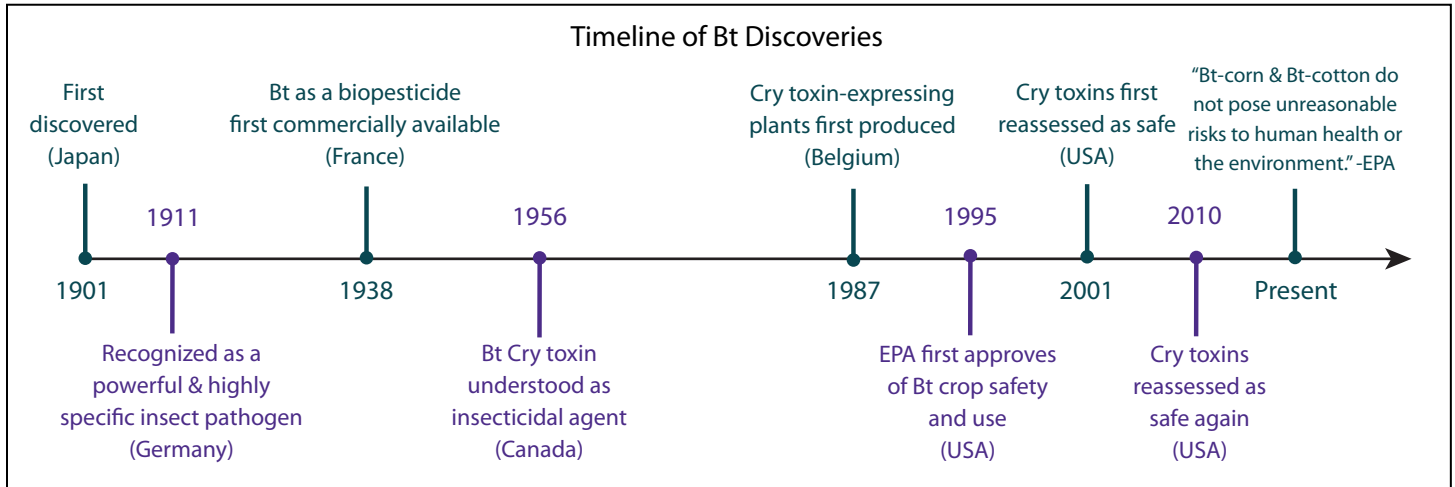




Is Bt Safe for Humans to Eat?

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- Bt is a bacterium that is not toxic to humans or other mammals but is toxic to certain insects when ingested.
- Bt works as an insecticide by producing a crystal-shaped protein (Cry toxin) that specifically kills certain insects.
- Bt is naturally found on leaves and in soil worldwide and has been used commercially both in organic and conventional agriculture for over fifty years.
- Most genetically engineered, insect-resistant crops express one or more Bt insecticidal Cry toxins.
- Over two decades of review, the EPA and numerous scientific bodies have consistently found that Bt and engineered Bt-crops are not harmful to humans.



What is Bt?

Bacillus thuringiensis (often referred to as simply "Bt") is a common, naturally occurring bacterium found in soils and on plant leaves worldwide. First discovered in 1901 in Japan, Bt has revolutionized how we stop insects from eating our crops. For over fifty years, Bt has been applied directly to a variety of agricultural crops and plants in home gardens as a living pesticide to control insect pests.

The secret to Bt's success is a family of proteins that these bacteria produce that specifically target insect digestive tracts. These proteins are shaped like crystals, so they are commonly called "Crystalline toxins" or "Cry toxins." These Cry toxins remain inactive until consumed by an insect. Once digested, the protein is activated and then binds to specific receptors in insect guts. Once bound, the Cry toxins pierce holes in the insect's gut, ultimately causing the contents to leak and the insect to starve. Importantly, humans do not have the same receptors or gut conditions as insects, which means Cry toxins pass through us with no effect. Studies show that humans digest Cry toxins like any other protein that would be ingested when eating foods like meat, beans, leafy greens, or tofu.

Many types of Cry toxins exist with varying specificity to different insects (primarily moths and butterflies, beetles, and flies). The diverse Cry toxins can be mixed and matched to control several pests at once.

