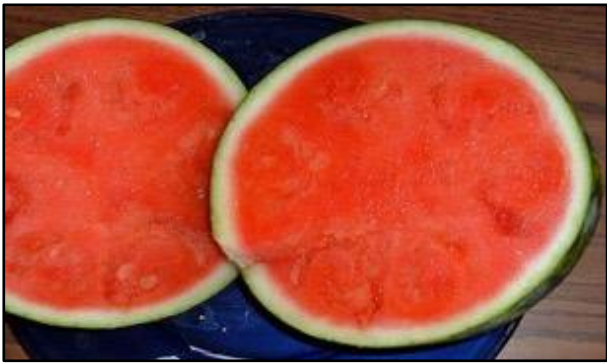
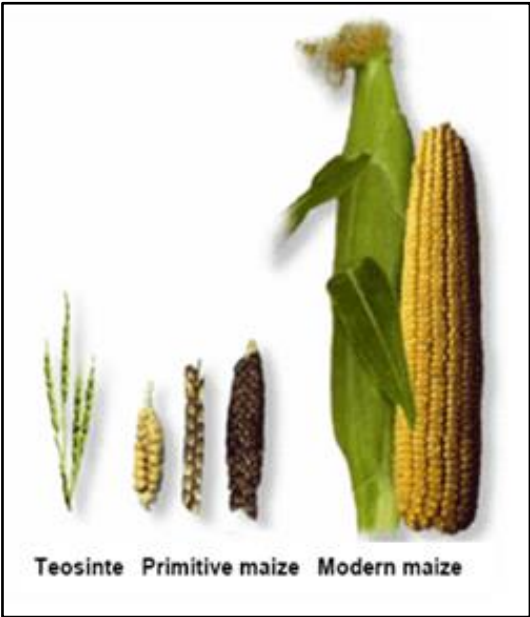
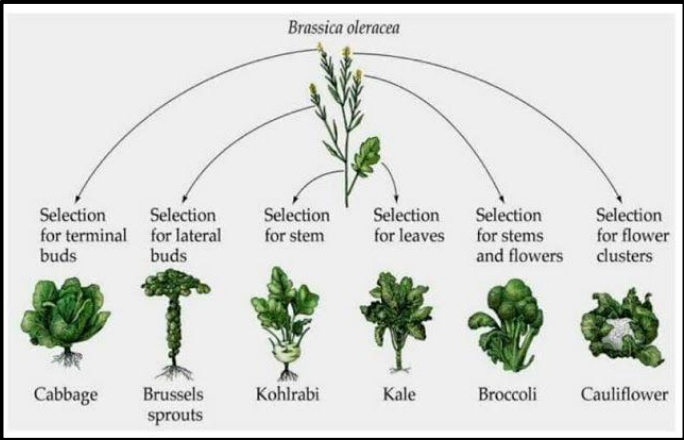


