Towards a more sustainable soybean production in Austria: A socio-ecological review

Lisa Achathaler, l.achathaler@students.boku.ac.at
Supervisor: Johann Vollmann[1]

(1) Department of Crop Sciences (DNW), Division of Plant Breeding, University of Natural Resources and Life Sciences Vienna (BOKU), Austria

Introduction

Developing a new soybean cultivar takes years. Therefore soybean breeding needs to be foresighted and current predictions on future developments considered. *Sustainability* has become a true buzzword, however the concept may still offer a roadmap towards solving current and future challenges.

Aims

The aim is to identify long-term soybean breeding targets (agronomic and consumption related) in Austria until 2050, coherent with the concept of sustainability and aligned with current discussions on e.g. enhancing *soil health*, global food systems and *food security.*

Developing a new soybean cultivar takes years.

Material and Methods

The thesis is based on literature research and complemented by data gathered during five months of project related work at the Chamber of Agriculture Upper Austria, Department Plant Production in 2014.

Results

Improvements in one breeding trait might lead to a trade-off in another due to genetic correlations. Breeding goals are therefore connected (Figure 1).

Selection of future breeding goals in agronomy:

- Improve non-chemical and economical weed control (Figure 2)
- Intercropping (complicated, further research needed)
- Enhance soil quality/*health*
- Enhance yield /yield stability:
  - Cultivar selection
  - improve drought and chilling tolerance
  - improve lodging resistance (Figure 3)
  - Improve susceptibility against pests and diseases, e.g. sclerotinia (Figure 4)
- Improve foliar disposition and light interception

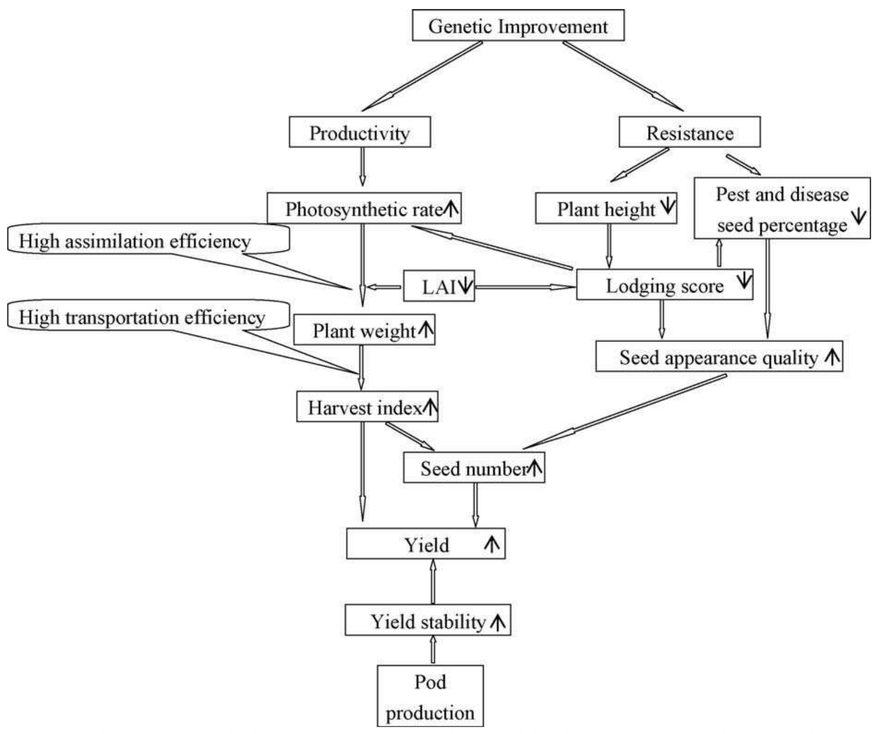

Figure 1: Genetic improvements in northeast China between 1950 and 2006, and how they lead to enhanced yield-stability. The figure shows how traits are connected: upward pointing arrows signal improvements, whereas downward pointing ones signal decrease. LAI is an abbreviation for Leaf Area Index. Source: Jin et al. (2010).

Figure 2: Heavily weed infested soybean field. Site with high weed pressure from volunteers (sunflower) and *Chenopodium*/*Atriplex* species in Carinthia, 2014 .

Figure 3 (left): Lodging soybeans. Experimental site of *LK Oberösterreich* in Upper Austria, 2014.

Figure 4 (right): Sclerotinia (fungi, connected to unsuitable crop rotations) infested soybean. Experimental site of *Knt. Saatbaugenossenschaft reg.Gen.m.b.H.* in Carinthia, 2014.

Selection of future breeding goals related to consumption patterns:

- Improve food safety issues:
  - reduced allergenic proteins
  - reduced heavy metal uptake,…
- Improve seed quality parameters:
  - high and stable protein content
  - improved amino acid composition
  - improve digestibility (animal feeding),…
- Support *cultural value* of soybean (e.g. as valuable foodstuff)

Discussion and Conclusion

Agriculture in times of climate change is highly complex and an ostensibly challenging undertaking. Consequently, the necessity of transdisciplinary research is increasing, as is an ongoing dialogue between stakeholders and, in a best case scenario, purveyors of a multitude of well-coordinated measures. Furthermore, the implementation of the concept of ***resilience*** – the ability to 'recover' and evolve after disturbances (see Folke, 2006) – is strongly emphasised, as it most profoundly complements the sustainability concept. Careful attention should also be directed at aims listed in the yellow circle in order to allow for a significant shift towards a more sustainable soybean breeding sector.

Promote…

- → **resilience + sustainability**
- → **diversity, non-chemical weed control and intercropping**
- → **collaboration between stakeholders**
- → **transdisciplinary research**
- → **'robust' cultivars + yield stability**
- → **food safety, seed quality + cultural value**
- → **soil health**

Literature

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