The socio-economic and environmental values of plant breeding in the EU

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Content

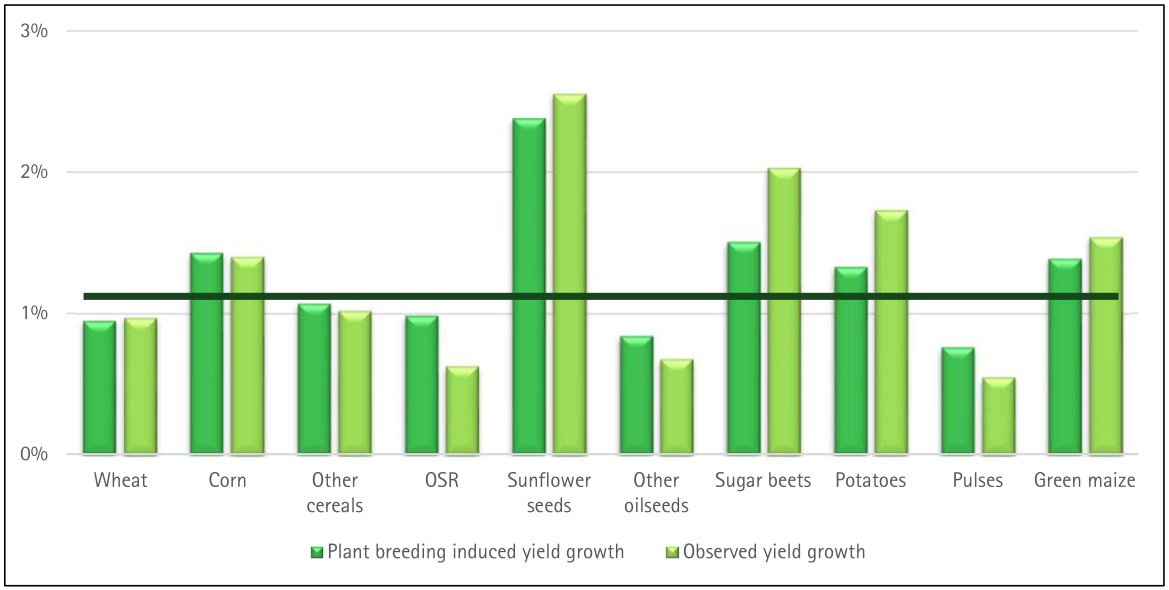
- **Ex-post evaluation (2000-2019)**:
  - → Yield developments and importance of plant breeding for EU productivity growth
  - → Modelling results referring to the year 2020
- **Ex-ante assessment (2020-2039)**:
  - → Future scenario including the EU "Farm to Fork" and "Biodiversity" strategies
  - → Modelling plant breeding impacts in 2030 / 2040 and effects of the two strategies
- **Case study analyses** for the impact of New Plant Breeding Techniques (NPBT)
- **Recommendations** for private business and policy-making

The socio-economic and environmental values of plant breeding in the EU were calculated for effects on …

- Yield growth
- Trade
- Sector / farm income
- Land use / net virtual land trade
- GHG emissions
- Biodiversity
- Market supply
- Market prices
- GDP
- Jobs
- Food availability
- Water use

Plant breeding is responsible for approximately 66 percent of annual productivity growth

Plant breeding-induced vs. real yield growth per year



- Shares of plant breeding in innovation-induced yield growth are between 59 and 75 percent.
- On average, weighted by hectare:
  → **1.16 percent per annum** productivity growth through plant breeding.
- Plant breeding has a tremendous impact on EU arable farming.

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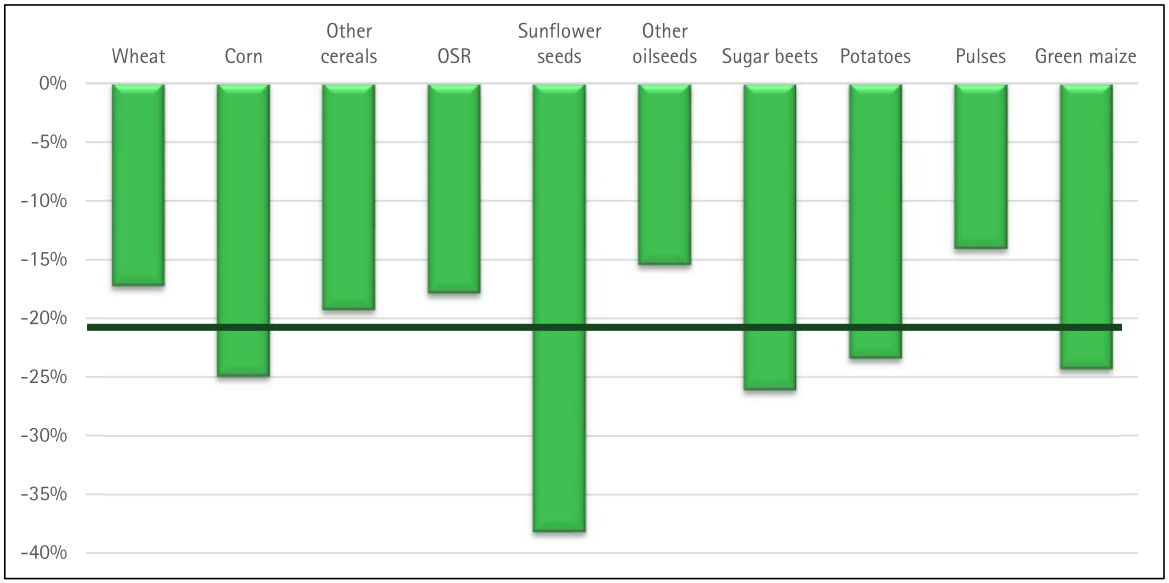
Without 20 years of plant breeding in the EU yields would be over 20 percent lower

