

U.S. Soybean Production:

A Comparison of Sustainable Production Systems for Conventional, Biotech, and Organic Soybeans





**The United Nations
has called for a 50
percent increase in food
production by 2030.**

Can high-yield soybean crops help meet this call to feed a hungry and growing world, while remaining environmentally and economically sustainable?

To assess the sustainability of U.S. soybean production, the United Soybean Board requested the Council for Agricultural Science and Technology conduct an extensive literature review. This brochure summarizes the key findings.

Introduction – Sustainable Soybean Production

Farmers live off the land, and so they take their environmental stewardship very seriously. **Sustainable soybean agriculture** allows U.S. soybean farmers to meet the needs of the present, while improving the ability of future generations to meet their own needs, by:

1. **Adopting technology and best practices that increase productivity to meet future needs while being stewards of the environment,**
2. **Improving human health through access to safe, nutritious food, and**
3. **Enhancing the social and economic well being of agriculture and its communities.**

Feeding the World

An estimated 800 million people around the world suffer from chronic food shortages, and millions more could go hungry due to current and future food crises. To meet this need, **the United Nations has called for a 50 percent increase in food production by 2030.**

High-yield soybean crops can help feed a hungry and growing world with high-quality protein. But, can this crop production feed the ever-growing world population while remaining sustainable?

A Comprehensive Review

To assess the sustainability of U.S. soybean production, particularly on environmental and economic scores, the United Soybean Board commissioned the Council for Agricultural Science and Technology (CAST) to conduct an extensive literature review. CAST published this report in their Special Publication 30 by a task force led by Dr. Larry G. Heatherly in April 2009.

This brochure summarizes key findings of CAST Special Publication 30, referred to throughout this brochure as the **CAST report**. It also includes information on the environmental benefits and global adoption of biotechnology provided by the Conservation Technology Information Center (CTIC) and the International Service for the Acquisition of Agri-Biotech Applications (ISSSA).

Key Sustainability Findings

The CAST report determined that over 92 percent of U.S. soybean acres are planted with soybean varieties developed through agricultural biotechnology. These currently commercialized biotechnology-derived soybean crops yield environmental benefits, primarily by supporting conservation tillage on more fields than previously implemented.

The benefits include:

- **93 percent decrease in soil erosion**
- **Preservation of one billion tons of top soil**
- **70 percent reduction in herbicide run-off**
- **326 million lbs reduction in CO₂ emissions**

The overriding conclusion of the CAST report is that all three of the major soybean production systems (conventional, biotech and organic) are environmentally sustainable and can be managed for profit, assuming that appropriate market rewards exist for each system.

However, most soybean production in the U.S. today relies on biotech soybean varieties that are resistant to one or more herbicides for sustainable weed management. Thus, this brochure has a pragmatic focus on the sustainability of biotech soybeans.

Feeding the World

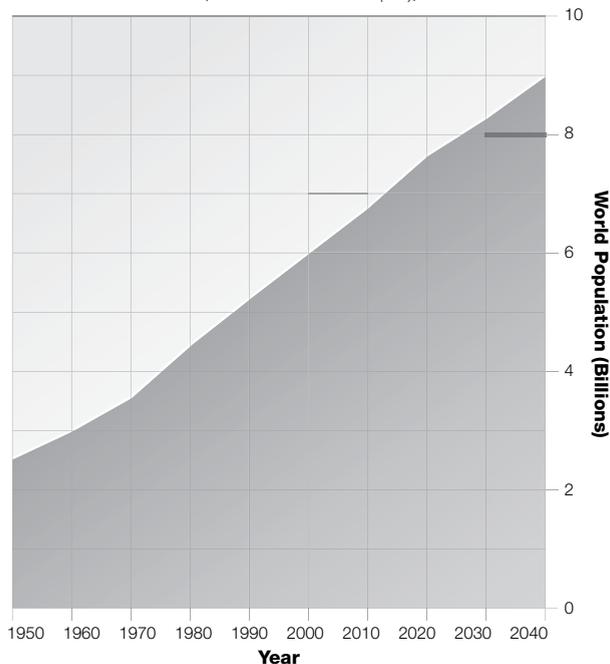
The UN Calls for Increased Food Production

United Nations (UN) Secretary General Ban Ki-moon has urged nations to seize an “historic opportunity to revitalize agriculture” as a way of tackling the food crisis. Mr. Ban told a UN-sponsored summit in June 2008 in Rome that food production would have to rise by 50 percent by the year 2030 to meet demand. The UN’s Food and Agriculture Organization has warned industrialized countries that, unless they increase yields, eliminate trade barriers and move food to where it is needed most, a global catastrophe could result.

