



# New Plant Breeding Techniques

## What future for breeding innovation in Europe?

Garlich v. Essen ; GMCC ; Amsterdam; 18.11.2015



## THE EUROPEAN SEED SECTOR

---

### Diverse

> 7.000 companies  
> 90% micro  
enterprises & SMEs



### Competitive

leading innovator  
leading exporter



### Innovative

+ 3.500 new  
products/year  
> 40.000 products  
> 15% R&D of  
annual turnover



### Contributive

Bioeconomy ;  
Food, feed, fibre,  
fuel, fun ;  
Growth & jobs in  
rural areas

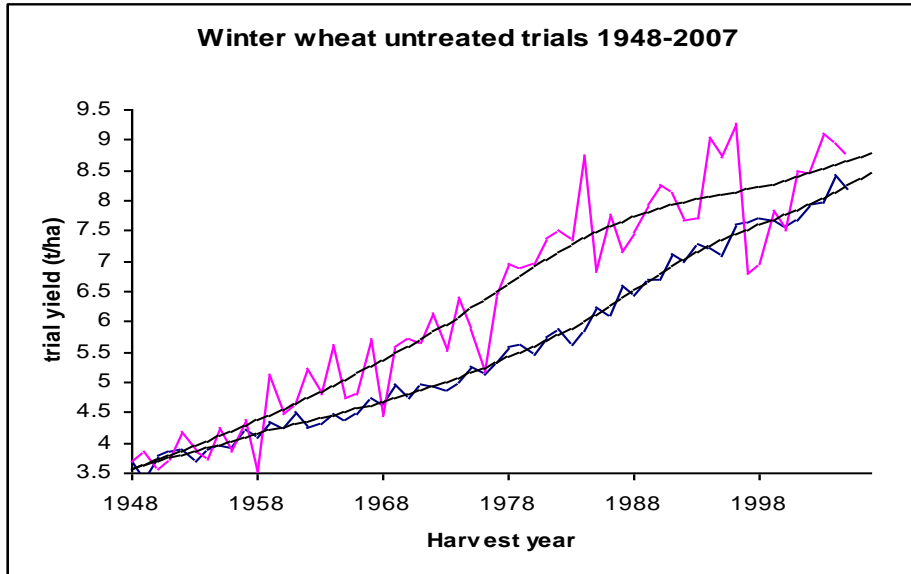


## FACTS

---

- ✿ 10 billion people in 2050
- ✿ growing demands for quantity and quality of food produced sustainably
- ✿ Limited natural resources and increasing restrictions on many inputs
- ✿ > 80% of productivity gains today are due to improved varieties and quality seed





- 1948-1981:  
60% of gain due to improved varieties
- 1948-2007:  
88% of gain due to improved varieties
- Since 1982:  
almost all gain has been due to varieties