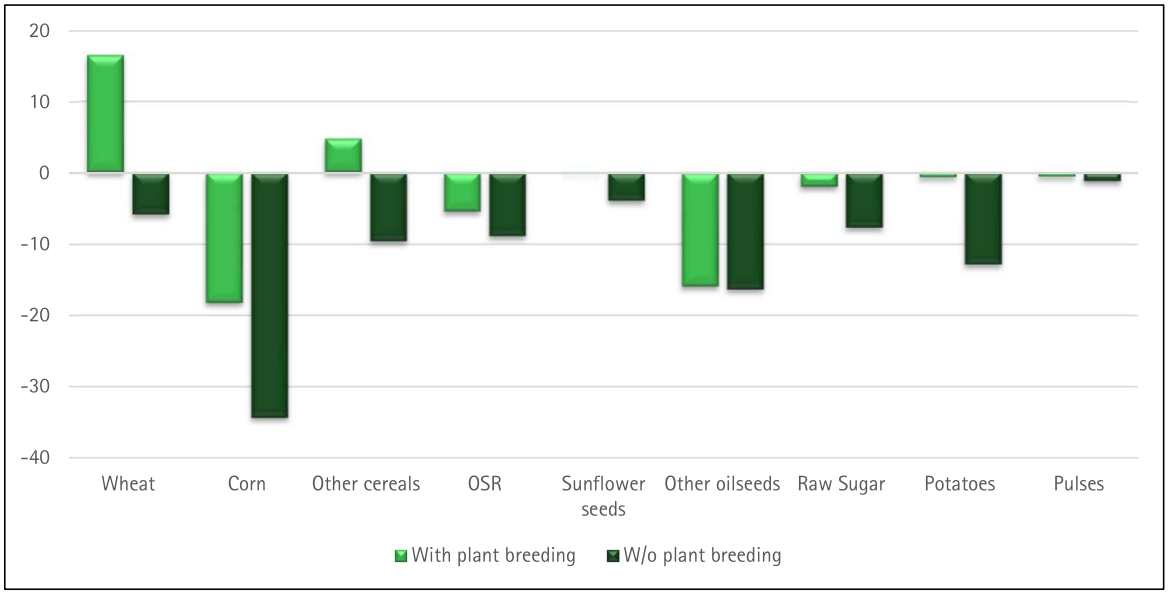
Yield shock (2020) w/o EU plant breeding (2000–2019)



- Without 20 years of plant breeding, yields in EU arable farming today would be significantly lower.
- On average, hectare-weighted, **a minus of 20.6 percent** would have occurred.
- Considerable amounts of wheat, corn, etc. would be missing!

Without 20 years of plant breeding the EU would become a major net importer

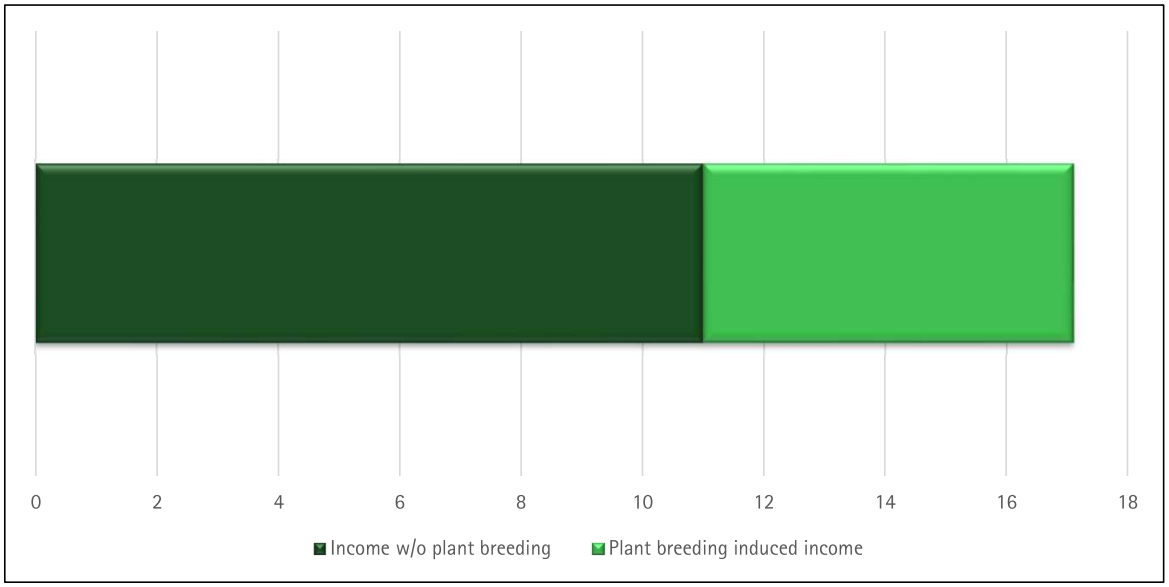
Net trade with and w/o plant breeding (in million tons)



