Public Acceptance and the GMO ghost:
The Conundrum in The Gene-Editing Revolution

Group 2

Annis Fatmawati

Guilherme Silva Martins

UNIVERSITÉ DE SHERBROOKE

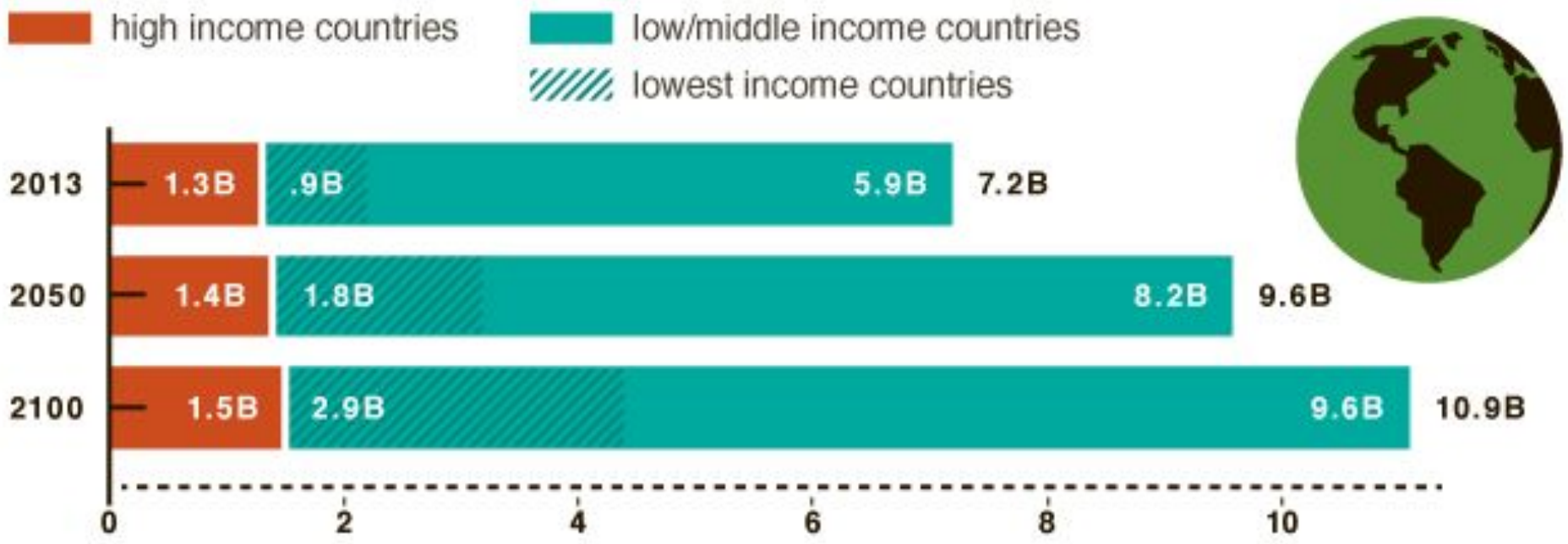
GEFSES Genome Editing for Food Security and Environmental Sustainability

McGill UNIVERSITY

Outline of the Presentation

1. The rise of Genetically Modified plants (GMOs) and their benefits to agriculture
2. The reasons of public's mistrust towards GMOs and its consequences
3. Gene-editing as a new genetic engineering approach in agriculture
4. Strategies to address public acceptance of gene-editing

The World Will Have 10 Billion People to Cater for



Source: cgiar.org

Additional Challenges in Agricultural Production

Limited arable land

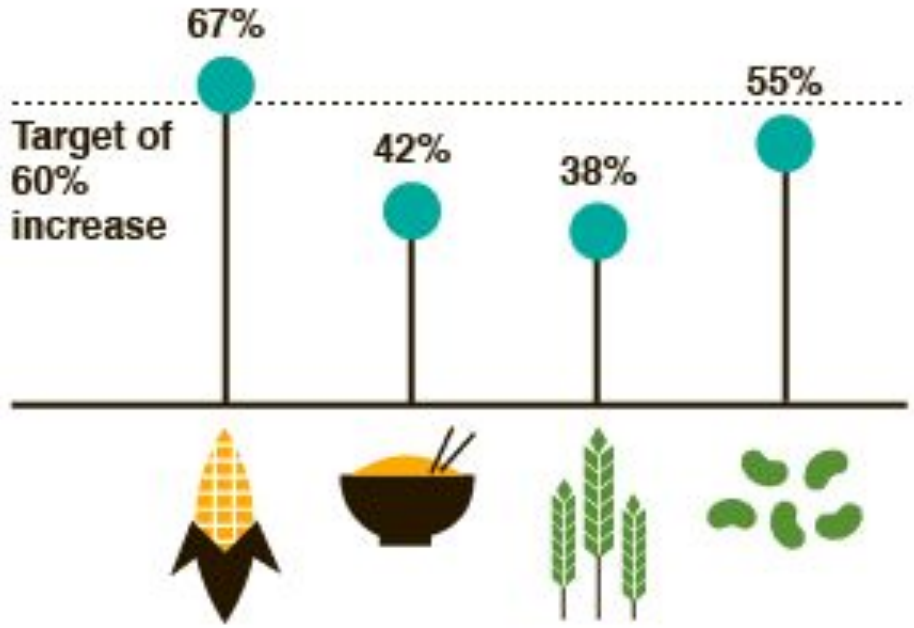
Environment protection

Climate change

Agriculture Must Increase in Productivity

- Food production need to increase by 60%
- Current growth in yield are failing short of the target

