



**FiBL**



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## Boosting Organic Seed and Plant Breeding across Europe 2017-2021

### Highlights and Main Achievements

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**Eucarpia General Congress**

26<sup>th</sup> August 2021 video conference

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.



# Aim: Improve integrity and competitiveness of organic sector by reaching 100% organic seed of cultivars suited for Organic Agriculture

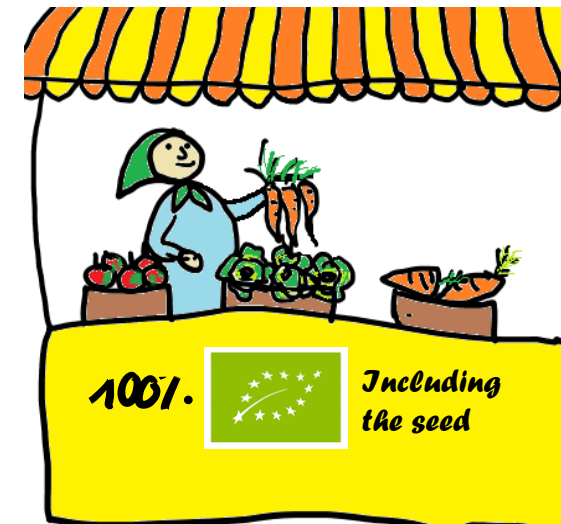
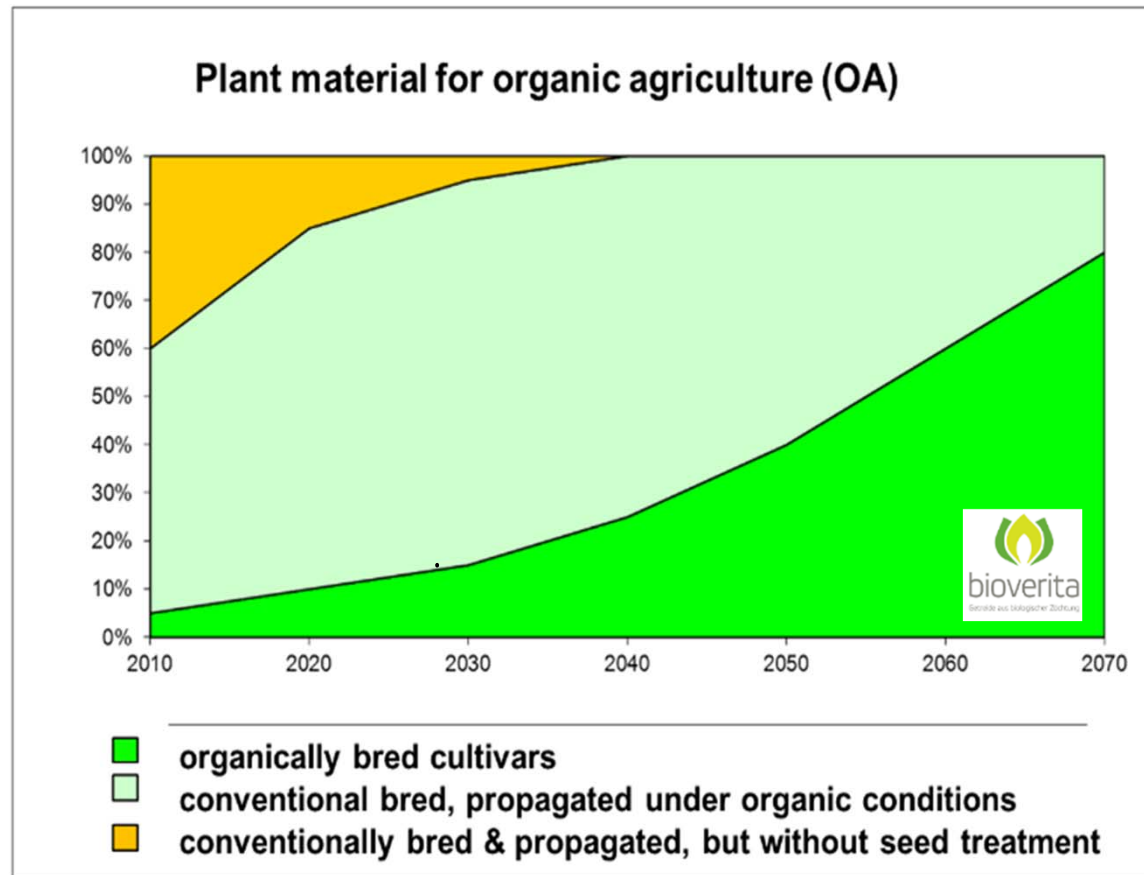


Figure 1 : Schematic time line to reach the goal of 100% organically propagated seed of suitable cultivars (light green) in short term and to foster cultivars specifically bred for organic farming systems (bright green) in the long term

# Main objectives

cereals maize  
legumes  
vegetables  
forage fruits

## Policy & regulation

Harmonized Implementation of Organic Regulation with respect to seed  
Recommendation for delegated acts of new organic Regulation (848/2018)

## Research & development in organic plant breeding and seed health

Innovative approaches in plant breeding for more resilient cultivars and holistic seed health strategies improve quality of organic seeds

## Cultivar testing & seed multiplication

Increase accessibility of organic seed and adoption of new cultivars  
Recommendation for release of organic cultivars, toolbox for OHM

## Economy & market

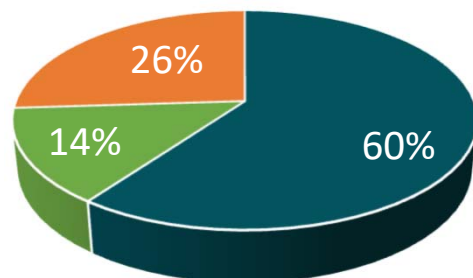
Improve the competitiveness of the organic seed supply chains  
from breeding to the consumer, financing of organic plant breeding