- Without 20 years of plant breeding, the EU would become a net importer in all arable crops:
  → **including wheat and other cereals**
- International competitors would gain in competitiveness and increase their market shares.

Without 20 years of plant breeding EU arable farmers would have a considerably lower income

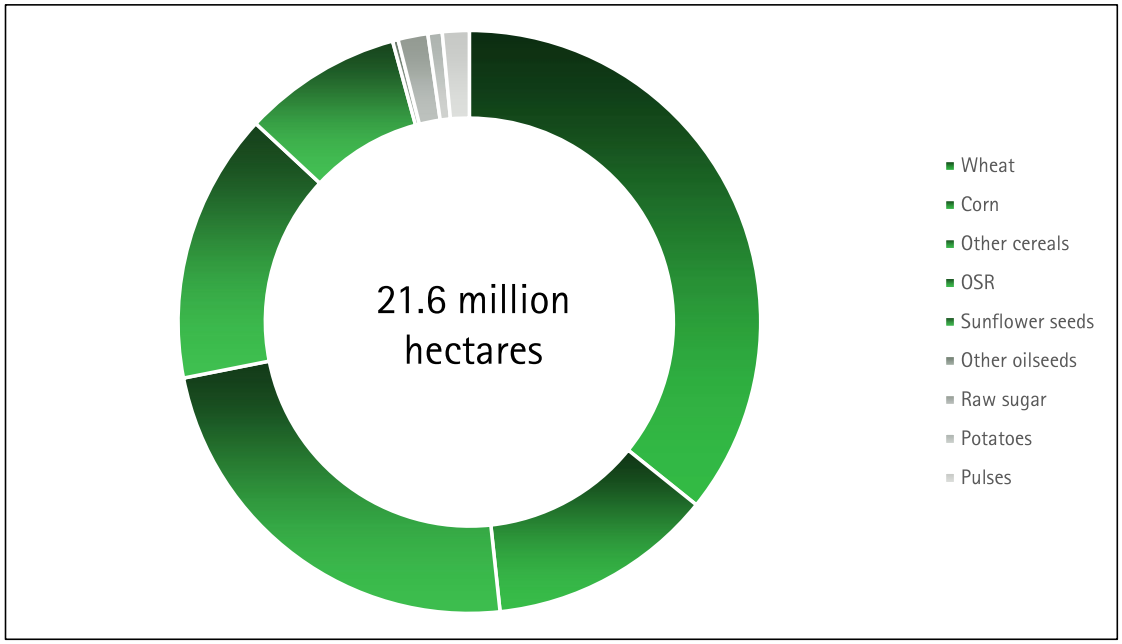
Income with and w/o plant breeding (in 1,000 EUR/AWU)



- Without 20 years of plant breeding, the current annual income of an EU arable farmer would be **6,100 EUR lower** (i.e., one third of 17,100 EUR).
- In terms of the agricultural value added, approximately **14 billion EUR** would be missing today.

Without 20 years of plant breeding in the EU 22 million hectares of additional land would be needed

Additional global land use w/o plant breeding in the EU



- Without 20 years of plant breeding, scarce global resources would additionally be exploited:
  - → N. Am.: 2.4 million ha
  - → S. Am.: 1.8 million ha
  - → Asia: 2.9 million ha
  - → MENA: 3.6 million ha
  - → SSA: 2.3 million ha
  - → Oceania: 2.7 million ha
  - → CIS: 5.3 million ha
  - → RoW: 0.5 million ha

