



Boosting organic seed and plant breeding across Europe
2017 – 2021

Deliverable 2.1

Overview on the current organizational models for cultivar testing for Organic Agriculture over some EU countries

Due date: M24

Actual submission date: 27 May 2019

Project start date: June 2017 **Duration:** 48 months

Work Package concerned: WP2

Concerned work package leader: Frédéric Rey

Authors: Tina Kovács, Tove Mariegaard Pedersen

Project ID: 727230



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. The information provided reflects the views of the authors. The Research Executive Agency or the SERI are not responsible for any use that may be made of the information provided.



TABLE OF CONTENTS

SUMMARY	4
Acknowledgment	4
I. INTRODUCTION	5
II. METHODOLOGY	6
III. OVERVIEW OF DIFFERENT ORGANIZATIONAL MODELS AND ORGANIC VCU IN EUROPE.....	7
ARABLE CROPS	8
VEGETABLE CROPS	18
FRUIT TREES	21
IV. COUNTRY REPORTS ON ORGANIC VARIETY TRIALS	23
ARABLE CROPS	24
FRANCE	24
GREECE	26
AUSTRIA	28
HUNGARY	32
ITALY.....	34
LATVIA	36
NETHERLANDS.....	38
POLAND.....	40
ROMANIA	41
SWITZERLAND	43
UNITED KINGDOM	44
DENMARK.....	47
GERMANY.....	50
VEGETABLES CROPS	55
FRANCE	55
GREECE.....	57
AUSTRIA	57
HUNGARY	60
ITALY.....	60
LATVIA	61
NETHERLAND	61
POLAND.....	62
PORTUGAL.....	62



ROMANIA	64
SPAIN.....	64
SWITZERLAND	66
UNITED KINGDOM	67
DENMARK.....	67
GERMANY.....	68
FRUIT TREES	70
FRANCE	70
GREECE.....	71
POLAND.....	72
SWITZERLAND	73
DENMARK.....	74
V. REFERENCES.....	76
VI. LIST OF TABLES AND GRAPHS.....	77



SUMMARY

Variety trials are an important way to evaluate the suitability of existing varieties (conventional, organic, landraces, heirloom, etc.) for organic farming, and are a necessary step in plant breeding and variety registration. However, it is essential that beside on-stations trials, varieties are also tested on-farm in different climatic regions as this gives more accurate and realistic variety performance assessment (Lyon et. al. 2019). Varieties of different crop species are in service to various stakeholders. Thus, their involvement may play an important role in variety trials. They could contribute, with knowledge, seed material in kind or financial support, to build cost-effective variety testing models also for crops that are not grown on a large scale and have small market share.

In the report evaluation of different organic variety trials for pre- and post-registration as well as VCU across 15 EU countries (for arable incl. forage, vegetable and fruit crops) is presented through 4 main criteria (trial setup, organizational model, dissemination of results and financial model). Through the range of organizational models of variety trials there were some that were mainly governmentally supported and involving researchers, others that have strong engagement of breeders and seed companies, or are done within seed companies, and some that are running just if project financing is available or some that are mainly established by farmers and done on voluntary basis. Organizational models of variety trials have quite complex nature and therefore, it is not possible to give a general recipe for establishing successful variety trials network. Institutes or initiatives organize trials depending on different socio-economic conditions, such as financial possibilities, economic importance of the crop in the country, chain actors' engagements, organic sector development, existing trial infrastructure etc. In the report, SWOT analysis of different organizational model groups give better understanding of pros and cons of the different systems and show necessary infrastructure for different models. These analyses will serve as a base for development of guidelines for on-farm trials models that are low budget, with alternative financing and new infrastructures.

Acknowledgment

First of all, we would like to thank all the interviewees that took time and shared with us all the requested information. We would also like to express our great appreciation to MSc student at Aarhus University, Kaja Gutzen, who helped us collect and write information about German organic variety trials and organic VCU for registration. Lastly, we would like to thank reviewers, **Monika Messmer**, **Frederic Rey** and **Ambrogio Costanzo**, for all their suggestions and professional advices that improved this report.



I. INTRODUCTION

Organic food is produced in various environments and is facing several challenges because of heterogeneous field conditions unlike in conventional farming, where these differences are generally buffered with use of synthetic fertilizers, pesticides and/or herbicides (Baresel and Reents 2006). Therefore, successful organic farming requires crop varieties that can cope with multiple biotic and abiotic stresses, are adopted to specific environments and can meet requirements for organic food processing (Lammerts van Bueren et al. 2007, Andersen et al. 2016). Assessing variety performance across a range of on-farm conditions, involving farmers and other chain actors' participation, is crucial for development of such varieties (Lyon et al. 2019, Wolfe et al. 2008). Furthermore, separate variety trials under organic conditions are necessary as information obtained in conventional variety trials are not sufficient for the organic sector as varieties are not performing the same under organic or conventional management (Leistrumaite A. 2005, Baresel and Reents 2006, Le Campion et. al. 2014). The determination of specific traits (beyond yield and protein for cereals) for the evaluation in organic farming are highly required in variety trials in order to transfer them as selection criteria to organic breeding programs and to official registration variety testing (Baresel and Reents 2006, Rolland et. al. 2008, Fontaine et al. 2008). It is essential for organic farmers, breeders and seed companies to know organically or conventionally bred varieties performance under organic farming conditions to improve and expand the organic seed sector in the future.

Even though organic food demand has been constantly growing for several decades now, organic agriculture is still representing just 2,9 % of total agricultural land in Europe (Willer et al. 2019) and this presents a significant bottleneck for investing in organic breeding programmes and organic testing for value for cultivation and use (VCU). To overcome this problem collaborative breeding and variety testing models that are based on a multi-actor approach - involving farmers, commercial breeding, seed companies and food chain actors - have high perspective (Nuijten et al. 2013). Sharing knowledge, work and financial responsibility among participants from different sectors seems as a sustainable solution for further development of the organic seed sector. Furthermore, Murphy et al. (2007) showed in his study that one of the crucial points for reaching higher yield in organic farming is to breed and adapt varieties for organic agriculture in the target environment of organic system. However, in order to realize this, it would be vital to engage organic farmers with a participatory approach as organic food is produced in broad range of environmental and farming systems (Lyon et al. 2019). In this report we have analysed and compared various organic variety trials initiatives for arable incl. forage, vegetable and fruit crops.

In the European Union, marketing of seeds and plant propagating material is regulated through 12 basic acts (European Commission, 2019). According to these directives trading of the seeds is possible only from varieties which are registered in the official National Variety List and the EU common catalogue of registered plant varieties. To register a variety on these lists it should pass official testing for Distinctness, Uniformity and Stability (DUS) and in addition, for arable crops, the value for Cultivation and Use (VCU). In most of the EU member state countries VCU is conducted only under conventional farming practices and the problem is that traits that are important for organic farmers are not assessed. This issue was already discussed in previous EU projects (i.e. DIVERSIFOOD, COBRA and COST Action project SUSVAR).

However, in this report we wanted to present how certain countries were able to implement organic VCU and with this, motivate other member state countries to follow the examples.



The overall aim is to evaluate different models of currently active organic variety trials and organic VCUs in different EU member states to further provide i) ideas for new organisational models for organic variety trials and ii) guideline for improved protocol for organic 'Value for Cultivation and Use' (VCU) testing.

II. METHODOLOGY

To assess current organizational models of cultivar testing in organic agriculture over some EU countries we collected data through interviews as one of the most common formats for data collection in qualitative research (Jamshed, 2014). Our qualitative research interviews were in-depth structured (set of broad questions were asked more or less in order but flexible to adjust to respondent's answers) and were carried out between January 2018 and March 2019. Interviewees were mainly LIVESEED partners and experts that are actively involved in the variety trials of arable, vegetables, or fruit crops. We interviewed partners from 15 different EU countries (Austria, France, Greece, Hungary, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Spain, Switzerland, Germany, Denmark, UK). With selected countries, we tried to cover different climatic zones and socio-economic regions of Europe to gather representative information on current variety testing in organic agriculture in Europe. We presented the information from each country according to the crop type (arable crops / vegetable / fruit trees) and trial design (number of replications, locations, years), organizational structure (who is participating and what is their role), dissemination of results and financial model. Description of organic VCU testing for the countries where this is performed was included as these trials are closely related to organic pre- and post- registration trials. Information from countries with organic VCU trials and selected examples of post registration trials information was also presented through SWOT analyses.



III. OVERVIEW OF DIFFERENT ORGANIZATIONAL MODELS AND ORGANIC VCU IN EUROPE

In this chapter outcomes of the interviews are summarized according to CROP TYPE, TRIAL DESIGN, ORGANIZATIONAL STRUCTURE, RESULTS DISSEMINATION and FINANCIAL MODEL to provide a more condensed overview of the current situation on organic variety trials in some EU countries. The list of interviewed institutions is provided below in [Table 1](#).

Table 1: List of interviewed institutions

	Name of the interviewed institute	Short name	Country
1	Institut Technique de l'Agriculture Biologique	ITAB	France
2	Groupe d'Etude et de contrôle des Variétés Et des Semences	GEVES	
3	Network for Biodiversity and Ecology and Agriculture	AEGILOPS	Greece
4	The Institute of Organic Farming at the Agricultural Research and Education Centre Raumberg-Gumpenstein	AREC	Austria
5	Austrian Agency for Health and Food Safety GmbH	AGES	
6	The Horticultural College and Research Institute	HBLF	
7	the Arche Noah seed bank	Arche Noah	
8	The Hungarian Research Institute of Organic Agriculture	ÖMKi	Hungary
9	The Centre for Agricultural Research, the Hungarian Academy of Sciences	MTA-ATK	
10	The Council for Agricultural Research and Agricultural Economics Analysis	CREA	Italy
11	The Italian Farmers' Seeds Network	RSR	
12	The Institute of Agricultural Resources and Economics	AREI	Latvia
13	Institute of Horticulture, Latvia University of Agriculture	LLU	
14	The Louis Bolk Institute	LBI	Netherland
15	The Institute of Soil Science and Plant Cultivation State Research Institute	IUNG-PIB	Poland
16	the Research Institute of Horticulture in Skierniewice	InHort	
17	National Agricultural Research and Development Institute	NARDI	Romania
26	the Vegetable Research and Development Station Buzău	VRDS Buzău	
18	The Research Institute of Organic Agriculture	FiBL CH	Switzerland
19	The Organic Research Centre	ORC	UK
20	LANDBRUG & FØDEVARE F.M.B.A.	SEGES	Denmark
21	HortiAdvice Scandinavia	HortiAdvice	
22	Federal State of Hessen	LLH in Hessen	Germany

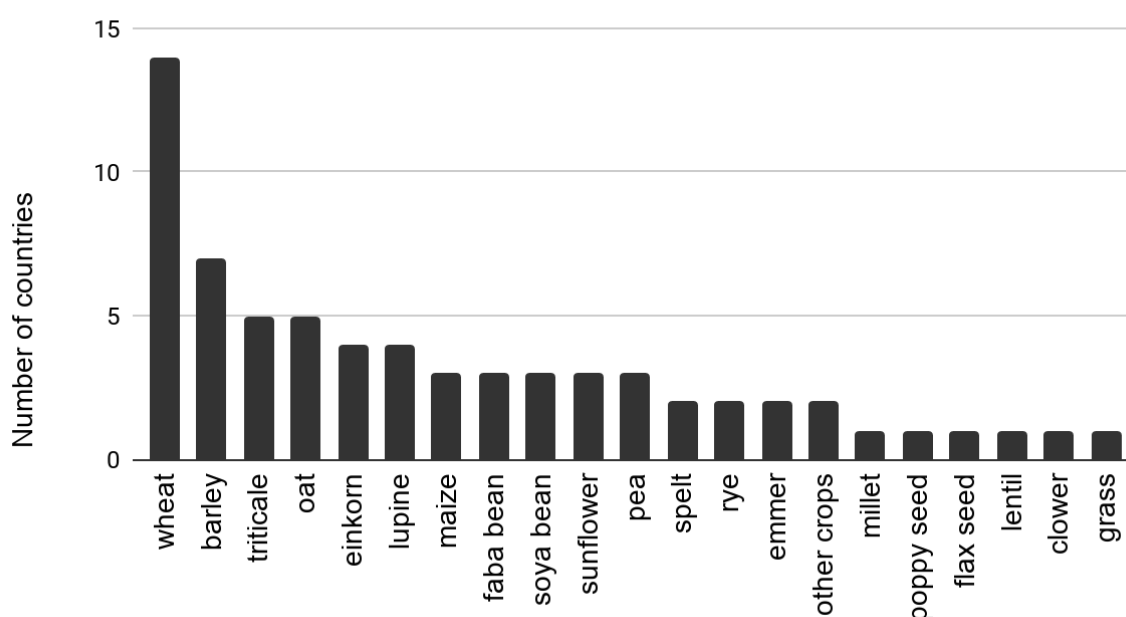
23	Bingenheimer Saatgut AG		
24	Landwirtschaftskammer Nordrhein-Westfalen	NRW	
25	Living Seeds Sementes Vivas	LSSV	Portugal
27	Universidad Politécnica de Valencia	UPV	Spain

ARABLE CROPS

CROPS IN THE TRIAL

In most countries where interviews were performed there are organic variety trials with wheat (winter/spring/hard/soft/durum). Barley is the second most popular cereal followed by oat and triticale (Graph 1). Organic variety trials with other crops, such as rye, emmer, einkorn, maize, legumes, sunflower are in minority (1-3 countries). This substantiates that the greater the economic importance of the crop is, the sooner the problem is collectively recognized and prioritized (Nuijten et al. 2013).

ARABLE CROPS UNDER ORGANIC VARIETY TRIALS in 15 EU countries



Graph 1 Arable crops in organic variety trials in 15 EU countries

TRIAL SET-UP

For most arable crops the trial set-up is very similar. The differences between the set-ups are more due to the trial's location (on-farm or on-station) and institutional capacities. Just 5 of the institutes that were interviewed have both on-farm and on-station trials, the rest of them have on-farm or on-station. Furthermore, more than half of the institutes that are doing on-farm trials are establishing

them with complex set-up (3 or more replications) which demand specialized machinery for sowing and harvest and more organizational work. Most of these institutes are financially supported by the government. However, such a trial set-up also brings results that can be statistically analysed and can

show if variation between varieties is due to environmental influences or genetic background. The number of locations highly varies between institutes, from 1-40 locations (Table 2).

Table 2 Organic variety trials according to the institutes, location and number of experimental sites.

Organisation	On-station or On-farm trials	Number of trial sites of 2017-18 growing season
ITAB, France	on-station	2-3
	on-farm	40 (for wheat), 20 (triticale), few for spelt
AEGILOPS, Greece	on-station	1
	on-farm	8-10
AREC Austria	on-station	1
	on-farm	few (potato, soy, triticale)
ÖMKi, Hungary	on-farm	8 - 10
MTA-ATK Hungary	on-station	1
RSR, Italy	on-farm	35 - 40
CREA, Italy	on-station	1
AREI, Latvia	on-station	2
	on-farm	2
LBI Netherland	on-station	1-2
IUNG-PIB, Poland	on-station	6
	on-farm	2
NARDI, Romania	on-station	1
FiBL, Switzerland	on-farm	7
ORC, UK	on-station	1
	on-farm	7
SEGES, Denmark	on-farm	4
LLH in Hessen, Germany	on-farm	3

Assessment of the varieties were divided according to the 2 categories. Varieties could be assessed with 1. conventional protocol, 2. simple protocol (yield and diseases and pests and maybe grain quality). We also checked if evaluation of specific traits (crop ground cover, early vigour, plant height, nutrient efficiency, disease resistance, etc.) are included, traits that are relevant for organic farming and were listed in the study by Löschenberger et al. (2008) and Wolfe et al. (2008). 11 institutes out of 15 evaluate varieties with the conventional protocol. However, half of them include in the evaluation also specific traits that are relevant for organic farming, such as weed competitiveness, soil

coverage, plant height, leaf diseases assessment. Baking quality is also one of the important traits for organic farmers but not many institutes are performing this, as baking quality tests can be quite costly, especially if bakers or/and millers are not actively involved in variety trials.

ORGANIZATIONAL STRUCTURE

For successful development of the organic seed sector active collaboration of farmers, traders, breeders and governmental organizations is essential (Lammerts van Bueren et al. 2003). However, it can be hard to convince farmers or other chain actors to actively participate in variety trials or even financially support it. It is important to have a common language, and everybody must be engaged in the problem. Most institutes reported that researchers, technicians and/or breeders are choosing the varieties that will be included in the trials, and researchers and technicians are establishing the trials and do the evaluation of varieties. Very few institutes actively include farmers in variety selection procedure and assessment (see Table 3 below). The reasons for this are different. In some countries farmers and other actors are not willing to dedicate extra time and take additional responsibility. Education and building farmer's skills would be highly necessary for their active involvement. A good example of this is the development of a simple application through which farmers can easily report the data from the trials on a more regular basis (CAPSELLA application developed by RSR in Italy). In other countries farmers value the trials to see which varieties do well on their own farm. Farmers seem more engaged in on-farm experiments with populations because they can develop seeds that are adapted to their own farm conditions.

Table 3 Level of different chain actor's involvement in variety trials

Chain actors	Level of involvement	Institutes
Researchers and technicians	Independent work in variety selection, trial set-up and evaluation	AREC, AREI, LLH, MTA ATK, CREA, NARDI
	Trial set-up and evaluation	FiBL
	Assistance in organization and evaluation	RSR, AEGILOPS, ITAB, ÖMKi, IUNG-PIB, ORC, SEGES
Farmers	Trial set-up, maintenance	ÖMKi, IUNG-PIB
	Trial set-up, maintenance and participation in evaluation	AEGILOPS, RSR, ORC
	Hosting trials on their farms	ITAB, SEGES, FiBL
	Use info from trials	AREC, AREI, LLH, MTA ATK, LBI, NARDI, SEGES
Farmers association	Recommendations of varieties and trial set-up	ORC, ITAB
Bakers and millers	Recommendations of varieties	LBI, ITAB
	Performing baking and milling tests	ÖMKi, LBI, ORC, ITAB
Breeders and seed companies	Recommendations of varieties and providing seeds	AREC, LLH, ÖMKi, IUNG-PIB, SEGES, ITAB

	Involvement in trial set-up	ORC
Wholesaler	Financing and organizing trials	LBI
	Recommendations of varieties	FiBL

DISSEMINATION OF RESULTS AND FINANCIAL MODELS

Dissemination of results is mostly organized by researchers who are also coordinators of the trials. However, in some institutes dissemination of results is taken over by the third party that is working on farmers education (Austria, Poland). Institutes mainly publish results on a yearly basis and are usually publicly available for everybody. Nevertheless, there are some institutes that share results just within the network. Even though institutes perform organic variety trials, not all of them are authorized to publish recommendation list of varieties for organic farmers and some of them do not have sufficient and reliable information from the trials to make recommendation lists. Countries that have an official recommendation list of varieties for organic farmers are France (for cereals), Italy, Switzerland, Germany.

Table 4 Financial resources in post-registration organic variety trials identified in the interviews (arable crops). It is common to have more than one financial source.

Public financing	Project financing	User financing (Levy on harvest, membership fees voluntary work)	Application fees
AREC	ORC	AEGILOPS	SEGES
Federal states DE	MTA ATK and ÖMKi	FiBL CH	
CREA	RSR	ÖMKi	
ITAB	AREI	RSR	
IUNG	AEGILOPS		
NARDI	NARDI		
FiBL CH			

Most of the interviewed institutes rely on public financing through governmental grants or project funding (Table 4). In a few countries, costs are partly covered by user financing, in the form of membership fees and voluntary work, and in Switzerland farmers pay a levy on harvest that goes to the organic label Bio Suisse who engages FiBL to perform variety trials. AEGILOPS in Greece run the trials mainly based on voluntary work. In Denmark an applicant fee covers the whole cost of the trials, and project financing covers only extra developmental work in the trials.

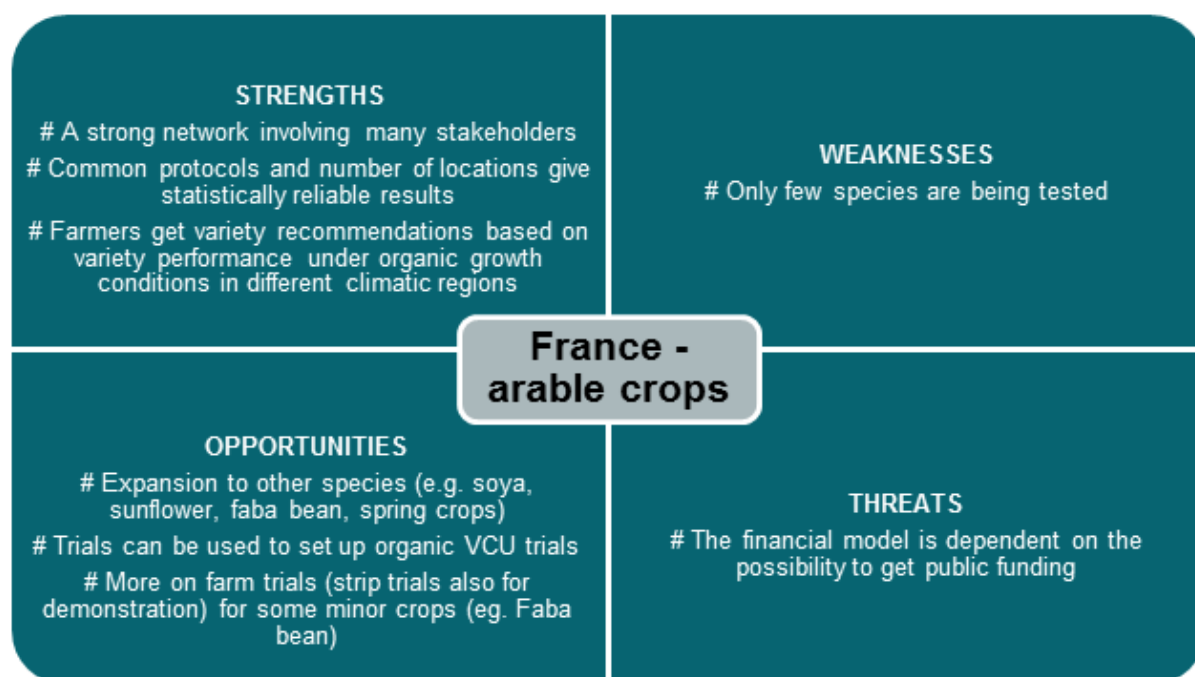
SWOT-analysis

Below different cases will be presented with a SWOT analysis. Each case represents a different type of organizational and financial model. The cases are from Denmark, Greece, France and Latvia.

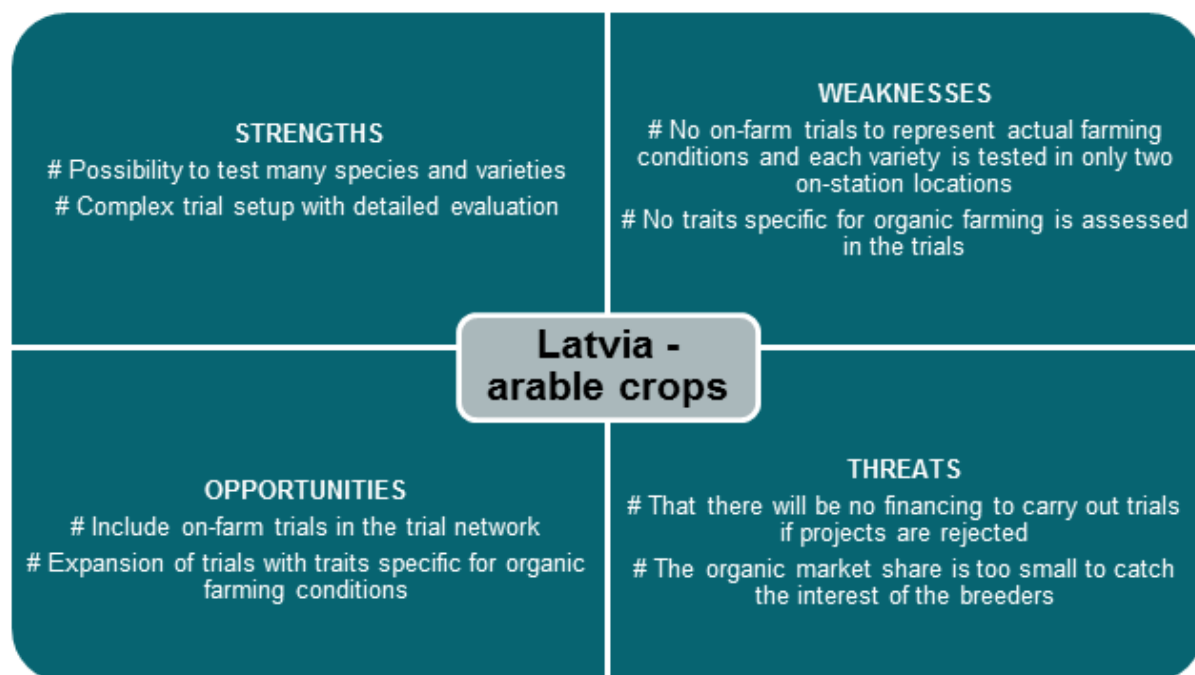


France - developed trial network

France has an extensive trial network involving many stakeholders, farmers are mainly involved by hosting the trials. Financing is based on public funding.

**Latvia** - researcher led trials

In Latvia trials are on-station only, with no assessments of traits specific for organic farming and with low involvement of farmers. Trials are dependent on running projects.

