7th Seed Congress of the Americas

Promoting Seed Business in the Americas

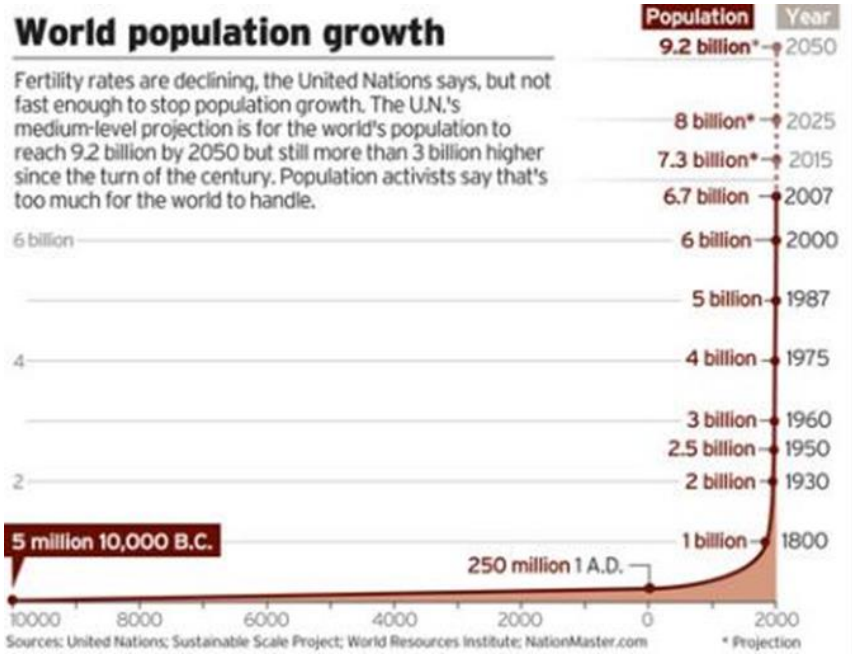
September 9 - 11, 2019
Buenos Aires, Argentina