# The potential of gene editing for sustainable agriculture

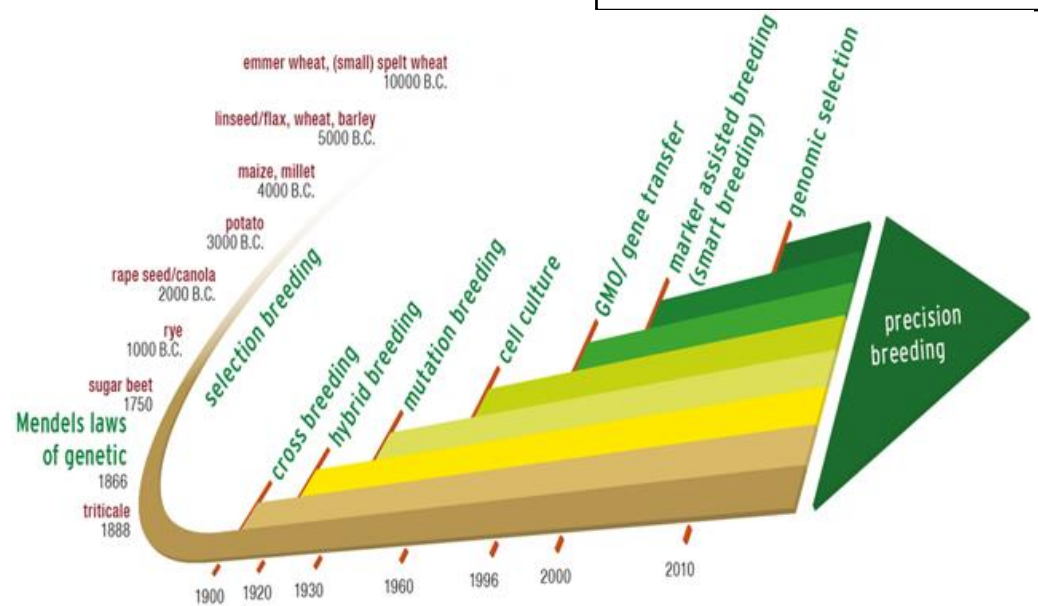
Dirk Inze

VIB-UGent Center for Plant Systems Biology

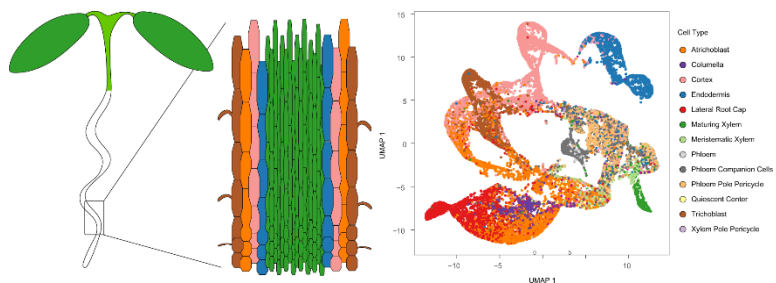
# Everything we eat is the result of plant breeding