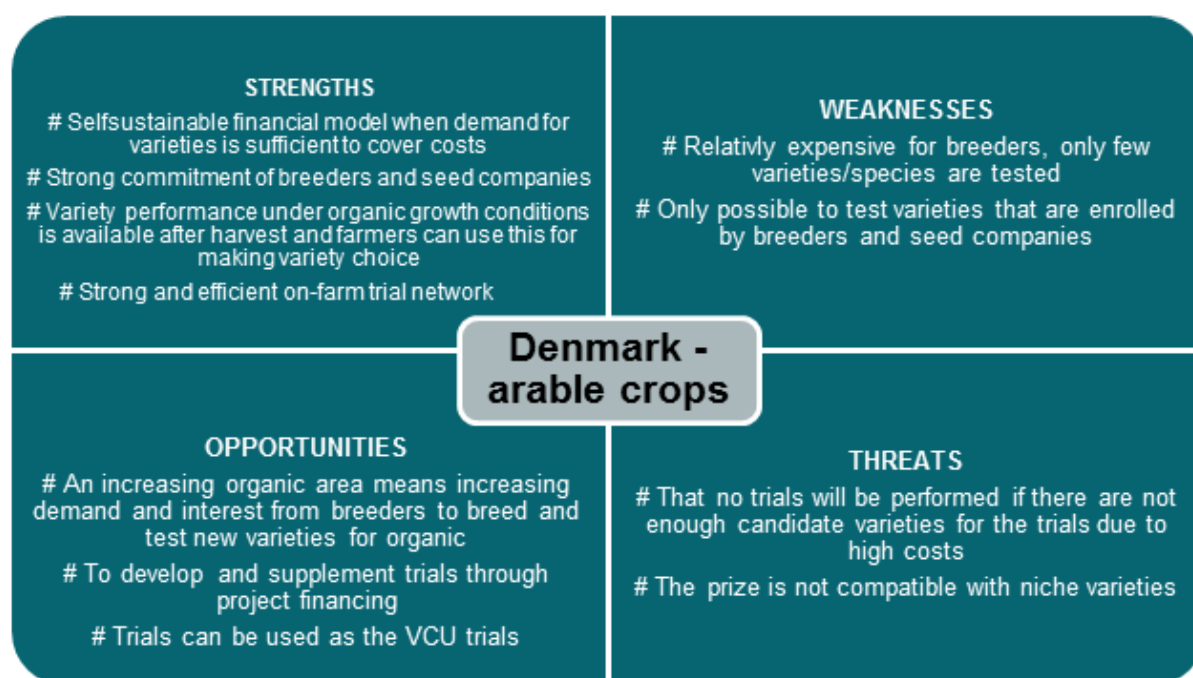


Greece - farmer run trials

At AEGILOPS in Greece, where financial resources are very limited, farmers are strongly involved in on-farm variety trials because they are very interested in getting information on the variety performance at their farm and are willing to do the extra work on the voluntary basis.

**Denmark** - applicant fee

In Denmark there is a commitment of breeders and seed companies to enter varieties in the trials. Farmers host trials on a voluntary basis because they are interested to follow the trials. Trials are financed by an applicant fee paid by breeders and seed companies who apply to have varieties in the trials.



The strengths, opportunities, weaknesses and threats of the different systems are very much dependent on the political, structural and financial situation and on the market situation and presence of people with strong commitment in each country.

In any case to build a successful multi-actor network that can run after projects end, stakeholders must feel ownership of the problem (Nuijten et al. 2013).

ORGANIC VCU FOR OFFICIAL VARIETY REGISTRATION

Organic VCU or supplementary organic registration trials are currently running in France, Austria, Latvia, Denmark and Germany (Table 5). In other countries, there is no official organic VCU because the organic market share is very low and there are no requests for official registration of varieties as organic breeding does not exist or there is lack of financial resources. First step for many countries would be to establish a solid trial platform for organic variety trials.

Table 5 Organic VCU for registration trials in Europe

Country	Organic	Suppl. organic
Germany	x (wheat, barley, oat)	
Austria	x (winter wheat)	x (several crops)
Denmark	x (winter wheat, spring barley)	
France		x (winter wheat, for soybean 2 organic locations)
Latvia		x (several crops)
Switzerland		One organic location (winter wheat, spelt)

Among the countries that reported about organic VCU Latvia and France offers the possibility for organic variety testing under VCU conventional trials supplemented with organic trials. In Latvia breeders must pay double price for registration and this consequently leads to less demand for organic VCU testing. In Austria several species can also be tested with supplementary organic trials. For winter wheat it is possible in Austria, Denmark and Germany to have only organic VCU testing, which means that no conventional trials need to be performed. This means that the costs for VCU will be lower. Cereal species that can be tested under organic VCU are different from country to country. In France so far only winter wheat can be tested for organic. In other countries (Austria, Denmark, Germany and Latvia) they have the possibility for VCU for organic for several cereal species (e.g. spring wheat, winter barley, spring barley, spring oat). Each country has some special assessment traits included in organic trials like weed competition, resistance against common bunt, nitrogen efficiency, lodging for cereals, an extra series under artificial inoculation for the resistance of *Pseudocercospora*, DTR, yellow rust and ear fusarium and milling and baking characteristics.

The basic principles for the testing of Value for Cultivation and Use are the same for all species and it is important to keep a common understanding of the technical approaches.

In the SUSVAR network (COST Action 860) chaired by Hanne Østergaard, Risø National Laboratory, Denmark) the Handbook on Cereal variety testing for organic and low input agriculture was published

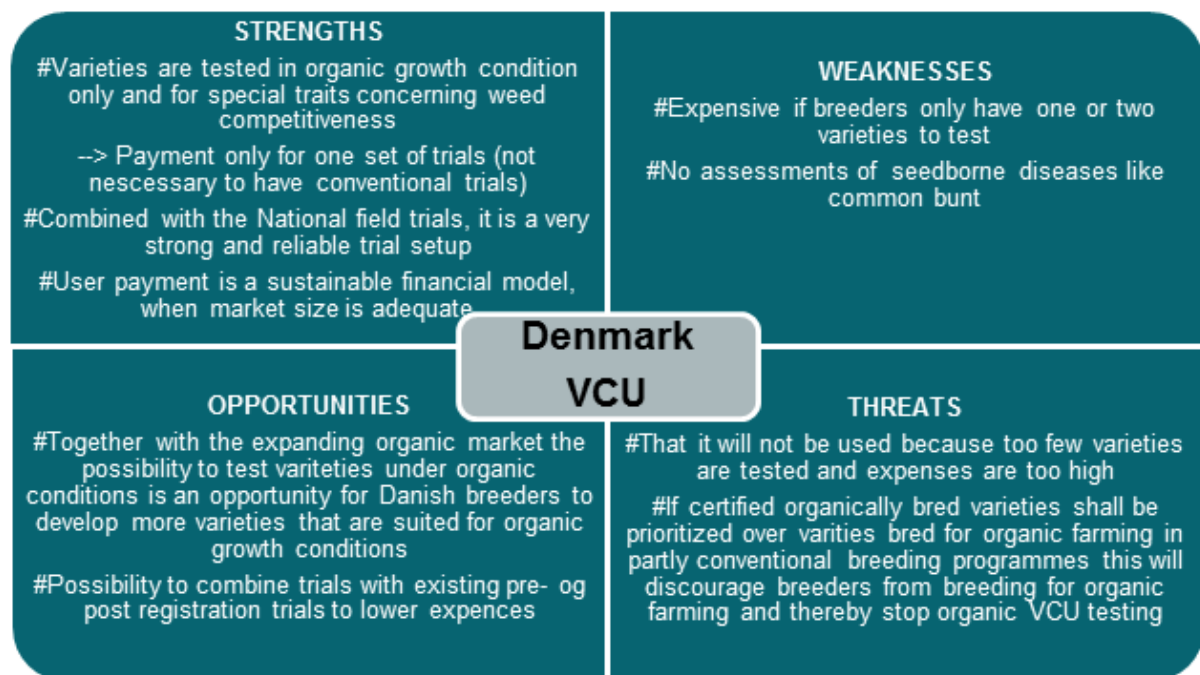
in 2006. The book was edited by Dingena Donner (Plant Variety Board, Netherlands) and Aart Osman (Louis Bolk Institute, Netherlands). It is a useful tool for those engaged in variety testing of cereals.

Prices for the VCU for organic differ from country to country. Some have the same fee for the organic VCU testing and for conventional VCU testing, others have double price for registration of organic varieties as both conventional and organic VCU trials must be done. In Austria testing of organic species costs less than testing for conventional varieties. The application and testing fee are usually covered by breeders or applicants. Varieties that have been tested under organic VCU or supplementary organic trials get a special signature in the descriptive list of varieties or the national variety list. However, these marks are not visible on the European variety catalogue.

SWOT-analysis

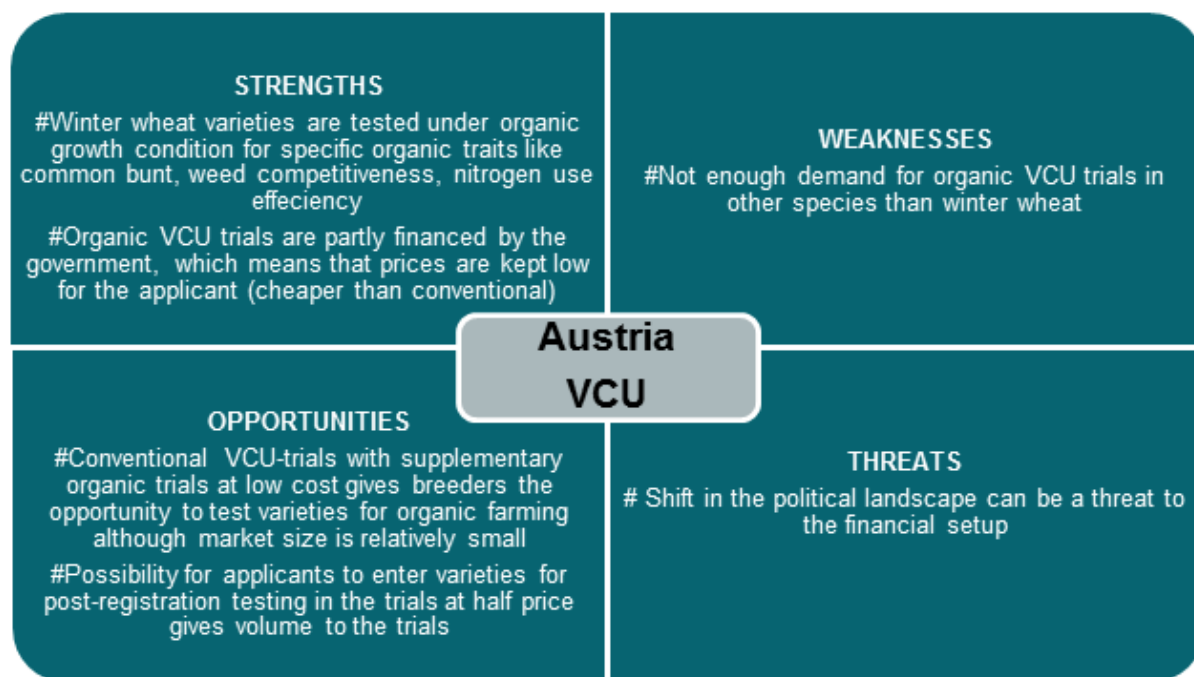
Denmark

In Denmark there is a political decision that it must be possible to test varieties in organic VCU trials and that breeders pay the costs for running the trials. So far only winter wheat and spring barley trials are running. These trials are combined with the organic post-registration trials.



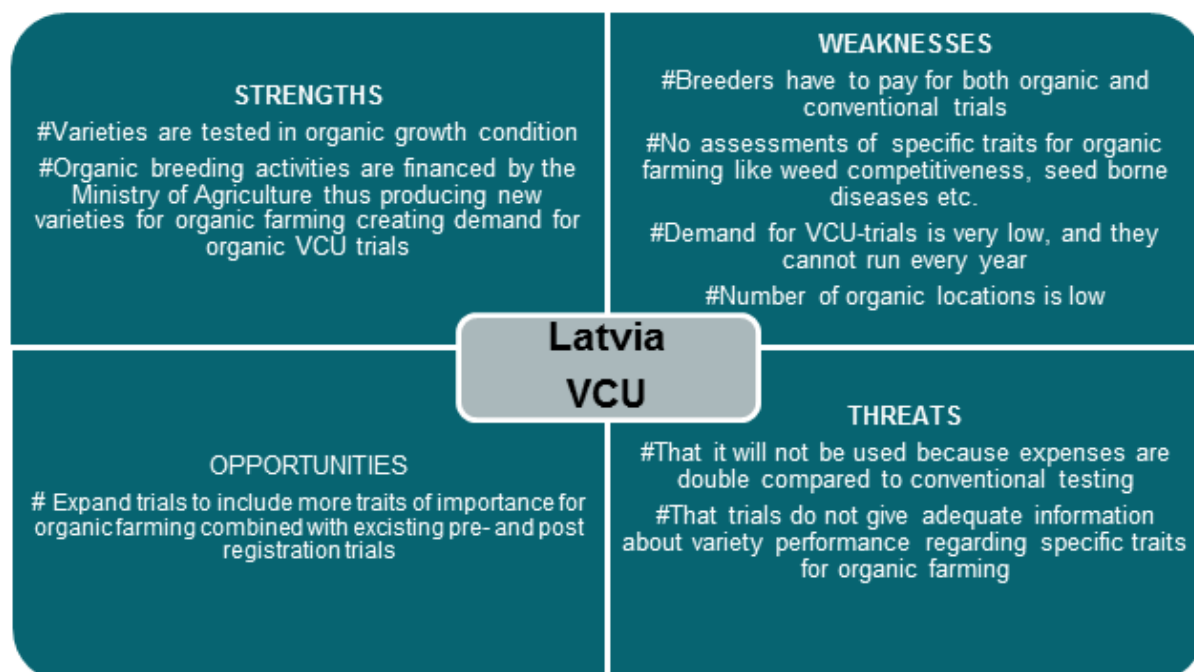
Austria

In Austria it is possible to have organic VCU trials in winter wheat, and supplementary organic trials in several other species. Trials are financed partly by governmental funds and partly by applicant fee, and organic trials are cheaper than conventional trials.



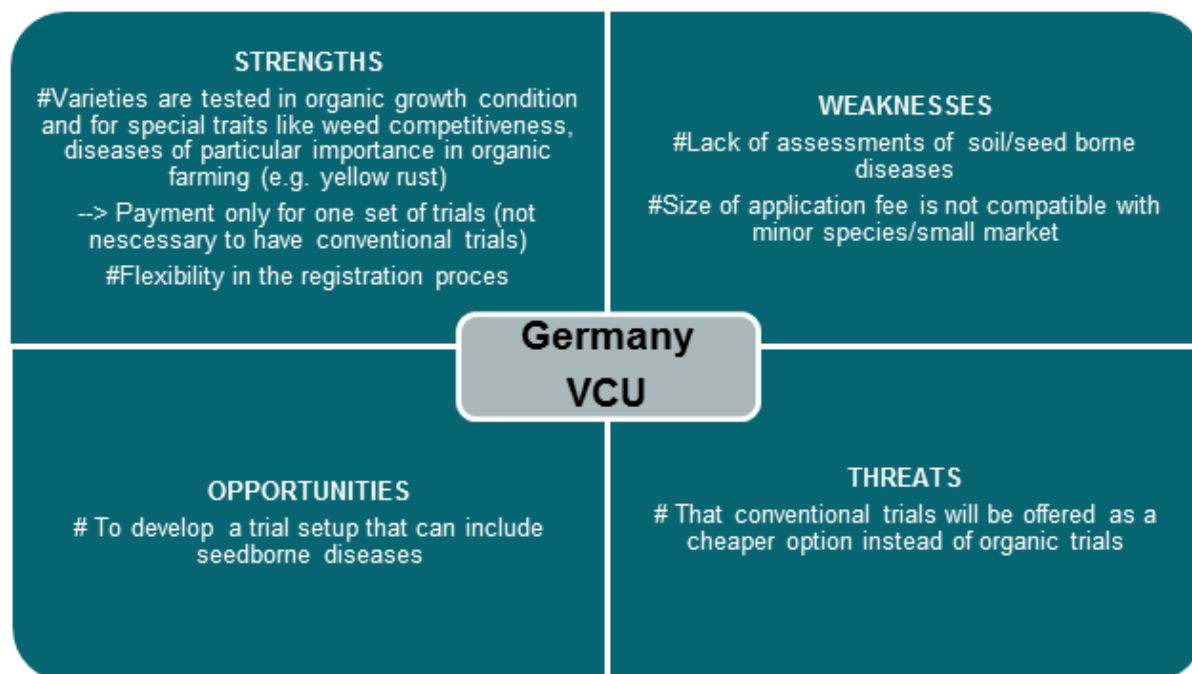
Latvia

In Latvia varieties for organic farming must be tested in both conventional and organic VCU trials making the price double the price than for conventional varieties. Breeders pay the costs for trials. In the trials no traits specific for organic farming is being evaluated.



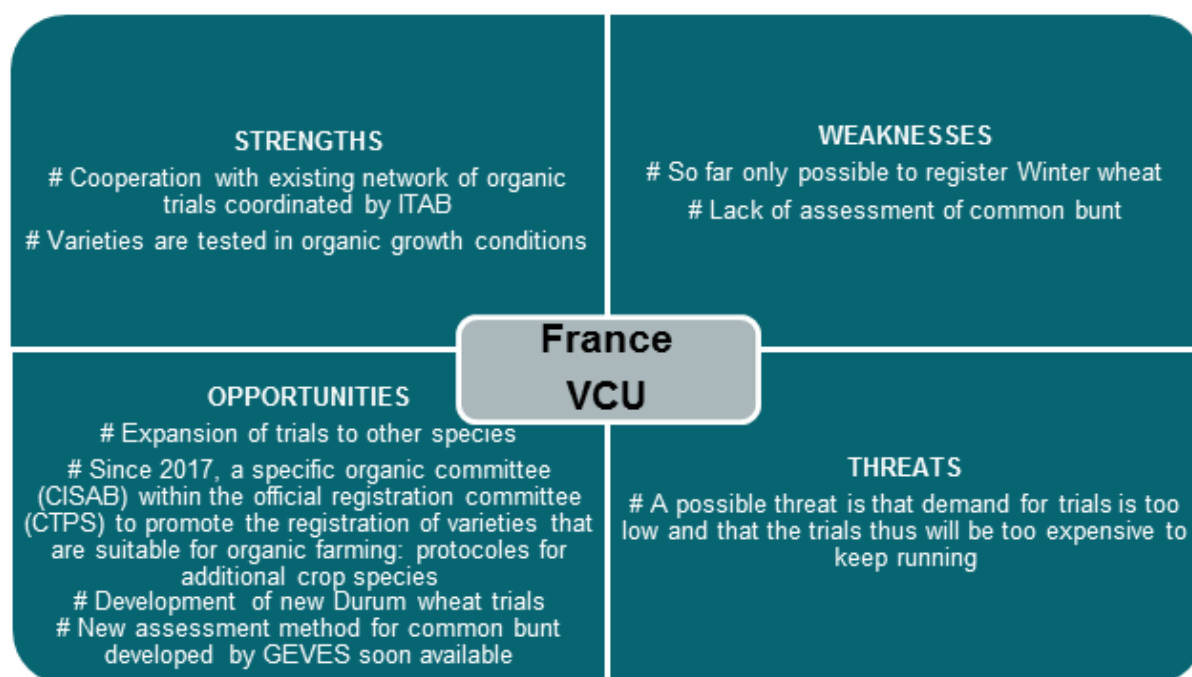
Germany

In Germany it is possible to test several species in organic VCU trials after a decision to accommodate the organic sector. Breeders pay the cost of trials. Cost is the same for conventional and organic VCU trials.



France

In France it is possible to test winter wheat in organic VCU trials, and there are discussions to expand to other species. Breeders pay a fee to cover trial costs, and the price is the same as for conventional trials (due to the current Ministry financial participation to cover additional organic trials).



VEGETABLE CROPS

Organic vegetable trials set-up is very different from species to species and therefore, we got more general answers on the organizational structure, experimental set-up and traits assessment from interviewed institutes. On the other hand, some countries gave specific information on selected vegetable crops, where they have the most of activities.

CROPS IN THE TRIAL

Majority of interviewed institutes performed organic vegetable variety trials with various vegetable species. However, most of them have a lot of activities with tomato and some of them also have well developed on-farm networks for organic tomato variety trials. These results came as no surprise as tomatoes are in the ranking as one of the most economical important vegetables worldwide.

TRIAL SET-UP

Variety trials for organic vegetables are performed in on-station and on-farm trials. Trials set-up and locations highly depend on the tested vegetable species. However, the on-farm trials setup and assessments are usually simplified. The traits that were most frequently expressed as relevant for evaluation in organic vegetable trials were: looking for disease and pest resistance, followed by yield, nutritional and organoleptic analysis. Performance of the last two mentioned traits highly depend on the available funding.

ORGANIZATIONAL STRUCTURE

Institutions that performs organic vegetable trials are very much interested in testing heritage and open-pollinated varieties and/or accessions from gene banks to enlarge biodiversity and bring unique flavours and new colours on the market. Nevertheless, seed availability for such varieties is often a challenge. Varieties in the trials are mostly chosen by researchers from the institutions in consultation with breeders and seed banks. Farmers that are hosting variety trials at their farm usually include experimental plots within their production area and are often actively involved in visual assessment of varieties (Table 6).

Table 6 Level of different chain actor's involvement in variety trials

Chain actors	Level of involvement	Institutes
Researchers, technicians, students	Choosing varieties, trial set-up and evaluation	AEGILOPS, HBLFA, LBI, InHort, VRDS, FiBL, HortiAdvice
	Trials organization and results evaluation	ITAB, OMKi, RSR, UPV, ORC, Arche Noah, LSSV
Farmers	Trial set-up, maintenance and participation in evaluation	ARCHE NOAH, RSR, UPV, ORC, ÖMKI
	Hosting and maintaining trials on their farms	HBLFA, LBI, LSSV, Bingenheimer Saatgut, FiBL, AEGILOPS
Farmers association	Choosing varieties and organize trial set-up, evaluation	ITAB, UPV
Breeders and seed companies	Recommendations of varieties and providing seeds	HBLFA, ORC

	Involvement in trial set-up and evaluation	LSSV, Bingenheimer Saatgut
Gene bank	Recommendations of varieties and providing seeds	LSSV, HBLFA, ÖMKi
Advisors	Recommendations for trials planning and varieties selection	HBLFA, ITAB
Retailers	Recommendations of varieties	ÖMKi

DISSEMINATION OF RESULTS AND FINANCIAL MODELS

Responsibility for result dissemination often lies on the researchers/coordinators of the trials. However, not all results are always publicly available. Sometimes, data are shared just within the network in order to motivate farmers and other chain actor to actively participate and financially contribute to the network in order to access the information. Nevertheless, the majority of organic vegetable trials highly depend on project funding (Table 7) and therefore, there is no guarantee that trials will continue even though interest will be there. None of the institutions publish recommendation list of varieties for organic vegetable growers or the information was not mentioned.

Table 7 Financial resources in post-registration organic variety trials identified in the interviews (vegetable crops). It is common to have more than one financial source.

Public financing	Private financing	User financing (memberships, voluntary work, fondations)	Project financing	Application fees	Company-seed sale
ITAB	ITAB	AEGILOPS	Arche Noah	Arche Noah	LSSV
HBLF	Arche Noah	UPV	RSR	LSSV	Bingenheimer Saatgut
InHort	ÖMKi	ÖMKi	LSSV	VRDS	
VRDS		LSSV	VRDS		
LBI			UPV		
ORC			FIBL		
			Arche Noah		

SWOT-analysis

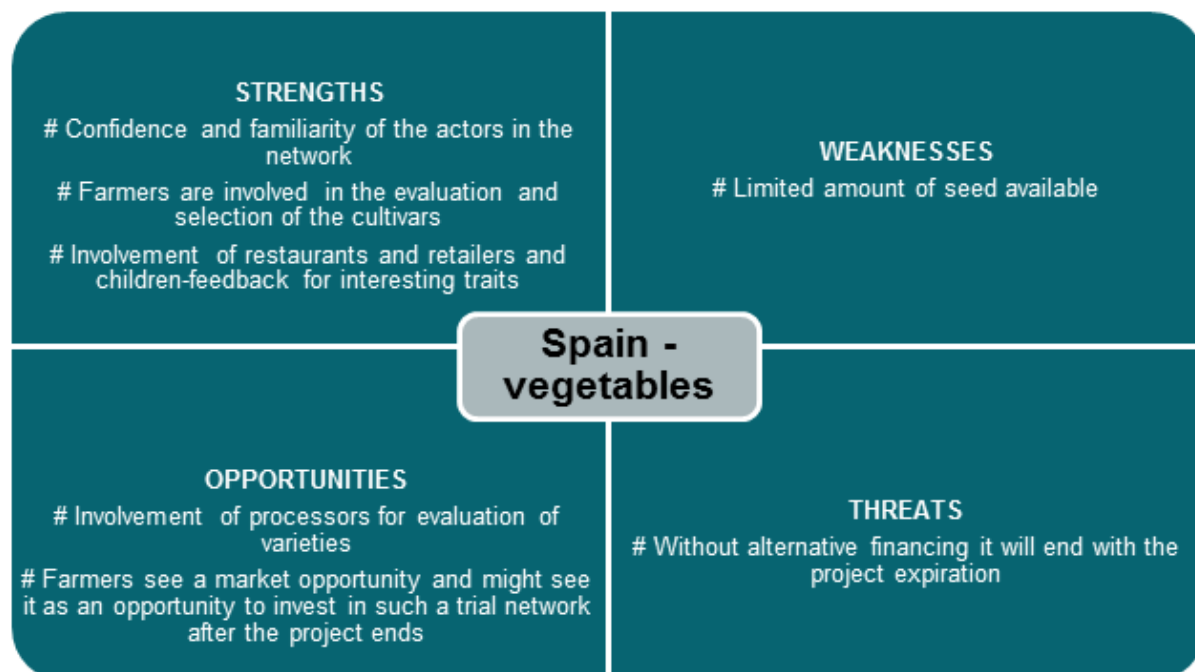
For the SWOT analysis we selected Spain, France and Germany as they present organic vegetable variety trials under three very different financial models and levels of farmers and other chain actor's involvement.

