European Sustainable Agriculture Through Genome Editing

- the role of scientists in policy making -

Plant Breeding Innovation - The role of the new genomic techniques in global food security

28/09/22 – Bucharest

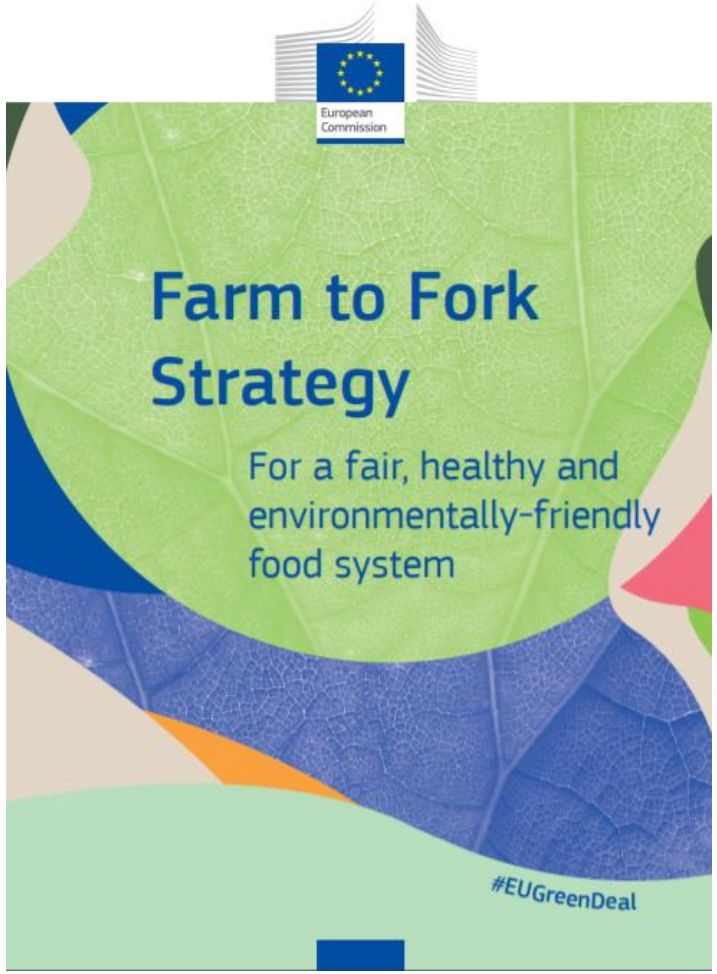
Oana Dima, Executive manager EU-SAGE

Green biotech valley in Ghent, Belgium

3950 high-tech professionals
10 university labs
7 public research centers
12 international corporate R&D centers
60 high-tech growth enterprises

Did you know that there are already more than **500** different genome-editing applications in crops published in peer-reviewed research studies?

Will genome editing be allowed to play a role in the European Green Deal?



[…] New innovative techniques, including biotechnology and the development of bio-based products, may play a role in increasing sustainability, provided they are safe for consumers and the environment while bringing benefits to society as a whole. They can also accelerate the process of reducing dependency of pesticides. In response to the request of Member States, the Commission is carrying out a study which will look at the potential of new genomic techniques to improve sustainability along the food supply chain. […]

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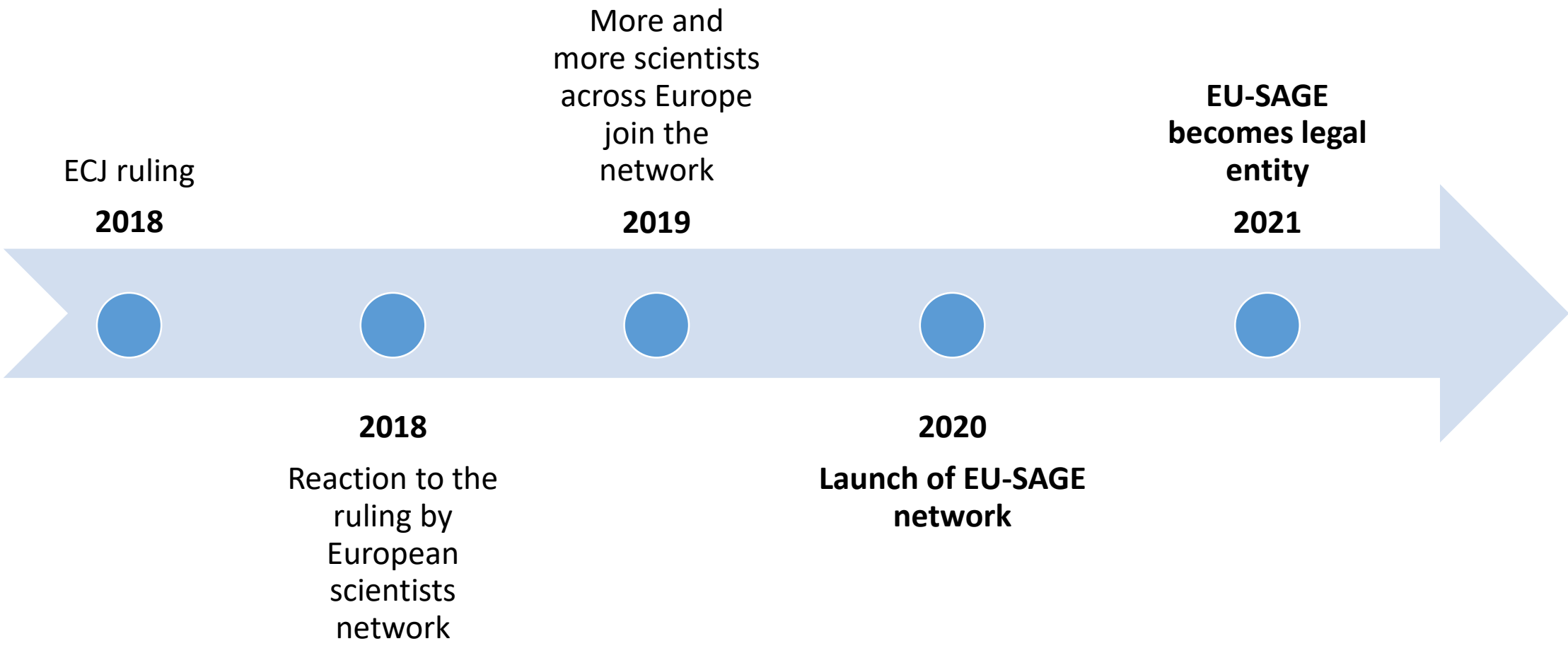
2018, when it all began

Position paper on court ruling with signatories:

„**Regulating genome-edited organisms as GMOs** has negative consequences for agriculture, society and economy.”