## Communication & network

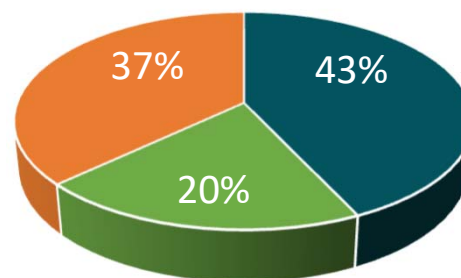
Enhance knowledge & rise awareness on the benefits of organic plant breeding and seed

# Status quo analysis on organic seed in EU and Switzerland in 2016

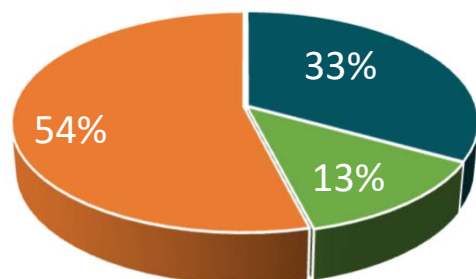
Northern Europe (23'887 t)



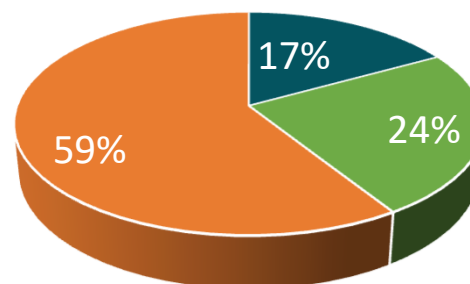
Central Europe (40'622 t)



Southern Europe (55'363 t)



Eastern Europe (24'692 t)



New organic regulation 2018/848 will phase out derogation for non-organic seed latest by 2036

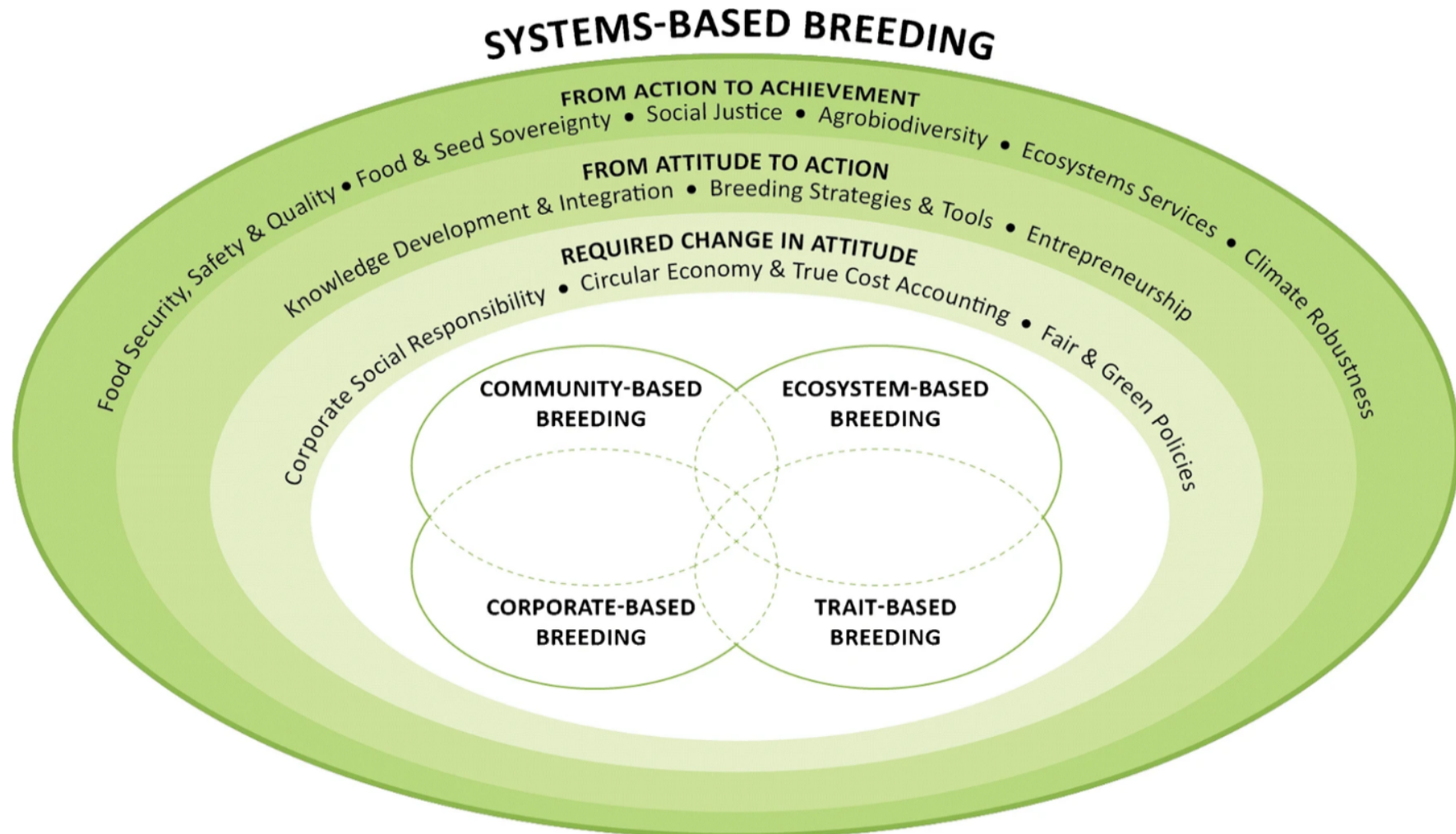
NON-ORGANIC SEED SUPPLY \*

ORGANIC SEED SUPPLY

ORGANIC FARM SAVED SEED

<https://orgprints.org/38616/>

# Systems-based breeding beyond direct benefit of value chain



Lammerts van Bueren et al 2018. Towards resilience through systems-based plant breeding. A review. *Agron. Sustain. Dev.* 38(42).  
<https://doi.org/10.1007/s13593-018-0522-6>

[www.LIVESEED.EU](http://www.LIVESEED.EU) > Results > WP3 > M3.5 Organic plant breeding in a systems-based approach

