ESA

THE ECONOMIC, SOCIAL AND ENVIRONMENTAL VALUE OF PLANT BREEDING INNOVATION

ATHENS, 15.09.2017

Yield developments in the European Union

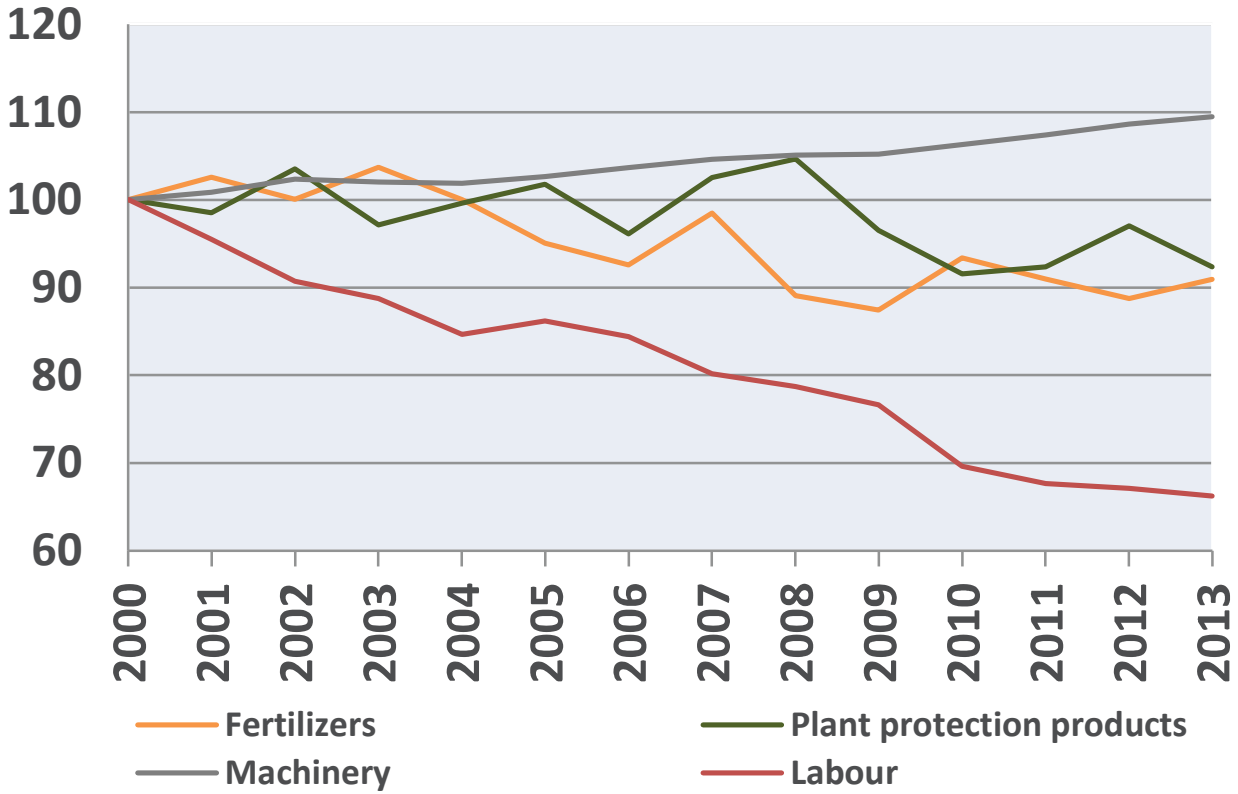
Crop	Yield growth rate % per year
Wheat	0.84
Corn	1.26
Other cereals	0.94
Oilseed rape	0.98
Sunflower seeds	2.15
Other oilseeds	0.19
Sugar beets	2.46
Potatoes	1.85
Pulses	1.77
Average	**1.1**

Productivity and plant breeding

- ✓ Global yield growth needed to satisfy current and forthcoming agricultural demands is **more than 2%** per annum.
- ✓ The increase of crop yields is **slowing down** although land productivity in the EU is still increasing.
- ✓ Observable yield improvements are usually a **multifactorial outcome.**

Source: HFFA Research GmbH (2016).

Change in use of agricultural inputs in the EU



EU reduced its use of specific agricultural inputs:

- ✓ Labor use (↓ 3.1% p.a)
- ✓ Fertilizer use (↓ 1.1% p.a)
- ✓ PPP use (↓ 0.6% p.a)

EU increased its use of specific agricultural input:

- ✓ Machinery use (↑ 0.7% p.a)