Prof. dr. Dirk Inzé
Science Director VIB-UGent center for Plant Systems Biology

Establishment of the EU-SAGE network

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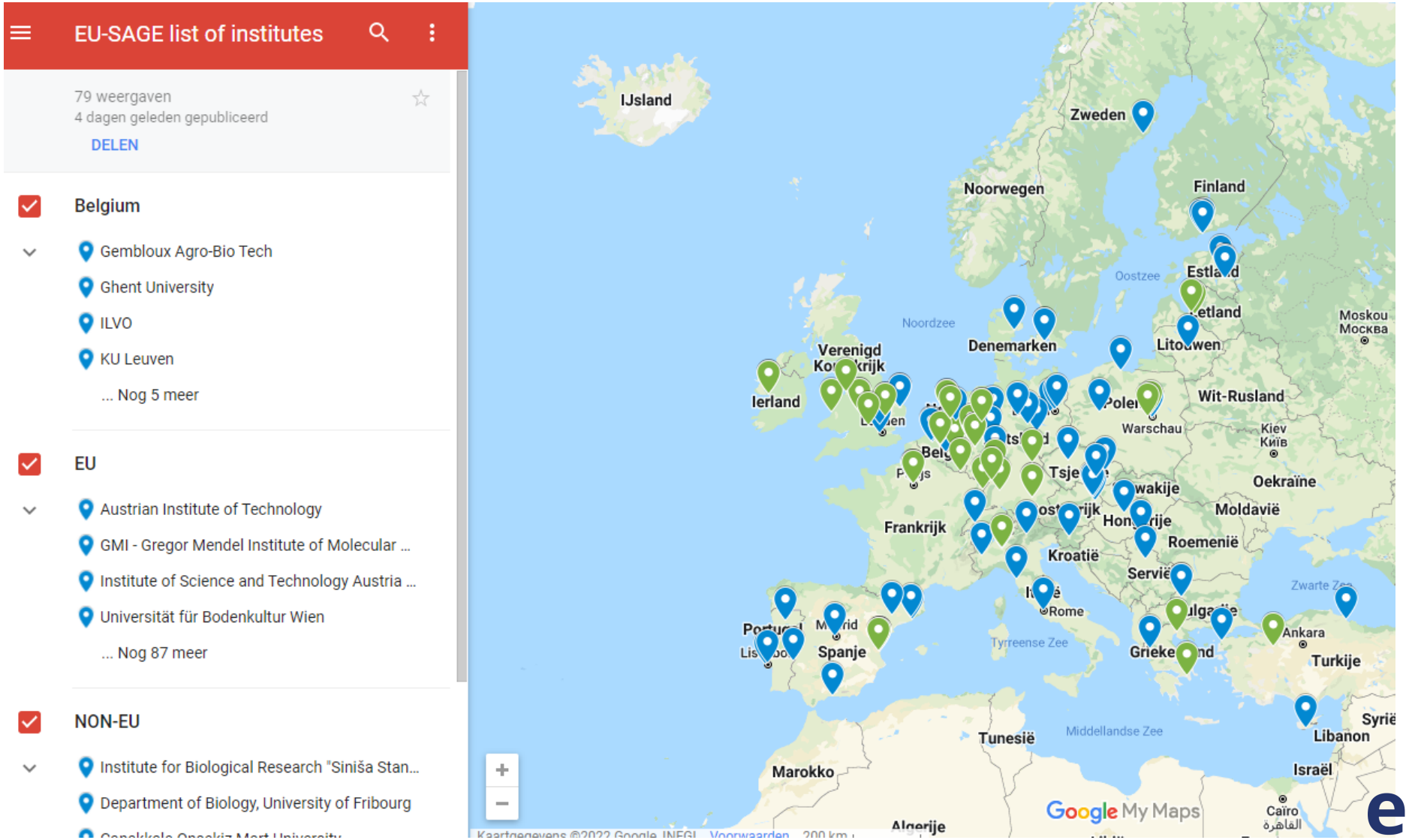
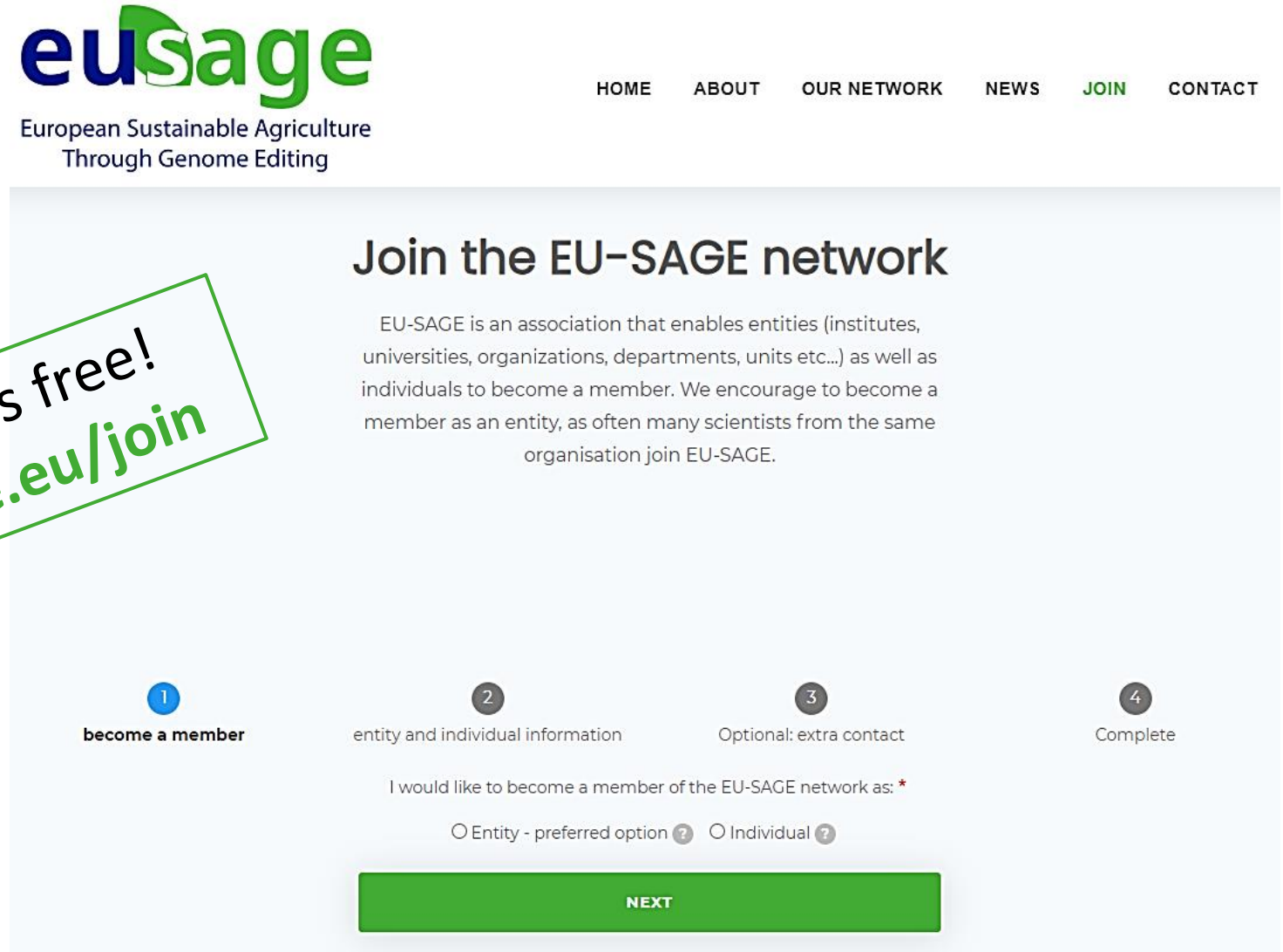
European Sustainable Agriculture
Through Genome Editing
www.eu-sage.eu
- **Represent** scientists in Europe working on genome editing
- **Advocate** the potential of genome editing for agriculture
- **Facilitate** science-based policy making