[www.LIVESEED.EU](http://www.LIVESEED.EU) > Results > WP3 > D3.5 Novel breeding concepts and strategies for organic and low-input farming systems

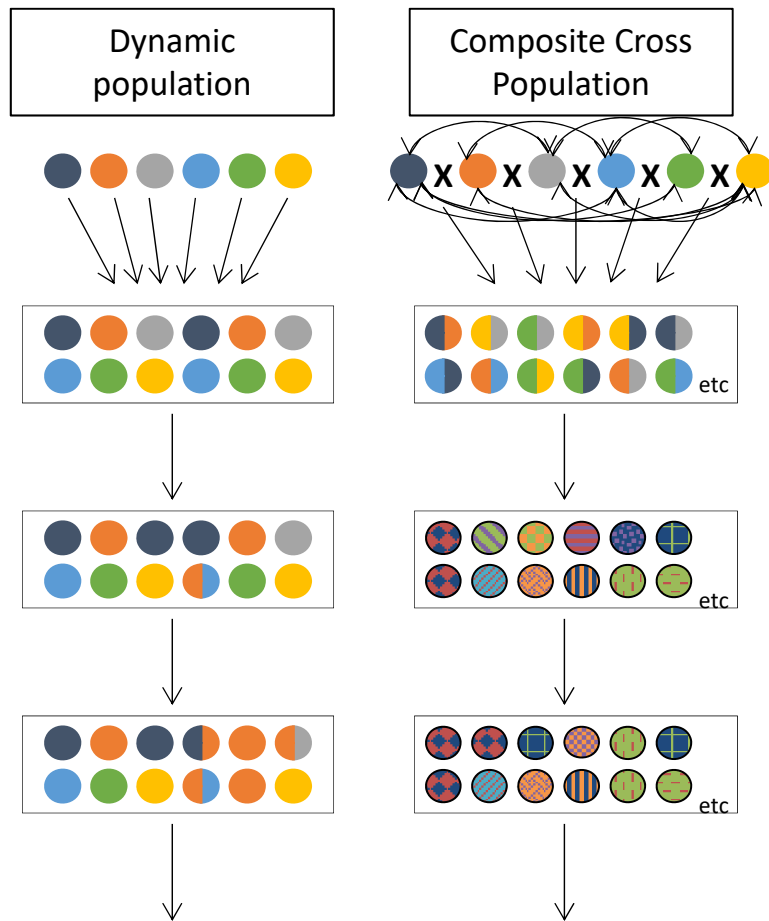
# Breeding for diversity

- Develop concepts, strategies, and tools for the development of cultivars with improved resilience:
  - Genetic diversity within cultivars e.g. **composite cross populations and dynamic populations** that can adjust to multiple stresses (cereals, legumes) [**organic heterogeneous material**]
  - Develop concepts for optimized **cultivar mixtures** (cereals)
  - Breeding cultivars suited for **species mixtures** (legume – cereal mixtures, Lucerne – grass species, agroforestry)
  - Participatory breeding incl. value chain actors



[www.LIVESEED.EU](http://www.LIVESEED.EU) > Results > WP3 > D3.6 Enhancing resilience at systems level through breeding for diverse cropping systems, D3.7. breeding for the holobiont, D3.8 breeding networks of lupin, brassica vegetables, wheat, apple, tomato

# Exploring and comparing breeding methods for diversity



Started in 2014 to study influence of :

- 2 Sites in France
- Selection strategy: Dynamic vs. CCP
- Human selection : natural vs. Human (farmer and two bakers)

Each year, phenotypic characteristics and yield components are observed on all the populations (10 populations in 2019)

- Human selection mainly determines crop traits (phenotypic characteristics and yield components). The farmer's and bakers' selection have conserved the overall diversity.
- Other determinant factor is the location
- No significant differences between the two selection strategies after 5 generations

# Participatory Breeding for bread making in Portugal – Selection traits



## General traits

- Root and Stalk lodging resistance;
- Pest and diseases resistance

## Pigarro, Verdeal Regadio & Sequeiro

- First ears' height – 165-185 cm;
- Ears' large length, fasciated and indeterminated;

## Fn 2014

- Plant height - >250cm;
- Reduce first ears' height – 190-200cm;
- Earliness to fit the cycle (dry bracteas at harvest);

## Amc397

- Selection for high stand;
- High lenght ears





# Participatory tomato breeding in Spain and Italy

## CATA DE TOMATES ECOLÓGICOS

CUÁNDO:  
31 de julio de  
2019 a las 11 h

DÓNDE:  
Centre d' Educació  
Ambiental de la CV Marjal  
dels Moros (Sagunto)  
<http://www.agroambient.gva.es/va/web/ceacv>