Food prices experienced in 2008 are believed to have pushed 100 million people into hunger worldwide. And, the world population continues to increase further straining food supplies. Currently at 6.7 billion people, the world population increased from 3 billion in 1959 to 6 billion by 1999, and is projected to grow to 9 billion by 2040.

World Population 1950-2040

Source: U.S. Census Bureau, International Data Base (IDB), 2008



Using biotechnology-derived soybean varieties results in improved weed control and better weed management efficiency. Plants that resist pests and diseases, tolerate harsh growing conditions and reduce spoilage prevent farmers from losing billions of pounds of important food crops annually.

Echoing this point, ISSSA calculates the major reasons farmers have adopted the biotech crops so widely are a 56 percent reduction in production costs and a 44 percent increase in yield, as well as simplicity and flexibility in crop management.

Changes in U.S. Soybean Production

Soybean production in the U.S. has changed since the time of its initial introduction into the Corn Belt in the mid-1800s. Initially, the crop was produced mainly for forage and received only minimal inputs. Its husbandry evolved to become a grain crop that is a major source of both protein in animal diets and vegetable oil for human consumption. Soybean production generally occupies approximately 22 percent of the harvested cropland or over 72 million acres in 31 U.S. states.

The majority of U.S. soybeans are grown in three distinct regions: the Midwest or Corn Belt; the Midsouth or lower Mississippi River Delta; and the Southeast and Atlantic coast. Producers in these three regions apply common components of sustainable production practices at differing levels due to soil and climate differences.

An Assessment of Present-Day Soybean Production

A recent report in *Field Crops Research* summarized the state of present-day soybean production in the U.S. using data from Iowa, Nebraska, Kentucky and Arkansas.

Harvested soybean acreage increased dramatically from 1972 to 2003.

Yields during the 32-year period increased in 79 percent of the analyzed areas.

Yield increases were concurrent with increased harvested acreage.

Permanent plateaus (i.e., no change in yield since 1972) were common in low-yield, high-stress environments.

The rate of yield increase was enhanced by irrigation in Nebraska and Arkansas.

Stagnant soybean yields and doublecropping were associated with each other.

High-yield systems had the greatest increases in yield.

Irrigation could greatly increase yields in drier areas.

The challenge for the future of soybean production in the U.S. is not only to keep yields increasing in productive environments, but also to develop and apply technology to increase yields in high-stress, low-yield environments. High-stress environments provide more challenge to sustaining U.S. soybean production.

Defining Sustainable Agriculture

The concept of sustainability in agriculture is not a new concept, and has been a consideration in agricultural systems for many decades. The key components of sustainability were summarized by the U.S. Congress in the 1990 Farm Bill, as an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

- Satisfy human food and fiber needs
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends
- Make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
- Sustain the economic viability of farm operations
- Enhance the quality of life for farmers and society as a whole.

Sustainable agriculture implies using production methods that result in the commensurate maintenance or enhancement of environmental quality and economic profitability. In other words, for a production system that is environmentally sound to be truly sustainable, it must be profitable for the producers who adopt and use the system over the long term.

Sustainability of Herbicide Resistant Soybeans

The Introduction of Glyphosate-Resistant Soybeans

Soybean varieties have been developed using conventional breeding techniques since about 1930, and these varieties have allowed progressive improvement in soybean production through improved yield, quality and resistance to pests.

Biotech soybeans were first introduced in the mid-1990s when glyphosate-resistant (GR) varieties became available. In 2008, biotech varieties (exclusively herbicide tolerant) were grown on 92 percent of U.S. soybean acreage.

GR Soybeans, Sustainable Weed Management and Water Quality

The development of GR soybeans has been considered the greatest step toward a sustainable weed management system. The use of glyphosate has displaced tillage operations and the use of non-glyphosate herbicides.

