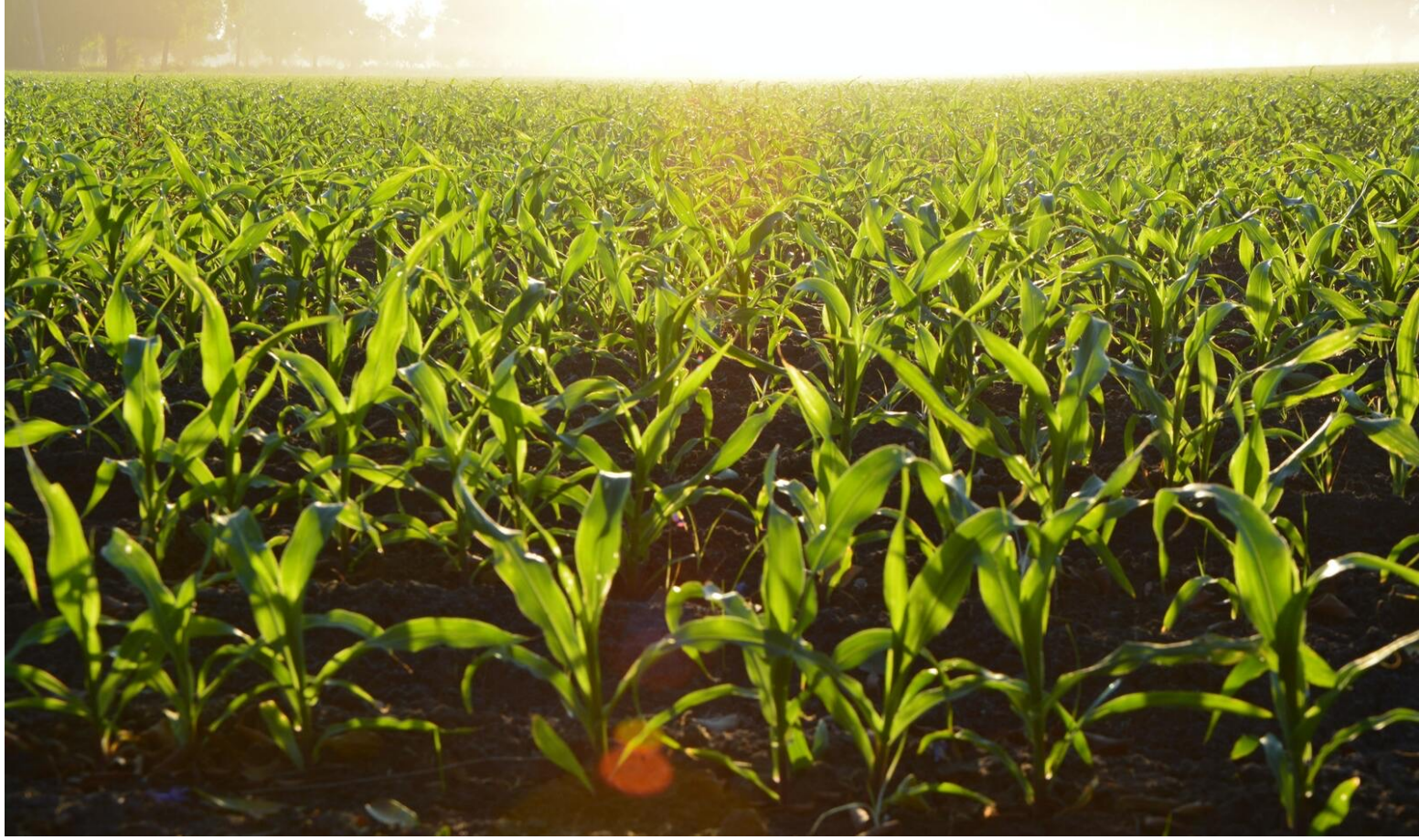
Editing genomico in mais nel solco di un agricoltura rigenerativa

Serena Varotto



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L’agricoltura rigenerativa ha bisogno di varietà appositamente selezionate

Genome editing

Selezione assistita da marcatori

Linee transgeniche

Mutagenesi

Miglioramento genetico mediante incroci

Domesticazione

12,000 B.C.

