AARHUS UNIVERSITY

LIVESEED

Organic Variety Testing

Qualitative content analysis approach to assess organic variety testing, case study of Germany

Master's Thesis

by

Kaja Gutzen

Organic Agriculture and Food Systems

Agrobiology Double Degree

at

Aarhus University

14th of June 2019

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Master's Thesis [30 ECTS] by Kaja Gutzen [201801238]

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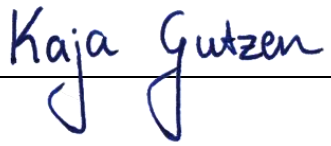

PREFACE

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They say that we not know anything
That we are backwardness
That our head needs changing for a better one
They say that some learned men are saying this about us
These academics who reproduce themselves
In our own lives
What is there on the banks of these rivers, Doctor?
Take out your binoculars
And your spectacles
Look if you can
Five hundred flowers
From five hundred different types of potato
Grow on the terraces
Above abysses
That your eyes don't reach
Those five hundred flowers
Are my brain
My flesh
~ José María Arguedas

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ABBREVIATIONS

AV	Amateur variety
BBCH	*Biologische Bundesanstalt, Bundessortenamt und Chemische Industrie*
BFCA	Breeding for conventional agriculture
BFOA	Breeding for organic agriculture
BSA	*Bundessortenamt* (FPVO)
CA	Conventional agriculture
CV	Conservation variety
CPVO	Community Plant Variety Office
DUS	Distinctness, Uniformity, Stability
E	Environment
EC	European Commission
EU	European Union
FAO	Food and Agriculture Organization of the United States
FPVO	Federal Plant Variety Office
G	Genotype
M	Management
NL	National listing
OA	Organic agriculture
OHM	Organic heterogeneous material
OPB	Organic plant breeding
PBR	Plant breeders' rights
PIAF	Planning, information and evaluation system for field trials (*Planungs-, Informations- und Auswerungssystem für Feldversuche)*
SWOT	Strengths, weaknesses, opportunities, threats
UPOV	International Union for the Protection of New Varieties or Plants
VCU	Value for Cultivation and Use
VRS	*Verrechnungssorten* (three varieties with high importance in cultivation throughout Germany, used as reference varieties in VCU trials and some post-registration trials)

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ABSTRACT

ENGLISH

This research work will contribute to a better understanding of variety testing as a potential barrier to release of organic varieties. The German system of organic registration and post-registration testing of agricultural plant and vegetable species is compared to other systems in EU Member States. Expert interviews with the Federal Plant Variety Office, three coordinators of post-registration trials of Federal State Offices, and seven breeders throughout Germany are qualitatively analysed in order to identify advantages and disadvantages of the existing testing system.

Within this context, the following hypotheses are examined: (1) The definition of "organic varieties suitable for organic production", in the new organic regulation (EU) 2018/848, represents a restriction of varieties available to organic farmers; (2) Variety testing under organic conditions is necessary to identify organic agricultural plant and vegetable species suitable for organic agriculture (OA); (3) Current DUS (distinctness, uniformity, stability) and VCU (value for cultivation and use) protocols are inadequate for assessing organic varieties. Testing criteria need to be adapted to the needs of the organic sector; and (4) EU Member States should strive for harmonised implementation and standardised methods to expand the variety assortment for the organic sector.

(1) The definition for "organic varieties suitable for organic production" leaves freedom for interpretation, and thus, hampers with its uniform implementation throughout the EU.
(2) Variety testing under organic conditions is necessary to identify certain traits in agricultural crops and vegetables which are important for OA. However, unclarity exists regarding the design of organic variety testing and whether organic and conventional trials can be combined in order to more efficiently reach the same conclusion.
(3) Current DUS and VCU protocols are designed for crops with major economic importance and inadequate for minor crops. Alternative registration options are regarded as restrictive and do not offer the possibility of variety protection. Thus, a need is identified to adapt DUS and VCU protocols. Disagreement exists in regard to the way of adaptation.
(4) Throughout the EU, variety testing takes place at different levels of organisational structure and trial design. Standardisation of organic variety testing can improve the quality of testing, and thereby, increasing the volume of organic seeds and adapted varieties. Governmental support of organic breeding and organic variety testing is crucial.

DANISH/DANSK (translated by Tove Mariegaard Pedersen)

Dette forskningsarbejde vil bidrage til en bedre forståelse af sortsafprøvning, som en potentiel barriere i forhold til registrering af økologiske sorter. Det tyske system til registrering og efterprøvning af arter af landbrugsafgrøder og grøntsager til økologi sammenlignes med systemer i andre EU-medlemsstater. Ekspertinterviews med det tyske sortskontor (FPVO), tre koordinatorer for økologiske sortsforsøg fra forbundsstaterne og syv forædlere fra hele Tyskland analyseres kvalitativt for at identificere fordele og ulemper ved det eksisterende afprøvningssystem.

I denne sammenhæng undersøges følgende hypoteser: 1) Definitionen af "økologiske sorter egnet til økologisk produktion" i den nye økologiforordning (EU) 2018/848 udgør en begrænsning af sorter til rådighed for økologiske landmænd; (2) Sortsafprøvning under økologiske forhold i landbrugsafgrøder og grøntsager er nødvendigt for at identificere egenskaber, der er vigtige i økologisk landbrug (OA); (3) Nuværende SES (selvstændighed, ensartethed, stabilitet) og VCU (værdiafprøvning) protokoller er utilstrækkelige til vurdering af økologiske sorter. Test kriterier skal tilpasses til den økologiske sektors behov og (4) EU-medlemsstaterne bør tilstræbe en harmoniseret implementering og standardiserede metoder til at udvide udbuddet af sorter til den økologiske sektor.

(1) Definitionen af "økologiske sorter, der er egnede til økologisk produktion", giver mulighed for fortolkning og hæmmer derved en ensartet implementering i EU.
(2) Sortsafprøvning under økologiske forhold i landbrugsafgrøder og grøntsager er nødvendigt for at identificere visse egenskaber, som er vigtige for OA. Der er imidlertid en vis uklarhed i forhold til design af økologisk sortsafprøvning, og om økologiske og konventionelle forsøg kan kombineres for mere effektivt at nå samme konklusion.
(3) Nuværende SES- og VCU-protokoller er designet til afgrøder med stor økonomisk betydning og er utilstrækkelige til mindre afgrøder. Alternative muligheder for registrering betragtes som restriktive og giver ikke mulighed for sortsbeskyttelse. Der er således identificeret etbehov for at tilpasse SES- og VCU-protokoller. Der er uenighed med hensyn til, hvordan tilpasningen skal ske.
(4) I EU finder sortsafprøvning sted med forskellig organisationsstruktur og forsøgsdesign. Standardisering af økologisk sortsafprøvning kan forbedre kvaliteten af afprøvningen og dermed øge mængden af økologisk frø og tilpassede sorter. Offentlig støtte til økologisk forædling og økologisk afprøvning af sorter er afgørende.

GERMAN/DEUTSCH

Diese Forschungsarbeit soll zu einem besseren Verständnis von Sortenprüfungen, als mögliches Hindernis für die Sortenzulassung von ökologischen Sorten, leisten. Das System der offiziellen Sortenzulassung sowie der Landessortenversuche für Ackerfrüchte und Gemüsesorten in Deutschland wird mit dem System anderer EU-Mitgliedsstaaten verglichen. Experteninterviews mit dem Bundessortenamt, mit drei VersuchsanstellerInnen von Landessortenversuchen und mit sieben Züchtern aus ganz Deutschland werden qualitativ analysiert, um Vor- und Nachteile des bestehenden Prüfsystems zu identifizieren.

In diesem Zusammenhang werden folgende Hypothesen untersucht: (1) Die Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte“, gemäß Verordnung (EU) 2018/848, stellt eine Einschränkung der Sorten dar, die für Öko-Landwirte zugänglich sind; (2) Sortenprüfungen unter ökologischen Bedingungen sind notwendig, um Ackerfrüchte und Gemüsesorten zu identifizieren, die für den Öko-Landbau geeignet sind; (3) Gegenwärtige Register- und Wertprüfungen sind unzureichend um ökologische Sorten zu bewerten. Testkriterien müssen an die Bedürfnisse des ökologischen Sektors angepasst werden und (4) EU-Mitgliedsstaaten sollten eine einheitliche Umsetzung mit standardisierten Methoden anstreben, um die Sortenauswahl für den ökologischen Sektor auszubauen.

(1) Die Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte“ lässt Freiraum zur Interpretation und beeinträchtigt somit ihre einheitliche Umsetzung in der ganzen EU.
(2) Sortenprüfungen unter ökologischen Bedingungen sind notwendig, um bestimmte Merkmale in Ackerfrüchten und Gemüsesorten zu identifizieren, die für den Öko-Landbau wichtig sind. Jedoch besteht Unklarheit bezüglich des Designs von ökologischen Sortenprüfungen und ob ökologische und konventionelle Versuche kombiniert werden können, um das gleiche Ergebnis effizienter zu erreichen.
(3) Gegenwärtige Register- und Wertprüfungen sind für Feldfrüchte konzipiert, die eine große ökonomische Bedeutung haben und sind ungeeignet für kleinere Kulturen. Alternative Zulassungsmöglichkeiten werden als restriktiv angesehen und erlauben keinen Sortenschutz. Dementsprechend kann ein Bedarf an angepassten Register- und Wertprüfungen identifiziert werden. Es bestehen Unstimmigkeiten bezüglich der Art und Weise der Anpassung.
(4) In der EU finden Sortenprüfungen auf unterschiedlicher Ebene, mit unterschiedlicher organisatorischer Struktur und Versuchsdesign statt. Standardisierung der ökologischen Sortenprüfungen kann ihre Qualität verbessern und so die Auswahl an ökologischem Saatgut und angepassten Sorten für den Öko-Landwirt erweitern. Staatliche Unterstützung von ökologischer Züchtung und ökologischen Sortenprüfungen ist wesentlich.

1. INTRODUCTION

Organic agriculture (OA), as defined by IFOAM-Organics International, "is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved" (IFOAM-Organics International, n.d., n.p.). However, agricultural biodiversity, vital for OA, is under threat. In 2019, the Food and Agriculture Organization of the United Nations (FAO) released "The State Of The World's Biodiversity For Food And Agriculture". The report stresses the ambivalent nature of official variety release. On the one hand, the replacement of farmer's varieties and landraces by officially released modern varieties led to a decrease of on-farm diversity and a loss of plant genetic resources stored within farmer's varieties. At the same time, the report recognises that released varieties can contribute to agricultural diversity, if, for example, they are maintained alongside farmer's varieties.

For a variety to be released within the European Union (EU), it has to be listed in the EU common catalogues of varieties of agricultural plant and vegetable species. The EU common catalogues compile information of EU Member State's national lists (2002/53/EC). Candidate varieties need to pass variety testing in which they are tested for Distinctness, Stability and Uniformity (DUS), and in the case of agricultural crops, they are additionally tested for their Value for Cultivation and Use (VCU) (2003/90/EC; 2003/91/EC). Normally, variety testing takes place under conventional conditions and testing criteria are adapted to requirements of the conventional system. As a consequence, if there is no organic variety testing, the release of varieties specifically bred for the organic system might be suppressed and organic farmers cannot identify varieties suitable for their agricultural system (Dawson et al., 2011; Osman et al., 2016). Some EU Member States have started to establish VCU trials for single agricultural crops under organic conditions as a supplement or replacement to conventional VCU testing. Likewise, some EU Member States established organic post-registration trials, in order to test the regional suitability of a variety. Organisation and trial design of organic variety testing differ throughout the EU, for instance, in regard to testing protocols and application fees (Kovács and Pedersen, 2019).

Additionally, organic breeding activities are scarce. The potential market share of organic varieties correlates to the organic share of total farmland in the EU which, in 2017, accounted for 7.2% (FiBL Statistics, 2019). This small market share of organic varieties creates a negative incentive as breeders do not expect a high economic return flow from royalties (Osman et al., 2016). As a result, merely 5% of the varieties used in OA originate from organic breeding programmes. The remaining 95% were bred for the conventional sector which is characterised by high-input conditions to standardise environmental influences. Varieties bred for the conventional sector, on the one hand, might lack traits which are required for the low-input conditions of an organic regime, and, on the other hand, cannot express the traits for which they were bred for (Dawson et al., 2011; Lammerts van Bueren et al., 2011). According to Murphy et al. (2007), poorly adapted varieties contribute to the yield gap between organic and conventional agriculture (CA). In their research work, a highly significant genotype (G) x management (M) interaction in four of five locations indicated that the highest yielding winter wheat varieties under conventional management deviated from the highest yielding

varieties under organic management. On the other hand, Lammerts van Bueren et al. (2012) acknowledges, depending on the species, the evaluated trait and the fertilisation regime, that the ranking of varieties under organic condition can correlate with the ranking under conventional condition. In that respect, the question arises, whether separate organic variety testing is necessary or whether information for the assessment of varieties suitable for OA can be derived from conventional variety testing. Furthermore, there is a lack of clarity and consistency regarding the design of organic variety trials.

Similarly, there is an ongoing debate whether selection of varieties should be conducted directly under organic conditions or indirectly under conventional conditions. Some argue that selection under conventional conditions can be equally efficient due to a high correlation of traits between both systems (Przystalski et al., 2008; Wolfe et al., 2008). Others argue that organic plant breeding is in line with organic principles (IFOAM-Organics International, 2014).

This research work will contribute to a better understanding of variety testing as a barrier to registration and release of organic varieties. The objective is to compare and assess organisation and design of variety trials, as well as the suitability of DUS and VCU criteria for selecting varieties adapted to organic conditions. The testing systems of arable crops, as well as vegetables are included, as there is, especially in organic vegetables, a lack in research, breeding and testing activities. Expert interviews with the German FPVO, coordinators of post-registration trials of Federal State Offices, and breeders throughout Germany are used to examine advantages and disadvantages of the existing testing system. The German variety testing system is compared to other systems throughout the EU, with a special focus on Denmark. Collected data serve to explore the differences between Member States of the EU, with the potential of extending knowledge and disseminating results across countries.

Within this context, the following hypotheses are examined:

(1) The definition of "organic varieties suitable for organic production", in the new organic regulation (EU) 2018/848, represents a restriction of varieties available to organic farmers.
(2) Variety testing under organic conditions is necessary to identify organic agricultural plant and vegetable species suitable for OA.
(3) Current DUS and VCU protocols are inadequate for assessing organic varieties. Testing criteria need to be adapted to the needs of the organic sector.
(4) EU Member States should strive for harmonised implementation and standardised methods to expand the variety assortment for the organic sector.

2. BACKGROUND

2.1. UPOV Convention

As illustrated in Figure 1, the formal and informal breeding and seed sector are imbedded in a system comprised of four interconnected cornerstones: societal and cultural norms and values, policy and governance, science and technology, and market and industry (Lammerts van Bueren et al., 2018). In this master's thesis the cornerstone policy and governance, and its influence on the availability of adapted varieties, is examined. Accordingly, first to deserve mention is the International Union for the Protection of New Varieties or Plants (UPOV) Convention.

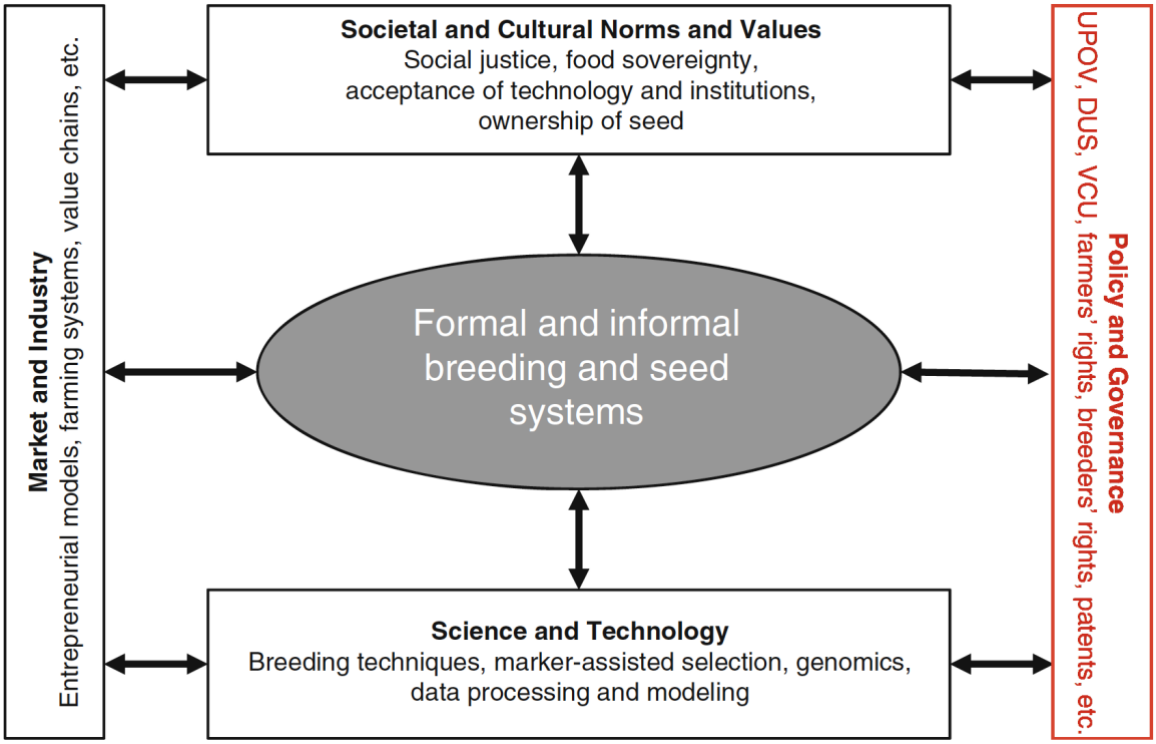

Figure 1: Formal and informal breeding and seed systems embedded in societal and cultural norms and values, policy and governance, science and technology, and market and industry (adapted from Lammerts van Bueren et al., 2018, p.5).

In 1968, the UPOV Convention came into force. The Convention recognises that the act of breeding is a laborious and time-consuming process. In order to make breeding a profitable profession, the outcome of the breeding process, i.e. the variety, requires protection from unlimited reproduction. Thus, the Convention grants plant breeders' rights (PBR). PBR imply that the use of the propagating material of the protected variety requires authorisation of the breeder in regard to:

(i) "production or reproduction (multiplication),
(ii) conditioning for the purpose of propagation,
(iii) offering for sale,
(iv) selling or other marketing,
(v) exporting,
(vi) importing,
(vii) stocking for the purposes mentioned in (i) to (vi), above" (UPOV Convention, Act of 1991, Chapter V, Article 14 (1)).

However, no authorisation is required for:

(i) "acts done privately and for non-commercial purposes […],
(ii) acts done for experimental purposes and
(iii) acts done for the purpose of breeding other varieties […]" (UPOV Convention, Act of 1991, Chapter V, Article 15 (1)).

Since 2005, the EU is accepted as a member of the UPOV Convention (UPOV Convention, 2019). Members have to adhere to the conditions for variety release set up by the Convention. Following UPOV guidelines, a variety must have a suitable denomination, and must be:

(i) "new,
(ii) distinct,
(iii) uniform and
(iv) stable" (UPOV Convention, Act of 1991, Chapter III, Article 5 (1)).

The Convention set up guidance for the species-specific examination of DUS, with the addition that other DUS examinations are acknowledged. Furthermore, the Convention grants the use of testing results done by authorities of other members to facilitate cooperation between members of UPOV (UPOV Convention, 2011). Test guidelines for examination of DUS criteria for 329 crop species can be found on the website of the UPOV Convention. Guidelines entail requirements for the material to be tested, information on the examination method (number of growing cycles, testing place, conditions for conducting the examination, test design, additional tests), the assessment of DUS, grouping of varieties, and organisation of the trial (UPOV Convention, 2017, TG/3/12).

To obtain PBR, a breeder applies for variety testing and provides the seeds which become the so-called definitive seed stock. The definitive seed stock defines the identity of the candidate variety from that point on. It is possible to apply for testing of special features in order to examine a special distinctness. For the assessment of distinctness, the candidate variety is compared to all varieties of the same species in common knowledge (Gilliland, 2010). In practice, a reference collection of example varieties is used to represent common knowledge (UPOV Convention, 2015, TGP/9/2). DUS guidelines have been designed to suit the examination of self-pollinated and hybrid varieties. For the examination of cross-pollinated varieties, the following applies:

> "Cross-pollinated varieties, including mainly cross-pollinated and synthetic varieties, generally exhibit wider variations within the variety than vegetatively propagated or self-pollinated varieties and inbred lines of hybrid varieties, and it is more difficult to determine off-types. Therefore, relative tolerance limits, for the range of variation, are set by comparison with comparable varieties, or types, already known. This means that the candidate variety should not be significantly less uniform than the comparable varieties" (UPOV Convention, 2002, TG/1/3, Chapter 6, 6.4.2, p.20).