In general, the fate of all herbicides in the environment is related to their retention, degradation (length of persistence) and transport in air, water and soil. The retention of herbicides in soil depends on adsorption. Adsorption refers to the binding of herbicide to soil particles. The sorbed portion of the herbicide is generally unavailable for leaching, degradation or plant uptake. Glyphosate is sorbed tightly and rapidly to soil and thus not readily available for leaching or runoff losses.

As a result, herbicide run-off in a GR soybean production system is much lower than in a non-herbicide-tolerant, conventional soybean system. The herbicide used with biotech GR soybeans has no soil activity with a half-life of 47 days, while herbicides that are active in the soil can last for 90 days or longer. Soil adsorption of glyphosate eliminates the potential for water contamination.

Between 1995 and 2006, the amount of non-glyphosate herbicide applied to soybeans decreased by 38.8 million pounds, or 83.5 percent, while the total number of soybean acres increased by 46 percent in the U.S.

This trend is thought to be due to the broad spectrum of weed control provided by glyphosate, which can substitute for the use of mixes of two or more conventional herbicides. The decrease in herbicide application demonstrates how U.S. soybean farmers are using fewer active ingredients, which translates into ease of management and strong environmental stewardship.

GR Soybeans and Low Insecticide Use

Insecticide use is low in most soybean producing regions of the U.S., with less than 16 percent of soybean acreage nationwide treated with insecticides. Research is underway on developing insect-resistant soybeans through biotechnology, with particular emphasis on beetle-resistance.

Because some strains of *Bacillus thuringiensis* (Bt) are known to kill beetles, and because new biotechnology using RNA interference also has been effective against Coleoptera, a biotech-derived insecticidal soybean variety will not be limited biologically to the control of moths.

New Varieties Emerge from the Research Pipeline

Beginning in 2009, additional soybean varieties will carry a different Roundup resistant “gene” known as “Roundup Ready 2 Yield” (Monsanto Company) or that carry a “gene” for resistance to glufosinate, the active ingredient in commercial herbicide products known as Liberty or Ignite. The latter varieties are known as “Liberty Link” (Bayer Company, Germany).

When used properly with other herbicides and resistance mechanisms, glyphosate and GR soybeans will continue to provide a large contribution toward the sustainability and environmental impact of soybean production in the U.S.

These new soybeans have gained approval in major international markets and will be commercially available for planting in 2009. In future years, additional varieties with resistance to dicamba and 2,4-D are scheduled for release as regulatory approvals are obtained, and will form the backbone of weed management strategies in U.S. non-organic soybean production, thus helping prolong the effectiveness of the current system that mostly depends on using glyphosate with GR varieties.

Beyond herbicide resistance, forthcoming varieties will possess value-added traits to improve product functionality and health benefits. Examples include increased oleic and stearic soybean oils and reduced saturated fat soybean oils, which will offer food companies highly functional oils with zero grams of trans fat; reduced raffinose and stachyose, two antinutrients in livestock feed; and low phytate, for both improved human absorption of iron and zinc, and also improved animal feed that will reduce phosphorus pollution and improve water quality. These traits are expected on the market during 2010 to 2015.

Most public soybean breeding programs will likely continue to emphasize conventional breeding rather than using biotech materials. But, the availability of seed will depend on the demand from domestic and international markets. It is unlikely that conventional varieties will reclaim significant soybean acreage in the U.S. in the foreseeable future due to weed control concerns and lack of variety availability.

The Rise of Conservation Tillage

U.S. soybean farmers have almost completely eliminated plowing on their fields. Although “no-till” was feasible on a limited number of farmland soil types and in a limited number of U.S. latitudes prior to the arrival of biotech crops, the biggest environmental impact of biotech crops has been the widespread adoption of no-till farming. In fact, no-till soybean acreage in the United States has increased by 35 percent since the introduction of herbicide-tolerant soybeans.

Sustainability Benefits of Conservation Tillage

Today, conservation tillage is used on over 65 percent of U.S. soybean acres, and results in the following achievements:

93 percent decreased soil erosion

31 percent decreased wind erosion

70 percent decreased pesticide run-off

80 percent reduction in phosphorus contamination of surface waters

An annual soil moisture evaporation loss reduction of 5.9 inches

Greater than 50 percent reductions in fuel use

Conservation tillage is thus both economically and environmentally sustainable for U.S. soybean production.

