



## OWC 2020 Paper Submission - Science Forum

### *Topic 3 - Transition towards organic and sustainable food systems*

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#### **LIVESEED - IMPROVING THE PERFORMANCE OF ORGANIC AGRICULTURE BY BOOSTING ORGANIC SEED AND PLANT BREEDING EFFORTS ACROSS EUROPE**

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**Abstract:** LIVESEED is a Horizon 2020 project applying interdisciplinary and multi-actor approaches aiming to transform the organic seed and plant breeding sector. The main goal is to reach 100% organic seed of cultivars suited for organic agriculture in order to improve competitiveness and integrity of organic production. LIVESEED covers the five main crop categories: legumes, vegetables, fruit trees, cereals and fodder crops, considering diverse cropping systems across Europe including mixed cropping and agroforestry. LIVESEED explored legal, technical, scientific, and socio-economic aspects that impact the use of organic seed from breeding to seed availability. LIVESEED developed policy recommendations on the implementation of the rules for organic seed in the EU organic regulation and an EU wide router database for organic seed. Innovative concepts for seed health and systems-based breeding have been developed as well as several breeding and selection tools for improved resilience. Innovative governance models for assessing suitability of homogeneous and heterogeneous cultivars for organic agriculture are designed and recommendations made to ease the official release of organic bred varieties. Economic business models for the whole seed supply chain including financing of organic breeding allowing simulation of interventions are under development. Science based policy recommendation of LIVESEED can have an immediate impact on the delegated and implementing act of the new organic EU regulation promoting organic seed and plant breeding.

**Introduction:** The use of a broad portfolio of cultivars and crops adapted to specific climatic, soil, and farming conditions are key to reduce the yield gap in organic agriculture (OA). However, information on the suitability of cultivars for OA is lacking (Döring et al., 2012). Although the European organic regulations (EC 834/2007 and EC 889/2008) prescribe the use of organically produced seed, for many crops there is still no or insufficient seed available, resulting in derogations for conventionally propagated but untreated seed (Döring et al., 2012). This has an obvious detrimental effect on the productivity under organic conditions (Ceccarelli, 2014). The goal of LIVESEED is to improve the productivity of the organic sector by boosting organic seed and plant breeding activities across Europe. Specific objectives are to (i) harmonize the implementation of legislative requirements and improve transparency of organic seed market, (ii) develop and improve efficiency of cultivar testing, develop an organic seed health and quality strategy, train on best practices for organic seed multiplication, and deliver new variety testing protocols to facilitate the registration of cultivars for the organic sector, (iii) develop novel breeding concepts and deliver new breeding tools, and initiate new breeding activities and more efficient collaborations to close most urgent gaps for legumes, cereals, vegetables, fruit trees and fodder crops, (iv) identify gaps and bottlenecks in the market of organic seeds, analyze business and governance models and develop incentives for the use of organic seeds.

**Material and methods:** LIVESEED follows an interdisciplinary and multi-actor approach with engagement of various stakeholder groups (Figure 1). Comprehensive surveys and desk studies, national visits and workshops were conducted on the production and use of organic seed, regulatory frameworks applied, and functionality of organic seed databases in different EU countries. Peer to peer knowledge exchange on seed multiplication was achieved in cross-visits. LIVESEED developed a novel seed health strategy integrating seed production, vitality, seed microbiome and seed treatment. A systems-based breeding concept was developed putting breeding into a broader perspective including societal challenge to reach the sustainable development goals. Experimental trials were implemented to improve breeding for within and between cultivar diversity and species mixtures. Organic breeding networks were established for various crops. Molecular markers are applied to identify resistance genes in various crops and next generation sequencing for elucidation of plant-microbiome interaction. Data were collected to develop an economic model for the organic seed value chain, which allows simulation studies on political or private sector interventions to overcome market failures.

**Results:** Based on a farmer survey in 2018 and averaged across crops and region, 50% of farmers purchased organic seed, 17% used own farm saved seed while still one third used untreated conventional seed. However, derogations for untreated conventional seed varied a lot across regions and crops, ranging from 10% for wheat in Central Europe up to 65% for soybean in Eastern Europe. National stakeholder working groups were initiated in 8 countries resulting in national seed declarations with a defined road map how to improve the availability of organic seed. Lack of business opportunity for seed companies as well as lack of suited cultivars were major bottlenecks for the production and use of organic seed. Also political bottlenecks, dysfunctional organic seed databases and lax derogation practice were preventing the growth of the organic seed business in certain countries. LIVESEED developed a software for an EU wide router database for organic seed and provided recommendations for most promising intervention strategies for policy makers and practitioners (see [www.liveseed.eu](http://www.liveseed.eu)). Innovative and cost-efficient on-farm organic cultivar models are under development targeting farmers' needs for an informed cultivar choice. A toolbox of descriptors was developed for heterogeneous populations of cereals for the running temporary experiments (C 2014/1681) and for Organic Heterogeneous Material as defined in the new EC Regulation (848/2018). Recommendations based on workshops and case studies on adapted DUS (distinctiveness, uniformity, stability) and VCU (value for cultivation and use) testing to ease the official release of organic bred varieties are developed together with breeders, examination offices, CPVO in close exchange with policy makers. A