Spain - project dependent

The tomato trial network started with the LIVESEED project and is coordinated by UPV. On-farm trials are set up in different regions. Farmers are testing a lot of local and landrace varieties on their farms.

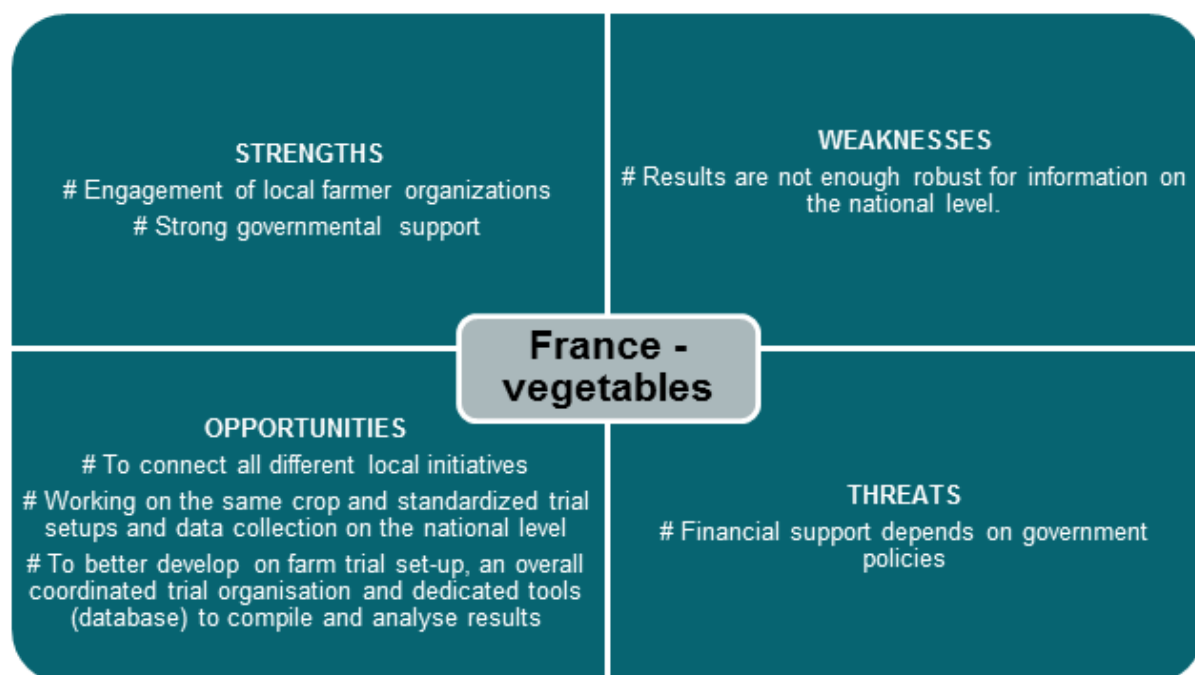


They also plan to involve retailers, restaurants and consumers for the fruit's evaluation. The organization of the network is financed by the LIVESEED project.



France - farmers organizations network

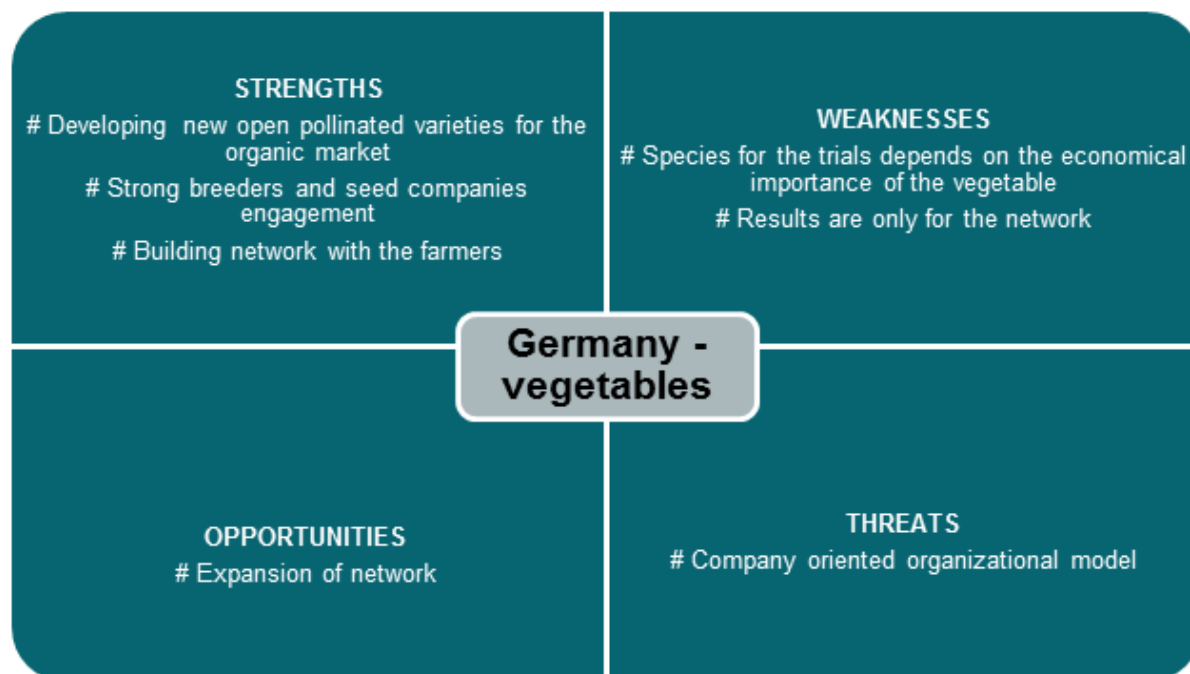
The local farmers' organizations are organizing the vegetable variety trials with the aim to find varieties that are adapted to the local organic farming conditions and that are cell-fusion free to replace cell-fusion derived CMS F1 Hybrids. They are working on the different species in various regions. Many varieties are screened on-station and best performing varieties are tested on-farm. The local variety trials are financed by local farmers organizations, by regional public support and by private financing.



Germany - seed company trial



Bingenheimer Saatgut AG is a seed company marketing exclusively open pollinated varieties of organic seeds and plants. They have a close cooperation with seed producers, organic farmers and a network of breeders working on-farm (the Kultursaat). They are mainly doing pre-registration trials with varieties under development. Cost for trials are covered by seed sale.



FRUIT TREES

Activities with organic fruit variety trials are very much connected to the project funding. In the EU there are several institutes that are dealing with organic fruit variety trials and organic fruit breeding. Unfortunately, we were only able to receive information from 5 countries. Nevertheless, we present different examples and compare their differences and similarities.

CROPS IN THE TRIAL

Several different fruit species are tested among the interviewed institutes. The most frequently mentioned were apple, pear, apricot and peach, followed by other fruits and nuts like cherries, plums, raspberries, strawberries, persimmon, mango, citrus and almond.

TRIAL SET-UP

Trials are at first set-up on experimental plots on-station and afterwards, interesting cultivars could be also brought to on-farm partners for testing under real production conditions. However, as fruit trials are long term experiments, cultivars cannot be changed very frequently.

Evaluation differs between institutes and depends on the project topic and available funding. Assessment traits relevant for organic vegetable growing and that were mentioned by everybody are: pests and diseases, yield, fruit size, fruit quality, shelf life.

ORGANIZATIONAL STRUCTURE

Most of the work in the fruit trials is done by researchers and technicians from the institute but if the trial is set-up on-farm, farmers would participate in assessment of tested fruit cultivars and identification of the more promising cultivars (Table 8). In Poland, the Institute of Horticulture

organizes workshops for farmers during which they get prepared for doing the assessments. They also get materials to help them make observations and measurements correctly. Furthermore, FiBL CH built a successful network for apple cultivar testing with apple breeders, organic apple growers, retailers and nurseries. In cooperation with one of the retailers, FiBL manage to develop flavour groups for apples so that consumers do not get attached to the name of the variety but to the taste. Now also other retailers use this system and it is mainly used for organic apples.

Table 8 Level of different chain actor's involvement in variety trials (fruit)

Chain actors	Level of involvement	Institutes
Researchers, technicians, students	Choosing varieties, trial set-up and evaluation	ITAB, InHort, FiBL, AU
	Trials organization and results evaluation	AEGIOLOPS
Farmers	Trial set-up, maintenance and participation in evaluation	AEGIOLOPS, InHort
	Hosting and maintenance trials on their farms	FiBL
	Participation in evaluation	ITAB
Breeders and seed companies	Recommendations of varieties	FiBL
Genbank	Involvement in trial set-up and evaluation	ITAB
Nursery	Recommendations for varieties selection and providing seedlings	FiBL
Retailers	Recommendations of varieties	FiBL

DISSEMINATION OF RESULTS AND FINANCIAL MODELS

All the institutes regularly disseminate results in different publication forms (brochures, leaflets, scientific articles, etc.). They are also organizing workshops and seminars for organic fruit growers and other chain actor interested in organic fruit trials. FiBL was the only institution that mentioned that they produce recommendation lists of fruit cultivars that is yearly updated. Financial funding for organic fruit trials is very different among the interviewed institutes (Table 9). Some of them highly depend on project funding or/and financially support from retailers, others have more stable financing from national governments.

Table 9 Financial resources in organic variety trials identified in the interviews (fruit crops). It is common to have more than one financial source.

Public financing	User financing (memberships, voluntary work, fondations)	Project financing	Retailer financially support
ITAB InHort	AEGIOLOPS	ITAB	FiBL
		AEGIOLOPS	
		AU	

SWOT-analysis



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.



We selected Greece and Switzerland for the SWOT analysis to show how organic fruit trials are running within two completely different organizational and financial possibilities.

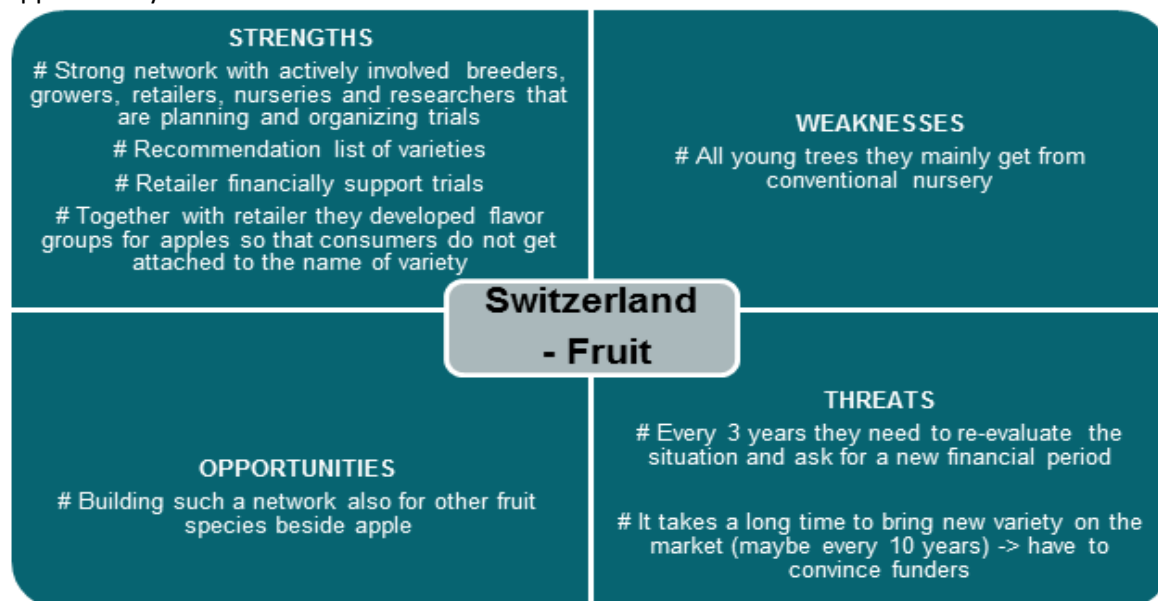
Greece - farm trial

In AEGILOPS fruit trial has been set up for apples and pears at one of their focal points and is under responsibility of local organic growers. Trials are set up with no replications and systematic experimental designs. The fruit nursery and trials in Kastoria focal Point is financed by AEGILOPS based on donation funds and there is also voluntary contribution from fruit growers.



Switzerland - retailer financed

Organic fruit trials are organized by FiBL mainly on-station, except for strawberries and apple where there are also on-farm trials. For apple cultivar trials FiBL built a network with apple breeders, organic apple growers, retailers and nursery and together they plan and organize trials. A retailer is financing apple variety trials.



IV. COUNTRY REPORTS ON ORGANIC VARIETY TRIALS



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.



This report presents different examples of organic pre- and post-registration variety trials as well as organic VCU testing in different EU countries. The examples presented are not comprehensive, as there are more organizations, seed companies, universities or institutes that perform organic variety trials in these countries, that we were not able to include in this report due to lack of information. In this report we dedicated a specific space for German organic variety trials and organic VCU as these are pioneering in organic breeding, variety testing and organic variety registrations.

In this chapter detailed information is given from interviews about organizational structure of organic post and pre- registration trials as well as for organic VCU. It is also described which institutes was interviewed and persons that provided given information. This chapter is divided into three sections: Arable crops, Vegetables crops and Fruit trees.

ARABLE CROPS

FRANCE

Since 2000 there has been organic variety trials in France. It was recognized that varieties were performing differently in the different regions of France and a network was set up to test the same varieties in different regions, and to exchange results and questions about methodology. The variety trials complement organic breeding activities, and half of the tested varieties are from other countries such as Switzerland, Austria and Germany. The information of variety performance under organic conditions has improved the choice of varieties for the organic farmers. The variety trials provide farmers with information about varieties adapted to their practices, the regional production conditions and markets. A next step would be to include more species in the trials. Funding for the trials is dependent on support from public authorities.

Interviews were done with **Laurence Fontaine**, **Marie-Hélène Bernicot** and **Frédéric Rey** for cereals.

CROPS IN THE TRIALS

Mainly winter wheat; but also, triticale and a few spelt varieties. Since 2017 also spring wheat.

TRIAL SET-UP

- **Locations:** 40 trial locations for winter wheat and 20 trial locations for winter triticale and a few trials with winter spelt. Trials are mainly set up on organic farms (on-farm) and on 2-3 experimental farms (on-station), but all of them are managed by organic advisors or institutes engineers.
- **Trial design, number of varieties, replications and years:** Randomized block design (plot size 15 m², seed density 300 and 400 seeds/m²) with at least 3 replicates (4 is usual). The size of the trials varies from 10-12 varieties to 25-30 varieties. A variety is usually tested for three years in the network.
- **Equipment:** Machinery is from institute or farm
- **Assessments:** Done by researchers or local organizations. There are common protocols for all locations with assessment of plant number, ground cover at 2 or 3 growth stages (for weed competitiveness), plant height, earliness, diseases if present (yellow rust in particular), HL-Weight, protein, water content, yield; ITAB organize analysis for baking parameters for a selection of samples from the network (usually tested for 2 or 3 years).

ORGANIZATIONAL STRUCTURE



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.



A collaborative network, coordinated by ITAB, includes various stakeholders such as advisors, organic cooperatives, the chambers of agriculture, local organic farmers' organizations, seed companies and researchers - they set up, maintain, harvest and evaluate their own trials.

Farmers are not directly involved but are hosting trials on their farms.

Bakers and millers do recommendations on best performing varieties for milling, relying on baking tests from the network.

A collective choice of new varieties to test is performed by a network consisting of:

- ITAB, the organic food and farming institute, which coordinates the organic network of variety trials. Propositions are made by breeders to test new varieties in the network; ITAB compiles the proposals and relays them to the members of the network. The final choice is done annually in a meeting occurring in September (winter varieties).

- ARVALIS, conventional institute for arable crops, which have several trials in organic farming.

- GEVES, Variety and Seed Study and Control Group

- INRA, research institute, which have some trials in organic farming, partner in the network.

- and all actors running organic trials involved for several years in the collaborative network.

Coordinator of this French network is Laurence Fontaine from ITAB.

DISSEMINATION OF RESULTS

ITAB facilitates the trial network at the national level and do a synthesis of trial results each year. Results are compared at the scale of large areas (south/west - under Atlantic conditions/north-east/centre). Three recommendation lists are published each year (for northern, southern and western part of France) of varieties suitable for organic farming¹. A leaflet is published each year in spring with baking test results and a synthesis of results from all trial sites. All results are available in French only. Results are also disseminated at local level by the local organizations. Recommendations for varieties are also done by local advisory centres.

FINANCIAL MODEL

Funding for trial costs is raised by the different local organizations. Local organizations receive government support for setting up and organizing the trials. ITAB funds its own work and receive a financial support through farmer's tax for the network coordination and the results' dissemination. Breeders pay for baking tests. However, French breeders or foreign breeders do not pay to have varieties in the trials. So far, the collaborative operation of the network is sufficient, but as the organic sector is growing, they have to be more and more attentive to the conditions of entry into the network.

ORGANIC VCU

Species: Winter wheat. In France, it is possible to have winter wheat varieties VCU tested with supplementary organic trials.

Years: 2 years

Locations: 8 locations in organic farms per year (locations are in the ITAB's network; but the 8 trials are coordinated by GEVES). The value for use is evaluated on samples produced in organic farming trials. The variety is also tested in 16 (20 the second year) locations in conventional and specific tests for the disease characterization. For the registration the yield obtained in organic field trials is the most important. The conventional trials are used to describe resistances against diseases, lodging and earliness.

¹ <http://www.itab.asso.fr/activites/varietes-bles.php>

Variety description: Contains the classical criteria as the other conventional varieties and a special description in organic agriculture (Yield, protein and ability to make bread, weed competition, and in the future hopefully sensibility to common bunt). The trial protocol is very similar to organic post-registration variety testing.

Protocol: Protocols are on the GEVES website²

Coordination: GEVES for the CTPS³: In France, the catalogue entries are made by the Ministry in charge of Agriculture, based on the CTPS proposals. CTPS is a structure where all stakeholders in the sector are participating incl. public research, breeders, seed producers, farmers, processors (e.g. millers, bakery, brewer) including some actors from the organic sector. L'ITAB participates in CTPS and for example helps GEVES to find experimental sites. ITAB is also active in the CISAB, a committee set up in 2017 dedicated to the organic.

Results: The results of the VCUE (Value for Cultivation and Use and Environmental) studies and the description of the variety are accessible from the name of the variety in the national list.

Link to National list⁴

Specification: There is a special mention (for wheat) in the French catalogue “variety tested in organic farming”, but no mention on the European catalogue.

Price: The price is the same for French breeders and foreign breeders, and for a variety for organic farming or not. The French ministry of Agriculture covers the additional costs related to the additional organic trials. The price for one year of winter wheat⁵

Registered varieties: Winter wheat: Hendrix, Skerzzo and 3 new varieties have been proposed: Gwastell, Grafik and Geny

Remark: For the registration of Soya beans (late soya, there are 2 organic farming trials in the registration's network

Variety official:

- Secretary General of the CTPS (Standing Technical Committee for the Selection of Cultivated Plants): Virginie BERTOUX virginie.bertoux@geves.fr
- Head of VCUE Coordination: Fabien MASSON fabien.masson@geves.fr
- Technical Coordinator of the Cross-sectional Committee for Organic Farming (CISAB): Marie Hélène Bernicot: marie-helene.bernicot@geves.fr

This Committee that was set up in 2017 is in charge of promoting the registration of varieties that are suitable for organic farming. It identifies the needs and gaps in organic farming for different species, in terms of varieties and seeds, with the aim to register varieties in the French Catalogue that are adapted to Organic Farming and clearly identified as such.

GREECE

² <https://www.geves.fr/acces-documents/>

³ (<https://www.geves.fr/about-us/the-ctps/>)

⁴ <https://www.geves.fr/catalogue-france/>

⁵ https://cat.geves.info/CAT_WEB/Data/BAREMECTPS2017EN.pdf



Organic field trials in Greece started in the 1990s organized by a group of voluntary enthusiasts. AEGILOPS was founded in 2003 due to the need to have adopted varieties for organic farming. AEGILOPS is a non-profit NGO and consists of a network of organic farmers and agronomist. The main activities of AEGILOPS are the conservation of heritage varieties, traditional agricultural knowledge and the reintroduction of these varieties into everyday agricultural practice (on-farm conservation). AEGILOPS has established focal points in various regions of the country and provides the communities with training for the characterization and evaluation work on local varieties of legumes and cereals. It has been shown that some landraces thrive better than modern varieties. The interview was done with **Kostas Koutis** from AEGILOPS.

CROPS IN THE TRIALS

Wheat (Durum, bread, emmer, einkorn, spelt, compactum, turanicum), barley.

TRIAL SET-UP

- **Locations:** 10 local networks (AEGILOPS focal points) coordinated by agronomists from the region and one on-station location of AEGILOPS.
- **Trial design, number of varieties, replications and years:** Some farmers test a variety for 2-3 years, but sometimes this is not possible. For on-farm trials simple protocols for evaluation and setting up trials are used. More elaborate trials are established at AEGILOPS on-station site and at the university. For on-station trials usually randomized complete block design (RCBD) with 3-4 replications are used, or for accessions where there is only a small amount of seed available they establish trials with no replications. Every 4-5 accessions they compare with known varieties. Sometime also single plant selection (honeycomb or Gardner's Grid design) is used. For on-farm trials randomized complete block design or moving check design with three replications are used. For randomized complete block design usually 6 to 12 varieties are tested and for moving check design more than 10.
- **Equipment:** For on-farm trials farm equipment is used.
- **Assessments:** Assessment of variety performance (drought resistance and adaptation; yield stability throughout the years, performance under low fertility conditions and drought, yield). Nutritional/quality assessments have been done for a number of local durum and bread wheat varieties, as well as for einkorn, emmer and spelt. For a large number of germplasm and selections quality (baking, nutritional) traits are still not estimated. Analysis of harvested material are usually performed if there is support from the University with e.g. a postdoc project. Level of complexity of assessments is adjusted according to the person doing the assessments. In some cases, participatory field days are organized where visitors evaluate visually agronomic performance.

ORGANIZATIONAL STRUCTURE

AEGILOPS works on organic breeding through a participatory approach and they multiply varieties they want to test in on-farm trials in cooperation with universities and research institutes. AEGILOPS is also responsible for a seed library and seed schools for farmers. The organizational structure of cultivar trials requires a strong involvement of farmers, processors and consumers. AEGILOPS works with the farmers on a participatory level through the local networks, called focal points. Greece does not have seed companies that would produce organic seeds, therefore most of the seeds come from import. Organic farmers are thus relying on receiving and testing organic material from the seed bank and AEGILOPS. Farmers choose the varieties that are suited for their farming conditions. Results from farmers are not systematically being collected by AEGILOPS. However, they keep record of all the trials, comments or data they receive from farmers or gardeners. AEGILOPS merely supports organic farmers and promote the quality of their farm products based on the seeds and varieties they grow.



DISSEMINATION OF RESULTS

Dissemination is done primarily by direct communication with farmers at a regional level. Results are also presented at conferences. Some trial results are reliable results based on systematic (scientifically) experimentation, and some are not so reliable and not all results are collected. There is no official recommendation list for organic farmers.

FINANCIAL MODEL

AEGILOPS has usually no funding for variety trials. Farmers work on a voluntary basis and local agronomist get a minor financial support for covering basic operational costs (e.g. materials, travel costs). Occasionally there are some projects that help to cover the operational costs and some small part of costs can be covered through membership fees for AEGILOPS. AEGILOPS is relying on voluntary work and cooperation with universities, farm schools, organic farmers associations and public agronomic research institutes (HAO Demeter).

ORGANIC VCU

Greece does not have organic VCU. It is difficult or not possible at the moments to establish organic VCU testing as there is no formal framework and protocols adapted to the system. Recently it has been made possible to register varieties developed by AEGILOPS on the heritage variety list. Two wheat varieties (Saritsam; hard wheat, Kaploytzas; einkorn) are under registration process.