We need plants with better performance under challenging conditions

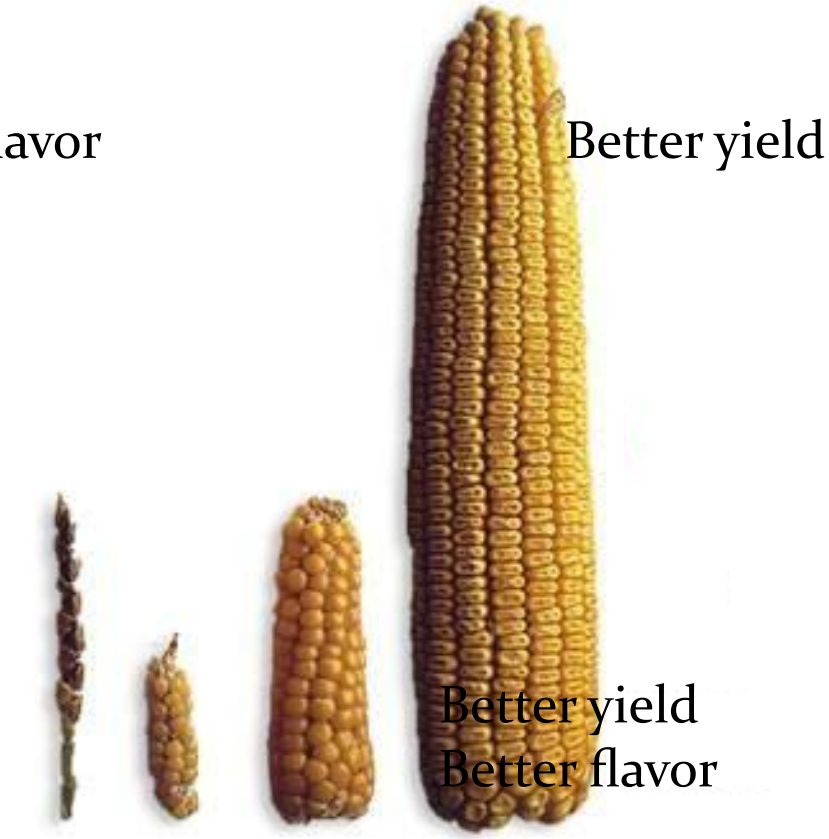


Source: cgiar.org

The First Strategy of Plant Improvement

Conventional Plant Breeding

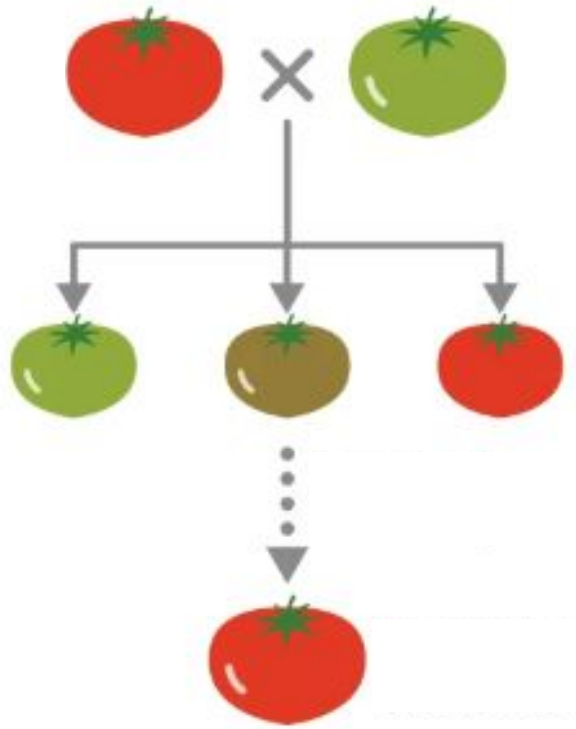
The science of changing the traits of plants through mating or cross-pollinating in order to produce desired characteristics.



(Kato-Nitta, et al., 2019)

Conventional Breeding Has its Downsides

- Time consuming
- Sometimes cost intensive
- Select for desirable traits (Example: Yield) but can also loose others (For example: Nutrition)



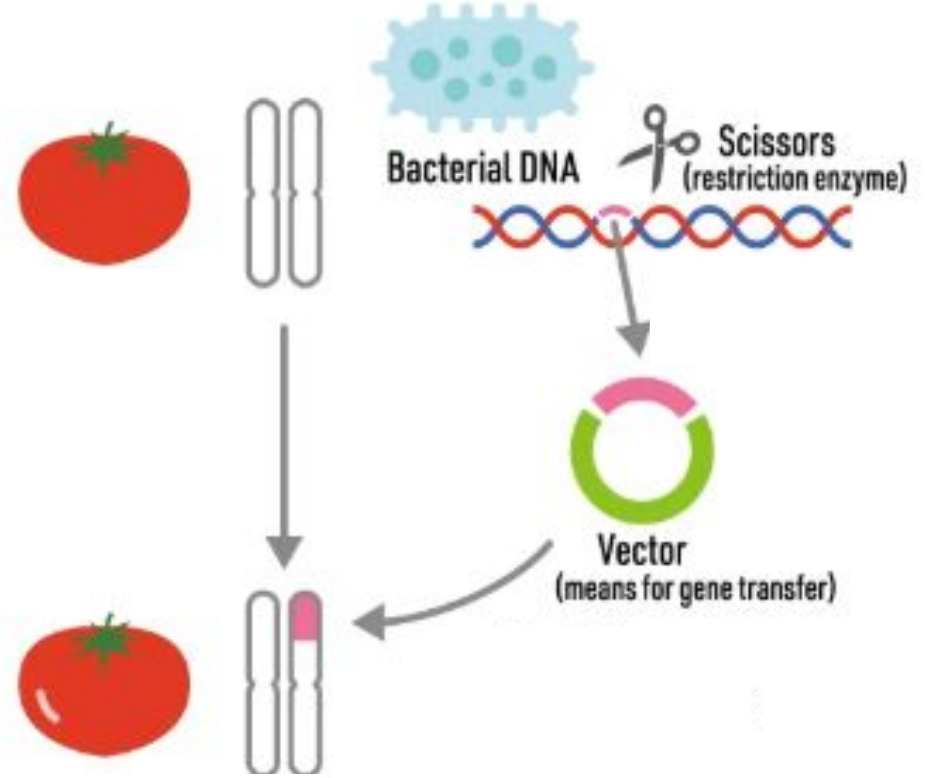
(Kato-Nitta, et al., 2019)

Genetically Modified (GM) Plants: Another Tool in the Toolbox

Genetic Modification (GM)

- Insertion of a DNA sequence into the plant's genome

- This DNA sequence will encode a desirable characteristic into the modified plant