 **Genes and brains drive growth**

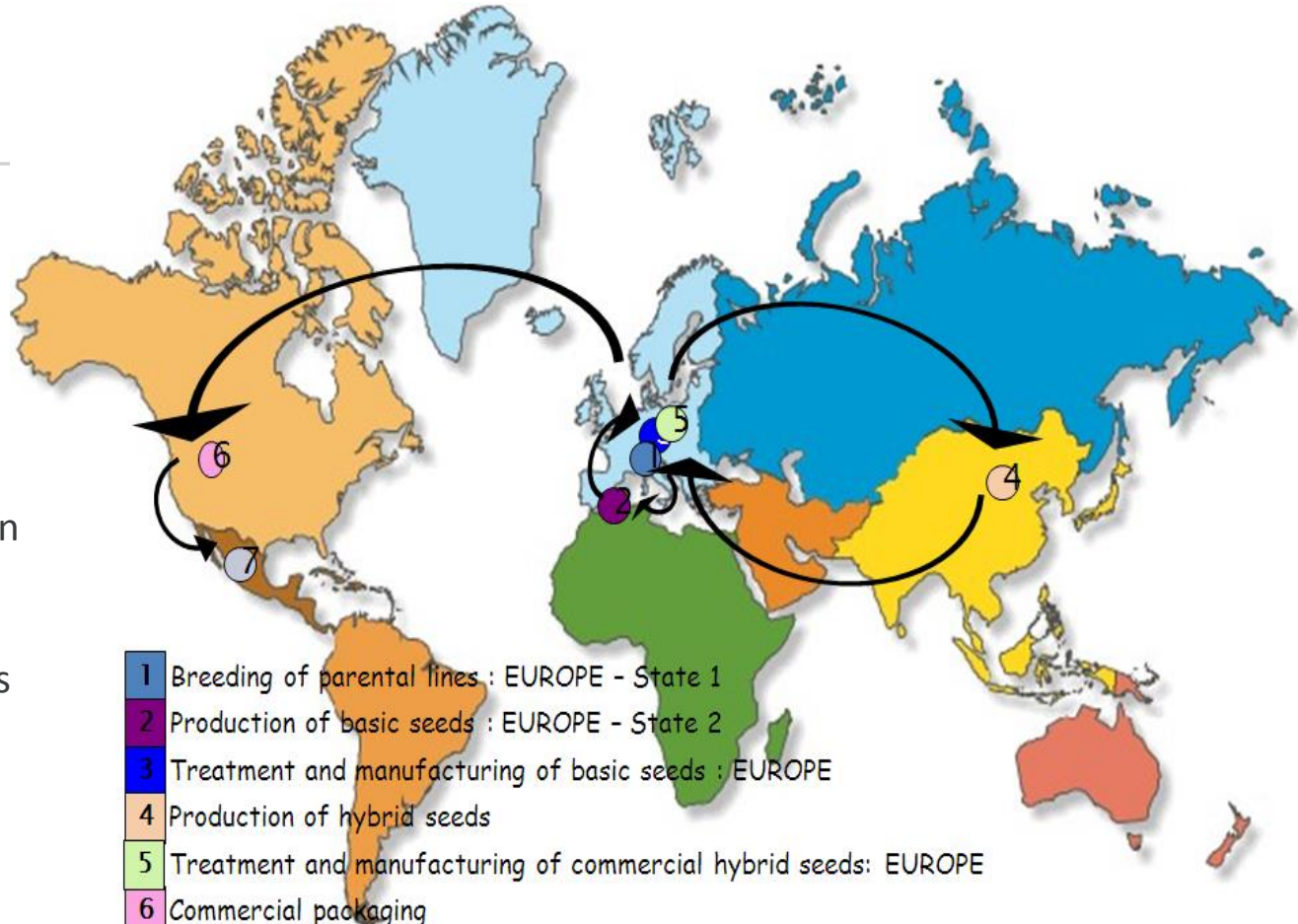


## A NEED FOR SPEED

---

- Working with nature has long biological timescales
- Historical progress is insufficient for the future
- Plant breeding is a foundation of modern agriculture and societies
- Productive agriculture is well aligned with sustainability objectives

 **We need to do more and better – and faster!**



- 1 Breeding of parental lines : EUROPE - State 1
- 2 Production of basic seeds : EUROPE - State 2
- 3 Treatment and manufacturing of basic seeds : EUROPE
- 4 Production of hybrid seeds
- 5 Treatment and manufacturing of commercial hybrid seeds: EUROPE
- 6 Commercial packaging
- 7 Final sale and use MEXICO

International cooperation in R&D and movement of seed speed up breeding innovation and drive growth worldwide