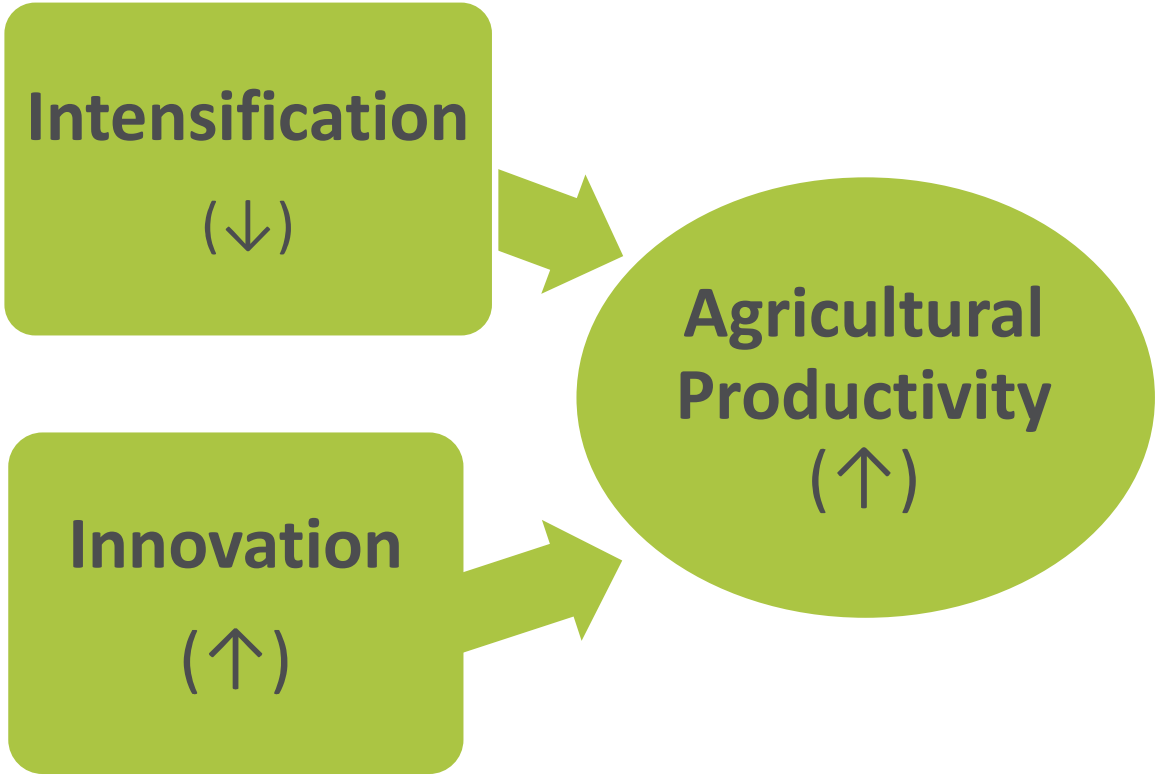
Additionally, the **use of arable land** in the EU has **decreased** by more than **6%** since 2000.

Use of inputs and labour in arable farming of EU, 2000–2013 (index, 2000 = 100)

Source: HFFA Research GmbH (2016).

Productivity growth and innovation

- ✓ **The input use** (plant protection products, fertilisers and labour) **decreased at a rate of 0.6% per year** in EU arable farming (2000-2013).
- ✓ **Agricultural production** on available acreage in the EU as a whole **has not intensified.**

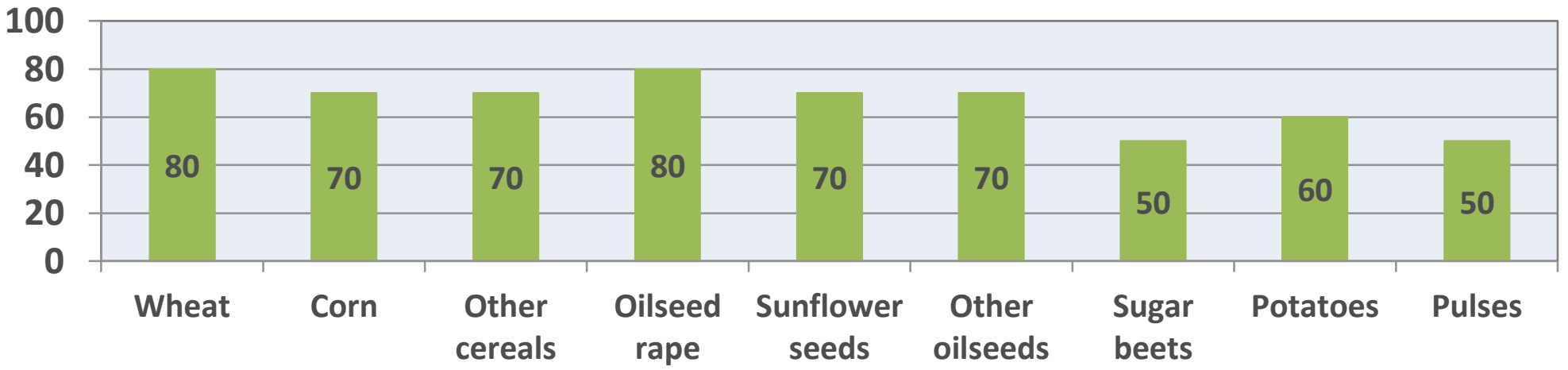


Better inputs rather than more inputs!

Source: HFFA Research GmbH (2016).