U.S. soybean farmers have almost completely eliminated plowing on their fields.

Decreased Soil Erosion

A recent summary of global soil erosion supports the conclusion that the conservation tillage systems used to produce soybeans in the U.S. can provide a foundation for sustainable soybean production, specifically by reducing soil erosion rates from 3.94 millimeters/year under conventional tillage to approximately 0.12 millimeters/year using conservation tillage. Additionally, crop residues left in no-tillage farming allow better soybean root system development.

Reduced CO₂ Emissions and Global Warming

Surveyed farmers made 1.8 less trips across the field using no-till. A decrease in number of tillage operations and number of trips across the field translates to decreased fuel usage and decreased carbon dioxide (CO₂) emissions from the motorized farm equipment. More precisely, CO₂ emissions will be decreased by 302 million pounds from farm operations using GR soybeans planted in a no-till system compared to other soybeans planted using conventional tillage. Consequently, global warming may be delayed with the adoption of GR soybeans in conjunction with no-till farming practices. The decreased CO₂ emissions brought about by no-till farming in 2008 are equivalent to removing 125,750 cars from the roads each year.

A review on global warming potential from greenhouse gases in intensive agriculture showed that global warming potential from conventional tillage practices is 8.14 times greater than no-tillage. This substantial reduction of global warming potential in no-tillage systems was attributed to increased carbon storage in no-till soils and reductions in fuel consumption for no-till. No-till systems accumulate 570 pounds more net carbon/acre annually than conventionally tilled systems. Conversely, a fivefold loss of CO₂ from soil was recorded from one pass of a moldboard plow than in no-tilled plots.

Looking ahead, approximately 21.6 million tons of topsoil would be preserved by planting herbicide-tolerant biotech soybeans in no-till systems. Reduced tilling saves approximately 3.9 gallons of fuel per acre, which will translate to a decrease of 3.3 million tons of CO₂ entering the atmosphere by 2020.

The decreased CO₂ emissions brought about by no-till farming in 2008 are equivalent to removing 125,750 cars from the roads each year.

Enhancing Biodiversity with No-Till Soybeans

Biodiversity is also maintained in no-till soybean fields. Soil microbes, beneficial insects and earthworms exhibit increased diversity in conservation tillage soybean fields relative to plowed fields.

Earthworm numbers were 3.5 to 6.3 times greater following 17 years of no-till cropping compared to conventional tillage. Bobwhite quail chicks needed only 4.2 hours to obtain their daily dietary insect requirement in no-till soybean fields compared to 22 hours in conventionally tilled soybean fields.

Advancements in Soil and Water Management

Soil tests provide the best opportunity to accurately measure nutrient deficiencies and prevent over-fertilization that may result in environmental contamination. Variable Rate Technology can be used to apply phosphorus on a site-specific basis as needed to increase profits and decrease nutrient loss.

On a small scale, cover crops provide positive environmental benefits including decreased nutrient loss to leaching, reduced water and herbicide runoff and improved control of winter erosion when used in a soybean or soybean-corn production system. While cover crops are rarely economically viable, farmers continue to use them on about 10 percent of soybean acreage in the Corn Belt.

The Advantages of Crop Rotation

Crop rotation provides positive production and environmental benefits to both soybeans and the rotated crop in most systems. Grain crops result in more dry matter and subsequent plant residue than soybean crops. And so, a rotation of a grain crop with soybeans, with soybeans planted no-till, decreases erosion potential.

Nitrogen fertilizer applied to a grain crop following soybeans can be reduced by an estimated 40 to 80 pounds/acre compared to the grain crop following itself. Energy output:input ratios favor a two-year soybean–corn crop rotation in the Corn Belt. In a comparison of cropping systems in Nebraska, the energy output:input ratio ranged from 4.1 for a continuous corn or sorghum system to 11.6 for a soybean rotation with corn or sorghum using conventional tillage.