EU-SAGE has members all across Europe



EU-SAGE has 130 members from 31 countries

Membership is free!
www.eu-sage.eu/join



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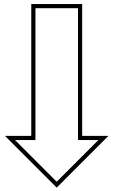
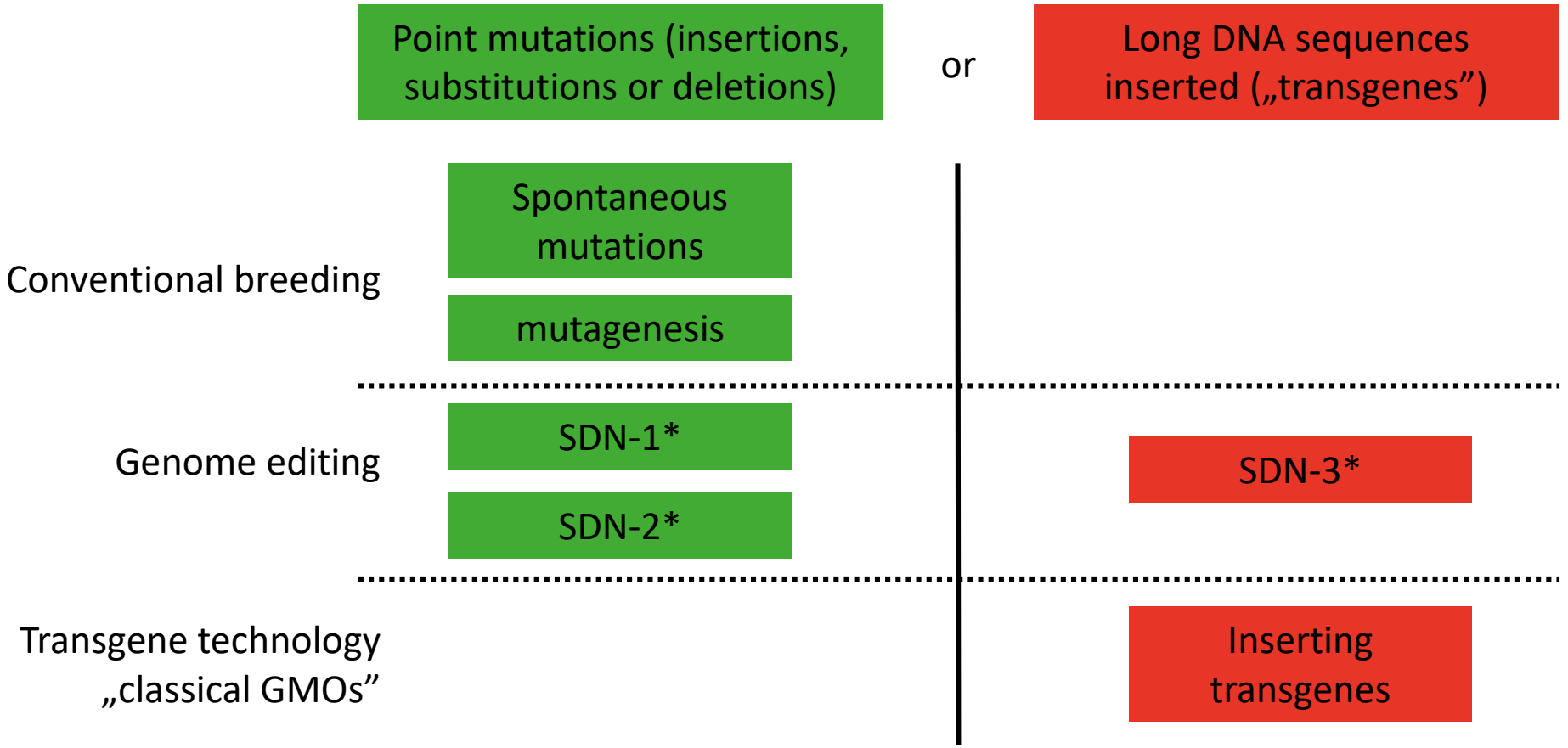
Policy aim of EU-SAGE:

„**Regulating genome-edited organisms as GMOs** has negative consequences for agriculture, society and economy."