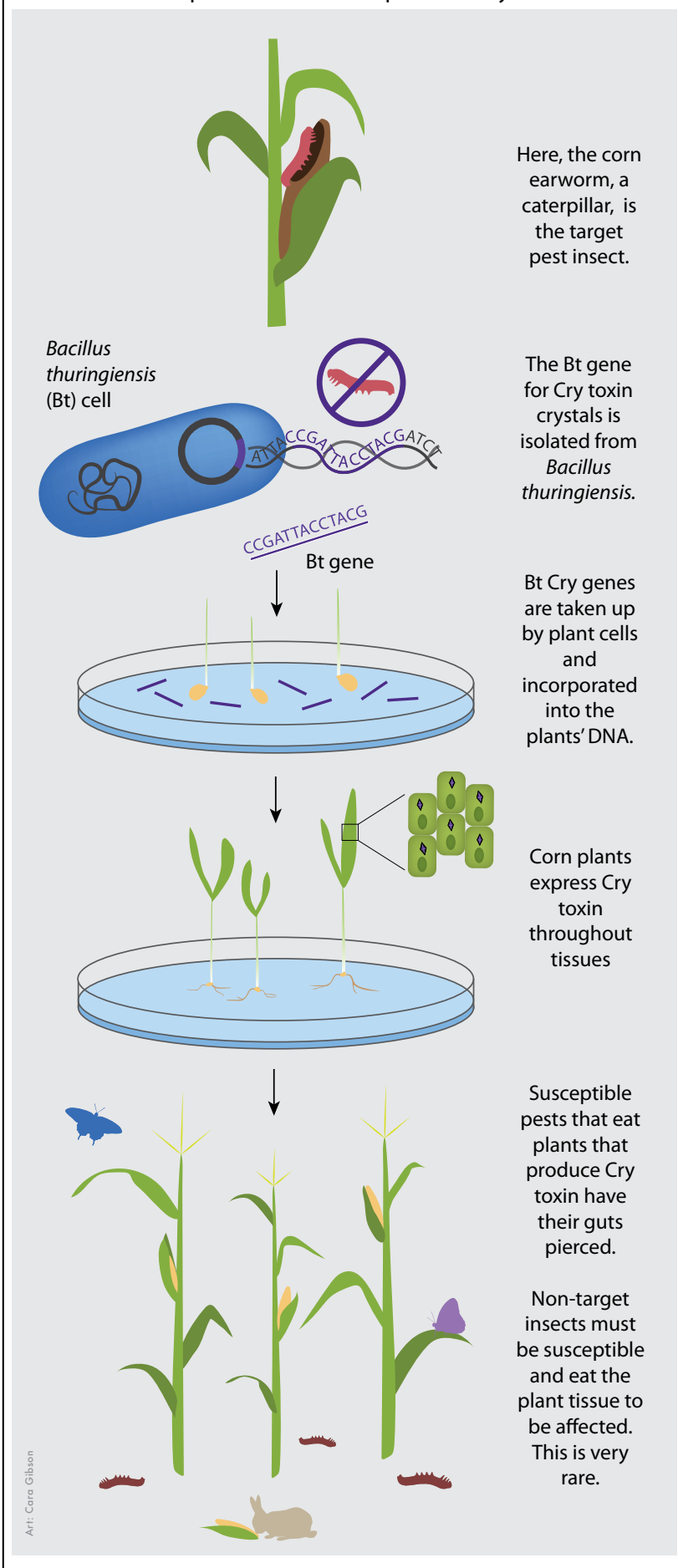
What are Bt-crops?

Crops that have been genetically engineered to produce Cry toxins are often described with the prefix “Bt” (such as Bt-cotton or Bt-corn), even though they do not contain living Bt bacteria; rather, they contain genes from Bt for producing insect-specific toxins. Cry toxins in their many forms have become the most common insect-killing trait engineered into plants to create insect-resistant (or pest-protected) crops. This technology is used widely in corn and cotton to prevent pest damage. It has been shown to dramatically reduce pest damage and, as a result, reduces the amount of synthetic insecticides sprayed to prevent these pests.

Bt-crops represent a technological advance over applying living bacteria onto plants. Instead of growers applying live Bt to a plant, Bt Cry toxin-producing plants are engineered and then bred conventionally for commercial release. Just as with applications of Bt or Cry toxin onto plants, insecticidal toxins are activated inside the gut of the insect when consumed, thereby only targeting insects that eat the crop and are susceptible to Cry toxin.

The specific targeting of pest insects by Bt-crops is unrivaled in commercial pest management, but this does not preclude possible negative effects on non-target insects. As these risks have proven minimal, Bt crops have been widely adopted: in 2017, 85% of all U.S. cotton was Bt-cotton, and 80% of all U.S. corn was Bt-corn. The vast majority of genetically engineered corn and cotton crops have been engineered to have both herbicide tolerance and insect resistance (in the U.S., 80% of all cotton and 77% of all corn in 2017). These crops continue to be monitored by regulatory agencies, ensuring ongoing oversight of this technology.

