

The First Decade of Genetically Engineered Crops in the United States

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Introduction

Over the past decade, developments in modern biotechnology have expanded the scope of biological innovations by providing new tools for increasing crop yields and agricultural productivity. Agricultural biotechnology is a collection of scientific techniques, including genetic engineering, that are used to create, improve, or modify plants, animals, and microorganisms. Genetic engineering (GE) techniques allow a precise alteration of a plant's traits (facilitating the development of characteristics not possible through traditional plant breeding), and permit targeting of a single plant trait (decreasing the number of unintended characteristics that may occur with traditional breeding).¹

The commercial success of GE crop varieties typically requires that biotechnology-derived trait enhancements be incorporated into successful cultivars (cultivated varieties with useful agronomic properties), the development of which requires significant knowledge of traditional plant breeding and the availability of genetic material (germplasm). This complementarity has been related to various institutional arrangements between seed and technology suppliers.

GE crops are often classified into one of three generations (Panos). Crops with enhanced input traits, such as herbicide tolerance, insect resistance, and tolerance to environmental stresses (like drought), represent the first generation. GE crops benefit farmers and may also offer environmental benefits. Second-generation crops include those with added-value output traits, such as nutrient enhancement for animal feed. Consumers will benefit directly from these products when they are available on the market. The third generation includes crops that produce pharmaceuticals or improve processing of bio-based fuels, and products beyond traditional food and fiber. At present, adoption of GE crops is generally limited to those with first-generation traits, which were tested on a large scale (field testing) in the 1980s to ensure that the desired traits will perform under production conditions. Second- and third-generation GE crops are in various stages of research and development.

Ten years after the first generation of GE varieties became commercially available, they have been widely adopted by U.S. farmers, driven by expectations of higher yields, savings in management time, and lower pesticide costs. Despite these benefits, environmental and consumer concerns may have limited acceptance of agricultural biotechnology, particularly in Europe. In the United States, foods containing GE ingredients currently available in the U.S. market do not require labels, since the U.S. Food and Drug Administration has determined that these foods are "substantially equivalent" to their non-GE counterparts (Shoemaker et al., 2003; FDA, 1992). Thus, U.S. consumers have been eating foods that contain GE ingredients (corn meal, oils, sugars) for the past 10 years while remaining largely unaware of their GE content.

¹In the United States, under guidelines issued by USDA's Animal and Plant Health Inspection Service (as published in the *Federal Register*, 7CFR340: 340.1), genetic engineering is defined as "the genetic modification of organisms by recombinant DNA techniques" (Fernandez-Cornejo and McBride, 2000). A full biotechnology glossary is in USDA (2005).