Plant breeding for productivity growth in EU agriculture

- ✓ **Shares of plant breeding innovation** in relation to other improved agronomic practices are currently between **50 and 80 %.**

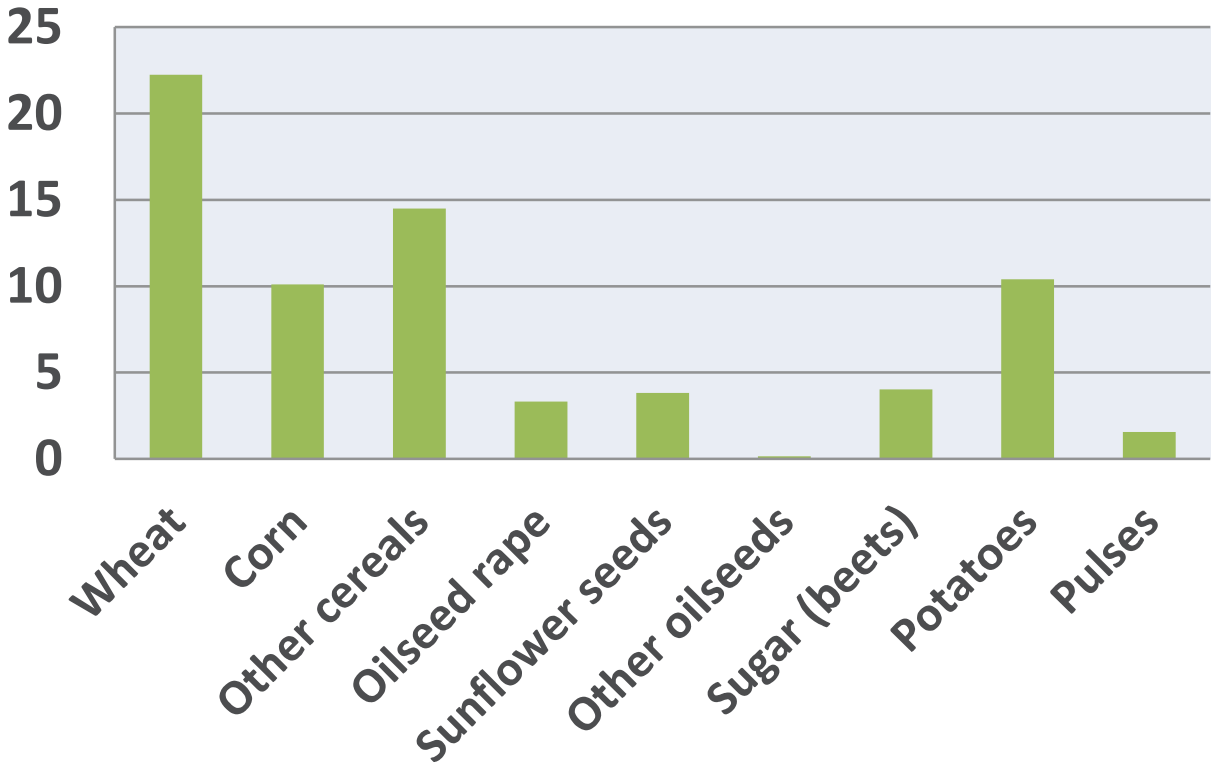


Approximate innovation share of EU plant breeding (in %)

Source: HFFA Research GmbH (2016).

- ✓ A 50% share of plant breeding in productivity growth in crop production may be assumed in the past decades of the last century.
- ✓ Higher shares are expected for future years.

Plant breeding – ensuring food security



Thanks to plant breeding, every year farmers in EU grow additional:

- ✓ 22 million tons of wheat
- ✓ 10 million tons of corn
- ✓ 10 million tons and potato
- ✓ 3.3 million tons of oilseed rape…

EU plant breeding has largely **improved global food supply** - enough to additionally **feed 160 million** people with kcal.

Additional annual crop supply of plant breeding in EU since 2000 (in 10^6 tons)

 Source: HFFA Research GmbH (2016).

WHEAT

Thanks to plant breeding over the last 15 years, EU wheat harvests have grown by more than 22 million tons.
That's enough for

32 billion loaves of bread

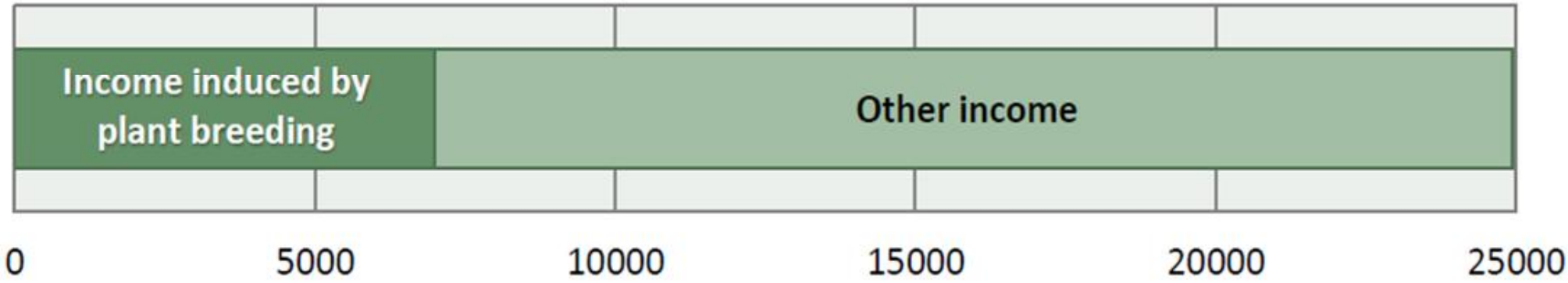
64 loaves for every person in the EU!

A world without plant breeding would mean less food security and higher prices.

Research source: http://bit.do/plantetp-HFFAResearch
More info: www.plantetp.org

Plant breeding – securing rural incomes and jobs

- ✓ Altogether plant breeding contributed more than EUR **14.5 billion to EU GDP** in the last 15 years.
- ✓ Plant breeding for arable crops in EU since 2000 has generated an **additional annual income** of almost **7 000 EUR for 1.2 million farm workers** compared to a situation with no plant breeding for years.