Biotechnology-Gene Editing

Luis Maas/Chair SAA BWG

SAA
Seed Association of the Americas

Plant Breeding Challenge: Feed World

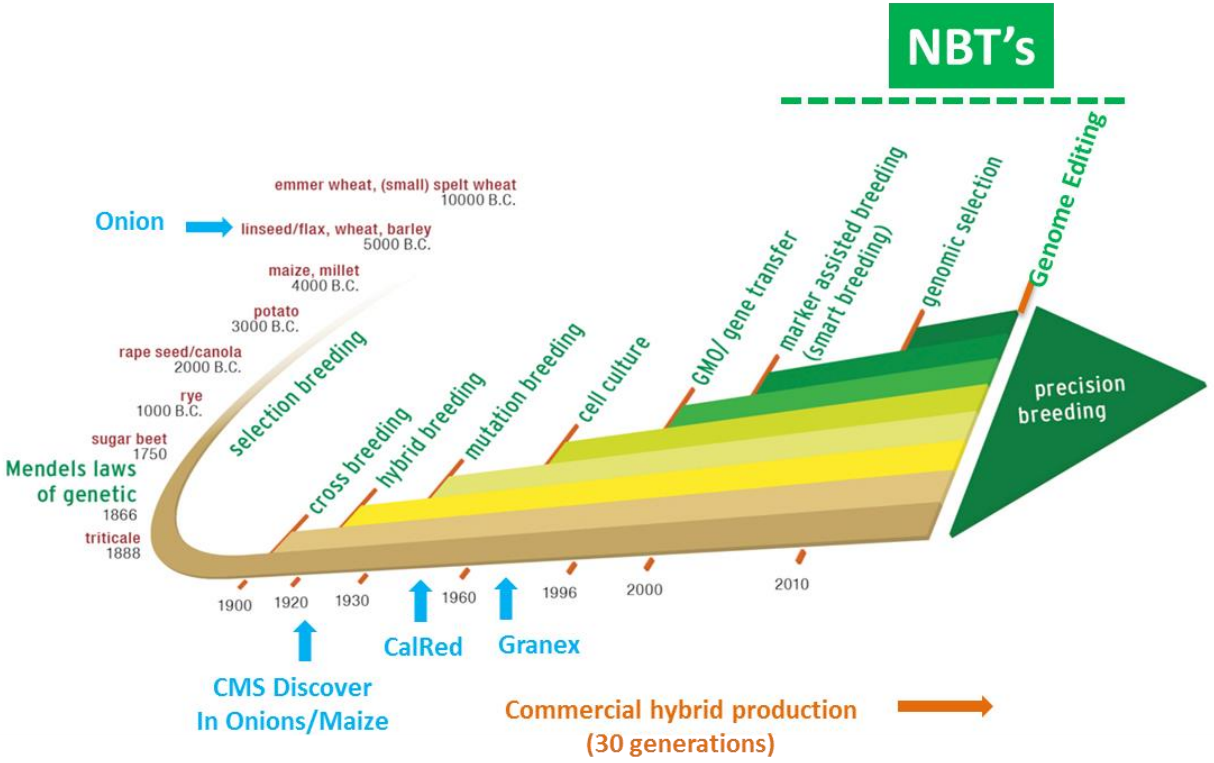




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Plant Breeding Milestones



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How can Gene Editing Help

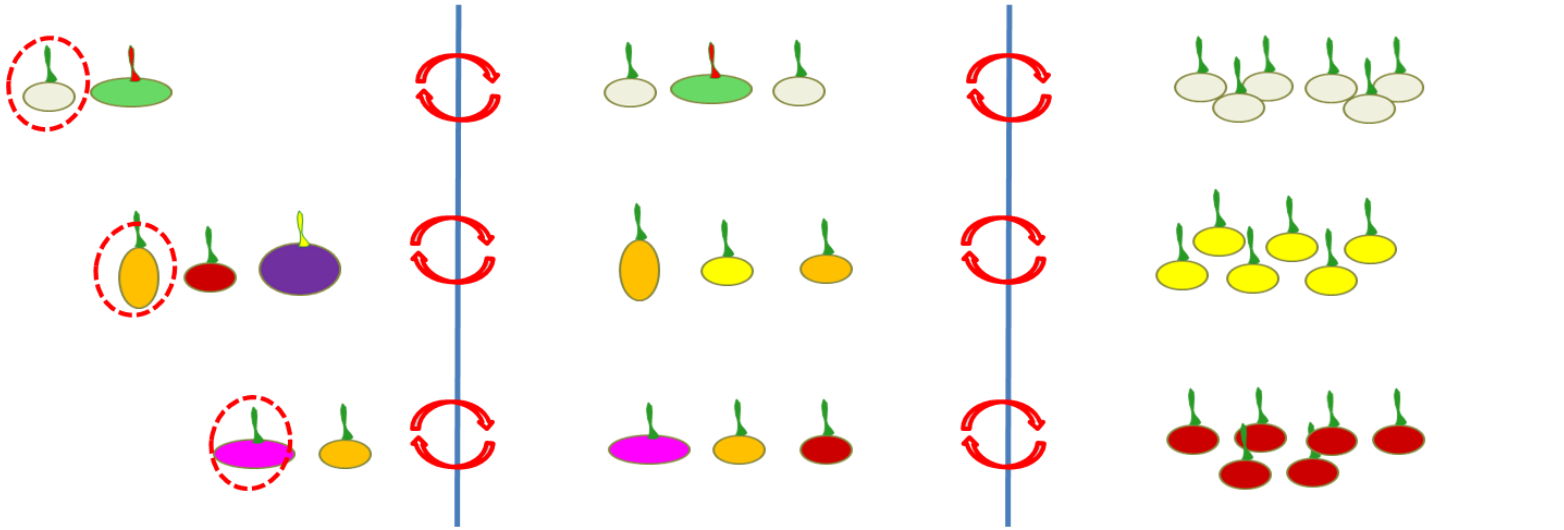
Potential Benefits:

1. *Allele replacement*
2. *Amino Acid Change*
3. *Gene knockout*
4. *Double Breaks*