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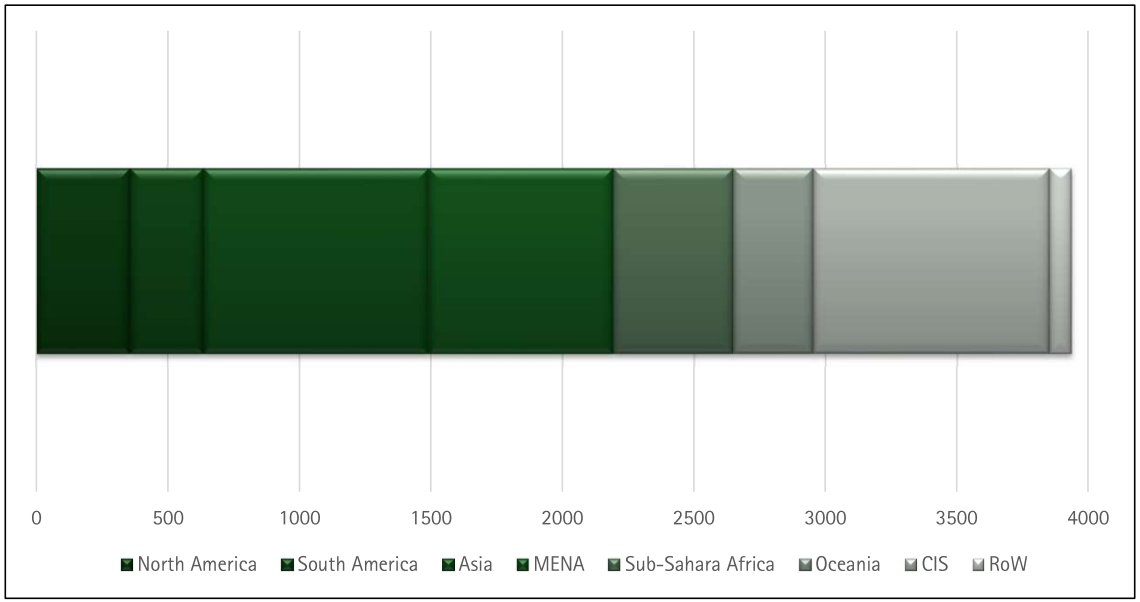
Without 20 years of plant breeding in the EU almost 4 billion tons of additional GHG would have been emitted

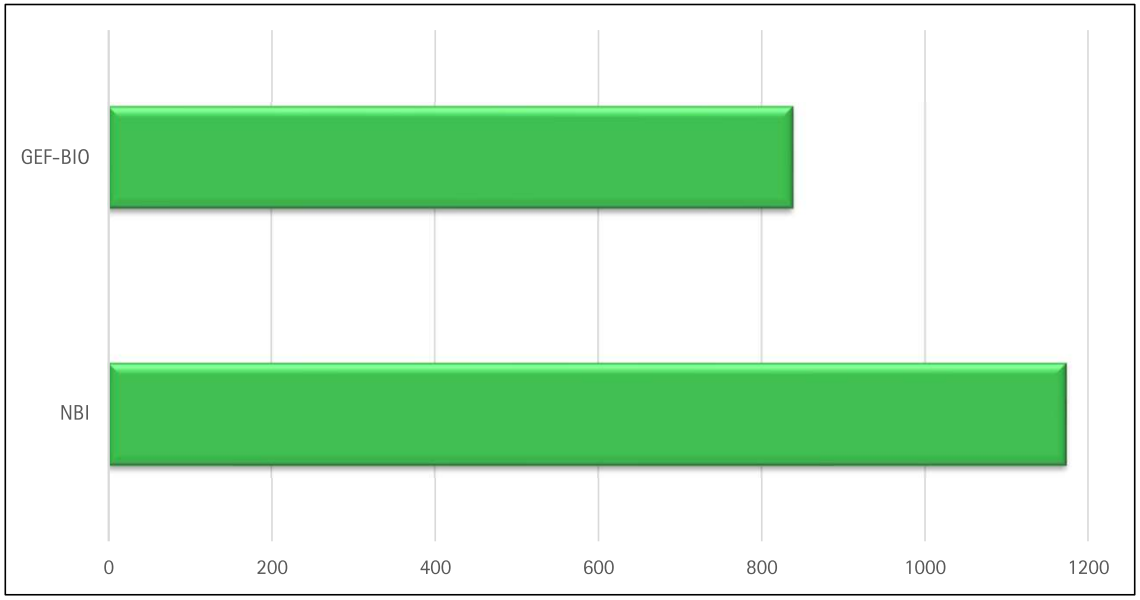
Avoided global GHG emissions due to EU plant breeding (in million tons of CO_2-equivalents)



- Almost 4.0 billion tons of CO_2 emissions did not occur due to avoided land use effects:
  - → Being a one-time effect, it equals 4-5 times the annual German GHG emissions.
  - → Annualised it is as large as the **yearly GHG emissions of The Netherlands.**

20 years of plant breeding in the EU helped avoid significant biodiversity losses

Avoided global biodiversity losses due to EU plant breeding (in million biodiversity "points")



- 830 million "points" are equal to biodiversity found in 8.3 million hectares of Brazilian habitats:
  → Compensation for **11 years of deforestation/savannah loss.**
- Similarly, 1,180 "points" equal biodiversity found in 11.8 million hectares of habitats in Indonesia:
  → Compensation for **26 years of deforestation/grassland loss.**

Future scenario including F2F and Biodiversity strategies

- **Future reference scenario**:
  - → In accordance with latest projections of the European Commission
  - → Plus, organic farming on 25 percent of all utilised agricultural area
  - → In addition, 10 percent of non-productive land
  - → Moreover, 50 percent less plant protection products and measures
  - → Finally, 20 percent less nitrogen fertilisers

Until 2030

- **Mitigation scenario**:
  - → Plant breeding in the next 10 and 20 years
  - → Can it close the gap arising from (non-intended) effects of the two strategies?