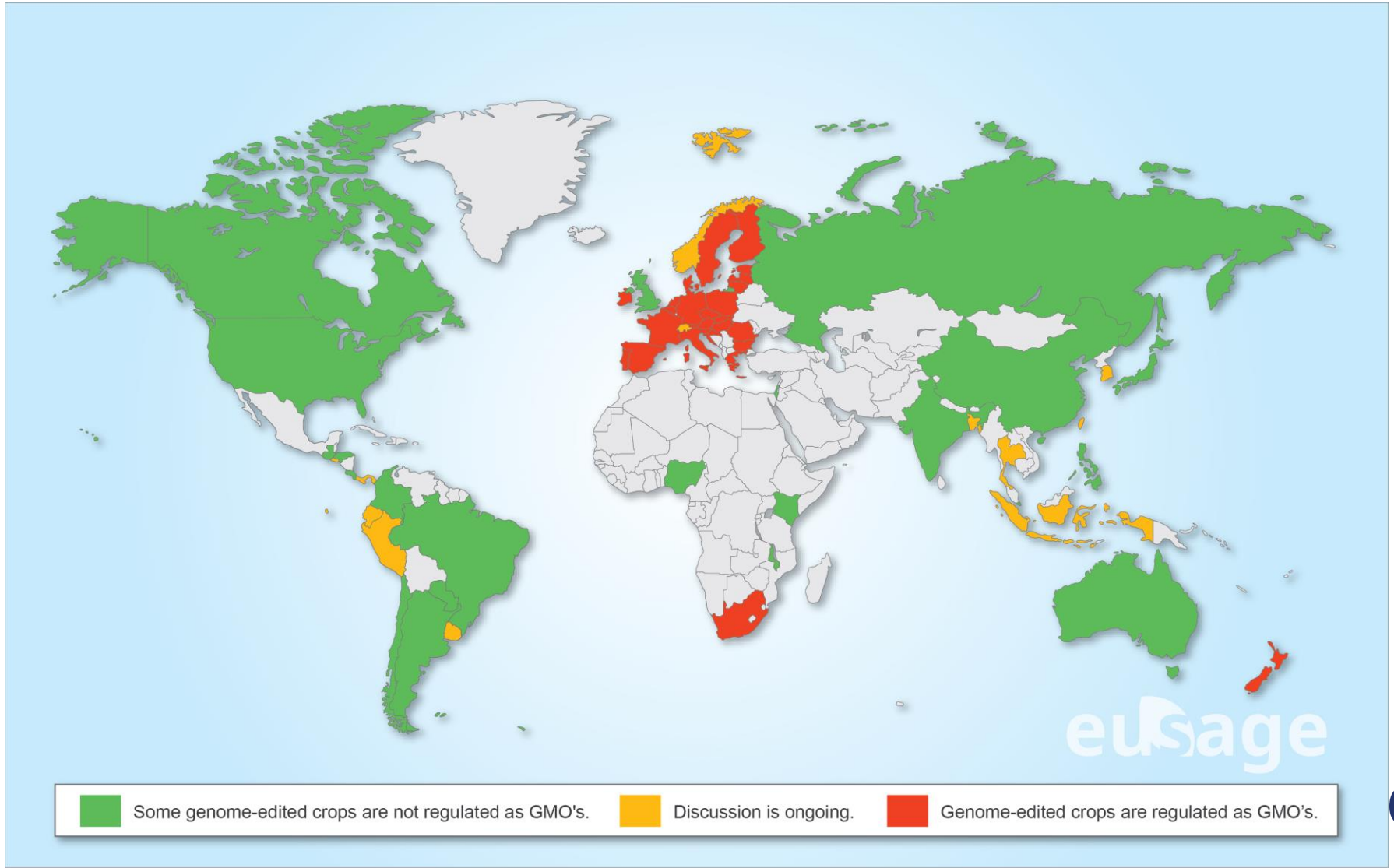
A **differentiated regulatory framework for genome edited plants** with DNA changes that also could have occurred naturally or through conventional breeding.

Genome-edited crops can be categorised according to the genetic change in the crop



***SDN**: genome editing with **S**ite-**D**irected **N**ucleases e.g. CRISPR

There is currently **no differentiated approach** for the regulation of genome-edited crops in EU



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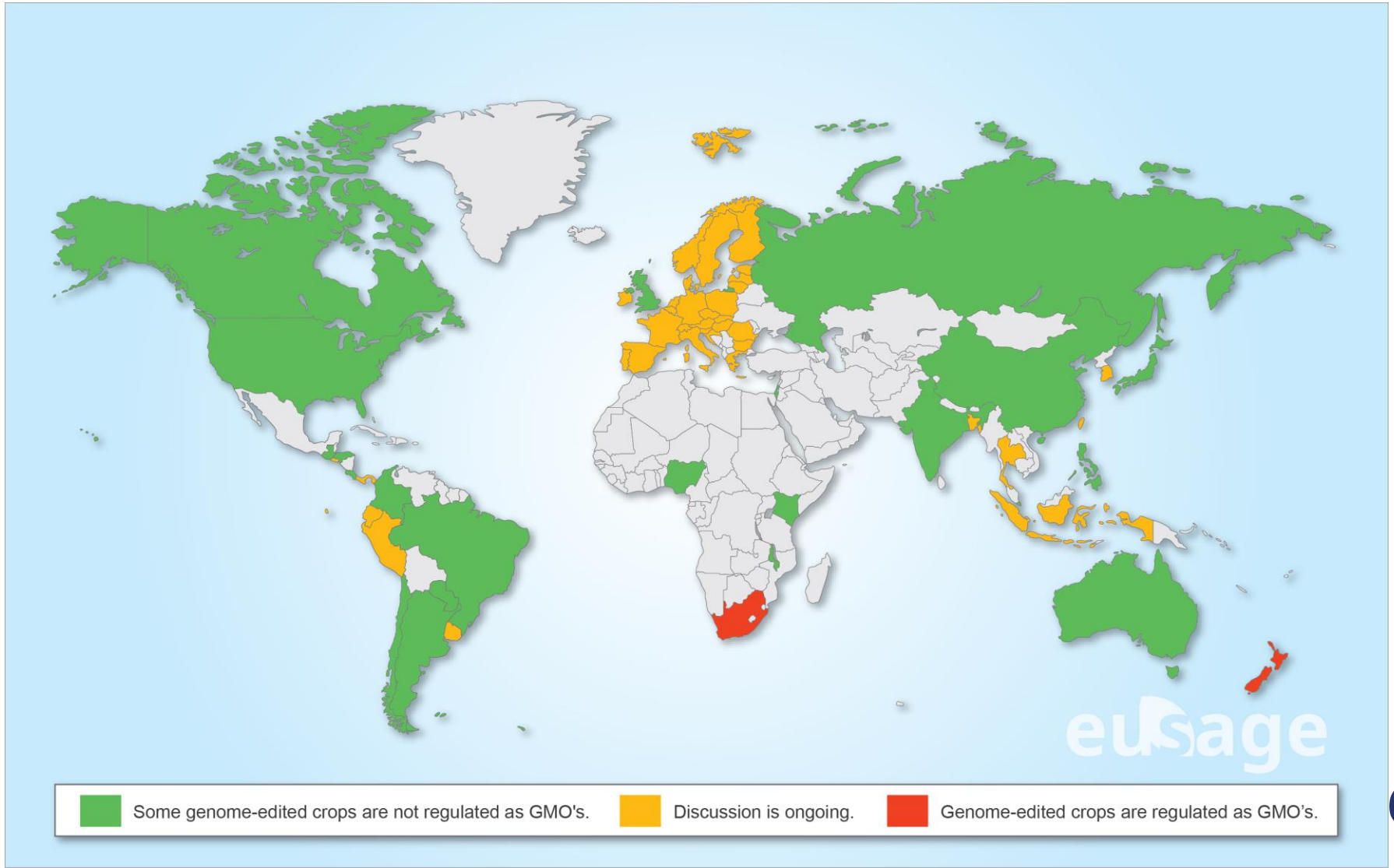

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Past policy developments in EU

Court ruling

2018

EU Council request to the Commission for a study on NGTs

2019

2020

Launch of EU-SAGE network and recognised stakeholder for contribution to the Commission study

Publication of Commission study on NGTs + policy proposal for legislative change

2021

April 29, 2021: publication of the European Commission study

Study methodology

The study has been performed by the Commission and includes external contributions via a targeted consultation.