Potential Challenges:

1. *Tissue culture/transformation*
2. *Off-Target Edits*

Genetic Variation is the Key Ingredient



Wild Relatives

Land Races/OP

Modern Varieties (hybrids)

Genetic Variation

Trait Uniformity

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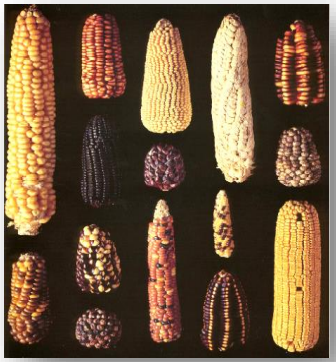
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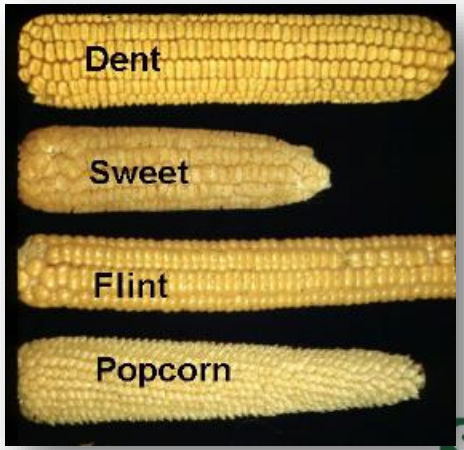
Use of untapped Genetic Variation