Organizan y colaboran:  
**LIVESEED**

Funded by the Horizon 2020 Framework Programme of the European Union

20 anys  
CENTRE D'EDUCACIÓ AMBIENTAL

LA UNIÓN DE LAURADORES I RAMADERES

SEAE



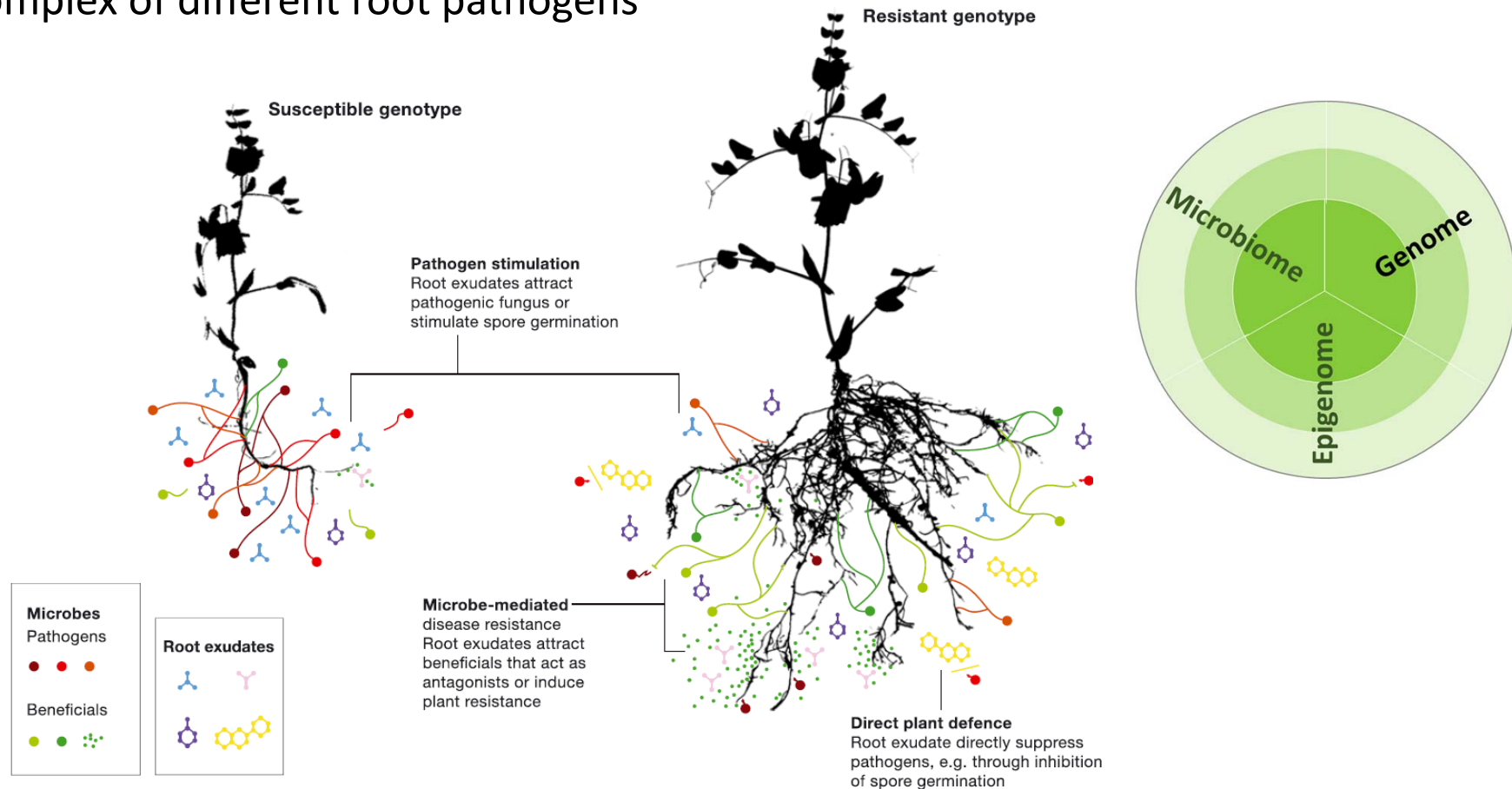
*Tomato PPB-social activities with general public and consumers' evaluations. Posters for announcements of activities in summers 2018 and 2019 in Valencia (left and right) and consumers evaluations in Mercado de los Toruños (Puerto de Santa María, Cádiz, August 2018, La Verde Coop selling point)*



*Tomato PPB activities in Italy. Locations of farms (left) and groups or evaluators coordinated by RSR and Arcoiris*  
**Figure 6. Tomato participatory trials and social activities in Italy and Spain.**

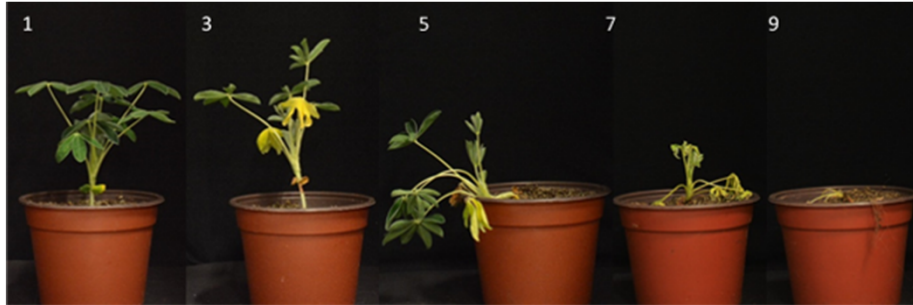
# Breeding on the holobiont: plant with associated microbiome community mediated disease resistance

A high-throughput screening system was developed for pea that successfully differentiates various resistance parameters against soil fatigue caused by a complex of different root pathogens

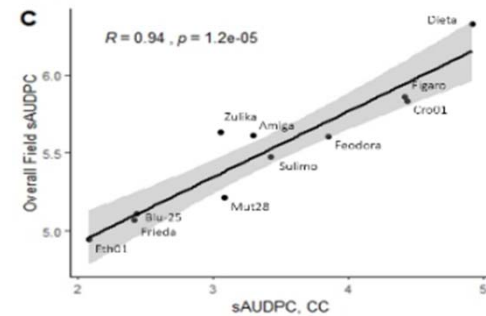
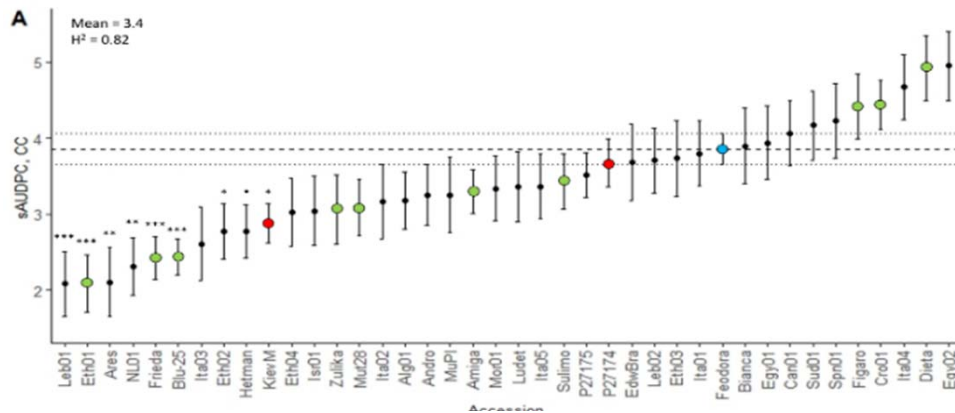