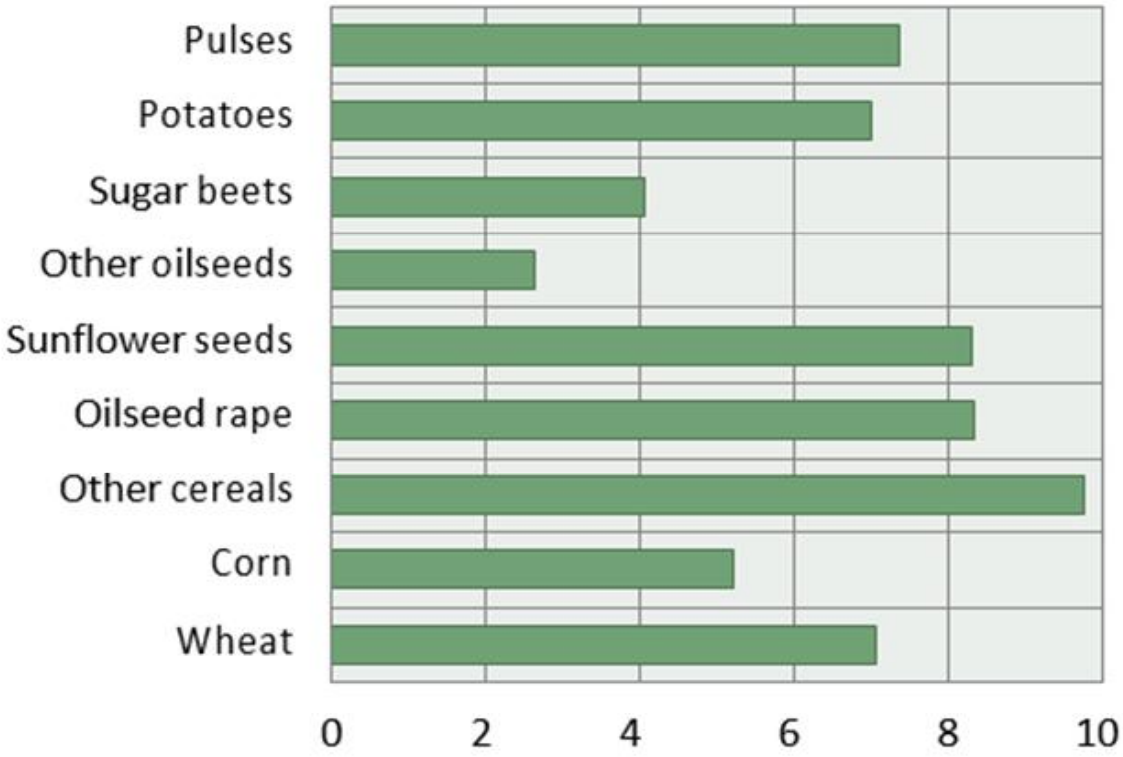
Income induced by plant breeding in EU since 2000 (farm net value added in EUR/AWU)

Source: HFFA Research GmbH (2016).

Plant breeding – keeping food prices down

Without the last 15 years of plant breeding advances prices at international agricultural commodity markets would have been 3 to 10 % higher they are at present.

- ✓ **Wheat and potatoes** would cost **7% more.**
- ✓ **Sunflower products** would cost **8% more.**
- ✓ **Corn** would cost **5% more.**



Avoided price increases with plant breeding for major arable crops in EU the last 15 years (in percent)

Source: HFFA Research GmbH (2016).

Plant breeding – keeping the EU competitive

Without plant breeding:

- ✓ Agricultural trade balance would suffer.
- ✓ EU arable production would be substituted by trading partners.

The EU would become **a net importer** in all major arable crops, including those we currently export