## Milestones in Plant Breeding



# CRISPR/Cas – Gene editing – Genome editing – NGTs



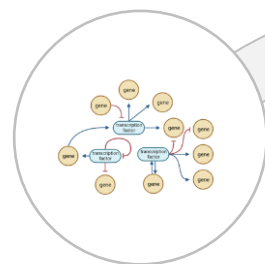
Varieties



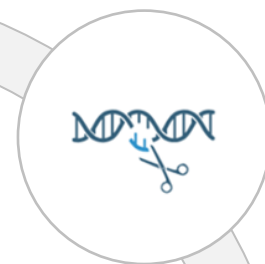
Traits



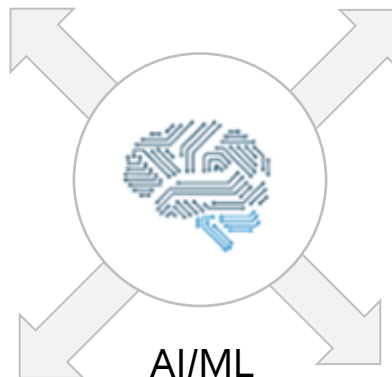
Genes  
selection



(Multiplex)  
genome editing



AI/ML  
Models



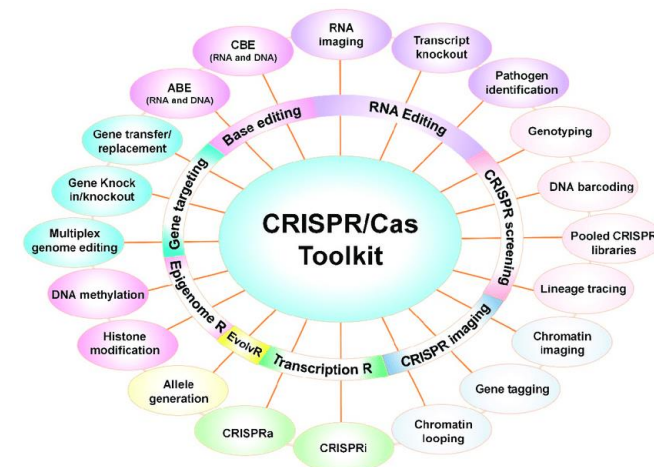
Phenotyping  
& genotyping



Breeding



Nobel Prize 2020





# Gene editing is applied on large scale



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## TRAITS CATEGORIES

- ☐ Traits related to biotic stress tolerance (149)
- ☐ Traits related to abiotic stress tolerance (66)
- ☐ Traits related to improved food/feed quality (174)
- ☐ Traits related to increased plant yield and growth (179)
- ☐ Traits related to industrial utilization (105)
- ☐ Traits related to herbicide tolerance (57)
- ☐ Traits related to product color/flavour (46)
- ☐ Traits related to storage performance (18)

## GENOME EDITING TECHNIQUE

- ☐ CRISPR/Cas (720)
- ☐ TALENs (30)
- ☐ BE (26)
- ☐ ZFN (7)
- ☐ ODM (6)
- ☐ PE (4)

## COUNTRIES

- ☐ China (444)
- ☐ USA (165)
- ☐ Japan (41)
- ☐ South Korea (34)
- ☐ France (31)

Displaying 794 results

## Traits related to biotic stress tolerance

Highly significant reduction in susceptibility to fire blight, caused by the bacterium *Erwinia amylovora*. Apple is one of the most cultivated fruit crops throughout the temperate regions of the world.  
(Pompili et al., 2020)

SDN1  
CRISPR/Cas

Università degli Studi di Udine  
Fondazione Edmund Mach, Italy

READ MORE

**Viral resistance:** Enhanced resistance to sweet potato virus disease (SPVD). SPVD is caused by the co-infection of sweet potato chlorotic stunt virus (SPCSV) and sweet potato feathery mottle virus.  
(Yu et al., 2021)

SDN1  
CRISPR/Cas

Jiangsu Normal University  
Jiangsu Academy of Agricultural Sciences  
Xuzhou Institute of Agricultural Sciences in Jiangsu Xuhuai District, China

READ MORE

**Fungal resistance:** enhanced resistance to *Phytophthora infestans*. *Phytophthora infestans* causes late blight disease, which is severely

SDN1  
CRISPR/Cas

Dalian University of Technology  
Beijing Academy of Agriculture &

READ MORE

[www.eu-sage.eu/genome-search](http://www.eu-sage.eu/genome-search)

EU-SAGE: > 150 Plant Research Centers across Europe

- > 850 peer reviewed publications on gene editing in crops
- > 70 different crop species
- High diversity of applications with benefits for the producer and the consumer