12,000 B.C. 1900 1930 2000

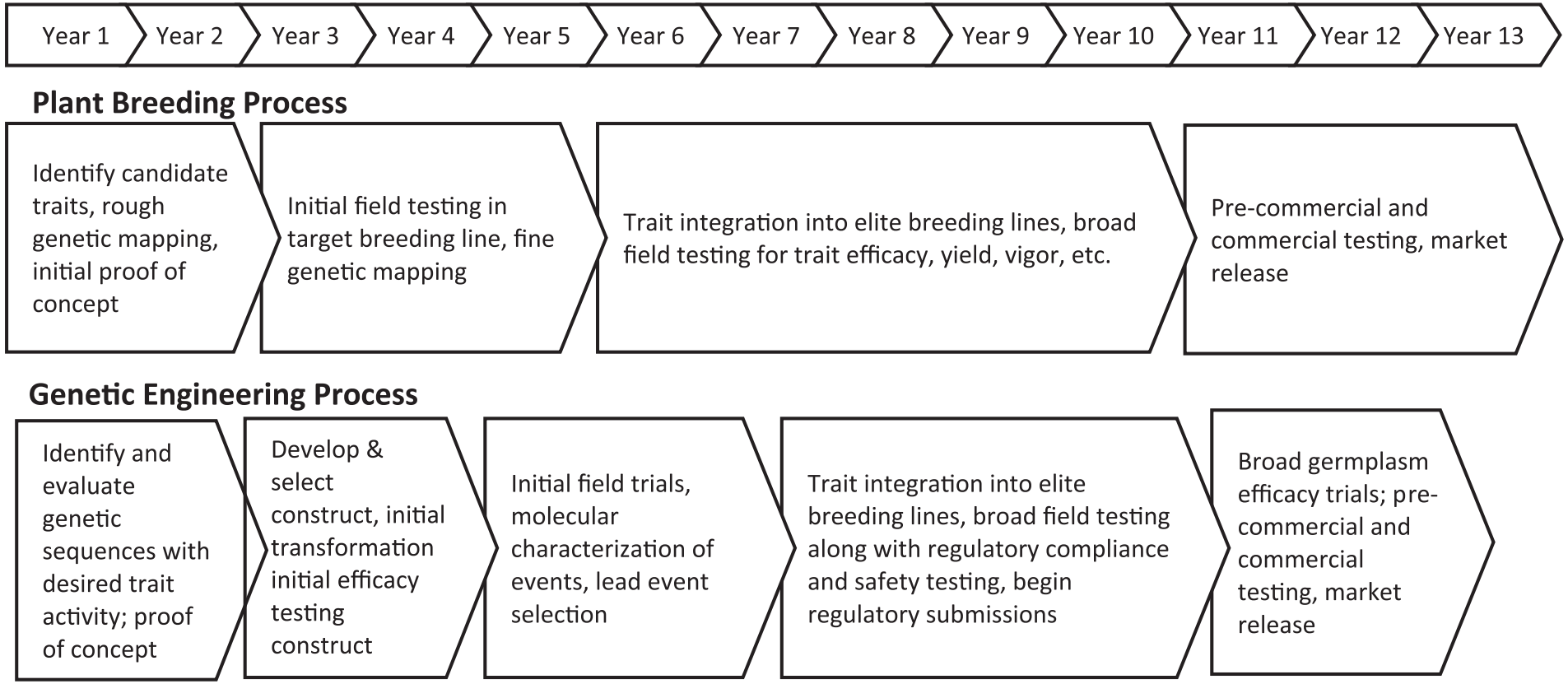
Coltura in vitro di espianti vegetali

The first transgenic crop released in 1994

The first genome-edited crop released in 2019

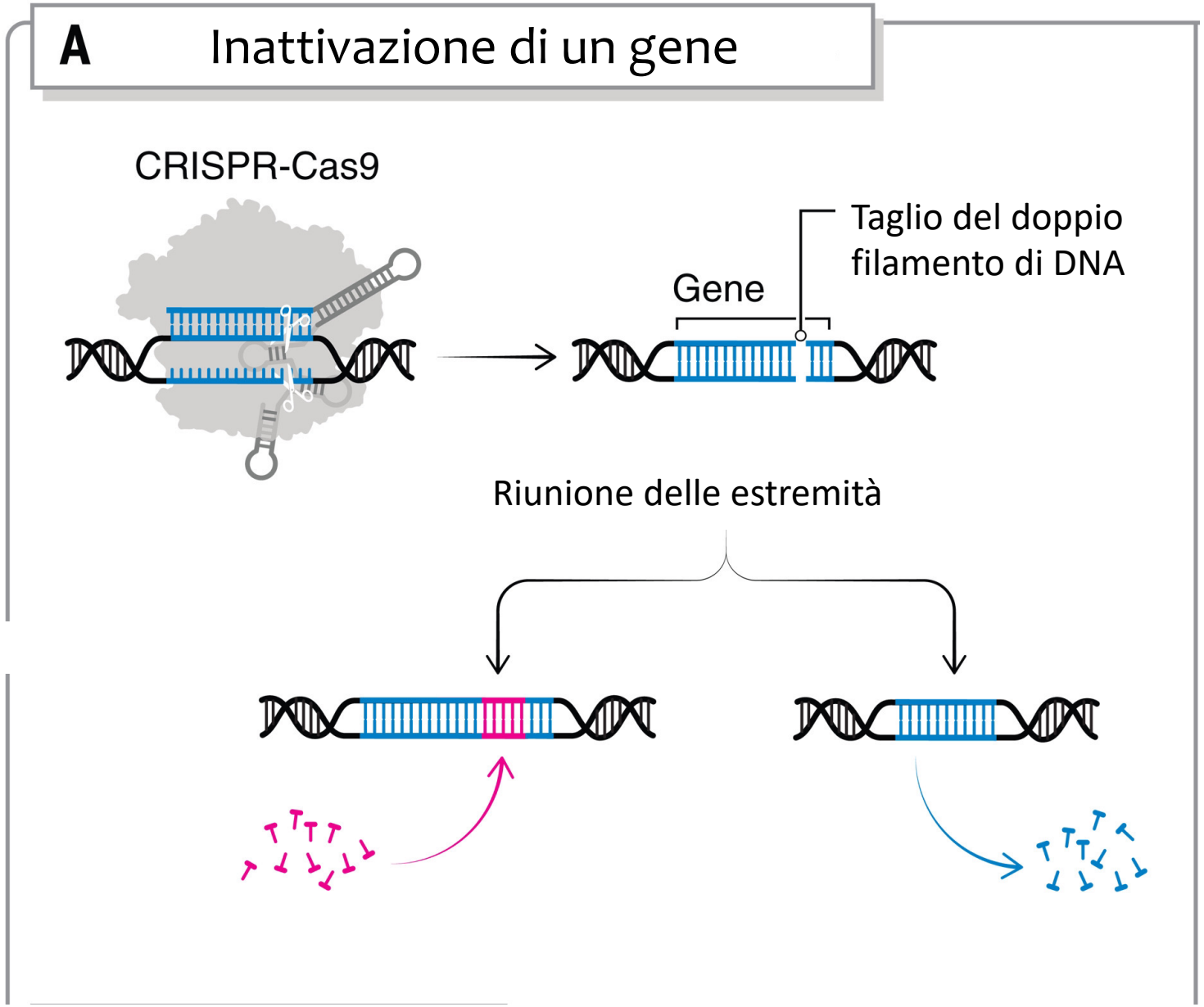
Domesticazione

Genetica Mendeliana



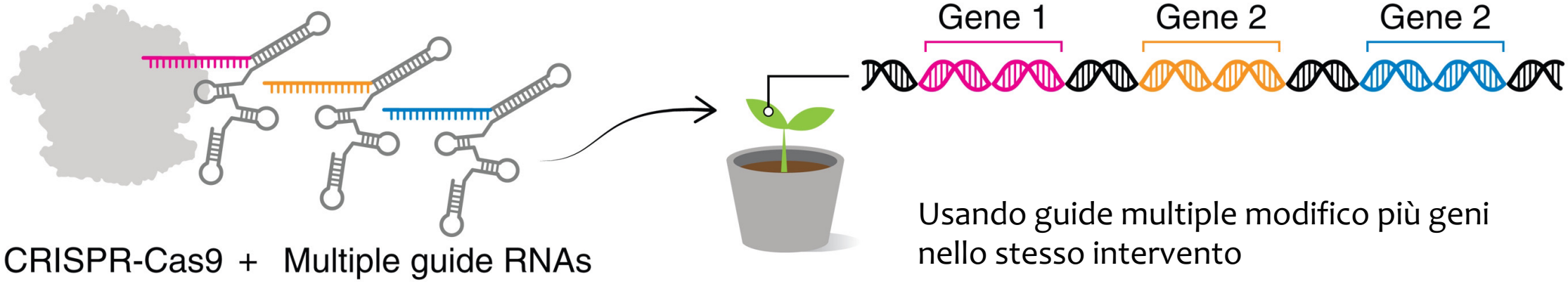
Crop improvement process through plant breeding & genetic engineering