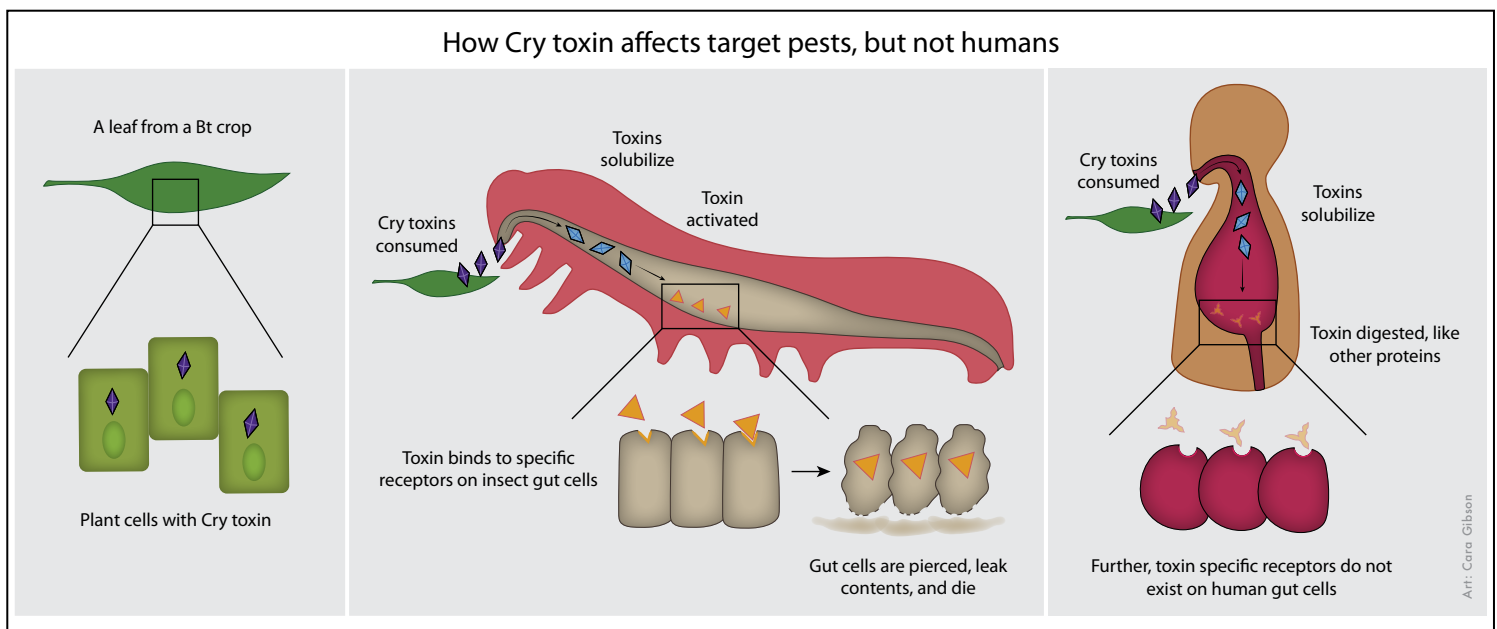
How plants are made to produce Cry toxin



Are Bt-treated crops and Bt-engineered crops safe for humans and domestic animals to eat?

Bt is among the safest pesticides for humans and other vertebrate animals. As a natural, targeted insecticide, it plays a critical role in pest management in organic agriculture. In our fields, in our grocery stores, and in the soil beneath our feet, Bt and its Cry toxins are almost everywhere; despite our frequent contact with Bt over decades of commercial use (since 1995), reported human infections with Bt are extremely rare. Most of these few reports come from patients with compromised immune systems, and only one such case has implicated an agriculturally used strain of Bt.

After extensive investigation of possible risks to human health and the environment, the EPA gave its first approvals of Bt crops in 1995. The safety of Cry toxins was then reassessed in 2001 and 2010, as well. The EPA has issued no limit to the amount of Cry toxins permissible on raw materials or agricultural products: this is an exemption from a standard limitation on other pesticides due to the safety of Cry toxins. After over two decades of scrutiny, the EPA continues to report “Bt-corn and Bt-cotton do not pose unreasonable risks to human health or the environment.”ⁱ Numerous major scientific and regulatory bodies worldwide have reviewed the research on Bt crops and support this conclusion.^{ii-v}



What are common Bt products?

Live Bt is available at most gardening stores as a natural pesticide for use in home gardens. Bt products containing a subspecies known as Bti (*Bacillus thuringiensis israelensis*) can be used to control pest flies like mosquitoes and black flies. It is sold as a pellet that can be dissolved in open water containers to kill fly larvae. Organic and conventional produce is often preventatively sprayed with Bt to control targeted pests. Bt is considered an environmentally friendly insecticide because it is already present in the soil and Cry toxins are specific to particular insect groups.

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i https://www.epa.gov/sites/production/files/2015-08/documents/are_bt_crops_safe.pdf

ii https://www.aaas.org/sites/default/files/AAAS_GM_statement.pdf

iii <https://www.nap.edu/read/10977/chapter/1>

iv https://ec.europa.eu/research/biosociety/pdf/a_decade_of_eu-funded_gmo_research.pdf

v <https://royalsociety.org/~media/policy/projects/gm-plants/gm-plant-q-and-a.pdf>