Rotating soybeans with a crop that is not a host to soybean cyst nematode (SCN) pests and using a rotation of resistant soybean varieties are effective in alleviating this pests' damage to soybean crops, as well as in delaying or preventing SCN adaptation. The biannual soybean–corn rotation, however, is not a guaranteed long-term pest control measure.

Monocropping and Doublecropping

The preponderance of evidence suggests that annual rotation of soybeans and a small grain (doublecropping) is an environmentally sustainable practice, but it may not always be viable. In most cases, though, soybeans rotated biannually with another summer crop will enhance economically and environmentally sustainable production.

The majority of soybean production is monocropped in the southern U.S., and there is little long-term research to evaluate the effects of doublecropping in that region. Total economic returns from a soybean–wheat doublecrop system are estimated to be similar to those from a soybean monocrop system. Irrigation to mitigate soybean yield loss due to drought stress is the most important factor in sustaining doublecropping in the Midsouth.

Crop rotation provides positive production and environmental benefits to both soybeans and the rotated crop in most systems.

Irrigated soybean systems are the most productive in the U.S., averaging over 48 percent more yield than dryland systems.

Dealing with Drought

Drought is the most damaging abiotic (non-living) stress to soybean crops. One of the major challenges for future soybean production is to develop technology to reduce the risk of yield loss due to drought stress in drought-prone production areas. Seed technology companies are evaluating soybean germplasm with drought stress tolerance traits that may be commercially available within the next three to five years.

Three recent advances in soybean production management and breeding provide an opportunity to mitigate some of the effects of drought:

- 1. The Early Soybean Production System for the Midsouth, which uses early planting of earlier-maturing varieties to avoid the most drought-prone period of the growing season**
- 2. Release of two breeding lines that maintain a higher rate of nitrogen fixation during drought periods**
- 3. Identification of two soybean plant introductions that are slow-wilting**

These developments offer management options and genetic potential that can be used to reduce yield loss in soybean as a result of the effects of mild to moderate drought stress.

Irrigated soybean systems are the most productive in the U.S., averaging over 48 percent more yield than dryland systems. Overcoming drought is a key factor to sustaining maximum soybean yields, but only about 8 percent of U.S. soybean acres are irrigated. The ability to continue using irrigation will rely on maintaining the quantity and quality of ground and surface water resources. Improvement of soybean productivity with limited moisture through plant breeding and biotechnology represents a more sustainable approach to dealing with drought.

Sustainable Pest and Weed Solutions

Economically important problems in soybean crops include weeds, insects, fungi, nematodes and viruses. Weeds are considered the number one problem in all major soybean-producing countries. Pests (disease-causing pathogens, nematodes and insects) cause pervasive and extensive management challenges in all U.S. soybean production systems. In the northern U.S., annual soybean yield losses attributed to diseases and nematodes averaged approximately 294 million bushels from 1999 to 2005. In the Midwest, most insect pests are attacked by natural enemies or biological control agents, with few consistent problems. In the southern U.S., insects caused an estimated 51.4 million bushels in annual yield losses from 1999 to 2005.

Sustainable Pest Management Techniques

The most effective and widely deployed management strategy for soybean pathogens is host-plant resistance. For diseases caused by fungi where host resistance has not been identified or is difficult to incorporate, there are now many fungicides labeled for use on soybean crops. For the management of soybean rust, fungicides were applied to less than 1 percent of U.S. soybean acres in 1995; in 2006, they were applied to only 4 percent of the acres.

SCN is effectively managed through a combination of planting resistant varieties, rotating varieties with alternative sources of resistance and rotating with non-host crops.

Integrated pest management has been promoted and used for insect management in U.S. soybean crops, and has resulted in significant cost savings with limited environmental impact. Scouting of fields to determine insect pressure is widely and effectively used to avoid unwarranted applications of insecticides. Early planting in the Midsouth is used to avoid damaging late-season defoliators.

When damaging insect outbreaks occur, chemical insecticides are available and can be used to provide consistent and effective control. However, synthetic insecticides were applied to only 16 percent of U.S. soybean acres in 2006.

Sustainable Weed Management

Weeds are typically responsible for more soybean production losses than either insects or diseases and are estimated to potentially cause as much as 37 percent yield loss globally if left uncontrolled. Sustainability of weed management in a conventional (non-biotech) soybean production system is limited by several factors.