The Plant Genome DOI: 10.1002/tpg2.20248



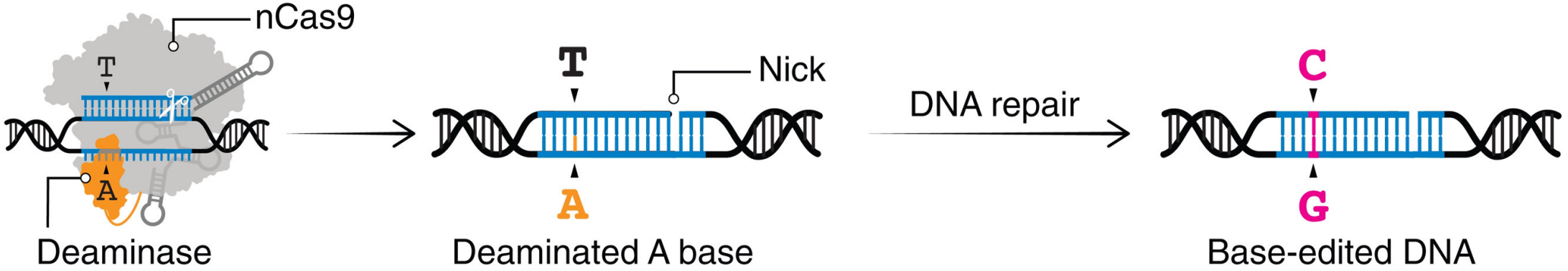
Inserzione o delezione di un nucleotide

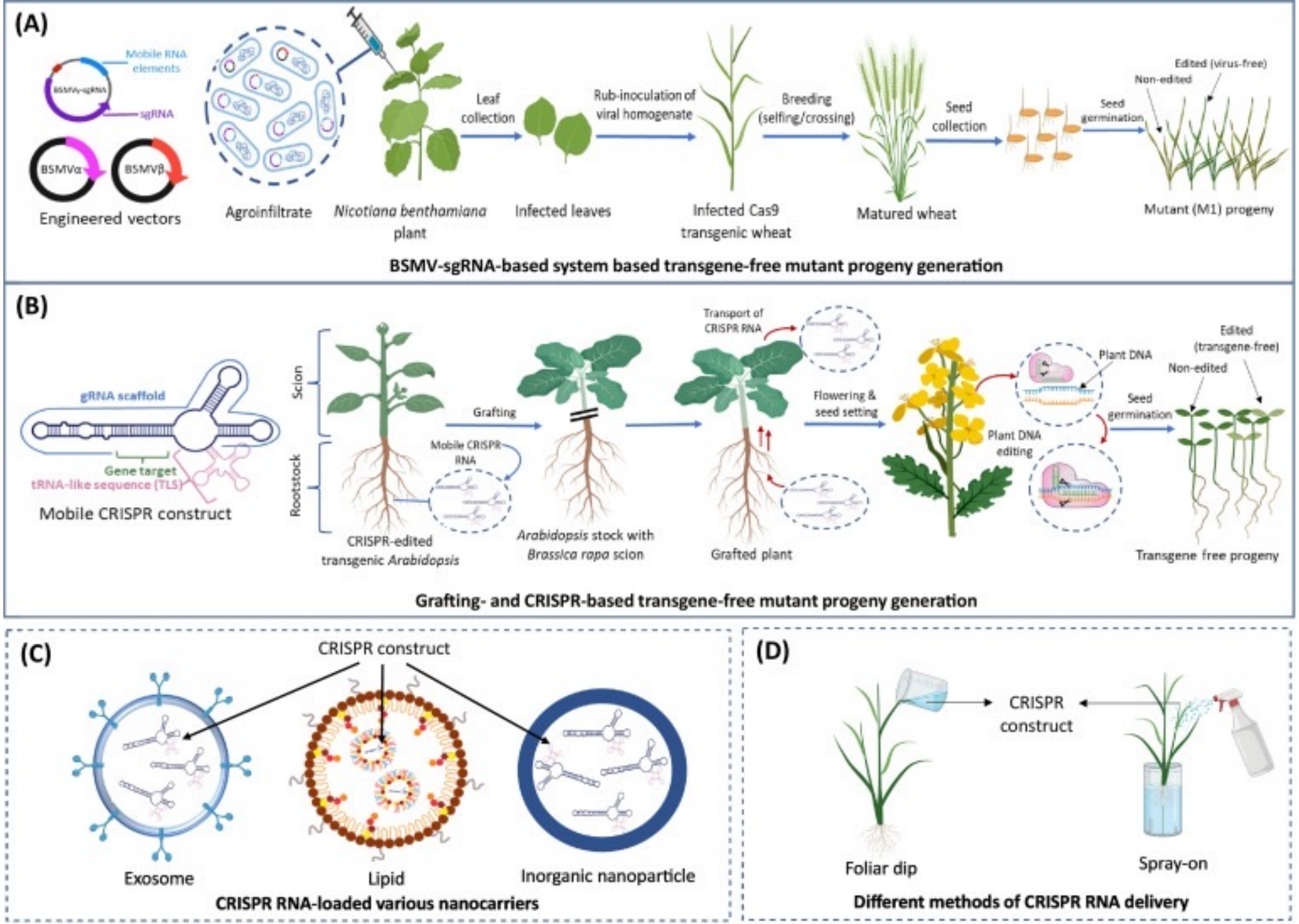
Modifica di più geni contemporaneamente

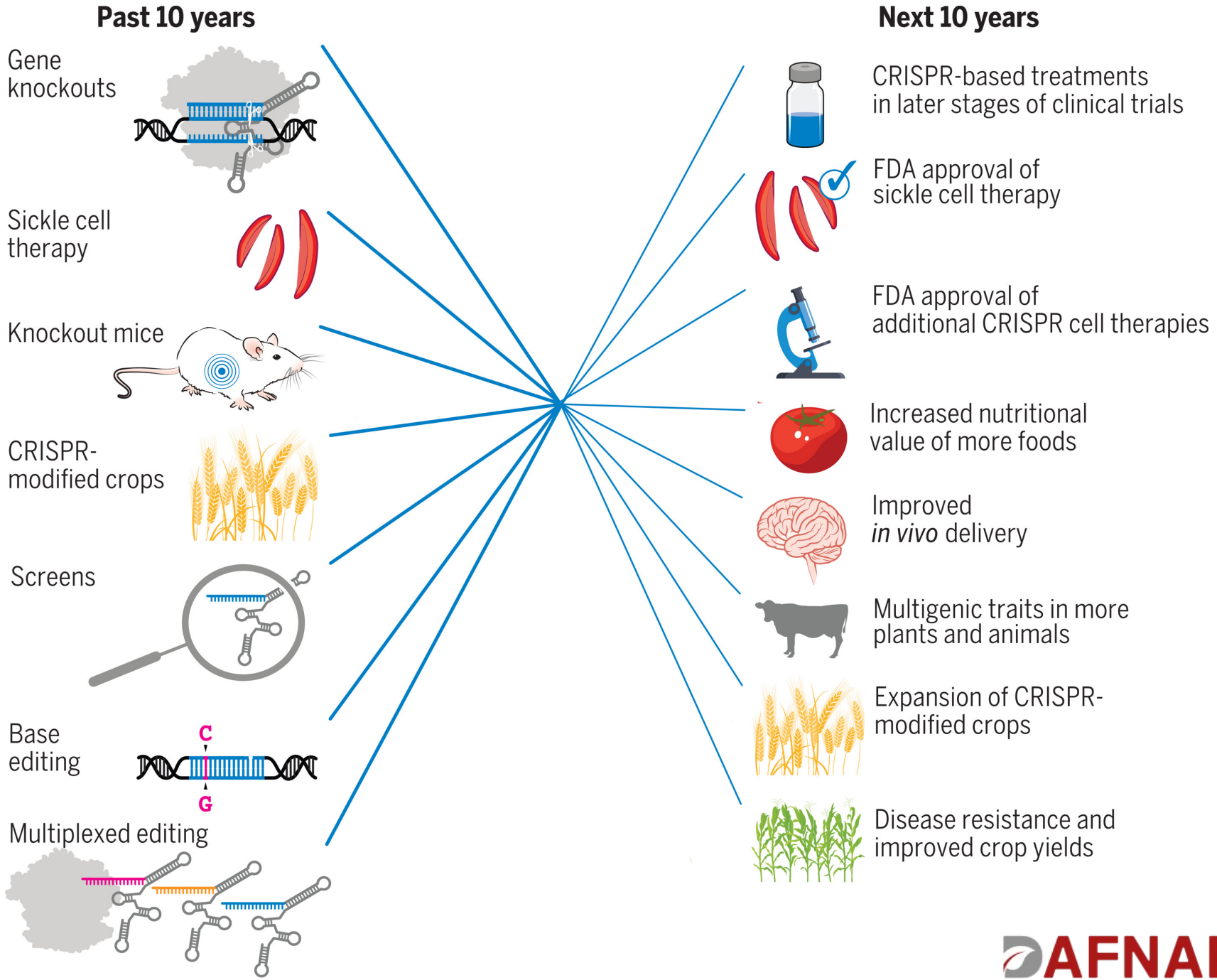


Usando guide multiple modifico più geni nello stesso intervento

Editing specifico di singole basi




(A)
Mobile RNA elements
BSMV-sgRNA
sgRNA
BSMVα
BSMVβ
Engineered vectors
Agroinfiltrate
Nicotiana benthamiana plant
Leaf collection
Infected leaves
Rub-inoculation of viral homogenate
