GENE-EDITED FRUITS AND VEGETABLES

THE THREAT OF NEW GMOS IN CANADA

01–10–2025

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This report is released in conjunction with the Canadian Biotechnology Action Network's *Protect Our Produce* campaign, which aims to raise awareness about genetically engineered (genetically modified or GM) whole fruits and vegetables that are on the market in Canada or could be coming soon. The campaign calls on retailers to provide non-GMO produce sections, demands that the Canadian government reintroduce pre-market regulation for all genetically engineered foods and seeds, and demands that the government introduce mandatory labeling for all genetically engineered foods.

This report reflects our ongoing monitoring and follows the investigations that led to our *No GMO Salad Update and Action Report* (July 2025) and our report *GMOs in your grocery store: Ranking company transparency* (December 2020).

cban.ca/ProtectOurProduce

The Canadian Biotechnology Action Network (CBAN) *brings together 15 groups to research, monitor and raise awareness about issues relating to genetic engineering in food and farming. CBAN members include farmer associations, environmental and social justice organizations, and regional coalitions of grassroots groups. CBAN is a project of the MakeWay Charitable Society.*

EXECUTIVE SUMMARY

This report focuses on genetically engineered (genetically modified or GM) fruits and vegetables. It profiles the **three GM fruits and vegetables on the market in Canada**, three new GM whole foods that could soon be introduced, and three prominent GM products that are not yet on the market despite many years of promotion.

There are only three genetically modified fruits and vegetables currently on the market in Canada, with a very marginal presence in grocery stores: GM sweet corn, GM papaya, and GM pineapple. **Until now, genetic engineering in our diets has been dominated by processed food ingredients** from GM corn, GM canola, GM soy and GM sugar beet, but this could start to change.

The new genetic engineering techniques of gene editing could soon mean many new GM whole fruits and vegetables will be sold in Canada, without labels for consumers. **These gene-edited whole foods would be the first GM foods eaten in Canada without safety assessments from Health Canada**, and they can also be released onto the market without companies notifying Health Canada or the public. Our research warns that gene-edited salad greens and gene-edited strawberries could be the first of these new unregulated genetically modified organisms (GMOs) coming to the market.

Meanwhile, GM potatoes and GM apples that were approved for eating years ago are not yet for sale in Canada. There are other GM whole foods that are hyped by investors and widely reported in the media, such as GM bananas, that may never actually be introduced.

GM CROPS GROWN IN CANADA

Crop	Trait	Where on the shelves
1 CORN	Insect resistant, herbicide tolerant	Corn flakes • Corn chips • Cornstarch • Corn oil and other corn ingredients in processed foods • Sweeteners like glucose and fructose • Eggs, milk and meat* • Some sweet corn (There is no GM popcorn.)
2 CANOLA	Herbicide tolerant	Canola oil • Eggs, milk and meat*
3 SOY	Herbicide tolerant	Soy oil • Soy protein • Soy lecithin • Eggs, milk and meat*
4 SUGAR BEET (WHITE)	Herbicide tolerant	Processed into sugar (There are no GM red table beets.)
5 ALFALFA	Herbicide tolerant, low-lignin	A small amount is grown to feed dairy cows and other farm animals. (Not grown for sprouts.)

*Many animals used to produce eggs, milk and meat are fed corn, canola and/or soy

GM FOODS IMPORTED TO CANADA

Food	Grown	Where on the shelves
6 PAPAYA	U.S. (Hawaii)	Papaya • Fruit juices and other processed foods
7 PINEAPPLE	Costa Rica	Whole pink-fleshed pineapple, in a few grocery stores.

cban.ca/gmfoods

UPDATES:

Salmon: The world's first GM animal for food was a GM salmon first sold in Canada starting in 2017, but production was stopped in 2024.

Squash: A few GM squash varieties from the United States (not grown in Canada) have been legal to import as food since 1998, but the GM seed will not be marketed in 2026.

ORGANIC FOOD

is a non-GM choice. Organic farming prohibits the use of genetically engineered seeds and animal feed.

INTRODUCTION

There are seven genetically engineered (genetically modified or GM)* foods on the market in Canada, with **only three that could be in the produce sections of our grocery stores**. Most GM foods on the market appear as processed food ingredients from GM corn, soy, canola and sugar beet, or as meat and milk from animals fed these GM products. However, the new GM techniques of genome editing (also called gene editing) could mean many new genetically modified organisms (GMOs) coming to the market, including more GM whole fruits and vegetables.