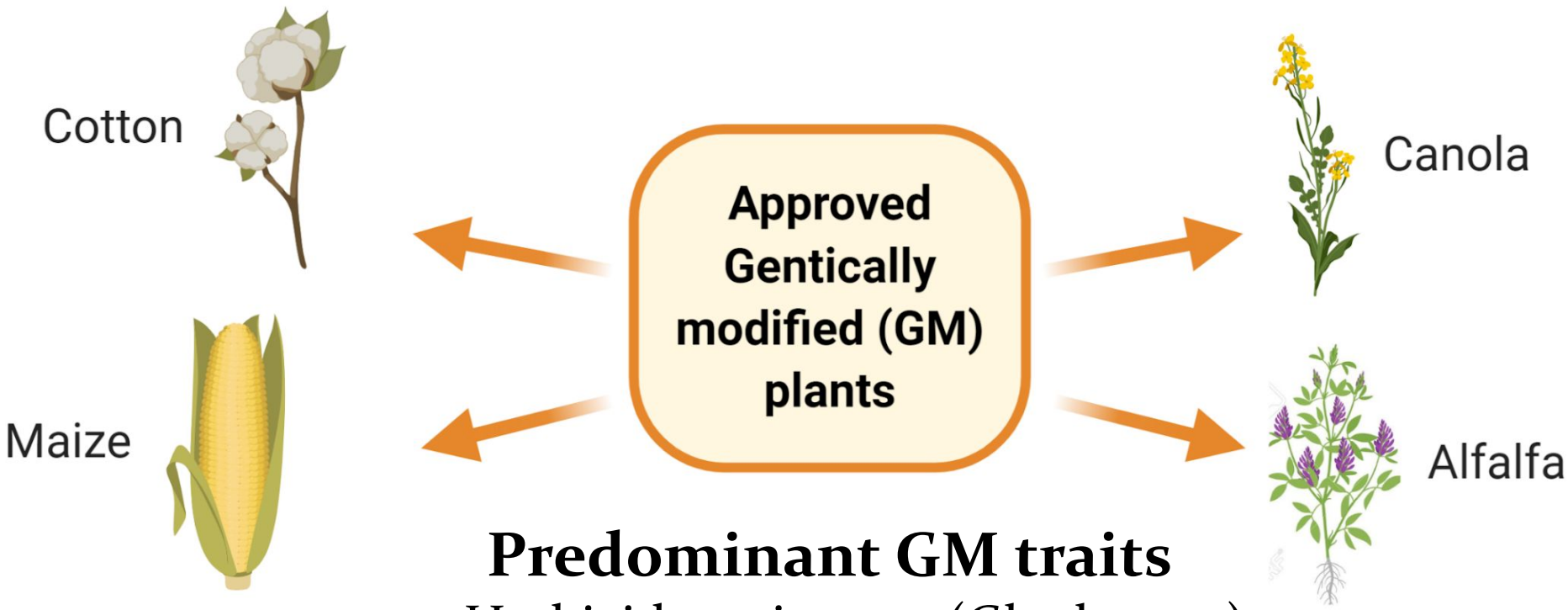


(Kato-Nitta, et al., 2019)

Herbicide-resistance Soybean

First released in 1996 by Monsanto

What GM Crops Are Being Grown?



Predominant GM traits

- Herbicide resistance (Glyphosate)
- Insect resistance (Bt)

Made in Biorender

Some Benefits of The Implementation of GM Crops

- Decrease in insecticide use;
- Decrease in target insect pests or pathogens threats;
- Improved yield
- Improved weed management;
- Decrease the usage of more toxic herbicides;
- Safe for human and animal consumption.

(National Academy of Science, EFSA, AAAS)

How Come Did We Lose Public's Trust?

GMO…OMG: How Did We Lose Public's Trust?

- Investments in commodities that were not necessarily for human consumption nor to help undernourishment

- Monopoly of Big Ag companies and monoculture;

- Lack of trust in regulation and scientific evidence;

GMO…OMG: How Did We Lose Public's Trust?

- Poor Risk-Benefits communication, transparency and public engagement.
- Limited understanding, misconceptions, and even unfamiliarity with GMO food products.
- The fear-based campaign of anti-biotech movement

Intense Public Debate and its Consequences

Block of GM crops application that could have had a positive impact in society

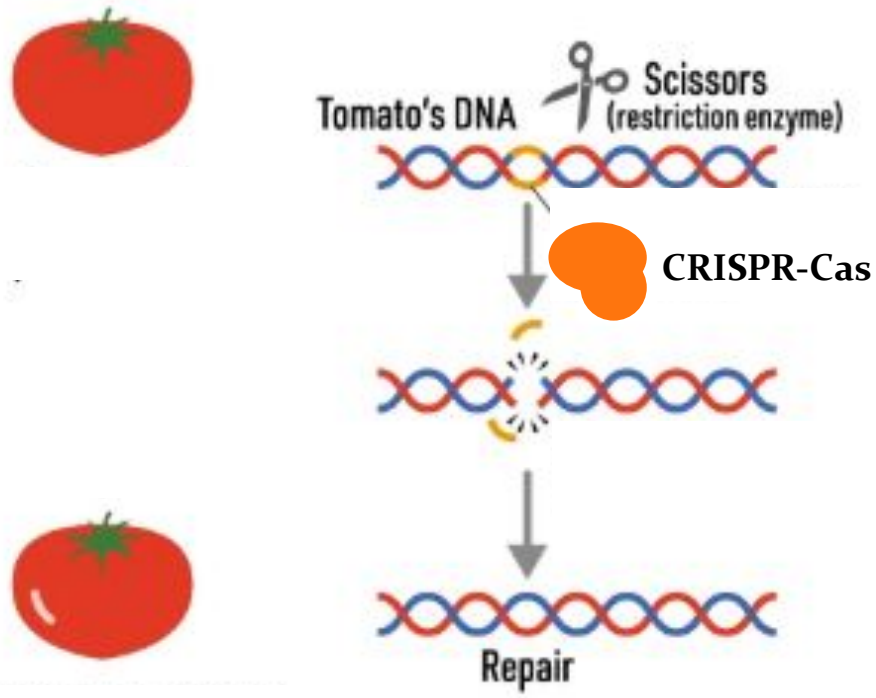
Bacteria Wilt-resistant

Vitamin A enriched Golden Rice

(Potricus,I., 2001; Ghag, S.B., et al, 2016)