Infected Cas9 transgenic wheat
Breeding (selfing/crossing)
Matured wheat
Seed collection
Seed germination
Non-edited
Edited (virus-free)
Mutant (M1) progeny
BSMV-sgRNA-based system based transgene-free mutant progeny generation
(B)
gRNA scaffold
Gene target
tRNA-like sequence (TLS)
Mobile CRISPR construct
Scion
Rootstock
Grafting
Mobile CRISPR RNA
CRISPR-edited transgenic Arabidopsis
Arabidopsis stock with Brassica rapa scion
Transport of CRISPR RNA
Grafted plant
Flowering & seed setting
Plant DNA
Plant DNA editing
Seed germination
Non-edited
Edited (transgene-free)
Transgene free progeny
Grafting- and CRISPR-based transgene-free mutant progeny generation
(C)
CRISPR construct
Exosome
Lipid
Inorganic nanoparticle
CRISPR RNA-loaded various nanocarriers
(D)
CRISPR construct
Foliar dip
Spray-on
Different methods of CRISPR RNA delivery



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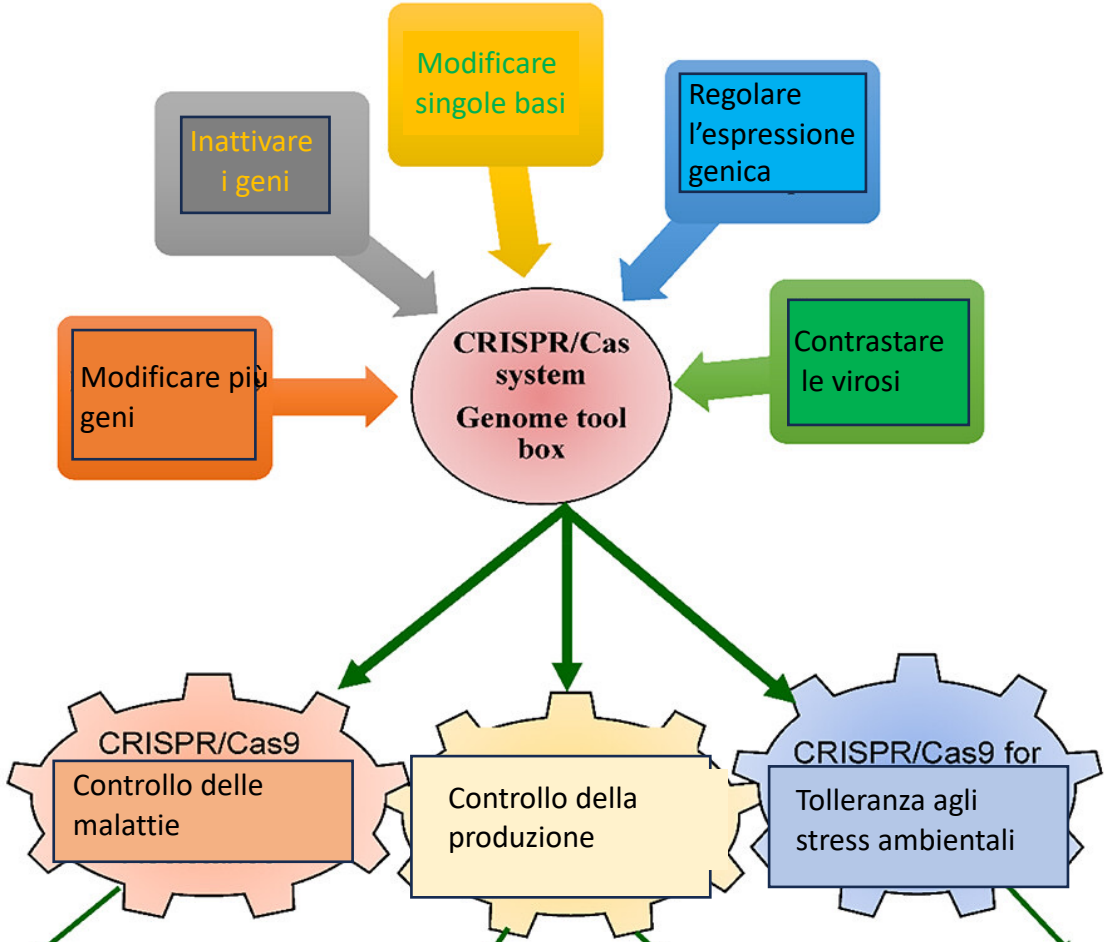
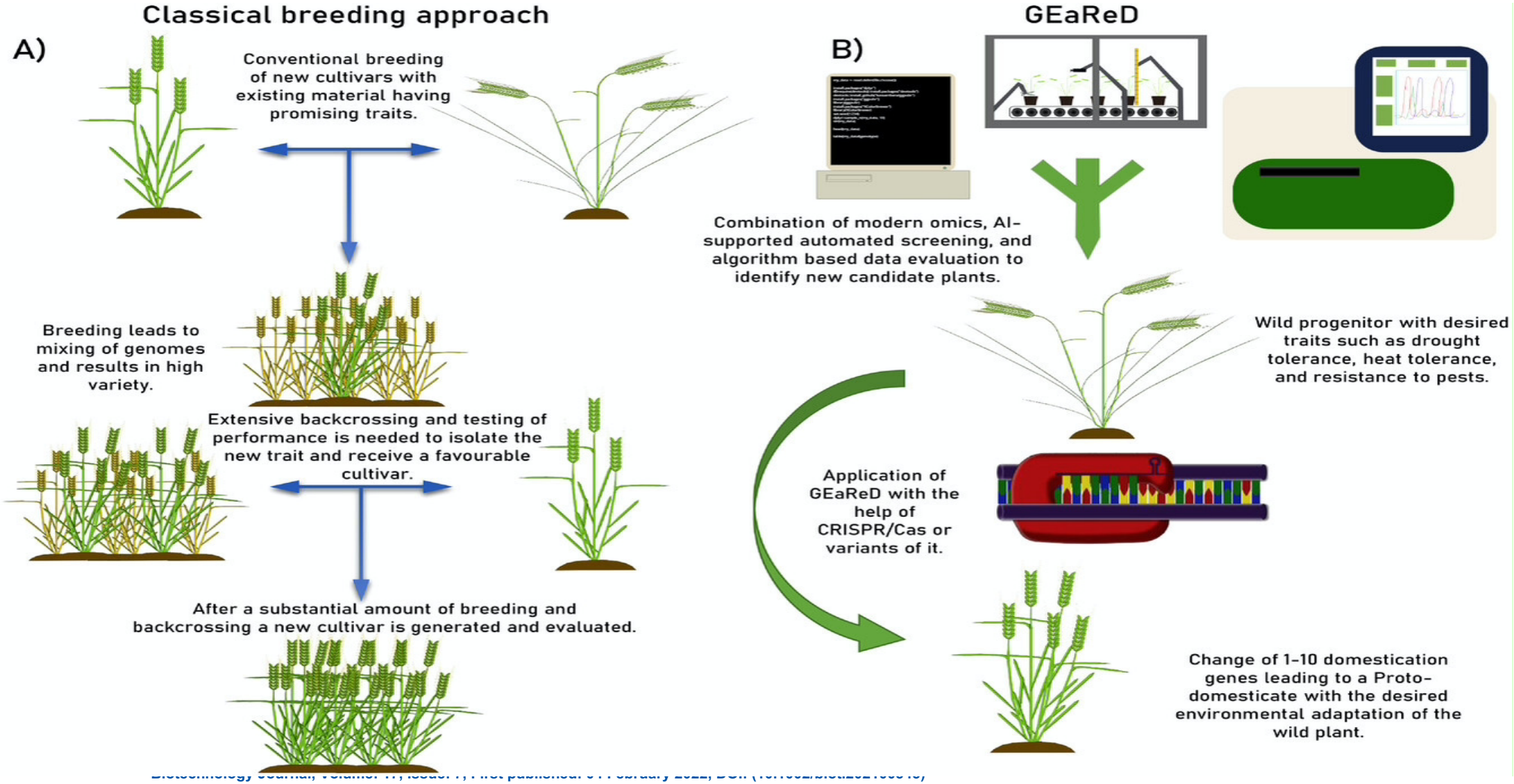
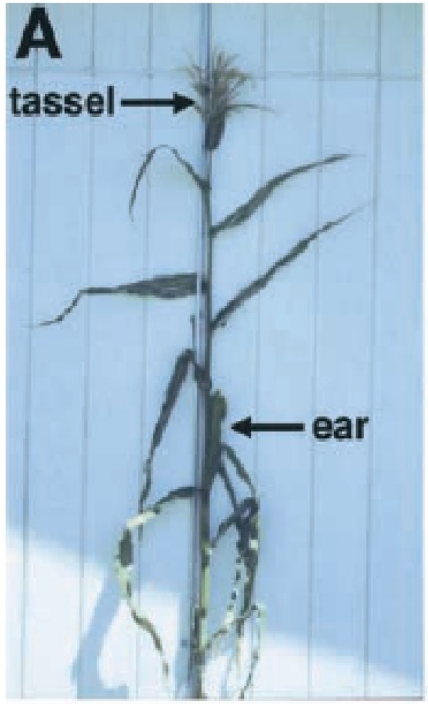
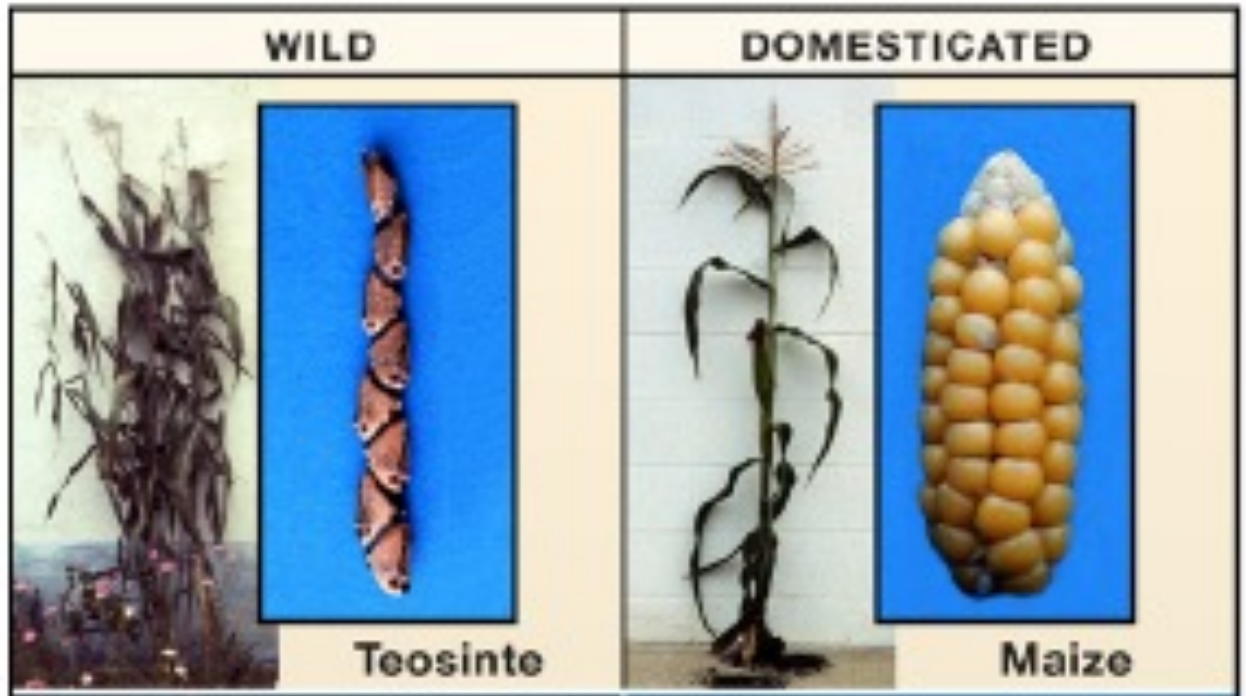