Wille et al. *Plant Cell Environ* 2019; 42:1–21. ; Wille et al. *Front. Plant Sci.*, 2020 <https://doi.org/10.3389/fpls.2020.542153> ; Ares et al. *Front. Microbiol.*, 2021 <https://doi.org/10.3389/fmicb.2021.636009>

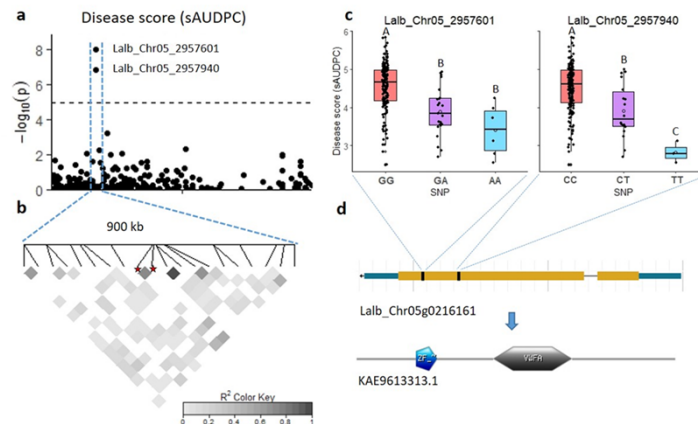
# White lupin breeding for anthracnose tolerance, low alkaloid content, calcereous soil and drought tolerance



Development of screening test for anthracnose tolerance in white lupin under controlled conditions

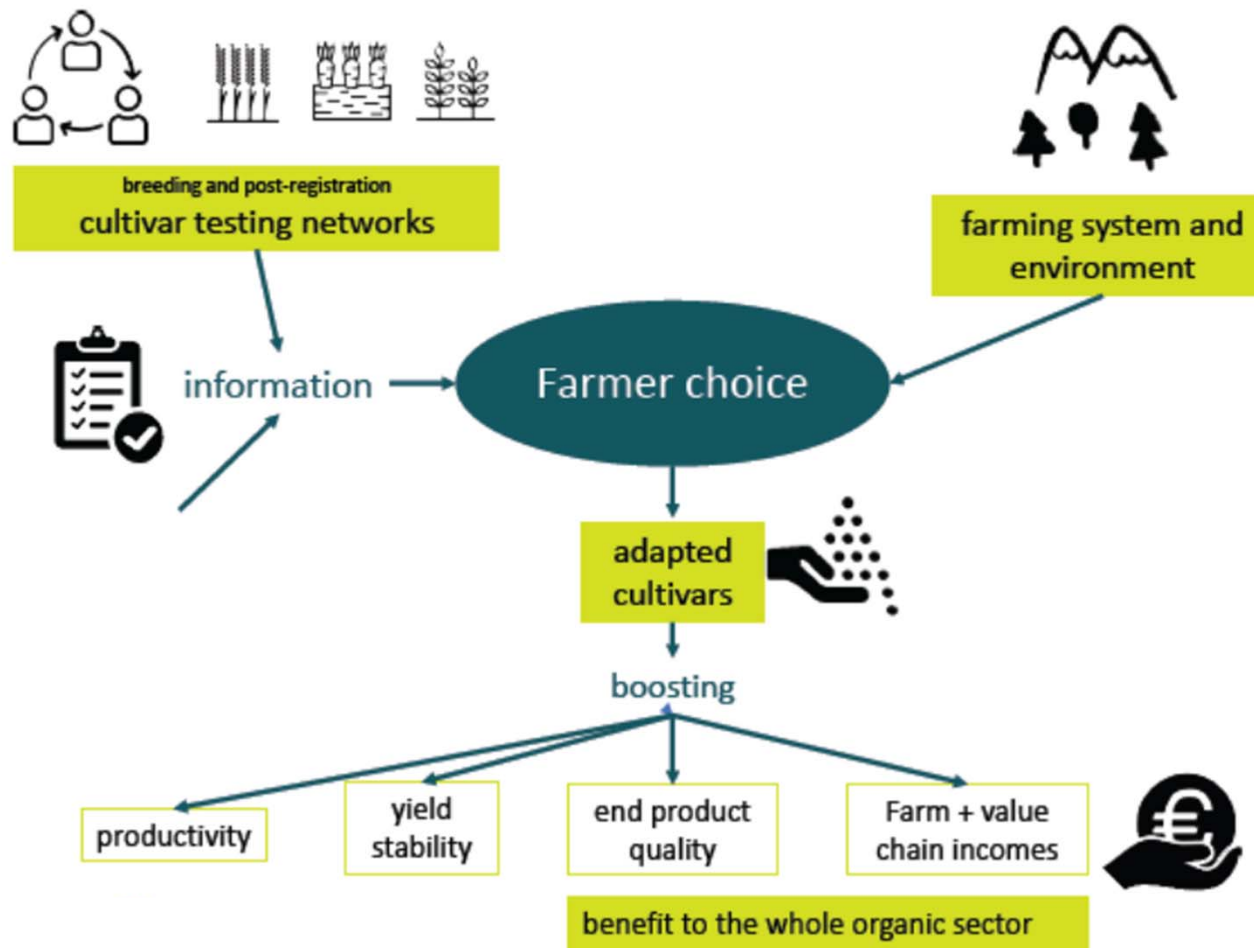


Validation with observed tolerance in the field *Alkemade et al. 2020 Plant Disease*