Gene editing techniques are new ways to genetically engineer plants and animals to express new traits. These techniques, such as CRISPR, aim to delete DNA segments or otherwise change a DNA sequence. Unlike traditional plant and animal breeding, genetic engineering makes changes directly to the genetic make-up of organisms in the laboratory. (See Annex)

In 2022/2023, the Canadian government removed pre-market regulation for foods from gene-edited plants if these new GMOs contain no DNA from other species.[1] **This lack of regulation means that many gene-edited foods and seeds can enter our food system and environment without any government safety assessments.** These changes were designed by a corporate-government committee, called the "Tiger Team," made up of representatives from the biotechnology and pesticide industry lobby group CropLife, with other industry lobby groups and government officials.[2]

There is no mandatory labelling in Canada to help consumers identify which GM foods are in grocery stores. However, the few GM foods currently on the market were all assessed for safety by regulators at Health Canada and were therefore also listed online by the government as approved "novel foods." Now, many future gene-edited GMOs will not go through any government approval process and Health Canada does not require companies to notify the government when they release these new unregulated GMOs into the food system (there is no "mandatory transparency").

The use of genetic engineering in food and farming, and the lack of transparency for consumers and farmers about these GMOs, raises environmental, social, economic, and ethical concerns, as well as food safety concerns.

***This report uses the terms genetic engineering and genetic modification (GM) interchangeably.** The term genetically modified organism (GMO) and the commonly-used abbreviation "GM" are both used to describe genetically engineered products. Gene editing is understood to be genetic engineering/genetic modification. For discussion see cban.ca/FAQ

CONCERNS AND RISKS

Health risks

Genetically engineered traits could pose health risks, and the processes of genetic engineering can have unintended consequences inside the organism that could lead to other harms when eaten.[3] Every GM crop and food is different, so **no generalized safety conclusions can be made**.[4] Some feeding studies with laboratory and farm animals have found that certain GM crops and foods have toxic or allergenic effects, notably liver and kidney disorders and immune system responses.[5] Other studies (mostly short-term) conclude that the GM foods tested are safe.[6] Often, when adverse effects are found, they are dismissed as not biologically relevant/significant.[7] There are no studies that look at the effects of eating GM foods on human health, though effects found in animal feeding studies on rats, mice, and pigs are considered relevant to humans. Furthermore, there is no government tracking of GM foods to monitor for potential health impacts. **cban.ca/health**

Environmental impacts

Contamination from GM plants is living pollution that can have serious ecological, economic, and social impacts. Unwanted gene flow from GM crop plants poses a threat to wild crop relatives, non-GM crops and foods, and organic farming, which prohibits the use of GMOs.[8] Genetically engineered crop plants can also harm other organisms. For example, insect-resistant GM plants produce their own toxins that can have negative impacts on non-target organisms,[9] and on soil and water ecosystems.[10] The expansion of GM herbicide-tolerant corn in North America has also led to entrenched use of the herbicide glyphosate, which has destroyed much of the habitat of the monarch butterfly.[11] Researchers are now also proposing to genetically engineer forest trees and insects for release into the wild, which raises profound new risks to complex ecosystems.[12] **cban.ca/environment**

More pesticides

All the GM crops currently grown in Canada are herbicide-tolerant, meaning that they are genetically engineered to be used with specific synthetic herbicides. Many of these GM crops are also genetically engineered to be toxic to certain insects. The biotechnology industry promised that GM crops would reduce the use of pesticides in farming (the term pesticides includes herbicides, insecticides, and fungicides).[13] Instead, herbicide sales in Canada have increased by 270% since GM crops were introduced.[14] The increased use of the herbicide glyphosate has resulted in the emergence and spread of glyphosate-resistant weeds and, in response, biotechnology companies have genetically engineered crops to be tolerant to the older herbicides 2,4-D and dicamba.[15] These GM crops will further increase the toxic herbicide load in the environment and our bodies, and lead to even more herbicide-resistant weeds. **cban.ca/pesticides**