Modificare singole basi
Inattivare i geni
Regolare l'espressione genica
Modificare più geni
CRISPR/Cas system
Genome tool box
Contrastare le virosi
CRISPR/Cas9
Controllo delle malattie
Controllo della produzione
CRISPR/Cas9 for
Tolleranza agli stress ambientali

Genome Editing-accelerated Re-Domestication (GEaReD) – A new major direction in plant breeding



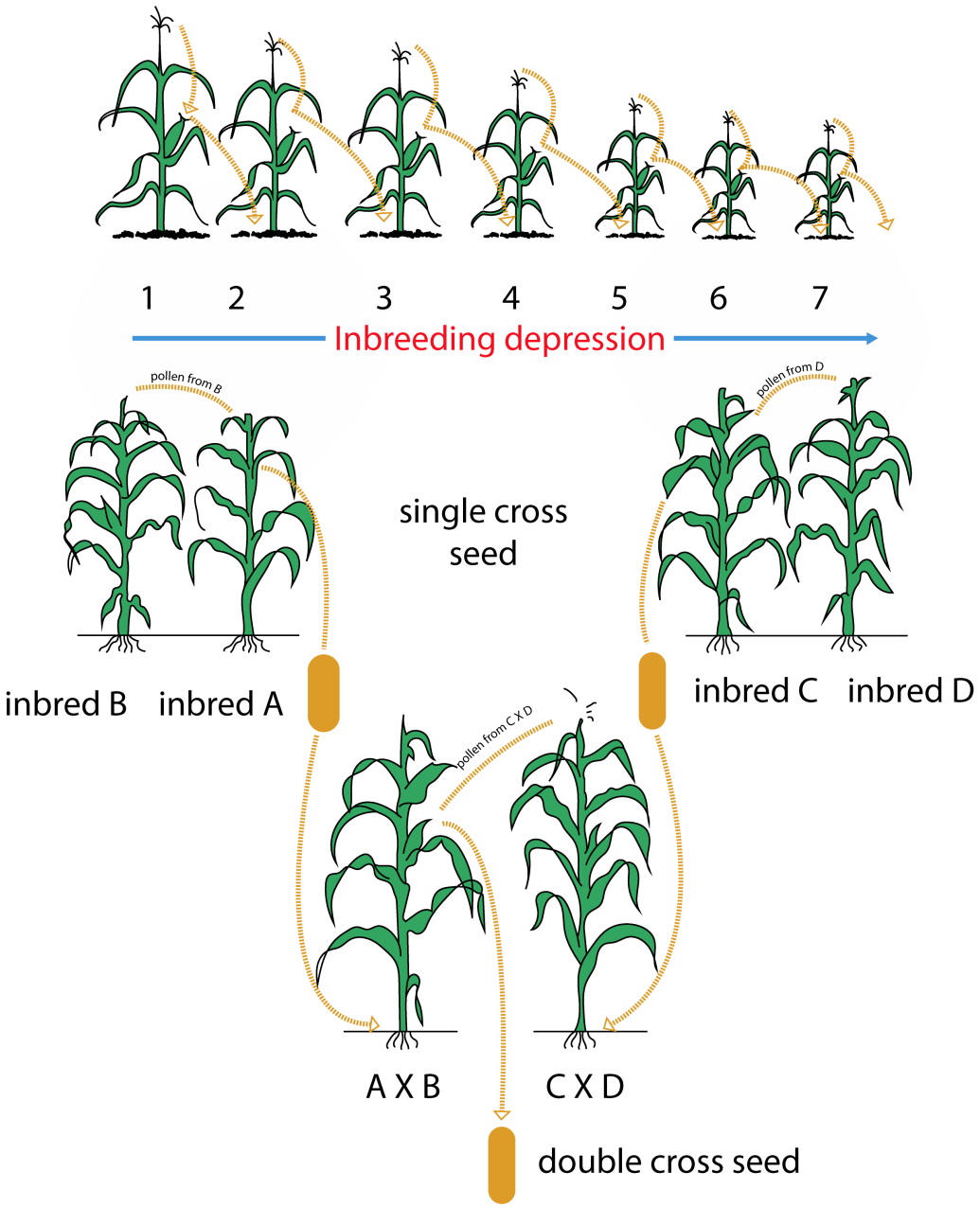
Biotechnology Journal Volume 17, Issue 7



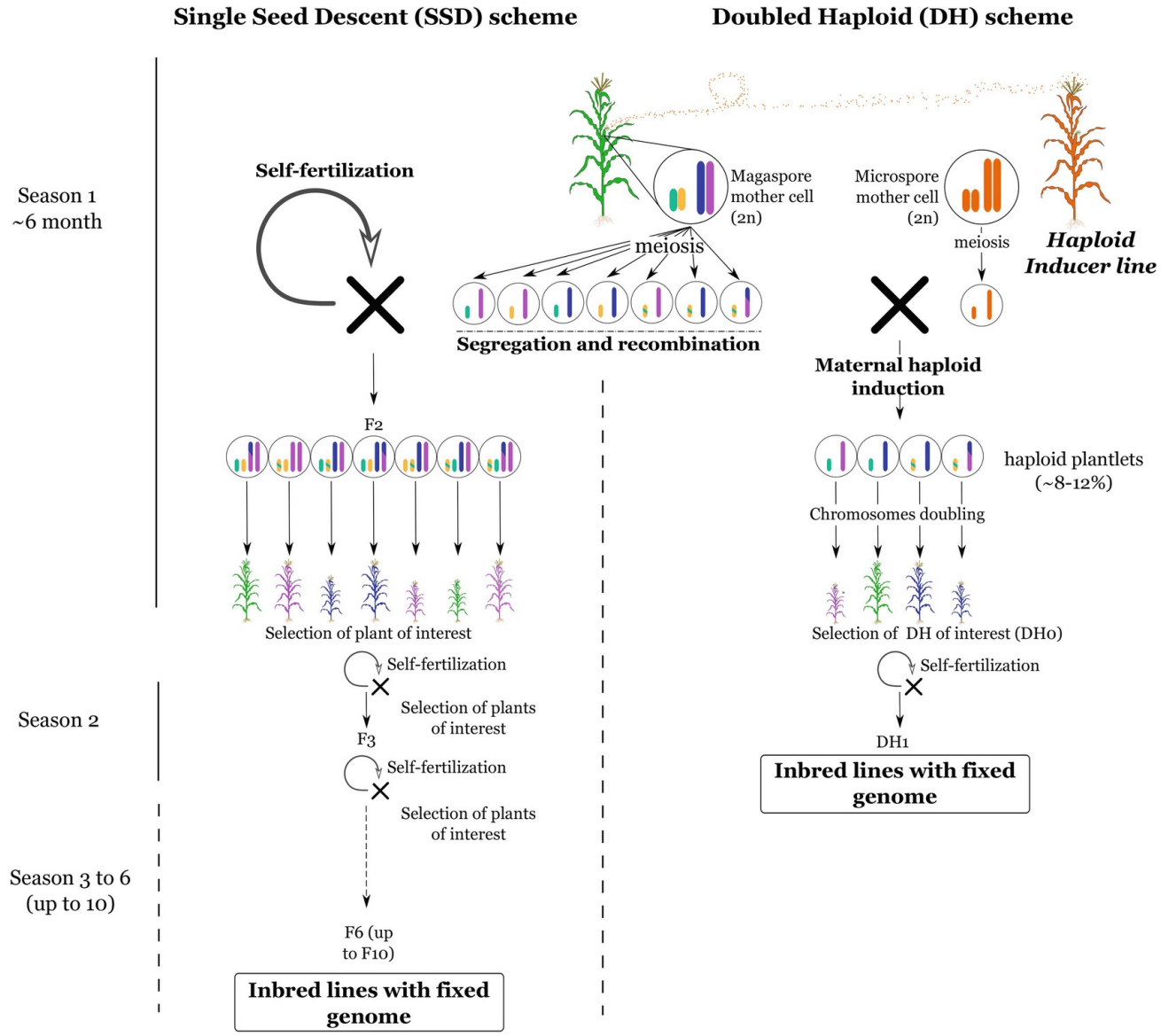


Il mais origina dalla domesticazione del teosinte con successivo contributo di geni da *Zea mays* ssp. *mexicana* circa 4000 anni dopo l'inizio della domesticazione.