AUSTRIA

Organic variety trials in Austria were established at small scale three decades ago at the Institute for "Agrarbiology" at Linz (today part of the Austrian Agency for Health and Food Safety - AGES). When more farmers converted to organic production more organic variety trials were carried out; and 18 years ago, AGES started to do official trials at organic locations for the official testing for variety registration. In Austria 20 percent of the arable land is under organic cultivation and several organizations are involved in organic variety trials. AGES do official trials in cereals and forage crops. Raumberg-Gumpenstein and FiBL Austria are conducting on-farm variety trials, BioForschung Austria do scientific projects and Arche Noah is an NGO collecting and conserving seed from old varieties. The Interview for arable crop trials was done with **Waltraud Hein** from the Institute of Organic Farming at the Agricultural Research and Education Centre Raumberg-Gumpenstein (AREC). AREC is specialized in research and development, education and training, consulting and expertise for sustainable land-use management and environment. Regarding VCU trials in organic farming **Clemens Flamm** from Department for Plant Varieties, Institute for Sustainable Plant Production at AGES was interviewed. The supplementary organic trials for VCU testing are the same trials used for organic post-registration trials as well, where varieties are tested for performance. The organic variety trials are established to inform organic farmers about variety performance in organic farming, including varieties from other countries. Organic breeding and seed production activities in Austria has developed according to the increasing numbers of organic farmers. There is more organic seed available today than 10 years ago. For example, 10 years ago there was organic seed available for only 2 or 3 varieties of maize and today there is organic seeds for around 15 maize varieties.

CROPS IN THE TRIALS

Many variety trials with different crops are carried out (cereals, maize, faba bean, soya bean, lupine, sunflower, potato and special crops like poppy and oil flax).



TRIAL SET-UP

- Locations:** There are two on-station locations: The Institute at Raumberg-Gumpenstein in the alpine climate where only cereals, potatoes and silage-maize can be tested and the other one at Lambach.
 Trials are carried out in cooperation with AGES for cereals (winter barley, winter triticale, winter wheat and spring oats). Besides on-station trials there are also few on-farm trials with lupine and soybean and there is also one innovative farmer that has been testing triticale varieties for more than 10 years.
- Trial design, number of varieties, replications, and years:** There are 2 types of on-farm trials:
 - 1) Small plot variety trials (cereals) – coordinators from AREC do the trial work.
 - 2) Strip design (soybean, maize and potatoes) where farmers are more involved and receive the seed and trial plan and use own machinery.
 Usually varieties are tested for 3 years, but it depends on the yearly results/performance of varieties and discussions between breeders, seed companies and farmers and on the availability and requests for varieties. For the plot design with AREC machines trials are set up with 4 replications. In strip design there is only one replication (2 strips per variety) due to the bigger area per variety. The length of such strips is sometimes about 100 m, the width depends on the machines of the farmer (seed drill and harvesting machine). The yield of one variety is filled in a big bag, weighed afterwards and then a sample for the quality analyses is taken to the laboratory.
 In the field trials where AREC is testing varieties in cooperation with AGES, the reference variety is chosen by AGES. In all other field trials AREC chooses reference varieties, mostly varieties which are important in that region or in the whole country.
- Equipment:** In plot trials machinery from AREC is used to sow and harvest. In strip trials farmers sow and harvest with their own machinery.
- Assessments:** Sampling and assessments in the trials during the growing season are done by researchers/coordinators from AREC. Height of the plants, disease and pest as well as soil coverage are assessed few times in the early stages, position of the leaves, plant height, ripening time, yield and protein content are assessed depending on the tested species. Baking analyses are only made at AGES as a part of official registration testing.

ORGANIZATIONAL STRUCTURE

The organic institute at AREC carry out some trials in cooperation with AGES (at Lambach) and in the frame of a national project BIONET. The coordinator of the trials discusses with the seed companies which varieties they wish to test in organic trials and then seed companies provide seeds for free and they use the trial results in their marketing of varieties to organic framers. However, AREC also test varieties from abroad (Poland, Czech Republic, France, Switzerland, Germany). Despite the activities in organic variety trials, most of the seeds on the market for organic farmers are still untreated conventional seeds. Organic farmers tend to buy most of their seeds, but if they are sure they have good quality seed they would use their own farm saved seed instead.

In the beginning the trials in BIONET were strictly coordinated and all the partners had the same trial design and tested the same varieties, but now it is no longer so strict as everybody do what and how they think is important in their region. The BIONET project is addressing different questions, not just variety trials and institutions involved are from different regions in Austria (FIBL Austria, BIO-AUSTRIA, the Austrian Chamber of Agriculture). They discuss by email, every autumn and spring on what kind of trials and varieties to test.



DISSEMINATION OF RESULTS

Performance of the varieties in the trials is compared to results of common/standard varieties that are every year in the trial. Results are published in autumn and spring together with FiBL Austria who coordinate and organize the dissemination. Nowadays only online versions are made, and links are provided for farmers. Costs for the dissemination are covered by LFI (the rural institute for advanced training) or the education department of the chamber of Agriculture.

FINANCIAL MODEL

AREC as a governmental institute is financed by the Ministry of Agriculture and gets resources to administrate and organize trials. On-farm trials are logistically more complicated and expensive (farmers expect financial compensation for establishing trials on their farms) compared to on-station trials.

Breeders pay a fee for official variety trials to AGES for registration of a new variety but in the pre- or post-registration trials at AREC there is no fee. And if breeders from e.g Germany or Switzerland want to test varieties there is no charge if AREC finds the material to be suited for trials - although there is a maximum capacity in the trials.

ORGANIC VCU

The Austrian Agency for Health and Food Safety (AGES) is responsible for variety registration and official testing. The organic VCU-testing was initiated through a scientific project. There has been a possibility for exclusively organic VCU testing in winter wheat since 2001. From 2002 till 2011 it was also possible for spring barley, but this was abandoned because of a decreased importance of spring barley. Now it is possible to have supplementary organic trials in spring barley, as it is also possible in winter barley, winter rye, winter triticale, winter spelt, spring wheat, spring oat and potato. It was possible to establish organic VCU testing in Austria because of the commitment of the people involved in the VCU-testing as well as the acceptance by the financially responsible people as well as the support from the Ministry of Agriculture.

Years: 3 years

Locations: In organic VCU-testing for wheat there were five locations until 2018, for 2019 there was added one further site (5 on-farm and one on-station) with 3-4 replications depending on the degree of homogeneity in the soil. There are two on-station trial sites for common bunt infestation trials. In rye trials there is one organic location, which is described separately in the descriptive list of varieties. AGES has 8 trial units with equipment (please see [Table 10](#) below).

Table 10: Trials and number of candidates 2018

Species	Conv. VCU	Organic VCU with different candidates and testing varieties	suppl. Organic VCU (locations) with the same candidates than in conv. VCU-testing	Number of VCU-candidates		
				conv.	organic	suppl. Organic
Winter barley	x		xx (2)	57		0
Spring barley	x		xx (1)	25		2

Winter rye	x		x (1) + xx (2)	15		15
Winter triticale	x		x (2) + xx (3)	15		15
Winter common wheat	x	x (5)	xx (2)	64	10	2
Spring common wheat*			xx (2)	0		0
Winter spelt wheat*			xx (1)	0		0
Winter durum wheat	x			10		
Spring durum wheat	x			9		
Spring oat	x		x (2) + xx (1)	9		9
Potato	x		x (3)	12		12

* no VCU testing in 2018

x = trials in VCU-testing, xx = other organic trials beside VCU-testing with less candidates

Variety description: Weed competitiveness and resistance against common bunt with artificial infestation are specific traits that are assessed only under the organic VCU trials standard protocol. If a variety is resistant to common bunt it is registered independently of other characteristics, due to the importance of this resistance. There are 15 quality parameters (same as for conventional trials) for winter wheat included in the testing fee, which explains the higher fee for winter wheat compared to other species. Nitrogen efficiency is an important parameter in organic trials and has also been included in conventional trials since 2017⁶.

Coordination: AGES is the coordinator, and breeders and seed companies use results for marketing varieties. Farmers provide fields for trials and benefit from the data, they receive a 600 € compensation for a trial. Reference varieties are chosen by AGES in relation to their importance on the market and to their specific characters.

Results: Trial results are published⁷ in the descriptive list of varieties.

For cereals, there is a specific chapter on organic farming in the descriptive list of varieties ("PDF-version der BSL...": 12 Getreide Biolandbau). Results are presented as adjusted means for all organic site. Results are also published in agricultural papers. Link to the National list can be found on the BAES's website⁸.

⁶ <https://www.baes.gv.at/amtliche-nachrichten/kundmachungen/saatgutgesetz/>

⁷ <https://bsl.baes.gv.at/?L=0>

⁸ <https://www.baes.gv.at/zulassung/pflanzensorten/oesterreichische-sortenliste/>



Specification: In the national variety list, varieties that have been tested under organic VCU are not specially marked. But in the descriptive list of varieties they are marked with a special signature - in wheat with 4) and in spring barley with 3).

Price: Organic VCU-testing is financed partly by testing fees which the applicant has to pay and partly by the government. Organic VCU-testing fee 2018 in wheat: 691.4 € per year (conventional 1180.5 € per year). Breeders can also apply and pay to have reference varieties in the trials in dialog with AGES. Also, varieties that are not applied for by the companies can be included. Price for these post-registration tests/reference varieties are around half price. The application fee is 312,2 €.

Registered varieties:

Varieties registered with organic trials exclusively:

Winter wheat: Aurolus and Pireneo (2004), Stefanus (2005), Bitop, Erian and Indigo (2006), Blasius (2007), Donnato and Peppino (2008), Ekolog, Rosso, Skorpion and Tobias (2011), Gregorius (2013), Ceraso (2014), Merlot (2015), Arminius and Tilliko (2016), Edelmann (2017), Adamus, Emotion, Tillexus and Tillstop (2018)

Spring barley: Armada (2006), Mona (2010)

In addition, there is a number of varieties registered with supplementary organic trials.

Variety official:

VCU: DI Mechtler Klemens klemens.mechtler@ages.at

HUNGARY

The economic value and possibilities of organic seed production is not recognised by most of the seed value chain actors in Hungary, since the organic sector is relatively small, and the demand for organic seed is very low. However, organic farmers wish to know which available commercial varieties give qualitative harvest. The Centre for Agricultural Research of the Hungarian Academy of Sciences (MTA ATK) and the Research Institute of Organic Agriculture (ÖMKi) are the only institutes that perform organic variety trials on-station (MTA ATK from 2009) and on-farm (ÖMKi from 2012) consistently in Hungary. Corvinus University, Department of Organic farming and the University of Nyíregyháza (one of ÖMKi's on-farm partners) also perform organic variety trials but only occasionally when connected to projects or study research. ÖMKi conducts participatory on-farm cultivar trials aiming to connect research and farming knowledge and test the performance of commercially available varieties under organic conditions. From 2017/2018 onwards, the on-farm variety trials of ÖMKi and the organic small-plot trials of MTA ATK were harmonized to build up a more detailed trial setup where the same varieties are examined on-farm and on-station. The interview was done with **Péter Mikó** from MTA ATK and regarding ÖMKi's on-farm trials with **Dóra Drexler**.

CROPS IN THE TRIALS

Winter wheat, emmer, einkorn, soybean

TRIAL SET-UP

- **Locations:** One on-station location of MTA ATK at Martonvásár and one at a farm involved in the on-farm trial network and 8-10 on-farm locations (the number of locations is changing through the years) spread around Hungary coordinated by ÖMKi.
- **Trial design, number of varieties, replications and years:** On-station trials (both in organic and conventional fields) are using small plots (6 m²/plot) arranged according to randomised complete block design with 3 replications. The on-station trial contains all varieties used at on-



farm trials and MTA ATK's own breeding lines. Each variety is tested for 3 years. On-farm trials had no replications until now. From fall 2018 the Bayesian Model has been implemented in the on-farm network. Each variety in the on-farm trials is tested for a different number of years, some only for one year, others are used repeatedly as reference varieties. Variety selection depends on the discussions with breeders, availability of the seeds and farmers variety preferences. The number of varieties per location depend on the capacity of the farm. There are 5-15 varieties tested per farm. One farm has been selected to host both large strip plots and the small plot trial.

- **Equipment:** For on-station trials machinery of MTA ATK is used and for on-farm trials farmers machinery is used for sowing, maintaining and harvesting the trials.
- **Assessments:** In on-station trials assessments in conventional and organic trials are mainly the same (heading time, height, yield, leaf diseases, lodging, grain quality traits), but also specific traits are assessed in organic plots that are connected to weed suppression, soil coverage at tillering and booting. In on-farm trials pests, diseases, yield (samples of yield are taken as 3 repetitions of a 1 square meter quadrat per variety which is extrapolated) are assessed. In case the farmer can harvest the varieties separately yield results are available. Standard grain quality is assessed by ÖMKi.

ORGANIZATIONAL STRUCTURE

Breeders and researchers at MTA ATK are organizing, maintaining and evaluating on-station variety trials. MTA ATK established the Elitmag Seed Multiplication and Marketing Company (<https://elitmag.hu/>) in 1991 for the commercial representation of cereal (wheat, durum wheat, barley, triticale, spelt, oat) varieties. Elitmag organize production of organic seed or untreated conventional seed, but only if organic farmers place the order in advance. Another company, called NaturGold Europe Ltd., has license to organize multiplication and marketing of one emmer and one einkorn variety of MTA ATK. Organic growers are not involved in the selection or breeding. In on-farm variety trials farmers are responsible for sowing and maintaining the trials. Researchers from ÖMKi coordinate, evaluate the on-farm trials, collect data during the season and at harvest and disseminate results. Occasionally students are also participating doing their practical experiments for BSc, MSc or PhD in collaboration with ÖMKi and MTA ATK. Breeders provide seed and suggest varieties for testing. Sometimes also small bakers are involved for testing baking quality (simple visual resp. sensory assessment) of some of the tested varieties (on a voluntary basis).

DISSEMINATION OF RESULTS

Detailed results from on-station trials are not publicly available, but concluding results are published in the variety catalogue and website of Elitmag Ltd each year. Detailed results from more years are disseminated in scientific media. The results from the organic trials are reliable, but not enough robust to write public recommendations for Hungarian organic farmers, as the trials are done in only two locations. In on-farm trials a summary of results is presented every year at the end of the season at an event, where all organic farmers are invited. Results are also published with open access on ÖMKi's website. The common farm where on-station and on-farm trials are also carried out and the comparison of the conventional and organic on-station trials, will deliver results on the comparability of these two types of trial methods and on the reliability of the on-station trials as a possible basis for organic variety recommendation.

FINANCIAL MODEL

Organic on-station trials are usually financed by national or international projects and the royalty income of the conventional breeding programme. Cost of organic variety trials is only a minor cost compared to the entire breeding programmes. For on-farm trials ÖMKi covers the costs mainly through EU research funding (Horizon 2020), support from private foundations, and a minor part from national grants. The farmers participate on a voluntary basis.



ORGANIC VCU

No organic VCU trials for winter wheat or other cereals exist in Hungary. Till now there have been no request for organic VCU from the breeder's side. Breeders at MTA ATK believe that first the organic VCU has to be launched to see if there is a need for organically selected varieties in Hungary. If there are some conventional varieties that perform also very good in these tests (for example Capo), then it would make more sense to upgrade the strategy of conventional breeding to also consider organic traits at selection, improve the organic seed propagation of the best conventional varieties and motivate organic farmers to use the organic seed instead of untreated seeds (whether it is from a conventional or organic variety). However, breeders agree that it would be very useful to launch official organic pre- and post-registration trials, and beside that also develop organic breeding. MTA ATK is testing their advanced wheat breeding lines also in organic trials to know which ones they can recommend to farmers if a question would arise.

ITALY

There are two organisations involved in organic variety testing in Italy: The Council for Agricultural Research and Agricultural Economics Analysis (CREA) working under the Ministry of Agricultural, Food and Forestry Policies and the Italian Farmers' Seeds Network (RSR) – the members of RSR are certified organic farmers, consumers, organic seed companies, regional farmers associations, association for organic agriculture, etc.

CREA test varieties bred for conventional farming under partly organic growth conditions to make recommendations for organic farmers. RSR has since 2010 carried out field trials for cereal populations and local varieties within H2020 research projects. The value of the field trials is mainly for research and to raise awareness and interest among farmers for local varieties and populations. A "Field catalogue" with representative farmers from different regions was produced to show other farmers how to diversify the production. With the years, demand for local populations and landrace varieties has grown and now the network faces the challenge, that there is not a lot of seed from landraces and selling unregistered seed is not legal. Interview was done with **Matteo Petitti** and **Riccardo Bocci** from RSR.

CROPS IN THE TRIALS

Durum and soft wheat

TRIAL SET-UP

- **Locations:**

CREA: On-station trials; one out of seven sites is organic - some trial sites are conventional low-input sites. Trial set-up and network of institutes are the same for conventional and organic trials.

RSR: On-farm trials are established at 4 organic farms in 4 different regions of Italy.

- **Trial design, number of varieties, replications and years:**

CREA trials are randomised block design with three replications.

RSR cereal trials are with small plots, 2 replications and 14 varieties. Few farmers have 1-2 big plots with varieties (for durum, bread wheat and barley). The 4 regions have the same cultivars/populations and the same reference variety (modern variety). Additionally, there is a number of farmers who grow populations and local varieties in plots of various sizes in different regions of Italy. Although these cannot be considered as proper variety trials. A modern variety for low-input and drought conditions Emese was chosen as reference variety.



- **Equipment:** RSR do not have equipment for small trials. In RSR experimental trials with small plot design a combine harvester is rented from CREA or from regional networks (expensive and logistically hard to organize at harvesting time). Therefore, RSR plan to have bigger plots, so that farmers can harvest the plots themselves.
- **Assessments:**
CREA trials follow the same protocols for conventional and organic trials. RSR works on specific traits (morphological, physiological and agronomic), whilst participants to their field days (technicians, farmers, consumers) can contribute with their preferences (expressed as a “value for cultivation” score, based on each participant’s experience). For field assessment farmers will be asked to mark a few (3-5) quadrants of 1x1m in the field. Morphological traits of plants and yield will be accurately recorded for each quadrant. Overall assessment of the field and its yield will also be recorded. An smartphone App CAPSELLA is under development, for farmers to collect data. The outsourcing of data collection is generally a challenge but offers great potential for RSR.

ORGANIZATIONAL STRUCTURE

CREA is organized as a network of 10-11 research institutions, generally no farmers are involved, and on-station trials represent the majority of cases. In CREA conventional varieties are tested under partly organic conditions (i.e. the field is managed organically only for the year in which the trial takes place). According to RSR the farmers do not use the recommendation lists made by CREA. Instead farmers are searching for local varieties, because they have useful characteristics for organic management and there is a market demand for these products. The yield is lower, but on the marginal lands this is of less importance and there is a market for landraces for flour and other products. RSR is working with landraces and populations in a participatory approach, where farmers are involved in the evaluation and selection process. This year RSR will try a new trial set-up with 21 farmers in a regional network. The new set-up requires less assessments and farmers will do most of the data collection assisted by regional technicians. Farmers do not get paid for hosting trials - they do it out of their own interest. Farmers see variety trials as an investment in the development of their farm, and they gain seed and knowledge. The local technicians are members of RSR or belong to partner organisations in a regional EIP Project “Cereali Resilienti 2.0”. There is a strong personal commitment and friendship with local farmers, and they help farmers with data collection. Processors are involved, but not directly - sometimes farmers test quality themselves. Each year the network organizes 2-3 days of meetings with different chain actors where processors attend, and local varieties are tested, and consumer can also contribute with quality assessments. RSR work together with one organic seed company (Arcoiris-Modena).

DISSEMINATION OF RESULTS

CREA publish a recommendation list for farmers.

RSR have results in the pipeline, that could be useful from a scientific point of view regarding adaptation of the populations to specific farming/environmental conditions as well as the role of farmers selection. RSR publish a newsletter every year and organize farm days in May/June for cereals. RSR also organize workshops with farmers and stakeholders. Through workshops, field days and farm visits 1000 – 1500 farmers are reached, and information travels from mouth to mouth.

FINANCIAL MODEL

CREA trials are paid by the Ministry of Agriculture.

RSR trials are financed by national and international projects and some small part from membership fees; they also get some support from the Ministry of Agriculture for sustainable use of agrobiodiversity. It is very common that farmers in Italy (conventional and organic) use farm saved seed. It is a challenge for seed companies’ business, that farmers don’t buy much certified seed.



ORGANIC VCU

There is no organic VCU trials, and in general there is poor financing even for conventional trials.
VCU official: CREA-DC⁹

LATVIA

In Latvia there are both organic post-registration variety trials and possibility for VCU testing under organic conditions. The Institute of Agricultural Resources and Economics (AREI), Plant Breeding and Genetics have been performing organic variety trials since 2002 based on a demand from farmers. Interview was done with **Ilze Skrabule** from AREI, where the main variety trial activity is located. There are also some trials at the University of Agriculture in Latvia.

CROPS IN THE TRIALS

Pea, potato, cereals; triticale, barley, oat, winter and spring wheat

TRIAL SET-UP

- **Locations:** AREI has 3 on-station experimental locations in different parts of Latvia and in two of these locations there are certified organic experimental fields.
- **Number of varieties, replications and years:** Each variety is tested for 2 years on two locations with 4 repetitions and there are always standard varieties (1-2) as control. Reference varieties are selected according to VCU testing regulations (LV MK noteikumi Nr 518. 24.07.2012.): **1.** Variety is included in State plant variety Catalogue (if for certain crop no varieties in Latvia PVC, then variety is selected from EU PVC) **2.** Variety is used in agricultural production **3.** Seed material for variety is available.
- **Equipment:** Equipment for setting up and maintaining the trials is from the institute.
- **Assessment:** Done by researcher responsible for the crop. No specific traits that are connected to organic farming.

ORGANIZATIONAL STRUCTURE

In 2002 organic trials were initiated as organic farmers were requesting information on conventional varieties that could be suitable for organic farming. For two years variety trials were financed by the Agricultural ministry and the aim was to develop organic VCU testing. They tested all locally bred cultivars in the plant variety catalogue for cereals, potatoes, pea and grasses. The varieties that performed well under organic conditions got a mark in the national plant variety catalogue (not visible in the European variety catalogue).

Post-registration variety trials depend on on-going projects. Otherwise, when there is a request for organic VCU trials AREI is authorized to conduct the organic VCU trials (2 location for 2 years/variety). Unfortunately, there isn't a lot of request for organic VCU trials and therefore, it would be interesting in the future to establish demonstration fields for new and old varieties. This year there will be demonstration fields in organic and conventional fields for the newest cereal lines. In the frame of the national project (DEVELOPMENT, IMPROVEMENT AND IMPLEMENTATION OF ENVIRONMENTALLY FRIENDLY AND SUSTAINABLE CROP BREEDING TECHNOLOGIES). AREI also once conducted on-farm trials on two locations. Farmers were paid for field maintenance work and for hosting the trials and researchers evaluated and collected material.

⁹ <http://abp.entecra.it/>



DISSEMINATION OF RESULTS

Almost every year there is a field trial demonstration for organic farmers. There is no recommendation list for varieties suitable for organic farming but results from the trials are published every year and are available online or in publications.

FINANCIAL MODEL

AREI, which is a public institution covers basic costs for organic breeding activities with support from the Agricultural Ministry. Breeders pay for organic VCU trials and other variety trials are covered and dependent on running projects.

ORGANIC VCU

There is a possibility for organic VCU trials but varieties from organic breeding programmes need to be tested in both conventional and organic VCU trials. This means double price for registration. Organic VCU trials are not running every year as there is not enough demand.

Years: 2 years for spring crops, 3 years for winter crops and grasses

Locations: Each variety is tested in a minimum number of two organic on-station locations with 4 repetitions. There are no VCU trials in farmers' fields. Varieties must also be tested under conventional growth conditions in 2 locations.

Variety description: Trial protocols are similar to conventional. The Latvian University of Agriculture are coordinating organic VCU trials - the same institution as for conventional VCU trials. Some additional traits are described and included in the evaluation for organic farming - for example - lodging for cereals.

Field data:

Winter hardiness for winter types, lodging resistance, plant height, diseases, vegetation period days and crop yield compared to standard varieties. There are always standard varieties (1-2) as control.

Quality analyses:

Wheat - Hectolitre weight (g l^{-1}), Protein content (%), Gluten content (%), Sedimentation (Zeleny index) (cm^3), Falling number (s), Thousand kernel weight (g), Starch content (%);

Rye, triticale - Hectolitre weight (g l^{-1}), Protein content (%), Falling number (s), Thousand kernel weight (g), Starch content (%);

Barley - Hectolitre weight (g l^{-1}), Protein content (%), Thousand kernel weight (g), Starch content (%);

Oat - Hectolitre weight (g l^{-1}), Husk (%), Protein content (%), Crude fat content (%), Thousand kernel weight (g);

Buckwheat - Hectolitre weight (g l^{-1}), Husk (%), Protein content (%), Thousand nuts weight (g), Starch content (%)

Coordination: In 2002 all local varieties in the National variety catalogue for cereals were tested in organic VCU trials, and since then only varieties on request from breeders. Unfortunately, there are only few requests for organic VCU trials. When organic VCU trials are requested AREI is authorized to conduct the trials. An expert group evaluates trial results and decide if varieties can be accepted for the National list of Varieties.

Specification: In the National variety catalogue, the variety is marked with "Bio" if it performed well under organic VCU testing (not visible in the European variety catalogue).

Link to National list¹⁰

¹⁰ <http://www.vaad.gov.lv/sakums/registri/augu-skirnes/latvijas-augu-skirnes-katalogs.aspx>



Price: For the first two years from 2002, variety trials were financed by the Agriculture ministry and the aim was to develop organic VCU testing. Now breeders must pay all costs. For cereals, price for one location/year is 242 € (usually done in two places) and 256 € for potato/one location/year. Price is double compared to conventional VCU, because VCU trials must be done under both conventional and organic conditions. Foreign breeders can have varieties tested in the Latvian trials and pay the same fee.