2.2. Variety testing in Europe

Varieties which are listed in the EU common catalogues can be legally marketed throughout the EU. The EU common catalogues are a compilation of EU Member State's national lists. In order to be listed, varieties have to display Distinctness, Stability and Uniformity (DUS), and, in the case of agricultural crops, have to show a satisfactory value for cultivation and use (VCU) (2002/53/EC).

The EU common catalogues do not entail a separate section for varieties suitable for OA (cf. EU Plant variety database, European Commission (EC), 2019).

According to 2002/53/EC, a variety is:

- distinct if "it is clearly distinguishable on one or more important characteristics from any other variety known in the Community" (Article 5 (1), L 193/3),
- stable if "it remains true to the description of its essential characteristics" (Article 5 (2), L 193/3), and
- uniform if "apart from a very few aberrations, the plants of which it is composed are, account being taken of the distinctive features of the reproductive systems of the plants, similar or genetically identical as regards the characteristics, taken as a whole, which are considered for this purpose" (Article 5 (3), L 193/3).

In the EU, protocols for DUS testing are based on UPOV test guidelines and CPVO technical protocols (2003/90/EC; 2003/91/EC). The Community Plant Variety Office (CPVO) was established in 1995. The CPVO is an EU agency which creates protocols for the technical examinations of DUS criteria in order to provide "protection with an intellectual property right for new plant varieties" (CPVO, 2019a). Contrary to UPOV test guidelines, the examination of DUS according to the CPVO is regulated in (EC) No 2100/94. The regulation states that "[t]he conduct of any technical examinations shall be in accordance with test guidelines issued by the Administrative Council and any instructions given by the Office" ((EC) No 2100/94, Chapter II, Article 56 (2), L 227/16). The Administrative Council acts as a collaborator between the CPVO, the European Commission and Member States. Technical protocols for examination of DUS criteria for 194 crop species, grouped into four crop sectors (agricultural, ornamental & forestry, fruit and vegetable), are available on the website of the CPVO. Similarly to UPOV guidelines, technical protocols entail requirements for the material to be tested, information on the examination method (number of growing cycles, testing place, conditions for conducting the examination, test design, additional tests, constitution and maintenance of a variety collection), assessment of DUS, grouping of varieties, and organisation of the trial. CPVO protocols build upon UPOV guidelines and, to a large extent, use the same wording (cf. CPVO, 2019b, TP/003/5).

DUS testing adheres to internationally agreed guidelines. In contrast, VCU testing is subordinate to the pedo-climatic, cultural and market-related conditions of the respective EU Member State. As a consequence, for VCU testing, different procedures for different species and regions are implemented (Gilliland, 2010). According to the EU regulation 2002/53/EC, a variety has a satisfactory value for cultivation and use if, "compared to other varieties accepted in the catalogue of the Member State in question, its qualities, taken as a whole, offer, at least as far as production in any given region is concerned, a clear improvement either for cultivation or as regards the uses which can be made of the crops or the products derived therefrom. Where other, superior characteristics are present, individual inferior characteristics may be disregarded" (Article 5 (4), L 193/3). VCU examinations include:

1. "Yield.
2. Resistance to harmful organisms.
3. Behaviour with respect to factors in the physical environment.
4. Quality characteristics" (2003/90/EC, ANNEX III, L 254/10).

In 2017, 12.8 million ha farmland in the EU were organically managed. This corresponds to an increase of 67% compared to 2008 (Willer et al., 2019). Following the increase in the importance of the organic sector and the demand of organic farmers, breeders and organisations, some EU Member States developed supplementary or separate VCU trials under organic conditions. Moreover, some EU Member States developed post-registration trials under organic conditions to assess the regional suitability of a variety.

DUS and VCU requirements can be bypassed by registering varieties as conservation or amateur varieties. Agricultural landraces and varieties can be registered as conservation varieties if the respective variety represents a plant genetic resource valuable to its region of origin. Production and marketing of seeds of a conservation variety are restricted to its region of origin and quantitatively restricted in regard to marketing and sowing (2008/62/EC). Vegetable landraces and varieties can be registered as amateur varieties. Production and marketing of an amateur variety are restricted to its region of origin. The quantity of seed marketed per year is limited to species-specific thresholds listed in Annex I (2009/145/EC). Additionally, there is the possibility of registering plant groupings of certain species as populations. From 2014 to 2018, the European Commission organised a "temporary experiment providing for certain derogations for the marketing of populations of the plant species wheat, barley, oats and maize" (2014/150/EU). The experiment was implemented to examine the suitability of heterogeneous material, such as populations of self-pollinating species for organic and low input agriculture, which do not meet DUS requirements. For release, the population needs to have a denomination and the applicant needs to submit a description of the population's characteristics as well as a representative sample of the population. The quantity of seeds marketed is restricted to "0.1% of seed of the same species produced in that year in the participating Member State" (2014/150/EU, Article 12 (1), L 82/33).

On the 1st of January 2021, the new organic regulation (EU) 2018/848 "on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007" comes into force. The objective of the new organic regulation is, inter alia, to safeguard a high level of agricultural biodiversity. This shall be achieved by using diverse plant reproductive material, i.e. organic varieties suitable for organic production and organic heterogeneous material. In the regulation, "organic variety suitable for organic production" is defined as:

> "a variety as defined in Article 5(2) of Regulation (EC) No 2100/94 which:
>
> (a) is characterised by a high level of genetic and phenotypical diversity between individual reproductive units; and
>
> (b) results from organic breeding activities referred to in point 1.8.4 of Part I of Annex II to this Regulation;" (EU 2018/848, Chapter 1, Article 3 (19), L 150/19).

According to point 1.8.4 of Part I of Annex II, organic breeding activities are defined by certified organic management conditions. Breeding goals include "enhancement of genetic diversity, reliance on natural reproductive ability, as well as agronomic performance, disease resistance and adaptation to diverse local soil and climate conditions" (L 150/58).

“Organic heterogeneous material” is defined as:

> “a plant grouping within a single botanical taxon of the lowest known rank which:
>
> (a) presents common phenotypic characteristics;
> (b) is characterised by a high level of genetic and phenotypic diversity between individual reproductive units, so that that plant grouping is represented by the material as a whole, and not by a small number of units;
> (c) is not a variety within the meaning of Article 5(2) of Council Regulation (EC) No 2100/94;
> (d) is not a mixture of varieties; and
> (e) has been produced in accordance with this Regulation;” (EU 2018/848, Chapter 1, Article 3 (18), L 150/19).

Organic heterogeneous material does not have to meet DUS and VCU criteria, but release requires notification of testing authorities. The concept of organic heterogeneous material, as in (EU) 2018/848, corresponds to the concept of populations, as in 2014/150/EU. The new organic regulation does not specify the crop species and opens the possibility to expand the concept of heterogeneous material to more species than wheat, barley, oats and maize.

Furthermore, new organic regulation opens the possibility for a temporary experiment over the course of seven years, in which adapted testing criteria could be developed (EU 2018/848). Furthermore, the European Union’s funds IFOAM EU’s LIVESEED project as part of the Horizon 2020 research and innovation programme. The project runs from 2017 to 2021 (IFOAM EU, n.d.a). The objective of the project is to strengthen the organic seed and breeding sector. In order to achieve this aim, LIVESEED identifies four challenges:

- “technical difficulties in organic seed production
- inconsistent implementation of EU organic regulation
- lack of transparency regarding the availability and demand of organic seed
- insufficient breeding programs” (IFOAM EU, n.d.b, n.p.).

The project is structured into seven work packages (see Figure 2). Investigation of organic variety testing falls within the scope of work package two on improving variety testing, seed multiplication, and seed health (IFOAM EU, n.d.b). Organic variety trials are considered to be a necessary precondition for developing recommendations of varieties suitable for OA (Kovács and Pedersen, 2018). In the EU, different models for organic post-registration testing and organic VCU testing exist. The report by Kovács and Pedersen (2019) provides an overview on the current organisational models for variety testing for OA in some EU countries. Evaluation of different organisational models will serve to motivate other EU Member States to develop a system for organic variety trials.

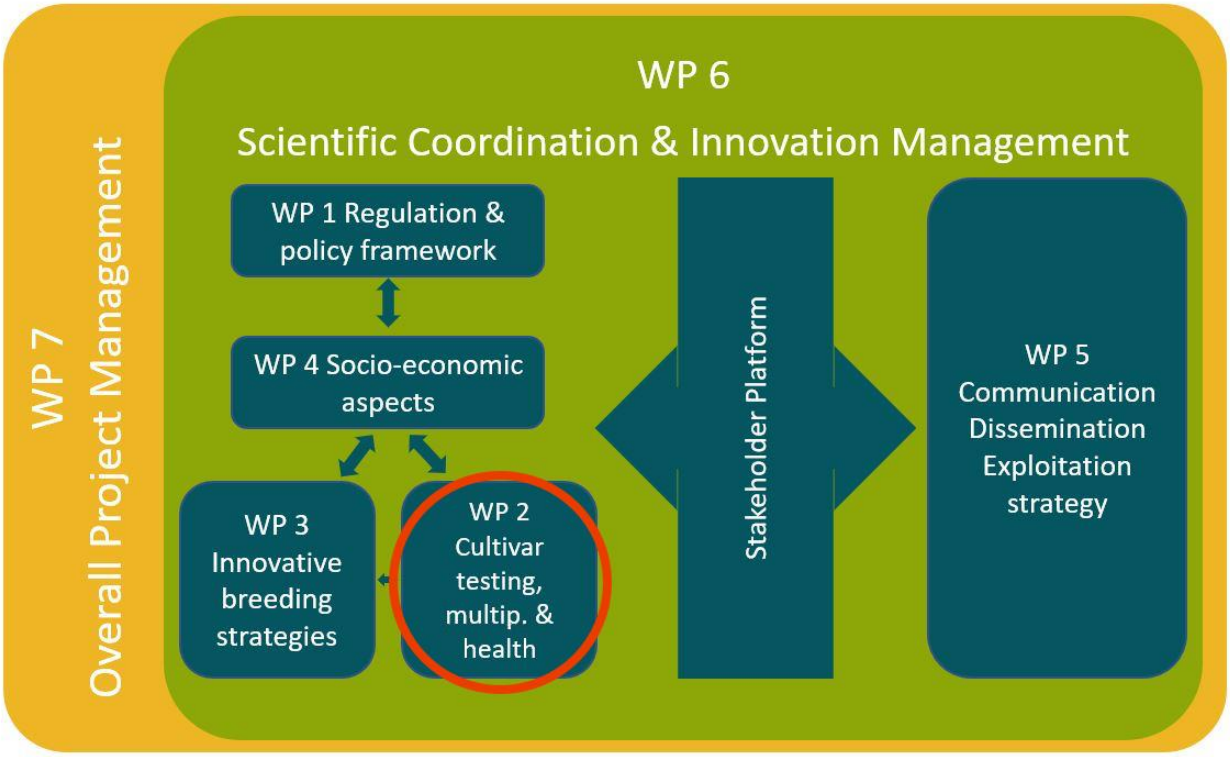

Figure 2: Structure of LIVESEED Work Packages (WP). Organic variety testing falls into WP 2 (indicated by red circle) (adapted from IFOAM EU, n.d.b, n.p.).

2.3. Variety testing in Germany

In Germany, the Federal Plant Variety Office (FPVO, *Bundessortenamt*) is the testing authority for, inter alia, variety release, composing of the national and descriptive variety lists, variety protection on behalf of the CPVO, and monitoring of varieties. For variety release, the FPVO is responsible for conducting DUS and VCU trials. On the website of the FPVO, access to DUS protocols requires a letter of inquiry and one is referred to CPVO's technical protocols. VCU protocols are publicly available without any restriction. VCU protocols for agricultural crops entail general information on the setup of trials and species-specific requirements for assessment of testing criteria (cf. Bundessortenamt, 2000). The VCU protocols for cereals (cf. Bundessortenamt, 2016) and potato (cf. Bundessortenamt, 2019) include special requirements which have to be considered under organic conditions. Table 1 compares testing criteria for conventional and organic VCU testing, using the example of winter wheat (*Triticum aestivum* L.). At the moment, there is no VCU testing with vegetables in Germany. Former VCU protocols for vegetables originate from 1995 and entail general information on the setup of trials and species-specific requirements for assessment of testing criteria of 34 species (cf. Bundessortenamt, 1995).

Table 1: Testing criteria for conventional and organic VCU (value for cultivation and use) testing of winter wheat (*Triticum aestivum* L.). Differences between conventional and organic protocols are marked in red (Bundessortenamt, 2018)

Testing parameter	Conventional	Organic
Agronomic performance		
Ear emergence	X	X
Ripeness	X	X
Plant length	X	X
Ground cover		X
Mass development		X
Winter hardiness	X	X
Risk of lodging	X	X
Density	X	X
Grains per ear	X	X
Thousand kernel weight	X	X
Grain yield	X	X
Susceptibility to diseases		
Pseudocercospora	X	X
Powdery mildew (*Blumeria graminis)*	X	X
Septoria tritici blotch (*Zymoseptoria tritici)*	X	X
Drechslera tritici-repentis	X	X
Yellow rust (*Puccinia striiformis)*	X	X
Brown rust (*Puccinia triticina*)	X	X
Fusarium head blight	X	X
Phaeosphaeria nodorum	X	X
Quality values		
Falling number	X	X
Stability of falling number	X	X
Crude protein content	X	X
Gluten content		X
Sedimentation value	X	X
Traction	X	X
Water absorption	X	X
Ash content	X	X
Flour yield	X	X
Loaf volume	X	X
Dough elasticity	X	X
Dough surface	X	X
Quality grade	X	X

On behalf of the FPVO, Federal State Offices conduct organic VCU testing. Additionally, Federal State Offices conduct post-registration trials with registered varieties to test their regional performance under organic conditions. Post-registration trials comply with VCU protocols. The number of varieties included in organic variety testing is usually lower than the number of varieties included in conventional variety testing (Baresel and Reents, 2006). In order to give regional recommendations for varieties to farmers, Germany is segmented into crop-specific cultivation areas with similar pedo-climatic conditions. On the basis of these cultivation areas, inter alia, field trials for variety testing are organised throughout Germany (see Figure 3).

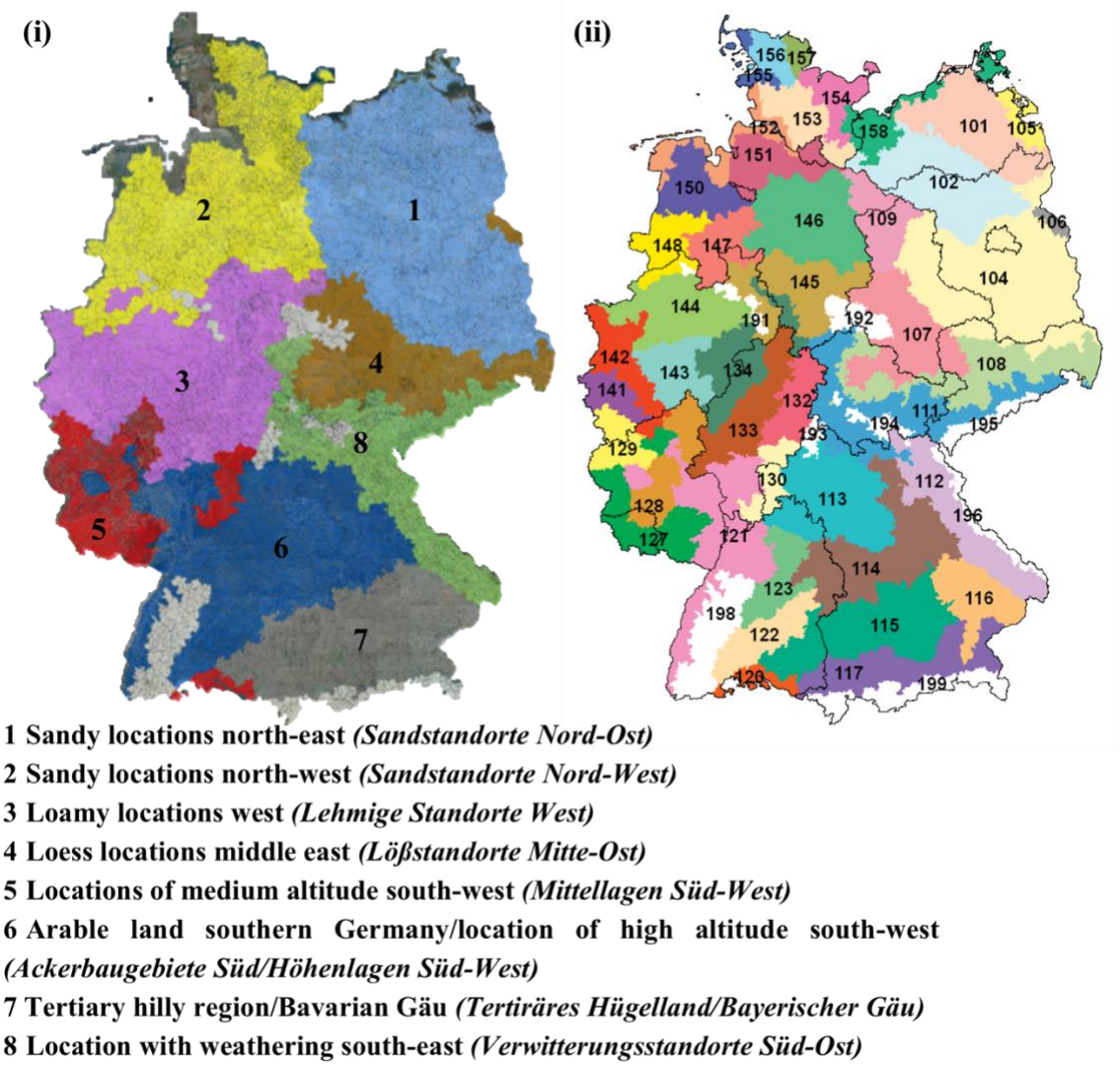

Figure 3: (i) Division of Germany into crop-specific cultivation areas (representatively for winter wheat) with similar pedo-climatic conditions for field trials under organic conditions (JKI, n.d.; own translation). (ii) Division of Germany into regions with similar pedo-climatic conditions. Numbers represent designation of pedo-climatic regions (not illustrated here) (Roßberg et al., 2007, p.159).

2.4. Definitions

In the context of this master's thesis, the terms BFCA, BFOA and OPB by Wolfe et al. (2008) have been adapted. Wolfe et al. (2008) identify three different breeding approaches for varieties used in OA. The most common approach is breeding for conventional agriculture (BFCA) in which varieties are bred under conventional conditions. Normally, varieties are bred for the global market, for wide adaptation and for a high level of uniformity. Organic farmers have to test the variety themselves for its suitability for OA under their on-farm conditions. Breeding for organic agriculture (BFOA) takes place within conventional organisations. In first generations, selection of traits with a high correlation between OA and CA takes place under conventional conditions. Selection of latter generations is conducted under organic conditions in order to test the suitability for OA. Varieties can be bred for global or regional markets, and wide or local adaptation. Organic plant breeding (OPB) takes place

within organic organisations and all breeding steps are conducted under certified organic conditions. Normally, varieties are bred for regional or local markets, as well as local adaptation.

The term “organic variety testing” refers to official variety trials which are conducted under certified organic conditions. Subcategories of organic variety testing are pre-registration testing, registration testing and post-registration testing. Pre- and post-registration trials can be conducted officially by testing authorities or unofficially by breeders, farmers or seed companies. Registration testing is conducted by testing authorities for the purpose of variety registration and release. Registration testing encompasses DUS and, in the case of agricultural crops, VCU testing. Within the scope of this master’s thesis, focus is put on registration testing and post-registration testing, conducted officially by testing authorities.

The term “organic variety” refers to a variety which originates from OPB. The term “variety suitable for OA” refers to a variety which, regardless of its breeding history, has been tested for its suitability in official organic VCU and/or organic-post registration trials. The term “candidate variety” refers to plant reproductive material prior to variety registration and release. In line with IFOAM norms (IFOAM-Organics International, 2014), the term “organic seeds” refers to seeds which have been multiplied under certified organic conditions for at least one generation.

Figure 4 visualises the plant reproductive material available to organic and conventional farmers and their respective breeding, testing, and seed multiplication history. In the current testing system, organic farmers have access to conservation and amateur varieties, organic heterogeneous material (wheat, barley, oats and maize), and varieties originating from BFCA, BFOA and OPB. All varieties, regardless of their breeding history, have the possibility to be tested in organic variety trials.