Corporate control

Markets for GM crops are dominated by a few seed and agrochemical (pesticide) companies. Four companies now control 56% of the global commercial seed market and 61% of the global agrochemical market. Bayer bought the world's largest seed and biotechnology company, Monsanto, in 2018, and now owns 23% of the world's seed market and 15% of the pesticide market. Bayer and Corteva control 42% of the seed market, and Bayer and Syngenta control 40% of the pesticide market. This high level of corporate concentration in the seed market has already meant higher prices, limited choices for farmers, a narrowing of genetic diversity in crops, and stagnating innovation.[16] **cban.ca/corporatecontrol**

Patents

Patenting is a legal tool that has been used to take control of seeds out of the hands of farmers. The demand for "No Patents on Life" describes the concern over the expansion of patenting from chemical and mechanical products to plant, animal and human life.[17] Higher life-forms such as plants cannot be patented in Canada but new genetic sequences and new traits and genetic technologies can be. Farmers cannot legally save patented seed to breed or plant again, and, unless they have purchased and paid a royalty on GM seed, farmers can be taken to court if patented plants are found on their farms. In 2004, Saskatchewan farmer Percy Schmeiser was found guilty of having Monsanto's property (GM canola) on his farm, even though how it got there was never determined.[18] **cban.ca/patents**

Farmer livelihoods

The federal government does not evaluate the economic impacts of GM crops, including possible benefits, and farmers are not consulted before GM crop plants are approved for growing. Research shows that **GM crop yields have not increased more than those of non-GM crops**.[19] The major benefit that GM crops offered farmers was easier weed management, but the increased use of certain herbicides on GM crops has led to the emergence and spread of herbicide-resistant weeds, which are reversing this benefit and creating new costs and complications. Unwanted GM contamination can also result in serious costs for farmers. For example, most organic farmers in Canada were forced to stop growing canola because of widespread, unstoppable contamination from GM canola.[20] **gmoinquiry.ca/farmers**

Lack of public debate

Genetically engineered foods and seeds were introduced into our food system and environment without a full public debate or a national consultation. The question of genetically engineering plants and animals raises moral and ethical questions for many people. For example, the use of genetic engineering conflicts with the worldview of many Indigenous peoples and many people in faith communities who were never informed or consulted. The Canadian government has never assessed "non-scientific" questions such as ethical considerations or the possible social and economic impacts of using GMOs. There is no consultation with consumers or farmers before new genetically engineered foods and seeds are allowed onto the Canadian market, and there is no mandatory labelling to aid public debate and choice. **gmoinquiry.ca/consumers**

No labelling

Mandatory labelling of GM foods is necessary to provide transparency and choice in the marketplace. However, **there is no mandatory labeling in Canada**, despite intense public protest and over twenty years of public opinion polls that consistently show 75-97% of people in Canada want to know where GMOs are in the grocery store.[21] This lack of labelling places the burden of investigating the location of GMOs onto those individual consumers who want to avoid eating them. It also means that companies that want to sell non-GMO food pay extra costs to get non-GMO certification. Furthermore, the government does not require companies to disclose when they put unregulated gene-edited foods and seeds on the market. This means that **there will be no mandatory government listing of many future GM foods, seeds, and animals that may enter the food system**. **cban.ca/labelling**

Weak or no regulation

Health Canada does not conduct its own safety tests on GM foods but relies on information provided by product developers. This information is not public. **In 2022, the government decided not to assess the risks of many future foods from GM plants developed using gene editing**, and, in 2023, decided not to assess the environmental risks of many new gene-edited plants. This means that most future gene-edited GM foods will be released without any government oversight, and without any government checks of corporate safety studies (companies may not conduct any tests). This lack of regulation, along with the lack of mandatory labelling, also means that the federal government does not track the GM foods and seeds that could be on the market in Canada. **cban.ca/regulation**

Genetically Engineered Fruits and Vegetables in Canada

There are three genetically engineered (genetically modified or GM) fruits and vegetables on the market in Canada, three that are at imminent threat of being introduced, and at least three others that require monitoring because they could also be sold in the future.

GM Fruits and Vegetables on the Market in Canada

1. GM Sweet Corn
2. GM Papaya
3. GM Pineapple

These genetically engineered fruits and vegetables are approved and currently sold in Canada, unlabelled.