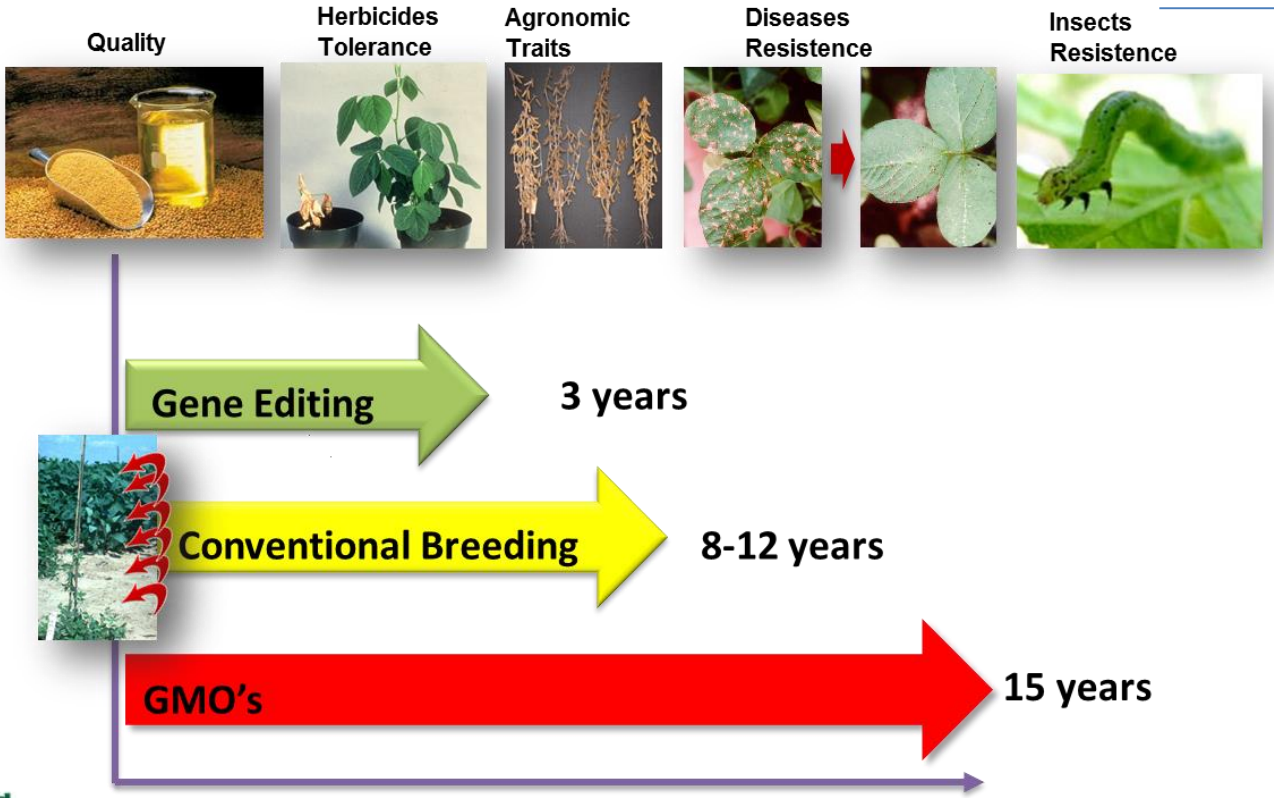








Speed to Market



Source: ChileBio

Different Routes Same Destination

Mutation by Radiation

Production and characterization of tearless and no
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Article | OPEN

Production and characterization of tearless and non-pungent onion

Masahiro Kato, Noriya Masamura [...] Shinsuke Imai

Scientific Reports **6**, Article number: 23779 (2016)
doi:10.1038/srep23779
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Gene Silencing

Silencing Onion Lachrymatory Factor Synthase Cau
www.ncbi.nlm.nih.gov

PMC Alt PDF

Plant Physiology
American Society of Plant Biologists

Silencing Onion Lachrymatory Factor Synthase Causes a Significant Change in the Sulfur Secondary Metabolite Profile[1,[W] [OA]

Colin C. Eady, Takahiro Kamoi, [...], and Shinsuke Imai

Additional article information

Conventional Breeding



gelsons.com
Gelson's Blogs-Sunions-The-Tearless-and-Sweet-Onion-with-a-Bright ...
Different from other onions, Sunions are both tearless and sweet – the first ...

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Breeding Goals Achieved by GE

Quality Traits	Yield	Resistances
Baking quality (e.g N-glycans modification in barley, gluten free wheat)	Corn yield (pod shatter resistant oil seed rape, grain weight and enhanced grain number in rice, parthenocarpic tomato plants)	Viruses (Cucumis: Zucchini Yellow Mosaic virus; Papaya ring spot Virus)
Brewing quality (e.g. low lox barley)	Biomass yield (improved C3-carbon metabolism in df)	Bacteria
Fatty acid composition (e.g. high oleic acid soybean/ Camelina; low sat. fatty acid canola)	Starch, Protein, Sugar, Oil content (higher oil content Camelina)	Insect
Increased Vitamin content	Nutrient use Efficiency	Fungi (e.g. Powdery Mildew in Wheat and tomato, late blight potato, blast resistant rice)
Improved shelf life (improved cold storage potato, non-browning mushroom/apple/potato)	Water use Efficiency (drought tolerant soybeans)	Drought, Heat, Salt (salt stress tolerant rice, drought stress resistant corn)
Starch quality (e.g. waxy corn, amylopectin potato, high-amylose rice)		Herbicides (e.g. oilseed rape, linum, rice, potato)
Food/Feed quality (low-phytate maize, high fiber wheat)		