The study was supported by:

- An overview from the European Food Safety Authority
- Two reports from the Commission's Joint Research Centre (technology landscape and current and future applications)

In addition, it took into account expert opinions from:

- Group of Chief Scientific Advisors
- European Network of GMO Laboratories
- European Group on Ethics in Science and New Technologies

Main outcomes of the European Commission study on NGTs

- Organisms obtained by new mutagenesis techniques that have appeared or have been mostly developed **since the adoption of Directive 2001/18** are GMOs and subject to the provisions od the GMO legislation

- Policy action on plant products derived **from targeted mutagenesis and cisgenesis** aimed at proportionate regulatory oversight

- NGTs, especially those based on CRISPR, are increasingly used in all sectors. **By 2030 a significant amount of NGTs is expected to be on the market**

Genome-edited plants released on the market:

High-oleic soy bean in the US

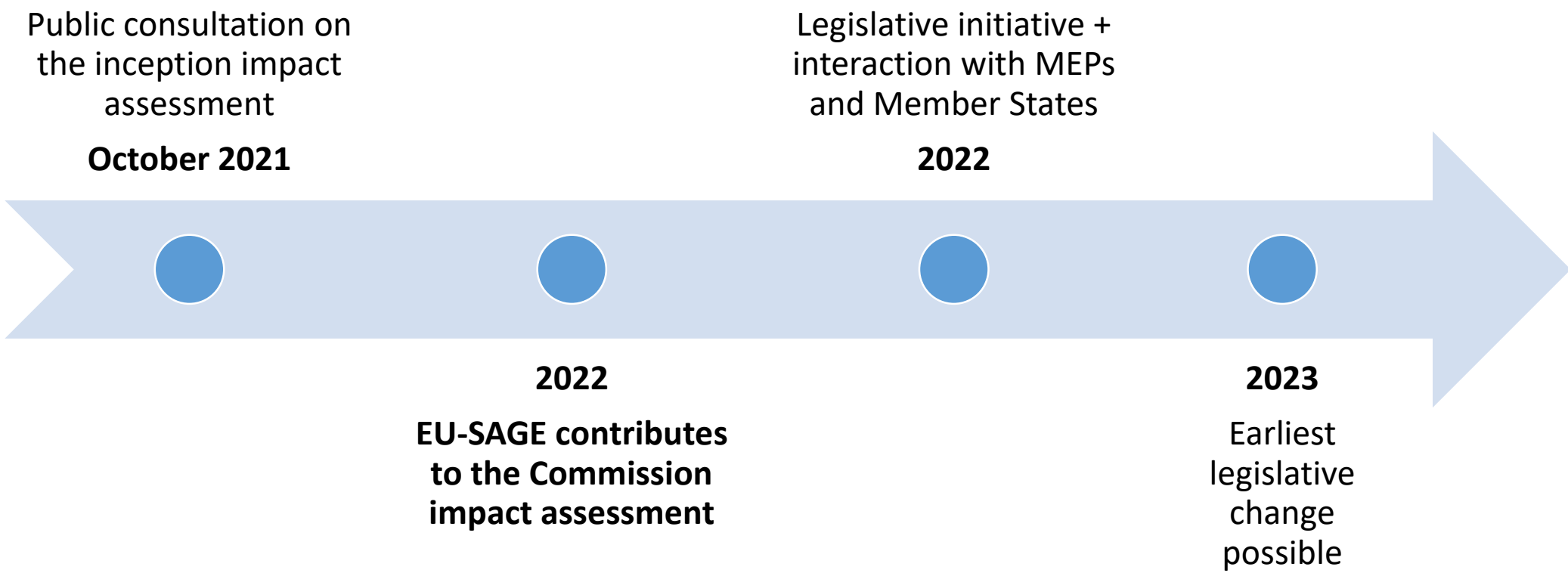
> more stable frying oil

> no trans fatty acids: healthier fried food

GABA-enriched tomato in Japan

> GABA lowers blood pressure: health benefit

Upcoming policy developments related to the legal initiative for plants targeted mutagenesis/cisgenesis



EU-SAGE database facilitates science-based policy making on state-of-the-art information

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N = 521

TRAITS CATEGORIES

- ☐ Traits related to improved food/feed quality (124)
- ☐ Traits related to increased plant yield and growth (116)
- ☐ Traits related to biotic stress tolerance (92)
- ☐ Traits related to industrial utilization (75)
- ☐ Traits related to herbicide tolerance (45)
- ☐ Traits related to abiotic stress tolerance (31)
- ☐ Traits related to product color/flavour (26)
- ☐ Traits related to storage performance (12)

