What are these NGTs?

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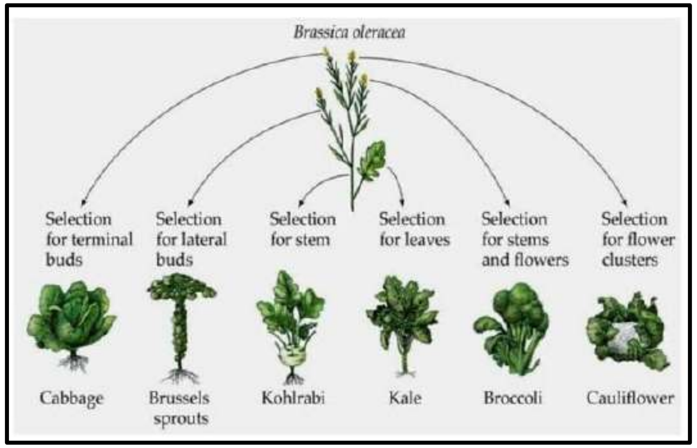
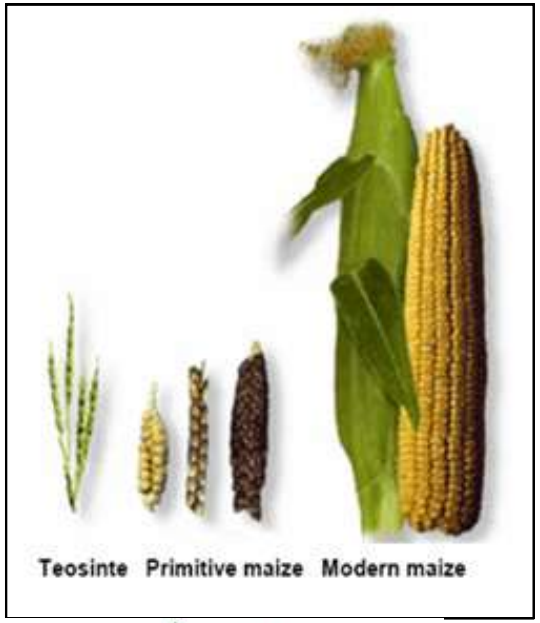
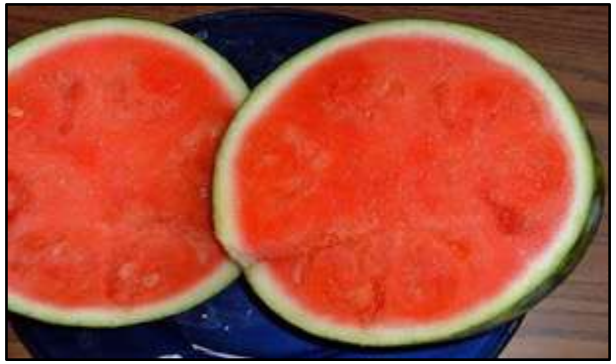
EUROPEAN FOOD FORUM