Registered varieties: One barley variety developed specially for organic farming RUBIOLA, Varieties registered with supplementary organic trials:

Spring wheat: Uffo (2009)

Rye: Kaupo (2006)

Spring barley: Abava (2004), Rasa (2005), Kristaps (2007), Rubiola (2008), Austris (2008)

Oat: Laima (2004), Arta (2005), Stendes Darta (2006)

Buckwheat: Aiva (2007)

Variety official: Responsible for VCU varieties trials is Anda Rutenberga-Ava, e-mail: anda.rutenberga@llu.lv, she is head of VCU laboratory at Latvia University of Agriculture.

NETHERLANDS

There is no official procedure for organic post-registration or VCU trials in the Netherlands. Seed companies organize their own trials. Big cooperatives like Agrifirm organise demonstration trials if they have varieties of interest for organic farming.

There are only few spring wheat varieties available as conventional farmers prefer to use winter wheat for feed and for organic farming only a few varieties with good baking quality and disease resistances are available, in some years only one variety is available. The production area is small, and it is a challenge to finance trials. Therefore, Louis Bolk Institute (LBI) in 2014 initiated field trials with the cooperative Agrifirm and the two biggest organic bakeries and a number of interested farmers to test commercially available wheat varieties that could be suitable for organic growers in the Netherlands. There are no populations in these trials. Together with the cooperative Odin separate on-farm trials were initiated for the testing of populations. Both initiatives are continued under the EU projects DIVERSIFOOD and LIVESEED. Agrifirm also do some trials and demonstration plots for arable and fodder crops. Interview was done with **Edwin Nuijten** from Louis Bolk Institute. The focus of the interview was spring wheat varieties.

CROPS IN THE TRIALS

Spring wheat trials were done in 2014-2018.

TRIAL SET-UP

- **Locations:** For spring wheat variety trials in 2014-2015 there were two locations, and in 2016-2018 only one on-station location at PPO Lelystad as farmers do not want to take responsibility to perform variety trials on their farms.
- **Trial design, number of varieties, replications and years:** In 2014, in total 20 varieties were tested and in 2015, 16 varieties, over two years 25 varieties were tested (with 3 replications in RCBD). In 2016, the trial design was reduced to a randomised block design with 2 replications and 5 varieties including 2 reference varieties (reference varieties were the varieties available as organic seed). In 2017, the trial was designed as larger strips with



4 varieties (approximately 150 m² per strip), and in 2018 the same setup was used with 5 varieties, including a variety for feed.

- **Equipment:** taken care of by PPO Lelystad (part of WUR)
- **Assessment:** Ground cover at several stages, earliness in maturity, diseases at several stages, plant height after flowering, lodging towards maturity, yield, baking quality parameters and baking tests.

ORGANIZATIONAL STRUCTURE

Louis Bolk Institute and Agrifirm started the initiative together with the two biggest organic bakeries and a small number of interested farmers. The organic variety trials were established with the aim to test commercial varieties suitable for organic crop production in the Netherlands and to develop organic VCU testing in the future, and to discuss how the sector can organize and finance these trials in the future. Farmers have passive participation and give feedback on what they are interested in. Bakers are involved in the initiative by testing selected varieties for bread quality - they are also financing baking tests (or conduct the baking tests for free).

The trials on populations were organized with the organic wholesaler Odin. Odin works together with growers and consumers. The potential advantage with on-farm populations testing is that it gives the opportunity to develop material that is adapted to local farm conditions. Also here, a baker is involved in the initiative by testing selected varieties and populations for bread quality - they are also financing baking tests.

For both initiatives, breeders provide varieties and populations for testing and researchers from LBI evaluate trials and act as moderator of the network and collect and disseminate results for the network.

DISSEMINATION OF RESULTS

Results are shared among the members/active participants in the initiative. LBI is responsible for disseminating results. People involved in the initiative are not interested in sharing the results in public.

FINANCIAL MODEL

In 2014 and 2015, cultivar trials were financed partly through project funding from LBI and partly through the cooperative Agrifirm and the two bakeries. From 2016 onwards Agrifirm pays for the trial management and takes care of baking quality parameter testing, LBI does trial evaluation and facilitation, and the two bakeries conduct baking tests.

The costs for performing assessments and dissemination are financed on a yearly basis depending on funding possibilities, and a more self-sustaining system is wanted. Calculations were made to find alternative financing with a levy on bread, but this proposal has been paused due to disagreements in the network.

In the case of the trial with the populations from 2014 to 2016, costs were partly covered by subsidies, and partly by Odin for trials set-up and harvest, trial evaluation, baking quality parameter testing and involving consumers in the trials. The baker took care of the baking tests. From 2017 onwards, trial costs and evaluations were covered by an EU project, and the baker continued to do baking tests. Odin was less involved.

For other on-farm trials farmers do the majority of the work and they are paid for this effort through project funding.



ORGANIC VCU

There is currently no organic VCU. In 2001 Aart Osman and Lubbert van den Brink had results of the first official VCU trials in the Netherlands with spring wheat. www.eco-pb.org/09/vcu_05_02.pdf. Trials were performed on a project basis with public funding. Protocol of conventional spring wheat was adapted for organic VCU and approved by the Plant Variety Board. 15 varieties were tested on 3 organic locations and 1 conventional location in order to investigate correlations. Suitable varieties were introduced in 2005. But most varieties were also quickly abandoned and in 2008 Aart Osman initiated a consortium (an agreement was signed) to set up a breeding program. From 3 breeding companies 30-45 lines each were tested, and no potential breeding line were identified. Because of lack of funding, this initiative stopped.

The price for DUS and VCU testing including maintenance breeding and seed multiplication was calculated by Art Osmann to be 17.000 €, and this is very prohibitive for testing and registering newly bred varieties for only organic, due to the limited production area. Hence, in 2014 trials were set up to test already registered varieties in post-registration trials.

POLAND

The Institute of Soil Science and Plant Cultivation State Research Institute (IUNG-PIB) operates under the Ministry of Agriculture and Rural Development (MARD). IUNG-PIB is the main institute that performs organic arable variety trials systematically every year, but there are also two more institutions that have more sporadic organic variety trials (The University of Life Sciences in Lublin, <http://www.up.lublin.pl/english> and The Plant Breeding and Acclimatization Institute (IHAR) - National Research Institute, http://www.ihar.edu.pl/index_en.php). IUNG-PIB started this research activity 15 years ago when the area of organic farming was increasing and there was a demand from the organic farmers, agriculture advisors and the government to have more knowledge on how conventional varieties perform under organic conditions. The interview was done with **Jaroslaw Stalenga** from IUNG-PIB.

CROPS IN THE TRIALS

Winter wheat, winter triticale, winter rye, spring wheat, spring barley, oat and since 2019 it is planned to start with the following grain legumes: blue and yellow lupin (for poor soil) and field pea.

TRIAL SET-UP

- **Locations:** In 2018-2019 there were six locations in the network: 3 at IUNG-PIB (1 on-station, 1 on-station of Agricultural Advisory Centre and 1 on-farm) and 3 on the Research Centre for Cultivar Testing. Each location has the same trial setup.
- **Trial design, number of varieties, replications and years:** 10-16 cultivars per species are tested in each location with 4 replications. Total area of field trial: $6.000 \text{ m}^2 \times 4 = 24.000 \text{ m}^2$; i.e.: 2,4 ha. Varieties are tested for 3 years. Crop rotation within which field trials are located includes potato – spring cereals - grain legumes - winter cereals.
- **Equipment:** Special precise machinery for seeding and for harvesting.
- **Assessments:** Intensity of infestation of leaf and ear by fungal pathogens, competitiveness against weeds, yield and yield structure and protein content. Additional activity in cooperation with Warsaw University of Life Sciences includes evaluation of material for bread and pasta. For fodder variety testing focus is on quality criteria that are important for feed production.

ORGANIZATIONAL STRUCTURE

The farmer is responsible for establishing on-farm variety trials. He receives detailed instructions for the establishment and maintenance (agro-technical) and he is paid for the work and the cost for



establishing and maintaining the trials. The farm with the necessary equipment was selected (special machinery for seeding and harvesting) and also a farm that is reliable and representative for the region. Varieties are selected in consultations with breeders and according to the present variety situation on the market, and variety characteristics as pathogen resistance, weed competitiveness, frost resistance and quality parameters like protein content. IUNG-PIB has a close collaboration with the main organic seed producers and share results from the variety trials. However, the seed company does not supply IUNG-PIB with seeds as the varieties selected for the field trials are the newest ones, only available from the conventional breeders. This means that conventional untreated seeds are used for variety trials. Researchers from IUNG-PIB are supervising all the variety trials (on-station and on-farm), collecting the samples and evaluating the varieties.

RESULTS DISSEMINATION

IUNG-PIB has a close collaboration with the Agricultural Advisory Centre (AAC) which is responsible for dissemination of the results from the variety trials to the farmers. Every year there are open days for farmers in AAC, that also has the capacity for demonstration of pre-processing technology. Moreover, each June IUNG-PIB organizes field days for farmers and advisors. Additionally, in February each year there is a workshop for advisors and other researchers in which the most important results from the field trials are presented. IUNG-PIB also develops leaflets and brochures for farmers and results from variety trials are posted on their website. Official recommendation list of varieties for organic farmers will be published in cooperation with the Research Centre for Cultivar Testing after 3 years cycle of research.

FINANCIAL MODEL

IUNG-PIB gets funding for this research from a special subsidy for organic farming research established by the Ministry of Agriculture and Rural Development. However, they need to apply for the grant each year.

ORGANIC VCU

There is no organic VCU trials as there is no organic breeding and private breeders are not enough interested to invest in organic breeding. Conventional VCU trials are financed by COBORU. Only post-registration variety trials for conventional varieties under organic conditions are performed.

Variety official: Jozef Zych, j.zych@coboru.pl

ROMANIA

NARDI is the biggest agricultural research institute in Romania and has conventional and organic trials that started in 1995. They have 14 ha organic fields, and in the fields, they are testing varieties of barley and winter wheat in the framework of the LIVESEED project, but beside this there are also variety and population trials with maize, wheat, triticale, barley, millet and legumes (lupines, alfalfa, soybean), sunflower and aromatic crops. From 2015-2018 they also participate in a national project in organic seed production. The field trials are divided in 3 parts: First many populations and conventional varieties are tested in small plots and then the second part is testing of the best performing varieties (performance test is for 3 years) and the third part is for organic seed production. Seeds are sold to organic farmers, there are no organic seed companies and 99 percent of the seed is conventional untreated. NARDI produces organic seed (certified as organic) on 8 ha. They mainly produce winter wheat, soybean, camelina, coriander, sunflower and maize sold directly to the farmers. Regulation in Romania dictates that a farmer cannot grow the same variety in both the organic and conventional farming system. Interview was done with **Ion Toncea** from the Agro-Ecological Research Centre in Fundulea, Romania (NARDI).



CROPS IN THE TRIALS

Wheat, barley, oat, triticale, maize, millet and legumes (pea, lentil, lupines, soybean), sunflower, forage crops, aromatic and medicinal plants, etc.

TRIAL SET-UP

- **Locations:** At NARDI winter wheat is tested in two locations and winter barley and winter triticale in one location. Beside NARDI's location there are 3 research stations in the regions Dobrogea (1) and Wallachia (2) where they test the same varieties and have the same trial design as NARDI, but in different climate conditions.
- **Trial design, number of varieties, replications and years:** Usually for comparative crops Randomized Complete Block Design is used, in 3 replicates. Plot size: 1,5x6m. The number of varieties and species differ from year to year. For a broad picture: Barley (more than 30 varieties), Wheat (>30), Triticale (25), soybean (around 70), peas (7), lentils (7), lupine (2), field bean (1), alfalfa (19), trifolium (1), oat (2), millet (3), maize (around 20), buckwheat (1), sunflower (around 30), camelina (10), linseed (9), thlaspi (1), crambe (1), phacelia (1)
- **Equipment:** From institute
- **Assessment:** Disease resistance is very important (last year *Tilletia* became a big problem - NARDI started to cooperate with breeders to develop a resistant variety), quality analysis: protein, starch, gluten, and other standard parameters. NARDI has equipment for analyzing dough and flour quality, but they only test the best-performed varieties for baking quality.

ORGANIZATIONAL STRUCTURE

Conventional breeders are interested in cooperation with NARDI as they want to see the performance of some of their populations/varieties in the organic fields (they do not have an organic breeding programme). They are testing conventional varieties under organic condition. Organic growers are passively involved, and farmers will often establish variety trials (2-3 varieties) at their own farm. Farmers are requesting varieties with special characteristics. NARDI plan to do on-farm trials in the future.

DISSEMINATION OF RESULTS

NARDI has regular meetings with organic farming associations and each year open field visits are organized in the experimental fields. Results are shared only with farmers that are part of the organic farming association and in close relation with the institute. No recommendation list exists as NARDI is not authorized to publish recommendation lists (this will demand authorization from the government).

FINANCIAL MODEL

The trials at NARDI were financed by the institute's development funds and later on from research projects and government.

ORGANIC VCU

The State Institute for Variety Testing and Registration (ISTIS) is the National Authority for variety testing of new varieties and registration in the official national Catalogue and for provision of legal protection (PBR). There is only VCU for conventional farming. The reason that there is no organic VCU is lack of financial resources and that they don't have any organic trial sites. NARDI has offered to use their organic fields for organic VCU testing, but ISTIS policy is to perform the VCU trials only in their own locations. Conversations have started about winter wheat, soybean, sunflower, barley, spelt (not stable market), maize, as they have a high market share. There is no special option for registering varieties for organic farming in the catalogue, this could be added like a comment from the applicant.



VCU official: ISTIS, office@istis.ro, www.istis.ro

SWITZERLAND

In Switzerland there is a relatively large market share for organic varieties, 23 % of all wheat sold is organic. Organic farming is supported by government policies and this is also reflected in research activities for organic farming. The Research Institute of Organic Agriculture (FiBL) has long-term trials in organic arable farming and has a wheat-testing on-farm network that is now 15 years old. Interview for arable crop was done with **Dierauer Hansueli** from FiBL.

CROPS IN THE TRIALS

Winter wheat, potato, maize

TRIAL SET-UP

- **Locations:** FiBL and Agroscope (conventional federal research centre that breeds wheat in Switzerland) have together 15 locations for cultivar trials (on-station and on-farm) only for wheat.
- **Trial design, number of varieties, replications and years:** Agroscope tests annually around 12-18 varieties at 8 locations in small plots with 3 replications. Recently Agroscope tested 3 standard varieties (Wiwa, Titlis, Runal) plus 9 new varieties per location. In the trials are included varieties that are not on the market or that did not pass all the official tests yet or sometimes they do parallel testing with official trials. FiBL tests 8 varieties at 7 locations. Half of the new bred varieties are from conventional breeder (Agroscope) and half of them from organic breeder Peter Kunz. FiBL selects the best varieties in cooperation with Bio Suisse's commission for arable crops, Agroscope research, consultants, and processors. Agroscope carries out 3-year preliminary tests in small plots, FiBL takes over the best varieties and tests itself again for 2 years in strip tests. After this 5-year test, the Commission for Arable Crops, together with Agroscope and FiBL, decides which varieties are included in the recommended list of varieties for organic farming for the next year.
- **Equipment:** Agroscope has equipment for small plot trials
- **Assessments:** FiBL and Agroscope researchers do the evaluation of varieties. Soil coverage of crops and weeds are visually assessed (in percentage). Samples of 2 kg per variety per location is sampled and sent to laboratory for quality analysis.
For disease resistance Agroscope do infestations trials.

ORGANIZATIONAL STRUCTURE

Agroscope started testing organic varieties in wheat over 20 years ago. FiBL carried out practical trials and recommendations to farmers for 15 years. Cooperation with Agroscope has intensified since then. FiBL organize a yearly meeting with the Technical group, "arable crops" Bio Suisse (market organization for organic farmers). For the meeting actors from the industry are invited. The retailers COOP and Migros have 80 % of the market for organic and wants to have Swiss wheat, but half of the wheat is imported, as it is a challenge to live up to the high-quality standards regarding protein content. At the meeting results from the cultivar trials are presented and the questions, suggestions and request for next year trials are discussed. The processors determine which quality they want. The choice of varieties must be based on this. The buyers only want high protein or gluten varieties. They are not interested in the agronomic properties. However, the farmers involved want varieties that are easy to grow and resistant to diseases. Farmers are involved in the cultivar trials of FiBL. Farmers do the same maintenance work on the experimental part of the field as on other parts that are meant for production and they get paid a normal price for this as a compensation. FiBL researchers are responsible for setting up, evaluating and harvesting of the practical trials. Agroscope rents itself quasi



with its small plot experiments on a big plot of an organic farmer and does all the work itself. They also carry out the assessments, harvests and evaluations separately.

RESULTS DISSEMINATION

Results from the FiBL on-farm trials are compared with the results from small plot trials at Agroscope. Results are then gathered and published in the on-line booklet available on the FiBL webpage.

There is a list of recommended varieties (LES) for organic farming. It contains varieties of the National list and the EU catalogue of varieties, which were additionally tested under organic conditions and found to be suitable. This list is based on the results of Agroscope's organic trial network and on the results of the FiBL coordinated on-farm stripe trials. The preliminary exact experiments are published separately from the practical experiments of FiBL.

FINANCIAL MODEL

Conventional and organic farmers pay a levy each year based on the harvest yield. Agroscope get around 40.000 Euro from this levy and FiBL around 20.000 Euro to run on-farm trials and the other part of the financial support comes from the government - Agroscope receive around 300-400.000 Euro in governmental support for variety trials.

ORGANIC VCU

The official VCU test for cereals is carried out under low input conditions (no fungicides, no insecticides), with one organic location out of nine on-farm locations. The ambitious plan to establish an official VCU trial for winter wheat under organic conditions had to be abandoned for cost reasons and for reasons of too little differentiation compared to the low input VCU trials. 15 conventional and 8 organic varieties are being tested.

VCU testing takes 3 years. Price is around 2075-2475 Francs plus 350 for baking tests in winter wheat

Variety official: paul.mewes@blw.admin.ch

UNITED KINGDOM

In the United Kingdom there has been no official organic variety trials in agricultural crops for 15 years. Currently, organic arable farmers rely on the recommended list which is produced by the AHDB (Agriculture and Horticulture Development Board)¹¹. The Recommended lists do not take into account organic conditions, but just untreated crops, with no pesticides but fertilisers and herbicides still applied. The list is funded by AHDB through producers levy fund. Organic variety trials are currently carried out by farmer's organizations, research institutions and seed companies, but on a limited scale only.

Within the LIVESEED project, ORC has started a decentralised variety testing on winter wheat, with the aim to set up a proof of concept of what a multi-actor model for organic variety testing could be and how it could integrate currently available information from private organic trials and from official conventional trials. In this model, commercially available varieties are tested in a network of farms to give information about different aspects of variety performance under organic conditions. As part of current conversations with the AHDB, the LIVESEED ORC-led variety trials network is developing as a resource to ascertain the actual performance of varieties in low-input conditions, thereby integrating the information from conventional recommended-list trials that are more informative about the varieties' genetic potential.

¹¹ <https://cereals.ahdb.org.uk/varieties/ahdb-recommended-lists.aspx>

Parallel to the LIVESEED-funded network, ORC is also engaged with a winter wheat variety testing “Field lab” funded under the Innovative Farmers programme¹². Interview was done with **Charlotte Bickler** from the Organic Research Centre, United Kingdom.

CROPS IN THE TRIAL

Winter wheat

TRIAL SETUP

- **Locations:** for 2017-18, seven farms in addition to on-station trials.
Trial design, number of varieties, replications and years:

- Incomplete Block Design for the farm network: Overall seven varieties are tested with a minimum of three allocated varieties on each farm. Varieties are selected based on outcome of several independent plot-scale trials run in previous seasons, on farmers’ preferences and by focusing on representative varieties for the organic sector.
- Randomized complete block design (RCB) on-station in two positions in rotation and with two soil management systems (ploughed and shallow non-inversion tillage) with four replications. This trial is embedded in an organic rotation in the experimental station of the University of Reading.
- For 2018-19, the network has enlarged to 10 farms organised as two connected Incomplete Block designs testing eight varieties, and an RCB factorial plot-scale trial as in 2017-18, testing the eight farm-network varieties and seven additional varieties. In this second season, the whole operation has been improved in terms of better integration with other existing, independent and so far, isolated initiatives.
- The Innovative Farmers field lab is based on a plot-scale trial carried out in an organic farm. It started in the 2017-18 growing season and is continuing in the 2018-19 season with three farms also testing a subset of varieties at a field-scale.

- **Equipment:** Each farm in the LIVESEED network drills, manages and harvests the varieties with their own farm machinery. The plot-scale trials are drilled with a plot driller and harvested with a plot combine. The central LIVESEED trial is managed by the university of Reading Crops Research Unit in their experimental station. The Innovative Farmers field lab is drilled and harvested by a contractor.

- **Assessments:**

LIVESEED on-farm network: The ORC team visited all seven farms during the second half of June 2018, in line with wheat anthesis, to collect key performance indicators. For each variety in each farm, five random positions were selected and measured for:

- Wheat canopy height (cm)
- Wheat canopy cover (visual estimated over a 2m² area)
- Ears density over two linear metres
- Weed abundance – visual ground cover estimates by species over a 2m² area
- Disease severity: yellow rust, brown rust, septoria, powdery mildew

Yield was measured by farmers using their own machinery for combining the crop and weighing grains from each strip separately (Fig. 4). Grain samples were then sent for analysis at the Trinity Grain laboratory for determination of:

- Protein content
- Moisture
- Specific weight
- Hagberg falling number

Data analysis was carried out using the open source software R (version 3.4.3, Platform: x86_64-w64-mingw32/x64 (64-bit)). Analysis is based on **mixed effect models** run through the

¹² <https://www.innovativefarmers.org/field-lab?id=fb1a6e1d-2aba-e711-816a-005056ad0bd4>

lmer() function of package lme4. Estimated marginal means (i.e. estimated mean values averaged over, and corrected taking into account differences between farms), were obtained based on the mixed model through the 'emmeans()' function in library 'emmeans', using Kenward-Roger Degrees-of-freedom method and Tukey method to estimate pairwise comparison (each pairwise difference has an associated p-value). The five different assessments per variety/farm carried out in June 2018 are treated as pseudoreplicates and therefore their mean value was used in statistical analyses. This analysis is completed with multivariate analysis (Principal Components Analysis) of the main variables assessed. Results are presented at four levels: (1) Mean values with statistical analysis and outcome of pairwise comparisons; (2) Estimated Marginal Means (EMM): varietal mean values corrected across farms; (3) 'Absolute differences', i.e. average difference between the value of a variety and the average of the farm where it has been grown expressed in actual units (e.g. t/ha above or below farm average for yield); (4) 'Relative differences', i.e. average difference between the value of a variety and the average of the farm where it has been grown expressed as a percentage (e.g. % more or less than farm average).

Assessment on the **central plot trial** mirror those of the farm network, with more intensive measurements of cover and diseases during different growth stages, particularly during late winter. Data are analysed through mixed models taking into account the nesting structure of the error (varieties nested into tillage system, in turn nested into rotational position).

The Innovative Farmers plot-scale trial mirrors surveys protocol of the LIVESEED on-farm network. Data are analysed through a randomised complete block ANOVA.

ORGANIZATIONAL STRUCTURE

Organic variety trials are carried out by farmer organizations, research institutions and seed companies. The LIVESEED-funded variety trial network is performed in association with Organic Arable, a farmer owned grain trade business with approximately 70 members. ORC and Organic Arable set up and manage the trials network. ORC is the main coordinator in close contact with Organic Arable. Organic Arable is organising the network and managing the marketing of grains and the main quality analyses. ORC is defining trial design and facilitate trial protocols. In addition to the ORC-led assessment at crop flowering stage, farmers assess crop growth and development and upload data on SharePoint managed by ORC.

ORC started, within the LIVESEED project, winter wheat on-farm and on-station trials in autumn 2017. They are developing links with a number of artisanal bakers who are interested in performing baking trials on the wheat from the trials, the bakers are particularly interested in the varying characteristics of the ORC Wakelyns Population and other varieties grown across different environments. Links are also being developed and strengthened with other independent plot-scale trials and with the Agriculture and Horticulture Development Board, with the aim to better integrate and validate data from different sources including the conventionally managed Recommended list trials, environmental and climatic datasets.

The Innovative farmers trial is funded through an UK programme aimed to support farmer-led initiatives for on-farm research. ORC is working on integrating as much as possible this initiative with its own LIVESEED-funded start-up network and other independent organic trials.

DISSEMINATION OF RESULTS

Results from the LIVESEED network trials are at first available just for the involved farmers and at the end of the trial period results are made publicly available with farms anonymised. Using the multi-location nature of the trial, simulation of varietal performance in farms where a variety has not been grown is also being developed. The overall goal of the variety trials network is to develop into an integrated decision support system which could extend its scope beyond winter wheat, beyond



varieties and beyond of organic farming, to potentially support a large-scale transition to low external inputs in organic arable farming. Results are disseminated via Organic Arable and other communication materials as ORC Bulletin.

Results from the Innovative Farmers plot-scale trials are publicly available through the innovativefarmers.org portal.

FINANCIAL MODEL

The organic variety trial network as a proof-of-concept work is financed through LIVESEED, but ORC, Organic Arable and other stakeholders are working to develop a business model during the LIVESEED project in order to continue with the cultivar trials also after the project period. Farmers are provided with commercial seed of the allocated varieties (between 50 and 500 kg) but no direct payment to farmers has been in place. Although not having the unsustainable cost of multi-location plot trials, running a season of variety trial network can still be expensive. On the other hand, with a thorough data collection and analysis, the scope of the information produced can be much wider than performance of the tested varieties. Many stakeholders could/would contribute financially, including farmers, seed and grain supply chain players, and opportunities for public funding, in front of publicly available results under an open-data policy are also being explored.