Displaying 521 results

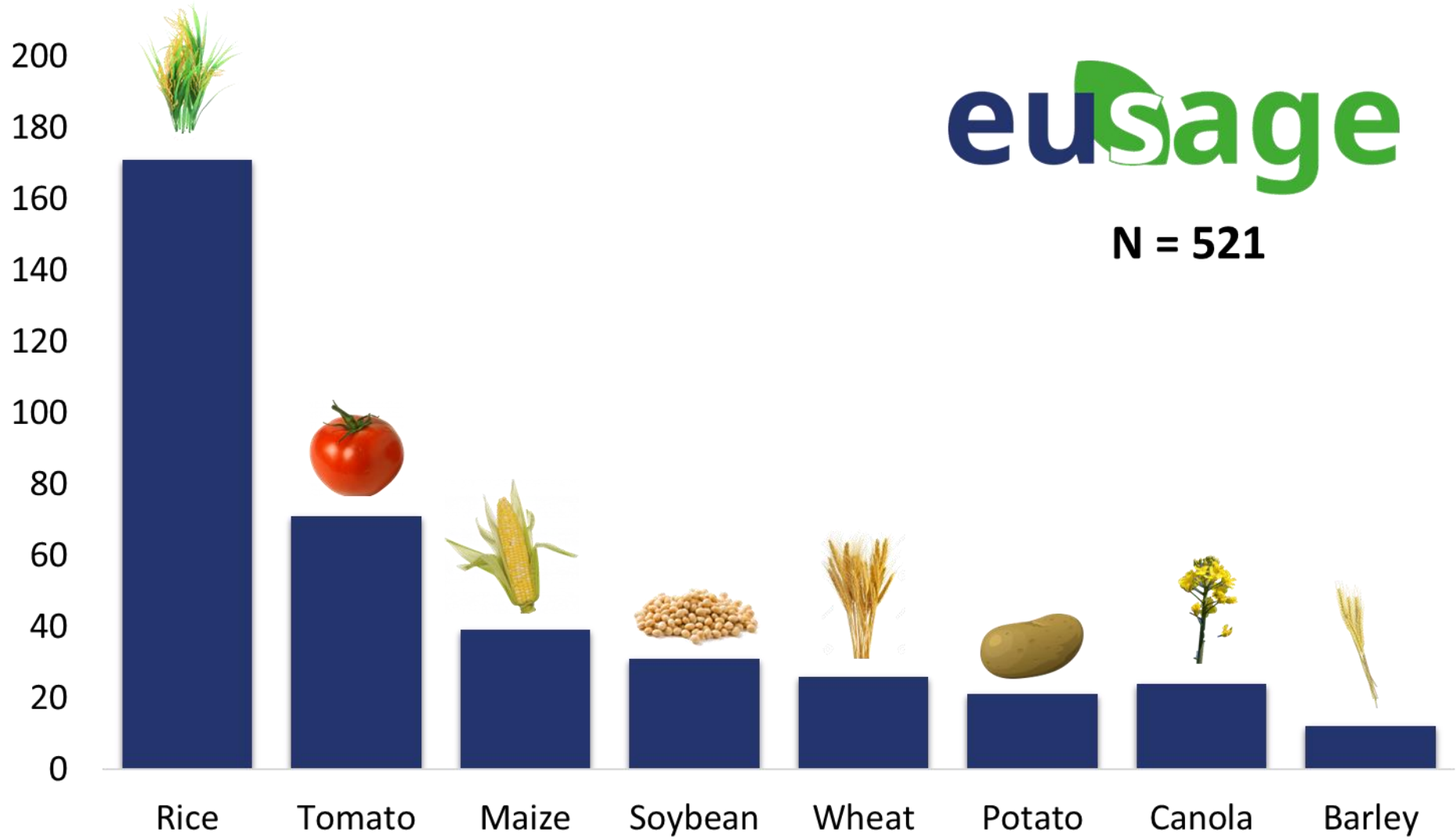
Traits related to industrial utilization

Male sterility. Important genetic resources for commercial hybrid seed production. (Zhang et al., 2021)	SDN1 CRISPR/Cas	Chinese Academy of Agricultural Sciences,	READ MORE
Manipulation of flowering time to develop cultivars with desired maturity dates. Stabilization of flowering time and period supports efficient mechanised harvesting. (Ahmar et al., 2021)	SDN1 CRISPR/Cas	Huazhong Agricultural University, China	READ MORE
Generating male sterility lines (MLS). Using MLS in hybrid seed production for monoclinous crops reduces costs and ensures high purity of the varieties because it does not produce pollen and has exserted	SDN1 CRISPR/Cas	University of Science and Technology Beijing, China Beijing Solidwill Sci-Tech Co. Ltd, China	READ MORE

Design of the EU-SAGE database:

- Literature search in bibliographic databases
- Peer-reviewed articles in English were screened
- A research article on any crop developed for agricultural production as a result of a genome editing was selected for the database
- Patents were not screened because inventions are far upstream of potential marketing

Genome editing is used in a wide variety of crops



Genome editing applications in crops bring benefits for producers and/or consumers

Trait category		Trait category explanation
Improved food/feed quality	**24%**	Modified composition of components such as vitamins, toxic substances, starch, oil, proteins, fibres, allergens, etc. to improve nutritional value.
Plant yield and growth	**22%**	Increased yield related to photosynthetic efficiency, to fruit size or weight or to increased number of flowers, seeds and fruits. Improved plant architecture, for example plant height and shape, growth pattern and fruit shapes.
Biotic stress tolerance	**18%**	Resistance to plant diseases caused by bacteria, viruses, fungi, pests, pathogens, or nematodes.
Industrial utilisation	14%	Applications of industrial interest such as breeding tools, bio-fuel production, nitrogen use efficiency etc.
Herbicide tolerance	9%	Tolerance of plants to various types of herbicides.
Abiotic stress tolerance	6%	Resistance to abiotic stress factors such as drought, heat, cold, salt, water excess and UV radiation.
Product flavour/colour	5%	Modified flavour or colour.
Storage performance	2%	Improvement of storage characteristics such as increased shelf-life, altered storage requirements, non-browning properties and reduced black spots.

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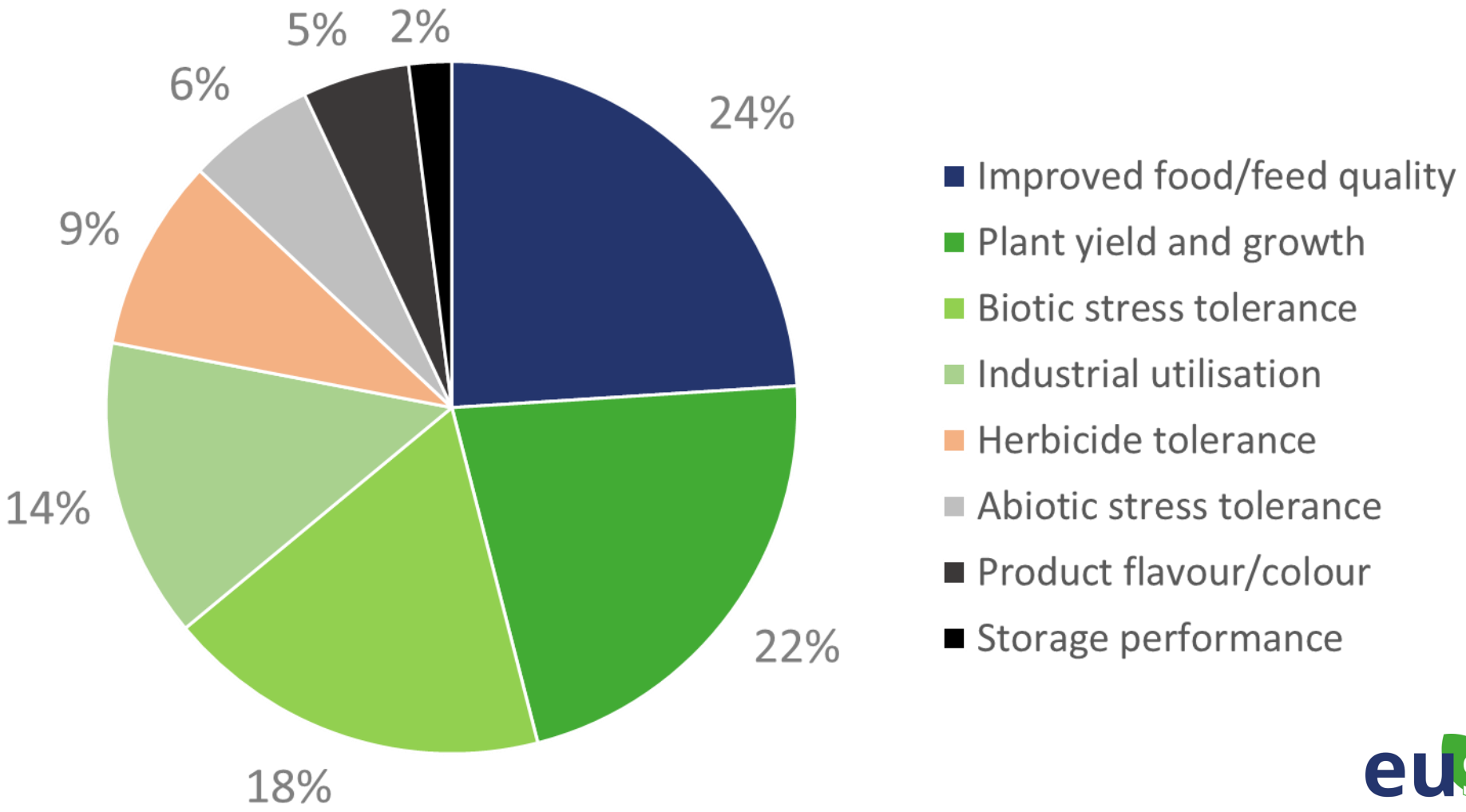