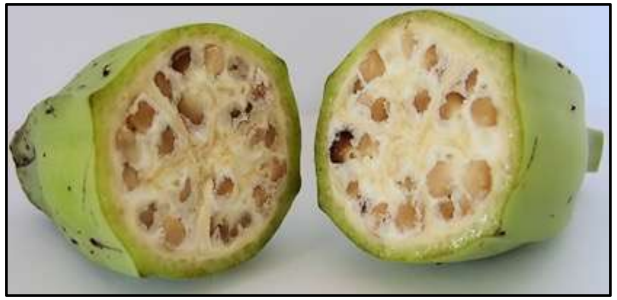
Dec 2023

Everything we eat is the result of plant breeding

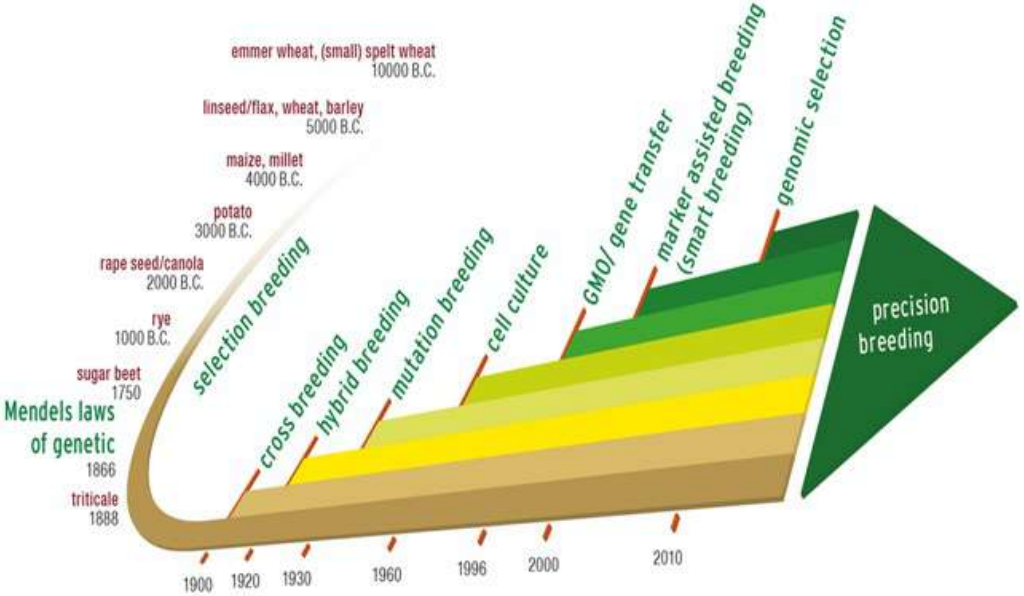




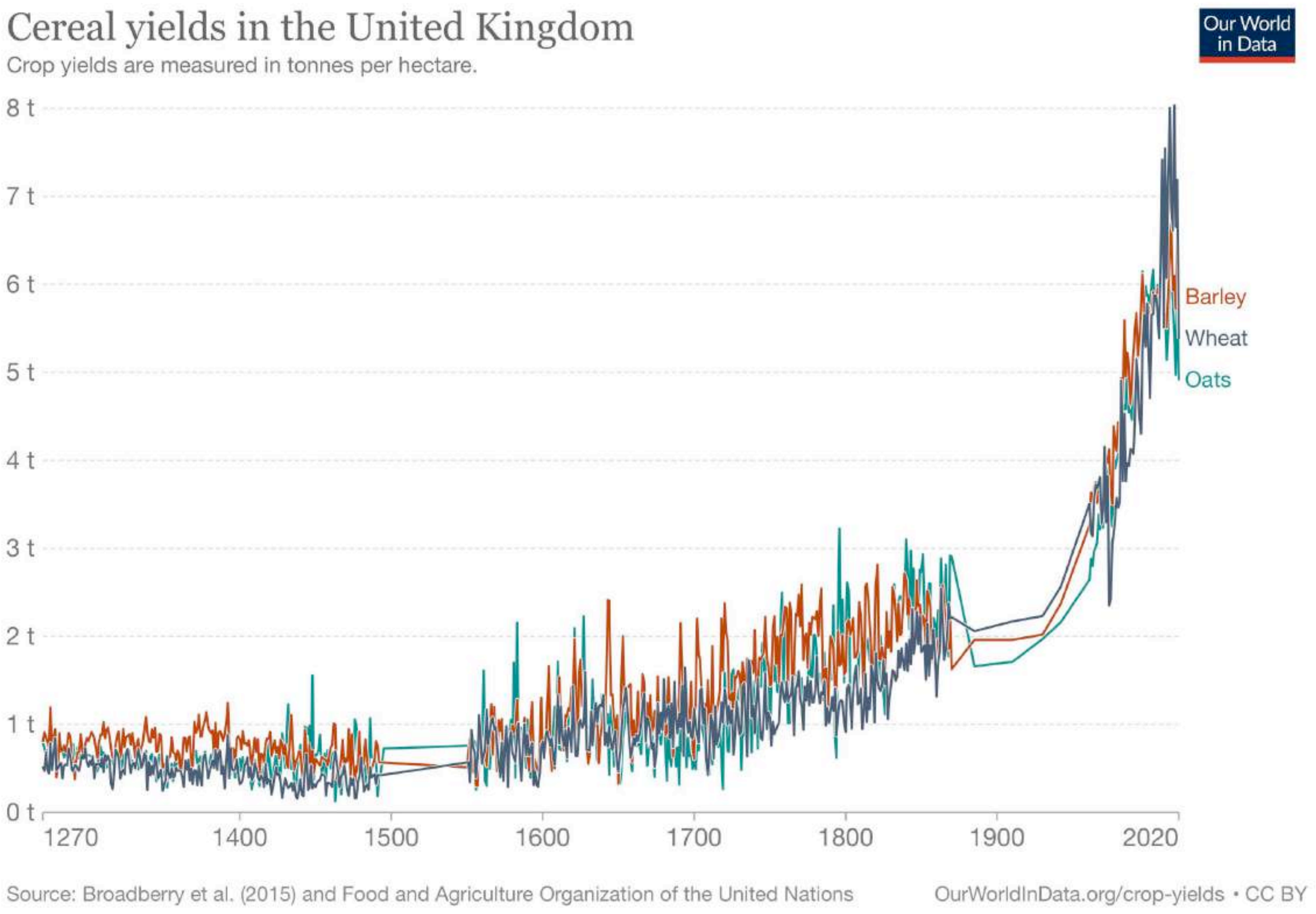




Milestones in Plant Breeding

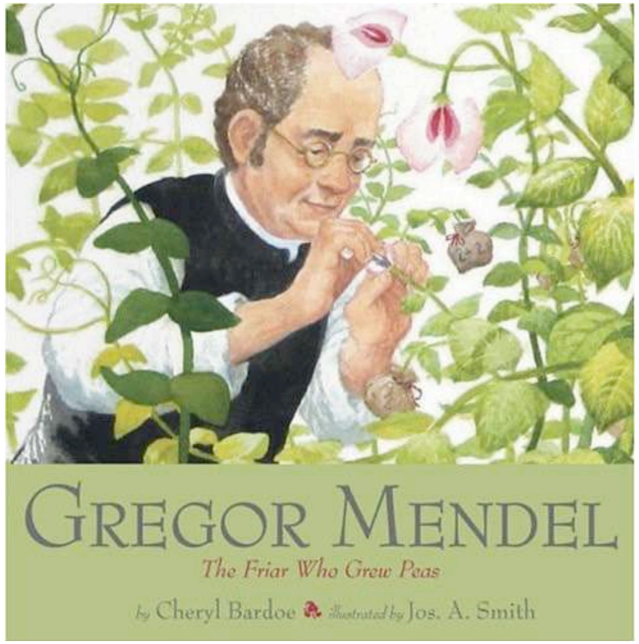


Knowledge of genetics was key to unlocking genetic potential



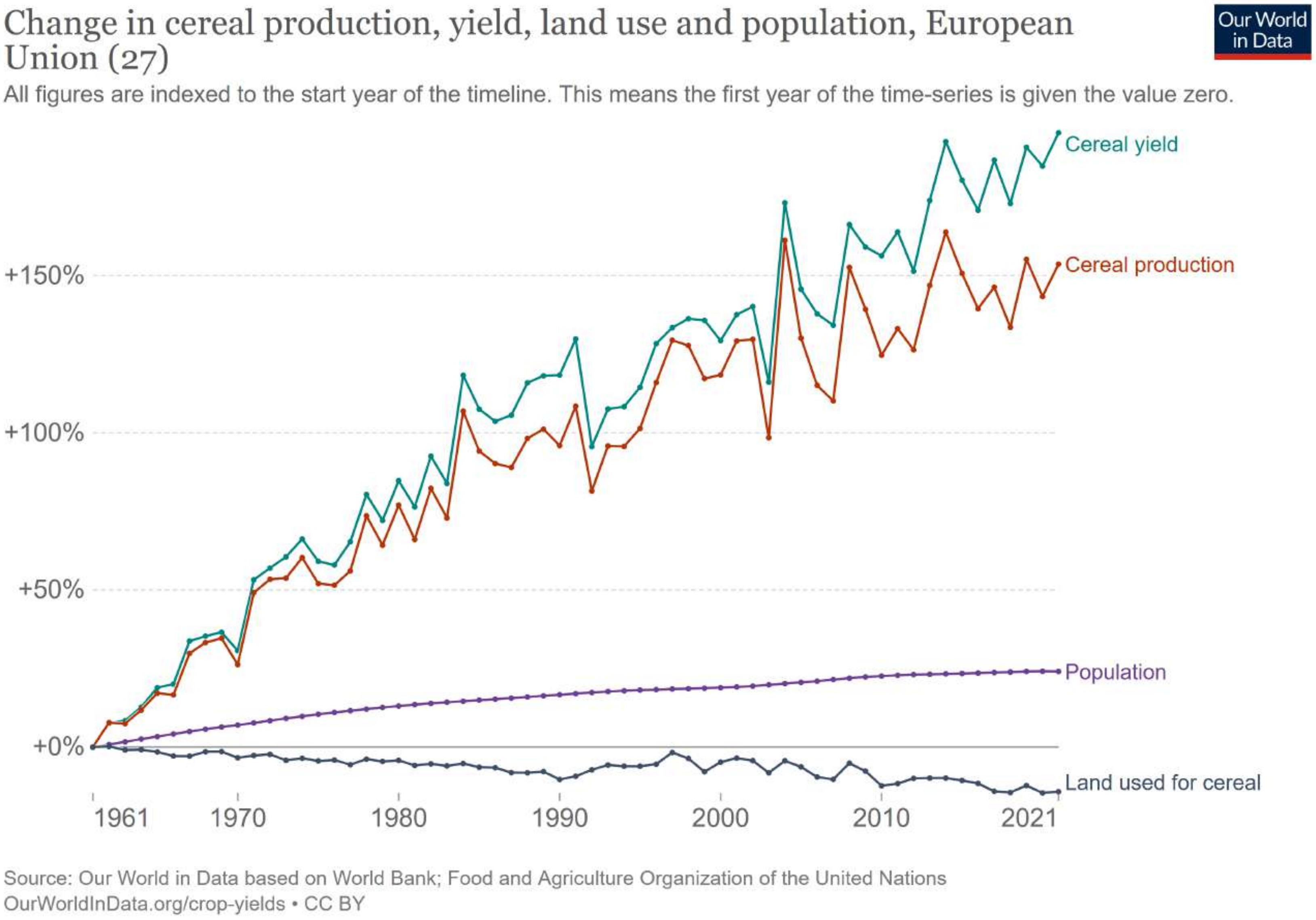