Production losses of more than 23 percent can be expected if the strategies are implemented by 2030

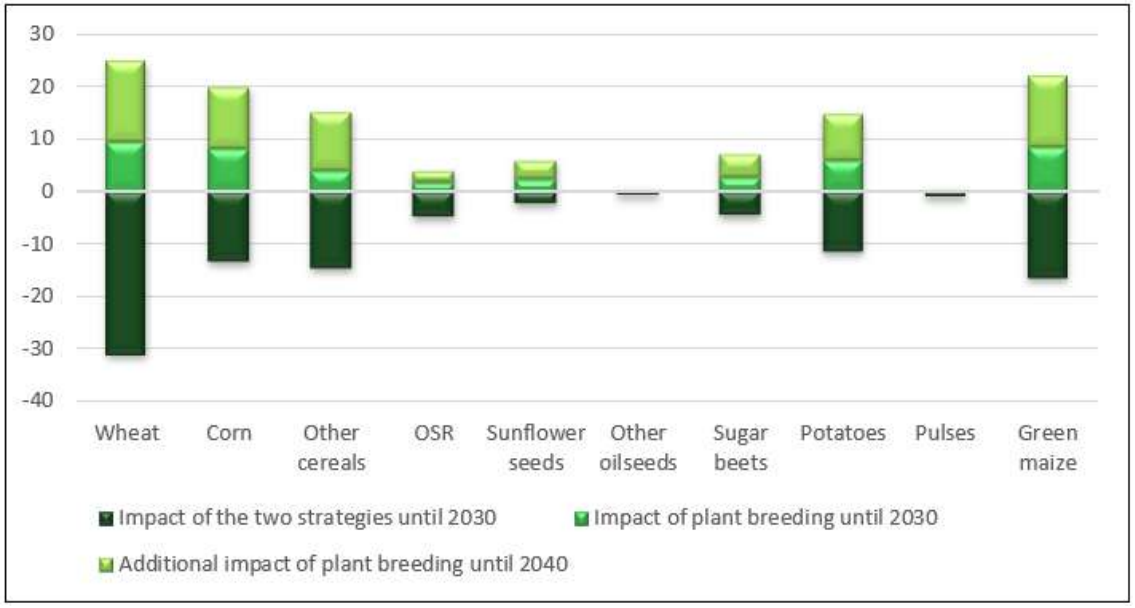
Production losses until 2030 (in percent)

Crop/Region	EU	DE	FR	IT	ES	UK
Wheat	26	32	29	23	22	31
Corn	22	30	22	19	19	23
Other cereals	23	31	22	22	21	23
OSR	24	28	25	19	19	26
Sunflower seeds	22	28	22	19	19	23
Other oilseeds	22	28	22	19	19	23
Raw sugar	21	19	25	27	27	26
Potatoes	23	29	24	22	22	26
Pulses	20	30	18	24	24	19
Green maize	23	30	24	22	22	26

- On average, hectare-weighted, production losses of more than **23 percent** might be the outcome for the EU in total if the strategies are fully implemented by 2030:
  - → **10 percent** from non-productive land
  - → **13 percent** from lower yields due to input change.

Plant breeding until 2040 will only be able to partially compensate for market losses

Comparing and balancing partial market supply effects



- Extra market supply in 2030 with plant breeding between 2020 and 2029 won't be enough to compensate for losses of the strategies.
- Two decades of plant breeding progress at current pace will potentially compensate for market losses with respect to six crops.
- In the cases of **wheat, OSR, other oilseeds** and **pulses**, however, this might not be adequate.
- Plant breeding should speed up.

