Texas Cooperative EXTENSION
The Texas A&M University System

L-5408
06-02

EXPLORE the genetic frontier

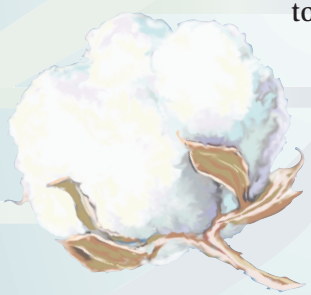
Biotechnology & Cotton— Texas' Biggest Crop

Biotechnology uses tools and techniques to alter the basic makeup of living organisms to make products or carry out processes that will benefit people and the environment. These processes include fermentation, reproduction, cloning, tissue culture, genetic engineering and DNA diagnostics (for example, studying chromosomes to diagnose diseases or find allergens or toxins in food). Although biotechnology has existed since ancient times, some of the most dramatic developments have occurred in recent years.

Over the years, traditional breeding and selection techniques have resulted in plants and animals that are more productive and more useful to people. Biotechnology is a tool for modifying the DNA of organisms so that they will produce safe and high-quality foods, medicines and other products. Biotechnology also may help farmers produce larger quantities of food for the world's growing population.

What is Bt?

Bacillus thuringiensis is a common soil bacterium that contains a gene *(Bt)* that produces a protein that is toxic to some major cotton insects when eaten, yet is harmless to mammals. *Bacillus thuringiensis* has been used as a natural insecticide sprayed on crops since 1958. The *Bt* gene was introduced into the cotton plants using biotechnology in 1985. After a decade of rigorous scientific evaluation, farmers planted fields with the new insect-resistant *Bt* cotton seed starting in 1996.

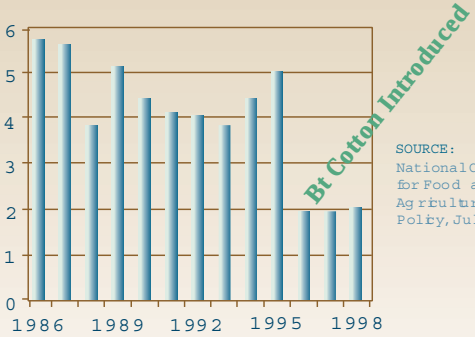


Why Bt cotton?

Nearly 5 million acres of cotton are planted annually in Texas, making the state the No. 1 producer of cotton in the United States. Cotton is Texas' biggest crop. Farmers benefit if plants are developed that are resistant to pests because they can produce more cotton at a lower cost. The public benefits by having an abundant supply of cotton for clothing and cottonseed oil for food processing of chips and baked goods and by the presence of fewer chemicals in the environment.

In 1996, almost 40 percent of all pesticides used in U.S. agriculture were used in cotton production. Since the introduction of *Bt* cotton, the application of bollworm and budworm insecticides to cotton has de-

Number of Pesticide Treatments for Bollworm/Budworm Across Six Major Cotton States in the United States



SOURCE: National Center for Food and Agricultural Policy, July '99

1998
Conventional Cotton.....5.3 insecticide applications
Bt Cotton.....1.4 insecticide applications
Net.....>5 mil. acre-treatments eliminated
2.0 mil lbs. of insecticide eliminated

creased 60 percent in the six major cotton-producing states. This illustrates the effectiveness of using *Bt* cotton to control insects rather than using insecticide sprays. Through the use of *Bt* cotton, farmers can cut their costs and increase their profits. They also drastically reduce their use of and exposure to traditional insecticides.

How does it work?

Bt controls certain insects in the immature larval stage, when most of the feeding occurs. When larvae ingest the *Bt* gene, toxic proteins are released that react with the cells of the stomach lining of a susceptible insect. The digestive system is paralyzed, causing the insect to stop feeding. *Bt*-affected insects will die within 12 hours to 5 days, depending on the amount of *Bt* consumed.

Is Bt cotton safe?

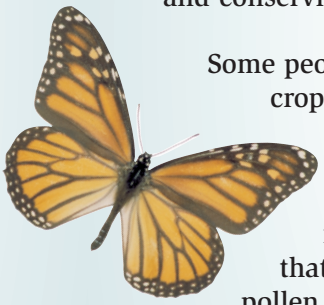
Yes. Research has shown that *Bt* has no effects on mammals, including people, and has been used safely to control insects on food crops since 1958. *Bt* cotton has been studied since 1985 and has no known toxic effects on consumers, the environment or those who physically handle the *Bt* cotton.

The main food product of cotton is cottonseed oil. People consume cottonseed oil in many well-known brands of chips, cookies and snack foods. *Bt* cotton eliminates the need for some insecticides, which can leave a residue on foods.

The Environmental Protection Agency, the U.S. Department of Agriculture (USDA) and the Food and Drug Administration have registered, regulated and approved plantings of *Bt* cotton since it was approved for field study in 1987 and commercial farming in 1996. The USDA has also approved production of genetically engineered *Bt* corn, potatoes and tomatoes.

Concerns about Bt cotton

As more farmers choose to plant *Bt* cotton seed, more insects are exposed to the *Bt* toxin. Insects that are resistant to the toxin may increase in number over time, thus reducing the effectiveness of *Bt* cotton. Farmers limit the potential increase of populations of resistant insects by using a variety of *Bt* strains, by limiting the acreage of cotton planted with *Bt* varieties and by traditional pest-management practices, such as planting early and conserving natural beneficial insects.



Some people also fear that use of *Bt* crops will affect nontarget species, such as monarch butterflies. Extensive laboratory and field studies have confirmed that, under field conditions, *Bt* pollen poses no significant hazard to monarch butterflies.

Bt cotton and industry

The success of *Bt* cotton production has boosted cotton biotechnology research. Through this research, farmers may be able to grow disease- and drought-resistant cotton with stronger fibers. Higher quality cotton helps U.S. farmers be more competitive in world markets and keeps consumer costs down.

For more information on biotechnology issues, see the other publications in this Explore the Genetic Frontier series:

"What is Biotechnology?"
"Developing Crops Resistant to Glyphosate Herbicide"
"Labeling of Foods Derived from Biotechnology"
"Regulating Plant Biotechnology—Ten Steps to Safety"

(http://texaserc.tamu.edu/pubs. Then search the word "biotechnology" to order or review these publications.)

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Web sites

http://texaserc.tamu.edu/pubs/ent/b6107.pdf

http://biotech.tamu.edu

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This is a joint publication of Texas Cooperative Extension and the Center for Nutrition, Health and Food Genomics at the Institute of Food Science and Engineering at Texas A&M University.

The publications in this series describe processes and products developed through rigorous scientific research and testing. Informed citizens are knowledgeable consumers and decision makers.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Chester P. Fehlis, Deputy Director, Texas Cooperative Extension, The Texas A&M University System.

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