Rediscovery of Mendel's findings in 1900 (from 1865)

Breeding becomes a science



Graph: Broadberry et al. (2015) British Economic Growth (Cambridge University Press) and United Nations Food & Agriculture Organisation

Knowledge of genetics was key to unlocking genetic potential



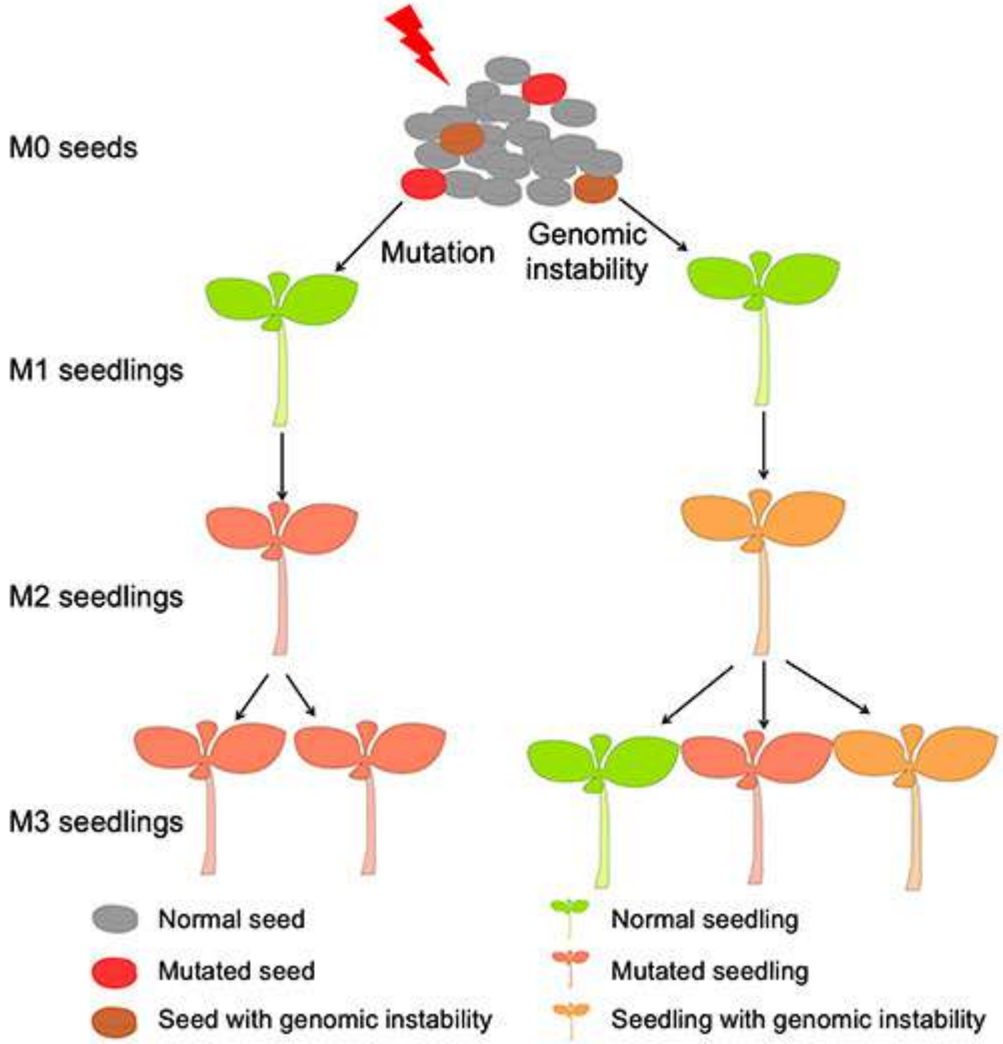
In the past two decades, plant breeding alone has contributed to