Gene-Editing (GE): A New Way of Crop Improvement

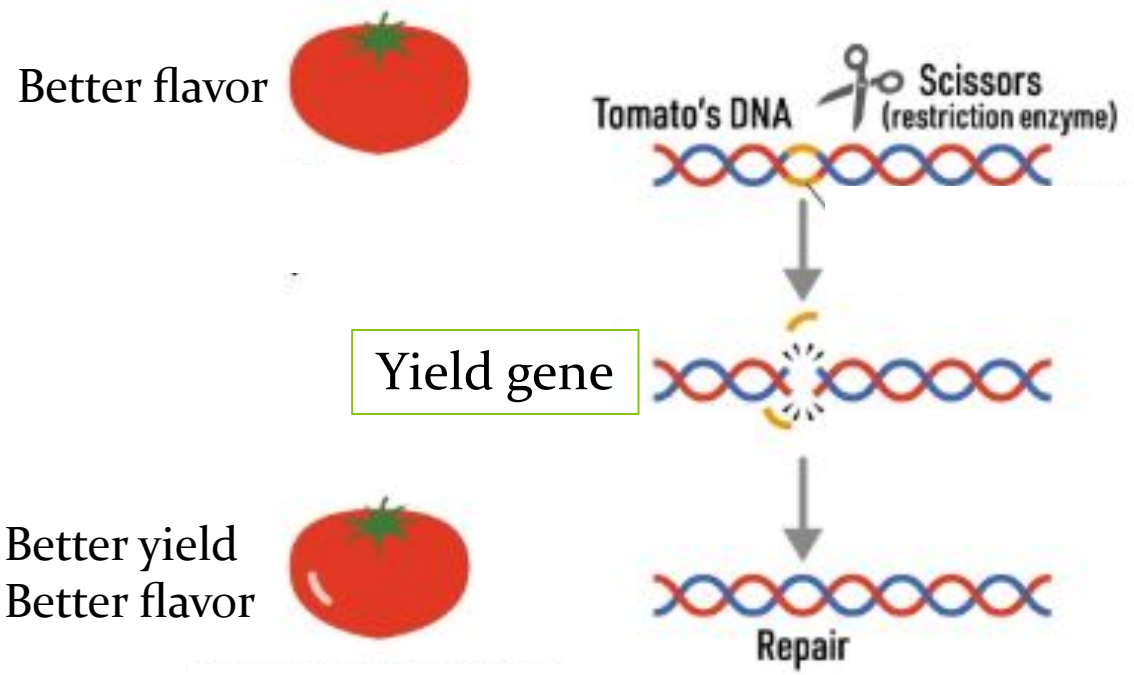
- *Low cost, easy and high precision*
- *Alter the DNA sequence and modify its function acquiring the desirable trait*



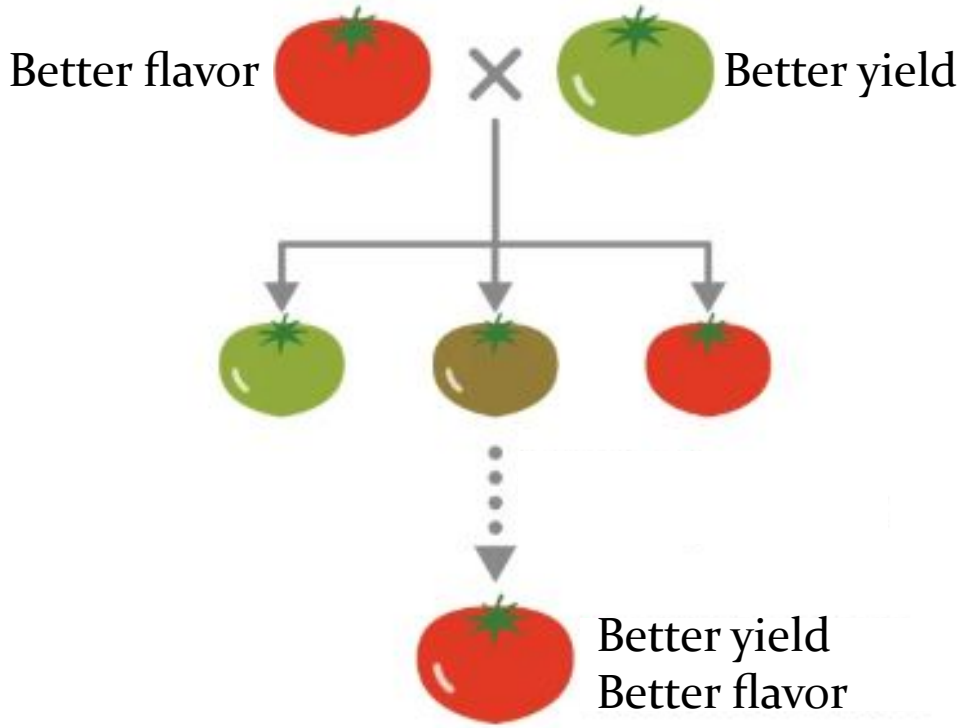
(Kato-Nitta, et al., 2019)