New GM Fruits and Vegetables that Could Come Soon to Canada

4. GM Salad Greens*
5. GM Strawberries*
6. GM Purple Tomato

There are a few genetically engineered fruits and vegetables that could soon be sold in Canada, unlabelled. The GM purple tomato is not yet approved in Canada. There are also GM gene-edited salad greens and strawberries that could come to market but will not require government approval before being released in Canada. This means they could be put on the market quickly, and without being listed by Health Canada.

Stalled GM Fruits and Vegetables

7. GM Potatoes
8. GM Apple
9. GM Bananas*

These genetically engineered fruits and vegetables could be sold in Canada at some point. Both the GM potatoes and GM apples were approved many years ago but have not yet entered the Canadian market. There are GM bananas that have been approved for growing and some gene-edited bananas that will not require government approval before being sold.

*** These gene-edited foods will not be assessed for safety by Health Canada**

GM fruits and vegetables on the market in Canada

1

GM Sweet Corn

What to Watch for:

Genetically engineered sweet corn grown in Canada and the United States.

Status:

A small amount of GM sweet corn may be sold in a few grocery stores as well as at roadside stands and farmers' markets. In 2024 and 2025, GM sweet corn was found in multiple Whole Foods stores in Canada, labelled as "bioengineered" (in compliance with US disclosure laws that require identification of some, but not all, GM foods).

Past testing by CBAN and the Quebec network Vigilance OGM (2013-2016, 2020) found very little to no genetically modified sweet corn in Canada. Generally, grocery chains in Canada have avoided stocking GM sweet corn.[22]

GM Traits:

All the GM sweet corn on the market is insect-resistant (Bt), meaning the plants are genetically modified to be toxic to certain insects, and most are also herbicide-tolerant.

Bt insect-resistant crops are engineered with a gene from the bacteria *Bacillus thuringiensis* (Bt), which is toxic to some insects. GM Bt plants are engineered to synthesize Bt toxins in their cells, making the entire plant toxic to some insects.

Bayer's GM sweet corn varieties produce one to three Bt toxins to kill a wide range of insect pests and they are also "Roundup Ready," to survive sprayings of the company's glyphosate herbicide formulation called "Roundup."[23] Most of Syngenta's GM insect-resistant corn varieties are also tolerant to Syngenta's "Liberty" glufosinate herbicide and some are also tolerant to Bayer's Roundup glyphosate herbicide.[24]

Companies:

GM sweet corn is sold by Bayer and Syngenta.

- Bayer acquired Monsanto in 2018 and is now the largest seed company, second largest pesticide company, and largest seller of genetically engineered seed in the world.[25] Bayer owns 23% of the global seed market and 15% of the global pesticides market.
- Syngenta is the world's largest pesticide company, controlling 25% of the global pesticides market, and 10% of the global seed market.

cban.ca/corn

Research continues to find indicators of potential harms to humans from eating genetically engineered Bt insect-resistant corn. For example, GM Bt toxins and GM Bt crops have been found to have toxic effects on mammals in controlled animal feeding studies.[26]

2

GM Papaya

What to Watch for:

Genetically engineered papayas imported from Hawaii.

Market status:

GM papayas are grown in Hawaii and China. However, most papayas imported to Canada come from Mexico, where it is illegal to grow GM papayas.

Genetically engineered papayas were first commercially grown in Hawaii in 1999 and approved for eating in Canada in 2003.

GM Trait:

The GM papayas are genetically engineered to be virus-resistant.

Company:

The GM papaya was developed by researchers at the University of Hawaii and Cornell University.

cban.ca/papaya

The GM papayas are generally celebrated as having saved the papaya industry in Hawaii from the Papaya ringspot virus. However, GM papayas have also resulted in widespread contamination in Hawaii where they are also an important local crop. "It is virtually impossible to find non-GMO papayas. The genetically engineered papaya trees have pollinated practically all papaya trees in the state. This is a serious change to one of Hawai'i's major crops," says Makana of the group Hawai'i GMO Justice.[27]

3

GM Pineapple

What to Watch for:

A genetically engineered pineapple with pink flesh inside, branded "PinkGlow" from Del Monte.

Market Status:

The genetically engineered pineapple is branded "PinkGlow" and has been sold in Costco and Save-on-Foods. It is genetically engineered to have pink flesh but the outside looks the same as other pineapples. (There are no genetically engineered yellow-flesh pineapples.)