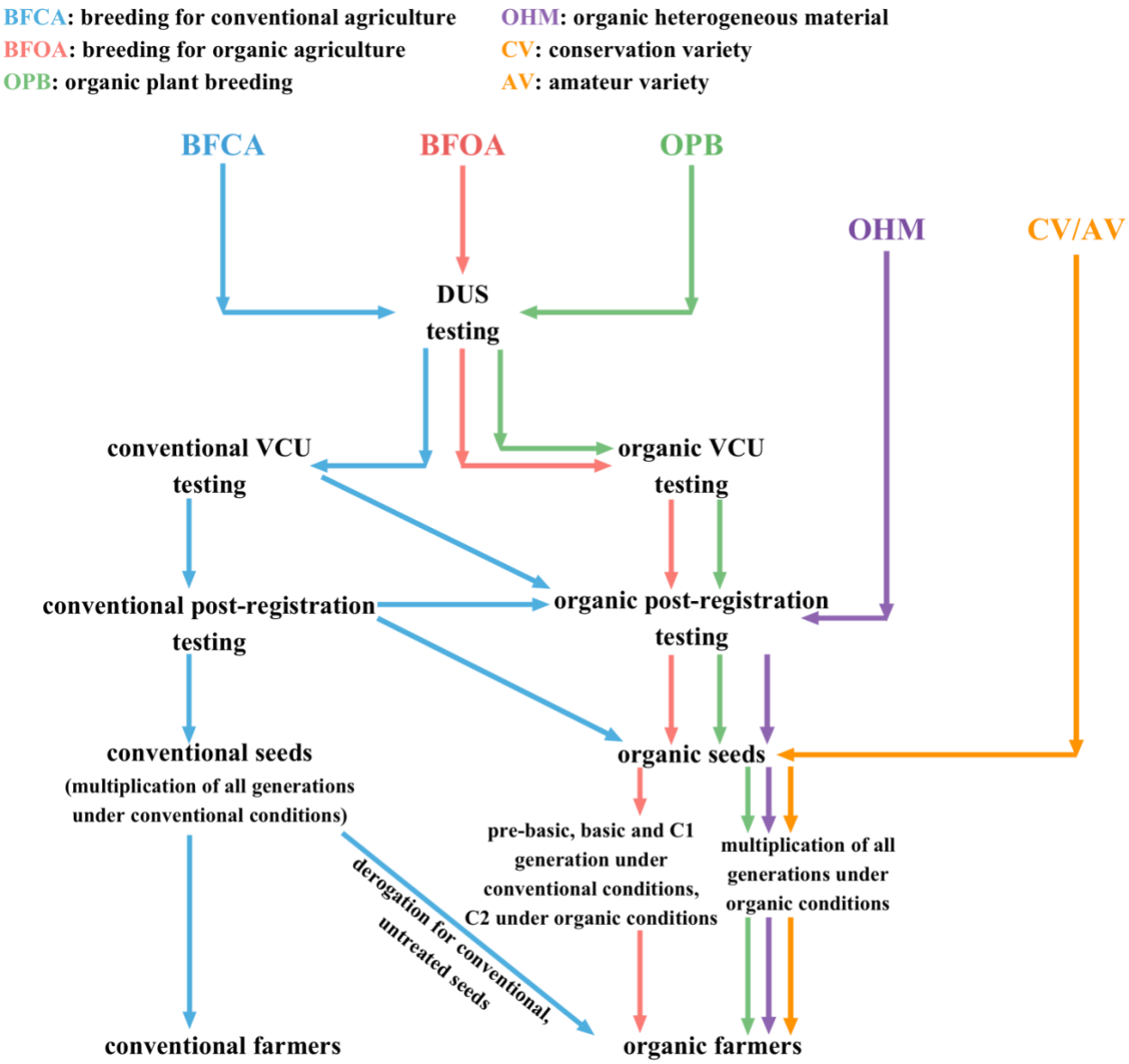

Figure 4: Differentiation between breeding for conventional agriculture (BFCA), breeding for organic agriculture (BFOA) and organic plant breeding (OPB) with respective testing procedure, seed multiplication and target group. Integration of organic heterogeneous material (OHM), conservation varieties (CV) and amateur varieties (AV) in testing procedure and seed multiplication, respectively. Note that only agricultural crops are included in VCU (value for cultivation and use) testing and not all varieties which pass DUS (distinctness, uniformity, stability) and VCU testing are included in post-registration testing. Additionally, according to (EU) 2018/848, the option for derogation for the use of conventional, untreated seeds in organic agriculture phases out on 1st of January 2028.

3. METHODOLOGY

To investigate the proposed hypotheses, the German variety testing system was analysed and compared to other systems in the EU, with special focus on Denmark, with the help of interviews and literature research. The underlying population was divided into three subpopulations in order to represent different interest groups of organic variety testing: persons responsible for organic registration testing, organic post-registration testing, and breeding. No exact numbers for the size of the subpopulations are available, but sampling is restricted by the number of respective institutions. In Germany, the FPVO is responsible for registration testing by conducting DUS trials and ordering VCU trials. Coordinators of 12 Federal State Offices are responsible for post-registration testing (see Table 11 in ANNEX) and, on behalf of the FPVO, organic VCU testing. Selection criteria for the subpopulation of breeders, and representatives of breeding companies and organisations was to include different breeding conditions (breeding under organic, biodynamic and conventional conditions) and the use of different registration procedures (varieties for national listing, organic heterogeneous material, conservation varieties and amateur varieties). Table 2 gives an overview of the number of recruited and interviewed experts as well as the material collected. For the full list of recruited interview partners see Table 3. Figure 5 illustrates the distribution of interview partners throughout Germany, indicating that the sample selection is representative for different pedo-climatic regions.

Interviews were analysed using qualitative content analysis in an inductive approach. Qualitative content analysis is "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh and Shannon, 2005, p.1278). Qualitative content analysis can be conducted in an inductive, deductive or abductive approach. In an inductive approach, "the researcher moves from the data to a theoretical understanding – from the concrete and specific to the abstract and general" (Graneheim et al., 2017, p.30). In a deductive approach, the researcher "move[s] from a more abstract and general level to a more concrete and specific one" (p.30). In an abductive approach, the researcher uses a combination of an inductive and deductive approach. Elo et al. (2013) recommend using an inductive approach "when the aim is to form a theory on a subject on which little information is available, if the information is fragmentary, or if the aim is to find a new viewpoint on the subject." (p.1). In an inductive approach, specific data are used to form a broader, more general overview (Elo and Kyngäs, 2008). Accordingly, the data collected within this master's thesis represent the starting point to develop guidelines for organic variety testing and regulations within the EU. The interviews are based on expert knowledge of which only fragmented scientific research exists. Within the LIVESEED project, information throughout the EU are gathered to form a theory on how to strengthen organic seeds and adapted varieties within the new organic EU regulation (EU) 2018/848.

The inductive qualitative content analysis is structured into a preparation, organising and reporting phase (Elo and Kyngäs, 2008). In the preparation phase, the interviews were prepared, conducted and transcribed. In the organising phase, with the help of MAXQDA Analytics Pro 12 ©, a category system was developed by coding interview transcripts, grouping codes into categories, and thereby, abstracting the qualitative content. The aim of this process is to classify categories which illustrate coherences or differences among the interviews, and which allow drawing of a conclusion regarding

the hypotheses (Cavanagh, 1997). In the reporting phase, the categories were discussed and compared with literature and data collected within the LIVESEED project, in order to revise proposed hypotheses (cf. Elo and Kyngäs, 2008).

To guarantee trustworthiness of the method following measurements were implemented: Questionnaire for interviews were send to the experts prior to the interview. During the interview, the order of questions was adapted to the expert's answers. Interviews were transcribed using recordings and notes. The interview transcripts were sent to the interview partners for verification. All interview partners were given the chance to rethink and rephrase their answers. Transcripts of expert interviews in German and English translation can be found in the ANNEX. Categorisation took place by forming sub-codes, which were compiled into more generic codes and further into main categories (cf. Elo and Kyngäs, 2008). In an iterative process, the final main categories were revised and validated by supervisors. To ensure representativeness of interviews, the sampling size was determined by saturation, i.e. replication of codes within main categories (cf. Elo et al., 2014). In each round of revision, reliability and validity of the category system were assessed. Reliability refers to the stability of the categories over time by the same researcher and reproducibility of the categories by other researchers. Validity refers to how well the codes are represented by the main category (Cavanagh, 1997). To further guarantee objectivity, quotations are used to represent the link between collected data and analysis. Visualisations are used to represent the link between codes, categories and analysis (cf. Elo et al., 2014; cf. Graneheim et al., 2017). Unless otherwise specified, all information under results (see chapter 4), are provided by interviewees.

In the discussion part (see chapter 5), the analysed data is reviewed on the basis of scientific literature, data collected within the LIVESEED project, data collected within COST Action 860 – SUSVAR, and an expert interview conducted with Gerhard DENEKEN, administrative manager at TystofteFonden. TystofteFonden is the Danish testing authority for coordinating variety testing of arable crops and grasses and for implementing official trials for examination of DUS and VCU criteria (TystofteFonden, n.d.). For the transcript of the interview with DENEKEN, see Table 12 in ANNEX.

For literature research, the databases Web of Science and ECO-PB were used. Keywords included "organic agriculture", "'organic variety testing' OR 'organic variety trials'", "'organic breeding' OR 'organic plant breeding'", "'organic seed regulation' OR 'organic seed legislation'", and "EU regulation". For designing and editing of figures, Pixelmator Version 3.8.2 Phoenix © was used.

Table 2: Number of recruited and interviewed experts of respective subpopulations, as well as type of collected qualitative data.

Subpopulation	Recruited	Interviewed	Response rate	Material
Organic registration testing (FPVO)	1	1	100%	Mail-based statement, conducted in November 2018
Organic post-registration testing (Coordinators)	12	3	25%	Interview per phone call, conducted in February/March 2019
Breeding (Cereal and vegetable breeders)	10	7	70%	Interview per phone call (6) and mail (1), conducted in February/March 2019

Table 3: List of interview partners grouped by subpopulations of persons responsible in organic registration testing, organic post-registration testing, and breeding.

NAME, surname	Contact details
Registration testing	
SCHNOCK, Uta	Head of Section for VCU Testing and Descriptive Variety List Federal Plant Variety Office (*Bundessortenamt*) Osterfelddamm 80, 30627 Hannover, Lower Saxony Phone: +49 0511 9566 5655 Mail: Uta.Schnock@bundessortenamt.de URL: www.bundessortenamt.de
Post-registration testing	
KARALUS Dr., Wolfgang	Department for seed registration and variety trials (*Referat 94 Saatenanerkennung, Sortenprüfung*) Saxon State Office for Environment, Agriculture and Geology (*Sächsisches Landesamt für Umwelt, Landwirtschaft und Geology*) Waldheimer Str. 219, 01683 Nossen, Saxony Phone: +49 35242 631 7205 Mail: Wolfgang.Karalus@smul.sachsen.de URL: www.smul.sachsen.de/lfulg
URBATZKA Dr., Peer	Institute for Organic Farming, Soil and Resource Management (*Institut für Ökologischen Landbau, Bodenkultur und Ressourcenschutz*) Bavarian State Research Centre for Agriculture (*Bayerische Landesanstalt für Landwirtschaft*) Lange Point 12, 85354 Freising, Bavaria Phone: +49 08161 71 4475 Mail: peer.urbatzka@lfl.bayern.de URL: https://www.lfl.bayern.de/iab/index.php
WEGNER, Carolina	Department for arable and plant production (*Sachgebiet Acker- und Pflanzenbau*) Institute for organic agriculture (*Fachgebiet ökologischer Landbau*) State Research Institute for Agriculture and Fishery (*Landesforschungsanstalt für Landwirtschaft und Fischerei*) Dorfplatz 1, 18276 Gülzow, Mecklenburg-Western Pomerania Phone: +49 03843 789 233 Mail: c.wegner@lfa.mvnet.de URL: https://www.lfamv.de
Breeding	
FLECK, Michael	Management Kultursaat e.V. Kronstraße 24, 61209 Echzell, Hesse Phone: +49 60 35 20 80 97 Mail: michael.fleck@kultursaat.org URL: www.kultursaat.org
HEYDEN Dr., Bertold	Keyserlingk-Institut Rimpertsweiler 3, 88682 Salem, Baden-Wuerttemberg Phone: +49 07544 71371 Mail: bheyden@saatgut-forschung.de URL: www.saatgut-forschung.de
KÖRBER Dr., Niklas	Lead Breeder HILD samen GmbH Kirchenweinbergstr. 115, 71672 Marbach, Baden-Wuerttemberg URL: www.hildsamen.de
MÜLLER Dr., Karl-Josef	Cultivari Getreidezüchtungsforschung Darzau gGmbH Hof Darzau 1, 29490 Neu Darchau, Lower Saxony Phone: +49 5853 98098 11 Mail: k-j.mueller@cultivari.de URL: https://www.cultivari.de
ROSSMANITH, Gebhard	Chief executive officer Bingenheimer Saatgut AG Kronstraße 24, 61209 Echzell, Hesse Phone: +49 6035 1899 15 Mail: Gebhard.Rossmanith@bingenheimersaatgut.de URL: www.bingenheimersaatgut.de
SPIEß Dr., Hartmut	Research & Breeding LBS Dottenfelderhof e.V. Holzhausenweg 7, 61118 Bad Vilbel, Hesse Phone: +49 6101 6385 Mail: h.spiess@dottenfelderhof.de URL: www.forschung-dottenfelderhof.de
WATSCHONG, Ludwig	Demeter-Saatgutbetrieb Ludwig Watschong / Dreschflegel e.V. Ahornweg 6, 34399 Oberweser-Arenborn, Hesse Phone: +49 5574 1345 Mail: ludwig.watschong@gmx.de URL: www.alte-kulturpflanzen.de / https://www.dreschflegel-saatgut.de/hoefe/arenborn/

1 Federal Plant Variety Office (Schnock)
2 Saxon State Office for Environment, Agriculture and Geology (Karalus)
3 Institute for Organic Farming, Soil and Resource Management (Urbatzka)
4 State Research Institute for Agriculture and Fishery (Wegner)
5 Kultursaat e.V. (Fleck)
6 Keyserlingk-Institut (Heyden)
7 HILD samen GmbH (Körber)
8 Cultivari Getreidezüchtungsforschung Darzau gGmbH (Müller)
9 Bingenheimer Saatgut AG (Rossmanith)
10 LBS Dottenfelderhof e.V. (Spieß)
11 Demeter seed company/Dreschflegel e.V. (Watschong)

Figure 5: Location of interview partners throughout Germany (adapted from Google Maps, 2019).

4. RESULTS

4.1. Category system

Figure 6 and Figure 7 visualise the category system using Category-Code Model and Code Matrix, respectively. The Category-Code Model (see Figure 6) arranges the six main categories (EU definition of organic varieties, breeding, DUS, VCU, post-registration testing, alternative registration) and respective codes in a circle around the main icon of organic variety testing. Main icon, categories and codes are connected by non-directional lines (MAXQDA, 2019a). Here, the Category-Code Model is used to illustrate the structure of the qualitative content analysis. Firstly, experts are asked for their opinion about both subpoints of the definition of "organic varieties suitable for organic production" according to the new organic regulation (EU) 2018/848 (see chapter 4.1). Secondly, breeders are questioned about their breeding material and breeding goals (see chapter 4.2). In the ensuing chapters, experts report about registration testing involving DUS and VCU testing, as well as post-registration testing (see chapters 4.3, 4.4 and 4.5). These chapters are subdivided into organisation, design, and testing criteria. The subchapter organisation entails information on actors involved, equipment, financing of trials, communication, data exchange and dissemination of results. In the subchapter design, focus is put on location of trials, statistical evaluation, criteria for variety assortment, choice of reference varieties, and origin of seeds. In the subchapter testing criteria, experts are asked about their issues with the current system and possibilities for adaptation to OA. The last chapter looks at alternative registration options (see chapter 4.6).

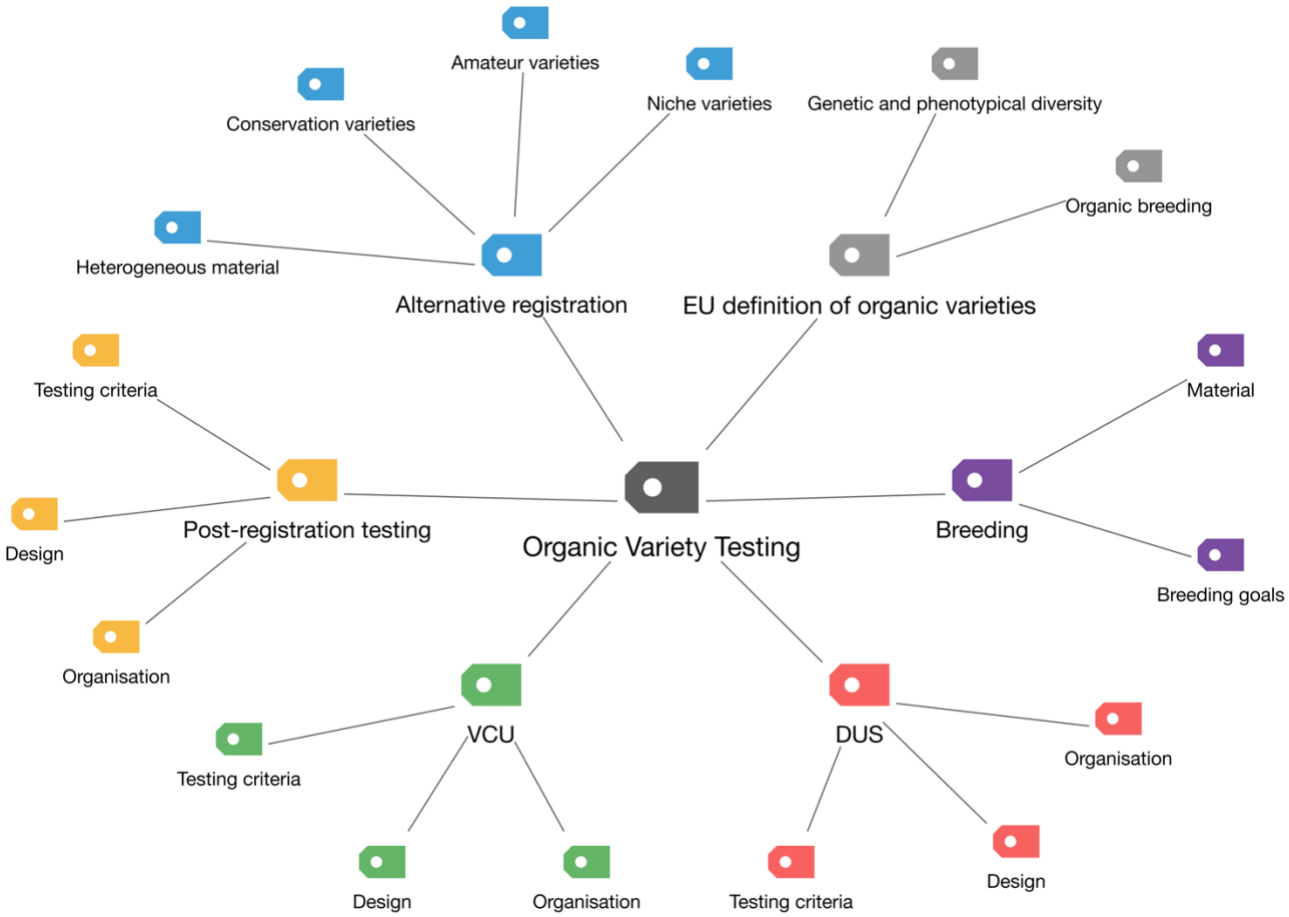

Figure 6: Category system displayed as Category-Code-Model.

The Code Matrix (see Figure 7) arranges experts, categories, and codes in columns and rows, respectively. If the expert interview entails the respective code, the intersection of row and column is marked by a node. Codes are grouped into six categories. The size of the nodes symbolises the number of document segments assigned to the respective category and code. The sum represents the number of segments per expert (column) or per category and code (row) (MAXQDA, 2019b). It should be noted, that the frequency of segments (size of nodes) is influenced by the questionnaire and only provides limited information. Here, the Code Matrix is used to display the saturation and completeness of qualitative data sampling. Each category is used by the experts and the pattern of nodes shows a certain uniformity among subpopulations of persons responsible in organic registration testing, organic post-registration testing, and breeding. Additionally, the Code Matrix illustrates that trials conducted by FPVO and Federal States Offices is closely connected through VCU testing, which Federal State Offices conduct on behalf of the FPVO. The FPVO provides information on post-registration testing and Federal State Offices provide information on registration testing. Consequently, as the organisation of both trials is connected, some of the expert's statement could not clearly be assigned to VCU or post-registration testing.