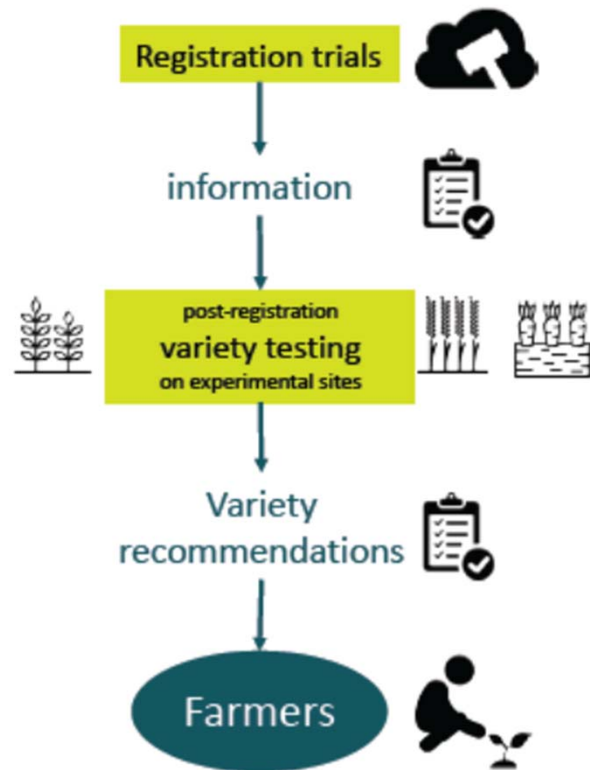
Genom wide association study  
 → 1 QTL encodes for protein with a RING zinc-finger and VWFA domain potential resistance gene *Alkemade et al. 2021 TAG submitted*

# New models for post-registration on-farm cultivar testing

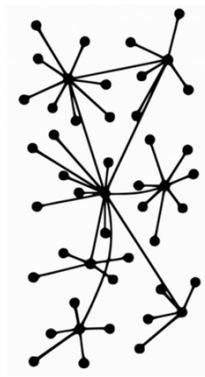


# New models for post-registration on-farm cultivar testing networks

## “conventional” variety testing



**Decentralized on-farm cultivar testing networks:**  
multiactor – simple - cost efficient - interactive –  
shared data – digital tools / app



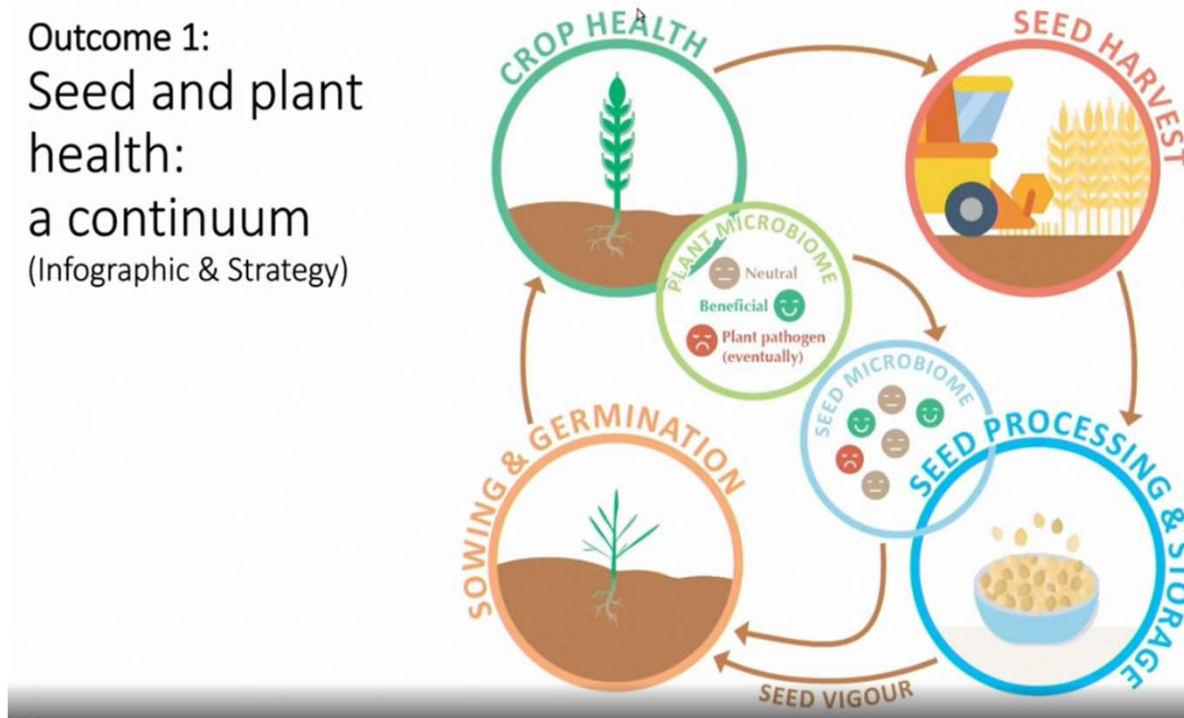
Intuitive platform + crowdsourced data from experts and growers + environmental data + analytics =  
**POWERFUL RECOMMENDATION ENGINE**



[www.LIVESEED.EU](http://www.LIVESEED.EU) > Results > WP2 > D2.3 Frugal, multi-actor and decentralised cultivar evaluation models for organic agriculture

# Holistic Seed Health Strategy

Outcome 1:  
Seed and plant  
health:  
a continuum  
(Infographic & Strategy)