The GM pineapple is sold loose (sometimes with a pink ribbon around it) or in a pink cardboard box. There is no mandatory GM food labelling in Canada but the boxes and cardboard crates carry the line, "This product was made possible through bioengineering," which complies with the US disclosure law that requires some (but not all) genetically engineered foods to be labelled in the US. It is only grown in Costa Rica, by Del Monte.

GM Trait:

The pineapple is genetically engineered to have pink-coloured flesh inside but looks the same on the outside as other pineapples.

It was engineered using DNA from a tangerine to express more lycopene in the fruit (lycopene is the compound that gives watermelon and tomatoes their pink/red colour).[28]

Company:

The GM pineapple is sold by the large global fruit and vegetable company Del Monte Foods.

cban.ca/pineapple

Del Monte says the GM pineapple is intended to be "a niche product that could expand the market for pineapple."[29]

GM fruits and vegetables that could soon come to Canada

COULD SOON BE ON THE MARKET IN CANADA

This product will not be assessed for safety by Health Canada.

4

GM Salad Greens

Products of Concern:

- Gene-edited mustard greens and seeds from Bayer.
- Gene-edited romaine lettuce seeds from GreenVenus.

Market Status:

There are no GM salad greens on the market in Canada yet.

- In 2024, Bayer was getting ready to launch gene-edited mustard greens, engineered using CRISPR, for use in packaged salad mixes. However, in May 2025, Bayer told CBAN that it had "no specific target date for commercialization in Canada." For details, see CBAN's *No GMO Salad Update and Action Report*, July 2025.[30]
- In early 2025, GreenVenus sold a limited amount of gene-edited, non-browning romaine lettuce seeds in the US, online in small packets to gardeners. The sales website is no longer online.

GM Traits:

- Bayer's GM gene-edited salad greens are mustard greens (*Brassica juncea*) that have been gene edited to reduce their mustardy flavour. The spicy mustard flavour was removed so they could be advertised as "leafy greens that don't bite back! (a mustard green that eats like a lettuce)"[31] and as "more nutritious than lettuce."[32]
- GreenVenus' gene-edited romaine lettuce is genetically engineered to be non-browning.[33]

Companies:

- Bayer is the largest seed company, second largest pesticide company, and largest seller of genetically engineered seed in the world.[34] Bayer is partnering with different biotechnology companies to focus on gene editing to develop "nutrition enhanced vegetables."[35]
- GreenVenus is a small biotechnology company owned by the venture capital firm Third Security which also owns the GM apple company Okanagan Specialty Fruits and the GM mosquito company Oxitec, and was a majority shareholder in the now non-operational GM salmon company AquaBounty.[36]

cban.ca/NoGMOsalad

"The risk for certified organic seed producers is that GMO greens might be grown nearby, and allowed to flower (on purpose or unintentionally), allowing pollen to cross-pollinate the organic seed crop. This would make the seeds unusable as organic seeds, and harm the seed producer's business and livelihood." – Bob Wildfong, Executive Director, Seeds of Diversity Canada, March 2025[37]

COULD SOON BE ON THE MARKET IN CANADA

This product will not be assessed for safety by Health Canada.

5

GM Strawberries

Products of Concern:

- Gene-edited strawberries for a longer harvest season.
- Gene-edited strawberries for extended shelf-life.

Market Status:

There are no GM strawberries on the market in Canada yet.

- In December 2024, the company Simplot formally stated its intention to start selling a GM gene-edited strawberry in Canada as soon as 2025, gene-edited for a longer harvest season (remontant).[38]
- In 2021, Simplot announced it would use gene editing to genetically engineer strawberries with extended shelf-life.[39]

GM Traits:

- Simplot says it wants to introduce a gene-edited "remontant" strawberry meaning that the plant has multiple flowerings in one season.

"Everbearing" (remontant) strawberry varieties that flower and set fruit multiple times during a season have already been created through traditional breeding and are common in gardens and farms across Canada.

- Simplot also announced the development of a gene-edited strawberry with extended shelf-life.