Impact of Gene Editing

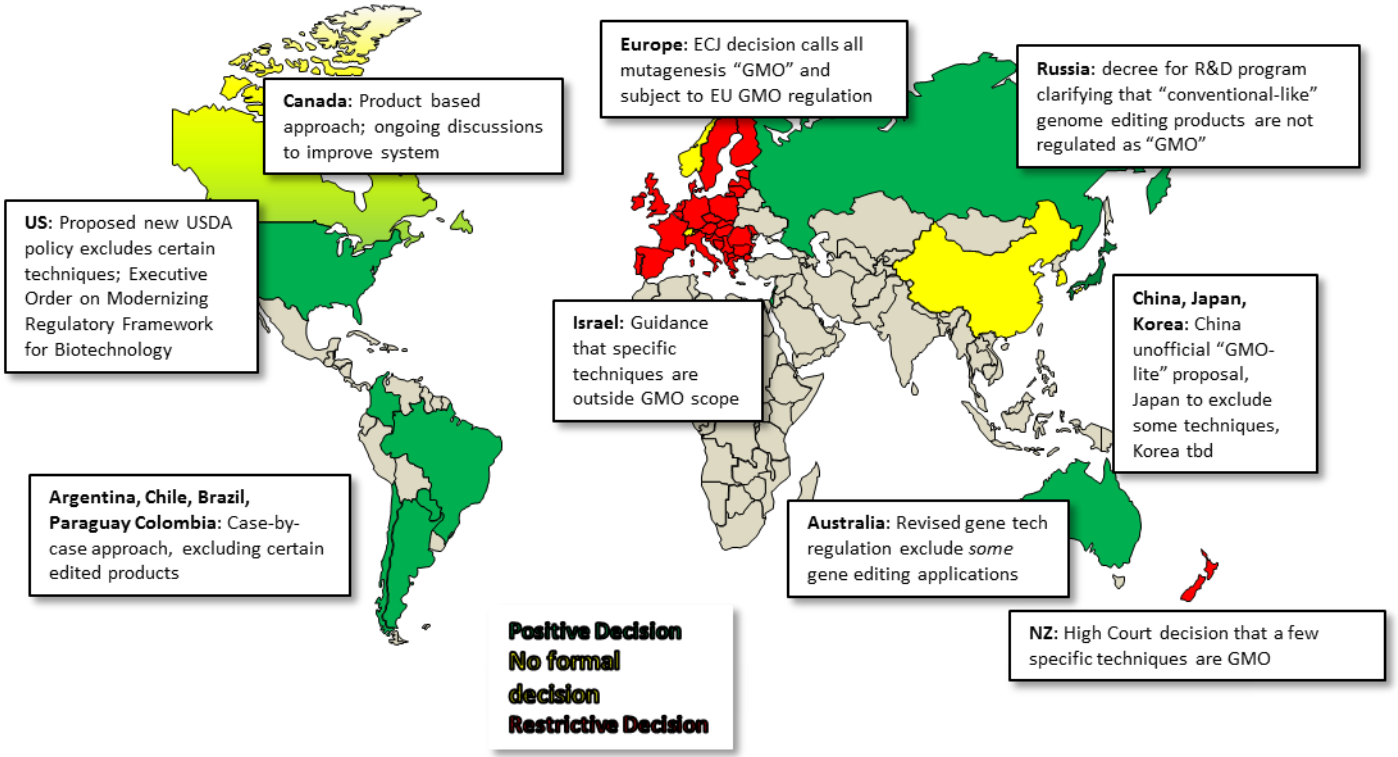
1)Worldwide **new stakeholders are engaging in plant breeding innovation** discussions (PBI).

2)The application of **consistent criteria for evaluation of PBI products by regulators** is key

3)Several governments, IICA, CAS, PROCISUR, etc., have gene editing (products) in their agendas.

4)Global (ISF), regional (SAA), national seed associations (NSA´s) from Canada down to Chile/Argentina are supporting the use of gene editing technologies.

Gene Editing Regulation Progress



Regulation Alignment

Last Updated July 09, 2019	Agency	Targeted deletions	No DNA sequence from a different species				DNA sequence from a different species
Country			Targeted edits	Targeted allele replacements	Targeted insertions	Null Segregant	Targeted Insertion
Enacted Policy / Official Statement							
Argentina	MAGYP	No	No	No	Yes	No	Yes
Chile	SAG	No	No	No	Yes	No	Yes
Brazil	CTNBio	No	No	No	Yes	No	Yes
Colombia	ICA	No	No	No	Yes	No	Yes
Paraguay	CONBIO	No	No	No	Yes	No	Yes

Source: ISF

Regulation Alignment

Underlying principle:

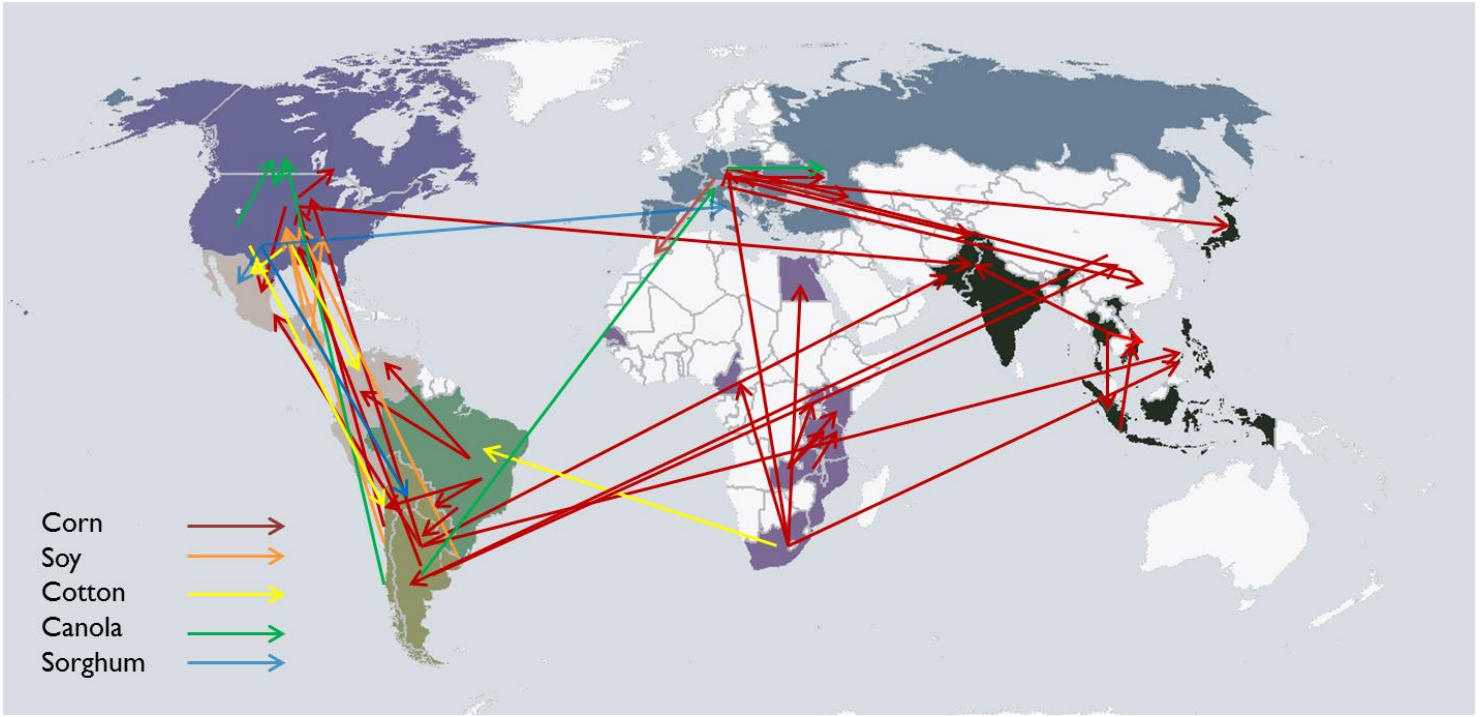
"Plant varieties developed through the NBTs methods should not be differentially regulated if they are similar or indistinguishable from varieties that could have been produced through earlier breeding methods."

Source: ISF

Lack of Regulation Alignment

- The risk is to create another system of patchwork regulations
  - –Few large players and crops actively using gene editing
  - –Limited access for public research institutions, Universities, CGIARS etc
  - –Decrease seed and grain trade will decrease.
  - –Research cooperation and germplasm exchange for global breeding will become more challenging.
  - –Increasing productivity in a sustainable way will become more challenging.

Global Seed Flows



Closing Remark

- Gene editing has the potential to fundamentally change vegetable breeding:
  - Reducing time from R&D to market
  - Significant impact breeding in crops with long generational cycles or poor molecular resources.
  - Generation of new genetic variation
- Lack of an international align regulatory environment will lead to:
  - Limited access of the technology to big companies and crops
  - Restricted seed flow for breeding purposes
  - Reduce trade of seed and cereals/grains