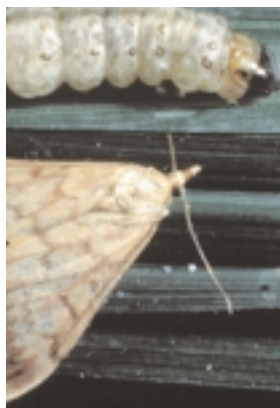


# Insight



## YieldGard® Corn: Food & Feed Safety

Plant biotechnology holds tremendous promise for offering a sustainable, ecological approach to pest control. YieldGard® corn protects itself against the European and Southwestern corn borer, thereby reducing reliance on chemical insecticides to control pests.

YieldGard corn's built-in protection comes from a naturally occurring microorganism called *Bacillus thuringiensis*, or *Bt*. *Bt* creates a protein that binds to specific receptors in the midgut of sensitive insects, but does not affect mammals or insects that lack those receptors. Therefore, the *Bt* protein has selective toxicity to a specific group of lepidopteran insects (e.g. borers such as the European corn borer), but is harmless to humans, fish, wildlife and beneficial insects that can help control other pests. *Bt* proteins have been used safely for nearly 40 years in microbial insecticides.

### Food and feed safety overview

The safety of biotech products such as YieldGard corn is established through comprehensive studies, which are reviewed by national and international regulatory authorities. These studies demonstrate that the newly introduced *Bt* protein is safe, and the genetic modification has not changed the food, feed or environmental safety of the corn.

YieldGard corn has worldwide import approval. It has cleared food, feed and environmental reviews by the U.S. Department of Agriculture, the Food and Drug Administration, and the Environmental Protection Agency in the United States. Food and feed regulatory agencies in Canada, Japan, the European Union and Argentina have reviewed YieldGard corn and have all concluded that YieldGard corn is the same ("substantially equivalent") as other corn in nutrition, composition, safety and how it functions in food and feed products.

### Food and feed safety history of the Cry1A(b) *Bt* protein

The safety of the Cry1A(b) *Bt* protein in YieldGard corn has been thoroughly evaluated. These tests confirm that the protein:

- Has a long history of safe use on food products, spanning almost four decades by organic farmers and home gardeners.
- Is present at very low levels in grain (and, therefore, in foods).
- Is rapidly degraded (in seconds) when exposed to simulated gastric fluids.
- Shows no similarity to known allergens.
- Shows no harmful effects to animals when fed at very high levels.

Based on the scientific information, regulatory agencies have concluded that the Cry1A(b) *Bt* protein in YieldGard corn is safe for human and animal consumption.

### "Substantially equivalent" to conventional corn

A basic principle in the regulation of plant biotechnology is a concept called "substantial equivalence." It was established in the early 1990s by the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the Organization for Economic Cooperation and Development (OECD). When a safety assessment of a new variety is conducted, the goal is that food must be **as safe as** traditionally bred varieties and foods.

To establish "substantial equivalence," the composition of YieldGard corn was compared to commercial varieties. The grain and forage assessments included proximate analysis (protein, fat, ash, fiber, carbohydrates and moisture), as well

### Regulatory assessment summary for YieldGard corn

Nutritional composition	✓
Animal feed performance (poultry, beef and dairy cattle, swine)	✓
Processing	✓
Wildlife effects	✓
Disease susceptibility	✓
Allergenic potential	✓
Non-target organism effects (outside of the intended class of insects)	✓
One additional protein/gene	•
<b>KEY</b>	Changed <span style="background-color: yellow;">■</span> Unchanged <input checked="" type="checkbox"/>

### YieldGard corn is compositionally equivalent to conventional corn

Protein	✓
Fat	✓
Ash	✓
Fiber	✓
Carbohydrates	✓
Calcium	✓
Phosphorus	✓
Amino acid composition	✓
Fatty acid composition	✓

*YieldGard corn – just like all biotech foods reviewed to date – was found to be comparable, or substantially equivalent, to its traditional counterparts aside from the defined differences conferred by the novel trait.*



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as calcium and phosphorus measurements. In addition, amino acid composition and fatty acid profile were compared for grain. Data showed that YieldGard corn is comparable in composition to conventional corn hybrids.

### Nutritionally equivalent to conventional corn

In addition, feed performance studies have confirmed that YieldGard corn is nutritionally equivalent and performs comparably to conventional varieties for livestock and poultry feed.

The safety of feed produced from YieldGard corn has been confirmed through numerous field and feeding trials. Across the biotech industry, 19 animal feeding studies using *Bt* corn have been completed or are in progress. The results show that animals perform in a comparable manner when fed biotech and conventional corn products.