~67% increase of crop production*

in the EU, ensuring a stable supply of food and feed for the EU and beyond, while reducing the need for agricultural land

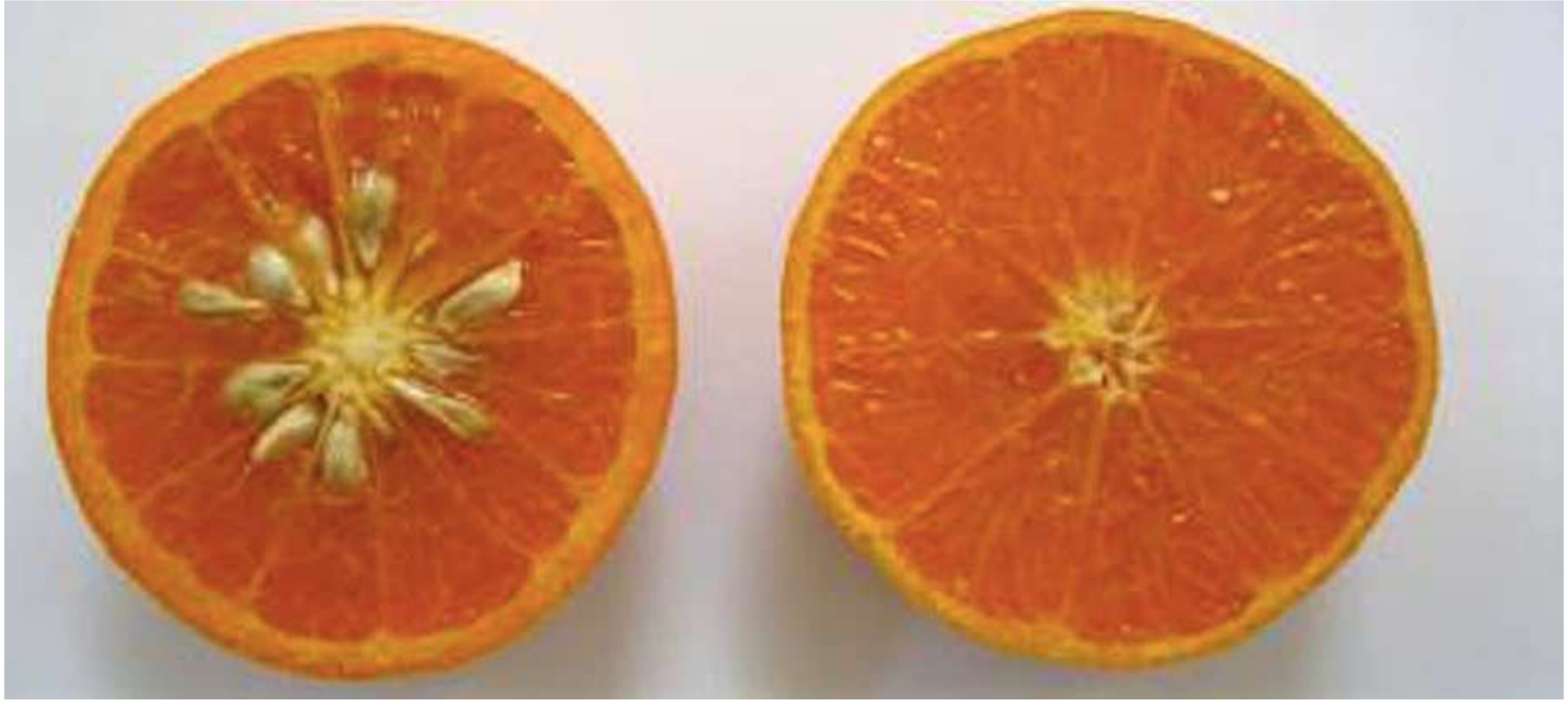
Spontaneous mutations were for a long time the only source of variability

Increasing the mutation frequency by chemicals or irradiation



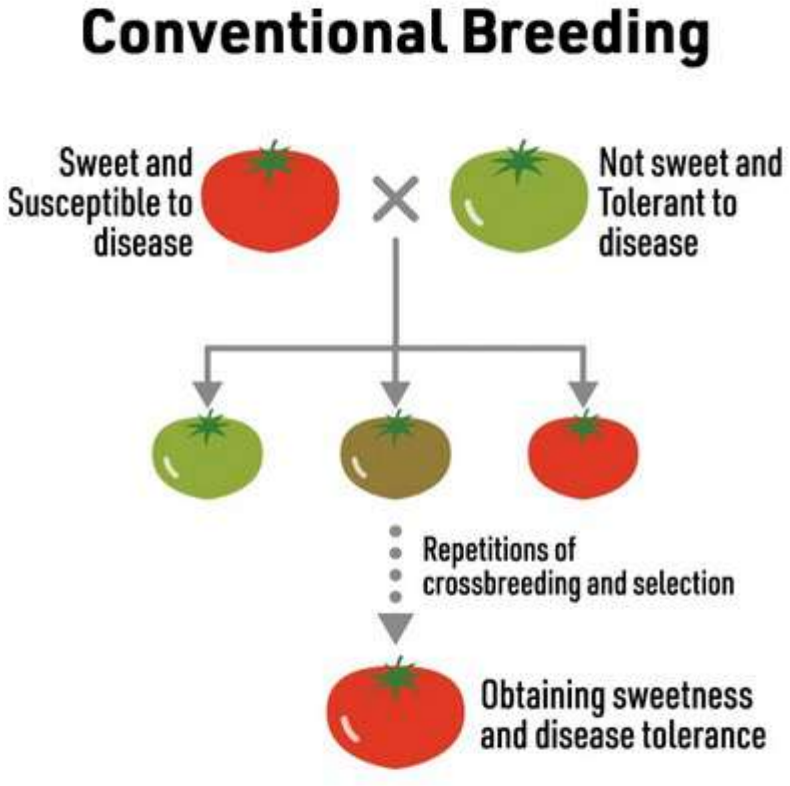
Non-targeted mutations

Increasing the mutation frequency by chemicals or irradiation



- More than 3,200 mutant varieties – including numerous crops, ornamentals and trees – have officially been released for commercial use in more than 210 plant species from over 70 countries (Source: FAO/IAEA Mutant Varieties Database)