GE is a Viable Alternative for Plant Improvement

Gene-editing



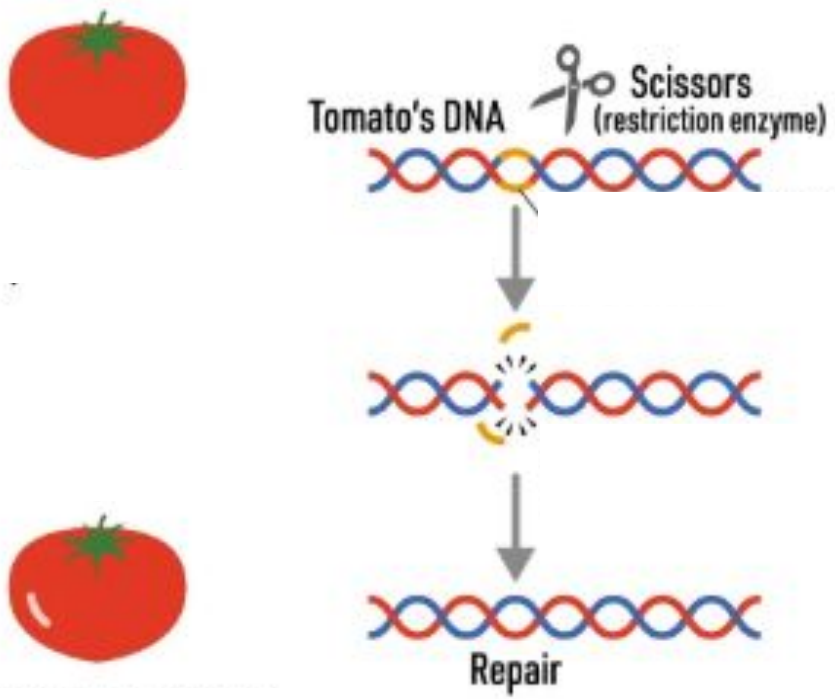
Conventional breeding



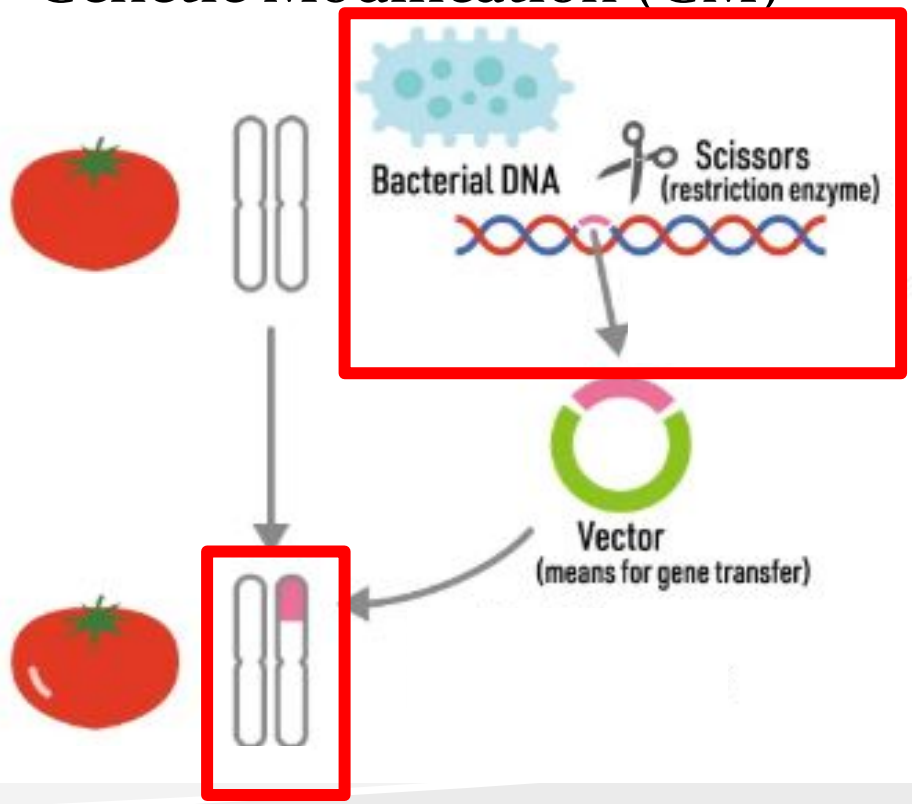
(Kato-Nitta, et al., 2019)

GE is a Viable Alternative for Plant Improvement

Gene-editing

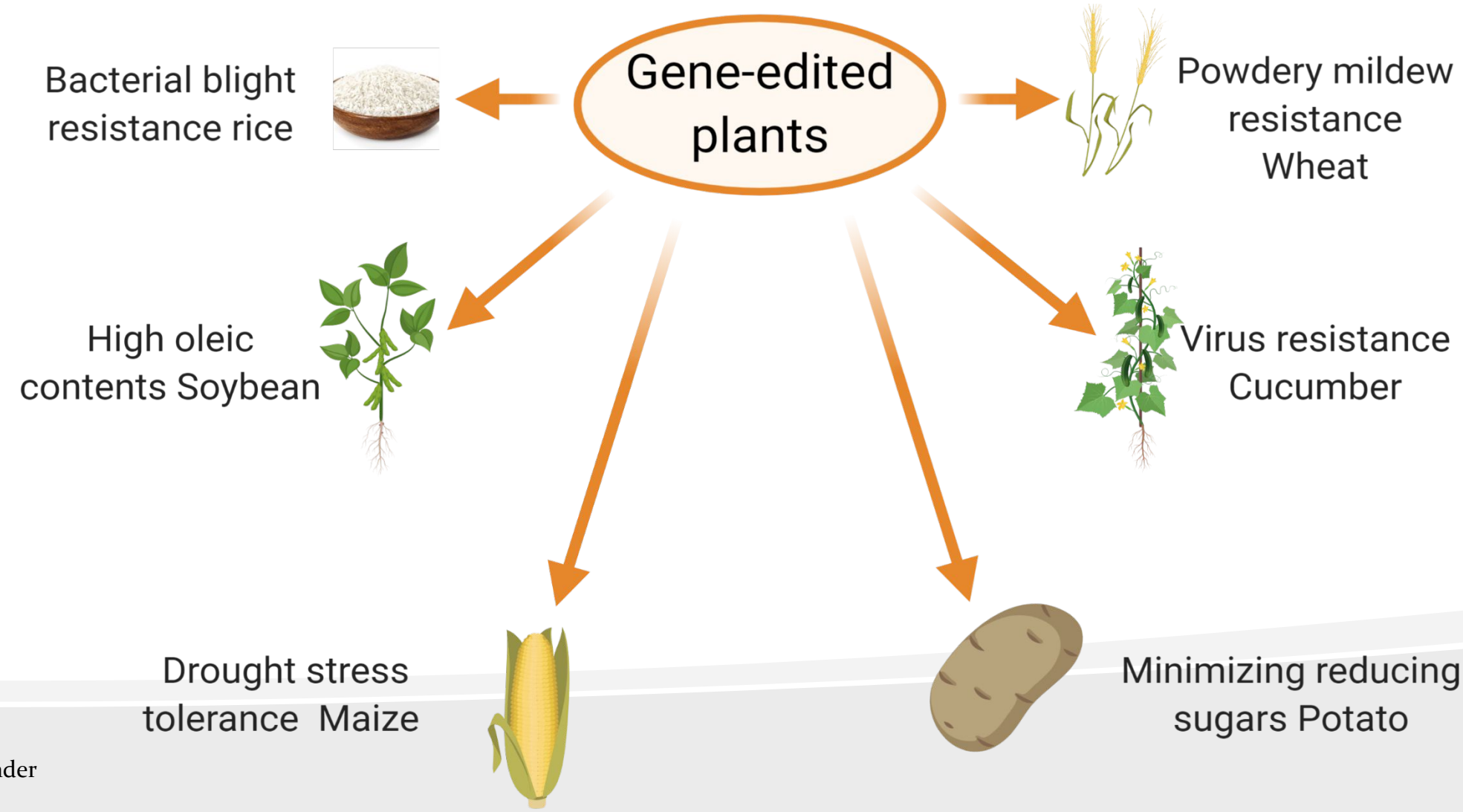


Genetic Modification (GM)



(Kato-Nitta, et al., 2019)

Some Examples of GE Plants Being Developed



Made in biorender

Addressing Public Acceptance of GE Plants

1. **Priority-Setting Research**
2. **Democratization of Gene-Editing**
3. **Regulation**
4. **Science Communication**

