Organic Plant Breeding

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The World of Organic Agriculture 2015

Organic Land 2015

- North America: 3.0m ha
- Europe: 12.7m ha
- Asia: 4.0m ha
- Latin America: 6.7m ha
- Africa: 1.7m ha
- Oceania: 22.8m ha

Organic Producers 2015

- Number of organic producers is increasing
- 2.4 million Organic farmers
- +7.2% From 2014

Organic Market 2015

- The global market is growing and consumer demand is increasing
- Approx. 75 Global organic food market in billion euros

Top 3 countries (market in billion euros)

- USA: 35.8
- Germany: 8.6
- France: 5.5

FiBL Survey 2017 based on national sources
Why we need Organic Plant Breeding

Ecological intensification of organic production through

• Focused breeding for target environments with limited external inputs
• Selection for specific traits, like seed-borne diseases, weed competition
• Meeting market demand and expectation of farmers and consumer
• Alternative breeding programs refraining from genetic engineering and certain breeding techniques

Enabling more sustainable food production systems through

• Large portfolio of crops on farm level to mitigate risks of crop failure
• Functional biodiversity on field level to reach high level of self regulation and closed nutrient cycle
• Safeguarding and evolving genetic resources for future generations
Reduced number of crops and cultivar per crops

John Tomanio, NGM Staff Food Icons, Quickhoney, Source Rural Advancement Foundation International
Breeding for functional biodiversity

Diversity of landscapes

Diversity of habitats

Diversity of species

Diversity within species

Fotos: FiBL
Strategies for Organic Plant Breeding

Combining breeding & agronomic innovations for Organic

Breeding for increased diversity
- Breeding for diversity within cultivars
- Breeding for mixed cropping systems
- Breeding for improve diversity of associated soil microbes
- Decentralized participatory breeding for local conditions

Embedding diversity into markets
- Involving all stakeholders (farmer, value chain and community driven breeding)
- New concepts for the ownership of cultivars and their financing
- Changing regulatory framework to foster greater agrobiodiversity (official variety testing, seed regulation)
- Valorization of organic plant breeding along the value chain (www.bioverita.org)
Breeding for improved symbiosis

Plant – Soil Microbe Interaction
- N fixation by symbiotic and free living bacteria
- Improved access to water and nutrients by mycorrhiza
- Mineralisation of organic fertilizer
- Root exudation
- Plant growth promoting rhizobacteria (PGPR)
- Pathogenes & counterparts
Main Challenges to obtain high quality seed of cultivars adapted to organic agriculture

• Very limited breeding initiatives to develop improved cultivars that are adapted to organic farming conditions with slow release nutrient supply
• Breeding is dominated by commercial sector while public breeding programs get reduced personnel and financial resources
• Concentration on few main crops neglecting grain legume and minor crops
• Organic breeding initiatives are not well connected with each others and to conventional breeders
• Missing funding for organic plant breeding and research as focus is on molecular breeding
• Official Variety Registration is optimized for F1 hybrids (DUS) and testing for Value of cultivation and use (VCU) is conducted mainly under conventional farming
Restriction of exchange of genetic material by IP rights

Overview of patent applications on plants under PCT/WIPO (WO) and at the EPO as well as of patents granted by the EPO. Research according to official classifications (IPC A01H or C12N001582).

Christoph Then & Ruth Tippe March 2012

www.no-patents-on-seeds.org

Who will control the Green Economy?

www.etcgroup.org
Increase of GM varieties

GLOBAL AREA OF BIOTECH CROPS
Million Hectares (1996 - 2010)

Source: James Clive 2011, ISAAA
www.fibl.org

www.fibl.org
Drift between conventional and organic plant breeding

The degree of overlap between conventional and organic suited cultivars depends on:

- Breeding goals & philosophy, Selection environment
- Applied breeding techniques
Decentralized Participatory Plant Breeding

Involvement of whole value chain to support organic plant breeding

Green Cotton Project (2013-2021): Participatory cotton breeding in India  
www.greencotton.org

Bioimpuls Programme 2009-2013: Perspectives on Phytophthora-resistant potato varieties, Lammerts van Bueren et. al. 2013 Broshure
Criteria for Organic Plant Breeding

Ethical issues

Genom is respected as indivisible entity, no technical/physical intervention (e.g. isolated DNA)

Cell is respected as indivisible functional entity, no technical/physical intervention (e.g. cell fusion)

Maintain reproducibility in species specific manner

No legal or technical barriers to restrict breeders’ right

Natural crossing barriers are respected

Promotion of open pollinated varieties as alternative to F1 hybrids to enable farm saved seed

Transparency
Position of the Organic Sector on the compliance of New Breeding Techniques (NBT)