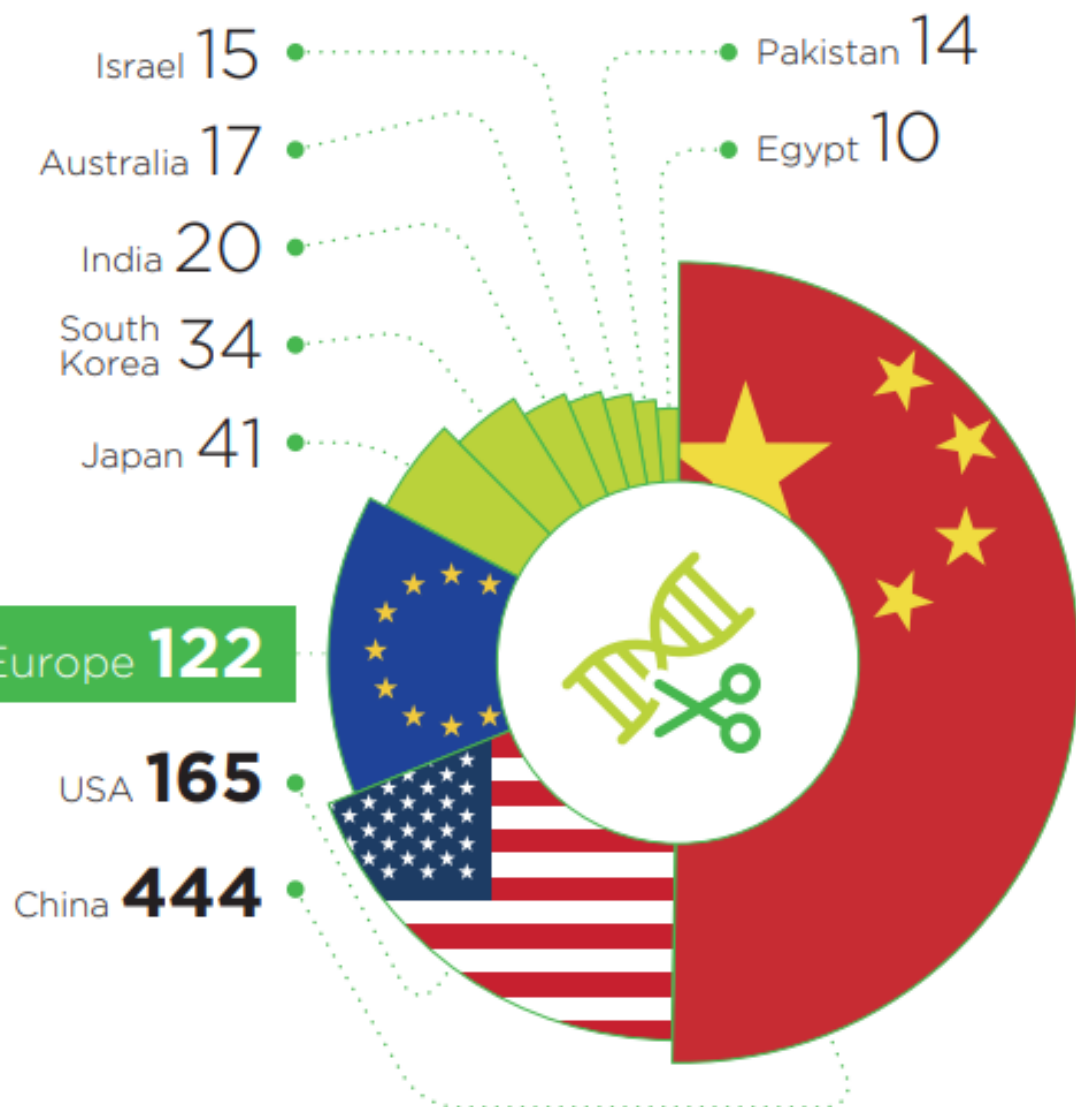
# Where does gene editing take place?

In the list of countries where most gene-editing research on plant varieties is conducted –