Variation in the genetic blue print is the basis of plant breeding

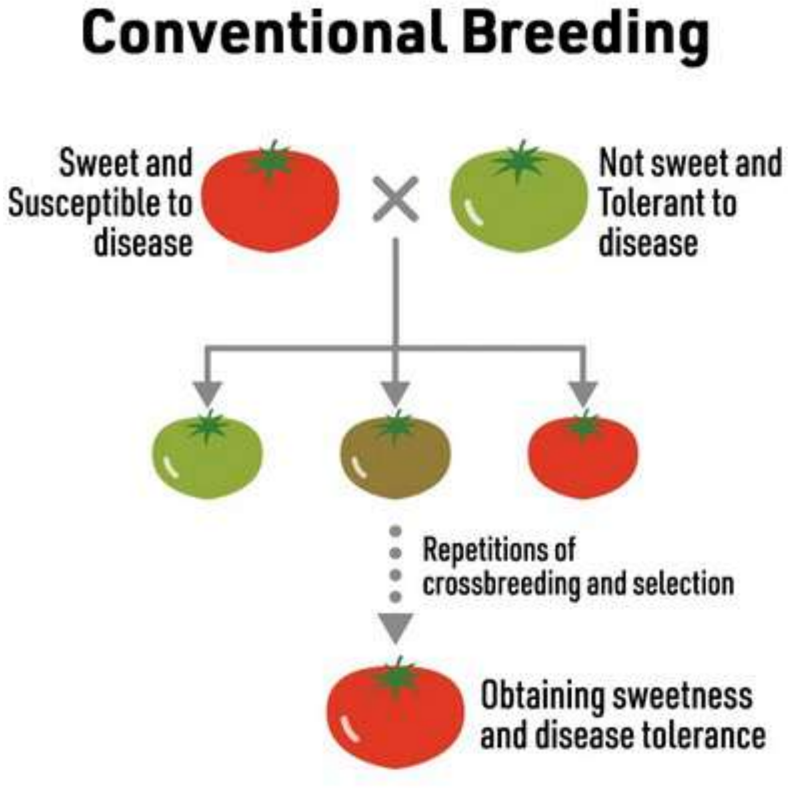


Random mutations
Non-targeted

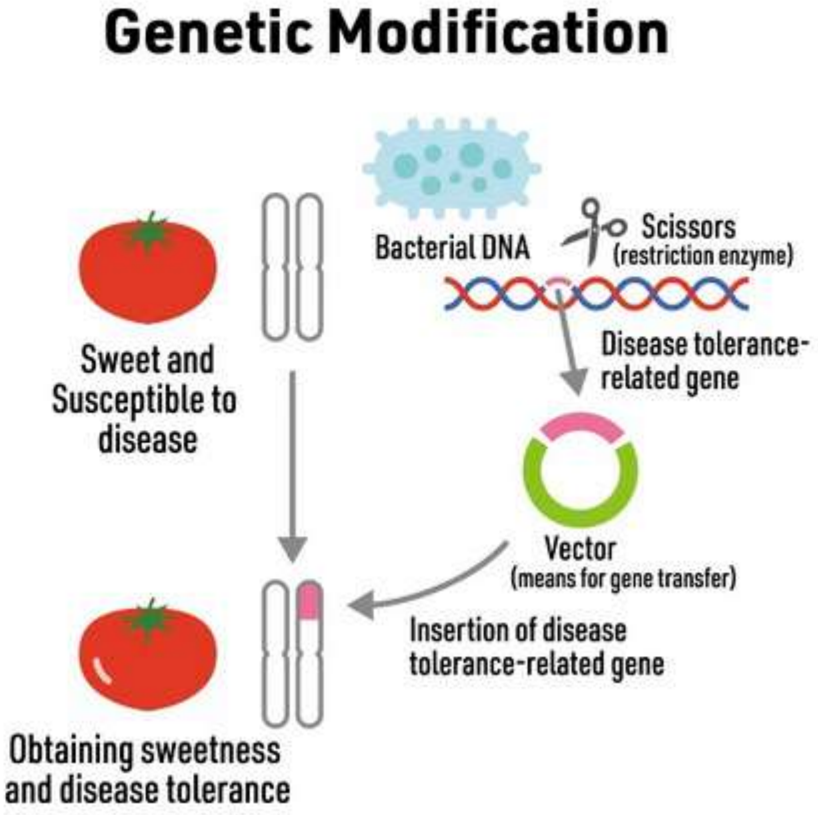
Conventional breeding has served mankind but ...

