

CULTIVAR TESTING FOR ORGANIC AGRICULTURE

What is cultivar testing and who uses it?

Cultivar testing is used by breeding and seed companies, farmers and variety testing authorities to assess the general performance or specific traits of a cultivar. Three different forms of cultivar testing can be distinguished: pre-registration testing, registration testing and post-registration testing.

Pre-registration testing: Breeders conduct cultivar testing to make selection-decisions for the improvement of a cultivar. Once breeders are satisfied with the new cultivar, they send seeds to registration testing.

Registration testing: Variety testing authorities use cultivar trials to test whether a cultivar fulfils all the necessary criteria for variety registration and release. In the EU, this is a legal precondition for the marketing of seeds. It can be distinguished between so-called DUS and VCU testing (see article on Organic Heterogenous Material on p44). All cultivars have to undergo DUS testing in which they are examined for a sufficient Distinctness, Uniformity and Stability. Arable crops have to also undergo VCU testing in which they are examined for their Value for Cultivation and Use (see Table 1).

DUS	VCU (arable crops)
A candidate variety has to be novel, distinct, uniform, stable and has to have a suitable denomination to be listed in the EU common catalogues of varieties.	A candidate variety has to have a clear improvement in value for cultivation and use in regard to yield, resistance to harmful organisms, robustness to abiotic environment and/or quality characteristics.

Table 1: Definition of DUS and VCU according to EU regulation 2002/53/EC, 2003/90/EC, 2003/91/EC.

Post-registration testing: Post-registration testing can be conducted by testing authorities or seed companies to give regional recommendations to farmers. Nevertheless, in some countries and for some species farmers do not have enough information on hand to assess the cultivar's suitability for their specific on-farm conditions. A farmer who, for instance, faces a high pest pressure of common bunt, could set up small-scale trials on their farm to screen for wheat cultivars with a high disease tolerance.

Why do we need cultivar testing for organic agriculture?

Organic and conventional agriculture is based on inherently different principles. In conventional agriculture, it is possible to standardise some environmental influences by using external inputs such as synthetic fertilisers, pesticides and herbicides. Organic agriculture abstains from these practices, and thus, must cope with more diverse environmental conditions. Yield, agronomic performance, and quality parameters of a cultivar can be influenced by the genotype, the management system, the environment, and their interactions. Therefore, cultivars might perform differently under organic and conventional management, as well as under different pedo-climatic conditions.



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In line with this, breeding goals of organic and conventional plant breeding differ. Cultivars from conventional plants are generally bred for the global market and for adaptation to high-input and large-scale farming systems. These conditions require a high level of uniformity. In contrast, organic plant breeding normally focuses on more local markets and regional adaptability. Cultivars might display a higher level of diversity which could be more favourable to cope with abiotic and biotic stresses. As the stringent requirements of DUS and VCU testing are designed to suit the needs of cultivars from conventional plant breeding, the release of cultivars, which are specifically bred for the organic system, might be suppressed. Additionally, organic farmers cannot identify cultivars suitable for their agricultural system, since information obtained from conventional trials are insufficient to evaluate the suitability of a cultivar for the organic system.

In order to strengthen sustainable agricultural practices throughout Europe, the development of cultivar trials under organic management conditions using adapted testing protocols, which include specific traits of interest for organic agriculture, is an important milestone. Moreover, environmental effects make regional cultivar trials indispensable to give regional recommendations to farmers.

LIVESEED Project

The LIVESEED project aims to develop guidelines for organic cultivar testing and registration which can also be used for low-budget on-farm trial models, alternative financing situations and new infrastructures.

The LIVESEED project is an EU Horizon 2020-funded project that runs from 2017 to 2021. The multi-actor project is coordinated by IFOAM EU and FiBL-Switzerland and supported by 50 partners (research institutes, breeding and seed companies, organic associations, and national authorities) covering 18 EU countries.

The mission of LIVESEED is to boost organic seed and plant breeding across Europe, and thereby, improving the competitiveness as well as sustainability of the organic sector. An important part of fulfilling this objective is the development of cultivars adapted to the needs of the organic value chain and to widen the cultivar choice available to organic farmers. To assess the current status-quo of cultivar testing in Europe, LIVESEED partners ÖMki (Hungarian Research Institute of Organic Agriculture) and SEGES (Danish Agriculture & Food Council) conducted a series of interviews with partners and stakeholders from 15 different EU countries. The outcome is a comprehensive and in-depth overview covering crop

type, trial setup, organisational models, dissemination of results and financial models of cultivar trials with arable, vegetable and fruit crops.

How is organic cultivar testing implemented in Europe?