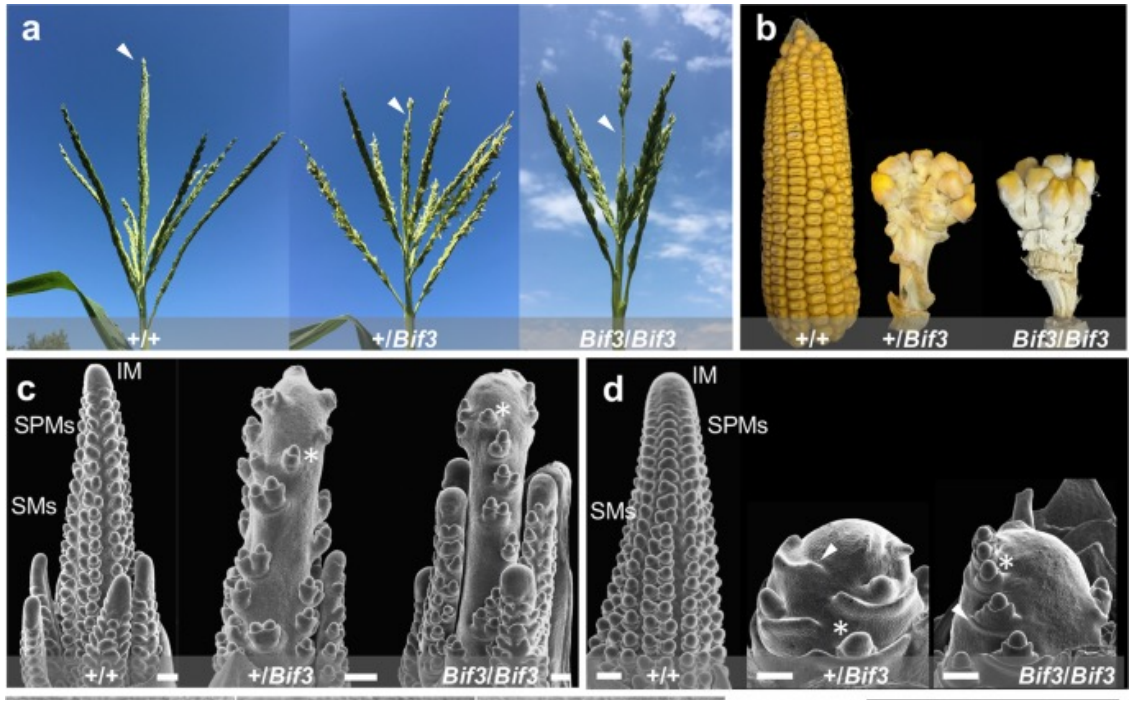
Il vigore ibrido



Le linee di-aploidi



La mutagenesi

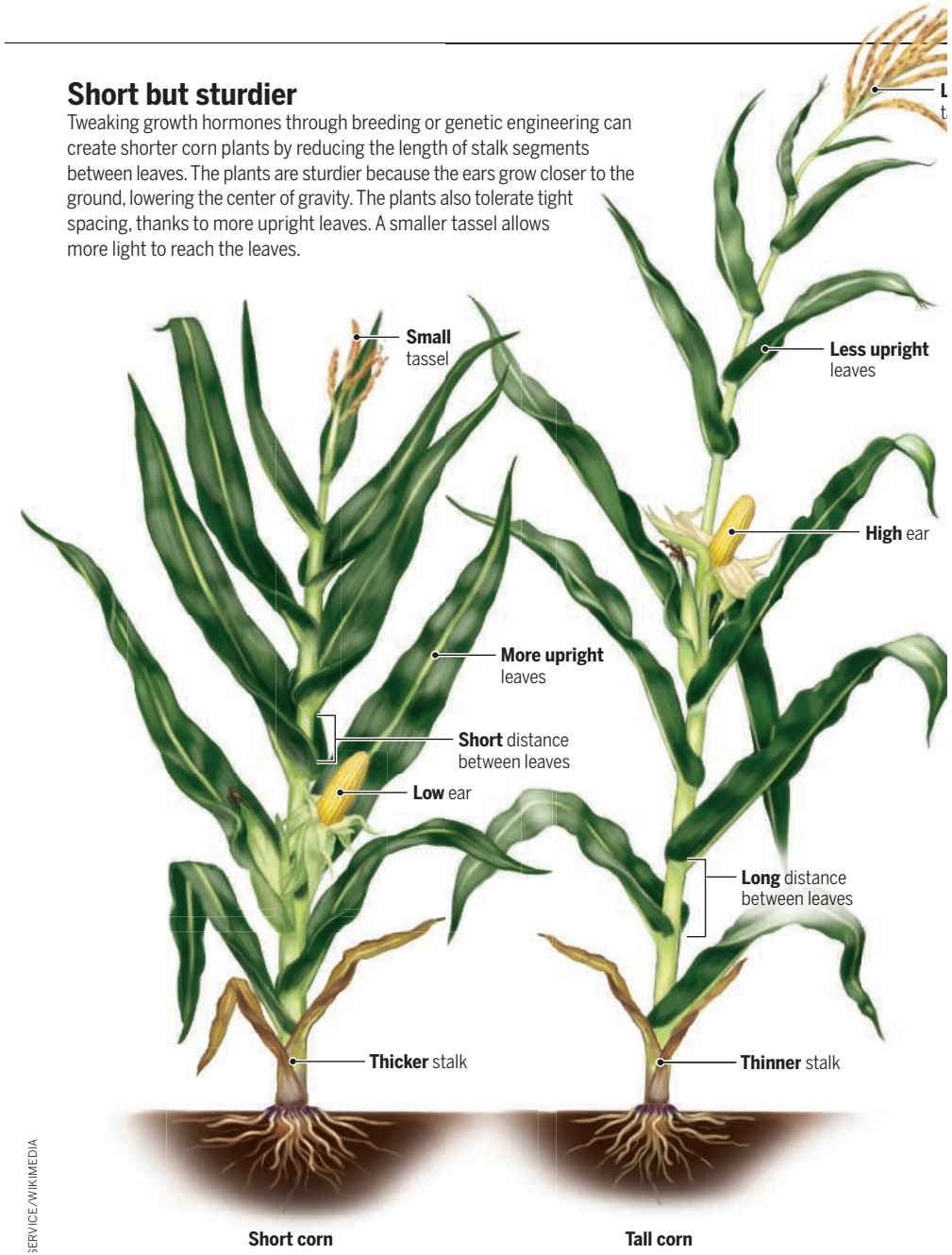


FEATURES

HIGH HOPES FOR SHORT CORN

Plants bred or engineered to be short can stand up better to windstorms. They could also boost yields and benefit the environment *By* **Erik Stokstad**

Bayer ha prodotto una varietà di mais nano per Mexico, mente altre compagnie stanno costituendo varietà nane per gli USA. Bayer ha inoltre prodotto mediante breeding convenzionale almeno 3 ibridi nani che sono stati testati negli USA da circa 300 agricoltori.
Anche Corteva, proprietaria di Pioneer Hi-Bred International, sta producendo ibridi nani mediante miglioramento genetico convenzionale.
Trasferire il carattere in ibridi affermati richiede almeno 5 anni, per cui Bayer sta adottando strategie alternative.