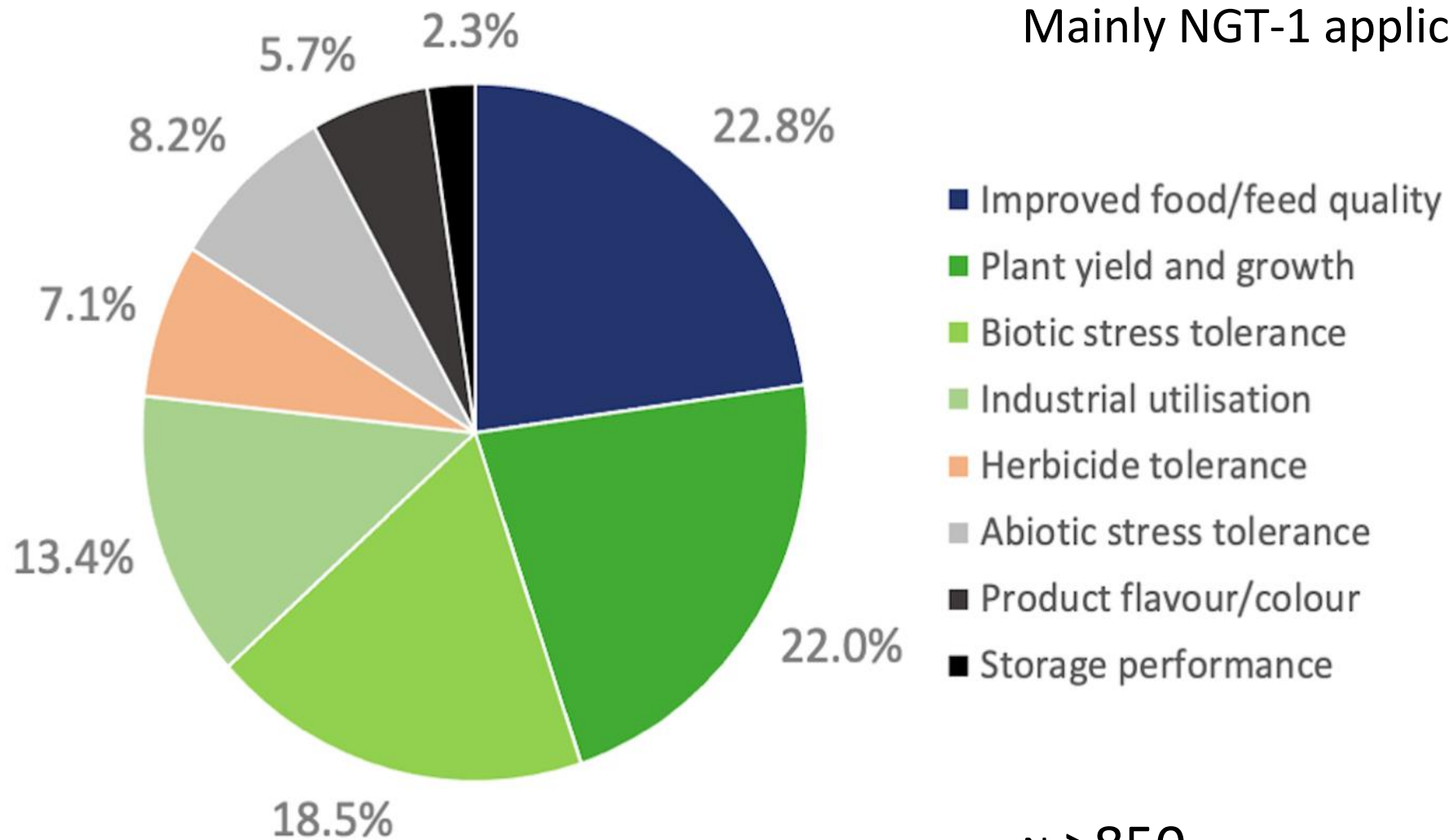


**THE TOP 5 EUROPEAN COUNTRIES COMBINED (FR, DE, IT, BE, NL) PRODUCE LESS THAN 1/3 OF THE RESEARCH COMPARED WITH CHINA (93 VS. 444) AND SLIGHTLY MORE THAN HALF THAT OF THE USA (93 VS 165)**

To ensure a resilient and competitive European agri-food sector, an enabling and science-based regulatory framework for NGTs is urgently needed to help translate innovative research into impactful commercial products.



# High diversity of applications



N >850

70 different species

# CRISPR based solutions!

- Pathogen- and pest resistant varieties: less **pesticides**
- Improved nutritional quality (eg. more unsaturated fatty acids, reduced gluten levels,...):  
**healthier food**
- Protein crops for Europe (Soya bean, Faba beans,...): **alternative protein source**
- Improved uptake of nutrients such as nitrogen: **biodiversity, less fertilizer**
- Resilience to drought and high temperatures: **food safety**
- High yields : **food security**
- Bio-energy crops (efficient CO2 capture and storage,...), **not in competition with food production**
- ....