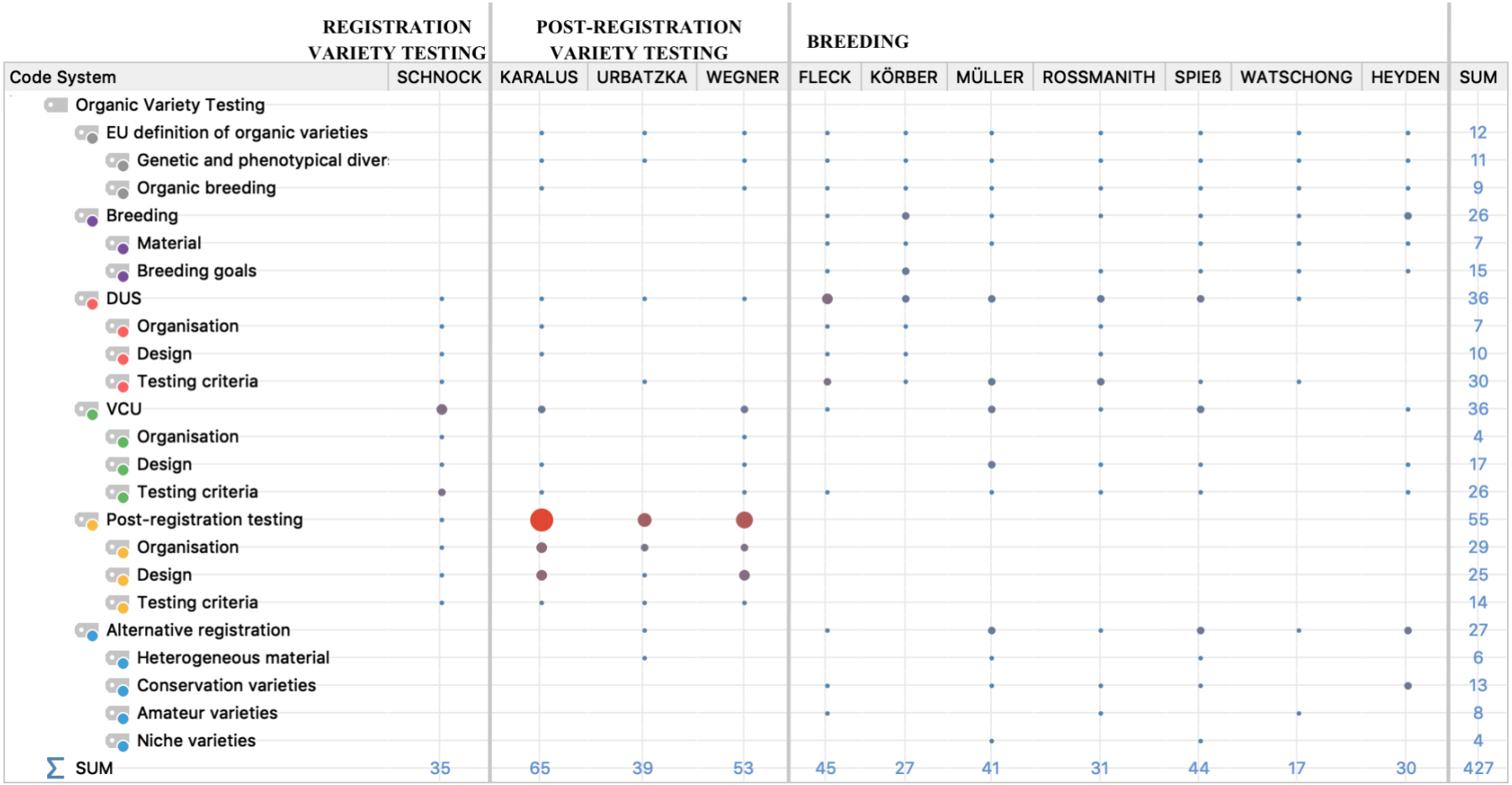

Figure 7: Category system displayed as Code Matrix. The size of the nodes symbolises the number of document segments assigned to the respective category and code. The sum represents the number of segments per expert (column) or per code (row).

4.1. EU definition of "organic varieties suitable for organic production"

4.1.1. Genetic and phenotypical diversity

According to the new organic regulation (EU) 2018/848 organic varieties suitable for organic production are characterised by a high level of genetic and phenotypical diversity.

Coordinators*:* Coordinators of post-registration testing associate populations with this subpoint of the definition. URBATZKA acknowledges that varieties intended for national listing, entail a high level of genetic diversity, since they originate from various parental lines:

> *"Genetic diversity can be understood twofold. On the one hand, a variety has a genetic diversity, because it was selected from various varieties. On the other hand, populations have a genetic diversity and, thus, they might be more adaptable"* (URBATZKA, coordinator).

According to KARALUS, regardless of the level of diversity, varieties with improved characteristics such as yield, quality, winter hardiness, low risk of lodging, weed competitiveness and resistances are needed for OA.

Breeders: Breeders agree with coordinators, that this subpoint of the definition uses the same wording as for the definition of organic heterogeneous material. Thus, they request a clarification of the definition. On the one hand, breeders agree that a high level of genetic and phenotypical diversity can have advantages in OA such as robustness against diseases and adaptability to the conditions of the farm. On the other hand, the demand for a high level of genetic and phenotypical diversity contradicts with the DUS system:

> *"A phenotypical diversity does not define a variety. A variety has to be uniform at a sufficient level and within this uniformity has to be distinct and stable. These are the standard DUS criteria. […] These criteria are also in the interest of the customer"* (ROSSMANITH, organic vegetable breeder).

If the definition is taken literally, varieties which adhere to DUS criteria would be excluded from OA. Especially in the case of self-pollinators, it is difficult to reach a high level of heterogeneity.

> *"The definition can only be applied for cross-pollinators, but even here, heterogeneity should be an option for variety registration and not an obligation or precondition to obtain the label 'organic variety'. […] an organic variety does not necessarily need an intrinsic high degree of genetic and phenotypical diversity, to see a great manifoldness on-field."* (FLECK, organic vegetable breeder).

Nevertheless, there is a certain consent among the breeders that the strict regulation of homogeneity should be reduced. MÜLLER summarises:

> *"To force diversity is as impractical as exclusion of diversity"* (MÜLLER, organic cereal breeder).

4.1.2. Organic breeding

According to the new organic regulation (EU) 2018/848 organic varieties suitable for organic production should stem from organic breeding activities in which all generations are managed under certified organic conditions.

Coordinators: Coordinators of post-registration testing regard this subpoint of the definition as a restriction to variety choice. A major share of the varieties tested in organic post-registration trials originates from BFCA. WEGNER acknowledges that some breeding goals might differ between organic and conventional breeding programmes. Nevertheless, coordinators experienced that varieties originating from BFCA display traits which are of interest to organic farmers. Thus, coordinators agree that, instead of regulating the breeding history, propagation of seeds used in OA should be mandatorily conducted under organic conditions.

> *"The definition is ok but should not result in the sole use of varieties from organic breeding. This restriction would be too large, because there are good varieties from conventional breeding. Both forms of breeding are legitimate. Solely propagation of organic varieties should be conducted under organic conditions"* (KARALUS, coordinator).

Breeders: Breeders who conduct their activities under organic or biodynamic conditions agree that organic varieties should originate from OPB. ROSSMANITH appreciates that this subpoint of the definition goes in line with the principles of OA as postulated by IFOAM. Furthermore, he adds:

> *"We wish for a clearer differentiation from biotechnological methods and genetic engineering. A relevant part of the definition has to be that organic varieties are bred under organic conditions as defined in the organic regulation"* (ROSSMANITH, organic vegetable breeder).

HEYDEN acknowledges that, with the exception of wheat, OPB is not able to offer a wide range for variety assortment, yet. If this subpoint of the definition is enforced, farmers would face the problem of finding a suitable variety for their farm. In line with ROSSMANITH, HEYDEN asks for an exclusion of certain breeding technologies:

> *"The problem with conventional breeding is that they are normally not transparent. Especially with the new genetic engineering, it will become even more difficult to determine the breeding technology. It is necessary to create a positive list and to demand that breeders disclose that this new genetic engineering was not conducted"* (HEYDEN, organic cereal breeder).

According to FLECK and SPIEß, it is important to select under organic as well as regional conditions because the genotype is influenced by the environment and management system. SPIEß regards it as misleading to label varieties from BFCA, which undergo organic variety testing, as organic varieties. Another argument for OPB is presented by FLECK:

> *"[…] conventional breeding programmes are less concerned with crops with a minor financial return, i.e. companies reduce their breeding activities in minor crops and use their resources for crops which promise a high probability of refinancing. Organic agriculture is very diverse; thus, it is necessary to include minor crops in breeding which are not economically lucrative"* (FLECK, organic vegetable breeder).

KÖRBER, who represents conventional vegetable breeding, requests for the legal use of organically produced seeds regardless of their breeding history. OPB is more costly and less economically rewarding, and in the end, the farmer has to carry the additional costs of OPB. Furthermore, KÖRBER

states that in OPB some breeding goals are compromised, as it is more difficult to control trial conditions; whereas in BFCA, the desired result can be reached faster and more precisely.

> *"There are farmers which demand organically bred varieties, but there are also farmers which demand organically produced seeds regardless of the breeding aspect. Organic and conventional breeding result in different products on the market. The products are suitable for different challenges"* (KÖRBER, conventional vegetable breeder).

4.2. Breeding

4.2.1. Material

Table 4 provides an overview of the breeding conditions, breeding material and registration options used by the interviewed breeders, and respective breeding companies and organisations. It can be noted, that organic and biodynamic breeders make extensive use of alternative registration options. Breeders report different problems with DUS and VCU criteria which force them to register varieties as amateur or conservation varieties, respectively (see chapter 4.6).

Table 4: Breeding conditions, breeding material and registration options used by the interviewed breeders and representatives of breeding companies and organisations.

Institution	Representative	Breeding conditions	Material	Registration[1]
Kultursaat e.V.	FLECK	Biodynamic	Vegetables	Varieties for NL AV
Keyserlingk-Institut	HEYDEN	Biodynamic	Cereals (winter wheat)	CV
HILD samen GmbH	KÖRBER	Conventional[2]	Vegetables	Varieties for NL
Cultivari Getreidezüchtungsforschung Darzau gGmbH	MÜLLER	Biodynamic	Cereals	Varieties for NL CV OHM
Bingenheimer Saatgut AG	ROSSMANITH	Biodynamic and organic	Vegetables	Varieties for NL AV
LBS Dottenfelderhof e.V.	SPIEß	Biodynamic	Cereals (vegetables)[3]	Varieties for NL CV OHM
Demeter-Saatgutbetrieb Ludwig Watschong/ Dreschflegel e.V.	WATSCHONG	Biodynamic	Vegetables	AV

[1] NL: national listing, AV: amateur varieties, CV: conservation varieties, OHM: organic heterogeneous material

[2] production of conventionally propagated seeds with and without post-harvest treatment, and production of organically propagated seeds (HILD samen GmbH, n.d.).

[3] for cereal breeding, Dottenfelderhof cooperates with Cultivari Getreidezüchtungsforschung Darzau, Getreidezüchtung Peter Kunz and Keyserlingk-Institut; for vegetable breeding, Dottenfelderhof cooperates with Kultursaat e.V. (LBS Dottenfelder-Hof e.V., 2017).

4.2.1. Breeding goals

Cereal breeders: In organic cereal breeding, resistances against diseases play an important role. In the face of extreme weather events associated with climate change. SPIEß reports to breed for polygenetic resistances, which are more stable than monogenetic resistances, but more complicated to breed for. In CA, resistances against seed-borne disease are neglected since they can be managed by the use of chemical seed treatment agents. In OA, resistances against bunt (*Tilletia caries*) and loose smut (*Ustilago tritici, U. nuda, U. avenae*) are vital (SPIEß). However, the FPVO does not conduct any test in this regard. Thus, SPIEß reports that they themselves are responsible for testing disease resistances in winter and spring wheat, winter barley and oats. Similarly, HEYDEN reports that

breeders themselves are responsible for the quality of conservation varieties. Conservation varieties do not need to pass official VCU testing which verifies their added value. HEYDEN conducts single-ear selection of conservation varieties to maintain or improve the variety. As a consequence of selection activities, the variety reaches a relatively high homogeneity, which, however, is insufficient to register the variety according to DUS criteria.

Vegetable breeders: According to FLECK, organic vegetable varieties do not require full disease resistance. FLECK reports to breed under organic management conditions, i.e. without the use of fungicides. Thus, the crops have to cope with the pressure from different fungi. Varieties are selected for certain aesthetics and nice harvesting organs. Varieties are favoured which show horizontal resistances, such as growth behaviour which makes the crop unattractive for certain pests. The result are healthy and robust varieties which can cope with organic management conditions. FLECK adds that taste has a higher relevance in organic vegetable breeding as it represents an important purchase criterion for organic consumers. Likewise, ROSSMANITH reports to breed for robustness. According to him, organic vegetable breeding respects the nature of the plant and makes the plant fit for its interaction with the environment. Conversely, the fertilisation regime in conventional breeding as well as in intensive organic systems leads to the distanciation from the plant's natural interaction with its environment. ROSSMANITH claims that breeders have to focus their breeding efforts on fulfilling DUS criteria, because the rejection of a candidate variety implies a financial loss, and thereby breeders neglect certain traits which are more relevant to OA. According to ROSSMANITH, food quality and taste are important for the value of an organic vegetable variety. In line with SPIEß and HEYDEN, he reports that breeders themselves are responsible for the description of the value of a variety.

Moreover, ROSSMANITH stresses the importance of adapting a variety to the specific pedo-climatic conditions of a region:

> *"Organic breeding always has a regional character. […] All regions need their own varieties. We do not want to sell our varieties globally. Instead, we want that, for example, Spain or England develop their own breeding projects. However, this implies, that the business model of breeding cannot go in the direction of cash crops"* (ROSSMANITH, organic vegetable breeder).

WATSCHONG, who conducts breeding of amateur varieties for hobby gardeners, also reports to consider robustness by breeding on different soils and in different climate conditions throughout Germany. This way, hobby gardeners can choose a variety which is adapted to their environmental conditions. Furthermore, WATSCHONG adds long harvesting periods and robustness in storability to the list of organic breeding goals. These qualities are of special interest to hobby gardeners who practice self-sufficiency as compared to commercial farmers. For instance, focus on uniformly ripening Brussel sprouts in commercial farming has led to the disappearance of Brussel sprouts which ripen gradually from the bottom to the top.

KÖRBER does not conduct organic breeding because organic vegetable breeding does not promise sufficient economic return due to the small market share of OA.

> *"We consider cost-benefit analysis, i.e. if the market is large enough and if we are able to make a profit, we would consider organic breeding. At the moment, we only breed*

conventionally, but we produce organic seeds which are bred under conventional conditions but propagated under organic conditions. The market for organic seeds is growing. Thus, we invest in organic seeds and produce more each year" (KÖRBER, conventional vegetable breeder).

KÖRBER reports that, to ensure that varieties from conventional breeding programmes perform well under organic conditions, breeding goals have been adapted:

> *"We are putting more emphasis on integrating biotic resistances in our breeding programmes, so that we can reduce the amount of spraying. This is also demanded by the conventional sector"* (KÖRBER, conventional vegetable breeder).

Cereal and vegetable breeders agree that, farmers and other actors along the value chain, such as processors, researchers, doctors and nutritional experts, can deliver valuable inputs to breeding decisions. Through consumer feedback and communication with other gardeners, breeding goals and projects are iteratively adjusted (FLECK, ROSSMANITH, SPIEß).

4.3. DUS testing

4.3.1. Organisation

FPVO: If a variety passes DUS testing, has a suitable denomination, and, in the case of agricultural crops, passes VCU testing, it is accepted to the national variety lists. The FPVO is responsible for the performance of DUS trials. DUS testing of arable crops and vegetables are conducted under conventional conditions (SCHNOCK).

Breeders: The FPVO cooperates with testing authorities in France, Scotland and Hungary which conduct trials with vegetables on behalf of the FPVO (ROSSMANITH). Breeders appreciate the cooperation and communication with officials of the FPVO in regard to testing conditions. For instance, FLECK reports that it was possible to test the candidate variety for another year or to agree on registering the variety as an amateur variety. KÖRBER reports that it was possible to adapt testing conditions for herbs for pot cultivation, which displayed problems in uniformity when tested under conditions of outdoor cultivation. Similarly, ROSSMANITH reports that it was possible to adapt the UPOV protocol in favour of open-pollinated varieties. The zucchini variety *Serafina* was rejected due to lack of uniformity because it was compared to all hybrids of common knowledge. For hybrids, the UPOV protocol uses absolute homogeneity, i.e. only one outlier in 100 plants is accepted, which is difficult to reach for open-pollinated varieties in 64 categories. Through communication with auditors in Cavaillon, South-France, it was possible to use relative homogeneity in which the variety is evaluated in relation to existing varieties which gives auditors a certain leeway. As a result, *Serafina* was accepted with the highest values in uniformity (ROSSMANITH).

4.3.2. Design

FPVO: DUS testing is conducted on the basis of technical guidelines of CPVO and UPOV protocols. The FPVO conducts DUS testing of agricultural crops on one or two locations in Germany (SCHNOCK).

Breeders: FLECK criticises that DUS testing of vegetables is conducted only on one location in Germany:

"A necessary addition is to collect data on more locations and over several years in order to illustrate, on this basis, a certain yield stability and stability of other properties. Additionally, it is necessary to test the suitability of varieties under different conditions, for example, on lighter soils or clayey soils. This would help farmers to assess varieties for the suitability in their region" (FLECK, organic vegetable breeder).

ROSSMANITH reports that trials which take place outside of Germany are unsuitable for assessing varieties which were bred under the conditions of his breeding garden, located close to Frankfurt. Varieties which display a high homogeneity under his conditions, risk of being rejected due to a high level of heterogeneity if they are tested under different pedo-climatic conditions.

In general, organic breeders wish for DUS testing under organic and regional conditions. However, according to ROSSMANITH, due to the lack of testing locations and organic vegetable breeders, it is impossible to establish organic DUS testing:

*"We wish for organic variety testing, even though, we know that our request will not be met. Thus, we wish for more acceptance in variability, in stability, and in homogeneity. If the FPVO does not have locations on which the plant can optimally grow, we ask for more tolerance in the testing process" (*ROSSMANITH, organic vegetable breeder).

Organic breeders report to send organically propagated seeds to DUS testing, whereas conventional breeders provide conventionally propagated seeds. KÖRBER, representing conventional breeders, prefers to provide conventional seeds in order not to risk rejection of the candidate variety, because conventional seeds have a lower infestation rate and a better performance in uniformity. ROSSMANITH states that seed-borne diseases are an integral part of the nature of the plant. Nevertheless, he reports that, with the use of hot water treatment, it is possible to provide close to germ-free seeds without using pesticides. FLECK did not experience any disadvantages in DUS testing based on the origin of seeds. However, in internal testing he observed, that the intensive fertilisation during conventional seed propagation leads to more vigorous seeds and seedlings. These properties are lost if the variety is maintained under organic conditions.

4.3.3. Testing criteria

Coordinators: Criteria of distinctness, uniformity and stability are necessary for the identification of a variety and serve as a consumer protection (URBATZKA). According to URBATZKA, DUS testing is vital for cash crops with a high economic importance. He acknowledges that it might be possible to forego DUS testing on a small market level:

"When the farmer is regarded as a consumer, then the DUS criteria can be regarded as a consumer protection legislation, which ensure, that the farmers buys a certain quality. In the private sector, which takes place on a smaller level and is based on trust, it could be ok to forego DUS trials. However, considering the size of the market, it is not possible to rely on trust" (URBATZKA, coordinator).

Vegetable breeders: ROSSMANITH wishes for a reduction of testing criteria in the DUS protocol and a higher tolerance in homogeneity.

"The DUS system in general is ok. We are criticising the narrowness of the DUS system. This narrowness results from a one-key-several-doors system. In DUS testing, varieties are not

only tested for descriptiveness and distinctiveness, they are also tested for the possibility of variety protection. The question of variety protection influenced the Variety Office's freedom of interpretation. The definitive distinctness is meticulously tested" (ROSSMANITH, organic vegetable breeder).

Using the example of zucchini, he explains, that breeders are putting all their effort in meeting uniformity in 64 criteria, instead of focusing on traits which are more important to OA. He hypothesises, that this genetic restriction can lead to a reduction in performance. Instead, a reduced number of testing criteria would be sufficient for describing a zucchini variety:

> *"There are around 100 hybrid varieties of zucchini and they are all phenotypically almost the same. They are only distinct because they are described using 64 criteria and within these criteria no deviation is possible"* (ROSSMANITH, organic vegetable breeder).