In the EU, registration testing conducted by variety testing authorities is designed to fit the needs of the conventional sector. Following the increase in the importance of the organic sector, some member states established organic VCU and/or organic post-registration testing. In the EU, organic VCU testing is either conducted supplementary (in Austria, France and Latvia) or substitutional (in Austria for winter wheat, Denmark and Germany) to conventional VCU trials. Among the countries that have implemented organic cultivar testing, there are significant differences in trial design and organisational structure.

Within the EU, the German system of organic cultivar testing is comparatively well developed. This development is facilitated by governmental financial support as well as the demand by organic farmers, breeders and seed companies to ease the release of organic cultivars to the market. Table 2 illustrates Strengths, Weaknesses, Opportunities and Threats (SWOT) of the organisational structure and trial design of organic cultivar testing in Germany.

The Federal Plant Variety Office, the German variety testing authority, commissions Federal State Offices to conduct organic VCU testing with winter wheat, winter barley, spring barley and spring oats. As these trials are conducted separately, applicants must pay the same fees as for conventional trials. Besides, Federal State Offices conduct organic post-registration testing based on regions of similar pedo-climatic conditions. As these trials are funded by the Federal States, no fees have to be paid, but the number of testing locations and species included is limited to arable crops of high economic importance. Organic farmers can identify cultivars suitable for organic agriculture by looking at the descriptive variety lists, issued by the Federal Plant Variety Office and the recommended variety lists, issued by the Federal State Offices. However, there is no separate category in the national variety lists and the EU common catalogues which aggravates the identification of cultivars suitable for organic agriculture for farmers in other EU Member States. Furthermore, it remains a challenge to adapt DUS testing to organic requirements and no official testing system has been set-up for minor arable crops and other crop sectors.

Strengths	Weaknesses
<ul style="list-style-type: none"> Separate organic VCU testing costs the same as conventional VCU testing Possibility for organic post-registration testing, based on crop-specific cultivation areas Governmental support in research and financing of post-registration trials Communication between Federal Plant Variety Office, trial coordinators and breeders Uniform standards and methods; good statistical evaluation; transparency 	<ul style="list-style-type: none"> No separate category in national/EU variety lists Limited number of testing location and species included in cultivar testing; no testing of vegetables Limited number of organic breeders
Opportunities	Threats
<ul style="list-style-type: none"> Separate organic VCU testing decreases price burden Regional recommendations based on pedo-climatic conditions Iterative development of cultivar testing to increase efficiency Possibility for adjustment of trial conditions and protocols 	<ul style="list-style-type: none"> Restriction of agricultural diversity by focusing on crops with major economic importance Little incentive to breed and cultivate minor crops

Table 2: SWOT (strengths, weaknesses, opportunities, threats) analysis of the organisational structure and trial design of organic VCU (value for cultivation and use) and post-registration testing in Germany.

The German model of cultivar testing might not be suitable for less affluent countries with a smaller organic sector. Thus, LIVESEED aims to develop different approaches and alternative financial models to suit the needs of the organic sector and facilitate the development of cultivar testing throughout Europe. Collaborative and participatory approaches which include various chain actors in the cultivar testing procedure represent promising alternatives. As a starting point, it is important to investigate the status-quo of cultivar testing across Europe and all crop sectors.

Arable crops

Crop type: Analysis of performed interviews illustrated that, the greater the economic importance of the arable crop, the more likely it is that organic cultivar trials are set up. Almost all 15 interviewed EU countries have set up pre- or post-registration trials with wheat; whereas, cultivar trials with crops such as spelt, rye and emmer are in minority (see Figure 1). The same applies to VCU testing: cereal species included in organic VCU trials differ from country to country but usually include wheat and barley.

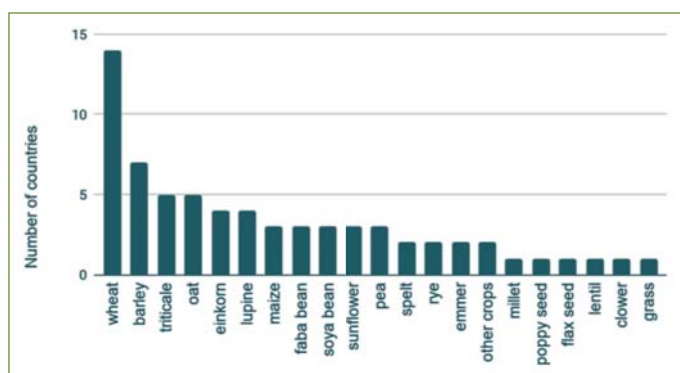


Figure 1: Arable crops included in organic cultivar testing in 15 EU countries.