ORGANIC VCU

In the UK there are no official VCU trials for organic varieties and so far, there has not been any requests for organic VCU trials. If an applicant would like to see if a candidate is suitable for an organic system, they could make a request for a special test on the application form. BSPB (British Society of Plant Breeders), who organize VCU trials in the UK on behalf of the National Authorities, may be able to arrange a separate trial. The first step would be to get organic variety trials in place.

Variety official: Jeremy Widdowson jeremy.widdowson@bspb.co.uk
Variety Office (VCU) BSPB, British Society of Plant Breeders¹³

DENMARK

There is a broad agreement in the Danish seed sector to use the “The National Field Trials” (Landsforsøgene®) for variety trials in general. There is a long tradition for organic variety trials - in the beginning trials were financed by project-funds, but around 15 years ago it was gradually converted to the existing financing model where breeders pay all expenses to have their varieties tested in the trials. The Danish breeding companies have breeding activities for organic farming in a few species as part of or in parallel with their conventional breeding program. But organic variety trials are mainly used for testing the performance of conventional varieties under organic conditions. Organic variety trials run only in a few species, mainly in spring barley as one of the most significant organic cereal crops and occasionally in spring and winter wheat and oat. For other species trials are mainly financed by projects to develop trials and it is difficult to finance trials for species with only a small market share. The organic area in Denmark is increasing and is now around 10 % of the total farming area.

Information was provided by **Tove Mariegaard Pedersen**, SEGES. SEGES is part of the Danish Agriculture & Food Council, who represents the farming and food industry of Denmark. SEGES covers all aspects of farming and farm management including organic production. SEGES has close

¹³ <http://www.bspb.co.uk/>



partnerships with universities, government departments, businesses, trade associations and 30 regional farmer-owned advisory companies.

CROPS IN THE TRIAL

Cereals; oat, spring barley, spring- and winter wheat financed by breeders - other crops on request from breeders and with project financing (faba beans, sunflower, clover, grass etc.).

TRIAL DESIGN

- **Locations:** For cereal trials there are 4 locations in different parts of Denmark and with different bonitation.
- **Number of varieties, replications and years:** Number of varieties differ from year to year, the number of replications depends on number of varieties (minimum 4 replications). Some varieties are in the trials for several years and some only for one year.
- **Equipment:** Farmer's equipment is used for preparing the soil, and local trial units has specialized equipment for sowing, harvesting and other specialized operations.
- **Assessments:** Trial plans with all assessments can be found online in the Nordic Field Trial System (English version is available)¹⁴: - choose "2 Organic farming" and year). The following is assessed: At trial start; soil samples are analysed, after germination; plant density, and at earing; weed cover and diseases, before harvest; lodging, straw length and weed cover, after harvest; yield and protein content and hectolitre weight. In spring barley weed competitiveness is assessed by digital photos taken in the field at an early stage, before weeds are significantly present. Photos are analysed with a computer tool to determine the percentage of leaf cover, which shows good correlation with weed cover. This allows for registrations of weed competitiveness in varieties regardless of the weed cover in the field.

ORGANIZATIONAL STRUCTURE

The variety trials are part of a national set-up: The brand "The National Field Trials" (Landsforsøgene®) covers the national collaboration in trials and demonstrations that are carried out in cooperation between the local farmers unions and SEGES departments for Plant Innovation and Organic Innovation. The practical trial planning and administration of The National Field Trials are carried out by the Technological Institute on behalf of SEGES. The final responsibility for the trial plans is with SEGES' specialists. Every year there are around 1000 national field trials including the variety trials. The National Field Trials are the "development department" of plant production as through a quality assured and well-tested set-up ensures that Danish farmers has access to the latest knowledge about plant production including information about variety performance. Trials are implemented in close cooperation with local farmers hosting the trials and is organized so that the local advisory centres participate in cooperation with one of the 14 local trial units. Organization in local trial units makes the trial work efficient and rational, at the same time as the requirements for specialization, equipment and quality is respected.

One of the cornerstones in the set-up is the online access to knowledge. Nordic Field Trial System is an international data system, owned by SEGES, which is used for reporting results, administration and calculations of trials. The system is developed and maintained by the Technological Institute. Each year a letter is send to breeders and seed companies to enrol varieties in the trials. Breeders and seed companies then deliver varieties for the trials and the companies use trial result in the marketing of varieties. Farmers and consultants use trial result for making variety choices.

DISSEMINATION OF RESULTS

¹⁴ <https://nfts.dlbr.dk/Forms/planoversigt.aspx?list=0&type=1>



Results are available shortly after harvest in the trial data management website “Nordic Field Trial System”¹⁵ and after statistical revision results are entered into the variety database “SortInfo”¹⁶. In late autumn results are published in a book (Danish only) with all trial results from The National Field Trials.

Every year there are several field demonstration days for farmers, consultants and companies and other interested people.

FINANCIAL MODEL

In standard variety trials in cereals all costs are financed by breeders or seed companies or others, who wish to have a variety tested. The price is around 2900 Euro for one variety for one-year trial. The results are used as part of their marketing of varieties. Sometimes trials are expanded with developmental activities financed by projects, e.g. development of weed competitiveness assessments. But companies may still pay the costs to have the standard assessments depending on the setup.

ORGANIC VCU

Recently it is now possible to have a variety tested in organic VCU trials in principle in all species, but the price will be a limitation if only one or few varieties are signed up for the trials. Before this conventional VCU was supplemented with organic trials, which meant that the price would have to cover both conventional and organic trials. The first organic VCU-trials in organic winter wheat started in autumn 2017.

As part of the official trial setup there are observation plots for tested species in a number of locations where assessments for diseases, lodging etc. are done. In the LIVESEED project in 2018 and 2019 observations plots are expanded to include organic locations to find an easy and low-cost way to get access to more information on variety performance under organic conditions in winter cereals (not described below).

Years: Typically, 2 years depending on the species

Locations: In 2017 organic winter wheat trials were set up at the location of the two breeders that had entered a variety and a population in the trials, the locations were both at organic farmland in an organic crop rotation, and in addition there was one trial location at an organic farm. The population was withdrawn from the trials after the first year, and in 2018 the trials were set up at one breeders’ location (organic farmland) and at two organic farms, and the trials were included in the national organic field trial set-up. Results from the different locations can now be found at the Nordic Field Trial System website¹⁷.

In 2019 one spring barley variety was signed up for organic VCU-testing as part of the organic post-registration variety trials. For this trial there are four location¹⁸. In 2011 and 2012 there was a VCU-trial in spring barley for a variety with supplementary organic trials in four locations.

Variety description: The trial protocol for winter wheat is available (in Danish language) on the registration office website¹⁹ and at Nordic Field Trial System website (partly in English)²⁰. Additional quality assessments can be made on request. Trial protocol for spring barley is also available at Nordic

¹⁵ <https://nfts.dlbr.dk/Forms/Forside.aspx?&applLangID=en>

¹⁶ <https://sortinfo.dk/oversigt.asp?Sprog=uk>

¹⁷ <https://nfts.dlbr.dk/Forms/ForsogPlacering.aspx>

¹⁸ <https://nfts.dlbr.dk/Forms/ForsogPlacering.aspx>

¹⁹ <https://www.tystofte.dk/afproevning/vp-protokoller/>

²⁰ <https://nfts.dlbr.dk/Forms/VisPlan.aspx?PlanID=17999&GUID=cec81b97-bfac-40a3-bf75-636adef30c72&applLangID=en>



Field Trial System website²¹. For winter wheat two references are used - one reference mixture as yield reference and one variety as a reference for quality. In spring barley trials, a reference mixture is used. The same reference mixtures are used in conventional and organic farming. Usually one variety of the reference mixture is substituted each year.

Coordination: The coordination of the trials is handled at the examination office TystofteFonden. SEGES is coordinating organic post-registration trials in cooperation with the Technological Institute and the local trial units, and when the organic post-registration trials are used for VCU-trials there is a close coordination of seed delivery, trial planning, exchange of results etc. This is normal procedure for conventional trials, so it is easy to implement for the organic trials as well.

Specification: There is a mention in the descriptive list of varieties that the variety is tested and approved under organic conditions

Link to National lists

- National list of varieties²²
- Descriptive list of varieties²³

Price: The price for one-year testing is now around 2500 Euro²⁴. Prices can be found here:

Registered varieties:

Spring barley Invictus was registered in 2013 after two years trials in 2011 and 2012 (conventional and organic trials).

Variety official: Anders Søndergaard Larsen (asl@tystofte.dk)

GERMANY

There is a long history of organic post-registration trials in Germany which can be traced back to the increasing importance of organic farming. The introduction of organic variety trials was relatively easy due to the existing infrastructure of conventional trials.

In Germany organic variety trials (post-registration) are performed by the Federal States with trans-regional cooperation between neighboring Federal States. Germany is divided into different cultivation areas based on pedo-climatic regions, and Federal States in the different cultivation areas agree upon variety recommendations for these areas. The same Federal State can be located in more cultivation areas. The coordinator of the federal trials network is Dr. Claudia Hof-Kautz, Landwirtschaftskammer Nordrhein-Westfalen. In the organic post-registration trials, all varieties that are tested under organic VCU conditions are included and also varieties from conventional breeding programmes are included. Thus quite a few varieties are described based on results from both the conventional and the organic network. In the network there is a general agreement on the trial setup and evaluation protocols, which makes comparisons much easier. Information for the Federal State of Hessen was given by **Thorsten Haase**.

CROP IN THE TRIAL

²¹<https://nfts.dlbr.dk/Forms/VisPlan.aspx?PlanID=18158&GUID=f35203a3-c3de-4b88-a5e3-6d2d2f293ded&applLangID=en>

²² <https://www.tystofte.dk/sorter-status/officiel-sortliste/>

²³<https://www.tystofte.dk/wp-content/uploads/2018/07/bsl-landbrugsplanter-2018-descriptive-variety-list-agricult.pdf>

²⁴ <https://www.tystofte.dk/wp-content/uploads/2019/02/prisliste-2019-pricelist-2019.pdf>



Winter wheat, winter rye, winter barley, winter triticale, winter spelt; spring barley, spring wheat, spring triticale, oats, faba bean, pea, lupine, soybean, potatoes, maize, sunflower (not all species are tested in all Federal States).

TRIAL SET-UP

- **Locations:** Number of locations differ from one Federal State to the other, and for the cultivation area a mean value can be used for trials from different Federal States. Both on-station and mostly on-farm trials are used in the network. Number of locations for each species differ.
- **Number of varieties, replications and years:** Block design with 4 replications is most common, varieties are tested for 3 years to take into account the climatic fluctuations. In Hessen as an example 25 varieties of winter wheat are tested per year and 18 maize cultivars (15 hybrids and 3 populations)
- **Equipment:** Trial stations/federal offices have machinery
- **Assessments:** Assessments are done by technicians on each location (no differences in evaluation between hybrids and populations) and the protocol is common with other federal institutions in the working group for organic arable variety trials in Germany.
Depending on the crop species there might be different weighing in organic compared to conventional trials of the criteria in the quality analyses (Examples: Rye - falling number, Wheat - baking volume and gluten content, Malting barley - share of large grains, Potato - presence of Rhizoctonia). In organic trials weed competitiveness (soil coverage and mass development in juvenile stages) is assessed.

ORGANIZATIONAL STRUCTURE

Coordinators from federal institutes doing post-registration trials take part in a working group that is organized by Verband der Landwirtschaftskammern (contact person Andreas Lege). The working group meets on a yearly basis. There is a general agreement to use the joint guidelines for protocols for VCU-trials and post-registration trials. Reference varieties are decided by the Federal State Offices and the Federal Plant Variety Office. These reference varieties are used in most Federal states and are the same as for VCU trials, they are the 2-3 most important varieties and they can be conventional or organic. In Mecklenburg-Western Pomerania, three varieties are used as reference varieties which have been tested for at least 5 years and in Bavaria they use the mean value of varieties as a reference. Coordinators from neighbouring federal states meet around twice a year and decide upon common varieties for trials, and with common trial set-up this makes data analysis easier. Trial coordinators use the common web-based platform PIAF for trial planning, data collection, sharing and evaluation. Data in PIAF is not publicly available but results from trials are made available after harvest. In some cases, a central trial department is responsible for statistical evaluation and examine the validity of the trials. PIAF is funded by the federal states and by service-companies who pay a license to use PIAF. Choice of varieties to enter in the trials is done by coordinators in cooperation with breeders, seed companies and seed propagators. In some species like rye, field pea and lupine varieties from Poland and Czech Republic are included in trials. Farmers host on-farm trials but are not actively involved in the evaluation of trials. Recommendations lists for the cultivation areas are made in cooperation with neighbouring Federal States.

DISSEMINATION OF RESULTS

Trials are displayed at field days. Results and recommendations lists are made available on the websites of the different institutes performing the organic variety trials. Results from different Federal States are published as mean values. In some Federal States there are only 1-2 locations and the common data analyses are important to do recommendations for the cultivation area. In some cases,



consultants and others receive the results in advance as variety choice by farmers need to be done during the data evaluation period.

Table 10 Links to trials results in German Federal States

Federal State	Institution	URL
Baden-Württemberg	Centre for Agricultural Technology Augustenberg (<i>Landwirtschaftliches Technologiezentrum Augustenberg</i>)	http://www.ltz-bw.de/pb/,Lde/Startseite/Arbeitsfelder/Versuchsergebnisse
Bavaria	Bavarian State Research Institute for Agriculture (<i>Bayerische Landesanstalt für Landwirtschaft</i>)	https://www.lfl.bayern.de/iab/landbau/030541/index.php
Brandenburg	State Office for Rural Development, Agriculture and Restructuring (<i>Landesamt für Ländliche Entwicklung, Landwirtschaft und Flurneuordnung</i>)	https://www.isip.de/isip/servlet/isip-de/regionales/brandenburg/landwirtschaft/landessortenversuche-neu-2
Hessen	Hesse Department of Agriculture (<i>Landesbetrieb Landwirtschaft Hessen</i>)	https://www.llh.hessen.de/pflanze/oekologischer-pflanzenbau/versuchswesen-oekologischer-pflanzenbau/
Mecklenburg -Western Pomerania	State Research Institute for Agriculture and Fisheries Mecklenburg-Western Pomerania (<i>Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern</i>)	https://www.landwirtschaft-mv.de/Fachinformationen/OekologischerLandbau/Sorten-und-Empfehlungen/
Lower Saxony	Chamber of Agriculture Lower Saxony (<i>Landwirtschaftskammer Niedersachsen</i>)	https://www.lwk-niedersachsen.de/index.cfm/portal/betriebumwelt/nav/328.html
North Rhine -Westphalia	Chamber of Agriculture North Rhine-Westphalia (<i>Landwirtschaftskammer Nordrhein-Westfalen</i>)	https://www.oekolandbau.nrw.de/fachinfo/pflanzenbau/ackerbau/ , https://www.landwirtschaftskammer.de/Landwirtschaft/ackerbau/index.htm
Rhineland-Palatinate	Competence Centre Organic Agriculture Rhineland-Palatinate (<i>Kompetenzzentrum Ökologischer Landbau Rheinland-Pfalz</i>)	https://www.oekolandbau.rlp.de/Internet/global/inetctr.nsf/dlr_web_full.xsp?src=5YFFWMK232&p1=1J255BJ61E&p3=6J1Y474WUL&p4=TT6A030J05
Saxony	Saxon State Office for the Environment, Agriculture and Geology (<i>Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie</i>)	https://www.landwirtschaft.sachsen.de/sortenempfehlungen-19902.html

Saxony-Anhalt	Agriculture and Gardening Office of Saxony-Anhalt (<i>Landesanstalt für Landwirtschaft und Gartenbau Sachsen-Anhalt</i>)	https://llg.sachsen-anhalt.de/themen/sortenpruefung/hinweise-zur-sortenwahl/
Schleswig-Holstein	Chamber of Agriculture Schleswig-Holstein (<i>Landwirtschaftskammer Schleswig-Holstein</i>)	https://www.lksh.de/landwirtschaft/pflanze/o-ekologischer-landbau/
Thuringia	Thuringia Regional Office for Agriculture and Rural Areas (<i>Thüringer Landesamt für Landwirtschaft und Ländlichen Raum</i>)	https://www.thueringen.de/th9/tlllr//wir/publikationen/voe/sortenratgeber/index.aspx

FINANCIAL MODEL

Post-registration trials are financed by the Federal States. The institutes performing VCU-trials as well receive payment for doing this. Trial stations are financed by the budget of the federal institutes. Breeders provide own seed for the trials. In some Federal States farmers are compensated for hosting trials.

ORGANIC VCU

From 1999 to 2011 varieties for organic production were tested in the conventional VCU test and additionally in a series under organic conditions as well. The variety could then be described based on the results of both trial series. For both trial series fees had to be paid. Starting from 2012 the VCU of a variety intended for organic production is tested under organic conditions only and the decision on the value for cultivation and use of a variety is based on the results from the organic trials. For the organic VCU testing the same fee has to be paid as for VCU in conventional testing.

There has been a thorough discussion during stakeholder workshops on how to organize testing of varieties for organic production and to find out which characteristics are of special interest in organic production. The guidelines for VCU testing under organic conditions were set up on basis of the results of these workshops. Furthermore, it has been tested if varieties for organic production had to be trialled under organic conditions and according to specific technical guidelines in research projects in specific species.

The outcome of the workshops was that conventional value tests give important information for the selection of varieties for organic production and in cereals it would be helpful to have additional information on weed competitiveness, the suitability to harrowing, the susceptibility to seed-borne diseases and the nutrient use efficiency, but there was no method available to test the suitability to harrowing. Research on the susceptibility to seed-borne diseases has to be done by research institutions and the judgment of the nutrient use efficiency is too complex to find out in normal variety testing. But weed competitiveness assessments were included in the trial guidelines.

In the research project the same varieties were tested under conventional and under organic conditions and results were compared. Results from the conventional and organic VCU trial series showed that the relation of the varieties in their characteristics for cultivation, susceptibility to diseases and yield remained the same in both production systems. The same was true for quality except for the baking quality of wheat. The additional observations for weed competitiveness showed a good differentiation in winter wheat and to a lesser extend in spring barley. It was concluded that



results from conventional trials do not find enough acceptance in the interested circles. Additional arguments for a trial series under organic conditions were organic soils, seed is (preferably) from organic production and not treated. Seed and/or soil borne diseases can be assessed. Weed competitiveness is tested on organic soils, biotic stress is higher as no insecticides or herbicides are allowed, nutrient efficiency must be high because only organic fertilization is allowed and the quantity in organic soils is limited.

Based on these arguments the Federal Plant Variety Office judges the value of cultivation and use of varieties for organic production as far as possible on basis of results and characteristics important in organic production. Information was provided by Uta Schnock, Head of Section VCU Testing and Descriptive Variety Lists, Bundessortenamt.

Species: Up to now only cereal varieties have been applied for registration under organic conditions. Varieties of winter wheat, spring wheat, winter barley, spring barley and spring oat are in course of testing/have been tested and registered.

Years: The normal duration of the value tests is two-three years depending on species.

Locations: A trial series is run on 14 organic field locations distributed in Germany. The trials have four replications.

Variety description: The Federal Plant Variety Office took part in the COST860 – SUSVAR Action (Chair Hanne Østergaard, Riso National Laboratory, Denmark) and is co-author of the Handbook on Cereal variety testing for organic and low input agriculture which was published in 2006 and enlarged by some more chapters in the following time. The book was edited by Dingena Donner (Plant Variety Board, Netherlands) and Aart Osman (Louis Bolk Institute, Netherlands).

Protocol: Ground cover % - the ground cover shall be judged in the beginning until the middle of tillering (BBCH 21-25). The ground cover of the plants shall be estimated in %. Mass during shooting/during juvenile development (1 – 9) - mass during shooting shall be notified in BBCH 32 – 37. Both ground cover and mass during shooting are means to judge the competitiveness of varieties to weeds.

For most diseases the susceptibility can be judged based on the notifications from field trials. Nevertheless, as in conventional VCU testing the organic field trials are replenished by some additional tests if necessary. Thus, in winter wheat the varieties are included in an extra series under artificial inoculation for the judgement of *Pseudocercospora*, DTR, yellow rust and ear fusarium.

The quality judgement is made on basis of the harvested material from organic production. In winter wheat besides all milling and baking characteristics also the gluten content is analysed and described (this feature will also be described in the future for the conventional varieties).

Up to now the problem of the examination of a possible resistance to seed and/or soil borne diseases could not be solved. An institution and/or safe methodology still has to be found.

In case applications for other species than cereals are made in the future the question of testing will be discussed with the stakeholders before setting up a testing protocol.

Coordination: The Federal Plant Variety Office (Bundessortenamt) is the responsible institution for the acceptance of a variety in the German National List. For many species the Federal States have established an extra organic trial network for post registration trials on organic fields. The candidate



varieties for organic registration are included in the Federal States' organic network on behalf of the Federal Plant Variety Office. For more information see the previous chapter.

Results: The test results of all variety trials done in Germany are collected by the Federal Plant Variety Office and form the basis for the Descriptive Variety List in which all registered and other varieties are described in their valuable characteristics.

After registration the new varieties are included in post-registration trials carried out by the German Federal States. In those trials the regional suitability of the variety is tested. On basis of all results from VCU and post registration trials the federal states issue regional recommendations to the farmers.

Link to National list:

National list²⁵:

Descriptive list of varieties²⁶:

Specification: All varieties tested in the organic trial series are described on basis of those results in the Descriptive variety List in a special section 'varieties in organic production'.

Price: For winter wheat the annual fee for VCU would be 3.340 € no matter whether in the conventional or in the organic network. Fees are available online at the Bundessortenamt website following the path Service-Antragsteller-Gebühren

Registered varieties

Winter barley: Cayu, Highlight, KWS Keeper, KWS Meridian, Lomerit, Quadriga, Semper, SU Ellen, Tamina, Titus

Spring barley (two row): Avalon, Catamaran, Eunova, Odilia, RGT Planet, Solist, Pirona (naked)

Oat: Apollon, Bison, Ivory, Kaspero, Max, Poseidon, Sinaba, Symphony

Winter wheat: Adesso, Akratos, Aristaro, Aszita, Axioma, Bernstein, Butaro, Discus, Elixer, Famulus, Florian, Genius, Govellino, Graziaro, Julius, KWS Essenz, KWS Milaneco, Meister, Naturastar, Pionier, Purino, Roderik, Senatur, Thomaro, Tiger, Tilliko, Trebelir, Wendelin

Variety official: Uta Schnock, Head of Section, VCU Testing and Descriptive Variety Lists, Bundessortenamt

VEGETABLES CROPS

FRANCE

The key element for starting organic vegetable trials in different regions of France came from farmers needs to know which commercially available varieties on the market are good for organic vegetable production, are adapted to the local conditions and are CMS free (Cell Fusion Hybrid). In 2001 ITAB took the initiative to connect the different local initiatives in a network. ITAB provides guidelines, recommendations for protocols, varieties and testing models and collect data for dissemination. In the future they wish that all local initiatives working on the same crop will have standardized trial setups

²⁵ <https://www.bundessortenamt.de/bsa/sorten/blatt-fuer-sortenwesen/archiv-sonderheft/>

²⁶ <https://www.bundessortenamt.de/bsa/sorten/beschreibende-sortenlisten/>



and will collect data together to have recommendation lists of vegetable varieties at national level. Interview was done with **Mathieu Conseil** from ITAB.

CROPS IN THE TRIAL

Tomato, carrot, zucchini, celery, asparagus, potato, sweet potato, bean, spinach, eggplant, pumpkin etc. Different vegetable crop species are tested in different regions. Note that for registration, potato is an arable crop with VCUE.

TRIAL SET-UP

- **Locations:** The number of testing locations depends on the species. For some species 2-3 regions are working with the same protocol and the same varieties in the same season.
- **Trial design, number of varieties, replications and years:** Trial design depends on the species. Usually 2 year, trials with 3 replications if the trial is on the experimental farm, but on-farm there are usually 1-2 replications only. Many varieties are screened on-station and then the varieties that perform well under organic and local conditions are tested on-farm as a next step.
- **Equipment:** Equipment is available on the farm or experimental station. Often specific equipment is needed to produce peat pots for sowing, and planting/sowing machines (potatoes, beans).
- **Assessments:** Depends on the crop species. Nutritional analyses are usually not performed. ITAB did some nutritional and organoleptic analyses of tomato and broccoli in the framework of the EU projects Solibam and Diversifood. Assessments are done by engineers or technicians from the experimental station (for both on-farm and on-station trials). There is a focus on disease and pest resistance/tolerance in the field. Taste can also be evaluated for some species (more or less precisely). For pumpkins and tubers conservation issues are also assessed.

ORGANIZATIONAL STRUCTURE

The local farmers' organizations are organizing the vegetable variety trials for the members of their organization. Trials are performed at the local experimental farms (e.g. GRAB and CivamBio 66 in the south-east of France, and PAIS-IBB in Brittany). A large amount of varieties is screened on-station and then the ones that perform well are tested on-farm as a next step. The local initiatives are choosing species and varieties for trials both from commercial catalogues and gene banks. In 2001 ITAB took the initiative to connect the different local initiatives in a network. ITAB provides guidelines, recommendations for protocols, varieties and testing models and collect data for dissemination.