First Approach

Priority-Setting Research

Identifying Priorities

Consumers Values

Farmers Needs

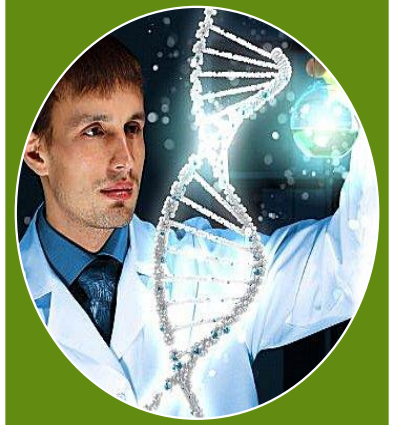
Priorities on a Trait Basis

Resistance to pathogens

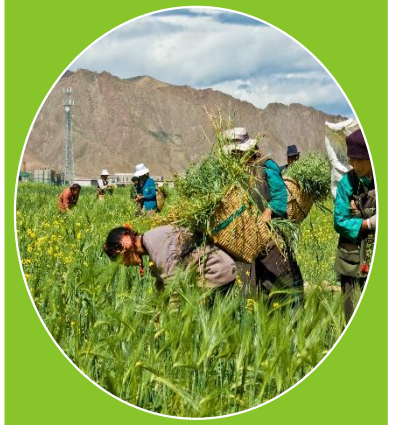
Tolerance to abiotic stresses

Nutrition

Nitrogen fixation



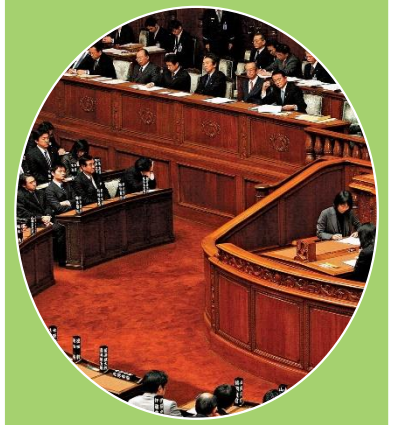
Scientist



Farmer Association

Policy Maker

NGO



Local Government

Developers

Conduct of a participatory consortium

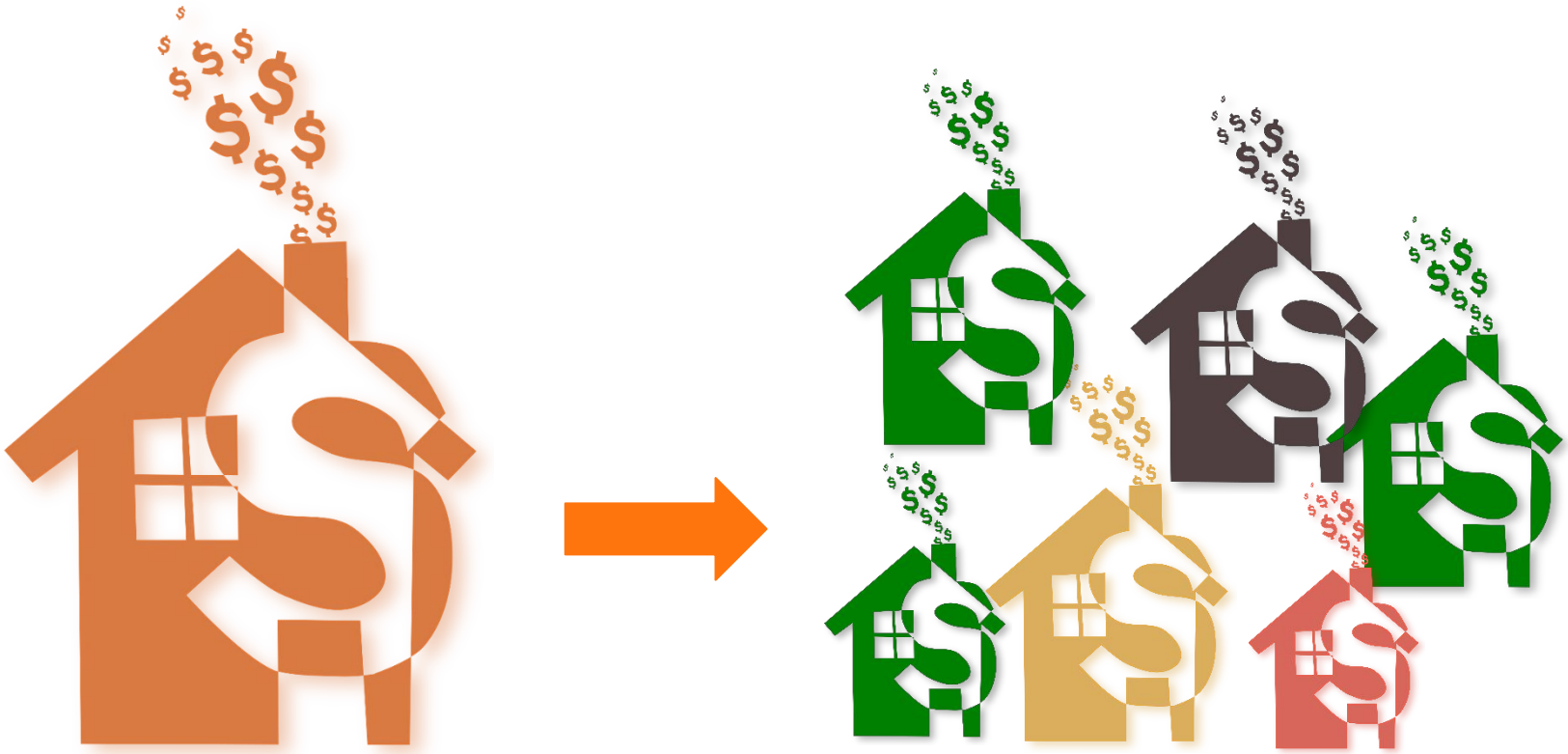
Second Approach

Democratization of Gene-Editing

Big Companies and the Polarization of The GMO Debate

Monopoly of Big Ag Companies

CRISPR Will Open Doors for Small Companies



CRISPR

Easy, Inexpensive

Wide market

Decentralization is Dependent on The Regulation Cost

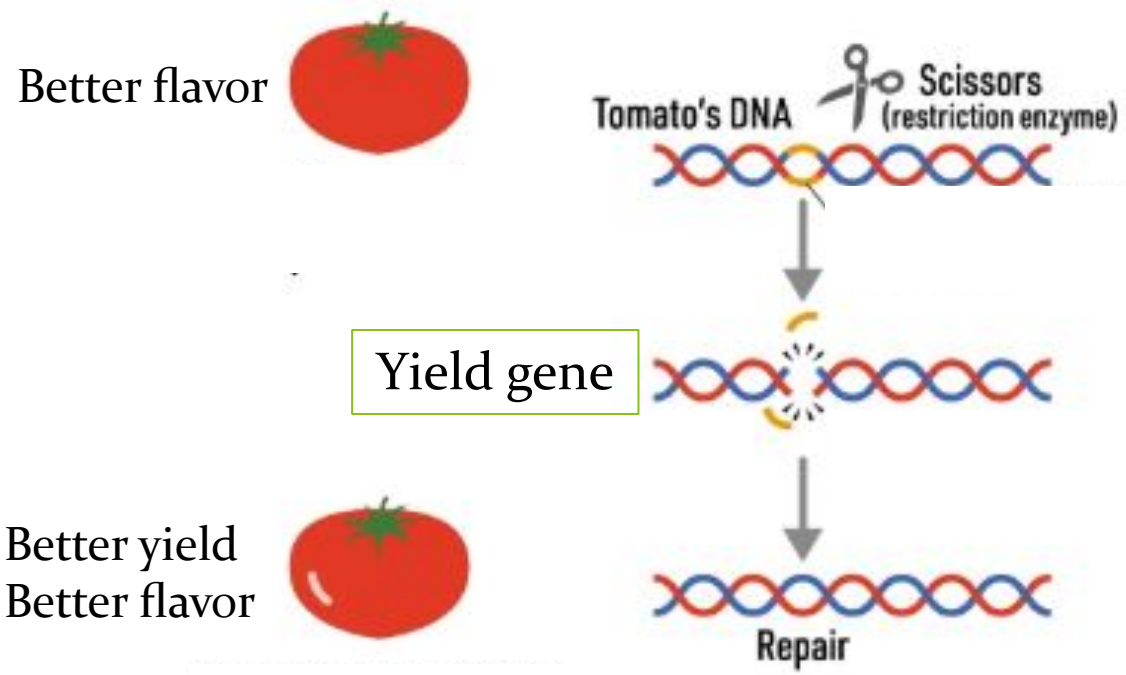
The cost of regulation is a challenge for small companies