ROSSMANITH describes DUS testing as concealed VCU testing in which the value of vegetable varieties is defined by a high level of homogeneity. However, especially in cross-pollinators such as cabbage, carrots, beetroot, and zucchini it is difficult to meet the criterion of homogeneity. All things considered, ROSSMANITH does not believe that it is possible to adapt DUS criteria to organic varieties while simultaneously combining DUS testing with variety protection.

Contrary to ROSSMANITH, FLECK does not completely agree with the demand for a reduction in testing criteria and even regards the inclusion of additional criteria such as taste as useful in order to classify a special distinctness, especially since selections for taste is a major component of breeding activities of Kultursaat e.V. If a variety does not meet the demands of DUS testing, there is the possibility of alternative registration. Accordingly, about 20 to 30% of the varieties produced by Kultursaat e.V. are registered as amateur varieties by default. FLECK reports that this is especially the case for tomatoes, cucurbits, aubergines, broccoli and paprika which fail on meeting uniformity requirements. As an example, FLECK presents the case of broccoli and tomatoes: Open-pollinated broccoli varieties do not meet the demands for morphological uniformity, especially if compared to hybrids. Tomatoes do not meet the demands for pathological uniformity. It is not possible to clearly classify the candidate variety as resistant or susceptible, and in DUS protocols there is no option to classify an intermediate disease susceptibility. In order to avoid rejection, FLECK reports that there is the possibility of applying for pre-registration testing which is conducted by trial stations. Pre-registration testing is cheaper but is conducted under the same conditions and criteria as official DUS testing. Disadvantage of pre-registration testing is that the introduction of the variety to the market is postponed by two years.

WATSCHONG, who targets hobby gardeners, does not apply for official variety registration because the criteria which are important to hobby gardeners are not considered in DUS testing. WATSCHONG criticises that the registration system threatens agricultural biodiversity:

> *"For our varieties, we do not necessarily require official registration. For us, it is important, that marketing of variety diversity is enhanced and facilitated. At the moment, the access of certain varieties to the market is restricted and every restriction entails loss of diversity. In general, marketing of all varieties should be legalised, as long as criteria such as purity of seeds and germination capacity are considered"* (WATSCHONG, organic vegetable breeder).

KÖRBER, who represents conventional breeders, did not experience significant problems with DUS testing but he acknowledges, that organically bred varieties need adapted testing criteria such as more tolerance in uniformity.

Cereal breeders: MÜLLER regards DUS testing under a high fertilisation regime as problematic for organic varieties. MÜLLER presents the example of the winter wheat variety *Sandomir*. Under organic conditions it would meet uniformity requirements. However, under the conventional conditions of DUS testing, it displayed more differentiation in the waxy layer of the hulls and in length. MÜLLER regards it as useful to adapt DUS testing to organic conditions:

> *"It is related to the species, but also for the heterogeneous material, there could be some characters to be similar on the one hand and others with special frequencies like 'from to' and those related to 'with a special character at all' and 'without'"* (MÜLLER, organic cereal breeder).

Similarly, SPIEß experienced rejections due to lack of uniformity. In some cases, he received a warning that more than three of 1000 plants showed deviations. This can be adjusted within one selection step, but an enormous effort is needed to fulfil DUS criteria. SPIEß reports that he could not register cross-pollinators, such as maize and rye, for national listing, because they are compared to F1 hybrids in uniformity. Instead, registration took place as conservation varieties. As a consequence of these experiences, SPIEß requests to put a smaller emphasis on DUS criteria and a bigger emphasis on VCU criteria which are of importance to OA:

> *"It is necessary to discuss with the FPVO about the very small number of allowable deviations. If other criteria of VCU testing, i.e. yield, health, etc., are improved, a smaller homogeneity should not be an exclusion criterion by the FPVO"* (SPIEß, organic cereal breeder).

4.4. VCU testing

4.4.1. Organisation

FPVO: In 1999, organic VCU testing was implemented in Germany. Until 2011, organically bred varieties were tested under conventional conditions which were supplemented with organic trials. Breeders had to pay fees for both trials in order to test a candidate variety for its suitability for OA. Since 2012, varieties originating from OPB, can be tested in separate VCU trials solely under organic conditions. For separate VCU trials, the same fees have to be paid as for conventional VCU testing. The testing protocol is set up in cooperation with stakeholders and officials of Federal State Offices. Varieties which pass conventional DUS testing and organic VCU testing are listed on the German national variety lists and described in the descriptive variety lists under a separate category. The descriptive variety lists are adjusted, based on the information provided by organic post-registration trials, conducted by Federal States Offices (SCHNOCK).

Coordinators: Data are exchanged between Federal States Offices and FPVO via PIAF (planning, information and evaluation system for field trials; *Planungs-, Informations- und Auswerungssystem für Feldversuche*) (KARALUS, URBATZKA, WEGNER). PIAF is not open to the public and requires a license for which Federal States pay into a fund. If a service company wants to have access to PIAF, they require a special license (WEGNER). Federal State Offices are payed for conducting VCU testing

on behalf of the FPVO. For wheat, the FPVO orders additional baking tests which are conducted by the Federal Institute for Grain, Potato and Fat Research in Detmold (*Bundesanstalt für Getreide-, Kartoffel-, und Fettforschung*) (KARALUS).

4.4.2. Design

FPVO: Organic VCU testing takes place on 14 locations. A variety, depending on the species, is tested for two to three years until variety release or rejection. For the statistical evaluation, trials are set up as one-factorial with four replications. All VCU trials are conducted without fungicides and growth regulators in order to identify the genetic characteristics of the variety. Additionally, organic VCU trials are conducted without chemical treatments and mineral fertilisation. Varieties of winter wheat, spring wheat, winter barley, spring barley and spring oat are included in organic VCU trials. Seeds for VCU testing are not treated and preferably from organic production (SCHNOCK).

Coordinators: For VCU testing, the FPVO uses so-called *Verrechnungssorten* (VRS) as reference varieties. These are three varieties which are tested besides the candidate varieties (KARALUS, WEGNER). VRS are calculated to one mean reference variety which is set to a value of 100. Candidate varieties have to reach a value above 100 in order to have a satisfactory value for cultivation and use and to be accepted on the national variety lists (SPIEß). Every year, the FPVO, in cooperation with the Federal States Offices, separately agrees upon three VRS to be used in organic trials. The challenge is to find three varieties, which have a high relevance for OA throughout Germany, and which display high yield as well as high quality values (WEGNER). Varieties originating from OPB are increasingly used as VRS (KARALUS). For the reference varieties, the FPVO receives seeds from the breeder and provides them to Federal States Offices for VCU trials (WEGNER).

Cereal breeders: MÜLLER criticises that VCU testing takes place on high-yielding locations. Instead, he asks to include locations that are representative to organic farms. This is especially necessary when assessing the baking quality which depends on the fertilisation level of the soil. Similarly, HEYDEN experienced that some biodynamically bred varieties could not display their qualities on some of the testing locations, which caused a lower scoring.

Furthermore, MÜLLER criticises that VRS are not always suitable for assessing a candidate variety. He presents the example of food barley for Tsampa: In VCU testing, food barley is compared to fodder barley as a reference. However, fodder barley is bred to supply half of Europe, and thus, displays other yield and quality characteristics than food barley. Moreover, MÜLLER requests the sole use of organically certified seeds in all testing stages in order to identify varieties which produce high-quality seeds under organic conditions.

> *"Organic seeds were sent to be tested, and this has only disadvantages, because it cannot easily be enriched with nutrients to get a higher grain weight or protein content. In addition, organic seeds always carry a background noise of seedborne diseases"* (MÜLLER, organic cereal breeder).

MÜLLER refers to a research study which looked at the influence of the origin of seeds on variety testing with spring barley. The results indicate that organic seeds are three times more likely to be put at a disadvantage when compared to conventional seeds (cf. Müller, 2009). SPIEß reports to put a lot of effort into producing high-quality seeds. According to him, their seeds display a sufficient homogeneity and resistances against seed-borne diseases.

4.4.3. Testing criteria

FPVO: In order to determine the necessity of organic VCU and in order to identify testing criteria which are of importance for assessing varieties suitable for OA, the FPVO took part in the COST Action 860 – SUSVAR; is co-author of the handbook on "Cereal Variety Testing For Organic And Low Input Agriculture" (cf. Donner and Osman, 2006); conducted research with potato, winter wheat and spring barley (cf. Schnock, 2008); and organised workshops (SCHNOCK). Based on this research, it was concluded that results from conventional VCU testing give important information for selecting suitable varieties for OA. Accordingly, trial protocols for observations and measurements for organic VCU testing are almost the same as for conventional VCU testing. In cereals, additional information on weed competitiveness, suitability to harrowing, susceptibility to seed-borne diseases and nutrient-use efficiency are needed. Thus, the FPVO included following observations in organic VCU testing of wheat:

> *"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."* (SCHNOCK, FPVO).

The FPVO can test for disease susceptibility of winter wheat under artificial inoculation with *Pseudocercosporella*, tan spot (*Drechslera tritici-repentis*), yellow rust (*Puccinia striiformia* var. *tritici*) and *Fusarium* head blight. However, the FPVO does not test for seed- and soil-borne diseases due to a lack of an executing institution and a suitable methodology. The same applies for suitability to harrowing. Furthermore, SCHNOCK assesses the judgement of nutrient-use efficiency as too complex. In organic VCU testing, milling and baking characteristics are assessed using samples from organic production. In organic wheat, additionally the gluten content is analysed and described. In the future, the gluten content will also be part of conventional VCU testing (SCHNOCK). According to SCHNOCK, despite research hinting to a correlation between organic and conventional variety testing for most traits, actors in the organic sector demand for organic trials:

> *"Additional arguments for a trial series under organic conditions are: 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"* (SCHNOCK, FPVO).

Cereal breeders: Interviewed breeders have conflicting opinions on VCU testing. SPIEß requests to put a higher emphasis on VCU testing and a smaller emphasis on DUS testing. If, for instance, VCU criteria such as plant health are improved, he requests a higher tolerance in homogeneity. Similarly, MÜLLER wishes to reduce the amount of additional testing criteria which all have to be paid; instead, he wishes to focus on testing criteria which are of importance to OA such as nutrient-use efficiency, resistance against seed-borne diseases, and weed competitiveness. MÜLLER and SPIEß criticise that resistances against bunt and loose smut are not part of VCU testing. According to SPIEß, breeders themselves have to score general leaf health which includes leaf area duration and qualitative ripeness. SPIEß and HEYDEN wish to include quality criteria such as nutritional quality in VCU testing.

The problem is that the inclusion of new testing criteria, which are of importance to OA, requires an extensive process in which new methods are developed, validated, and approved by the FPVO. Thus, according to HEYDEN, breeders should be responsible for testing the value of a variety:

> *"In my opinion, VCU testing is outdated. Seed laws were adopted to protect farmers from bad seeds. This is not necessary anymore, since breeders cannot afford to release bad varieties to the market, which could potentially ruin their reputation"* (HEYDEN, organic cereal breeder).

Vegetable breeders: Vegetable breeders do not wish for VCU testing. According to FLECK, it would take too long to establish the administration necessary to conduct VCU testing for vegetables. He proposes that interested parties or variety users publish their own description and assessment of a variety. In line with FLECK, ROSSMANITH reports that in vegetable breeding, the breeders themselves are responsible for describing the value of a variety. He regards an official description by a testing authority as useful, but he does not want obligatory VCU testing in which the value is a criterion of exclusion. According to him, the definition of the value of a vegetable is the task of the farmer.

> *"We do not want obligatory VCU testing because in VCU testing a variety has to be at least as good as existing varieties. This might have been a necessary criterion in times of hunger, but today, to always reach an improvement does not correlate with the aim of OA of a sustainable and stable agricultural system"* (ROSSMANITH, organic vegetable breeder).

4.5. Post-registration testing

4.5.1. Organisation

Coordinators: In 1998, the German Chambers of Agriculture founded the working group "trial coordination in organic agriculture" ("*Versuchsansteller im ökologischen Landbau*"). The working group consists of employees from all Chambers of Agriculture, Regional Offices and State Offices of all Federal States that are involved in OA. The working group developed an organic trial network throughout Germany with joint reference varieties and the compilation of trial results (cf. statement by Dr. Harriet Gruber in Figure 13, in ANNEX, provided by WEGNER). The system of conventional variety testing was used as a starting point for the development of organic variety testing (WEGNER).

Figure 8 schematically displays the procedure of post-registration testing. Post-registration testing examines the regional suitability of a variety which has passed registration testing, conducted by the FPVO or other EU Member States. On the basis of these trials, Federal States release regional recommendations to farmers. Mostly agricultural crops are included in the trials. KARALUS reports that the horticultural department of the Saxon State Office for Environment, Agriculture and Geology (*Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie*) has established a variety trial for spring onions (*Sommer-Säzwiebeln*) under organic conditions. Apart from this, nothing is known about official organic post-registration trials with vegetables.

Post-registration testing is financed by the Federal States and trial teams are state offices. In some Federal States, farming associations financially support organic post-registration testing. Breeders provide seeds for trials for free (KARALUS, URBATZKA, WEGNER). The organisation of post-registration testing is similarly structured in the three Federal States of Bavaria, Saxony and Mecklenburg-Western Pomerania. There is a close trans-regional cooperation with the neighbouring Federal States of one crop-specific cultivation area. For instance, responsible persons from Saxony,

Thuringia and Saxony-Anhalt jointly agree upon varieties to be tested. On the basis of a common trial evaluation, responsible coordinators of one cultivation area, jointly agree upon varieties to be recommended (KARALUS).

Websites of Federal State Offices represent the most important dissemination channel. Variety recommendations are issued for different management systems and regional conditions. All trial results are available online, shortly after harvest and evaluation. WEGNER reports to publish preliminary results which are constantly updated during and after harvest. Furthermore, trial results are sent directly to interest groups, published in the agricultural professional press or in a variety booklet for a more detailed overview. The variety assortment is transparent and becomes available shortly after ordering of seeds from the breeders (KARALUS, URBATZKA, WEGNER). Communication takes place via phone or mail. There are regular meetings with the coordinators of one cultivation area and meetings with all responsible persons form all Federal States to ensure that decisions are taken jointly, and that methodology and standards are uniformly implemented throughout Germany (WEGNER). In the Bavarian State Research Centre for Agriculture, communication takes place via a Central Trial Department which is responsible for ordering the trials, for statistical evaluation and for examination of reliability and validity of the trial (URBATZKA). For data exchange, PIAF is used as a common software. In PIAF trials are managed, and results are entered, statistically evaluated and exchanged with the FPVO for adjusting the descriptive variety lists and, after request, with other Federal State Offices (KARALUS, URBATZKA, WEGNER).

In organic variety trials, the infrastructure, methodology and equipment from conventional variety trials is adopted. In some cases, service companies and farmers provide additional equipment. Trials are either conducted on-station and/or on-farm. In some Federal States, the farmer gets financial compensation for providing fields for variety testing. The farmer's motivation is to receive results from the specific conditions of his/her farm (KARALUS, URBATZKA, WEGNER). Normally, a trial team is responsible for sowing, scoring and harvesting the trial. If the trial is on-farm, the farmer is included in some tasks such as marking the plots and harrowing the field. In Mecklenburg-Western Pomerania, some tasks are outsourced to a service company which is responsible for conducting the trials on the on-farm location (WEGNER).

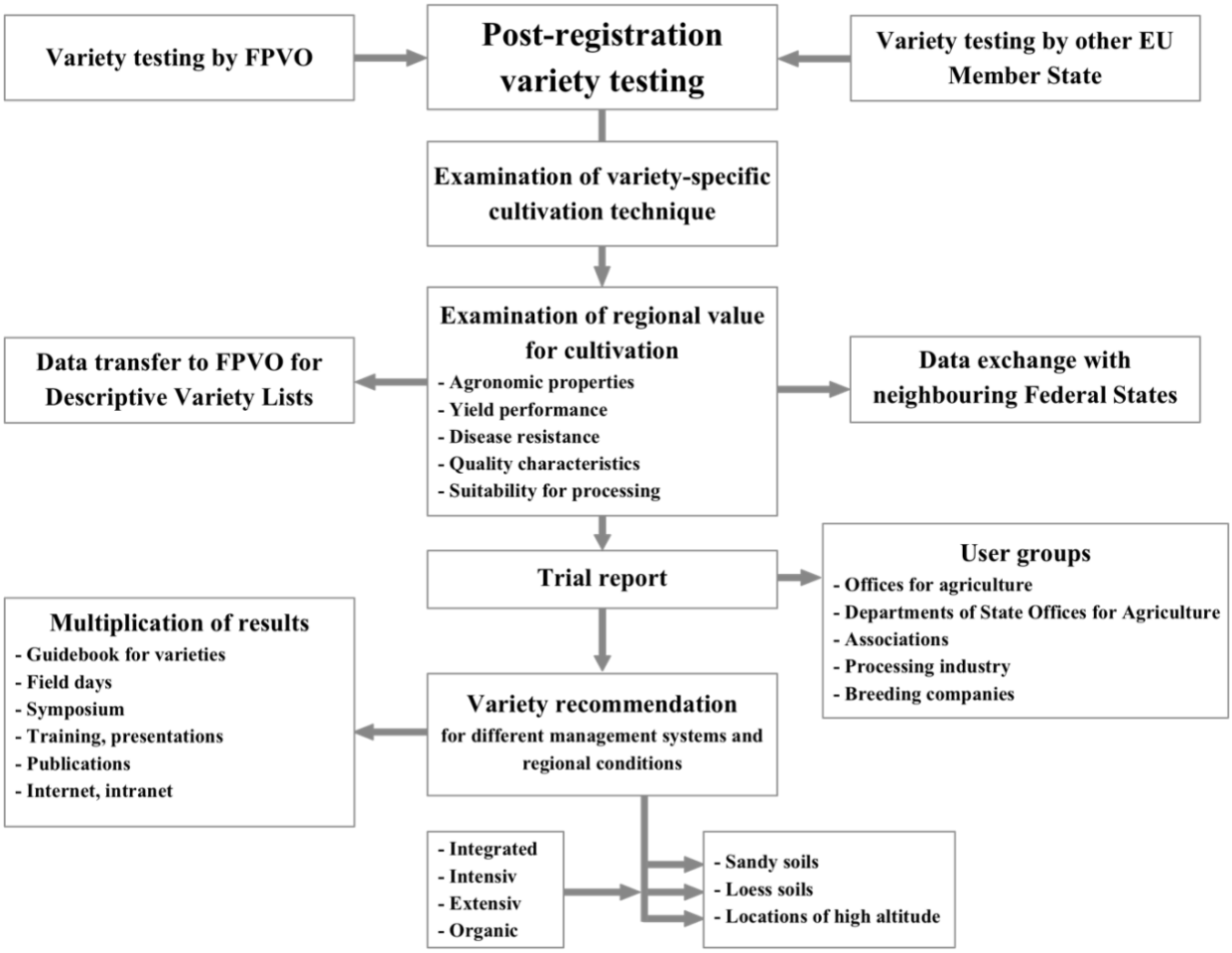

Figure 8: Schematic illustration of the procedure for post-registration testing (adapted from Sächsische Landesanstalt für Landwirtschaft, n.d., n.p.; own translation).

4.5.2. Design

Coordinators: Variety trials are either conducted on-station and/or on-farm. Cooperation with neighbouring Federal States of one cultivation area allows a better data basis for statistical evaluation based on a larger number of locations. The number of locations per crop species differs. For instance, in Bavaria there are 22 locations in total. Spring wheat is tested on two locations, whereas winter wheat on six locations (URBATZKA). In Mecklenburg-Western Pomerania, there are two locations. In the respective cultivation area, there are ten locations in total (see Figure 9). Nevertheless, WEGNER reports that for some crops and in some years, the on-station location in Gülzow is the only evaluable testing location because on the other locations, variations are too wide.