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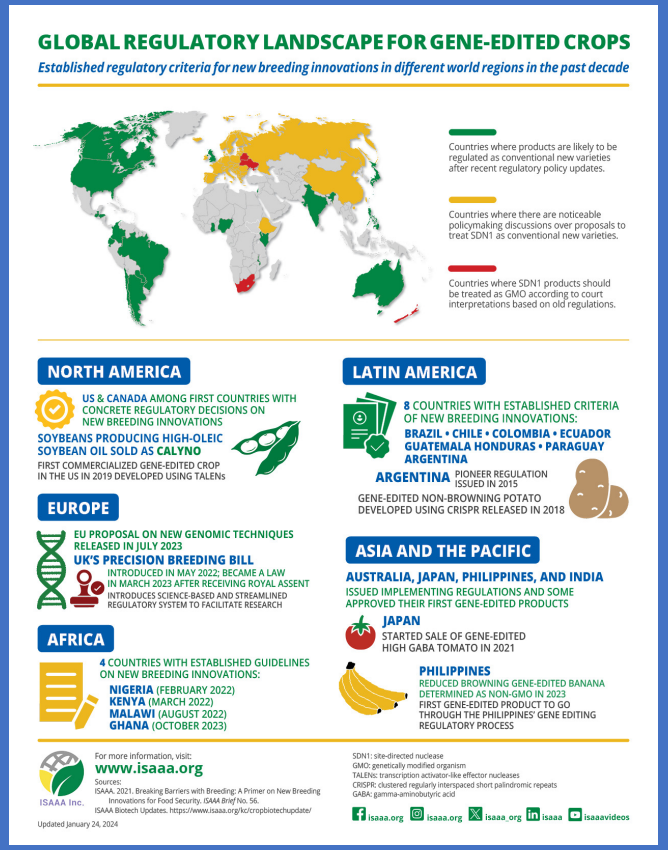
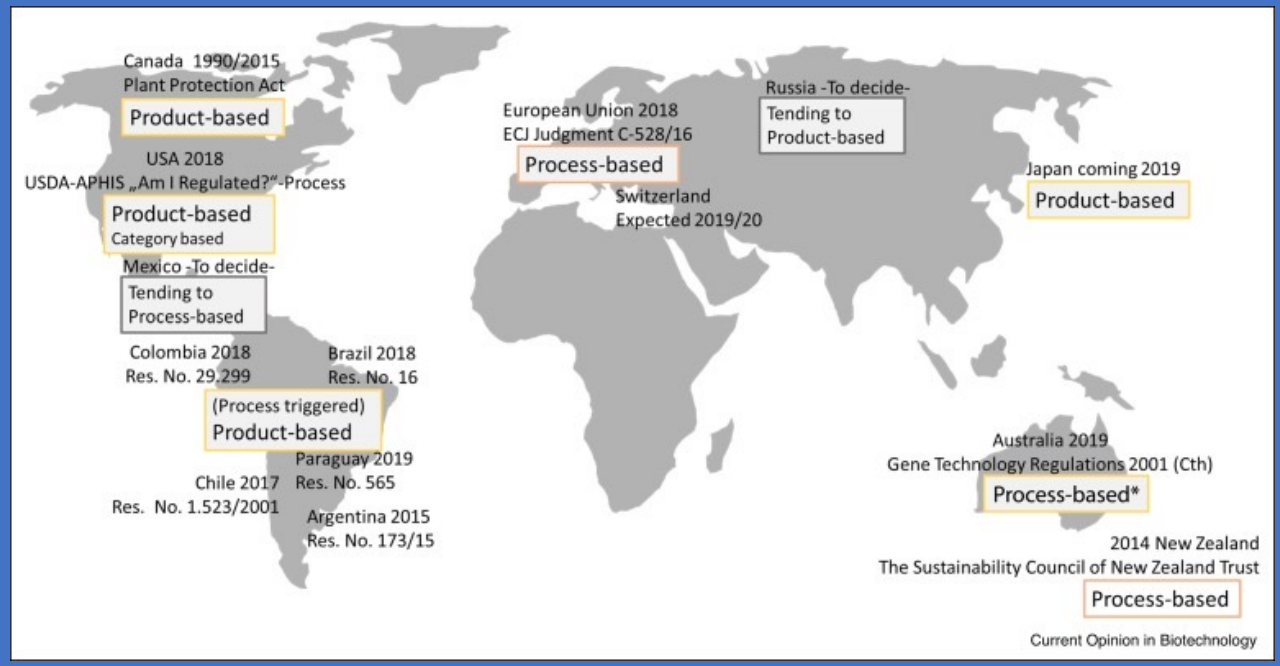

GLOBAL REGULATORY LANDSCAPE FOR GENE-EDITED CROPS
Established regulatory criteria for new breeding innovations in different world regions in the past decade
Countries where products are likely to be regulated as conventional new varieties after recent regulatory policy updates.
Countries where there are noticeable policymaking discussions over proposals to treat SDN1 as conventional new varieties.
Countries where SDN1 products should be treated as GMO according to court interpretations based on old regulations.
NORTH AMERICA
US & CANADA AMONG FIRST COUNTRIES WITH CONCRETE REGULATORY DECISIONS ON NEW BREEDING INNOVATIONS
SOYBEANS PRODUCING HIGH-OLEIC SOYBEAN OIL SOLD AS CALYNO
FIRST COMMERCIALIZED GENE-EDITED CROP IN THE US IN 2019 DEVELOPED USING TALENs
EUROPE
EU PROPOSAL ON NEW GENOMIC TECHNIQUES RELEASED IN JULY 2023
UK'S PRECISION BREEDING BILL
INTRODUCED IN MAY 2022; BECAME A LAW IN MARCH 2023 AFTER RECEIVING ROYAL ASSENT
INTRODUCES SCIENCE-BASED AND STREAMLINED REGULATORY SYSTEM TO FACILITATE RESEARCH
AFRICA
4 COUNTRIES WITH ESTABLISHED GUIDELINES ON NEW BREEDING INNOVATIONS:
NIGERIA (FEBRUARY 2022)
KENYA (MARCH 2022)
MALAWI (AUGUST 2022)
GHANA (OCTOBER 2023)
LATIN AMERICA
8 COUNTRIES WITH ESTABLISHED CRITERIA OF NEW BREEDING INNOVATIONS:
BRAZIL • CHILE • COLOMBIA • ECUADOR
GUATEMALA HONDURAS • PARAGUAY
ARGENTINA
ARGENTINA PIONEER REGULATION ISSUED IN 2015
GENE-EDITED NON-BROWNING POTATO DEVELOPED USING CRISPR RELEASED IN 2018
ASIA AND THE PACIFIC
AUSTRALIA, JAPAN, PHILIPPINES, AND INDIA
ISSUED IMPLEMENTING REGULATIONS AND SOME APPROVED THEIR FIRST GENE-EDITED PRODUCTS
JAPAN
STARTED SALE OF GENE-EDITED HIGH GABA TOMATO IN 2021
PHILIPPINES
REDUCED BROWNING GENE-EDITED BANANA DETERMINED AS NON-GMO IN 2023
FIRST GENE-EDITED PRODUCT TO GO THROUGH THE PHILIPPINES' GENE EDITING REGULATORY PROCESS
For more information, visit:
www.isaaa.org
ISAAA Inc.
Sources:
ISAAA. 2021. Breaking Barriers with Breeding: A Primer on New Breeding Innovations for Food Security. ISAAA Brief No. 56.
ISAAA Biotech Updates. https://www.isaaa.org/kc/cropbiotechupdate/
SDN1: site-directed nuclease
GMO: genetically modified organism
TALENs: transcription activator-like effector nucleases
CRISPR: clustered regularly interspaced short palindromic repeats
GABA: gamma-aminobutyric acid
isaaa.org isaaa.org isaaa_org isaaa isaaavideos
Updated January 24, 2024


Canada 1990/2015
Plant Protection Act
Product-based
USA 2018
USDA-APHIS „Am I Regulated?"-Process
Product-based
Category based
Mexico -To decide-
Tending to Process-based
Colombia 2018
Res. No. 29.299
Brazil 2018
Res. No. 16
(Process triggered)
Product-based
Paraguay 2019
Chile 2017
Res. No. 565
Res. No. 1.523/2001
Argentina 2015
Res. No. 173/15
European Union 2018
ECJ Judgment C-528/16
Process-based
Switzerland
Expected 2019/20
Russia -To decide-
Tending to Product-based
Japan coming 2019
Product-based
Australia 2019
Gene Technology Regulations 2001 (Cth)
Process-based*
2014 New Zealand
The Sustainability Council of New Zealand Trust
Process-based
Current Opinion in Biotechnology

Grazie per l'attenzione

Serena Varotto

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