- Requires a lot of time (7-25 year)
- Non-targeted: based on co-incidence: searching for a needle in a haystack
- Not applicable for a number of plants (eg. grapes, trees,...)
- Often difficult to separate positive and negative traits
- Requires vast investments despite the use of molecular markers

Variation in the genetic blue print is the basis of plant breeding



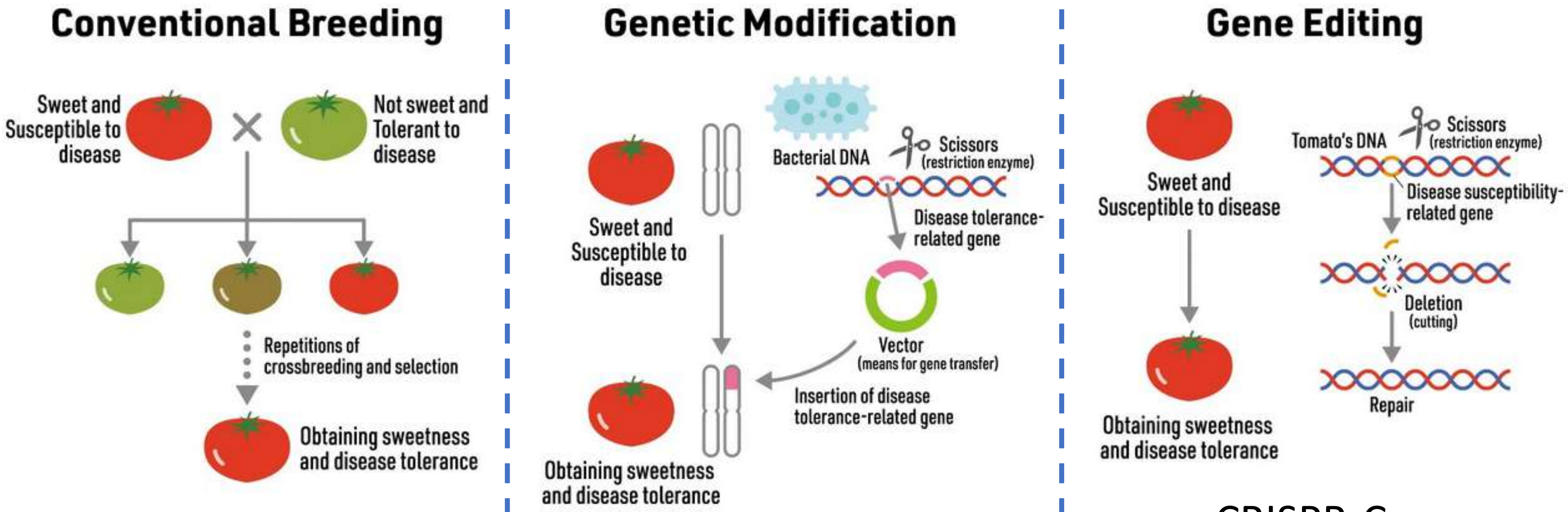
Non-targeted



GMO

Contains ‘foreign’ DNA

Variation in the genetic blue print is the basis of plant breeding



Non-targeted

GMO
Contains ‘foreign’ DNA

CRISPR-Cas
Does not contain ‘foreign’ DNA
2012

Precision breeding of crops using gene editing

2020 Nobel Prize

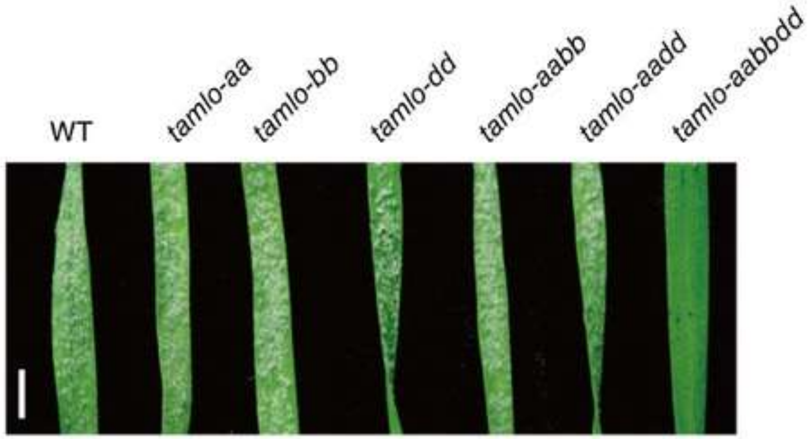
- Very efficient (2 - 7 year)
- Very precise: targeted changes
- Cheap and easy
- Improved varieties can not be distinguished from varieties obtained by conventional breeding
  (no DNA from unrelated species)
- Can rely on an overwhelming knowledge on plant genes and genomes
- Increasing agrobiodiversity -> from elite commercial varieties to improving low acreage varieties of regional and cultural relevance
- Specific contributions to sustainability incl. the time and resource benefits of using NGTs vs conventional breeding

NGT applications in crops: examples

WHEAT RESISTANT TO POWDERY MILDEW

Using genome-editing breeders made this wheat variety more **resistant to powdery mildew**. Farmers using this kind of wheat obtain **higher yields.**

- Inactivation of six MLO susceptibility genes in wheat results in disease tolerance



- Reduction of breeding time to 3-4 years vs 10-15 years by conventional breeding; directly in modern varieties, no trade offs

NGT applications in crops: examples

POTATO VARIETY WITH LESS BROWNING

A genome-edited potato variety was developed containing undetectable levels of reducing sugars.

Chips and French fries made from these potatoes are **healthier and look better.**

BETTER TASTING YELLOW PEAS

Genome editing was successfully deployed to **slash levels of bitter-tasting saponins** in yellow peas.

MULTIPURPOSE PENNYGRASS

With genome editing, this penny grass was developed into a cover crop that can be used outside of cropping seasons. It is used to **protect soil and control carbon loss.**

BROCCOLI WITH HIGHER NUTRITIONAL VALUE

Broccoli contains **substances which help prevent a variety of chronic diseases.** Researchers used CRISPR to develop a variety of broccoli with **even more of these beneficial substances.**

LETTUCE WITH HIGHER VITAMIN CONTENT

This genome-edited lettuce variety contains more vitamin C which makes this kind of lettuce **extra healthy.**

GRAPEVINE HIGHLY RESISTANT TO FUNGUS

This specific genome-edited grapevine variety is highly resistant to fungus. Farmers that plant this grapevine need to use **less fungicides.**