Position Paper of ECO-PB on Organic Plant Breeding 2013:
• Organic plant breeders in Europe will refrain from any breeding technique that technically interferes below the cell level

IFOAM EU Position Paper on New Plant Breeding Techniques 2015:
• NBT are not compatible with organic farming
• Should be declared as GMO according to EU regulation and labelled accordingly

IFOAM International: Position Paper on New Breeding Techniques 2017
• Draft February 2017, consultation and final approval on General Assembly of IFOAM in November 2017
• Transparency & traceability to allow freedom of choice for farmers & consumers

[FiBL](http://www.fibl.org)
Outcome: Compatibility of Breeding Techniques in Organic Systems

Clarity & Transparency on the Criteria Used to determine what breeding techniques are compatible with Organic Farming Systems
Recommendations

• Clarity on new genetic engineering technologies
• GMO regulations need to protect organic integrity
• Genetic resources need to be protected, preserved, and maintained
• Breeding techniques need to be transparent
• Varieties and breeds acceptable to organic need to be identified
Recommendations (cont’d)

• Greater public resources are needed for research & development of breeding techniques acceptable for organic production
• Intellectual property rights need to be fair to all
  • No patents should be granted for genetic resources
  • Participatory breeding should involve and reward all stakeholders
• Polluter Pays Principle for GMO contamination of seed
• Responsibility for Diversity and Rural Livelihood
European Projects to promote new Breeding Concepts

- FP7 Solibam: Strategies for Organic and Low-input Integrated Breeding and Management [www.solibam.eu](http://www.solibam.eu) 2010-2014
- Core organic COBRA: Coordinating organic plant breeding activities for diversity [www.cobra-div.eu](http://www.cobra-div.eu) 2013-2016
- Horizon 2020 LIVESEED: Improve performance of organic agriculture by boosting organic seed and plant breeding efforts across Europe 2017-2021
- Horizon 2020 ReMIX: Redesigning European cropping systems based on species MIXtures 2017-2021
- New Horizon 2020 BRESOV organic vegetable breeding 2018-2022
- New Horizon 2020 ECOBREED organic cereal breeding 2018-2022
- New Horizon 2020 call Innovation in Variety Testing

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Boosting organic seed and plant breeding across Europe 2017 - 2021

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LIVESEED in a nutshell

- **Budget:** 7.4 M EUR EU funding & 1.5 M EUR Swiss funding
- **Duration:** 4 years
- **Coordinator:** IFOAM EU
- **Scientific coordinator:** FiBL (Switzerland)
- **Goal:** Boosting organic seed and plant breeding in order to improve the performance, sustainability and competitiveness of the organic sector
- **Approach:**
  - Inter- and transdisciplinary
  - Policy – economy – science interface
  - Multi-actor & stakeholder involvement
  - Wide geographic representation
Working together

49 partners
18 countries

23 breeding & research institutes
7 breeding companies
8 seed companies
11 organic associations
Aim: 100% organic seed of adapted cultivars

Figure 1: Schematic time line to reach the goal of 100% organically propagated seed of suitable cultivars (light green) in short term and to foster cultivars specifically bred for organic farming systems (bright green) in the long term.
Main objectives

**Policy & regulation**
Provide a level playing field for the use of organic seed and variety registration across Europe

**Research & development**
Develop innovative approaches in organic plant breeding and improve quality of organic seeds

**Socio-economics**
Increase access to organic seed and promote use of adapted cultivars

**Economy & market**
Improve the competitiveness of the organic seed supply chain

**Communication & network**
Enhance knowledge exchange & rise awareness on the benefits of organic seed and plant breeding
Crop categories

Research activities of LIVESEED will cover five main crop categories:

- Legumes (lupin, pea)
- Vegetables (carrot, tomato, broccoli, cauliflower)
- Fruit trees (apple)
- Cereals (wheat, barley, maize)
- Fodder crops (lucerne, grasses)

considering different farming systems (mixed cropping, agroforestry) pedoclimatic zones across Europe
What LIVESEED will do:

- Foster **harmonised implementation of the EU organic regulation** on organic seed. Strengthen organic seed databases in the whole EU.

- **Widen the choice of organic cultivars** meeting the demand of farmers, processors, retailers and consumers

- **Develop innovative breeding and seed health strategies**

- **Investigate socio-economic aspects related to production and use of organic seed**

- **Improve availability and quality of organic seed. Develop guidelines for organic cultivar testing and registration**
It is important for the organic sector to have a wide range of species & cultivar types that are adapted to different growing conditions and match the demand of different market chains:

- Homogeneous inbred lines
- Homogeneous F1 hybrids
- Open pollinated populations (e.g. population varieties of outcrossing species)
- Heterogeneous material (e.g. composite cross populations of inbreeding species)
Normal people just see a seed:

Gardeners see the dreams within:

Thanks a lot for your attention