Wheat

Barley

Potatoes

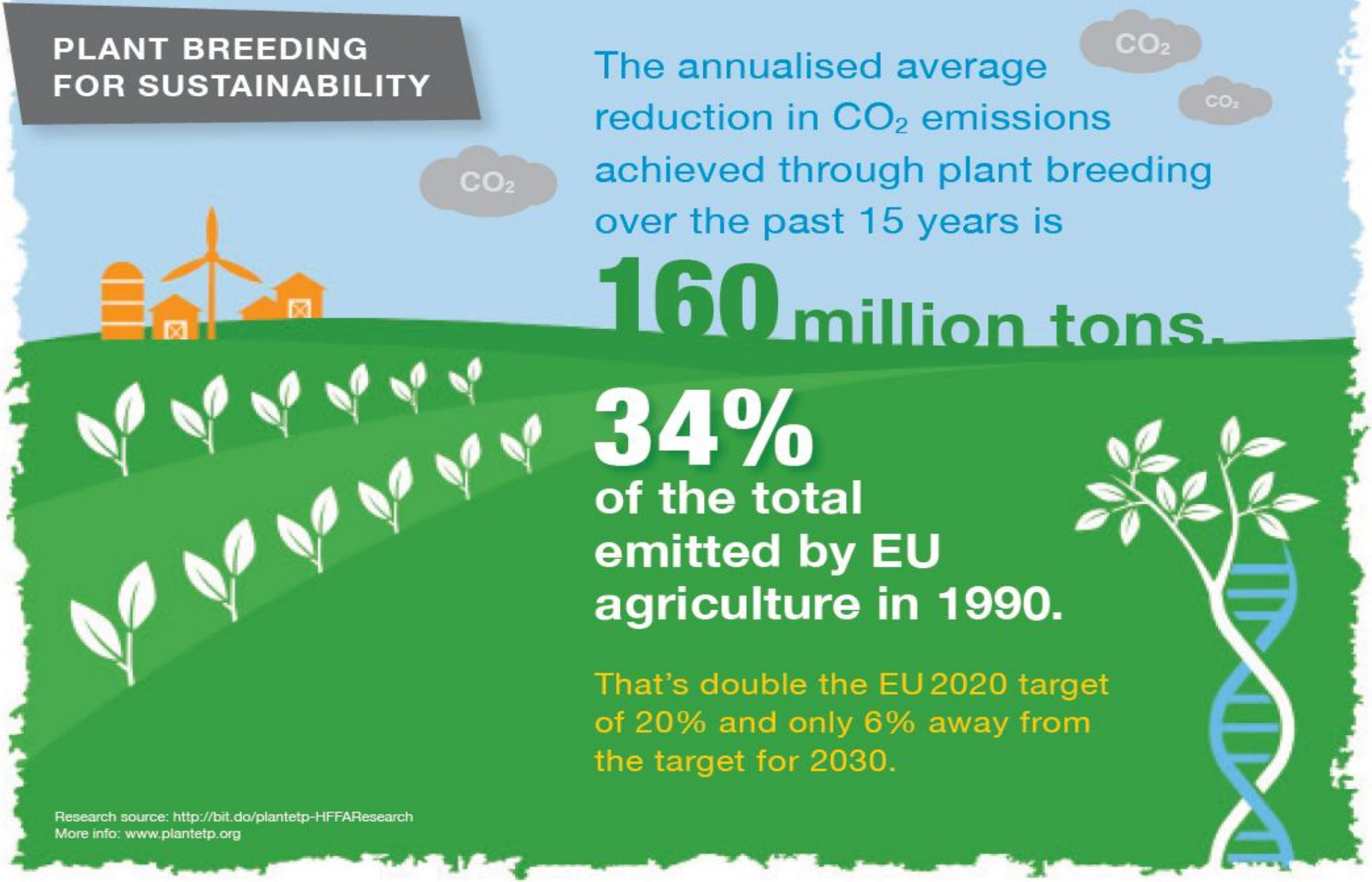
PLANT BREEDING FOR SUSTAINABILITY

Without plant breeding, Europe would need an extra 19 million hectares of farm land to produce the same amount of food.

Turning 19 million hectares of forests, wetlands and other habitats into farmland would have the same impact as deforesting an area of the Amazon the same size as Latvia, rich in wildlife and biodiversity.

Research source: http://bit.do/plantetp-HFFAResearch
More info: www.plantetp.org

PLANT BREEDING FOR SUSTAINABILITY



The annualised average reduction in CO_2 emissions achieved through plant breeding over the past 15 years is

160 million tons.

34%

of the total emitted by EU agriculture in 1990.

That's double the EU 2020 target of 20% and only 6% away from the target for 2030.

Research source: http://bit.do/plantetp-HFFAResearch
More info: www.plantetp.org

PLANT BREEDING FOR SUSTAINABILITY

Without plant breeding, Europe would need an extra 19 million hectares of farm land to produce the same amount of food.

Turning 19 million hectares of forests, wetlands and other habitats into farmland would release 3.4 bn tons of CO_2.

Annualised, that's the same as all the greenhouse gas **emissions from traffic in Germany,** or the annual CO_2 emissions of **a country like the Netherlands.**

Research source: http://bit.do/plantetp-HFFAResearch
More info: www.plantetp.org

PLANT BREEDING INNOVATION IN EUROPE

making a difference to agriculture and our world

ENSURING FOOD SECURITY

Thanks to plant breeding, every year farmers in the EU grow an extra:

22 million tons of Wheat

3.3 million tons of Oilseed rape

10 million tons of Potatoes

KEEPING FOOD ON OUR PLATES

The past 15 years of plant breeding accounts for:

80% of growth in Wheat and Oilseed Rape harvests

60% of growth in Potato harvests

SECURING RURAL INCOMES AND JOBS

The benefits of better harvests have included:

A contribution of more than €14bn to EU GDP

1.2 million farm workers earn on average €7,000 more annually

ENSURING SUSTAINABILITY

Through plant breeding, Europe has:

Prevented biodiverse habitat the size of Latvia being turned into farmland

Saved enough water to fill 22 million Olympic swimming pools

KEEPING FOOD COSTS DOWN

Without the last 15 years of plant breeding advances:

Wheat and Potatoes would cost 7% more

Sunflower products would cost 8% more

DELIVERING MILLIONS OF TONS OF FOOD

Since 2000, plant breeding has enabled EU farmers to produce enough extra calories to feed at least **160 million people a year**

By 2030, plant scientists hope to increase the harvests of key crops by **76 million tons**

MEETING EU 2020 TARGETS

The annualized average **reduction of CO_2** emissions due to plant breeding is around 160 million tons