Trial design: Trials for arable crops can take place on-station and/or on-farm. Institutes that receive governmental support are able to set up more complex trials including three or more replications. The number of locations included in the evaluation, ranges from 1 to 40. Trials follow the protocol used in conventional cultivar testing, a simplified protocol with less testing criteria, or an adapted protocol which includes traits relevant for organic agriculture, such as weed competitiveness or leaf disease assessment.

Organisational structure: Usually, researchers, technicians and breeders are involved in the organisation of trials. Despite the valuable input of farmers, very few institutes report to include the farmers' expertise in the procedure of cultivar selection and evaluation.

Dissemination of results: Most interviewed institutes report to make results publicly available and only some disseminate results just within a closed network. Official recommendation lists of cultivars for organic farmers are issued by France (for cereals), Italy, Switzerland and Germany. Cultivars that have passed organic VCU testing are described in the national descriptive variety lists under a separate category. However, the EU common catalogues do not provide any information on the conditions of the trials.

Financial model: Most of the interviewed institutes are funded through governmental grants or project financing. Other means for funding are user financing (e.g., membership fees and voluntary work) and application fees. Application and testing fees for VCU testing differ among interviewed countries and are usually covered by breeders or applicants. In the case of supplementary VCU trials, usually organic and conventional trials must be paid, increasing the costs significantly.

Vegetable crops

Crop type: Various vegetable species are included in organic cultivar testing. As tomatoes represent the most economically important vegetable worldwide, most institutes report to have set up trials for the assessment of different tomato cultivars.

Trial design: Due to the diverse nature of different vegetable species and due to differences in funding, the trial design differs substantially. Trials take place on-station and/or on-farm. On-farm trials often use a more simplified design with less repetitions. Testing protocols include the assessment of disease and pest resistance, yield, nutritional and organoleptic analysis.

Organisational structure: Usually, researchers, breeders and seed banks are involved in the organisation of trials. Interviewed institutes report more frequently to make use of farmers' expertise in the visual assessment of cultivars.

Dissemination of results: Most institutes disseminate results just within a closed network. There were no reports about recommendation lists of cultivars suitable for organic vegetable growers.

Financial model: Most trials are highly dependent on project funding. Other means for funding are public and private financing, user financing, application fees, and company-seed sale.

Fruit crops

Crop type: Various fruit crops are included in organic cultivar testing. The five institutes interviewed on fruit crops most frequently included apple, pear, apricot and peach.

Trial design: Due to the perennial nature of fruit crops, trials are conducted over a longer period and cultivars cannot change frequently. Thus, trials often take place on-station and only interesting cultivars are tested for their performance under on-farm conditions. Testing protocols include the assessment of pest and disease resistance, yield, fruit size, fruit quality, and shelf life.

Organisational structure: Usually, researchers and technicians participate in the organisation of trials. Farmers participate in the assessment if trials are conducted on-farm.

Dissemination of results: Institutes regularly disseminate results in different publication forms. Additionally, some report to offer workshops and seminars on cultivar assessment for organic fruit growers. Of the five interviewed institutes, only one mentioned to disseminate recommendation lists.

Financial model: Some institutes receive financing from national governments; while others depend on project funding, financial support from retailers, or user financing.

Concluding remarks

Throughout the EU, organic cultivar testing takes place at different levels of organisational structure, trial design, dissemination and financial model. Cultivar testing within the arable crop sector is the most developed and within each crop sector cultivar testing is most likely to be set up for major crops.

More affluent countries, such as Germany, have established a comprehensive cultivar testing system. However, in less affluent EU member states with a smaller organic market, there is a lack of incentive for its development. A harmonised implementation and



Pea seeds grown as pea shoots

standardisation of the EU regulation might help in increasing the volume of organic seeds and adapted cultivars available to organic farmers. The LIVESEED project is a valuable starting point to foster cooperation among EU member states and to strengthen the organic seed and breeding sector throughout Europe.

The full Overview On The Current Organizational Models For Cultivar Testing For Organic Agriculture Over Some EU Countries by Tina Kovács (ÖMKi) and Tove Mariegaard Pedersen (SEGES) can be found on the LIVESEED website. The German system of organic cultivar testing was analysed and compared to other systems throughout the EU in the scope of a Master's Thesis Organic Variety Testing: Qualitative Content Analysis Approach To Assess Organic Variety Testing, Case Study Of Germany by Kaja Gutzen. The Master's Thesis is also available on the LIVESEED website²

¹ https://www.liveseed.eu/wp-content/uploads/2019/07/LIVESEED_D2.1_Overview-of-the-organisationalmodels-of-cultivar-trials-for-organic-agriculture.pdf

² https://www.liveseed.eu/wp-content/uploads/2020/02/MASTER-THESIS_Organic-Variety-Testing_Kaja-Gutzen.pdf



LIVESEED is funded by the European Union's Horizon 2020 under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090.