25% of all commercial seed is traded internationally

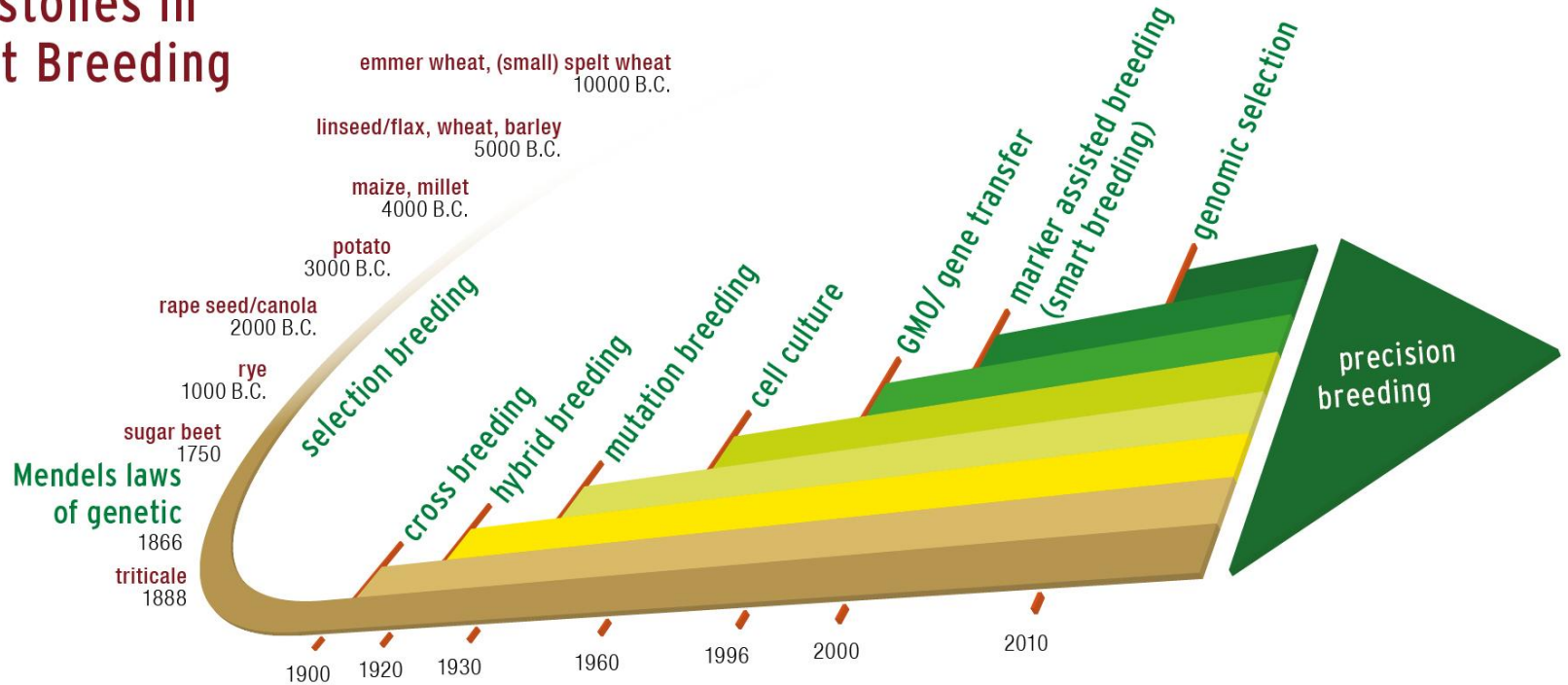
EU a leader in R&I

EU a leader in seed exports and imports



SMARTENING UP

# Milestones in Plant Breeding





THE NEXT FRONTIER: GETTING EVEN SMARTER

---

## RNA-dependent DNA methylation

**PLANT** agro-inoculation

**REVERSE BREEDING** **ZINC FINGER NUCLEASE**

**BREEDING** *double stranded*

**ODM** cisgenesis

**AGRO-INFILTRATION**

**site-directed mutagenesis**

**SILENCING**

**INTRAGENESIS**

oligonucleotide

**GENE TARGETING**





2009...

---

**What is the regulatory status of these New Plant Breeding Techniques?**

**And is this really an important question?**

- 1) Are these techniques covered by the existing EU-legislation (Directive 2001/18) or is there a need to open and amend the Directive?
  
- 2) If the techniques are covered by the existing Directive:  
do the resulting products require an authorisation as a GM plant or are they exempted?
  
- 3) What is the economic relevance and potential of these techniques?



## Socio-economic relevance: JRC REPORT ON NPBTs (2010/11)

---

- **Each of NBTs used** by two to four of the surveyed plant breeding companies
- All NBTs have been **adopted in commercial breeding**
- ODM, cisgenesis/intragenesis and agro-infiltration are most used
- Most advanced crops close (2-3 years) to commercialisation (if classified as non GM)
- Main traits and species (a.o.)
  - herbicide tolerance and insect resistance in rapeseed and maize
  - fungal resistance in potatoes
  - drought resistance in maize
  - scab-resistant apples
  - potatoes with reduced amylose content



## Socio-economic relevance: JRC REPORT ON NPBTs (2010/11)

---

Great **technical potential** of techniques

New possibilities of producing **genetic variation**

- ✿ targeted mutagenesis (ZFN 1 and 2 technology and ODM),
- ✿ targeted introduction of new genes (ZFN 3 technology, cisgenesis and intragenesis)
- ✿ or gene silencing (RdDM)
- ✿ improvement of selection (agroinfiltration)

- **Technical advantages**

- ✿ site specific and targeted changes
- ✿ commercialized crop will not contain an inserted transgene