MORE TOLERANT RICE

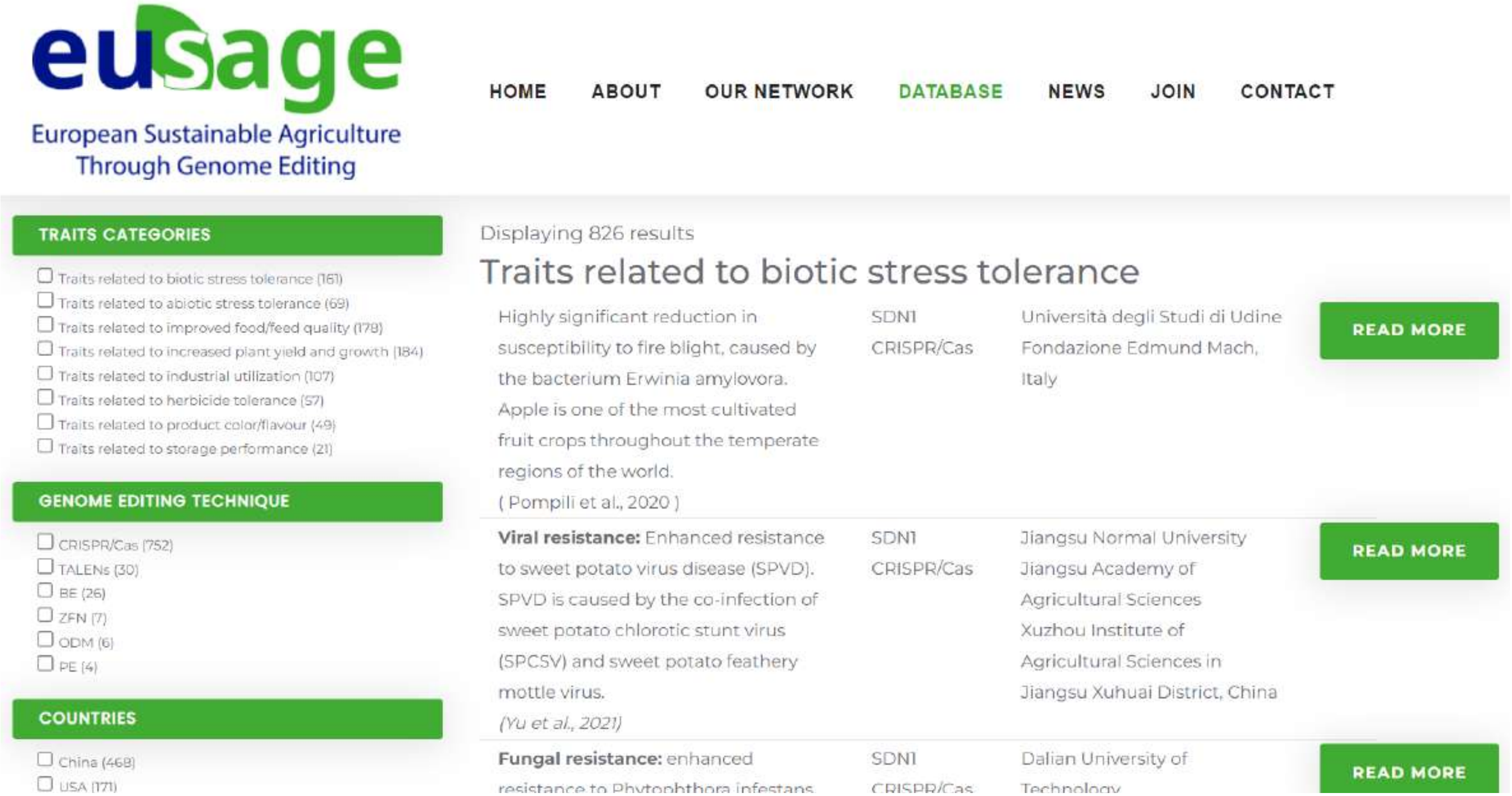
Using CRISPR, researchers developed a semidwarf type of rice.

This variety shows **better tolerance of low-nutrient conditions** and **higher resistance to pathogens and insects.**

HIGH-OLEIC SOYBEAN

This species of genome-edited soybean contain more omega-9 fatty acids, less saturated fatty acids, and no trans fats. This **aids to reduce coronary heart disease.**