## 43 reported field trials using gene editing in the EU, UK and Switzerland

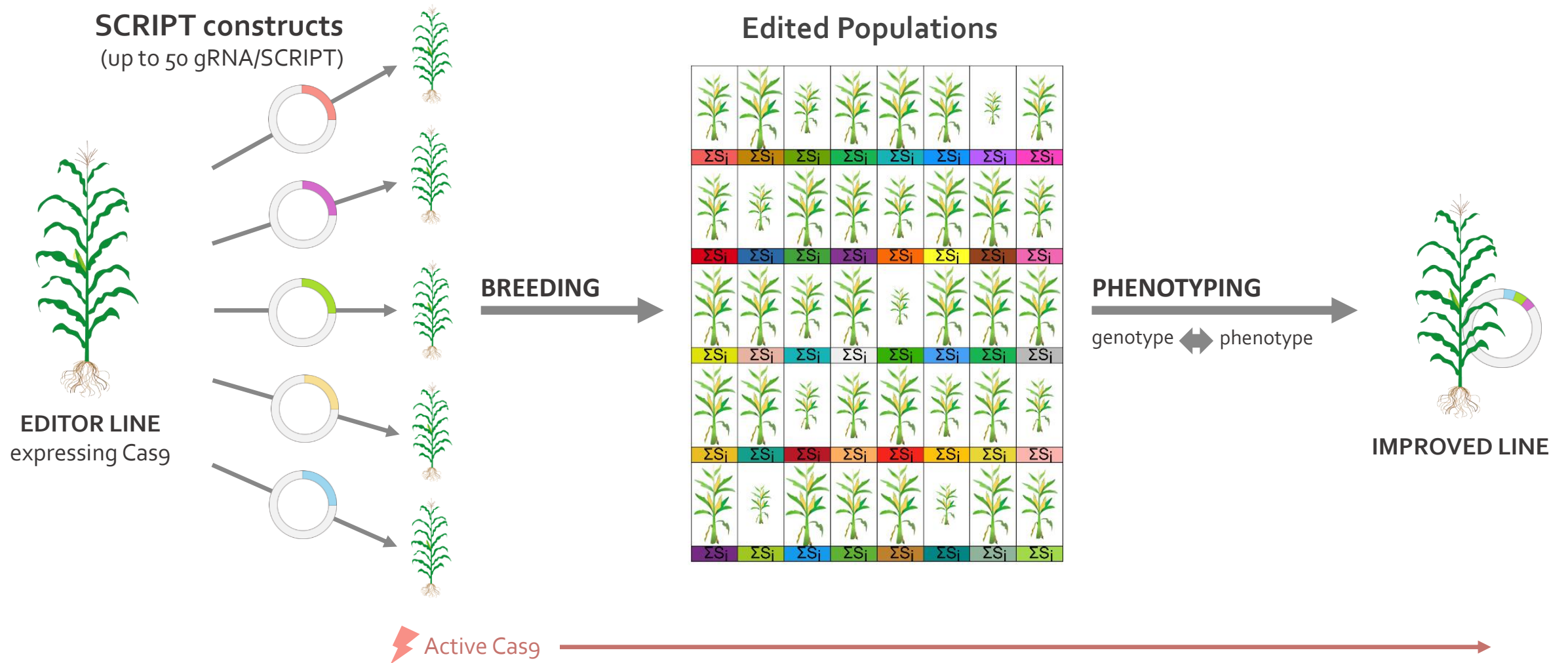
- Blight resistance in potato
- Early flowering wheat
- Improved digestibility in maize
- Enhanced yield in maize
- Increase drought tolerance in maize
- Barley with a lower requirement for nutrients
- Short stature maize
- Increased Vitamin D3 content
- Improved tomato storage time
- Eliminating tuber browning in potato
- ....



UK, Denmark,  
Belgium, Sweden,  
Italy, Switzerland,  
Spain



# BREEDIT: Multiplex gene editing and Breeding



Powerful approach to tackle complex, polygenic traits

Dirk Inze  
VIB-UGent Center for  
Plant Systems Biology



If the **future**  
could whisper,  
it would call out for

**CRISPR**

**eusage**

European Sustainable Agriculture  
Through Genome Editing