Third Approach

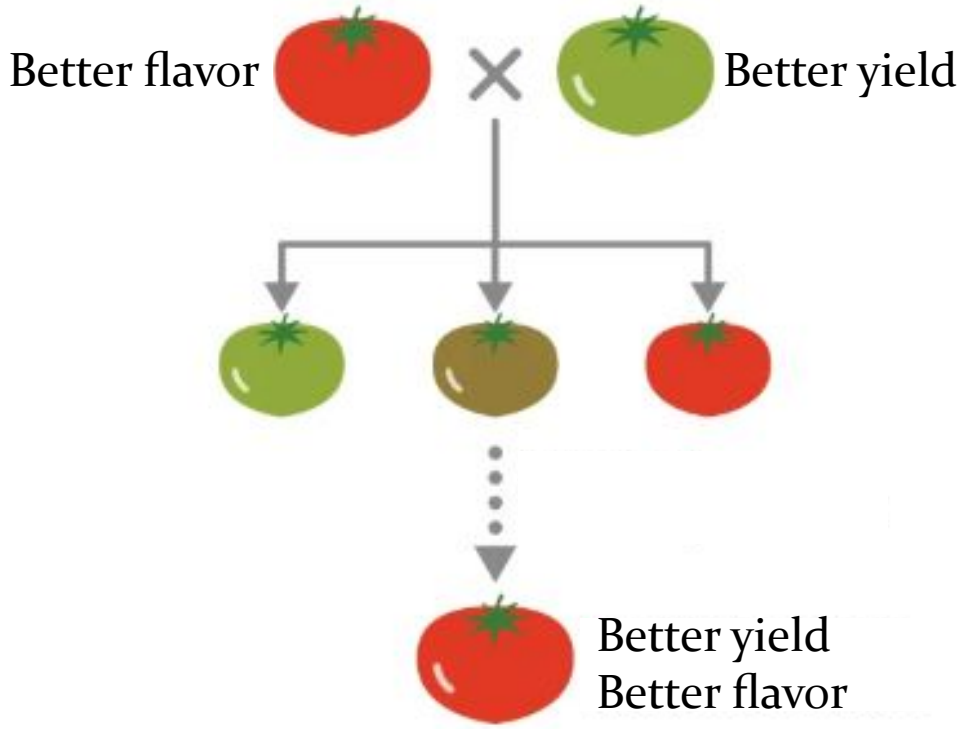
Regulation

To Regulate or Not To Regulate… That is The Question

Gene-editing



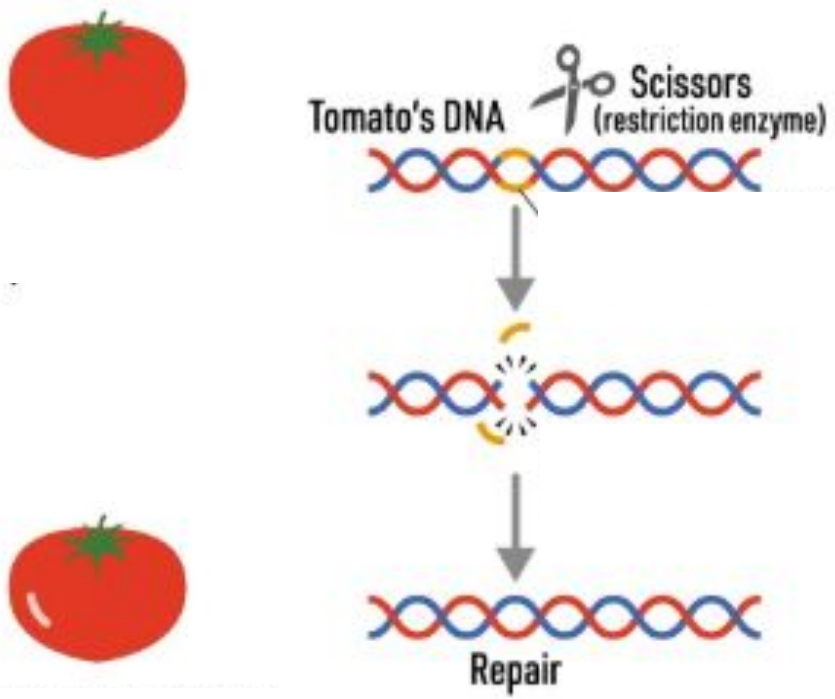
Conventional breeding



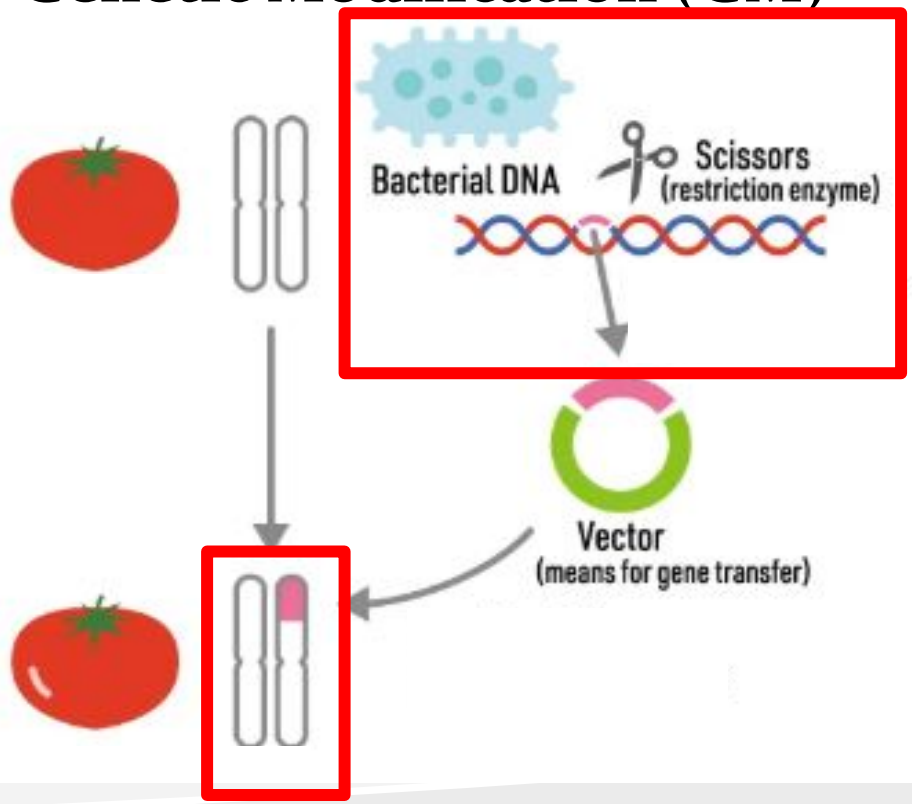
(Kato-Nitta, et al., 2019)

To Regulate or Not To Regulate… That is The Question

Gene-editing



Genetic Modification (GM)



(Kato-Nitta, et al., 2019)

GE Can Be Regulated Based on The Traits

Evaluation of putative environmental risks

Herbicide-resistance

Enhanced yield

Other Suggestions for GE Regulation

Gene-editing regulation

Although it is a precise technique, off-target and biosafety data should be taken into consideration

Multiplex gene-editing: when multiple genes are edited at once

GE Regulation May Increase The Cost of Application

Gene-editing regulation

- Increase the cost of the application

- Affecting the access of this technology to small companies and institutions

The Lack of Regulation May Trigger Public's Mistrust

No Gene-editing regulation

- No transparency

- No decision on Labelling and Traceability

The Fourth Approach

Science Communication

What Should We Communicate?

1. *Awareness of acute global food security threats*
2. *Scientific similarities/differences between genetic modification techniques*
3. *Full transparency about potential benefits, risks and regulation framework*

How Should We Communicate?

1. *Communicate in a manner that affirms rather than threatens people's values*
2. *Communication and listening skills*
3. *Highlight shared purpose*
4. *Communication made by a diverse set of experts*

How Can We Reach The Public?

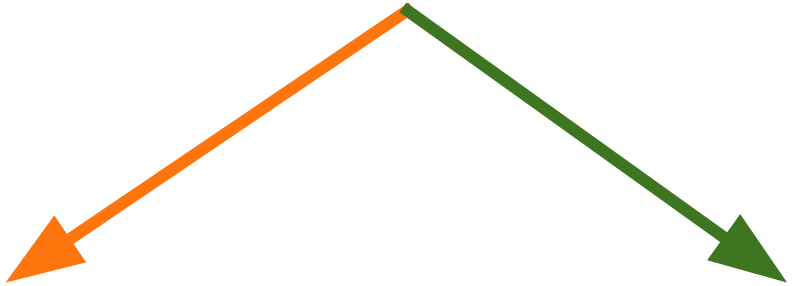
1. *Usage of the vast network from the consortium*
2. *Engage the public through social media, workshops and communicating with the media*
3. *Marketing strategies*

USA

