



At the crossroads -
what future for plant breeding innovation in Europe?



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





A NEED FOR SPEED

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

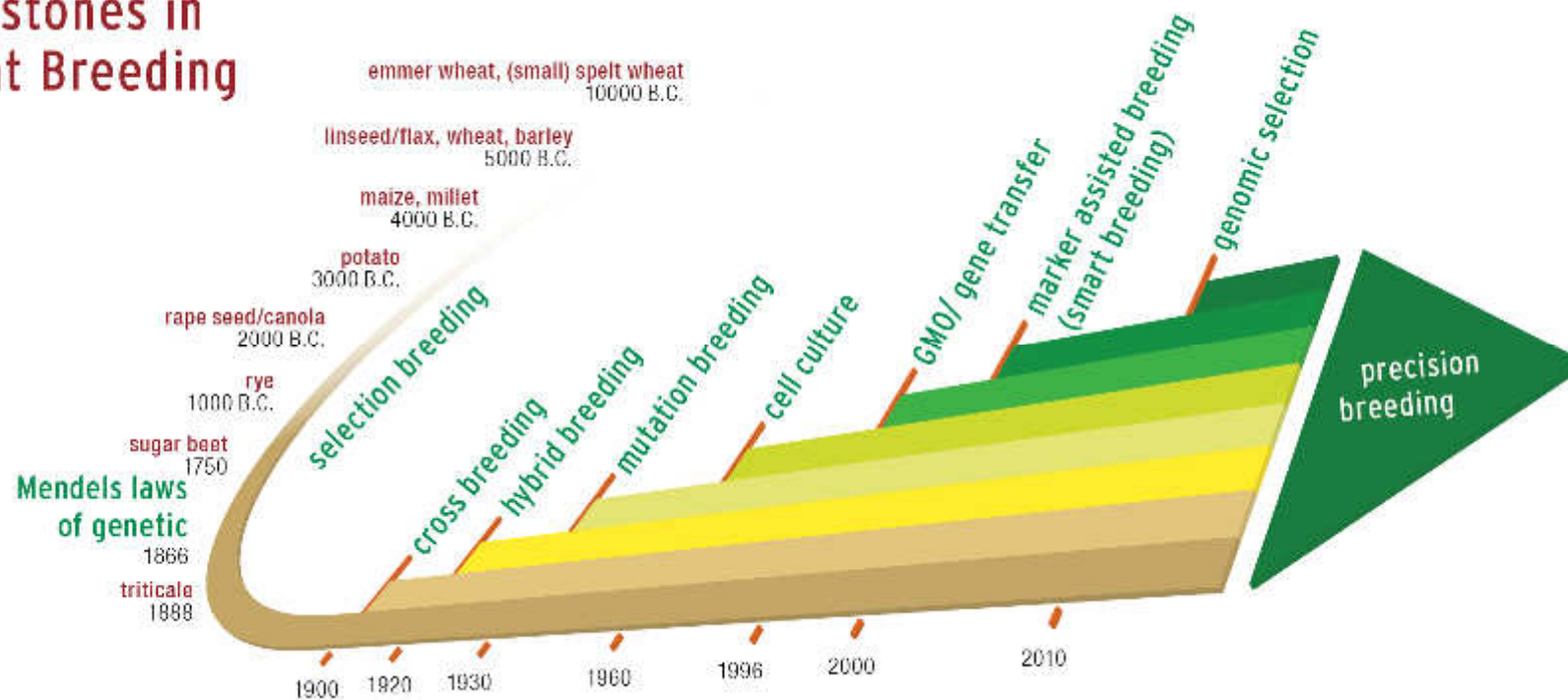


We need to do more and better – and faster!



SMARTENING UP

Milestones in Plant Breeding





THE NEXT FRONTIER: GETTING EVEN SMARTER

RNA-dependent DNA methylation

PLANT agro-inoculation

REVERSE BREEDING **ZINC FINGER NUCLEASE**

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**
- 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 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
- Over-regulation of NPBTs could 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** for:

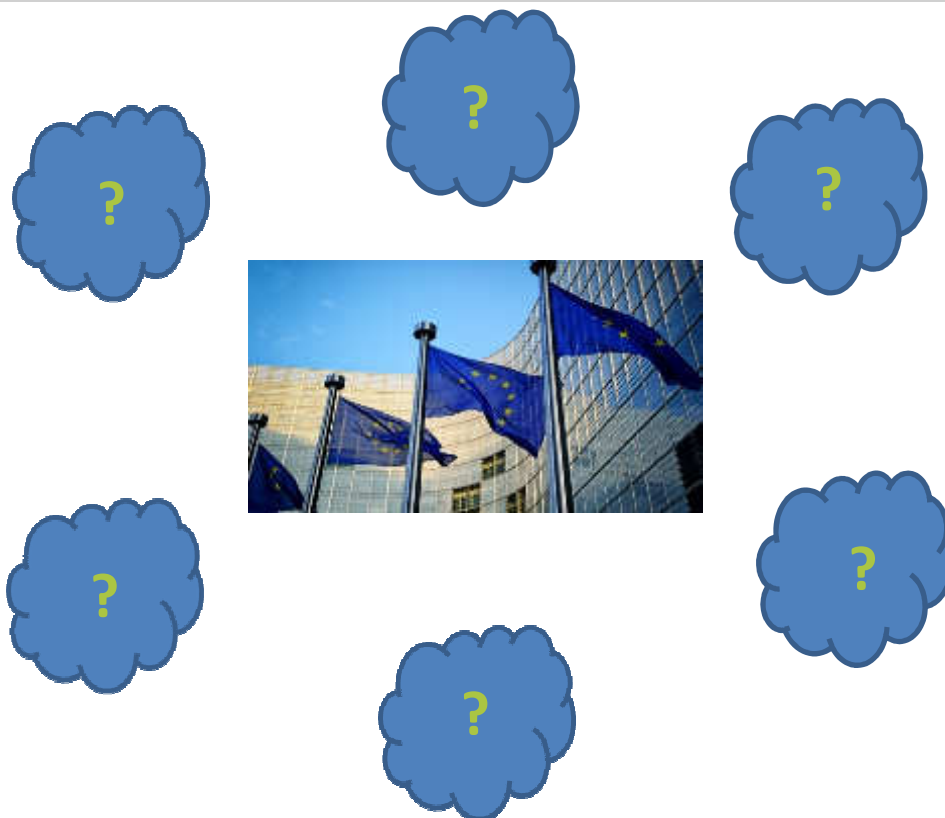
- ✿ ZFN 1 and 2
- ✿ ODM
- ✿ RdDM
- ✿ reverse breeding
- ✿ agro-infiltration “sensu stricto”
- ✿ agro-inoculation

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 (early 2016?)



SPEAK UP
FOR SEEDS!





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