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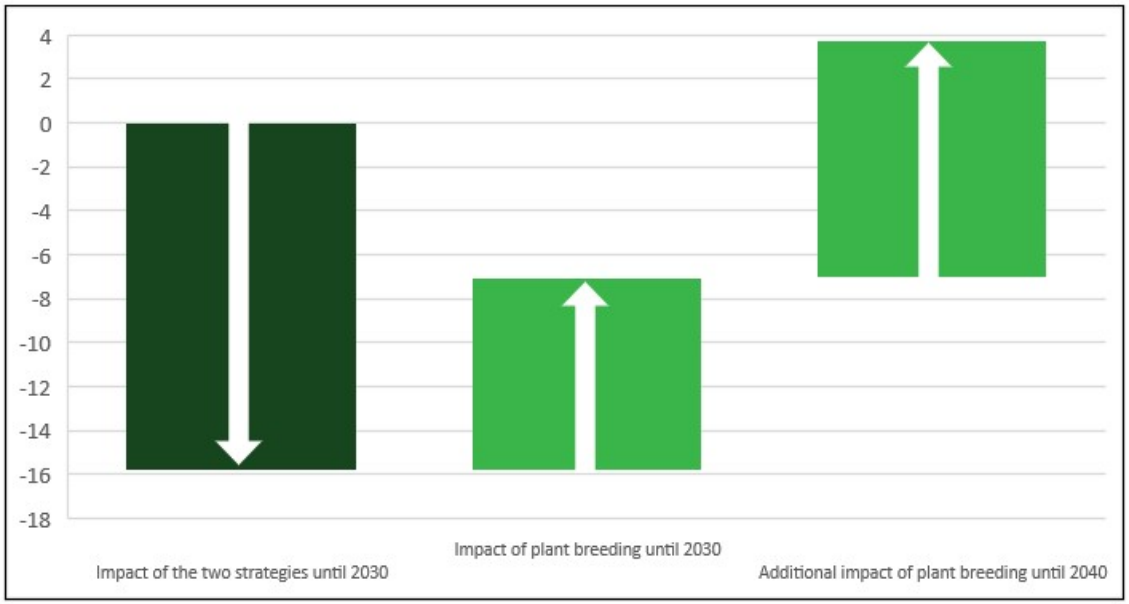
Plant breeding can help compensate sectoral income losses until 2040

Comparing and balancing sectoral income effects



- The implementation of the two EU strategies until 2030 (as defined) would lead to sectoral income losses equivalent to 15.8 billion EUR.
- One additional decade of plant breeding may reduce this loss by 8.7 billion EUR in 2030.
- Two additional decades of plant breeding could reduce it by 19.5 billion EUR in 2040.
- On balance: **-7.1 (+3.7) billion EUR in 2030 (2040).**

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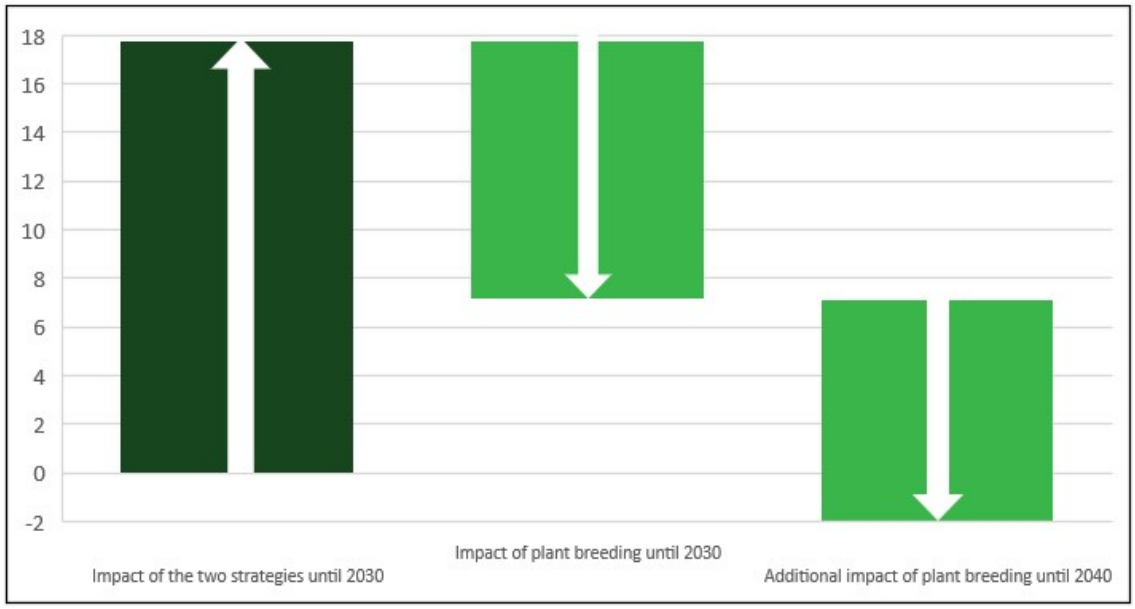
Plant breeding until 2040 can help compensate for almost 18 million hectares additional global land use

Comparing and balancing virtual land use effects



- The implementation of the two EU strategies until 2030 (as defined) would lead to 17.9 million hectares additional global land use.
- One additional decade of plant breeding may reduce this extra use by 10.7 million hectares until 2030.
- Two additional decades of plant breeding could reduce it by 19.8 billion hectares in 2040.
- On balance: **+7.2 (-1.9) million hectares in 2030 (2040).**