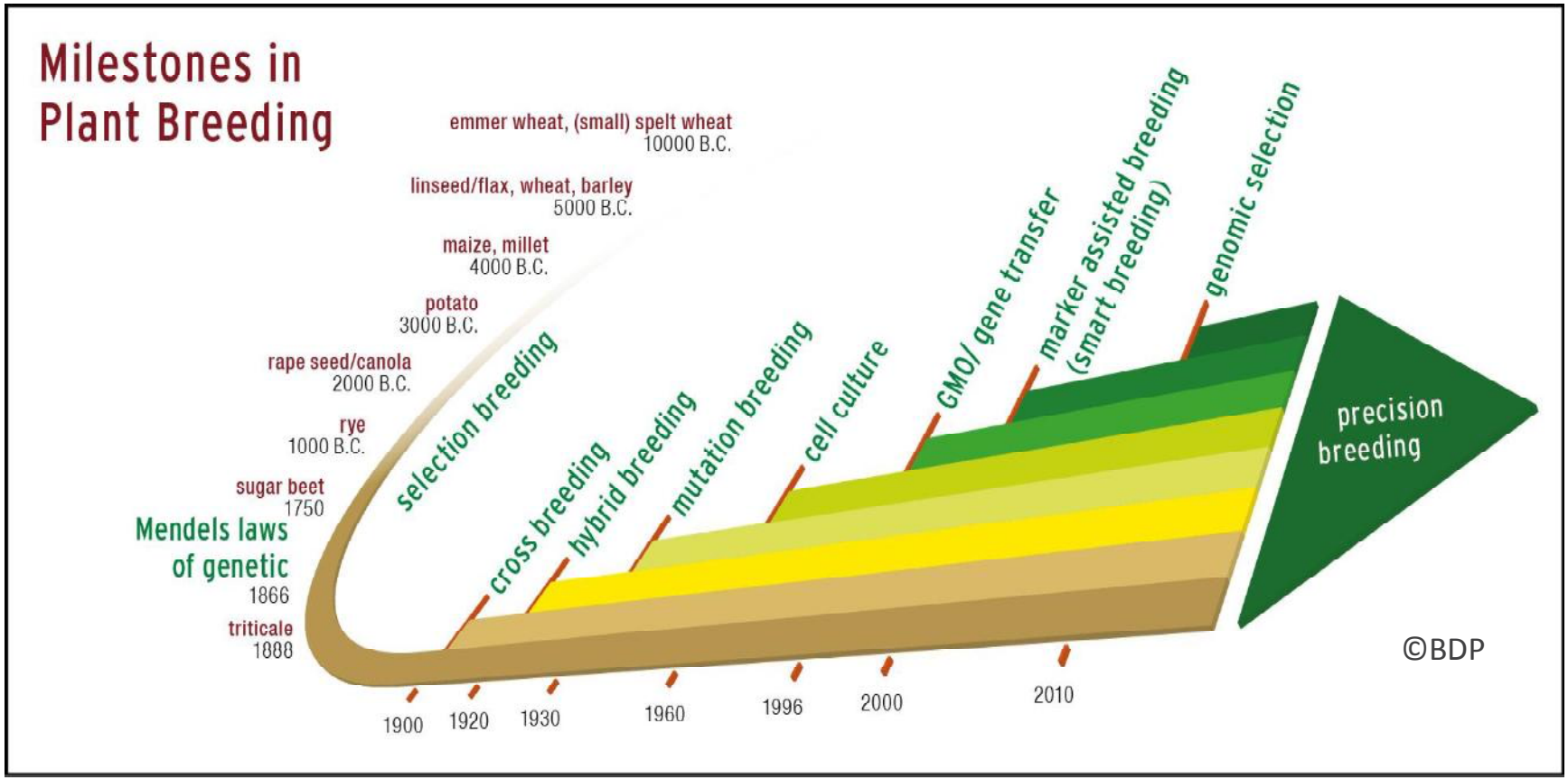
That's nearly double the EU 2020 target

Speak Up For Seeds!

Research source: http://bit.do/plantetp-HFFAResearch

More info: www.plantetp.org

PLANT BREEDING INNOVATION: THE NEXT FRONTIER...



Genome editing & the CRISPR revolution

Classical mutagenesis

Classical transgenesis

Random Mutation	Targeted Mutation (SDN-1)	Targeted Edit (SDN-2)	Targeted Replacement (SDN-3)	Targeted Insertion (SDN-3)	Targeted Insertion (SDN-3)	Random Insertion
unspecific nucleotide 1-exchanges, 2-additions or 3-deletions		small edits (specific base pair exchanges, additions or deletions) or replace a gene from **plant's own** gene pool		of a gene from **plant's own** gene pool	of gene from **outside plant's own** gene pool	

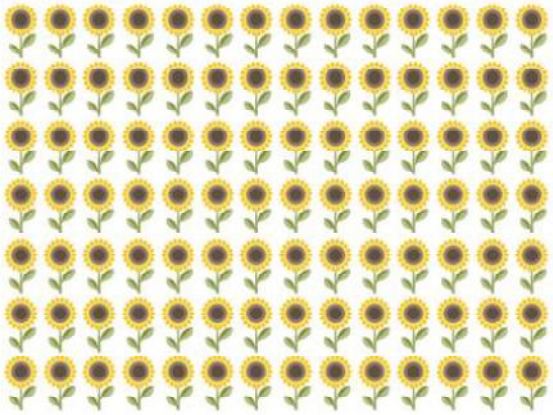
Faster and more efficient to identical results