Company:

The US agriculture company J.R. Simplot (Simplot) has partnered with the biotechnology company Plant Sciences Genetics to genetically engineer strawberries using gene editing.[40] Simplot sells frozen strawberries and other prepared produce to food service providers through its Simplot Foods division.

cban.ca/strawberry

Strawberries are a beloved fruit across cultures and traditions. In some nations indigenous to Turtle Island (North America), the name for the strawberry translates to "the heartberry" in English. In these communities, the heartberry's cultural significance is vast and diverse and the berry is often held as an important symbol and teacher of love and connection to Mother Earth.[41]

6

GM Purple Tomato

COULD SOON BE ON THE MARKET IN CANADA

Product of Concern:

A genetically engineered dark purple tomato.

Market status:

There are no GM tomatoes on the market in Canada yet.

The genetically engineered Purple Tomato™ is not yet legal to sell in Canada but the company says it wants approval soon.[42]

It is approved in the US and sold in a small number of US grocery stores.[43] The "Empress Limited Edition Tomato" is its commercial retail name, grown and packaged for stores by Red Sun Farms. It is also sold as seeds for home gardeners and small growers in the US on Norfolk Healthy Produce's website and has been sold as seedlings and fruit at a few farmers' markets in the US.[44]

A different GM tomato was very briefly sold in the US, and in at least one grocery store in Canada in 1996. The slow-ripening GM "Flavr Savr" was taken off the market by Monsanto in 1997.[45]

GM Trait:

The company says the Purple Tomato™ was engineered for "health and nutrition."[46] It was genetically engineered with two genes from snapdragon flowers, to increase the plant's anthocyanin production which also makes the tomato purple.[47] Anthocyanins are a type of flavonoid that has antioxidant properties. Media headlines over the years have claimed this GM tomato can fight cancer because of the health benefits associated with anthocyanins.[48]

There are already non-GM purple tomato varieties that have been bred using traditional breeding methods to contain higher levels of anthocyanins, such as the popular variety Indigo Rose.[49]

Companies:

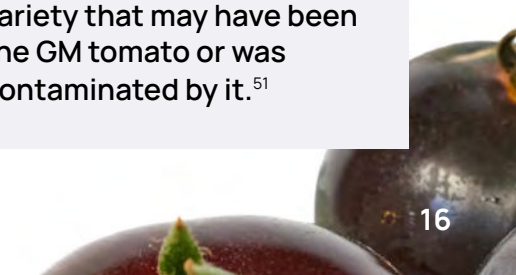
Norfolk Healthy Produce is a US-based company founded in 2021 to market products developed by Norfolk Plant Sciences, which is a company that originates from two UK research institutes.

Red Sun Farms is one of the largest greenhouse companies in North America. It is headquartered in Kingsville, Ontario and owns and operates farms in Canada, Mexico, and the US.

cban.ca/tomatoes

If these GM tomatoes or their seeds are sold in Canada, there is a high likelihood they will contaminate seed stocks and end up, unwanted, in gardens across Canada. Norfolk Healthy Produce encourages gardeners to save and share the patented GM seeds as long as they do not sell them.[50] Saving and sharing the seeds means that GM contamination will occur.

There has already been confusion and controversy over this product when, in 2024, a well-known, non-GM heirloom seed company in the US sourced and advertised a purple tomato variety that may have been the GM tomato or was contaminated by it.[51]



GM fruits and vegetables not yet on the market in Canada

7

GM Potatoes

Product of Concern:

Genetically engineered potatoes are approved but not sold in Canada yet. They are grown and sold in the US.

Market Status:

The Canadian government has approved multiple types of the genetically engineered potato called "Innate," with many GM traits, from the US company Simplot (2016, 2017, 2020). A small amount is grown in Canada by Simplot for research purposes.[52]

The GM potatoes are grown commercially in the US and have been sold in some US grocery stores, in bags in produce sections under the brand "White Russet."[53]

The major global Canadian-based French fry companies McCain Foods and Cavendish Farms have long-standing policies to not use GM potatoes.[54]

There was a different, insect-resistant (Bt), GM potato from Monsanto that was briefly sold in Canada and the US in the late 1990s, but it was taken off the market by Monsanto in 2001 because of poor sales.[55]

GM Traits:

The potatoes are genetically engineered with four traits: reduced bruising, protection from late blight, reduced sugar levels, and reduced asparagine to reduce acrylamide from frying (acrylamide is a carcinogenic by-product of the cooking process).

