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In focus

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GMOs and Environmental Safety: Do genetically modified crops harm monarch butterflies?

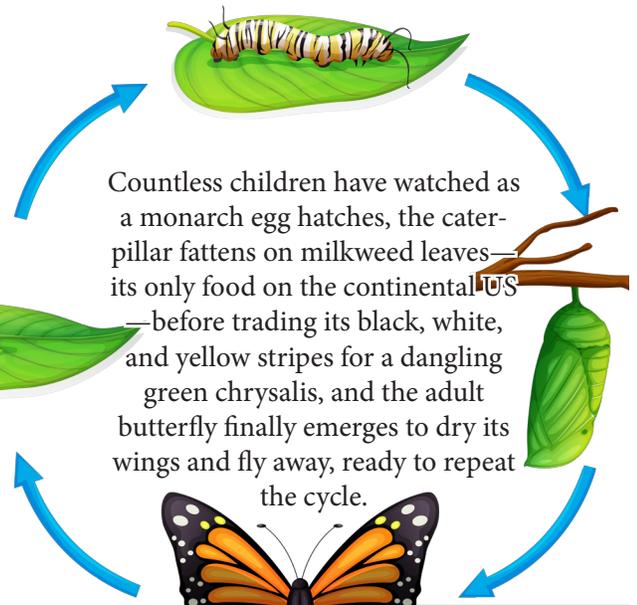
You don't have to love bugs to be a fan of the monarch butterfly. Its familiar orange and black wings can be seen in much of North America and on many scattered islands, including Hawaii. Completed over the course of several generations, the annual monarch migration from eastern North America to Mexico and back is a natural wonder.

In 1999, a one-page paper was published in *Nature*, one of the world's most widely read science journals. The authors reported that when monarch caterpillars were fed milkweed leaves dusted with pollen from a GM corn variety that makes a biological insecticide, a protein formed by a bacterium – *Bacillus thuringiensis* - abbreviated as Bt, the caterpillars ate less and were more likely to die than caterpillars fed pollen-free leaves or leaves dusted with non-GM corn pollen.



The story made headlines nationwide, and the monarch was adopted as a symbol of unintended hazards posed by GM crops. At the same time, many scientists criticized the research methods used in the study. The amount of pollen applied to the milkweed leaves and the amount of pesticidal protein in the pollen hadn't been measured. As a result, it was difficult to determine whether the same results could occur in or near an actual cornfield.

As a result, in the following two years, multiple studies sought to determine whether Bt corn was truly a threat to the monarch and other butterfly species. Cornfields were found to be an important habitat in which monarchs lay eggs and the timing of corn pollen release and monarch egg-laying did overlap in some regions. It is important to remember, that this is only true in places where milkweed tends to occur within corn fields (this happens in the NE USA); which is not the case for most of the range of the butterfly, where the milkweed plants are typically outside cornfields.



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Assessing the Risks

It was found that Bt corn varieties differed greatly in how much of the engineered protein their pollen contained. One variety, event 176 (which hadn't been used in the Nature study), produced much more insecticidal protein in its pollen than did other Bt corn varieties. Even low doses of event 176 pollen had adverse effects on monarch caterpillars, whereas pollen from other types of Bt corn did not. As a result, the company that bred event 176 took it off the market. Overall, the risk posed by Bt corn pollen to monarch butterfly larvae on milkweed even close to cornfields was found to be low, owing to low mobility of the pollen (corn is adapted to be wind pollinated, and its pollen drops rapidly once released).



It's worth noting that monarch caterpillars that ate milkweed leaves from a field sprayed with the pyrethroid insecticide lambda-cyhalothrin (Warrior®) were much more likely to die than caterpillars that ate leaves on which event 176 pollen had fallen. In other words, the now-discontinued GM corn variety that was most harmful to non-target butterfly species was significantly less harmful than a commonly used non-GM pest control method. In 1995, the year before Bt corn entered commercial use, 0.21 pounds of insecticide were sprayed per acre of corn planted. By 2010, that rate had declined dramatically to an average of 0.02 pounds of insecticide per acre, as a direct result of the use of Bt corn varieties.

Popularity Risk?

Finally, scientists are studying whether the popularity of herbicide-tolerant GM crops represents an added risk for North America's monarch butterflies, which are also threatened by weather events and loss of winter habitat.



Milkweed Control



As herbicide-tolerant corn and soy varieties have become more popular, milkweed in fields has become easier to control and less abundant. We currently don't know what contribution herbicide-tolerant crops have made to the decline in milkweed populations.

Ongoing Research

The monarch depends on a native plant that is also an agricultural weed. Determining how best to manage that weed to support monarch populations is a subject of ongoing research.



An interesting question relates to what the Monarch Butterfly populations were before farming became common in North America. The Monarch Butterflies feed only on milkweed that occurs almost solely in disturbed areas such as created by farming. The acreage of naturally disturbed areas is very limited without farming activities.