DISSEMINATION OF RESULTS

Communication practices at the local level is done through local farmers' organizations and at national level ITAB is collecting the yearly reports (not for a detailed database) from the variety trials that are sent on a volunteer basis. Every two years ITAB together with the local organizations publish main results, for selected crops, in the ITAB technical newspaper called Alter-Agri. The results are reliable for local farmers, but they are not valid for information at national level. The recommendation list of varieties is set-up and disseminated at local level only.

FINANCIAL MODEL



The local variety trials are financed by local farmers organizations, by regional public support and by private financing. Costs for the coordination work of these trials by ITAB are covered by the agriculture ministry.

GREECE

For vegetables and particularly tomato, AEGILOPS has set up field evaluation trials in the period 2017-2018. The main aim of the organic vegetable variety trials is to find local varieties that can have great performance (yield and quality) under organic conditions. In 2019 AEGILOPS will continue with tomato variety trials and additionally set up trials with eggplant varieties. Information was provided by **Elias Avdikos** from AEGILOPS.

CROPS IN THE TRIAL

Tomato (also one pepper variety (Mpachovou) is under registration process)

TRIAL SETUP

- **Locations:** in a non-heated greenhouse in Thermi Thessaloniki, Greece. On-station experiment.
- **Trial design, number of varieties, replications and years:** 21 heritage varieties, like Milo, Dramas, Lagada, Olympou, Feta and Chamoti, originating mainly from central and north regions of Greece, with the commercial tomato hybrid Formula as control. The experimental design was a randomized complete block with three replicates, each consisting of five plants.
- **Equipment/machinery:** Equipment needed to measure the qualitative characteristics
- **Assessment:** The evaluation of the trials was made by PhD researcher in plant breeding Avdikos Ilias. Assessments were done for yield, earliness, fruit and nutritional value measurements.

ORGANIZATIONAL STRUCTURE

The coordination, establishment, maintenance and evaluation work were done by PhD researcher Avdikos Ilias. There was passive involvement of farmers and other chain actors from AEGILOPS network for biodiversity.

DISSEMINATION OF RESULTS

The dissemination of the results from the variety trials was done on ICOAS Congress 2018 and in the 17th plant breeding congress organized in Greece in 2018. Results were also shared on the webpage of AEGILOPS (www.aegilops.gr), in the newsletter of AEGILOPS "kivotos" and in AEGILOPS Facebook page.

FINANCIAL MODEL

There was no funding. Trial was done on voluntary basis.

AUSTRIA

The Horticultural College and Research Institute (HBLFA Gartenbau Schönbrunn und Österreichische Bundesgärten) in Vienna is a federal institute that belongs to the agricultural ministry of Austria and is one of the institutes, beside Arche Noah, Bio Austria and the Versuchsstation für Spezialkulturen in



Styria, that performs organic variety trials in vegetables and has been doing so since 2007. The organic vegetable variety trials have an impact on the variety choice by organic farmers. Organic vegetable breeding activities in Austria are still very low. There is only one organic vegetable breeder (Reinsaat www.reinsaat.at). Parallel to organic vegetable variety trials The Horticultural College and Research Institute also support Austrian growers in producing fresh vegetables locally for the domestic market and try to develop new cultivation systems such as low-energy-systems or year-round-production (winter vegetables). The interview was done with **Wolfgang Palme** from HBLFA.

Trials at the Horticultural College and Research Institute (HBLFA)

CROPS IN THE TRIALS

Different vegetable species and on-farm trials in tomato.

TRIAL SET-UP

- **Locations:** The Horticultural College and Research Institutes research Station in Lower Austria (www.zinsenhof.com) has the size of 1,5 ha, protected area: 1.000 m² (polytunnels, greenhouse) and a third of the area is certified organic.
- **Trial design, number of varieties, replications and years:** Trials have 1 or 2 replication - it is not scientific trials, but very practical oriented trials. Plots have 10-15 plants per variety (fruit vegetables) or 30-40 plants (leafy vegetables); sometimes varieties are tested for 1 or 2 years, but sometime the whole set of varieties changes; all together 400 varieties are tested per year, 150 of them under organic growth conditions. On-farm trials are established in a tomato working group - farmers set up trials as part of the production area. Farmers provide information about yield, resistance and consumers experience and preference.
- **Equipment:** For on-farm trials machinery is from farmers and for on-station trials it is from institute.
- **Assessments:** Yield, agronomic characters, growth ratings; for the tomato working group quality characteristic of fruits (sugar, acid, firmness etc.) are assessed as a part of a Master thesis. Majority of the work focus on the fresh production. Processing is not part of the research focus.

ORGANIZATIONAL STRUCTURE

The Horticultural College and Research Institute is carrying out variety trials on various vegetable species. Every year they also select one focus group vegetable for which they develop specific trials with a lot of different varieties (from gene banks, breeders, seed companies, farmers) and they present result to various stakeholders (growers, traders, chefs, etc.). Focus crop trials can be grown organically or conventionally. Varieties in the trials are selected by The Horticultural College and Research Institute according to the resistance of varieties, the market situation or recommendations from farmers and seed companies (seed companies send the seeds for free). Moreover, the Horticultural College and Research Institute also participate in the tomato working group where different chain actors (10-15 actively involved growers - including organic growers, advisors, other research stations) are involved. The main aim of variety testing in the tomato working group is to find good non-hybrid tomato varieties for organic farmers. Actors from the working group meet 3-4 times a year and they discuss the results, make plans for next year, visit farm trials, etc. The role of organic growers in the working group is to grow different varieties as part of their production. The working group also motivates farmers to develop their own varieties which are better suited to the local climate and their growing conditions. Advisors from Bio Austria, as a main organic advisor company in Austria, is participating as coordinator together with Arche Noah.

DISSEMINATION OF RESULTS



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.



The Horticultural College and Research Institute disseminate their results in the yearly report (available on www.gartenbau.at), at field days, lectures all over the country and abroad (Germany, Switzerland, etc.), in papers for specific agricultural magazines where the main target group is not just farmers but the whole production chain. Moreover, several tasting sessions are organized, hosted by farms, research institutes and a cooking school. Part of the dissemination is also connected to the collaboration with Association City Farm (<https://www.cityfarm.wien/team/>) where they are teaching urban people how to produce their own organic food. For the working group of tomato each institute involved is publishing results in their own newsletters and Arche Noah publish an overview of the yearly results. However, not all results will become publicly available. There is no official recommendation list. Different institutions make their own list and publish it on their webpage or in newsletters.

FINANCIAL MODEL

The Horticultural College and Research Institute is financed by the Ministry of agriculture. Bio Austria and Arche Noah are coordinating the tomato working group and they are getting support from the Ministry of Agriculture for the organization.

Trials at the Arche Noah seed bank

Each year Arche Noah conducts several variety trials in cooperation with organic farmers and research stations. This year together with some organic farmers they set-up on-farm research and breeding in tomatoes, snack peppers, snow and snap peas, vicia faba, brassica oleracea – kale, cichorium. However, they do not have a common protocol for on-farm trials. It always depends on the context (crop, project, research questions, partners etc.). Therefore, an example is given for tomato varieties screening for leaf mould resistance done in 2018. The tomato on-farm network will also continue in 2019. Information was provided by **Philipp Lammer** from ARCHE NOAH.

CROP IN THE TRIAL

Tomato

TRIAL SET-UP

- **Locations:** 2 on-farm locations and one one-station:
Kainbach bei Graz (Styria, organic farm 'Jaklhof')
Nitscha (Styria, organic farm 'Biohof Scharler')
Ruprechtshofen (Lower Austria, research station 'Zinsenhof')
- **Design:**
Kainbach + Nitscha: 20 varieties, 2 replications
Ruprechtshofen: 20 varieties, 1 replication
- **Assessment:** Data collection is done by a student from the University of Kassel (master thesis) - focus on level of leaf mould resistance. Yield evaluation is done by the research station

ORGANIZATIONAL STRUCTURE

Arche Noah together with the working group "Bauernparadeiser" (a participatory tomato breeding initiative) is looking for open-pollinated varieties with partial resistance to *Cladosporium fulvum*. For organic tomato growers the most devastating threat to yield stability is leaf mould (*Passalora fulva*, syn. *Cladosporium fulvum*) as they do not use intensive heating in their polytunnels. They already have shown that there are detectable differences in the resistance level. Now they conduct broader screenings to identify promising cultivars for further breeding work. In very close collaboration with farmers they conducted on-farm screenings in 2016 and 2017. These results have been used to design an in-depth trial with 20 varieties on three locations in 2018. Arche Noah coordinates between locations and researchers. Evaluation work is mostly done by a student from the University of Kassel (master thesis).



DISSEMINATION OF RESULTS

Preliminary results have been published on the project homepage²⁷

Results and implications have been discussed at the annual meeting of the “Bauernparadeiser” working group. Results in detail will be published in the master thesis at the University of Kassel in the next months.

FINANCIAL MODEL

This experiment was part of H2020 Diversifood project²⁸

In 2019 tomato activities are funded by private donors and ARCHE NOAH members.

HUNGARY

ÖMKi had between 2012-2015 on-farm potato variety trials where 22 certified organic farms participated and between 2013-2016 tomato variety trials where 39 organic (both certified and non-certified) farms participated widespread in Hungary. For the potato on-farm trials, ÖMKi’s network coordinator (researcher) selected varieties together with breeders, farmers and retailers. One of the main criteria for potato variety selection was resistance to stress factors (abiotic or biotic). Regarding tomato on-farm trials, varieties were selected from national gene bank of Hungary (NÖDIK), according to the regions where the cooperating farms were located. ÖMKi’s researchers were in regular contact with farmers via phone or email to assist farmers in the establishment and maintenance of the trial, and at the harvest ÖMKi researcher gathered data regarding quality and quantity attributes. ÖMKi then organized annual meetings where all the participants in the network could meet, discuss results and plan the trials for next year. Both the potato and tomato on-farm research ended by 2016, because the best varieties were determined for participating farms and for further research. Now there are scientific research plots in only a few farms and research moved on to product development. Potato and tomato on-farm research was financed by ÖMKi. The farmers participated voluntarily. Information about vegetable on-farm trials at ÖMKi was provided by **Orsolya Papp**.

ITALY

Four years ago, there used to be variety trials in organic vegetables, but there have been no trials in the last three years. Only CREA-ORA (Monsampolo) has a long-term experiment under organic conditions, where trials and breeding for horticultural crops are carried out. CREA-ORA also uses a network of organic farms in different regions of Italy (Veneto, Marche, Basilicata).

Now there are two different initiatives in tomato pre-registration trials. There are trials carried out by CREA-ORA on a MAGIC tomato population created by the seed company ISI-sementi, and trials carried out by RSR/Arcoiris on a population of local varieties created during the SOLIBAM project. The most likely scenario is that the CREA trials will lead to DUS registration for organic, whilst the RSR/Arcoiris trials will lead to registration as Organic Heterogeneous Material (OHM). Registration of OHM is still being defined by EU Commission. In the framework of the LIVESEED project a participatory breeding program in tomato has been initiated in 2018. The objective of the tomato participatory breeding network is to develop tomato cultivars with specific adaptation and farmers preferences under organic conditions. The first two years are used for selection and the third year for performance trials. Interview was done with **Matteo Petitti** and **Riccardo Bocci** from RSR.

²⁷ <http://www.diversifood.eu/workplan-deliverables/>

²⁸ www.diversifood.eu



CROP IN THE TRIALS

Tomato

TRIAL DESIGN

- **Locations:** 4 on-farm and 1 on-station location
- **Number of varieties, replications and years:** single plot of 400 unique plants (population). No controls are used in the first and second year (selection). Controls are planned during the third year for evaluation of results. The experiment will last for 3 seasons.
- **Equipment:** Labour and equipment are provided by farmers, who are compensated for their effort and use of valuable garden space.
- **Assessments:** During field days, through participatory evaluation of each of the 400 plants

ORGANIZATIONAL STRUCTURE

Farmers are the main actors in this network. Farmers are hosting trials and evaluating plants for selection. RSR is moderating and connecting partners in the network.

DISSEMINATION OF RESULTS

Results from the network will be shared with farmers hosting the trials and LIVESEED partners. RSR organize farm days in July/August for tomatoes.

FINANCIAL MODEL

Farmers receive 1000€ per year as compensation for hosting the tomato trials. These costs are covered by the LIVESEED project.

LATVIA

There are no organic vegetable variety trials in Latvia. Farmers are testing/discovering suitable varieties by themselves and are looking for varieties in the offers of different seed companies (abroad – since there are no seed companies in Latvia producing vegetable seeds in reasonable amounts). There is no variety testing for conventional vegetable varieties either. Vegetables production in Latvia is not economically so important for farmers and therefore, there is no financial support for variety testing. Information was received from **Līga Lepse**, Institute of Horticulture, Latvia University of Agriculture.

NETHERLAND

There have been two organic vegetable variety trials, but both were running just for a project period. Spinach variety trials were focused on phenotypic changes of different spinach population varieties and were explored over three years project, from 2007 to 2009, in on-farm trials. Results were presented in a scientific article (Serpola et al. 2011). Onion variety trials were running for 4 years (2001-2004). Commercially available onion cultivars were tested at a certified organic and a non-organic location. Variety research projects were carried out to investigate whether setting up a variety testing system combining conventional and organic variety trials is feasible and efficient rather than organizing separate variety trials under the two management systems. Specific criteria for field evaluation during the growing season were identified with a group of 30 organic onion growers. Post-registration trial in beetroot will be initiated in the framework of the LIVESEED project. Information was given by **Edwin Nuijten** from Louis Bolk Institute.



POLAND

Organic vegetable trials in Poland are organized by the Research Institute of Horticulture in Skierniewice (InHort). Information was provided by **Regina Janas** from the Research Institute of Horticulture.

CROPS IN THE TRIALS

The research concerns the most important species of vegetable plants in Poland: carrots, cabbage, red beet, onion, tomato, cucumber, beans, peas, as well as other: cauliflower, broccoli, radish, garden and Italian fennel, lettuce and others.

TRIAL SETUP

- **Locations:** One on-station trial at the Research Institute of Horticulture in Skierniewice and usually 2-3 on-farm locations when they want to determine how the given variety will behave under different climatic conditions in Poland.
- **Trial design, number of varieties, replications and years:** Trial design highly depends on the species in the trial, but all seeds used for sowing are certified as organic. The experiments are carried out in 3-4 repetitions, at least 2-3 years before the results are put into practice.
- **Equipment:** The Institute uses its own agricultural machinery
- **Assessment:** For different species they assess different traits but the most important are resistance to diseases, abiotic factors (low temperatures and drought) and fertility.

ORGANIZATIONAL STRUCTURE

The Research Institute conducts parallel research for improvement of organic seed production as well as recommendations and testing of varieties useful in organic production of vegetables. They choose varieties from the current variety register, considering resistance to disease, drought, fertility and yield stability.

DISSEMINATION OF RESULTS

The research results are disseminated through trainings organized for seed producers (in Agricultural Advisory Centres), through publications for organic cultivation of particular vegetable species for seeds. The research institute also disseminate results through their website, as well as at scientific conferences and universities in the form of lectures and posters.

FINANCIAL MODEL

The research is financed by the Ministry of Agriculture and Rural Development under the Multiannual Program (5 years) and by a program Research for Organic Agriculture.

PORTUGAL

In Portugal only Living Seeds Sementes Vivas (LSSV) performs organic cultivar trials. The organic market is increasing rapidly, and the consumer demand is higher than production. LSSV is an organic seed company, founded in 2015 and based in Idanha-a-Nova, central Portugal, near to the border of Spain. LSSV produces and processes open pollinated organic and biodynamic seeds of vegetables, fruits, flowers, herbs, quinoa and cereals for a greater biodiversity. Both old and modern material is tested, and 50 percent of the seed come from other countries. LSSV operates its own seed production site of 25 ha in addition to external multiplier fields. Currently LSSV is working with 17 multipliers across Portugal. LSSV and INIAV-BPGV – the gene bank under the research institution of the Ministry of



Agriculture have a cooperation on organic variety trials of seed bank material. Interview was done with **Stefan Doeblin** from LSSV.

CROPS IN THE TRIAL

During winter 2018/19 broccoli, kohlrabi and broad bean were in the organic trials. In summer usually one or two species are tested (e.g. melon and tomato), changing species from year to year.

TRIAL SET-UP

- **Locations:** The trials for the cabbages within the LIVESEED project were performed at two locations: at INIAV and at our location in Idanha-a-Nova. For other variety trials often only one location is used (LSSV site) and sometimes two locations: either the gene bank or the University in Coimbra.
- **Trial design, number of varieties, replications and years:**
Broccoli: randomized block design, 3 replications, 10 varieties, 50 plants each.
Kohlrabi: randomized block design, 2 replications, 6 varieties, 20 plants each.
Trials run for 3 or 4 years.
- **Equipment:** On farm machinery and some specialized equipment
- **Assessment:** Adaptation to biotic and abiotic stress as well as nutrient content, taste, weed competitiveness, uniformity, nutrient content. For quinoa weed, taste, uniformity for harvest, nutrient content.

ORGANIZATIONAL STRUCTURE

The initiators for organic variety trials in Portugal were INIAV-BPGV (the research institution of the Ministry of Agriculture, the gene bank included) and the company Living Seeds - Sementes Vivas (LSSV). LSSV started in 2016 when they made an agreement with the seed bank to improve seed that are stored in the seed bank and to commercialize the seed. LSSV selects and improves the quality of seed bank material. Material that is tested in LSSV is already pre-selected and LSSV prepare the material for registration as conservation varieties. Directorate General for Food and Veterinary (DGAV) use the LSSV trials for the registration procedure. LSSV plan to expand its multiplication sites and distribution channels in Spain as well. LSSV is responsible for the quality control, storage, packaging and distribution of the seeds. LSSV is also working with Polytechnic Institutes like ESAC-IPC (Coimbra), ESACB (Castelo Branco), ESA-IPVC (Ponte de Lima) as well as with INIAV, the Portuguese seed bank. LSSV and the mentioned institutes cooperate to establish trial fields to develop high quality organic and biodynamic seeds, train farmers in organic seed multiplication and to design tools and applied technology for farming and seed processing. LSSV and INIAV, the Portuguese gene bank, are developing a joint plant breeding program aiming to improve the quality of the top traditional crops of Portugal for organic and biodynamic farming. Alongside the Green Valley programme which is supporting organic projects and education development in the Beira Baixa region, the Camara Municipal of Idanha-a-Nova has from the beginning been a strong and active supporter of LSSV. LSSV works with 20 organic farmers that are multiplying the seed. For organic breeding/selection there is 3 locations and the University, the gene bank and breeders are evaluating and setting up the trials, but farmers are not involved in the breeding process. Multiplication is more attractive for farmers as it is commercially interesting. Farmers are not interested in participatory breeding. Main market for LSSV are hobby gardeners, the farmers prefer hybrid varieties and are buying imported seeds. LSSV is working only with open pollinated varieties in the trials to convince farmers otherwise. Interview was done with **Stefan Doeblin** from LSSV.

RESULTS DISSEMINATION

Result will be accessible at the LIVESEED projects webpage. There is no list of recommended varieties for organic farming.



LSSV has also organized model/demonstration farms in 6 regions. Farmers are invited to see what is going on as farmers that have good experience can give more practical advice to other farmers.

FINANCIAL MODEL

LSSV get part of their financial support from the LIVESEED project and a national project CONVINIA. A bigger financial support comes from donations from non-profit associations in Germany and Switzerland.

ROMANIA

At the Vegetable Research and Development Station Buzau (VRDS Buzau) the research and development unit was founded in 1957 and it is part of the scientific coordination of the Academy of Agricultural and Forestry Sciences, "Gheorghe Ionescu-Sisesti" Bucharest, Romania. Information about organic vegetable trials in Romania was sent by **Floarea Burnichi** from VRDS Buzau.

CROPS IN THE TRIALS

VRDS Buzau is testing many species of vegetables, flowers, aromatics, spices and medicinal plants under organic farming systems.

On the organic area the institution produced seedlings and set up vegetable collections and crops of tomato, hot pepper, bell pepper, eggplants, aromatic perennial plants, basil, bean, thyme, onion, zucchini, carrot, parsnip, horseradish, cabbage, okra and flowers.

TRIAL DESIGN

- **Locations:** One on-station location at the Vegetable Research and Development Station Buzau with an area of 2,85 ha of land certified under organic agriculture. Experiments are conducted in the greenhouse and at the open fields.
- **Number of varieties, replications and years:** Randomized block design. Number of varieties in the trials depends on the species and objective of the trial.
- **Equipment:** From the trial station
- **Assessment:** The assessment protocol depends on the species in the trials. In general, they are testing within variety trials specific cropping technologies, different organic fertilizers, diseases and pests, yield stability, etc.

ORGANIZATIONAL STRUCTURE

The experiments are carried out by the research teams of the Physiology and Ecological Laboratory and the Plant Protection and Floriculture Laboratory.

DISSEMINATION OF RESULTS

Results are presented at national and international conferences, in doctoral theses; publications and in a catalogue with presentation of new varieties.

FINANCIAL MODEL

Research is funded by the Ministry of Research, the Ministry of Agriculture, the Ministry of Education, from international projects and projects financed from VRDS Buzau and from testing contracts from various specialized firms.

SPAIN



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.



In Spain there are only very few planned breeding activities from a participatory plant breeding perspective. Apart from the research of seed companies with modern varieties (initially developed for conventional high-input systems) to see which ones adapt better to organic, there is a lack of breeding for adaptation to organic conditions with real agrodiversity (i.e. traditional landraces, heirlooms, ecotypes). Tomato is the main production crop in vegetables and one of the economically most important crops in conventional and organic production in Spain. A network consisting of farmers, farmers organisations, university and seed bank has started an initiative to test landraces of tomatoes in organic in both big and small/pilot trials and pepper on a smaller scale. Interview was done with professor in Genetics and Plant Breeding **Adrian Rodriguez Burruezo** from Universidad Polit cnica de Valencia (UPV).

CROPS IN THE TRIAL

Tomato large variety trials and small-scale trials with pepper were mainly done in Valencia and Andalucia.

TRIAL SET-UP

- **Locations:** There are on-farm trials in 5 locations
- **Trial design, number of varieties, replications and years:** A total of about 300 heirlooms of tomato are evaluated. In the big trials there are three blocks of 10 plants per variety, distributed randomly on the field (i.e. block design). In the small trials, there are only one block of 10-20 plants per variety (about 20 varieties per trial). Testing will be organized for 3 years (spring-summer season): 1-2 years selection of material from 300 cultivars and in the third year there will be a re-testing of the best performing material from the first and second year. There will be between 20 and up to 150 different tomato cultivars tested per location (cultivars: 70% from gene bank and 20% from growers' associations and modern varieties as controls). In the case of Year 1, big trials 130 accessions: Valencia (90) and Cadiz-Andalusia (100), 60 accessions in common. Pilot trials (50 accessions distributed in 3 locations): 20 accessions per location (some accessions in common). For Year 2, 70 new accessions in Valencia and 40 new in Andalusia, as well as 25-30 pre-selected from year 1 (preliminary re-evaluation).
- **Equipment:** UPV will organize logistics of equipment
- **Assessments:** First year farmers will have freedom on evaluation for pests, diseases and quality. Farmers will evaluate plots themselves as they are well experienced in visual disease evaluation and quality evaluation.

The main traits to be evaluated are yield, regional performance, management of cultivar, flavour, shape and colour (also evaluated during the open field days by participants). From analytical methods pH, acid and sugar content will be evaluated. Analyses will be done on-farm and UPV will organize logistics of equipment (e.g. hand refractometer to estimate soluble solids and acids). UPV will take care of nutritional analysis of raw material from the Valencia region and material from other regions will be solved locally.

ORGANIZATIONAL STRUCTURE

The main purpose for this cultivar testing network is to test performance of landraces and ancient heirlooms material under organic condition. The LIVESEED project helped to connect different organizations and financially support part of the activities to test local cultivars in 5 different on-farm locations. The organic growers' association saw it as a very good investment to diversify their cultivation and as a new market potential, as consumers demand new flavours and growers demand quality. Before the LIVESEED project tomato cultivar trials were not well organized and organizations from different regions were not connected and there was no scientific support of the network. The University plays a linking role between grower's associations in different regions and can reach the wider public with information from the research trials. Farmers/associations/agents will be



responsible to provide information on what is important for retailers, restaurants and consumers. Farmers will cultivate tested material as part of their production; and farmers and technicians will maintain and evaluate trials. Researchers from UPV will provide breeding and analytical knowledge for analysing the material and results. UPV is also responsible for multiplication of 80% of material in green houses and 20% farmers will provide seed for themselves or their cooperatives. Processors do not plan to be actively involved yet, as they are planning to work just with raw material.

UPV plans to register landraces (growers' rights protection purpose) on the official list for heritage varieties or conservation varieties after 2 years of evaluation under conventional conditions.

DISSEMINATION OF RESULTS

UPV plan to organize restaurant exhibitions, farmer days, perhaps also TV and newspaper reportage/articles and invite families with children as future consumers. A recommendation list of varieties with pros and cons for each variety will be published.

FINANCIAL MODEL

The network is financed by the LIVESEED project. Farmers are volunteering for the first year but perhaps in the next year they can get some local funds. However, farmers seem to be motivated also to participate after the project, but they wish to find some financial support as otherwise it is hard to keep trials in the long term.

SWITZERLAND

FiBL is performing vegetable variety testing when the funding is available and in some special cases as described below. Information was provided by adviser in vegetable and ornamental crops, **Martin Koller**, from FiBL Switzerland.