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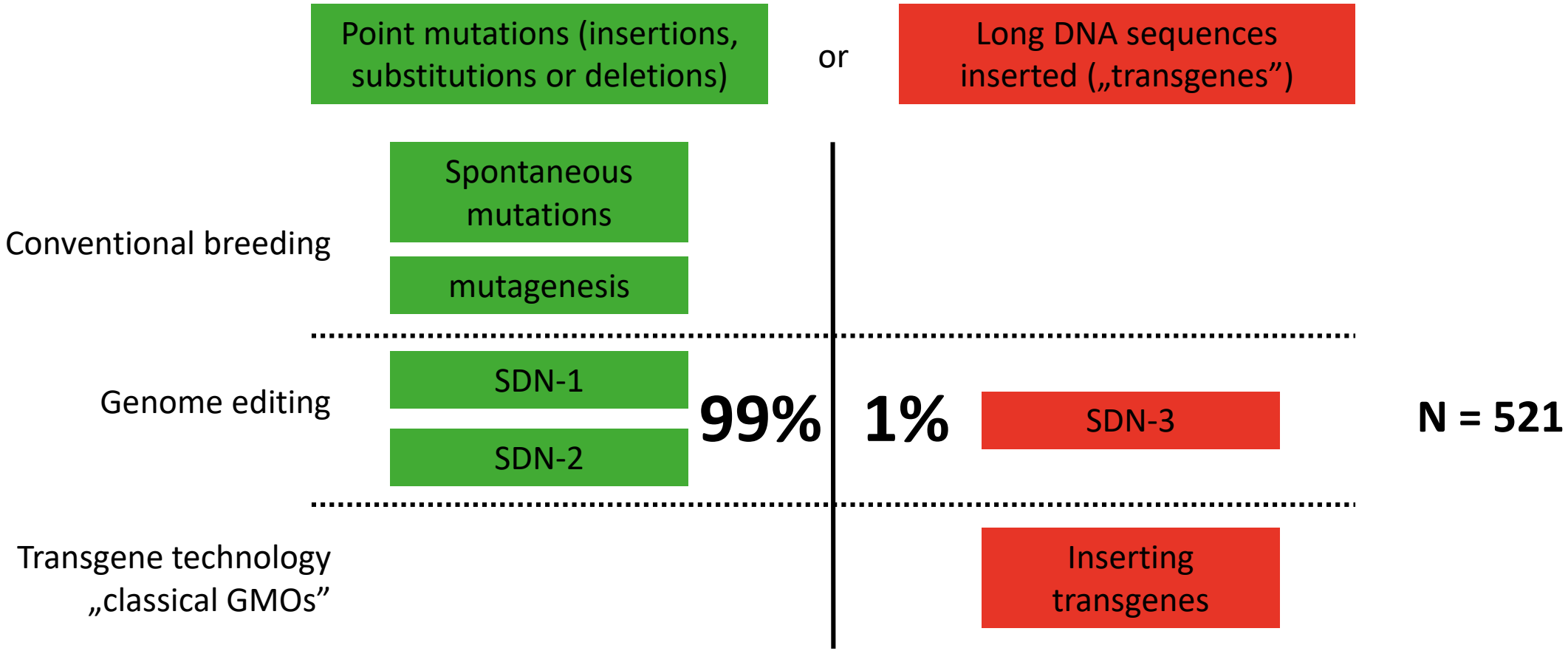
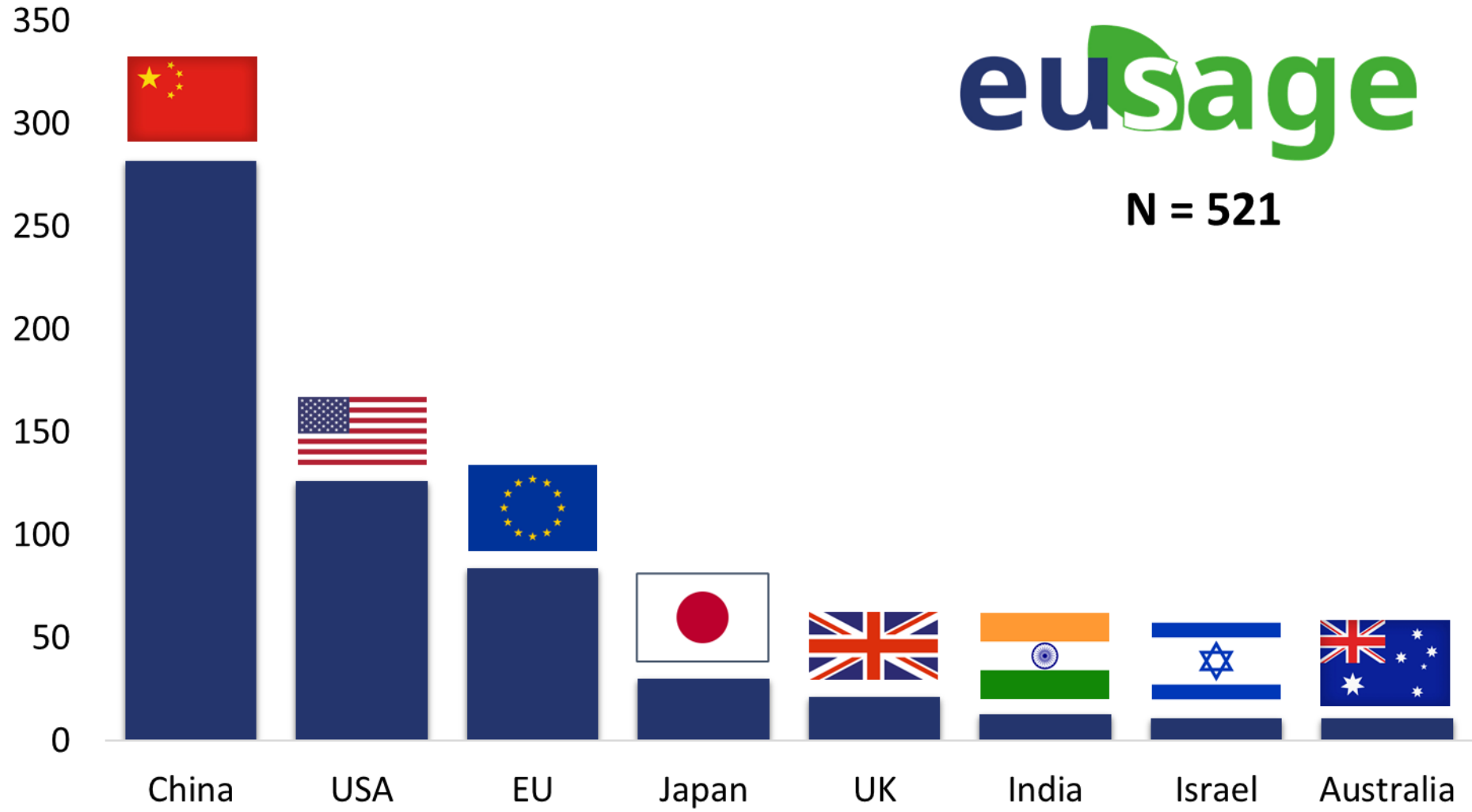
Most of the genome-edited crops have mutations or SDN1/2 small genetic changes



