, both in the U.S. and globally. Some of these "biofortified" products are currently being field-tested in developing countries, and many more are under development by public sector research institutions.

We already have the know-how to develop the biotech varieties just described that would allow "more" to be done with "less." The necessary genes exist and technology has been developed to provide them to various agricultural products. But having these much needed technologies is not sufficient. There must also be in place government policies that allow both the public and private sectors to develop these crops, trees and animals.

[10] Presented by DOE National Renewable Energy Laboratory scientists at 33rd Symposium on Biofuels and Chemicals. Seattle, Wash. May 5, 2011.