Company:

Simplot sells frozen French fries and other potato products around the world and is now one of the top global frozen potato companies, along with McCain Foods.

cban.ca/potatoes

A public opinion poll in 2020 found that 37% of Canadians said they would not eat the GM potatoes, even though they were told that the potatoes are approved by Health Canada and are sold in the US. Only 18% said they would eat them, and 38% said maybe.[56]

8

GM Apple

Product of Concern:

Genetically engineered non-browning apples are approved but not sold in Canada yet. They are grown and sold in the US, in packages of pre-cut apple slices only.

Market status:

The GM apples are not sold in Canada. Canadian regulators approved the GM "Arctic" Golden Delicious and Granny Smith apple varieties in 2015, and then GM Fuji (2018) and GM Gala (2024) varieties.

They are grown in the US where they are sold only as packaged sliced apples, not as whole apples. The company has also started marketing a small brand of hard cider in Washington state.

GM Trait:

The GM Arctic Apples™ are genetically engineered to be "non-browning". The company says they have a longer shelf-life because they do not go brown for about a month after being cut.

There are many varieties of apples that are naturally slow-browning, such as Ambrosia.

Company:

The GM apples are sold in the US by the small biotechnology company Okanagan Speciality Fruits, which was founded by an apple grower in British Columbia. It is now owned by the venture capital firm Third Security, which also owns the biotech company GreenVenus (see page 14).

cban.ca/apple

The genetically engineered apple is unnecessary. There are already non-GM techniques that the food industry and consumers use to slow browning after apples are cut (the industry uses ascorbic acid and the public uses lemon juice). Browning in fruit and vegetables also gives consumers important information about the freshness of the foods they are buying.

The company Okanagan Specialty Fruits wants to sell its sliced GM apples in schools.[57] In 2025, the company launched the mascot "Artie" to market its GM apple to children, and, in August 2025, it partnered with Bayer to donate a salad bar with snack-sized bags of GM apple slices to a high school in California.[58]

NOT YET ON THE MARKET IN CANADA

GM Bananas

This product will not be assessed for safety by Health Canada.

9

Products of Concern:

- A disease-resistant GM banana was approved in Australia and New Zealand.
- There are at least two GM bananas that have been developed using gene editing, and will not require any government approval before being sold.[59]

Market Status:

There are no GM bananas on the market.

- The first GM banana in the world was approved in 2024. It is a disease-resistant banana that was approved for eating and growing in Australia and New Zealand. However, the university that developed it says it has no immediate plans to commercialise it, and the Australian Banana Growers say they will not grow it at this time.[60]
- A biotechnology company says it has gene-edited a reduced-browning banana that it wants to introduce in the Philippines over the next decade.[61]

GM Traits:

- The Australian researchers claim that the GM banana is resistant to a strain of Panama Disease (TR4).
- The GM gene-edited bananas are genetically engineered with a claim to longer shelf life through reduced browning as well as delayed ripening.

Company:

- The GM disease-resistant banana was developed at the Queensland University of Technology in Australia.
- The GM gene-edited bananas were developed by the UK biotechnology company Tropic Biosciences. Syngenta is also working with Tropic to develop gene edited vegetables.[62]

cban.ca/banana

Bananas are the most eaten fruit around the world with over 1000 varieties, but there is one standard variety of banana sold in grocery stores in Canada, called Cavendish. For over twenty years there have been news stories warning that the banana will go extinct because of a new strain of Panama Disease, and that genetic engineering is needed to save it.[63] The Cavendish banana is particularly vulnerable to disease because it is produced in large monocultures with no genetic diversity.

The Australia Banana Growers say, "The Australian banana industry is well and truly capable of meeting consumer demands without a genetically modified variety, at this time," and that non-GM research is showing "great promise."[64]

ANNEX

Genome editing is new genetic engineering

INTRODUCTION AND OVERVIEW

Genetic engineering, commonly called genetic modification, leads to the creation of genetically modified organisms (GMOs). This includes the new techniques of genome editing.

Genetic engineering

Genetic engineering is a set of laboratory techniques that are used to change the characteristics of organisms, resulting in genetically modified organisms (GMOs).

Genetic engineering makes changes to an organism by **directly intervening in its genetic make-up**, without mating. Genetic engineering techniques are used to insert new genetic material or to induce changes to targeted DNA sequences. They can also be used to delete and rearrange DNA, for example. The techniques are powerful but can also result in unintended changes to an organism.