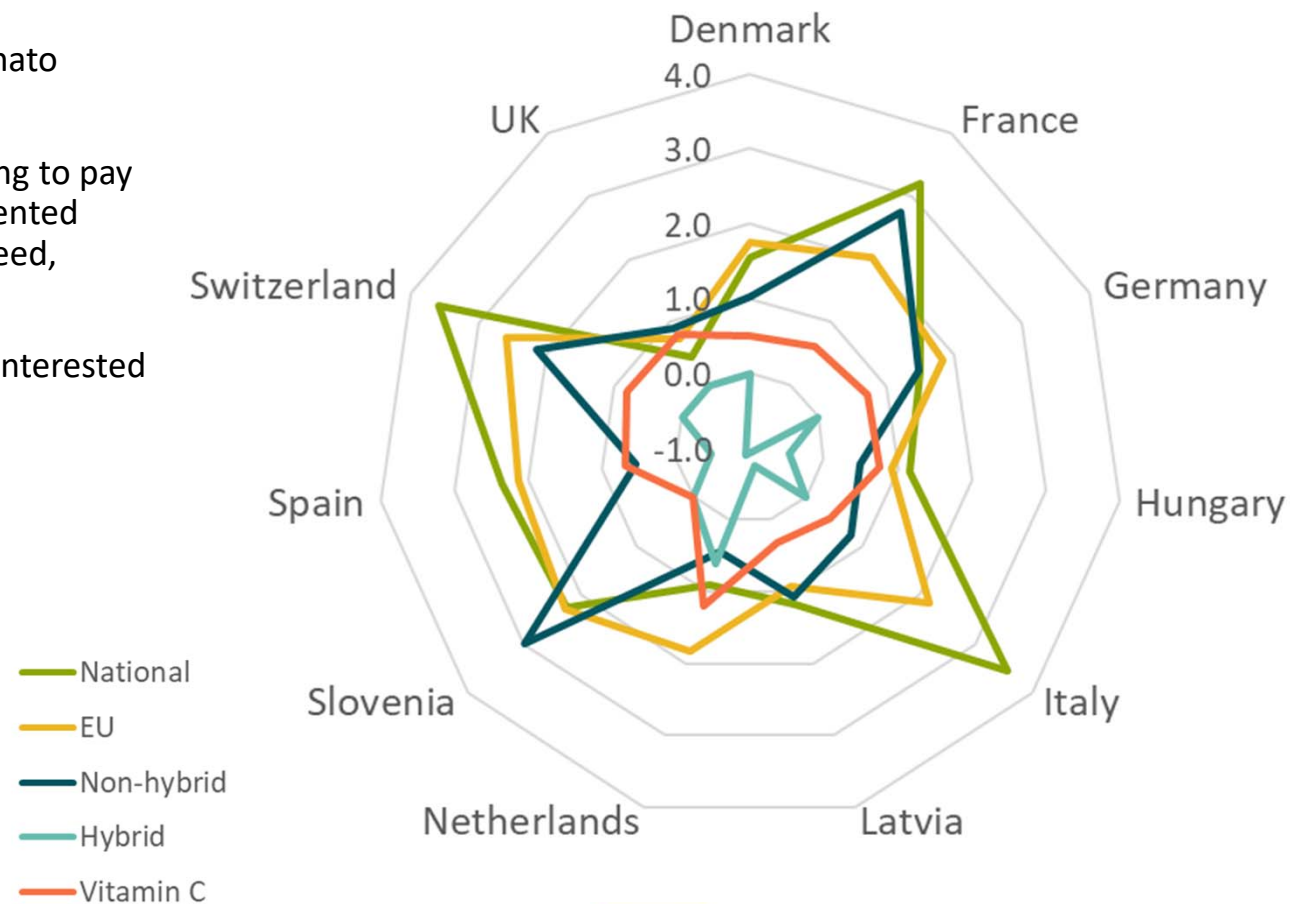


- High seed vigour maintenance is important for resilience
- Organic farming is based on healthy soils and diversified crop rotation
- Management of seed production from sowing till seed harvest
- Impact of seed microbiome
- Seed treatments as last option

# Survey of organic consumers on their attitude towards NBT and hybrids

## Willigness to pay (WTP) in euro for type of seeds

- Choice experiment with tomato sauce
- Organic consumers are willing to pay more for non-hybrid, unpatented seeds to allow farm saved seed, especially in FR, CH, SL
- Organic consumers are not interested in NBT (baseline 0.0)



# Seed Sector Innovations for Organic Food Systems

- Exploration of **frugal on-farm organic cultivar testing models** considering different contexts in Europe, **European digital platform** and **adjusted statistics** to allow farmers to take informed choice → **develop software for EU digital platform and establish pilot trials for implementation, adjusted to local context**
- Promotion and **professionalisation of organic seed production** for commercialized and farm saved seed, recognition of importance of farm saved seed → **training and infrastructure in South and Eastern Europe, → involvement of conventional seed companies willing to convert certain share to organic**
- More **holistic seed health strategies** including also the seed microbiome
- Clear legal framework and **incentives for production and use** of organic seed
- Involvement of **stakeholders (expert groups) and national authorities** to develop **national roadmap** allowing phasing out of derogation for non-organic seed and monitoring on achievements across Europe
- **Keep on the political agenda**



# Breeding Innovations for Organic Food Systems

- Great wealth of **genetic resources** of many crops need to be characterized to be useful for organic breeding and farming, sharing of data, → **importance of data repository like EVA of genebanks, Findable, Accessible, Interoperable, Reusable FAIR data**
- Exciting research on seed, root and rhizosphere **microorganism communities** and their impact on resilience → **more research is needed to identify their impact on plant health and the integration into seed production and breeding**
- **New cultivar types and concepts for increased diversity** (CCP, Dynamic populations, variety mixtures, species mixtures, agroforestry) supported by new EU organic regulation, upcoming EU seed regulation, IPR issues → **apply CCP and dynamic populations to different crop species, test potential for adaptation under severe stress conditions**
- **New cultivars OHM and OV for commercialisation**
- New temporary EU experiment is a chance for **adjusted process for release of organic varieties**, important to have close exchange with examination offices to find common practical solutions to complement instead of competing each other  
→ **important to motivate breeders and examination offices to apply, multiply seed of candidate varieties and make resources available (fundraising to cover costs)**