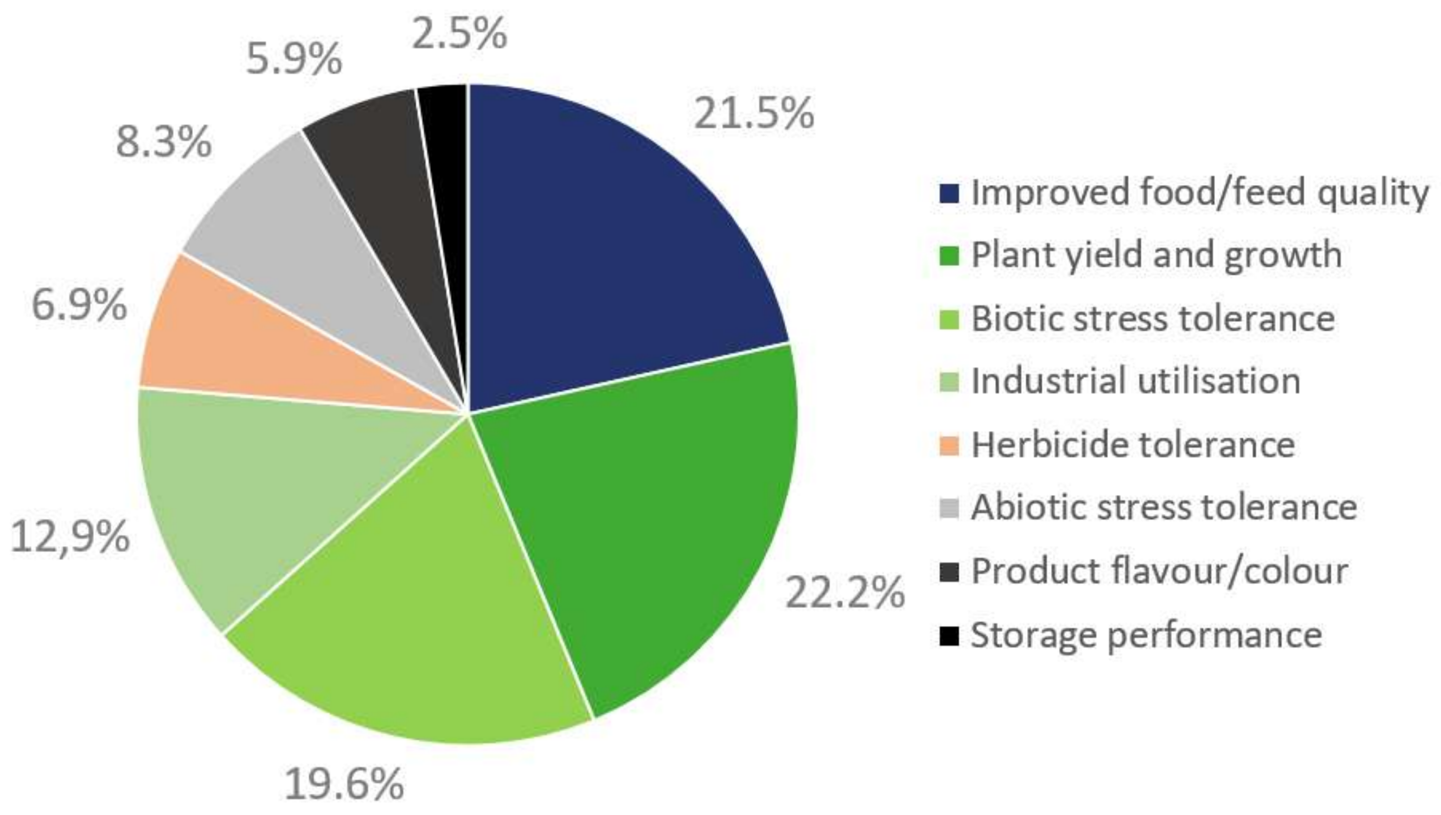
NGT is applied on large scale



www.eu-sage.eu/genome-search

- > 800 peer reviewed publications on gene editing in crops
- > 70 different crops species
- Mostly category 1-”conventional-like”- applications
- High diversity of applications with benefits for the producer and the consumer

High diversity of applications



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70 different species

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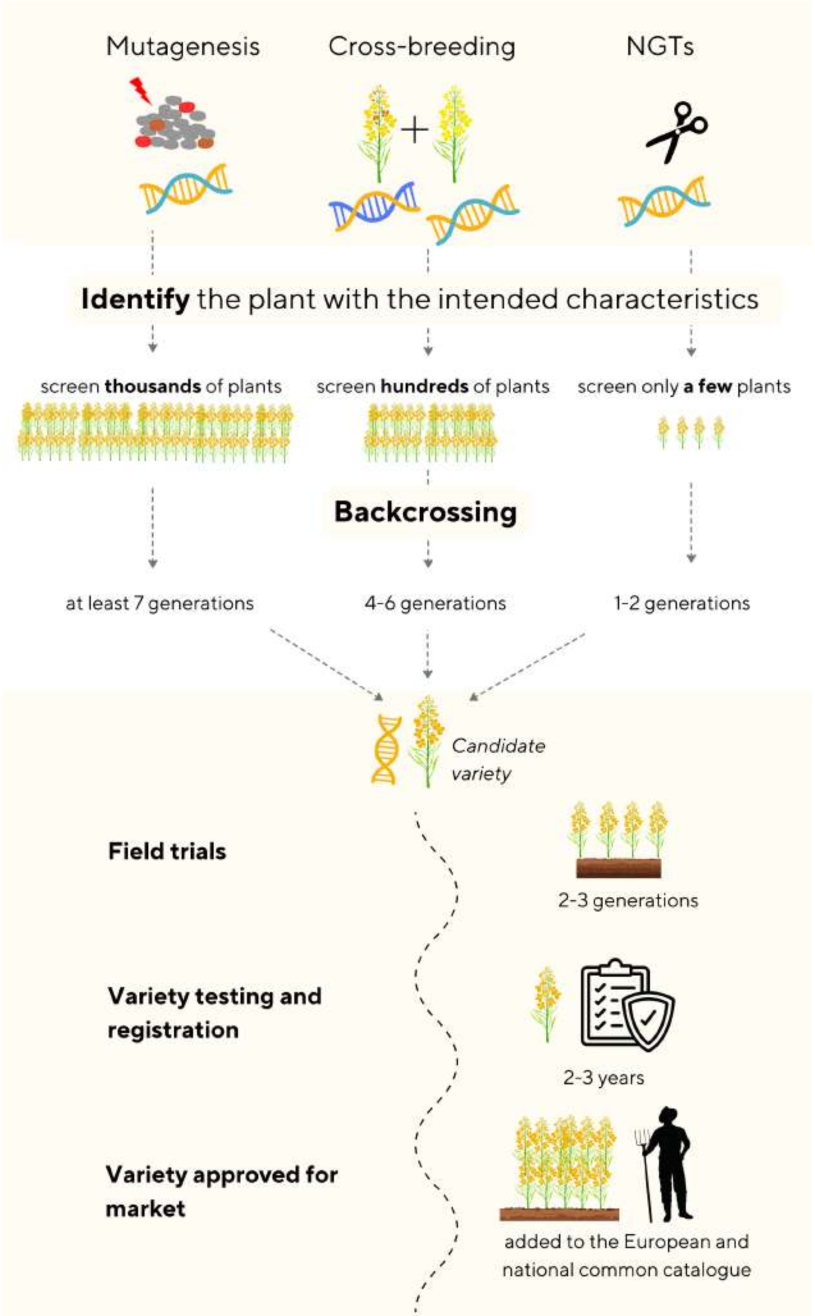
The process of bringing new varieties on the market



The legislation and its' implementation will determine if and how NGTs will be used in shaping our future agri-food systems

Thank you

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