Crossing and Selection

High-performance variety

Wilde type with desired trait

7 generations / about 1000 plants



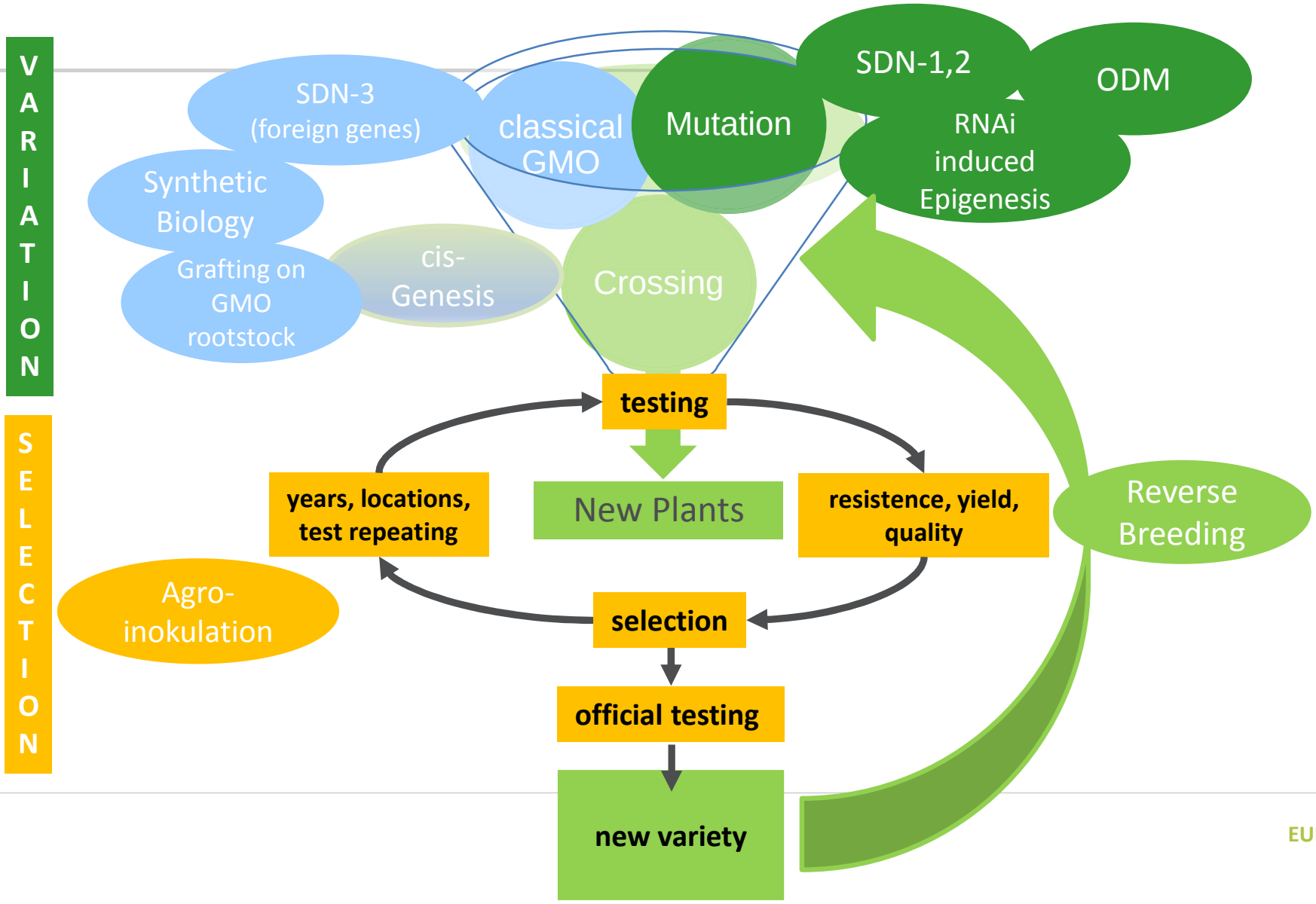
Improved high-performance variety

Genome Editing – SDN1/2

High-performance variety

2 generations / about 20-50 plants

How do the new methods fit into the breeding process?