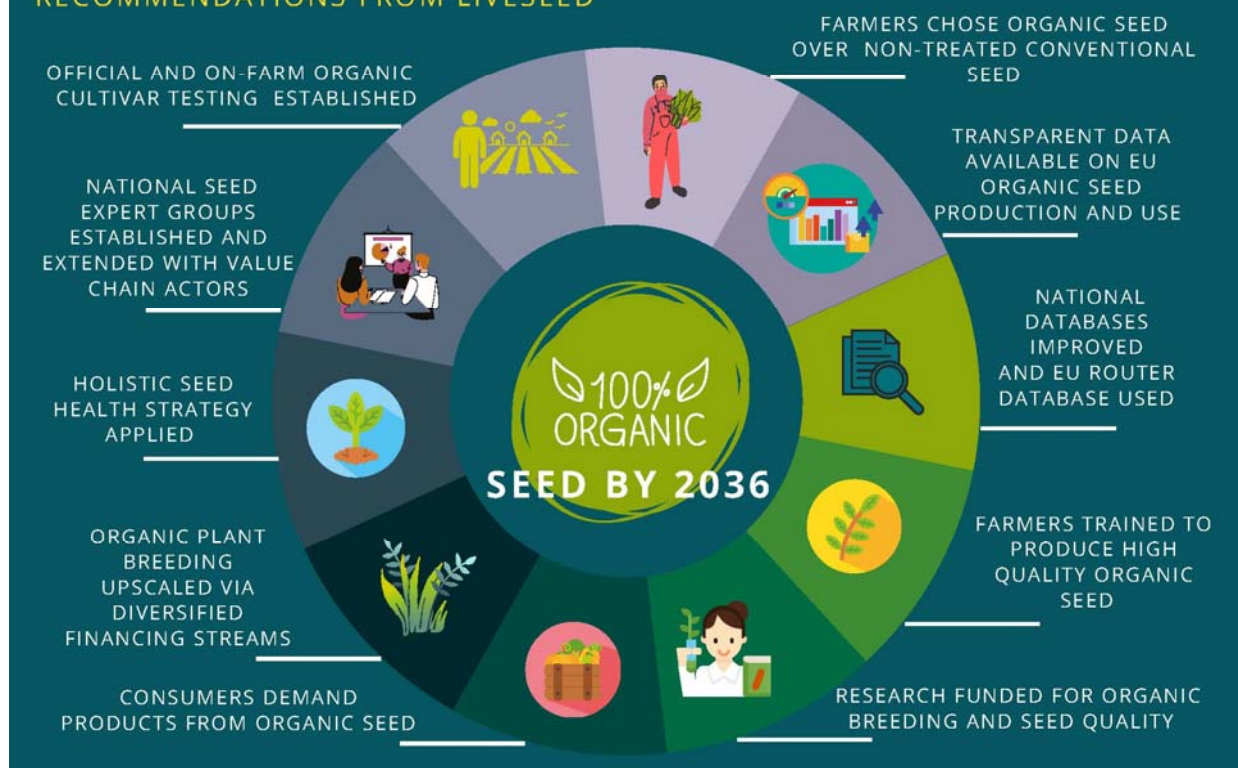
# Breeding Innovations for Organic Food Systems

- **Participatory approaches on local level** creating partnership between breeders, farmers, value chain actors, consumers, society are key for societal acceptance of breeding
- **Financing models** for organic breeding are urgently needed, support of organic sector, consumers and society as a whole → awareness raising, diversified financing strategy: engagement of value chain, public funding, PPP, foundations to support start up (Workshop Day 2)
- **Organic consumers value non-hybrid cultivars derived natural breeding** as an alternative to the monopolisation of the seed industry → awareness raising (Workshop Day 2)
- **Communication on need and added value of organic seed and breeding** is needed to get supported by value chain, public funding and society → transparency and positive labels
- For transition towards sustainable food production **inter- and transdisciplinary systems-based approaches** taking ethical, societal and cultural norms and values into account are needed achieve the **United Nations' Sustainable Development Goals** → embedding organic breeding into socio-economic context including global south
- **Revisit our approaches to align them to SDGs and evaluate achieved impact** → define social norms, true cost accounting, accessibility of seed, fair business models, etc.

# Synthesis & Recommendations

## A VISION TOWARDS 100% ORGANIC SEED IN THE EU

### RECOMMENDATIONS FROM LIVESEED



## Boosting organic seed and breeding across Europe: recommendations for stakeholders and policy makers

A roadmap towards achieving 100% organic seed from adapted cultivars in the organic sector



[www.LIVESEED.EU](http://www.LIVESEED.EU) > Results > D6.3 Synthesis of LIVESEED results and stakeholder and policy recommendation

[www.LIVESEED.EU](http://www.LIVESEED.EU) > Tools for Practitioners > booklet > Boosting organic seed and breeding across Europe (July 2021)



This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

# International Conference on BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS

by EUCARPIA

Section Organic and Low Input Agriculture jointly with  
LIVESEED, BRESOV, ECOBREED, FLPP projects and ECO-PB

## TOPICS:

- ◆ Exploring underutilized genetic resources
- ◆ Breeding for diversity
- ◆ Breeding for culinary and nutritional quality
- ◆ Living soil – plant interactions
- ◆ Organic production of high quality & healthy seed
- ◆ Multi-actor & participatory approaches
- ◆ Socio-economic analysis of seed systems
- ◆ Market & consumers aspects
- ◆ Regulatory & policy opportunities
- ◆ Sustainability assessment

ONLINE

08-10 March 2021

E:organizing.eucarpia@arei.lv



ecobreed  
IMPROVING CROPS



Proceeding will be made available on organic eprints and LIVESEED webpage  
Special issue on «**Sustainability**» open now till end of the year



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# LIVESEED

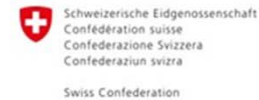


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# Criteria for Organic Plant Breeding

## Ethical issues of position paper of European Consortium for Organic Plant Breeding (ECO-PB) 2013

- Genom and cell is respected as indivisible entity, no technical/physical intervention (e.g. isolated DNA) → no technical/physical intervention (e.g. cell fusion)
- Maintain reproducibility in species specific manner
- No legal or technical barriers to restrict breeders' privilege
- Natural crossing barriers are respected
- Promotion of open pollinated varieties as alternative to F1 hybrids to enable farm saved seed
- Transparency
- [https://www.eco-pb.org/fileadmin/eco-pb/documents/discussion\\_paper/ECO-PB\\_Position\\_paper\\_2012\\_Translated2019\\_French\\_Version.pdf](https://www.eco-pb.org/fileadmin/eco-pb/documents/discussion_paper/ECO-PB_Position_paper_2012_Translated2019_French_Version.pdf)



## IFOAM International: Position Paper on New Breeding Techniques 2017

Draft February 2017, consultation and final approval on General Assembly of IFOAM in November 2017 <https://www.ifoam.bio/compatibility-breeding-techniques-organic-systems>

**Transparency & traceability to allow freedom of choice for farmers & consumers**



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