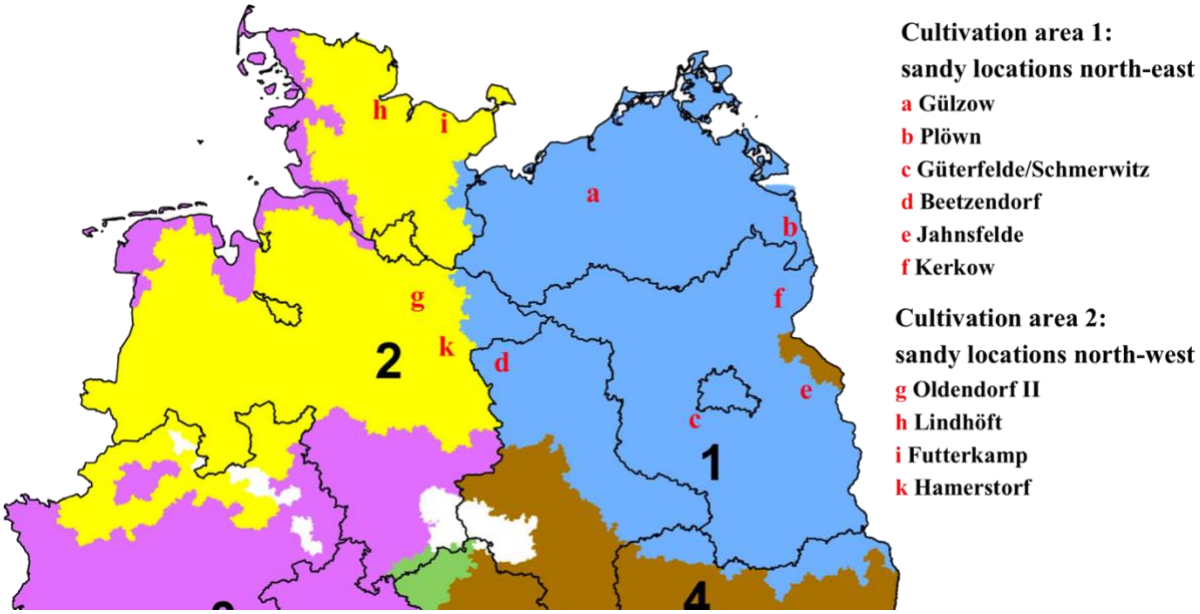

Figure 9: Locations for organic variety testing included in recommendations by State Research Institute for Agriculture and Fishery (*Landesforschungsanstalt für Landwirtschaft und Fischerei*) in Mecklenburg-Western Pomerania (adapted from Wegner et al., 2018, p.5).

Interviewed coordinators wish for more testing locations and the inclusion of different soil and climate conditions. However, they report that a lack of capacity in the research institutes and the lack of suitable organically managed locations with homogeneous conditions presents a challenge. On organic fields, different soil conditions or the presence of weeds lead to inhomogeneous conditions which can falsify trial results. In conventional variety trials, this inhomogeneity can be concealed by a different fertilisation and spraying regime (KARALUS, URBATZKA).

The standard procedure in variety testing is to include four randomised repetitions over a period of three years. After three years the variety is recommended and further tested or rejected. In some severe cases, the variety is rejected before the end of the three-year period. In some crops, which are more laborious such as potato and maize, three repetitions are conducted. For statistical evaluation, the so-called Latin square or lattice is used in order to correct for disturbance variables such as soil differences (URBATZKA). The t-test and analysis of variance is used in order to test for significance of results and in order to identify whether the variation of values correlates with varietal difference or with environmental influence (KARALUS, WEGNER). PIAFStat is used for data analysis and for visualisation of variation (WEGNER) (for an example, see Figure 14 and Figure 15 in ANNEX).

Variety assortment of post-registration testing includes all varieties which are intended for organic production as well as varieties intended for conventional production. From the latter, traits such as high-yield and high-quality characteristics; and agronomic properties such as disease resistance, winter hardiness and low risk of lodging are considered. Breeders, seed propagators and colleagues from conventional variety testing are included in the decision-making process of variety choice (KARALUS, URBATZKA, WEGNER). Material from other European countries can be included in post-registration testing. For instance, in Mecklenburg-Western Pomerania yellow lupins from Poland are tested for their suitability in the corresponding cultivation area (WEGNER). There is disagreement whether to include hybrids in variety testing. In Mecklenburg-Western Pomerania, rye hybrids are

included since they statistically yield more than open-pollinated varieties. However, they are problematic in sales due to lack of acceptance among German organic farmers (WEGNER). Representatively, Table 5 lists the species subject to organic post-registration testing and the number of varieties recommended by the Federal State Offices of Saxony, Bavaria and Mecklenburg-Western Pomerania for cultivation under organic conditions in autumn 2018 and in spring 2019.

Table 5: Species subject to organic post-registration testing and number of varieties recommended for cultivation under organic conditions in autumn 2018 and in spring 2019, displayed in brackets.

Saxon State Office for the Environment, Agriculture and Geology (KARALUS) (Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie, 2018)	**Bavarian State Research Institute for Agriculture (URBATZKA)** (Bayerische Landesanstalt für Landwirtschaft, 2018)	**State Research Institute for Agriculture and Fisheries in Mecklenburg-Western Pomerania (WEGNER)** (Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern, 2018)
Recommendations for cultivation under organic conditions in autumn 2018		
Winter wheat (7)	Winter wheat (11)	Winter wheat (4)
Winter rye (4)	Winter rye (4)	Winter rye (4)
Winter triticale (3)	Winter triticale (4)	Winter triticale (2)
Winter spelt (5)	Winter spelt (4)	Winter spelt (2)
	Winter barley (5)	Winter barley (2)
Recommendations for cultivation under organic conditions in spring 2019		
Spring wheat (2)	Spring wheat (2)	Spring wheat (3)
Spring oat (5)	Spring oat (3)	Spring oat (3)
Spring barley (5)	Spring barley (5)	Spring barley (2)
	Spring triticale (1)	
Grain peas (3)	Forage peas (5)	Forage peas (3)
Field beans (4)	Field beans (4)	
	Soybeans (5)	Soybeans*
Blue lupins (0)	Blue lupins (1)	Blue lupins (3)
		Yellow lupins (0)
		White lupins*
Potatoes (9)	Potatoes (14)	
	Silage maize (5)	Maize*
	Grain maize (7)	
		Sunflower*

*in the process of being tested

Coordinators in the Federal States Bavaria, Saxony and Mecklenburg-Western Pomerania report to use different methods for choice of reference varieties. In Saxony, the same VRS are used as for organic VCU testing. This allows the comparison of results from VCU and post-registration testing (KARALUS). In Bavaria, the mean value of all varieties in the trial is used as a reference variety (URBATZKA). In Mecklenburg-Western Pomerania, three varieties, which have been tested for more than five years, are used as reference varieties (WEGNER). For varieties and reference varieties, organic or conventional, untreated seeds are used. Seeds are obtained directly from the breeder to guarantee the same starting material throughout Germany and to give breeders the opportunity to provide high-quality seeds (KARALUS, WEGNER).

4.5.3. Testing criteria

Coordinators: Post-registration testing is conducted in order to give variety recommendation for different management systems and different regional conditions. Coordinators use a common testing

protocol which is determined in the joint guidelines for VCU and regional post-registration testing. Coordinators report that it is possible to adapt quality criteria after communication with producer organisations and commerce. In general, varieties in organic and conventional post-registration testing have to meet the same requirements. However, some species-specific criteria have different thresholds (KARALUS, URBATZKA). For instance, URBATZKA reports that analyses for barley, oats, triticale, peas, field beans, maize and blue lupin are identical. In wheat, baking volume and gluten content is valued higher in organic variety testing; whereas, the crude protein content is valued higher in conventional variety testing. In rye, there is a difference in the falling number and amylogram values. For organic processors, a low falling number is associated with a better baking quality for rye and sourdough bread. This quality criterion was adapted after consulting with marketing organisations. In spring malting barley, the share of whole grains, i.e. grains which are bigger than 2.5 mm, is given a higher importance because organic varieties tend to have a higher heterogeneity than conventional varieties. Spelt has a minor role in CA. Thus, no standard baking test for spelt has been developed yet. In potatoes, a bigger focus is put on resistance to *Rhizoctonia solani*. Furthermore, in cereals mass development, plant height and plant density are valued higher in organic variety testing, whereas resistance to lodging and stability of the culm is more important in conventional variety testing. Resistances against diseases are more important in organic variety testing but are predicted to become more important in conventional variety testing as well (URBATZKA). WEGNER reports that in Mecklenburg-Western Pomerania, the most important criterion is yield because on the poor locations of northern Germany, making it difficult to maintain qualities in OA. Ground cover, mass development and disease resistances are criteria which give an indication for yield performance. Nevertheless, it is possible to issue recommendations for varieties which do not have an added value from a conventional standpoint, such as *Lichtkornroggen* which is specifically demanded by organic bakers (WEGNER).

In general, coordinators agree that organic variety testing incorporates testing criteria which are of importance to OA. Furthermore, they report that financial resources and lack of equipment restricts the number of criteria tested. Thus, there are no baking tests (KARALUS, WEGNER). URBATZKA regards it as desirable to develop baking trials for spelt and rye and to include further species in organic post-registration testing, such as grass-clover, which have a high relevance in OA.

Breeders: All breeders stress the importance of testing the regional performance of a variety. They conduct their own pre- or post-registration trials and acknowledge the importance of official post-registration testing.

4.6. Alternative registration

4.6.1. Organic heterogeneous material

Coordinators: In Germany, populations of wheat, barley, oats and maize can be tested for their regional suitability within the scope of post-registration testing (WEGNER). URBATZKA states that populations have the ability to adapt to the conditions of the farm. The farmer selects the properties from the "colourful bouquet of flowers" which are of interest to the condition of the farm; thereby, genetically constricting the population. According to URBATZKA, breeding progress will lay within newly released varieties which are intended for national listing.

Cereal breeders: MÜLLER and SPIEß make use of the alternative registration option of populations, according to 2014/150/EU. SPIEß reports that populations display a high level of genetic diversity, and, thus, are not compatible with DUS criteria. However, populations have a higher chance of resilience which allows them to cope with abiotic and biotic stress associated with OA and climate change. Thus, SPIEß asks for a separate category for organic heterogeneous material in order to legally market seeds thereof. Likewise, MÜLLER asks for an extension of the category of populations to other cereals like triticale.

4.6.2. Conservation varieties

Cereal breeders: HEYDEN, MÜLLER, and SPIEß make use of the alternative registration option of conservation varieties, according to 2008/62/EC. According to MÜLLER, conservation varieties display a higher heterogeneity compared to varieties intended for national listing. However, the character of the conservation variety has to be identifiable. SPIEß describes the regulation of amateur and conservation varieties as "a regulation of prevention":

> *"With conservation varieties, we face the problem of quantitative restriction regarding area of cultivation and marketing of seeds. The regulation of amateur and conservation varieties is a regulation of prevention, i.e. the regulation prevents, that certain varieties are placed on the market in sufficient quantities"* (SPIEß, organic cereal breeder)

SPIEß presents the example of a pasta company which requests biodynamic durum wheat with special qualities such as anthocyanin colouration. The variety cannot be registered as a conservation variety, because it does not originate from an old variety. Even though cultivation and sales would be small-scale for the pasta company, the whole registration procedure including registration costs would be necessary.

HEYDEN criticises that propagation of conservation varieties is restricted to its region of origin. If propagation of the variety is, for example, of interest to regions in France, a special application is necessary. HEYDEN reports that, before the introduction of the category of conservation varieties, it was possible to make special arrangements with the FPVO which allowed seed sales within a producer association, on the condition that bakers within the region of seed production buy the harvested grain. This agreement on seed sales is still used today on a very small scale. When conservation varieties were introduced, it was still necessary for varieties to pass variety testing. However, in order to make registration easier and cheaper, variety testing was omitted. Thus, nowadays breeders of conservation varieties are responsible themselves for the quality of the conservation variety (HEYDEN). In order to maintain or to improve the variety, HEYDEN selects single ears. If the improved variety deviates beyond a certain degree, a new denomination is necessary. Furthermore, crossings of conservation varieties cannot be registered as the like because the objective of conservation varieties is to protect the biological diversity of the original variety.

4.6.1. Amateur varieties

Vegetable breeders: FLECK, ROSSMANITH, and WATSCHONG make use of the alternative registration option of conservation varieties, according to 2009/145/EC. FLECK and ROSSMANITH use the category of amateur varieties to register varieties which would be rejected in DUS testing due to insufficient homogeneity. According to ROSSMANITH this is especially the case for cross-pollinators such as cabbage, carrots, beetroot and zucchini, as these have a higher level of variability. FLECK adds

tomatoes, cucurbits, aubergines, broccoli and paprika which have problems with uniformity on a morphological or pathological level. In order to avoid the rejection of a candidate variety and the associated costs of variety registration, FLECK registers about 20 to 30% as amateur varieties by default. FLECK does not regard registration of amateur varieties as very restrictive but mentions that some practitioners have a stigma against amateur varieties:

> *"According to 2009/145/EG, packaging sizes of amateur varieties are regulated in which amateur varieties are allowed to reach commerce. This restriction in packaging size can be an obstacle for some crops. Another disadvantage is the designation of amateur variety which, for the uninformed customer, implies unprofessionalism or amateurism in the production process and does not stimulate to buy/use the variety […] As a consequence, in the legal sense, amateur varieties (as well as conservation varieties) are varieties of second class. They are not tested and approved by an authority […]. Variety description is based solely on the description of the breeder."* (FLECK, organic vegetable breeder).

ROSSMANITH criticises the quantitative restriction of amateur varieties. For him, the regulation of the seed packaging size is as a major obstacle if he wants to sell seeds to professional organic vegetable growers. ROSSMANITH illustrates the example of zucchini: The packaging size of zucchini is restricted to 25 g. Zucchini has a thousand kernel weight of up to 400 g. A farmer who wants to order 2000 plants loses interest when faced with 32 single packages. Thus, ROSSMANITH asks for unlimited packaging size and unlimited marketing possibilities within Europe. Due to these reasons and despite higher registration costs, FLECK and ROSSMANITH apply for DUS testing. WATSCHONG, who targets hobby gardeners, does not face problems with amateur varieties. He only experienced rejection in regard to denominations which did not adhere to the competition law.

4.6.2. Niche varieties

Breeders: MÜLLER and SPIEß wish for an additional category in the EU regulation for niche varieties. A similar category has been implemented in Switzerland (SPIEß). SPIEß requests that niche varieties do not have to be traced back to a plant genetic resource valuable to its region of origin, as is the case for conservation varieties, in order to release varieties for small market demands and in order to increase market diversity. MÜLLER requests an easier registration procedure with modified testing criteria to keep costs down:

> *"There should be an implementation of a new category for niche varieties with criteria similar to conservation varieties and heterogeneous populations related to inspection, threshold values for seed lots or yearly sold seed, and special threshold values for uniformity for niche varieties"* (MÜLLER, organic cereal breeder).

MÜLLER explains the demand for niche varieties as follows: In order to examine the value for cultivation and use for organic management, suitable technologies have to be presented to the FPVO which prove that the variety has a special property. This can be an extensive process. For instance, the FPVO does not trust any test for resistances against bunt disease. With a regulation for niche varieties not everything has to be proven extensively to the FPVO, while varieties with a special value can still be marketed. Both breeders wish for the possibility for variety protection of niche varieties. Without variety protection, breeders would not be interested in working with niche varieties and, instead, would concentrate on cash crops such as wheat, soy and maize.

5. DISCUSSION

5.1. Need for clarification of EU definition of "organic varieties suitable for organic production

5.1.1. Genetic and phenotypical diversity

Breeders and coordinators, interviewed in the scope of this master's thesis, agree that the demand for a high level of genetic and phenotypical diversity of organic varieties, as prescribed in EU 2018/848, conflicts with the demand for uniformity, as prescribed in DUS protocols. Thus, the first subitem of the EU definition of "organic varieties suitable for organic production" would restrict the availability of varieties which display a low degree of genetic and phenotypical diversity, such as self-pollinators, to organic farmers. Interviewed breeders and coordinators acknowledge the importance of diversity in OA which can be achieved by different means such as including organic heterogeneous material, reducing the strict regulation of homogeneity to a healthy level of homogeneity, and including minor crops in the crop rotation. Concurrently with interviewees, DENEKEN criticises that the EU definitions for "organic varieties suitable for organic production" and for "organic heterogeneous material" use the same wording: "is characterised by a high level of genetic and phenotypic[al] diversity between individual reproductive units" (EU 2018/848, Chapter 1, Article 3 (18) and 3 (19), L 150/19). This may result in a danger of confusion between two inherently different categories, i.e. a variety and a population which is composed of different genotypes (Lammerts van Bueren et al., 2018). DENEKEN identifies a further weak point in the definition: For him, the term "organic variety" contradicts with the variety definition of the UPOV Convention. In the definition, there is no distinction between an organic and conventional variety. A variety, regardless of its breeding history and regardless of its target agricultural system, is defined as:

> "[…] a plant grouping within a single botanical taxon of the lowest rank, which grouping, irrespective of whether the conditions for the grant of a breeder's right are fully met, can be
>
> - defined by the expression of the characteristics resulting from a given genotype or combination of genotypes,
> - distinguished from any other plant grouping by the expression of at least one of the said characteristics and
> - considered as a unit with regard to its suitability for being propagated unchanged;" (UPOV Convention, 1991, Chapter I, Article 1 (vi))

The same definition can be found in (EC) No 2100/94, Chapter 1, Article 5 (2). This definition corresponds with the DUS criteria. If a candidate variety does not meet DUS criteria because of a high level of genetic and phenotypical diversity, it is not considered as a variety according to the UPOV Convention. Thus, the breeder cannot obtain PBR, i.e. cannot protect his/her intellectual property rights, and there is no financial reflux for his/her breeding effort. These findings imply that the demand for a high level of genetic and phenotypical biodiversity requires adaptation of DUS protocols and a separate category for "organic varieties" in the UPOV Convention, such is already the case for cross-pollinated species (cf. UPOV Convention, 2002, TG/1/3). Nevertheless, a high level of genetic and phenotypical biodiversity implies the exclusion of varieties with an inherently high level of uniformity. For instance, according to DENEKEN, uniform maturation is indispensable for producing high-quality crops.

5.1.2. Organic breeding

Interviewed coordinators and breeders have conflicting conceptions in regard to the second subitem of the EU definition of "organic varieties suitable for organic production". According to interviewed coordinators, the demand for organic breeding restricts variety assortment available to organic farmers as there are only a few breeders conducting OPB. A major share of varieties included in post-registration testing, are varieties originating from BFCA, which are tested for their suitability for OA. In contrast, according to interviewed organic breeders, the demand for organic breeding is in line with the principles of OA, as postulated by IFOAM: "[…] Organic plant breeding is a holistic approach that respects natural crossing barriers. Organic plant breeding is based on fertile plants that can establish a viable relationship with the living soil. Organic varieties are obtained by an organic plant breeding program" (IFOAM-Organics International, 2014, p.43). Requirements for the production of organic varieties include selection under organic conditions, absence of products of genetic engineering, transparency of breeding techniques, and the respect for the integrity of genome, cell and natural reproductive ability (IFOAM-Organics International, 2014, p.43). BFCA and OPB differ in regard to permitted breeding techniques. According to IFOAM norms, "destruction of cell walls and disintegration of cell nuclei through cytoplast fusion" which is a standard technique in producing hybrids, is not permitted in OA (IFOAM-Organics International, 2014). One compromise solution could be to include varieties originating from BFCA in organic variety testing, provided that their breeding history is mandatorily made transparent. Apart from this, BFCA and OPB differ in regard to breeding goals. BFCA generally targets large-scale farming systems which rely on high levels of external inputs to standardise environmental influences (Lammerts van Bueren et al., 2018). OPB often takes the form of regional breeding projects which focus on regional adaptability of minor crops, instead of global sales of cash crops (Lammerts van Bueren et al., 2018). The combination of breeding under organic and conventional conditions might solve the economic issue of OPB, as long as selection under conventional conditions does not lead to a reduction of suitable genotypes for OA (Osman et al., 2016; Kokare et al., 2017). Interviewed organic breeders name yield stability, resistance to seed-borne diseases, resilience and robustness, taste and nutritional qualities as important to OA. Lammerts van Bueren et al. (2011) adds weed competition and tolerance to mechanical weed control, nutrient-use efficiency under a lower nitrogen regime, tolerance to abiotic stress, and artisanal bread-making quality to the list. Nonetheless, some conventional breeding companies, as represented by KÖRBER, increasingly include organic breeding goals to, one the one hand, reduce external inputs, and on the other hand, increase the share of organic sales. Conventional breeding companies still use only a small part of their capacity for BFOA, due to the small market size of OA (Dawson et al., 2011).