Brazil

The GMO Ghost and Gene-Editing Acceptance

Take-home message



The GMO ghost

- No consensus in the priority-setting
- Lack of trust in Big ag Companies
- Anti-biotech movement
- Poor public engagement

Gene-editing acceptance

- Discussion about priorities
- Democratization of gene-editing
- Regulation
- Efficient communication and Marketing

Let's welcome, communicate and inspire the public with Gene-editing

Thank you for your attention

UNIVERSITÉ DE SHERBROOKE

GEFSES

Genome Editing for Food Security and Environmental Sustainability

McGill UNIVERSITY

References

- Kato-Nitta, N., Maeda, T., Inagaki, Y., & Tachikawa, M. (2019). Expert and public perceptions of gene-edited crops: attitude changes in relation to scientific knowledge. *Palgrave Communications*, 5(1), 1-14.
- Ghag, S. B., & Ganapathi, T. R. (2017). Genetically modified bananas: To mitigate food security concerns. *Scientia Horticulturae*, *214*, 91-98.
- Potrykus, I. (2001). Golden rice and beyond. *Plant physiology*, *125*(3), 1157-1161.
- https://earthzine.org/the-role-of-genetically-modified-crops-in-attaining-food-security-in-the-developing-world/
- https://geneticliteracyproject.org/2014/09/29/gmo-opponents-worry-big-six-ag-companies-monopolize-global-food-supply/
- www.croplife.com/
- https://webstockreview.net/explore/clipart-money-cost/
- cgiar.org
- phys.org/news/2018-08-brazil-odds-huge-swathe-amazon
- (https://risk-monger.com/2017/04/14/carpetbaggers-american-ngo-activists-in-brussels/)
- (https://pubmed.ncbi.nlm.nih.gov/)
- https://www.sciencenewsdigital.org/sciencenews/december_21__2019___january_4__2020/MobilePagedArticle.action?articleId=1545002#articleId1545002
- https://www.newindianexpress.com/business/2019/oct/13/fmcg-firms-brace-for-tepid-q2-earnings--2046668.html
- https://www.nestle.com/csv/impact/rural-livelihoods/farm-economics