- 1. Few new herbicide chemistries that will control problem weeds or address weed resistance concerns are forthcoming.**
- 2. Available chemistries may disappear due to environmental concerns and lack of market to sustain their production.**
- 3. Few non-biotech varieties are being developed and released by seed companies because grower demand has been for GR soybean.**
- 4. Reverting to post-emergent tillage to facilitate weed management in conventional soybean is not likely to occur because of erosion concerns, labor constraints and farm size.**

Weeds are considered the number one problem in all major soybean-producing countries.

The Organic System

In 2005, there were 122,217 certified organic soybean acres in the U.S., which comprised 0.17 percent of the total soybean acres. Almost half of these organic acres were in Iowa, Michigan and Minnesota.

In order to sell certified organic soybeans, producers must be certified by the U.S. Department of Agriculture-Agricultural Marketing Service's National Organic Program. Requirements to be certified as an organic soybean producer include:

- 1. No synthetic fertilizers or pesticides for at least the previous 3 years,**
- 2. An approved, planned sequence of crops in each identified field,**
- 3. Use of organically produced seed, and**
- 4. Complete records of inputs and operations.**

Organic producers may not utilize biotechnology. Disease and pest management relies on varietal resistance and crop rotation. Tillage is used for cover crop management and weed control, and this may increase erosion potential. Where mechanical weed control is not effective, hand weeding is necessary. Crop rotation and rotation sequence are fundamental to managing weeds, insects, diseases and fertility, as is using animal manures and legume cover crops as fertilizer sources.

An extensive survey of Midwestern U.S. commercial soybean farmers compared the economics and practices of conventional and organic soybean production. The following key points are pertinent to U.S. organic soybean production:

- 1. Organic soybeans are produced on smaller farm operations (averaging 478 acres) than non-organic soybean (averaging 748 acres).**
- 2. Significant labor requirements associated with organic soybean production make organic production less practical on larger farms (labor cost of \$16.89/acre for non-organic vs. \$54.33/acre for organic).**
- 3. Organic soybean operations substitute field operations for chemicals and incur higher fuel, repair and hired labor costs.**
- 4. Organic soybean producers obtain an average yield of 31 bushels/acre compared with 47 bushels/acre for conventional producers.**
- 5. The market premium for organic soybeans is \$9 bushel compared to other production systems.**

Organic producers may not utilize biotechnology. Disease and pest management relies on varietal resistance and crop rotation. Tillage is used for cover crop management and weed control.

The Role of Economics in Sustainability

Farm communities must experience economic well-being in order to continue to farm, and pass family farms from one generation to the next. One of the criteria for determining sustainability of a production system is, therefore, the profitability of that system.

Most states compile budgets for only GR varieties; the few states that compile separate budgets for conventional (non-GR varieties) and biotech (GR varieties) systems show nearly identical per-acre costs for each system. The lower cost for seed of conventional varieties compared to biotech GR varieties, primarily associated with the technology fee, is offset by the higher cost for herbicides in the conventional system compared to the biotech system.

A Comparison in the Corn Belt

In the Corn Belt, the breakeven price for non-organic soybeans is estimated at \$5.88 to \$6.18/bushel (with low fertilizer input) and \$8.22/bushel (with normal fertilizer input). In the Midsouth, the breakeven market prices for non-irrigated, non-organic soybeans are estimated to be \$7.10/bushel (Early Soybean Production System, with a 40 bushels/acre yield) to \$10.60/bushel (25 bushels/acre yield).

In Iowa, the estimated breakeven price of \$8.22/bushel for non-organic soybeans is considerably lower than the estimated breakeven price of \$11.45/bushel (40 bushels/acre yield) to \$14.77/bushel (31 bushels/acre yield) for organic soybeans. The estimated additional costs for producing organic soybeans vs. non-organic soybeans total \$6.55/bushel. The profitability of soybeans in an organic rotation is dependent on a high price premium, which averaged more than \$9/bushel in 2006 for organic soybeans.

Conclusions on the Sustainability of U.S. Soybean Systems

The CAST report's comprehensive review of research findings leads to the conclusion that conventional, biotech and organic soybean systems are all environmentally sustainable, and can be managed for profit with appropriate market incentives when proper practices and technologies are used.