- In two separate published studies, chickens fed *Bt* corn showed no differences in growth and feed efficiency compared to chickens fed conventional corn. Allrich et al. (1998) and Halle et al. (1998), Institut für Tierernährung (Braunschweig)
- A lactating dairy cow study found no differences in feed intake, milk yield, milk composition or udder health between cows fed *Bt* or conventional green chop. Faust and Miller (1997), Iowa State University
- No difference reported in performance in the first year of a two-year study involving beef cows grazing on *Bt* or conventional cornstalks. Russell and Petersen (1999), Iowa State University
- No difference reported in digestibility in sheep fed *Bt* or conventional corn silage. Daenicke et al. (1999), Institut für Tierernährung (Braunschweig)

### Environmental impact evaluation

The assessment of a biotech product's environmental impact involves such criteria as its susceptibility to insects and diseases, and its potential impact on non-target organisms. The protective protein in YieldGard corn controls targeted insect pests without harming humans, livestock or other animals. It does not harm agriculturally beneficial insects, including honeybees, ladybird beetles and green lacewings, as well as a variety of other predatory insects and spiders.

YieldGard corn helps sustain the environment because its built-in insect protection eliminates the need to apply conventional insecticides for corn borer protection. The built-in protection replaces insecticide applications, thereby reducing handling, exposure and potential spillage. At the same time, it reduces the need for additional fuel, labor and trips through the field.

### Grain quality benefits

Another benefit of YieldGard corn is improved grain quality that helps to ensure food and feed safety. Researchers have confirmed that YieldGard corn reduces insect damage in ears, one of the main pathways by which mold infects grain. Molds can produce dangerous fumonisin, one class of mycotoxins hazardous to animals and humans. Research from Iowa State University and the U.S. Department of Agriculture conducted in the Corn Belt showed a 96 percent reduction in insect-damaged ears with the YieldGard gene. In correlating research conducted in 1997, a year with high corn borer pressure in the Corn Belt, the authors found a 90 to 93 percent reduction in fumonisins.

Likewise, YieldGard corn improves grain quality by reducing losses from some stored grain pests. Kentucky State University researchers (Sedlacek et al. 1999, submitted) found that YieldGard corn reduced survival from the larvae of the Indian meal moth and the Angoumois grain moth by approximately 80 percent. In addition, surviving insects produced 70 to 80 percent fewer eggs. Thus, the spread of pest populations is dramatically reduced.

### Summary of the safety assessment

Detailed food, feed and environmental safety assessments confirm that YieldGard corn is safe for human and animal consumption. In summary, YieldGard corn:

- Is substantially equivalent to conventional corn hybrids.
- Is nutritionally equivalent and performs comparably to conventional varieties for livestock and poultry feed.
- Produces the Cry1A(b) *Bt* protein that has a long history of safe use and consumption.
- Is effective at controlling targeted insect pests without harming humans, fish, wildlife and beneficial insects.
- Has shown in the Corn Belt a decreased risk of reduced grain quality caused by fumonisins and stored grain pests, thus enhancing food and feed safety.

YieldGard® is a registered trademark of Monsanto Company.

*"In general, our findings indicate that MON810 (YieldGard corn) hybrids are similar to their non-Bt counterparts for important feeding-related characteristics. Furthermore, composition of silages made from MON810 and respective non-Bt hybrids are similar."*

Faust (1999)  
Iowa State University



*"These results indicate that genetic engineering for insect resistance can suppress fumonisin concentrations and enhance the safety of maize for animal and human consumption."*\*

Gary P. Munkvold, Ph.D.,  
et al.  
Plant Pathology Department,  
Iowa State University  
[http://www.scisoc.org/  
feature/BtCorn/Top.html](http://www.scisoc.org/feature/BtCorn/Top.html)

\*Research applies to Corn Belt states.

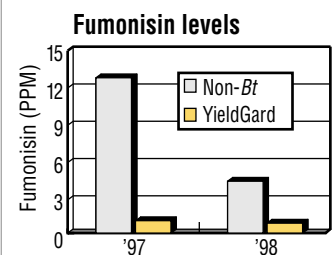
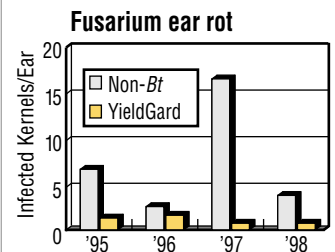


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*"The study showed no differences in the amounts or quality of milk produced by the cows. No Bt protein was detected in the standard sample of milk collected from cows fed Bt corn. The three diet groups produced essentially the same amount of milk – on average, nearly 84 pounds daily per cow."*

Faust and Miller (1997)  
Iowa State University

### Reduced ear rots and fumonisin, one class of mycotoxins\*



Source: 1995-98 Iowa State University Research, natural European corn borer infestations.

\* Results from research in the Corn Belt states.

### Additional reading

Sanders, P. R. et al. (1998). Safety Assessment of Insect-Protected Corn. In J.A. Thomas (Ed.), *Biotechnology and Safety Assessment, 2nd ed.* (pp. 241-256). Taylor & Francis.



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