novel concept of systems-based breeding has been developed (Lammerts van Bueren et al. 2018) and is further substantiated through workshops with various stakeholder groups. Mohanapriya et al (2019) showed the potential role of AOX as functional marker for stress tolerance. Forst et al (2019) developed methodology to assess mixing ability of variety mixtures in wheat. Novel screening tools were developed to assess tolerance of pea lines against a complex of pathogens (Wille et al. 2020 submitted) and white lupin for tolerance towards anthracnose (Alkemade et al. in preparation). European breeding initiatives involved in organic breeding, breeding for organic and organic seed were mapped to strengthen collaboration between individual actors and a European networks for breeding and cultivar testing were established for apple and cell fusion free brassica vegetables.

**Discussion:** Knowledge exchange between partners, stakeholders, competent authorities and policy makers are vital for the co-construction of innovations and the boost of the organic seed and breeding sector. Only with concerted action and combined resources in different disciplines a transition towards cultivars better adapted to the needs of the organic sector can be achieved. Due to timely coincidence of the new organic regulation (848/2018) and the new scope for “organic heterogeneous material” and “organic bred varieties suited for organic agriculture” LIVESEED has a great opportunity to directly contribute with scientific evidence to the delegated and implementing acts of this new regulation. Therefore, LIVESEED will have a great impact on the new landscape of organic seed and plant breeding. Novel concepts like systems-based breeding call for changes in attitude, and internalization of responsibilities for societal challenges of food security and human health. Considering the plant as a mega organism (holobiont), including the above and below ground associated microorganisms, has the potential to evoke a paradigm shift in plant breeding as happened lately in human medicine. Combining scientific and practical knowledge enable the consortium to generate innovative solutions adapted to the needs of end-users and the different pedo-climatic and socioeconomic contexts. Final impacts are improved breeding efficiency and greater choice and uptake of organic seeds derived from cultivars with high resilience for optimizing organic and low-input agriculture and strengthening sustainable food production in Europe (Figure1).

**References:** LIVESEED publications are available in the repository [www.orgprints.org](http://www.orgprints.org) > search LIVESEED and [www.LIVESEED.eu](http://www.LIVESEED.eu) > Results

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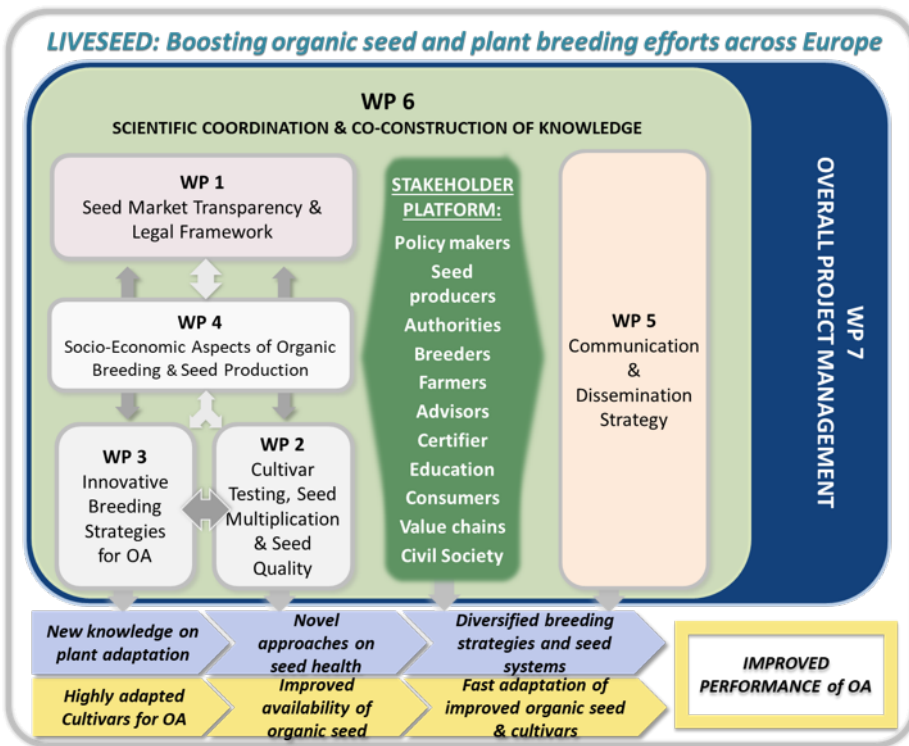
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**Image:**



**Disclosure of Interest:** None Declared

**Keywords:** organic breeding, organic seed, policy recommendation, seed health, seed supply chain, selection tools