Production practices are evolving to ensure the continued sustainability of soybean production in the U.S. These innovations include: improved production and management practices; advances in breeding and variety development; and new or improved materials and methodology for disease, nematode, insect and weed management.

However, conventional, biotech and organic systems are not equally viable to meet current and future needs.

A Changing Definition of Conventional Agriculture

The original "conventional soybean production system" (defined here as a system that uses non-biotech soybean varieties) now occupies less than 8 percent of total U.S. soybean acres, and likely will stay at or below this level in the future.

This "old" conventional system will only be used by growers to produce non-biotech soybean for a niche market that pays a premium price, by organic growers and by growers who refuse to plant biotech varieties because they are more expensive or because of their opposition to industry restrictions on the usage of biotech seed.

Conventional, biotech and organic soybean systems are all environmentally sustainable, and can be managed for profit with appropriate market incentives when proper practices and technologies are used.

Biotechnology's Role as the Predominant System

The results of the CAST report indicate that U.S. soybean production now has a “new” conventional system that is based on using biotechnology. Over 92 percent of the 75.7 million U.S. soybean acres are planted with soybean varieties developed through agricultural biotechnology.

As stated earlier, the CAST report notes that this biotech system has already led to the following achievements through conservation tillage:

- **93 percent decrease in soil erosion**
- **Preservation of one billion tons of top soil**
- **70 percent reduction in herbicide run-off**
- **326 million lbs reduction in CO₂ emissions**

In addition to no-till agriculture, biotech soybeans reduced farmers' needs to use pesticide applications, thanks to targeted pest control methods. New traits will improve water quality through decreased phosphorus waste deposition from livestock feed.

The UN Secretary General has indicated that the global food supply must rise by 50 percent by 2030 to meet demand. Agricultural biotechnology is a key tool for meeting the needs of a growing global population over the next two decades. Biotechnology-derived soybeans, planted on over 66.5 million hectares (164 million acres) worldwide, increased world production by 32 million metric tons in 2007. Continued development and adoption of biotech traits will be essential to meeting the goal of feeding the world's hungry while providing environmental sustainability through enhanced conservation of soil and water and improved water and air quality.

Over 92 percent of the 75.7 million U.S. soybean acres are planted with soybean varieties developed through agricultural biotechnology.

Organic Soybean Production Findings

Organic soybean production currently occupies less than 0.2 percent of U.S. soybean acreage (approximately 122,200 acres), and likely will continue to occupy a very small acreage in the U.S.

Reasons for this are: (1) individual operators will only be able to sustain management of small acreages because of the required inputs of hand labor and animal manure; (2) stringent initial requirements for establishment of and regulations for maintaining an organic cropping system may require more commitment than many producers are willing or able to make; (3) cost of production is greater and yields are lower than for a non-organic soybean system, thus requiring a significantly higher market price to sustain profitability; and (4) oversupply of organic soybeans will quickly eliminate the price premium paid for organic soybeans that is required for continued profitability of the system.

The present and anticipated future small organic soybean acreage in the U.S. will not contribute to the long-term sustainability of U.S. soybean production in general, but will be profitable for small-acreage producers as long as consumers are willing to pay a \$7 to \$10 premium. The organic system will be important in supplying niche markets that do not allow seed with biotech traits.

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Additional key points cited in this report were obtained from a report published by the Conservation Technology Information Center (CTIC) entitled *Conservation Tillage and Plant Biotechnology: How New Technologies Can Improve the Environment by Reducing the Need to Plow*. CTIC is a non-profit organization with the mission to provide reliable, profitable solutions to improve the relationship between agriculture and the environment. It is made up of members of ag industry, ag publications, ag associations, conservation organizations and producers and is supported by the U.S. Environmental Protection Agency, Natural Resources Conservation Service and other public entities.

The United Soybean Board (USB) is a farmer-led organization comprised of 68 farmer-directors who oversee the investments of the soybean checkoff for all U.S. soybean farmers. Soybean farmers are united by a commitment to produce wholesome, nutritious foods that can help sustain and nourish an ever-increasing population. And, soybean growers take pride in their role in producing one of the healthiest food crops in the world. USB has invested millions of dollars into health and nutrition research related to soy.

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