CROPS IN THE TRIALS

- Cabbage: looking for cell-fusion free variety
- Screening of old landraces and heirloom varieties together with a NGO

TRIAL SETUP

- **Locations:** Normally on-farm trials are established. Only with species where there is a lot of harvest (esp. fruit vegetable) they establish on-station experiments. Usually trials are limited to just one location because of lack of financial support.
- **Trial design, number of varieties, replications and years:** As they do not have regularly variety testing their variety testing design is always very specific to the certain questions. In general, there is randomized block design with 4 replicates, but according to the aim of the experiments sometimes only 2. Normally one variety is tested only 1 year and 6-8 varieties per location are tested.
- **Equipment/machinery:** The equipment of the farm is used, FiBL does not have own equipment.
- **Assessment:** Staff from FiBL. In on-farm trials visual observations are done together with the farmers and they also discuss the result together. Assessed trait that is very important for organic vegetable growers is disease resistance.

ORGANIZATIONAL STRUCTURE



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.



Staff from FiBL is coordinating, establishing and doing evaluation work. When trials are on-farm, farmers help with the establishment. FiBL will present the trial plan and instruct the farm staff. Farmers will then maintain the trial, but staff from FiBL will do the evaluation and the harvest of plots. The organic vegetable sector is big enough in Switzerland to cover the market demand for organic vegetables during the season. But growers are not interested in systematic variety trials. They get enough information from the seed industry. They ask and support FiBL with small funds to do research in plant protection, as that's much more important for them. Seed companies or retailers are not interested in organic variety trials. Two handbooks have been developed to help conduct experiments for organic horticulture throughout Europe with ideas for simplified trials:

-Setup and Evaluation of Trials on Organic Vegetable Cultivation²⁹

-Guidelines for Experimental Practice in Organic Greenhouse Horticulture³⁰:

DISSEMINATION OF RESULTS

Outcomes from the vegetable variety trial are published in a vegetable journal and are also presented at farmer courses.

FINANCIAL MODEL

Project funding with a specific focus (e.g. heirloom variety). Projects are mostly national but can also be international.

UNITED KINGDOM

Different vegetable crops (21 in total) were tested each year in the National programme which ran from 1991 until 2006. 4-5 crops were tested on two locations per crop each year, with some on research stations and some on-farms, in replicated trials. From 2004-2006, participatory on-farm trials were also carried out with two crops tested per year. Mostly commercially available varieties were tested to give information about variety performance under organic conditions. A steering group with organic seed companies and commercial organic growers guided the choice of crops and varieties in the trials. Evaluation traits were dependent on crop species and growers were consulted regarding which traits would be the most relevant to assess. Farmers participated in the evaluation of varieties in the participatory on-farm trials.

Trials were coordinated by NIAB (plant science organisation), together with HDRA (now Garden Organic), with governmental funding. At the end of the trial period a booklet was published by NIAB, with additional funding from the levy board, and was distributed free to levy payers and sold to other growers and there was a well-attended annual vegetable variety open day each Autumn. There is no recommended list for vegetable crops for either conventional or organic farming. Some seed companies still have demonstration days with organic demo plots but unfortunately, no data is available. Scores of performances were collected by ORC, but were difficult to compare, and has not been done in the last few years.

Since 2006 there has been no systematic independent organic trials, as unfortunately there was no funding available to continue with organic vegetable cultivar trials. It was not possible to find alternative funding for organic vegetable trials due to the small size of the sector. Interview was done with **Phil Sumption**.

DENMARK

²⁹ <http://orgprints.org/9863/> (German)

³⁰ <http://orgprints.org/30599/>



In Denmark there is very few breeding activities for vegetables. There are no systematic organic variety trials in vegetables. Until 2008/2009 there was governmental funding (levy fund) for conventional variety trials in vegetables. Every year there was a certain amount for vegetable variety trials and new suggestions for species to test in the trials. Trials series were running for 2-3 years. But trials were very expensive compared to the small acreage and funding stopped. Since then only project-based variety trials have been performed with testing of new and old varieties - examples are given for trials in carrot, onion and cabbage performed by AgroTech. AgroTech is an institution offering advice, product development and innovation in the food and farming sector. Trials were performed on station and on-farm.

Carrot (2013-2014): First year 6 commercial varieties and 3 old varieties from the gene bank were included in the trials, and the second year 9 commercial varieties and 3 old varieties. Trials were set up at 3 different location with 2-3 replications in the trials. Traits like disease tolerance, yield and quality were assessed.

Onion (2013-2014): 6 commercial varieties and 2 old varieties were tested in an on-station trial with 4 replications and in an on-farm trial with 2 replications. Varieties were cultivated at two different nutrient levels. Assessments like diseases, pests, nutrient use efficiency, yield and quality were made. Nutrient use efficiency was evaluated as nutrient uptake in relation to total yield.

Cabbage (2014-2015): In the screening trials 11 varieties of white cabbage, 9 varieties of pointed cabbage, 5 varieties of red cabbage and 4 varieties of savoy cabbage were tested. Trials were set up as a screening trial at one on-station trial and one on-farm trial with 2 replications. Traits like earliness, diseases and storage ability were assessed.

In open-field days experts and farmers were invited and participants did evaluations of the varieties. Besides from project related activities seed companies do their own trials, and these results are not publicly available. The professional Danish vegetable growers in general do not request national organic variety testing. They make their variety choice based on knowledge from seed suppliers, long-time experience or from own small-scale trials. The production is often very specialised, and they would not get information that would be sufficiently specific for their production in their region on their soil type and their marketing purpose in national variety trials. Interview was done with **Richard De Visser**, HortiAdvice A/A

GERMANY

There are only very few vegetable breeders in Germany and especially organic breeders are few. There are only very few official activities for organic vegetable trials. As an example, the department for Horticulture of the Saxon Office for Environment, Agriculture and Geology are conducting trials under organic condition in spring onions.

Bingenheimer Saatgut AG is marketing exclusively open pollinated varieties of organic seeds and plants. They have close cooperation with seed producers and the Kultursaat association. Kultursaat is a network of biodynamic breeders working on-farm across 25 different places in German speaking countries in EU, with the aim to develop open pollinated plant varieties for organic vegetable growers. Interview for organic vegetable trials in Germany was done with **Gebhard Rossmannith** from Bingenheimer Saatgut AG.

CROPS IN THE TRIAL



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.



Organic open pollinated vegetable varieties

TRIAL SET-UP

- **Locations:** Different stages of variety trials are performed in different locations:
 1. On 2-3 farmers location - testing of candidate for variety development
 2. Professional farmers in different locations in Germany - 2-5 different climatic conditions. Farmers receive the seeds to test developed varieties. Number of locations depend of importance of the crop and knowledge of the crop and if the crop is more sensitive to environmental differences. Bingenheimer experts assess varieties and sometimes it could happen that afterwards additional improvement of the variety is required, or variety is completely rejected.
 3. Testing for official registration
 4. When variety comes to the market, they might also send it for variety test done by governmental institutes that have organic and conventional fields. Bingenheimer give them samples to test varieties and they might do some additional observations in addition to what Bingenheimer did.
- **Number of varieties, replications and years:**

Farmers trials design: trials design depends on the economic importance and knowledge of the tested crop. For example: last year they did a lot of carrot trials as they could not decide if the varieties are enough stabile as wetness/heat of the year highly influenced performance of varieties. They see how many years are needed to have enough information for marketing. Therefore, sowing is done on around 1ha and farmers compare yield with hybrid varieties which is very relevant information for other farmers. When they need to look at more characteristics - like in the case of carrot for fresh consumption (freshness, storage, market requirements, colour, cleaning) they need trials with replications (2 replications are usually done by farmers, plot size 50mx1,5m) and Bingenheimer do the sampling (they select approximately 4 windows to cover as much field heterogeneity as possible). Bingenheimer knows the history and conditions on the farms where they have trials as they collaborate with the same farmers for many years.

Bingenheimer small-plot trials: Where they could make tests also with varieties from other seed companies and more detailed performance variety tests before/in parallel with on-farm tests. However, they work with a farm nearby - a Bioland farm - that has a very good soil and if often used as a first test site.
- **Assessments:** Bingenheimer is working by the biodynamic principle and for this, special tests are made before a variety come to the market - special biodynamic methods for evaluation of inner quality of the variety. These methods are very expensive and are made in parallel with official registration tests or sometimes breeders also do them during the breeding. However, sometimes, they need only yield data but for example in case of carrots for juice - processors are willing to do tests, but they will not be willing to do replications.

ORGANIZATIONAL STRUCTURE

Bingenheimer is in close cooperation with other organic breeding initiatives from Germany (The Kultursaat Association) and other countries. These organic breeding initiatives are doing testing of varieties on 4-5 locations. In parallel Bingenheimer also do trials with varieties under development and collect information from all breeding partners. Kultursaat breeders network have expert groups for each crop separately and Bingenheimer is participating in each of these expert groups. The expert groups decide which breeders will work on the specific crop and on how many on-farm locations the variety that is almost ready will be tested.

DISSEMINATION OF RESULTS



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.



Detailed trial results are only available for the network, but they use information from trials as qualitative variety description. Governmental Institutes that perform variety trials publish results in a Magazine.

FINANCIAL MODEL

Farmers are paid for setting up trials as sometimes they need to take extra work on and Bingenheimer needs a lot of samples for storage tests. Cost for on-farm trials are covered by seed sale.

FRUIT TREES

There is an existing paper from 2010 intending to provide an overview of fruit variety testing programs for organic and low-input farming in Europe (Warlop et al., 2010). In the paper from 2010 there is an overview of countries and key persons involved in cultivar evaluation for organic farming in Europe, a list of species, number of locations, involvement of growers, planting characteristics (number of cultivars, design, duration) and financing³¹.

In this current report only examples from different countries are included mainly to investigate the organizational model of the trials.

FRANCE

In France, there are several types of institutions that are involved in organic fruit cultivar testing: (1) experimental stations/units, such as La Morinière, GRAB, SEFRA, CTIFL Balandran, SudExpé Saint Gilles, CENTREX, La Pugère, SudExpé Marsillargues, ASSOFWI, SENUA, CEFEL, (2) botanical conservatories involved in fruit trees conservation and interested in the assessment for organic farming. There is not a formal national coordination of all these trials. The national network called 'Charte Fruitière' in charge of fruit assessments doesn't include assessment for organic farming. Information on the fruit trials was provided by **Claude-Eric Parveaud** from ITAB.

FRUIT IN THE TRIAL

A number of different fruit species are tested. The most popular are apricot, peach, apple and pear. Other fruits and nuts that are tested are: persimmon, mango, citrus, walnut, almond, sweet cherry, plum.

TRIAL DESIGN

- **Locations:** Most often, trials are set up on-station as experimental plots or as botanical conservation trials. Some trials are set-up on-farm, by experimental station or by organic grower's associations. Informal initiatives to assess cultivars in organic plots are occasionally organised by farmers.
- **Number of varieties, replications and years:** The type of cultivars tested are commercial cultivars (most frequently), patrimonial cultivars (especially in botanical conservatories) and advanced selection. The number of cultivars assessed in the trials is highly diverse between institutions, ranging from 4 to 56, or even up to 984 in case of apple for botanical conservation.

³¹ https://www.ecofruit.net/2014/24SC_Warlop_cultivar_selection_p167-171.pdf

Trials are usually running until projects end, but efforts are done to keep long term observations.

- **Equipment:** Equipment used for plot management, including phytosanitary protection, depend of the institute in charge of trial maintenance, and the purpose of the trial.
- **Assessments:** Cultivar evaluation is depending on the project aim, species and available funds. Most frequently they target pest and disease damages, phenology, fruit bearing, yield, fruit size, fruit quality, pomological description, vigour.

ORGANIZATIONAL STRUCTURE

Even though experiments are usually established on-station, farmers also participate in working groups for the selection of the cultivars regarding fruit tasting or for the identification of the more promising (less susceptible) cultivars.

DISSEMINATION OF RESULTS

Results are disseminated in the form of annual technical reports, leaflets and during the field visits, depending on the responsible institute, local possibilities and funding.

FINANCIAL MODEL

Most of the time, organic fruit cultivar trials are very much linked to available projects funds and there are no perennial cultivar trials under organic farming conditions so far. Most trials are funded through regional or national funds, covering 15% to 100% of the costs, and in some cases the European Agricultural Funds for Rural Development (EAFRD) supports.

GREECE

AEGILOPS has set up a conservation nursery for apples and pears at Kastoria focal point under responsibility of BIOFru organic growers (<http://www.biofru.gr/>). Information on the fruit trials was provided by **Kostas Koutis** and **Sevastiani Liouza** from AEGILOPS.

FRUITS IN THE TRIAL

Conservation nursery for apple and pears

TRIAL SET-UP

- **Locations:** Presently a trial is established in one location at Kastoria focal point under responsibility of BIOFru organic growers (<http://www.biofru.gr/>). Several landraces and rootstocks are being evaluated for performance and adaptability. They are planning to establish a trial also in Volos (Lotus Organic Research Farm) and at Olympus mountain but it depends on funding next year.
- **Number of varieties tested per location, replications and years:** 20 apple, 20 pear and several different rootstocks (commercial, local and wild). Nursery established in 2014. No replications and systematic experimental designs have been applied yet. Every year new varieties are being grafted (accessions), but it usually takes 3-4 years before a new evaluation cycle.
- **Equipment:** From the farm.
- **Assessments:** Evaluation is on graft-rootstock compatibility, insect- disease tolerance, yield performance under organic conditions, fruit quality and shelf life. Evaluation is done by Sevi Liouza and Stefanos Liouzas under the supervision of Kostas Koutis.



ORGANIZATIONAL STRUCTURE

Coordinator of the trial is Sevastiani Liouza (Environmentalist and organic farmer) from BIOFru, Organic Farm (AEGILOPS' Kastoria Focal Point), Vasileiada-Kastoria, Greece. He gets assistance for evaluation and management of the nursery from Stefanos Liouzas (Organic farmer in Kiriaki Liouza). The nursery does not sell seedlings or propagating material yet. Network members of AEGILOPS (fruit growers) can get material from varieties and conserved rootstocks to test performance in their field conditions.

DISSEMINATION OF RESULTS

Results are shared on the websites of AEGILOPS and BIOFru (www.aegilops.gr, www.biofru.gr), on Facebook (AEGILOPS, BIOFru), AEGILOPS Newsletter that is published 3 times per year and at the AEGILOPS Seed Schools that are organized 1-2 times per year.

FINANCIAL MODEL

The fruit nursery and trial In Kastoria focal Point is financed by AEGILOPS based on donation funds and there is also voluntary contribution from fruit growers. Cooperation with the Greek Pomology Institute (HAO Demeter) is under development including future common trials. AEGILOPS hopes that the nursery experiment and testing will continue and be expanded by establishing trials in different locations after the LIVESEED project ends.

POLAND

Organic fruit trials are performed at the Institute of Horticulture (InHort), Skierniewice, Poland. Information about the experiment was provided by **Dorota Kruczyńska** from InHort.

FRUITS IN THE TRIAL

Apple, pear, plum, sweet cherry, sour cherry, small fruit species etc.

TRIAL SET-UP

- **Location:** InHort owns and manages several experimental orchards, two of them have dedicated area for organic trials. In one orchard the main species are apple, covering 30% of the total area. Other species are plum, sweet and sour cherries, small fruits and others. The second experimental orchard is in Dąbrowice, 8 km from Skierniewice. Some organic experiments are located there. Within some projects additional trials are situated in experimental stations and on-farm.
- **Number of varieties tested per location:** The number of varieties depends on the project and ranges from 4 to 12, mainly in the experimental stations. The experiments are usually carried out for 10 years. Each variety is planted in 4 replicates with 3-4 trees per plot.
- **Equipment/machinery:** On experimental stations they have separate equipment for organic production. Their machines are not rented to farmers. If the trial is located at an organic farm, farms have the proper equipment for organic production.
- **Assessment:** Evaluation depends on the topic of research. Usually all aspects related to fruit organic production are considered. This covers cultivar evaluation, nursery production, fruit quality, fertilization, plant protection, fruit storage, post-harvest quality and storage diseases.

ORGANIZATIONAL STRUCTURE

The coordinator of the fruit trials is prof. Elżbieta Rozpara, the head of the Variety Assessment Department. Field trials, on trial stations of InHort and on farms, are conducted by specialists in a given field from the Institute of Horticulture. Additionally, if the trials are carried out on farms, the farmers



take part in workshops during which they are prepared for the assessments. Farmers also get materials to help them make observations and measurements correctly. Scientists conducting organic research actively participate in meetings organized by InHort (www.inhort.pl).

DISSEMINATION OF RESULTS

Results from the trials are shared at workshops and seminars organized by the Institute of Horticulture. Additionally, information is spread at the meetings that are taking place in the experimental orchard during the growing season. The Institute's employees involved in trials for organic production also take an active part in national conferences. The results of the work is also available in the form of brochures, leaflets, books and articles in the professional press.

FINANCIAL MODEL

Cultivar evaluation under organic conditions are financed by the government in the frame of a multi-annual program.

SWITZERLAND

FiBL has been testing organic fruit cultivars on-station for more than 20 years. With apple, as the most produced fruit in Switzerland, there is a well-established network with various stakeholders engaged. Information about the trials was provided by **Friedli Michael** from FiBL Switzerland.

FRUITS IN THE TRIAL

Apple, pear

TRIAL SET-UP

- **Locations:** One FiBL on-station trial for pear and for apple, they have on-station and on-farm trials.
- **Trial design, number of varieties, replications and years:** FiBL first select the varieties and they test on-station 16 trees per variety (2 different treatments and assessment of agronomic and genetic performance) for at least 3 years and then they discuss results within the “organic variety team”. If there is an interesting variety, they do some collaboration to test this variety with around 1500-3000 trees on-farm (3-4 varieties/farms). In the past 5 years they did not change varieties in their on-farm trials. Pear testing is mainly done at FiBL in the on-station trial.
- **Assessments:** Agronomic parameters of the tree, yield, taste, shelf-life etc.; FiBL visits on-farm trials and they have conversations with farmers on what they think about the variety, the resistance/robustness and storability. Just the apple fruits from the FiBL on-station trial are assessed for quality.

ORGANIZATIONAL STRUCTURE

Network of apple cultivar trials consist of breeders (Agroscope, Poma Culta), license holders, organic apple growers, storage keepers, retailers (Coop) and people from nurseries. They meet once per year to discuss the results and make plans for the next years. FiBL is also testing raspberries, strawberries, cherries (in collaboration with the “variety team stone fruits”; feedback to yield, fruit quality etc. is also coming from organic farmers) and most recently apricots. Most young trees FiBL get from conventional nursery, since breeding numbers or newer varieties are mostly not yet available in organic quality.



DISSEMINATION OF RESULTS

Recommendation list of varieties is updated yearly and FiBL also organize different events (e.g. yearly organic fruit meeting, experience exchanges with farmers on an organic farm) where they present the results.

FINANCIAL MODEL

The retailer Coop financially supports apple variety trials at FiBL since a long time. Different projects also financially support the trials. In cooperation with Coop FiBL developed the “flavour group concept” for apples so that consumers do not get attached to the name of variety but to the taste. Now also other retailers use this system and it is mainly used for organic apples.

DENMARK

Organic variety trials in fruits are based on project funding, and therefore there are no continuous trials. From 2016-2018 there were organic variety trials in apple and pear. And there have been previous trials in apple varieties earlier as well. Trials in blackcurrant have been running for several years. There have also been trials in blackberry and sour cherries.

Information was provided by **Hanne Lindhard Pedersen**, Aarhus University.

FRUITS IN THE TRIAL

Apple, (also pear, blackcurrant, blackberries, sour cherries)

TRIAL SETUP (eksample apples)

- **Locations:** One on-station location (Årsløv)
- **Trial design, number of varieties, replications and years:** In apple trials there were 4 replications with 5 trees of each variety in randomized trial design. Trees were planted in 2010 (around 32 varieties) and the best performing 10-12 varieties were tested for three years in 2016-2018
- **Equipment:** From institute
- **Assessments:** Tasting, character for peel, juiciness, hardness, crispness, sugar/acid, aroma and eating quality, yield, storing ability and shelf life.

ORGANIZATIONAL STRUCTURE

Trials are coordinated and performed by Aarhus University; Department of Food Science located at Årsløv until now. The future for organic variety trials is not certain due to relocation of facilities.

In 2010 varieties were collected by Aarhus University from breeders in other countries to find robust varieties suited for Danish climatic and organic conditions. Criteria for choosing varieties were that varieties should be high yielding with good eating quality and with robustness against pests and diseases.

Knowledge about grower's experiences with different varieties was collected from 30 organic plantations during the project.

DISSEMINATION OF RESULTS

Results are disseminated in the Gardeners newsletter (GartnerTidende) and in experience exchange groups. Results are available on-line.



A publication (DCA report nr. 148, 2019) “Frugt og bær - gode sorter til haven” (in Danish) summarizes previous years trial results³².

FINANCIAL MODEL

Organic variety trials were started as part of a research programme, and after the end of this programme trials have been running based on project funding (levy fund). There are no breeding activities for most fruits in Denmark and there are no other funding possibilities.

³² <http://www.havensfrugt.dk/pjecer.html>



V. REFERENCES

1. Andersen R., Bocci R., Howlett S., Pearce B., Dunsire G., Rey F., Nuijten E., Andersen R.T., Pedersen T.M., Miceli F. and Slabe A., 2016. Breeding for diversity–political implications and new pathways for the future.orgprints.org,1-28.
2. Baresel J.P. and Reents H.J. 2006. Observations on long-term wheat variety trials under organic and conventional conditions in Germany. In workshop on Cereal crop diversity: Implications for production and products, 83.
3. European Commission:
(https://ec.europa.eu/food/plant/plant_propagation_material/legislation/review_eu_rules_en)
4. Fontaine L., Rolland B. and Bernicot M.H. 2008. Contribution to organic breeding programmes of wheat variety testing in organic farming in France. 16th IFOAM Organic World Congress, Modena, Italy, June 16-20, 2008.
5. Jamshed S. 2014. Qualitative research method-interviewing and observation. Journal of basic and clinical pharmacy, 5(4), 87.
6. Lammerts van Bueren E.T., Wilbois K.P. and Østergård H. 2007. European perspectives of organic plant breeding and seed production in a genomics era. Journal of Agriculture and Rural development in the Tropics and Subtropics, Supplement 89, 101-120.
7. Lammerts Van Bueren E.L., Struik P.C. and Jacobsen E. 2003. Organic propagation of seed and planting material: an overview of problems and challenges for research. NJAS wageningen journal of life sciences, 51(3), 263-277
8. Le Champion A., Oury F.X., Morlais J.Y., Walczak P., Bataillon P., Gardet O., Gilles S., Pichard A. and Rolland B. 2014. Is low-input management system a good selection environment to screen winter wheat genotypes adapted to organic farming? Euphytica, 199:1-2, 41-56.
9. Leistrumaite A. 2005. In: “Proceedings of the seminar - Environmentally friendly food production system: requirements for plant breeding and seed production”, p. 103-108, eds I. Belicka and M. Viklante (State Stende Plant Breeding Station: Latvia)
10. Löschenberger F., Fleck A., Grausgruber H., Hetzendorfer H., Hof G., Lafferty J., Marn M., Neumayer A., Pfaffinger, G. and Birschtzky J. 2008. Breeding for organic agriculture: the example of winter wheat in Austria. Euphytica, 163(3), 469.
11. Lyon A., Tracy W., Colley M., Culbert P., Mazourek M., Myers J., and Silva E.M. 2019. Adaptability analysis in a participatory variety trial of organic vegetable crops. Renewable Agriculture and Food Systems, 1-17.
12. Murphy K.M., Campbell K.G., Lyon S.R and Jones S.S. 2007. Evidence of varietal adaptation to organic farming systems. Field Crops Research, 102(3), pp.172-177.
13. Nuijten E.H., Janmaat L., Lammerts van Bueren E.T. 2013. New models for plant breeding: Key elements for collaboration within the food chain. Green breeding project.
14. Rolland B., Al Rifai M., Bataillon P., Fontaine L., Gardet O., Oury F.X. 2008. Wheat trials networks for determining characters for organic breeding. Poster at: Cultivating the Future



Based on Science: 2nd Conference of the International Society of Organic Agriculture Research ISOFAR, Modena, Italy, June 18-20, 2008.

15. Willer H., Lernoud J., Huber B. and Sahota A. 2019. The world of organic agriculture. The 20th edition of 'The World of Organic Agriculture', was published by FiBL and IFOAM – Organics International in February 2019.
16. Wolfe M.S., Baresel J.P., Desclaux D., Goldringer I., Hoad S., Kovacs G., Löschenberger F., Miedaner T., Østergård H. and Van Bueren E.L. 2008. Developments in breeding cereals for organic agriculture. *Euphytica*, 163(3), 323

VI. LIST OF TABLES AND GRAPHS

Tables

Table 1: List of interviewed institutions	7
Table 2 Organic variety trials according to the institutes, location and number of experimental sites	9
Table 3 Level of different chain actor's involvement in variety trials.....	10
Table 4 Financial resources in post-registration organic variety trials (arable crops)	11
Table 5 Organic VCU for registration trials in Europe.....	14
Table 6 Level of different chain actor's involvement in variety trials.....	18
Table 7 Financial resources in post-registration organic variety trials (vegetable crops)	19
Table 8 Level of different chain actor's involvement in variety trials (fruit)	22
Table 9 Financial resources in organic variety trials identified in the interviews (fruit crops).....	22
Table 10 Links to trials results in German Federal States	52

Graphs

Graph 1 Arable crops in organic variety trials in 15 EU countries	8
---	---