THE LATEST PLANT BREEDING METHODS: IMPORTANCE TO BREEDERS

- Methodologies can be used across all agriculturally important crops

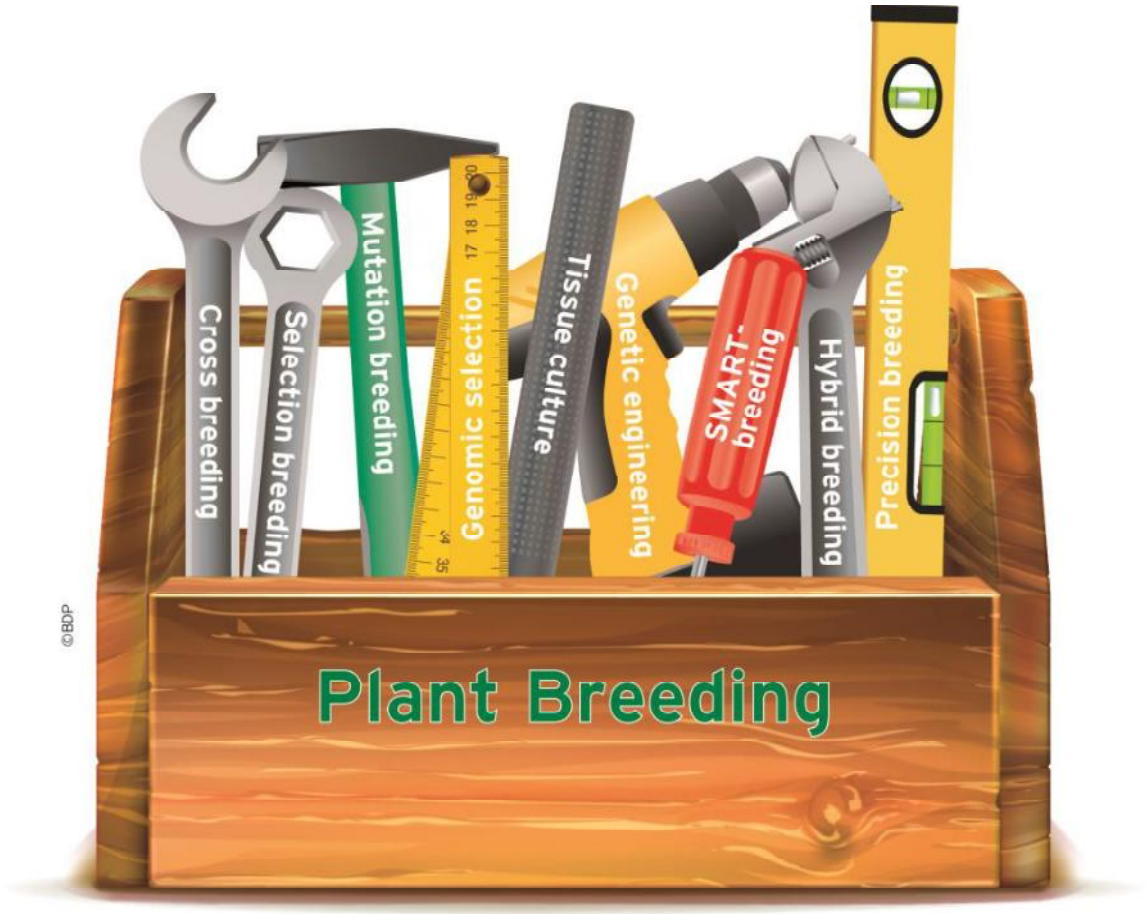
- Efficient and precise
  - Reduces R&D and breeding time
  - Important for plants with long generation times
  - Important for crops with rapidly evolving diseases and pests

- Accessible & relatively inexpensive
  - Important to companies of all sizes

RISK OF CUMBERSOME REGULATIONS FOR EUROPE'S AGRICULTURE

- Prevent esp. SME's from developing and using these methods
- Eroding competitiveness and leading to a less diversified plant breeding sector
- Exodus of innovative breeding companies from Europe
- Competitive advantage to the plant breeding industries outside Europe
- European scientific excellence (private and public), related jobs, innovation and consequently economic growth driven out of Europe;
- Small size of niche markets would not justify the regulatory approval costs
  - Portfolio of products reduced
  - less choice in products for Europe's farmers, growers, processing industries and consumers;
- Achieving goals of increased sustainability of EU agriculture will be put at risk

WINNING THE FUTURE: USE ALL TOOLS TO FOSTER INNOVATION



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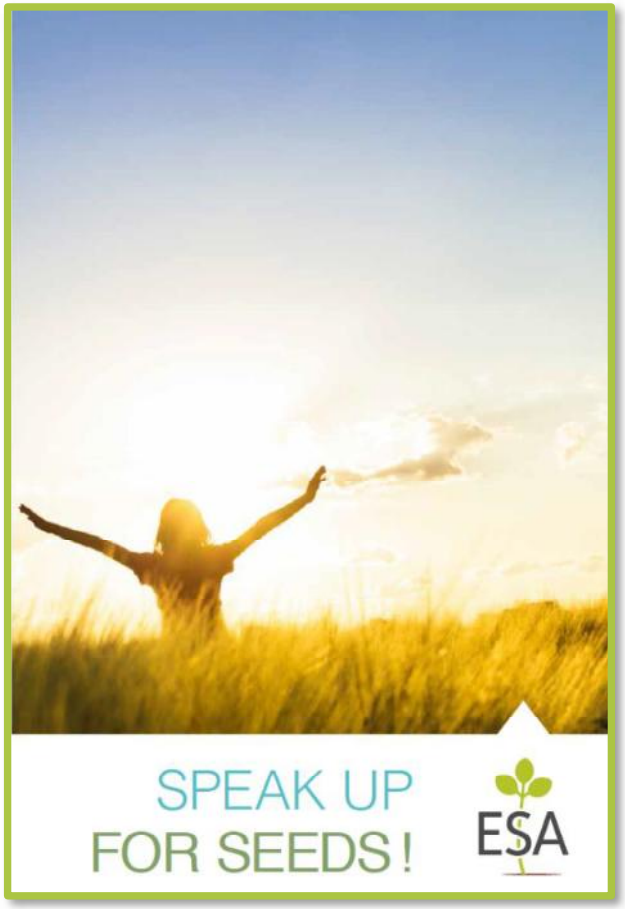
JOIN US! – SPEAK UP FOR PLANT BREEDING INNOVATION!



and...

SPEAK UP FOR SEEDS!

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