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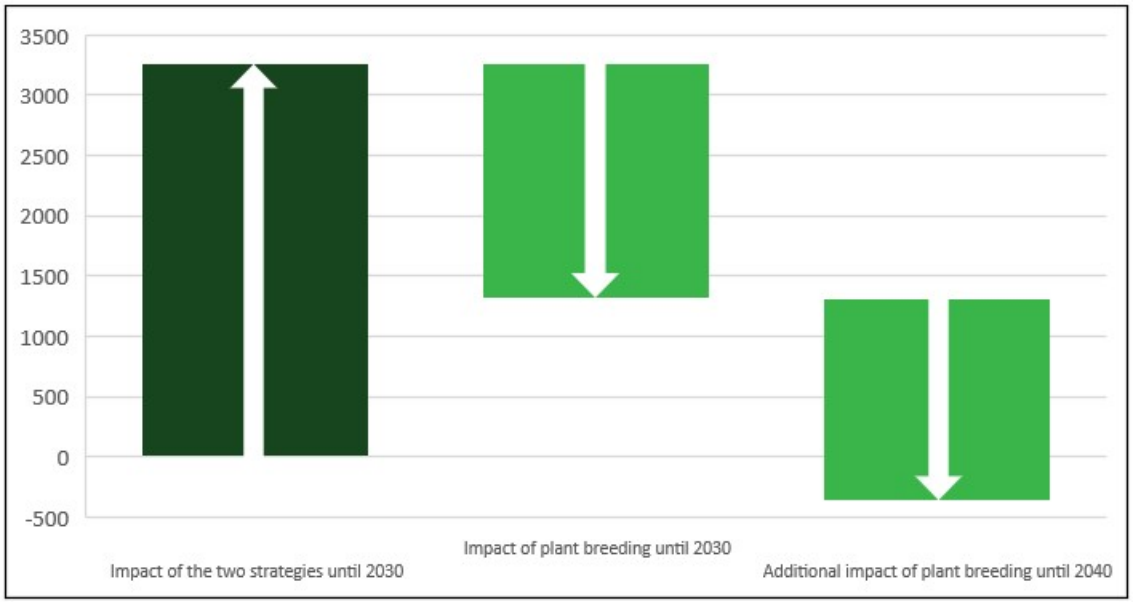
Plant breeding until 2040 can help compensate additional GHG emissions

Comparing and balancing GHG emission effects



- The implementation of the two EU strategies until 2030 (as defined) would lead to **3.3 billion tons additional GHG emissions** at global scale.
- One additional decade of plant breeding may reduce these emissions by 1.9 billion tons until 2030.
- Two decades of plant breeding could avoid 3.6 billion tons until 2040.

NPBT can speed up breeding and help achieve goals of the "Farm to Fork" and Biodiversity strategies

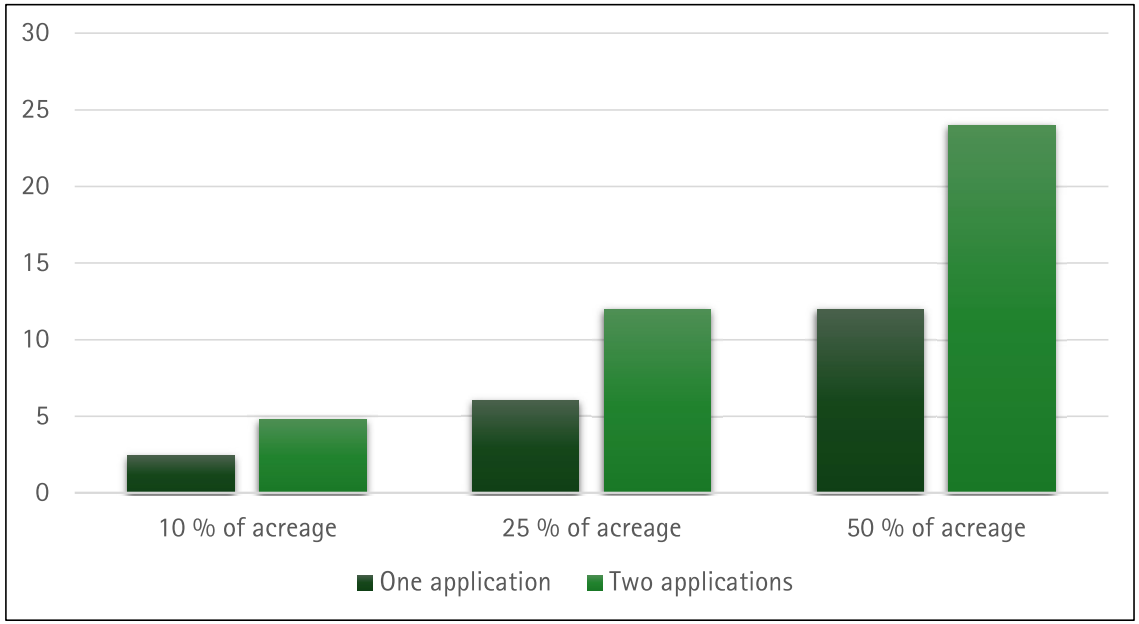
- **Scenario:**
  - → Conservative calculation: Saving two years of variety development
  - → Speed up plant breeding progress per time unit by 18 percent
  - → Not only 1.16 but 1.34 percent plant breeding-induced yield progress per annum in few years from now
  - → Until 2040: an extra yield increase of 2.6 percent

