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Brian Haberstroh  
*Iowa State University*

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# Biotech Crops in America: Development, Adoption, and Regulation

by

Brian P. Haberstroh

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in partial fulfillment of the requirements for the degree of

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Program of Study Committee:

Dr. Shuizhang Fei, Major Professor

Dr. Thomas Lubberstedt

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## Summary

Biotech crops were first planted in the U.S. in 1996 and their use has increased rapidly. Today nearly 90% of corn, soybean, and cotton acres are planted with biotech varieties. Biotech crops fall into 2 main categories, herbicide tolerant (HT) and insect resistant (IR). For HT crops the most common herbicide is glyphosate. Resistance to glyphosate was developed by incorporating a gene from *Agrobacterium sp.* strain CP4 which causes the plant to create CP4 EPSPS synthase which is an enzyme to which glyphosate cannot bind, thereby creating glyphosate resistance in the plant. Insect tolerant crops were developed by using a gene from *Bacillus thuringiensis* bacteria (Bt) The Bt gene causes the plant to produce a crystalline protein which kills a specific class of insects.

Herbicide use has decreased as a result of biotech crops; however, the development of herbicide resistant weeds is reversing that trend. Farmers now are beginning to use higher rates of glyphosate in an attempt to control herbicide resistant weeds. Insecticide use has also decreased as a result of (IR) crops. Similar to herbicide resistant weeds, some populations of insects are beginning to develop resistance to some IR crops.

Resistance to herbicide or insecticide can develop from overuse of one single pesticide. In every weed and insect population there are individuals with a higher level of tolerance to a given pesticide. With repeated use of the same pesticide the frequency of the resistant individuals in the population increases and a resistant population develops.

The rapid switch to biotech crops was driven by farmers who had better yields, simpler management decisions, and decreased pesticide use when using biotech crops. Since nutritional values of HT and IR crops are identical to non-biotech crops, the consumers of biotech crops see little additional value, except for lower prices in many cases. This may be part of the reason that consumers have mixed emotions about biotech crops. Approximately half of all U.S. consumers believe that genetically engineered (G.E.) crops are less healthy than non G.E. crops. In cases where the G.E. crop has some specific benefit to the consumer such as healthier oil, or disease fighting properties, consumers tend to look at G.E. crops much more favorably.

Companies who develop biotech traits for crops are looking at global population trends which project 9 billion people on earth by 2050. These companies see an urgent need to increase global crop production to feed these additional people and they think biotech innovations are the best way to do it. Biotech innovations will continue to be developed, and they will be focused on better yields through weed and insect control but they will also expand into areas which generate additional value to the consumer such as foods with improved nutritional value, healthier oils, and foods with disease fighting characteristics. Gene editing is another technology which holds tremendous potential for developing the next generation of biotech crops.