The research question which has to be further explored is, whether BFCA and BFOA can be as efficient as OPB in producing varieties suitable for OA, if respective breeding goals are taken into account. Current research suggests different outcomes when comparing the suitability of different varieties for OA, originating from BFCA, BFOA and OPB. In general, strong G x M and G x E interactions imply that selection should be performed in the target environment and management system, respectively. G x M, G x E as well as G x year interactions can affect the heritability of some traits. For instance, Kokare et al. (2014) identified weed pressure as a negative effect on the heritability of barley grain yield and yield components. As a consequence, heritability for barley grain

yield was lower under organic conditions and selection for aforesaid traits should be conducted under conventional conditions. Another option is to broaden the data basis by increasing the number of repetitions and organic locations, which, on the downside, would increase costs of organic breeding. For economic reasons, Wolfe et al. (2008) suggest using indirect selection, i.e. selection under conventional conditions, for highly heritable traits to increase selection efficiency. "Examples for highly heritable traits in wheat in some conditions are: tillering capacity, early vigorous growth, earliness (heading date), disease resistance, culm length, spike- length, other morphological characteristics and grain features such as thousand kernel weight (TKW)" (p.327). According to Mikó et al. (2014), heading date, susceptibility to leaf rust and powdery mildew in bread wheat can be selected indirectly under conventional conditions; whereas, grain yield, test weight, leaf inclination and vigorous growth during booting should be selected directly under organic conditions. According to Rakszegi et al. (2016), the year significantly influences quality traits such as protein, starch and gluten composition in wheat. The management system significantly influences physical properties, such as thousand kernel weight, and the gluten quality, such as dough stability. Thus, Rakszegi et al. (2016) conclude that, in order to identify varieties with a high-quality protein content, a high nitrogen-use efficiency and stable quality traits under diverse environmental conditions, breeding should take place under organic conditions. According to Müllner et al. (2014), local testing of winter wheat is indispensable as the environment effect on grain and protein yield is stronger than the management effect. Some traits, such as soil coverage, show a better differentiation under organic growing conditions.

Most research focuses on wheat and barley. Coherently, a survey with 100 participants involved in organic breeding in Germany, Switzerland and Austria, reports that OPB concentrates mostly on a few cereal and vegetable species and there is a lack of OPB in certain crop species such as grain legumes, Brassica vegetables and oilseeds (Wilbois and Messmer, 2017). As a result, the yield gap between organically and conventionally cultivated wheat, barley and potato is smaller compared to neglected crop species (Kucek et al., 2019). The survey identifies the lack of financial resources as the biggest impediment to OPB (Wilbois and Messmer, 2017). Conventional breeding relies mostly on royalties and seed sales to finance breeding activities. Due to the small market size of the organic sector, the return flow of royalties cannot cover the costs of breeding activities (Pedersen, 2016). The second leading impediment to OPB are legal regulations of variety protection, requirements for variety release and associated costs (Wilbois and Messmer, 2017). Rey (2016) conducted a survey with 36 participants from France, the United Kingdom, the Netherlands, Austria, Denmark, Switzerland, Germany, Latvia and Bulgaria. Participants represented breeding companies involved in conventional and organic seed production. Participants identified following limiting factors to OPB: 54% of participants name the insufficient return on investment and financing models, 22% name the lack of adapted rules to register, and 6% name the costs of organic variety registration.

To conclude, the demand for varieties adapted to organic conditions is important to boost OPB but necessitates financial support of organic breeding activities and adaptation of organic variety testing to avoid a lack of varieties available to organic farmers. Alternatively, as research suggests, BFOA, in which selection of highly heritable traits takes place under conventional conditions and the latter generations are managed organically, can be used to minimise costs and to increase efficiency, while producing varieties suitable for OA (Pedersen, 2016).

5.2. Need for variety testing under organic conditions

5.2.1. Agricultural crops

In Germany, agricultural crops have to pass conventional DUS testing. There is the possibility to test some agricultural crops under separate organic VCU trials and organic post-registration trials. VCU testing takes place on 14 locations throughout Germany. Post-registration testing is designed to take regional differences into account by issuing recommendations for different cultivation areas based on respective pedo-climatic conditions. Generally, crops species included in organic variety testing display a high economic importance. In a like manner, surveys with 15 EU Member States indicate that it is most likely that organic variety testing is set up for wheat and barley (see Figure 10).

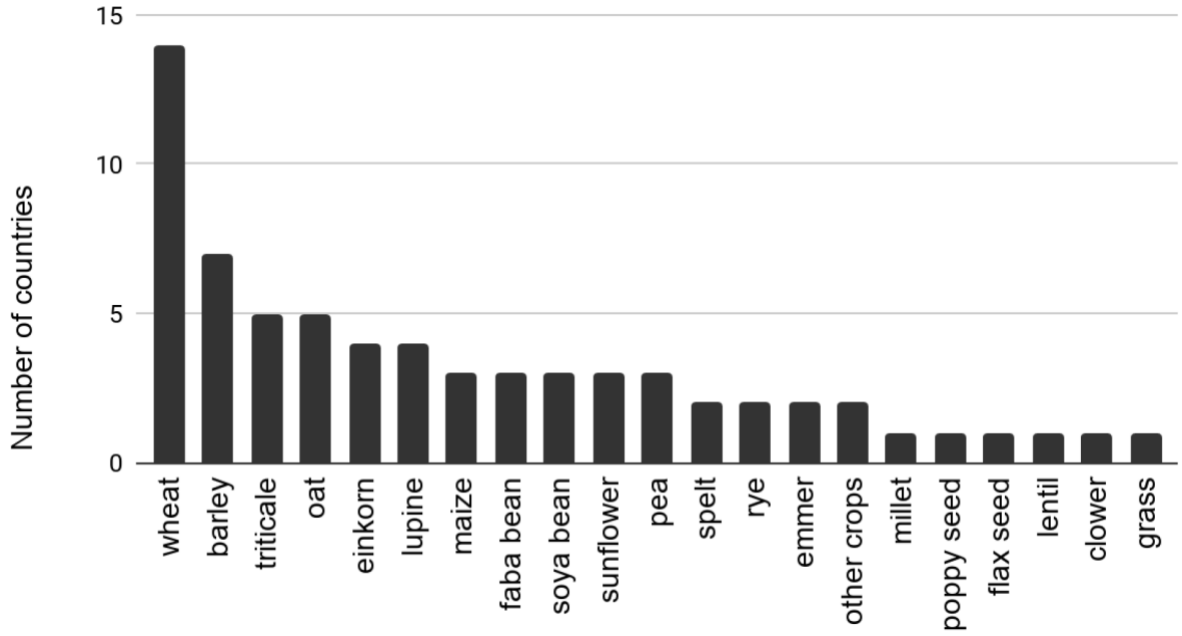

Figure 10: Agricultural crops included in organic variety testing in 15 EU Member States, examined in the scope of the LIVESEED project, work package two (Kovács and Pedersen, 2019, p.8).

Throughout the EU, implementation of organic variety testing ranges from no organic VCU testing to supplementary or separate organic VCU trials. Hitherto, Germany, Austria, Denmark, France, Latvia and Switzerland have implemented supplementary or separate organic VCU trials. Similarly, some EU Member States have no organic post-registration trials or have either established official or unofficial trials to test the regional performance of a variety. For a comparison of VCU and post-registration testing of agricultural crops in EU Member States, examined in the scope of the LIVESEED project, see Table 8 and Table 9 at the end of the discussion part. Regarding the necessity of organic variety testing, the research landscape presents conflicting statements. From 2004 to 2007, the FPVO conducted research on VCU testing of potatoes, winter wheat and spring barley under organic conditions (Steinberger et al., 2007). The ranking of potato and spring barley varieties under organic conditions correlated with the ranking under conventional conditions. Similarly, in winter wheat, information on yield, resistances and agronomic properties could be derived from conventional variety testing. In contrast, baking quality (dough elasticity and baking volume) of winter wheat should be measured using varieties cultivated under organic conditions. Steinberger et al. (2007) conclude that conventional VCU testing should be supplemented with organic VCU trials,

especially since most varieties used in OA originate from conventional breeding programmes and undergo conventional VCU trials either way.

Furthermore, from 2004 to 2008, the FPVO was involved in the COST Action 860 – SUSVAR on sustainable low-input cereal production in which the justification for separate organic variety testing of cereals was investigated by examining results from national variety testing throughout Europe. Within this context, Baresel and Reents (2006) evaluated the yield performance of 456 wheat varieties in conventional and organic VCU trials, conducted over a 15-year period in Germany. Yield performance correlated poorly between trials under conventional and organic management. Even low-input conditions with reduced fertilisation and no pesticide use could not modulate organic conditions (see Figure 11). Their research work emphasises the importance of differentiating between environments with high and low yield potential, within organic variety testing, due to G x environment (E) interactions. In contrast, according to Schwaerzel et al. (2006), winter wheat varieties perform similarly under organic and conventional conditions in regard to yield performance, risk of lodging, plant height, earliness, hectolitre weight and thousand kernel weight. Their evaluation included seven winter wheat varieties, tested on organically and conventionally managed fields over a three-year period in Switzerland. Conventional trials were managed extensively without growth regulators and fungicides.

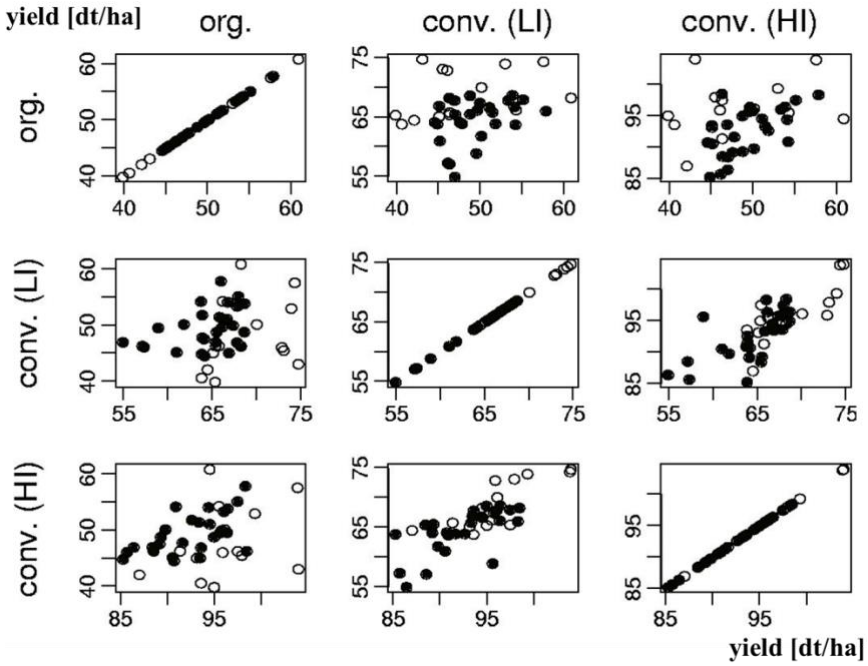

Figure 11: Relations between yield results of VCU (value for cultivation and use) trials with wheat conducted under different environmental conditions: organic (org.), low-input conventional (conv. LI), and high-input conventional (conv. HI). Yield performance is measured in dt/ha. Each point corresponds to a variety; filled circles represent those tested in more than 50 environments in the conventional and in more than 12 environments in the organic VCU trials (adapted from Baresel and Reents, 2006, p.86).

Przystalski et al. (2008) evaluated the agronomic performance of barley, wheat and winter triticale in Denmark, Sweden, Netherlands, France, Switzerland, UK and Germany. Despite high genetic correlations between the systems, correlation in the ranking of varieties was evaluated as moderate. Some traits, such as yield performance, could be derived from conventional variety testing. Thus, Przystalski et al. (2008) recommend the combination of organic and conventional variety testing, as

well as the inclusion of testing criteria such as weed competitiveness. Similarly, Osman et al. (2008) recommend supplementing conventional variety testing of spring wheat with organic trials as most traits can equally efficient be evaluated under conventional conditions. Organic trials are needed to evaluate baking quality under a low nitrogen fertilisation regime. Furthermore, Osman et al. (2008) recommend adapting baking tests to the needs of organic processors, i.e. establish baking tests for whole wheat bread instead of industrial baking tests.

Kokare et al. (2014) explored the research question, whether reduced-input conditions can simulate organic conditions. Therefore, they compared ten old and modern varieties of spring barley over a three-year period under high-input conventional, medium-input conventional, organic on-station and organic on-farm conditions. With a few exceptions, the ranking of varieties for yield correlated regardless of management conditions. Ranking under medium-input conventional and organic on-station conditions showed the highest correlation; whereas, organic on-station and organic on-farm conditions showed the lowest correlation (see Figure 12).

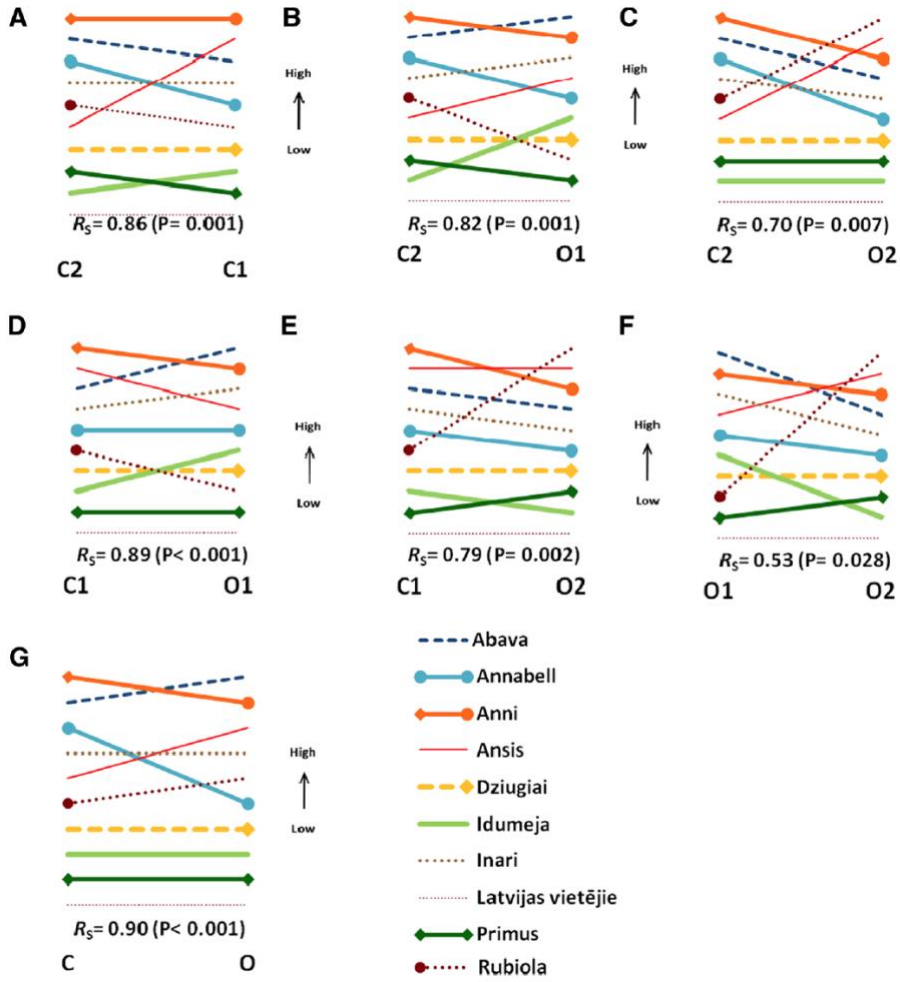

Figure 12: Ranking order from high to low mean yield (averaged over 2006 to 2008) of ten old and modern varieties of spring barley between all site combinations: C2 (high-input conventional), C1 (medium-input conventional), O1 (organic on-station), O2 (organic on-farm). *Abava*, *Annabell*, *Ansis*, *Idumeja* and *Rubiola* are listed in the Latvian variety catalogue. *Annabell* is the most popular variety throughout Latvia. *Abava* and *Rubiola* are recommended as suitable to organic agriculture in the catalogue. *Idumeja* and *Annabell* are also grown by organic farmers. *Inari* and *Anni* originate from Estonia. *Dziugiai* is planned to be reintroduced as a heritage variety in Lithuania. *Latvijas vietejie* is considered a landrace and *Primus* an old variety (Kokare et al., 2014, p.288).

Kokare et al. (2014) conclude that medium-input conventional conditions can be used to make statements about yield performance under organic conditions. However, final testing should be conducted in organic management to assess the suitability for on-farm cultivation. The research by Kokare et al. (2014) indicates that, if conventional VCU testing is done with reduced external inputs, there is the possibility to simultaneously test organic and conventional varieties. On the one hand, there is the risk that reduced-input conventional variety testing will not represent CA; on the other hand, the conventional sector can profit by reducing agrochemical inputs which goes in line with a more integrated and sustainable approach to CA.

A recent investigation by Kucek et al. (2019) emphasises the importance of decentralising variety testing. They assessed spring and winter wheat varieties on organic fields over a six-year period in north-eastern and north-central regions of the United States. Yield, protein, falling number, and test weight of varieties were significantly influenced by G x E interactions.

Research on variety testing is scarce and focuses mostly on major crops such as wheat and barley. More research is needed to test species-specific and trait-specific derivation. From above-mentioned research results, it can be concluded that reduced-input conditions and supplementary organic VCU trials provide valuable information for certain crop species and for certain traits. However, the necessity of separate organic VCU testing is controversial. Problematic in the system of supplementary organic VCU testing is that normally both trials have to be paid, creating a negative incentive for organic breeding activities (Kovács and Pedersen, 2019). Moreover, research supports the necessity of post-registration trials which evaluate the regional performance of a variety. In contrast to conventional varieties, regional adaptation of varieties is more important for organic varieties, as these are normally not intended for global cultivation.

These findings go in line with DENEKEN's statement. For him, there is no exclusive organic track to test a candidate variety. Instead, he strives to combine conventional and organic VCU testing to maximise the knowledge benefit for both production system. He states that if conventional and organic variety trials lead to the same result regarding the assessed parameter, it is more efficient to test the variety under conventional conditions. DENEKEN describes this as "parameter optimisation". Organic conditions can create noise in the trials, and, thus, conventional trials are more efficient and give more viable results. For instance, to measure disease resistance, the use of herbicides is useful to eliminate the noise of weeds in the trials which could affect disease susceptibility of a variety. Nevertheless, most organic farmers and breeders accept results of variety testing only if conducted under regional and organic conditions, similar to their farm or breeding garden, respectively. As a result of these uncertainties, the implementation and design of organic VCU testing throughout Europe is inconsistent.

Another barrier to organic variety testing, are organic testing locations. Fields for organic variety testing are ideally managed organically for at least five years since crop performance might deviate in the first years after conversion. In conventional variety testing, environmental influences can be standardised by the use of pesticides and fertilisers. In organic variety testing, heterogeneous soil conditions and differences in weed manifestation may influence results. Thus, the ideal organic field is as homogeneous as possible in order to be able to identify varietal differences, and an increased plot size and number of replicates are needed to minimise experimental error (Levy et al., 2006).

Interviewed breeders criticise that organic fields for variety testing are not representative of organic farms and do not provide information on the variety's on-farm performance.

Related thereto is the challenge of financing organic variety trials. With a share of total farmland of 7.2% in the EU in 2017, the organic sector represents a niche sector (FiBL Statistics, 2019), for which breeders have little incentive to breed for, and thus, there is little interest in organic variety testing. With 1.37 million ha organic agricultural land, Germany is one of the major players in the EU, after Spain, Italy and France (Willer et al., 2019). Additionally, the development of organic variety testing in Germany is financially supported by the government. In contrast, in Denmark, trials have to be paid by breeders. In theory, all crops can be tested in organic VCU trials, but there were only few applications for organic winter wheat and spring barley so far, as these are crops with the highest economic importance. This might lead to a suppression of varieties with minor economic importance (Kovács and Pedersen, 2019). According to DENEKEN, the development of organic variety testing for minor varieties requires an initial political support by financing organic breeding and organic variety testing until the market regulates itself.

Discrepancies exist in regard to the design of organic variety trials. In Germany, breeders provide seeds for VCU and post-registration trials. Normally, organic breeders deliver organically multiplied seeds, whereas conventional breeders deliver conventionally multiplied, untreated seeds. According to DENEKEN, it would be best to use seeds of the candidate variety and reference variety without seed treatment throughout the whole multiplication process. Similarly, the handbook of "Cereal Variety Testing For Organic And Low Input Agriculture" states that seed quality should be as similar as possible for all candidate varieties subject to variety testing. Despite this, organic seeds are often not available from conventionally bred varieties which are tested for their suitability for OA (Levy et al., 2006). Müller (2009) questions whether results of organic variety testing are significant. He demonstrated that the origin of seeds of spring barley influences test results in favour of conventional, untreated seeds. The use of highly soluble mineral fertilisers and synthetic variety protection agents gives conventional seeds an unfair advantage in variety testing; whereas, in practice, it is mandatory for organic farmers to use organically multiplied seeds. Müller (2009) wishes to base organic VCU testing on organic seeds in order to identify varieties which produce high-quality seeds under organic conditions.

Furthermore, in Germany, the choice of reference varieties is separately considered for organic and conventional variety trials. In contrast, in Denmark, the same reference varieties are used in organic and conventional VCU testing. On the one hand, this enables comparing of testing results of both trials (DENEKEN).; on the other hand, organic varieties have to compete with conventional varieties which are bred for high yields instead of stable yields. Nevertheless, the FPVO faces the challenge of finding three reference varieties which are representative of organic farming throughout Germany. Speciality varieties, such as food barley for *Tsampa*, might be suppressed if they are compared to the highest-yielding barley varieties in OA.