- **Positive effects:**
  - → Provide extra food for almost 20 million more humans
  - → Avoid global GHG emissions of roundabout 350 million tons
  - → Preserve biodiversity living in about 2.0 million hectares (global average)

  - → Various contributions towards meeting the objectives of the "Farm to Fork" and Biodiversity strategies of the EU

NPBT can help reduce the number of fungicide applications in wheat by fungi-resistant varieties

Avoidable fungicide applications in wheat (in millions)



- Example - PILTON:
  - → Breeding for multiple fungi resistance
  - → May avoid fungicide application
- Assumptions:
  - → One (two) application(s) less per season at current acreage
- Potential effects at EU level:
  - → Up to **25 million applications** less alone in EU wheat
  - → Thousands of tons of fungicides can be substituted

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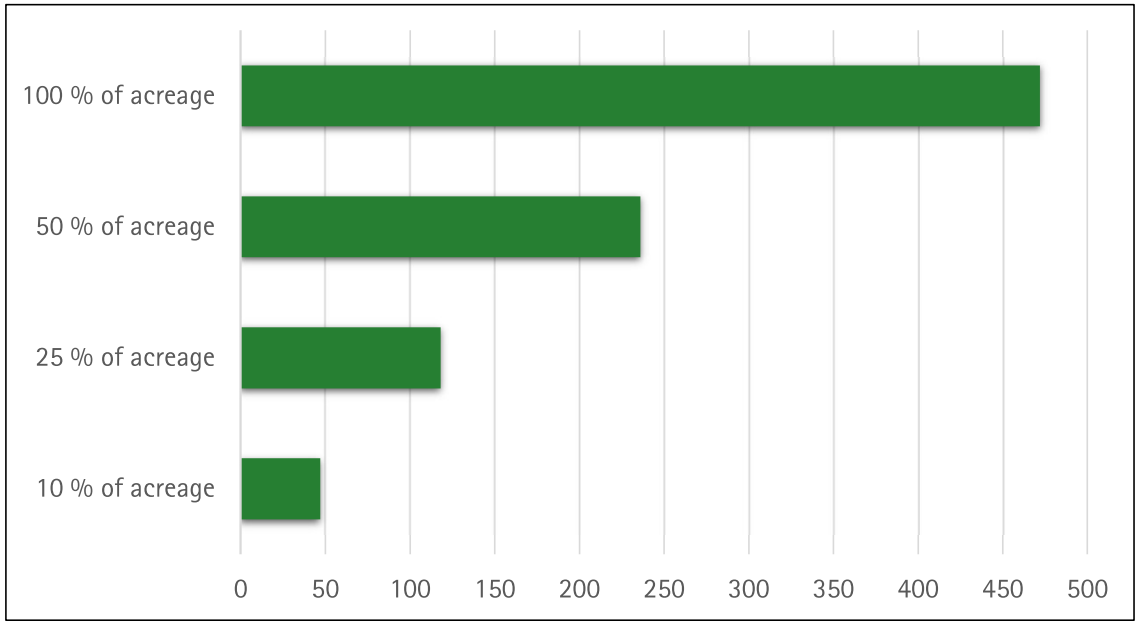
NPBT can help avoid pre-harvest losses in oilseed rape by increasing pod shatter resistance in new varieties

Avoidable land use for oilseed rape (in 1,000 hectares)



- Example - Project John Innes Centre:
  - → Breeding for reduced susceptibility to pod shattering
  - → May avoid seed losses and subsequent voluntary seeds
- Assumptions:
  - → Avoid yield losses of 9.0 percent
- Potential effects at EU level:
  - → **500,000 hectares** are almost one tenth of currently used area
  - → Lower pressure on land supports, e.g., mitigation of GHG emissions

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Recommendations

- **For private decision-making**:
  - → Plant breeding is an extremely important area of R&D, and plant breeders must take responsibility by investing even more into innovation.
  - → Targets: higher yields but also, e.g., resistances, agronomic traits, orphan crops etc.
- **For public decision-making**:
  - → Must encourage and not hinder plant breeders to further invest
  - → Strengthen R&D as well as fundamental research
  - → Support public awareness raising through interdisciplinary research and evidence-based information campaigns
  - → Establish differentiated regulatory framework based on proportionate and non-discriminatory safety considerations for individual techniques and resulting products

Thank you for your attention

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