

Bt corn
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[Disclaimer: I now, as of 2012, don't support use of Bt whether in GMO form or by organic farmers, because I think it brings [about a rather inhumane death to the insects](#). That said, pesticide use in general can be a good thing if it reduces insect populations.]

Bt corn is a genetically modified organism (GMO) meaning it has DNA that was inserted from another organism. The naturally occurring bacteria *Bacillus thuringiensis* (Bt) produces a protein, called the Bt delta endotoxin, that is toxic to caterpillars, butterflies, and moths, and can be used to kill the European corn borer. A few minutes after an insect consumes this protein, it attaches to the gut of the insect, and after a few hours, the gut wall of the insect is destroyed. The bacteria in the gut then spread throughout the body, and the insect dies of septicaemia, which is when bacteria get into the blood and multiply. The gene for this Bt delta endotoxin was isolated and then inserted into a corn plant, so the corn would produce the protein in all of the cells of its body, including its pollen. Along with the gene itself, a promoter sequence of DNA was inserted to activate the gene and determine where and when it will be expressed, and marker genes were inserted so scientists could determine if the gene had been inserted properly. The use of Bt corn has grown considerably, and in the year 2000, 6.2 million hectares of Bt corn were being grown in the US.

A few benefits of Bt corn exist, such as having reduced levels of the carcinogenic substances, mycotoxins, which are created by a fungal disease called fusarium that enters the corn through openings created by insects. However, the majority of the impacts of Bt corn are negative. One such adverse impact is the creation of insects that are resistant to the Bt toxin. Because insects will be exposed constantly to the toxin, it will kill many of the insects in the cornfields; however, those few insects with a mutation to resist the toxin will survive, reproduce, and pass that beneficial mutation on to their offspring. Many insects have already become resistant to the Bt toxin. This will not only render the Bt corn less effective, but it could also destroy one of the most important tools for organic farmers to deal with large pest invasions. The Bt bacteria is used by organic farmers as a natural, harmless insecticide; it is harmful to only caterpillars, butterflies, and moths (not humans), and it is destroyed by the sun's ultraviolet rays, so it disappears quickly. The bacteria has been used for over 50 years and has been used sparingly, so resistance did not develop. Bt corn constantly exposes insects to the toxin so resistance builds up much more quickly.

The biotechnology industry has claimed that because the Bt toxin is inserted into the corn, the harmful affects of insecticides are avoided. This, however, is not very accurate. Insecticides are rarely used on regular field corn to kill corn borers, and even the farmers that use them usually only apply them to the fields during years when insect populations are high. According to estimates in a report that was sponsored by the Biotechnology Industry Association, Bt corn caused a reduction in insecticide use on only 2.5 percent of the US farmland used for corn in 1998. United States Department of Agriculture (USDA) data shows that in 1997, in the Heartland region of the US, levels of insecticide use to kill corn borers were only slightly lower on Bt corn than on regular corn, and levels of insecticide use targeting any pests except the corn borer were equal for both varieties of corn.

Bt corn may also have adverse impacts on non-pest organisms, such as the monarch butterfly. Before approving Bt corn, the US Environmental Protection Agency (EPA) performed no tests on its impact on any butterflies or moths other than those it is meant to kill, although other tests have demonstrated that such impacts need to be taken into consideration. A study performed by John Losey and others at Cornell University, which was published in May 1999 in the magazine

Nature, found that pollen from Bt corn was harmful to monarch butterflies. Milkweed plants, the only food source for the larvae of monarchs, sometimes grow near or in corn fields. For the experiment, the scientists put monarch larvae on leaves of milkweed that had been sprinkled with pollen from Bt corn plants at about the concentrations that would be present near the fields of corn. They also put larvae on milkweed leaves that had been sprinkled with regular corn pollen and on leaves that hadn't been sprinkled with pollen, as a control group. After four days, 44 percent of the larvae on the leaves that had been sprinkled with Bt pollen had died, while none had died on the leaves with normal pollen. Also, the surviving larvae on the leaves with Bt pollen grew more slowly, ate only about half as much, and were only half as large as those on the leaves with normal pollen. Another study, performed by John Obrycki and Laura Hansen at Iowa State University, actually used milkweed that was growing near corn fields. After two days of feeding on the leaves, 19 percent of the larvae on the milkweed with Bt pollen died, while none of those on the leaves with normal pollen died, and only 3 percent of those on leaves without any pollen died. Given this evidence, monarchs migrating north from Mexico could be negatively impacted because about half of the monarchs going north pass through the Midwest, which is the largest area of corn cultivation in North America. It is hardly surprising that Bt pollen is harmful to monarch larvae, considering the toxin is meant to kill the European corn borer, which is the caterpillar of a moth. Bt corn pollen could also harm many other types of butterflies and moths, including 19 that are on the US endangered species list as endangered or threatened, such as the endangered Karner Blue Butterfly.

Apart from harming butterflies and moths, Bt corn could also adversely impact species that feed on insect pests in cornfields, such as the green lacewing. Researchers at the Swiss Federal Research Station found that 60 percent of lacewings fed European corn borers that had eaten Bt corn died, but less than 40 percent of the lacewings fed European corn borers that had eaten regular corn died. The researchers concluded that the deaths were "directly associated with [Bt]-related factors". In addition, lacewings fed European corn borers that had eaten Bt corn required an average of three more days to reach maturity, which scientists thought was due to the decreased nutritional value of the corn borers after they had eaten Bt corn.

Bt corn may also harm organisms in the soil. The toxin can get into the soil through the roots of the plants, through leaves that might fall down, and when parts of the plant are tilled underneath the soil. A 1999 *Nature* article reported a study that showed that Bt from the roots of the corn plants can travel into the soil, and within five days, 90 to 95 percent of the insect larvae exposed to it were killed. Guenther Stotzky and his colleagues at New York University found that the toxin can kill beneficial soil organisms needed to aerate the soil, that decompose organic matter, and which perform various other functions. They found the Bt toxin can bind to particles of clay and humic acid, which allows them to remain active for at least seven months. The normal toxin produced by the Bt bacterium are called protoxins because they remain inactive until they are activated by being dissolved in the gut of certain organisms. The toxin in Bt corn is already activated so it could harm organisms in the soil that wouldn't normally be hurt by the toxin produced by the bacterium.

Bt corn may have a few positive aspects, but the majority are negative, such as harm to non-pest butterflies and moths, harm to soil microorganisms, and the creation of Bt-resistant insects. As with any new technology, the impacts of Bt corn must be fully assessed and tested to determine if it is safe.