- **Economic advantages**

- ✿ faster breeding process and lower production costs



## Socio-economic relevance: JRC REPORT ON NPBTs (2010/11)

---

- NPBTs make plant breeding **faster and more precise**
- NPBTs are of **high commercial interest also for SMEs and small crops**
- Plants resulting from NPBTs are in most cases **genetically indistinguishable** from traditionally bred plants
- New or specific legislative requirements for NPBTs may **distort the level playing field** by discriminating some technologies versus others
- Over-regulation of NPBTs would lead to
  - competitive and technological disadvantage for European breeders and farmers
  - restricted access to genetic diversity for plant breeding
  - brain and technology drain
  - barriers to trade
  - lack of enforceability and potential fraud
  - limitation of consumer choice



## Regulatory status: EU Experts WG Opinion (2012/13)

Expert Opinion	non-gm	gm
ZFN 1/2	majority	minority
ODM	majority	minority
RdDM	majority	minority
ZFN3		all
cis-genesis		all
grafting on gm-rootstock		all
reverse breeding	all	
agroinfiltration	all	



## Regulatory status: EU Experts WG Opinion (2012/13)

---

**Minimum of information** about DNA sequence **is required** in order to allow identification

**Enforcement difficult** if resulting genetic modifications cannot be distinguished from those produced by conventional breeding techniques or by natural genetic variation

**Identification** is currently **not possible**:

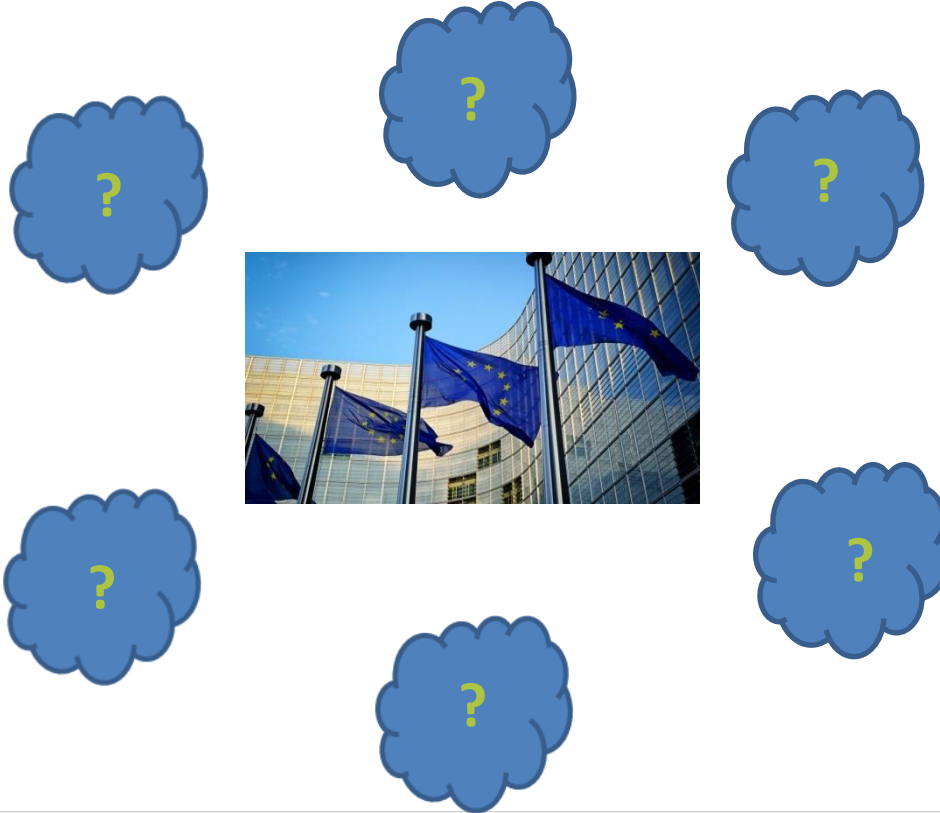
- ✿ ZFN 1 and 2
- ✿ ODM, as
- ✿ RdDM,
- ✿ grafting on GM rootstock,
- ✿ reverse breeding,
- ✿ agro-infiltration “sensu stricto”
- ✿ and agro-inoculation

**Identification possible** only for:

- ✿ ZFN 3 technology,
- ✿ cisgenesis/intragenesis

Since 2012/13...

---





2015/2016

---

Scientific advances

Products ready to market

International developments

Increased awareness of importance



[Commission Interpretative Document on NPBTs \(Jan. 2016?\)](#)





SPEAK UP  
FOR SEEDS!





## CONTACT

ESA European Seed Association  
Rue du Luxembourg 23  
B 1000 Brussels  
T. +32 (0)2 743 28 60  
[secretariat@euroseeds.eu](mailto:secretariat@euroseeds.eu)

## FOLLOW US ON