The EU is lagging behind in the development of genome-edited crops compared to China and USA



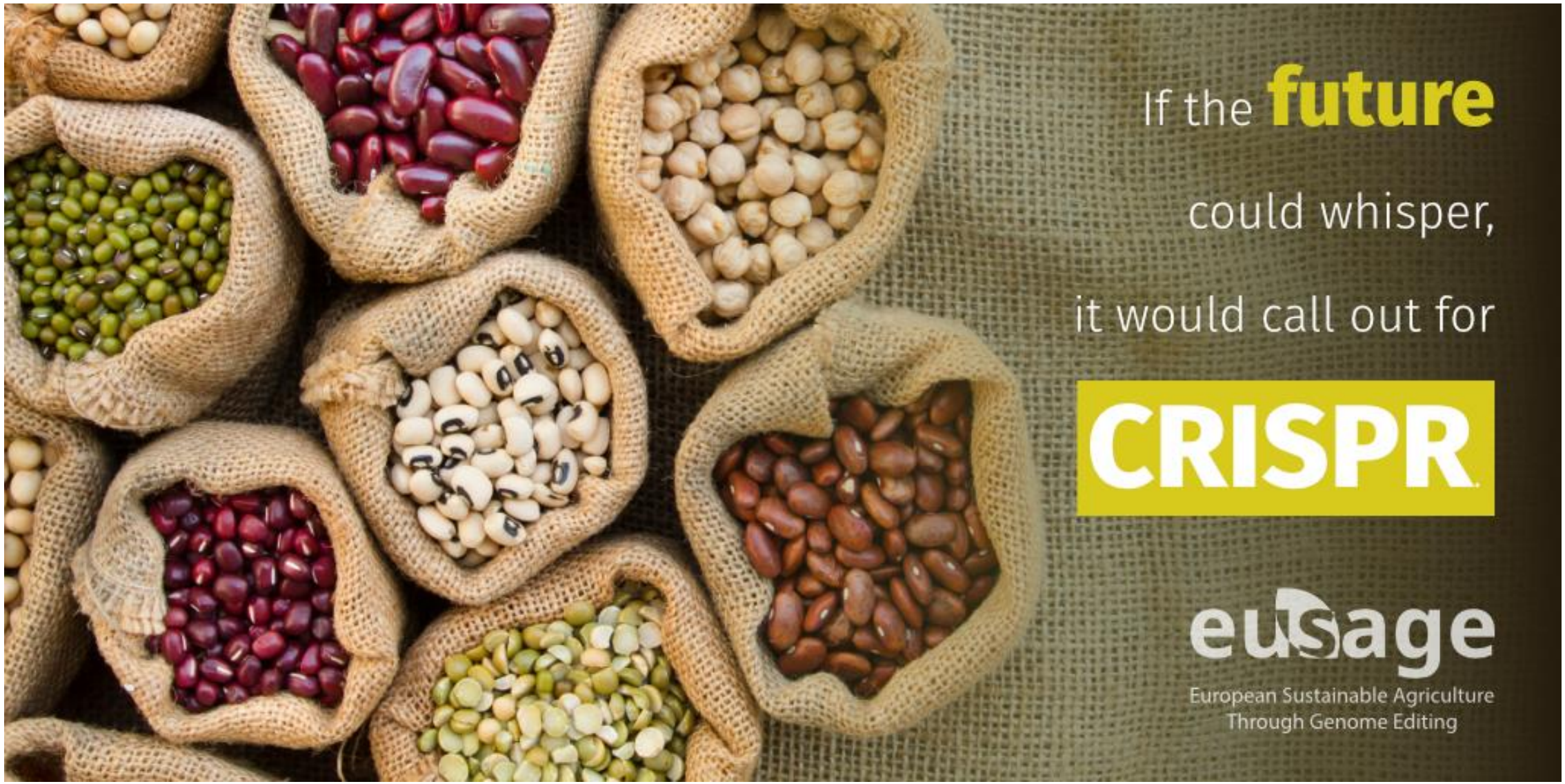
Main conclusions of the database:

- Genome editing applications were identified in **63 different crops** with the vast majority in rice, tomato, maize, soybean, and wheat
- The traits of the crops are diverse and relevant for **farmers** (e.g., agronomic value) as well as **consumers** (e.g., nutrition)
- Most of the genome editing applications are crops with targeted, **small genetic changes** (which belong to SDN-1 category).
- The applications in the database demonstrate that genome editing can contribute to the **‘EU Green Deal’ and the ‘Farm to Fork’ strategy**

Will the EU follow the same path as the UK?

Genome edited vitamin D tomato

Wild-type tomato



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