The processes of genetic engineering enable humans to intervene directly in the genome (the entire set of an organism's genetic material) of organisms, which was **not possible before this technology**. For example, the first generation of genetic engineering tools were used to insert additional genes into the genome of an organism, taken from any organism, even from entirely different species. More recently, with the genome editing technique of CRISPR/Cas, scientists can intentionally cut strands of DNA within cells, to initiate changes.

With new techniques of genetic engineering, humans can make **ever deeper and more complex changes** to the genetic makeup of living organisms. For example, with genome editing, genetic sequences that are otherwise carefully protected by an organism against random mutations, can now be targeted and modified. Genome editing can also be used to change all the copies of one gene or many different DNA sequences at once. Artificial intelligence further enhances the power of genetic engineering to redesign organisms. The magnitude of changes that are possible is dramatically and profoundly expanding all the time.

Genetic engineering gives humans unprecedented power to make changes directly to the genome of an organism even though our knowledge and understanding of genetics and organisms is incomplete and still growing.

GENOME EDITING

Genome editing, also called gene editing, is **a powerful new set of genetic engineering techniques**. The techniques aim to alter a specific, targeted DNA sequence, by deleting, adding or replacing some of its components. The most frequently used genome editing technique in experiments is CRISPR/Cas, but other techniques follow similar principles.

Genome edited organisms are genetically modified organisms (GMOs). However, there are many imprecise and confusing terms and definitions being used around the world to describe and regulate genome-edited organisms, and many of them lack a solid scientific basis. There is, however, no dispute in the global scientific community that genome editing techniques are techniques of genetic engineering. For example, Jennifer Doudna, one of the developers of the genome editing CRISPR/Cas-9 method, refers to CRISPR/Cas as "genome engineering."

These new techniques of genetic engineering raise many of the same **risk questions** as earlier techniques did, as well as some new ones. They also raise the same environmental, social, economic and ethical concerns.

How genome editing works

Genome editing systems are comprised of molecular components that are programmed to make changes (perform "edits") at a target DNA sequence.

Generally, genome editing involves the insertion of genetic material that works inside the cell as a set of instructions to produce the CRISPR/Cas guided DNA cutters. The CRISPR/Cas complex is made up of two components: the ability to recognize and attach ("dock") onto a specific DNA sequence (CRISPR), and the activity to cut the DNA at that place (the "molecular scissors") (Cas). Other components can be added to try to instruct the cell on how to repair its cut DNA.

Genome editing, generally, uses molecular DNA cutters that are guided to a specific DNA sequence in an organism, to cut the DNA (to create a DNA double strand break). When DNA is cut, the cell recognizes this cut as an injury and urgently sticks the broken DNA back together using its own repair mechanism. This repair makes mistakes, which are the "edits" to genes that may result in new, desired characteristics, but can also result in unexpected changes. The genome editing system can also be used to try to direct how the cell makes these repairs, and to delete whole genes.

Until now, genetic engineering created new DNA sequences by inserting genes which then became a permanent part of the GMO, to create the new desired characteristic. With genome editing, however, the genetic material that is inserted to trigger "edits" does not need to remain in the, now genetically modified, organism. This is why **many GMOs developed through gene editing do not have any "foreign DNA"** (DNA from other species).

Unexpected effects of genome editing

Genome editing is often said to be more precise than earlier methods because the changes occur to target DNA sequences whereas earlier techniques led to the insertion of genes at random places. However, **gene editing can be imprecise and, like other genetic engineering techniques, cause unexpected and unpredictable effects**.

Gene editing can create genetic errors in the GMO either due to the action of the DNA-cutters or due to the other processes involved. These effects can lead to unexpected and unpredictable outcomes, such as changes in protein composition and altered behaviour in and of the organism.

- The CRISPR system can make unintended edits to DNA at unexpected places, not just the target sequence.
- Genome editing can cause extensive deletions and complex re-arrangements of DNA at or near the cutting site.
- Unwanted DNA can unintentionally integrate into the host organism during the genome editing process.

Despite the power of genetic engineering to change the characteristics of organisms, there are many gaps in our knowledge. The interactions between the genes themselves, as well as the interactions between genes and the cell, the organism and the wider environment, are highly complex and not yet fully understood. There are many changing factors that make the outcomes and consequences of genetic engineering, for the genetically modified organism as well as for the environment, unpredictable.

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