5.2.1. Vegetables

In Germany, vegetable varieties have to meet requirements of DUS testing which is conducted under conventional conditions on one location in Germany or under different pedo-climatic conditions in other countries. There is no VCU testing for vegetables and, with the exception of spring onion in

Saxony, there is no information on official post-registration trials with vegetables under organic conditions. Breeding companies and organisations conduct their own trials to test for regional suitability under organic conditions. The limited number of organic locations and limited number of organic vegetable breeders aggravates the establishment of organic variety testing of vegetables. The absence of organic variety testing, as well as the absence of a special category in the national variety lists and the EU common catalogues create a negative incentive for breeders to breed for varieties suitable for OA (Kovács and Pedersen, 2018; Kovács and Pedersen, 2019). Döring et al. (2012) agree that more information on the performance under organic conditions of registered varieties is needed to combat the lack of organic seeds.

The situation in the EU is similar: Some EU Member States have established unofficial post-registration trials for vegetables, conducted by research institutes, organisations or farmers. For a comparison of post-registration testing of vegetables in EU Member States, examined in the scope of the LIVESEED project, see Table 10 at the end of the discussion part. In Denmark, variety trials of vegetables have been either part of projects by AgroTech, an institution for advisory, product development and innovation within the food and agricultural sector; or privately conducted by seed companies. The establishment of organic variety trials for vegetables which represent on-farm pedo-climatic conditions is difficult. Thus, Danish vegetable farmers base their variety choice on recommendations by seed suppliers and their own experience (Kovács and Pedersen, 2019).

In contrast to cereals, research on the necessity and conditions of organic variety testing with vegetables is scarce. Lammerts van Bueren et al. (2012) investigated onion varieties over a four-year period in the Netherlands. They examined whether it is necessary to have separate organic variety trials or whether a combination of organic and conventional variety trials provides sufficient information. Some onion traits, such as plant density and proportion of small and large bulbs was significantly affected by the management system. Other traits, such as uniformity and earliness were affected by G x M interactions. Nevertheless, the management effect and G x M interactions did not lead to a difference in variety ranking. Thus, Lammerts van Bueren et al. (2012) conclude that conventional variety testing can provide valuable information if plots for variety testing are managed extensively and if additional testing criteria such as leaf erectness, and susceptibility to downy mildew and leaf blight are included. Renaud et al. (2014) investigated 23 broccoli varieties over a three-year period in Maine and Oregon. They examined whether broccoli varieties should be evaluated in organic or conventional systems. Trials demonstrated that location and season were the major causes for variation in broccoli variety performance; whereas, the management effect played a subordinate role. On a local scale, the organic management system and G x M interactions significantly influenced broccoli variety variation, indicating the importance of organic post-registration trials to evaluate the regional suitability of an organic variety.

Some organic vegetable breeders attribute rejection of candidate varieties to testing conditions. Thus, they wish for variety testing under organic conditions as well as trials over several years and several locations in order to illustrate yield stability. Furthermore, they wish for the inclusion of different pedo-climatic conditions which reflect on-farm conditions in order to assess the regional suitability of a variety. The establishment of organic variety testing is difficult due to the lack of financial

resources and locations which have been managed under certified organic conditions. As a trade-off, organic vegetable breeders wish for more tolerance in DUS testing.

5.3. Need for adapted DUS and VCU protocols

5.3.1. DUS testing

Two conflicting views regarding the DUS system can be identified: Some interviewed breeders express the wish to lower the number of testing criteria, whereas others wish to include additional criteria, such as taste, to highlight a special distinctness of a variety. Interviewed coordinators do not have a strongly biased view. In general, interviewees do not criticise the DUS system per se, as it is important for identification of a variety and as it acts as a consumer protection law. However, interviewed breeders criticise that the combination of variety protection and identification of a variety has led to a rigid system with low tolerance levels. This rigid system restricts the access of varieties to the market, and thus, contributes to the loss of agricultural biodiversity. Coherently, Lammerts van Bueren et al. (2018) criticise that ”policy and governance rules involved in variety testing protocols, variety registration, and on-farm seed saving, once developed to protect the seed users (farmers), now more and more seem to develop into institutions that protect the interest of the breeding industry” (p.4). They argue that variety testing should be designed in a way that supports minor crops as well as alternative approaches to breed major crops in order to boost breeding activities to that effect.

The study by Ciancaleoni et al. (2016) indicates that varieties of interest to OA risk of being rejected due to the barrier of homogeneity in the current DUS system. Ciancaleoni et al. (2016) compared the yield performance of four broccoli varieties over a three-year period in Italy. Varieties included in the trial were one F1 hybrid, one landrace and two synthetics which were specifically developed for the low-input conditions of OA. The landrace and the two synthetics displayed a higher level of heterogeneity and a lower yield performance than the F1 hybrid. However, the landrace and the two synthetics displayed a higher yield stability in yield-limiting environments. Ciancaleoni et al. (2016) conclude that F1 hybrids should be used for favourable environments; whereas, landraces and synthetics meet the requirements of yield stability in OA.

Moreover, the genetic constriction necessary to meet homogeneity requirements may lead to a reduction in performance. According to the study by Dawson et al. (2011), a lot of effort is undertaken to select for a high level of genetic homogeneity to meet DUS requirements under testing conditions. However, when the variety is assessed under organic on-farm conditions, it displays a high level of phenotypical heterogeneity. In their study, Dawson et al. (2011) examined eight farmer varieties and two modern varieties of bread wheat on organic farms, over a three-year period in France, Italy and the Netherlands. Under organic on-farm conditions, farmer and modern varieties had a similar level of intra-varietal heterogeneity which may result from environmental influences which are stronger under organic conditions.

DENEKEN describes the DUS system as a “generic system which qualifies the species and not the suitability for either organic or conventional production”. In line with the UPOV and CPVO system, DUS testing is used to grant intellectual property rights. Thus, according to DENEKEN, it is not possible to reduce the number of testing criteria within DUS testing; otherwise, there would be the risk of piracy. DUS testing awards PBR which makes breeding a profitable business and promotes innovation in plant breeding (Gilliland, 2010; Andersen, 2016). On the other hand, PBR restricts

using, saving and exchanging of seeds (Andersen, 2016). The DUS system is an internationally agreed concept and needs to be internationally harmonised. Thus, adaptation proves to be more difficult than adapting the VCU system to the needs of the organic sector. One possible solution would be to differentiate between testing for the identification of a variety, and testing for variety protection. In such a scenario, farmers can choose themselves, whether to meet adapted criteria without the possibility of variety protection, or whether to meet the full criteria with the possibility of variety protection. Furthermore, adaptation assumes the inclusion of organic varieties as a separate concept in the UPOV Convention in which higher tolerance levels in homogeneity are granted.

5.3.2. VCU testing

Two conflicting views regarding the VCU system can be identified: Interviewed coordinators describe the testing system as a consumer protection law. Coherently, Renaud et al. (2016) describe mandatory variety registration and release as a strategy to protect farmers from low-quality seeds and varieties. VCU testing ensures that the farmer gets an improved variety: "[…] a clear improvement either for cultivation or as regards the uses which can be made of the crops or the products derived therefrom" (2002/53/EC, Article 5 (4), L 193/3). Thus, some interviewed breeders wish to put more emphasis on VCU testing, especially on traits which are important to OA, such as plant health, weed competitiveness and nutritional qualities; and to put less emphasis on DUS testing. Furthermore, they ask to adjust thresholds for certain testing criteria by, in some cases, allowing intermediary forms or traits frequencies; for instance, by allowing intermediate disease susceptibility as not the same diseases are equally important in OA and CA.

In contrast, other breeders request optional VCU testing. In such a scenario, there is the possibility to officially test the value of a variety, but more importantly the breeder is responsible for the description of value, and the definition of value is left to the farmer or seed user. A similar system exists in the USA, where it is mandatory to label seed packages with information on the quality of the seed and variety, but it is not mandatory to undergo variety testing. As a consequence, there is a wider varietal assortment on the market (Renaud et al., 2016). The wish for optional VCU testing stems from the criticism that current testing criteria are adapted to cultivation under conventional conditions and industrial bread-making (Lammerts van Bueren et al., 2011).

Traits vital for OA are not assessed in conventional VCU testing and the inclusion of new testing criteria requires an extensive process in which methods and standards for the assessment are validated. Breeders have the possibility to more quickly adapt to newly developed tests. For instance, the FPVO does not test for resistances against bunt and loose smut, due to a lack of a suitable methodology and/or executing institution; whereas, breeders, such as SPIEß, test for these resistances with tests described in scientific literature. This also applies to other parameters such as suitability to harrowing and nutrient-use efficiency. So far, only the examination of weed competitiveness and quality traits such as gluten content have been included in organic VCU testing in Germany. According to the handbook of "Cereal Variety Testing For Organic And Low Input Agriculture" examinations of organic wheat and barley should include weed competitiveness, nutrient-use efficiency, susceptibility to diseases, lodging resistance and processing quality. The handbook provides extensive information on methodologies for the assessment of aforesaid traits (Donner and Osman, 2006). An extension of the handbook to other crop species could provide a useful toolbox for

establishing organic variety trials throughout the EU. In agreement with the handbook of "Cereal Variety Testing For Organic And Low Input Agriculture", DENEKEN assesses weed suppression, quality of the crop, disease resistance and yield as important testing criteria for varieties suitable for OA. However, he claims that some of these aspects can be measured in adapted conventional trials, whenever they generate the same knowledge as organic trials.

Choice of testing criteria included in VCU testing can have an impact on the direction of future breeding activities. Osman et al. (2008) observed that the inclusion of weed competitiveness in VCU testing led to an increase in breeding efforts towards varieties with a higher weed competition capacity. This indicates that, in order to boost breeding of organic varieties, it is necessary to have adapted testing criteria.

In vegetable breeding, there is no official VCU testing, but breeders conduct their own value tests. Interviewed vegetable breeders do not wish for VCU testing as they regard it as restrictive. A higher nutritious value and a better taste are important purchase criteria for organic consumers (Hughner et al., 2007). Thus, the taste plays a vital role in organic vegetable breeding. As taste is subjective it is problematic to be valued by official tests. Furthermore, the quality of a vegetable depends on the target market. For instance, WATSCHONG breeds for non-uniform ripening suitable for self-sufficiency; whereas, DENEKEN assesses the quality of vegetables according to their uniformity as this is demanded by commerce. For the most part, organic vegetable growers in Denmark rely on company trials or conduct their own testing due to a very specialised production related to region of production and soil type (Kovács and Pedersen, 2019).

5.3.3. Alternative registration

Organic breeders have to focus on fulfilling DUS and VCU criteria while, possibly, neglecting criteria which are more important to OA. There are possibilities to bypass the DUS and VCU system, by registering a variety as organic heterogeneous material, conservation and amateur variety, respectively. Breeders specifically breed populations as these have the possibility to adapt to on-farm conditions. Currently, only varieties of wheat, barley, oats and maize can be registered as populations. With the new organic regulation (EU) 2018/848, it may become possible to register other species as organic heterogeneous material. Registration as amateur and conservation varieties are often used as an alternative registration option if the variety is rejected in DUS and VCU testing. However, these alternative registration options impose restrictions in regard to seed distribution and marketing, and thus, have the reputation of being a "regulation of prevention" (SPIEß). Breeders wish for less restrictive registration options and for the possibility of variety protection. In order to combine conflicting demands in regard to DUS and VCU testing, MÜLLER and SPIEß propose to introduce an additional category in the EU regulation for niche varieties, a concept similar to niche varieties in Switzerland.

In 2010, niche varieties were introduced in the Swiss legislation for seed and plant material (*Saat- und Pflanzgut-Verordnung*) by the Federal Department of Economic Affairs, Education and Research *(Eidgenössisches Departement für Wirtschaft, Bildung und Forschung, WBF)*.

According to the legislation, the following groups can be registered as niche varieties:

- landraces (varieties which originate from natural mass selection within traditional farming systems of a certain area),
- old varieties (varieties which have been removed from the national or a foreign variety catalogue, at least two years ago),
- *Ökotypus* of forage crops (plant groupings which originate from natural selection within the ecological conditions of a certain area and which are morphologically and physiologically diverse), and
- other varieties.

To be legally marketed, niche varieties require an official application but do not have to pass official DUS and VCU testing. The variety is not listed in the variety catalogue and seeds do not have to be certified but have to be labelled as "approved niche variety, seeds not certified". In contrast to conservation and amateur varieties, there are no quantitative restrictions in regard to cultivation and marketing, even though, the Federal Office for Agriculture (*Bundesamt für Landwirtschaft, BLW*) reserves the right to determine a maximum quantity of distributed seeds (Eidgenössische Departement für Wirtschaft, Bildung und Forschung (WBF), 1998). The concept of niche varieties was introduced to preserve agricultural biodiversity (Bundesamt für Landwirtschaft (BLW), 2018). This goes in line with FAO's recommendation of maintaining released varieties alongside farmer's varieties, as postulated in "The State Of The World's Biodiversity For Food And Agriculture" (FAO, 2019). Seeds of niche varieties, however, can only be marketed within Switzerland, as they are not legally accepted in EU Member States (Bundesamt für Landwirtschaft (BLW), 2018). As constituted on the 8th of April 2019, 63 varieties have been registered as niche varieties; inter alia, varieties of onion, cabbage, carrot, tomato, potato, wheat, spelt, triticale, and maize (Bundesamt für Landwirtschaft (BLW), 2019). Advantage of the concept of niche varieties is that seeds with minor economic importance can be legally marketed as DUS and VCU testing and associated costs do not present a limitation (Wilbois and Messmer, 2017). However, niche varieties, similar to conservation and amateur varieties, cannot be legally protected as they are not tested for DUS. To some interviewed breeders this presents a disadvantage. Instead, they ask for adapted DUS criteria, which allows variety protection of niche varieties, which, in turn, creates an incentive for breeders to breed for more diversity. Breeders accept costs of DUS testing due to the option of variety protection.

5.4. Need for harmonised implementation of organic variety testing

According to Gilliland (2010), the purpose of regulations is three-fold: "control the right to ownership, quantify fitness for use and supervise distribution to the end user" (p.175). The qualitative content analysis highlights the discrepancy of interviewees regarding the definition of "organic varieties suitable for organic production" in EU 2018/848. It becomes evident that the definition leaves freedom for interpretation, and thus, hampers with its uniform implementation throughout the EU. Renaud et al. (2016) identify an uneven regulatory implementation and associated trade conflicts as an impediment to the development of the organic sector. These imbalances arise from conflicting interests of stakeholders. Renaud et al. (2016) hypothesise that a harmonised implementation of the organic regulations would increase the volume of organic seeds available to organic farmers, and thus protect the integrity of the organic sector.

In the EU, Member States are responsible for enforcing regulations which are set up by the EC (Renaud et al., 2016). DUS testing conforms to internationally agreed guidelines. In order to implement organic DUS testing throughout the EU, a separate category for organic varieties in UPOV guidelines and CPVO protocols is necessary. In contrast, interpretation of organic VCU and post-registration testing is in the hand of responsible testing authorities. More affluent EU Member States are more advanced in the implementation of organic VCU and post-registration testing; whereas, in less-affluent EU Member States, the lack of organic breeding, especially in the vegetable sector; differences in language, agricultural and cultural traditions; and differences in pedo-climatic conditions hamper with the development of organic variety testing (Renaud et al., 2016). Testing authorities use different methodologies, standards, and weigh testing criteria differently. Gilliland (2010) proposes to standardise VCU testing in an internationally agreed concept, similar to DUS testing, in order to encourage breeding progress. Standardisation of organic variety testing can improve the quality of testing and increases the availability of organic seeds and adapted varieties. In order to achieve the objective of strengthening the organic seed and breeding sector throughout the EU, the LIVESEED project aims to harmonise the implementation of the EU organic regulation by developing guidelines for organic variety testing (IFOAM EU, n.d.b). Within the LIVESEED project, guidelines for adapted protocols for different species will be developed which could be tested in the expected seven-years-temporary-experiment, starting in 2021, "[i]n order to meet the needs of organic producers, to foster research and to develop organic varieties suitable for organic production, taking into account the specific needs and objectives of organic agriculture such as enhanced genetic diversity, disease resistance or tolerance and adaptation to diverse local and climate conditions" (EU 2018/848, (39), L 150/6). This cooperation between stakeholders in the organic sector, national authorities and the EC is important to ensure a harmonised implementation throughout the EU. However, according to Renaud et al. (2016), the EC needs to impose stricter regulations for the option of derogations.

In Germany, the organic market is one of the most developed markets within the EU which gives an incentive for developing framework conditions to ease the access of organic varieties to the market. Thus, Germany is a pioneer in registration and post-registration testing of organic varieties. However, breeding and variety testing take place mostly with crops of high economic importance, while minor crops, especially vegetables are neglected. In Germany, the FPVO is responsible for DUS and VCU testing. Federal State Offices are responsible for post-registration testing and conduct VCU testing on behalf of the FPVO. Federal State Offices within one crop-specific cultivation area cooperate in order to issue recommendations for similar pedo-climatic conditions. This cooperation between Federal State Offices and with the FPVO requires effective communication, uniform methods and standards to jointly evaluate results on a statistically significant basis. Regular meetings in working groups, workshops and research are used to establish and iteratively develop an efficient testing system for assessing varieties for OA. Statistical evaluation and data exchange are conducted with the software PIAF. PIAF is not open to the public but preliminary and final results are made available shortly after harvest. In general, great importance is attached to transparency. Moreover, communication between coordinators of variety trials and breeders is well-established which allows, in some cases, adjustment of testing conditions and protocols. For VCU testing, reference varieties are considered separately for organic trials and the same reference varieties are used throughout

Germany which allows comparison of results; whereas, for post-registration testing, Federal State Offices have different methods for choosing reference varieties. Varieties suitable for OA can be identified in the descriptive variety lists, issued by the FPVO and the recommended variety lists, issued by the Federal State Offices. However, there is no separate category in the national variety lists and the EU common catalogues which aggravates the identification of varieties suitable for OA in other EU Member States. In Germany, separate organic VCU testing costs the same as conventional VCU testing. Post-registration testing is funded by the Federal States. Financial resources limit the number of testing locations and species included in post-registration testing. Thus, mostly crops with major economic importance are subject to trials, which might restrict on-farm diversity. Paired with the difficulty of identifying varieties suited for OA in the EU common catalogues and national variety lists, there is little incentive for farmers to cultivate minor crops. Table 6 illustrates strengths, weaknesses, opportunities and threats (SWOT) of the organisational structure and trial design of organic variety testing in Germany.

Table 6: SWOT (strengths, weaknesses, opportunities, threats) analysis of the organisational structure and trial design of organic VCU (value for cultivation and use) and post-registration testing in Germany.

Strengths	**Weaknesses**
▪ Separate organic VCU testing costs the same as conventional VCU testing ▪ Possibility for organic post-registration testing, based on crop-specific cultivation areas ▪ Governmental support in research and financing of post-registration trials ▪ Communication between FPVO, coordinators and breeders ▪ Uniform standards and methods; good statistical evaluation; transparency	▪ No separate category in national variety lists ▪ Limited number of testing location and species included in variety testing; no testing of vegetables ▪ Limited number of organic breeders ▪ Uneven implementation of reference varieties in post-registration testing ▪ PIAF not publicly available
Opportunities	**Threats**
▪ Separate organic VCU testing decreases price burden ▪ Regional recommendations based on pedo-climatic conditions ▪ Iterative development of variety testing to increase efficiency ▪ Possibility for adjustment of trial conditions and protocols	▪ Restriction of agricultural diversity by focusing on crops with major economic importance ▪ Little incentive to breed and cultivate minor crops

In Denmark, TystofteFonden is responsible for DUS and VCU testing. DUS testing is conducted on one location and conforms with UPOV guidelines and CPVO protocols. Organic VCU testing is conducted separately for winter wheat and spring barley. Trials with winter wheat take place on three locations and trials with spring barley on four locations. Theoretically, all species can be tested for their value for cultivation and use under organic conditions. However, breeders have to pay for VCU testing and the price presents a limitation, especially for testing of minor crops. Results of VCU testing are issued on the website "SortInfo". In the descriptive variety lists, varieties get a remark about testing conditions. In the Danish national variety lists, there is no specification of testing conditions (Kovács and Pedersen, 2019). DENEKEN from TystofteFonden expresses an endeavour to make variety testing more efficient by combining conventional and organic trials whenever they

provide the same information in regard to the tested parameter. Organic post-registration testing is conducted as part of "The National Field Trials" (*Landsforsøgene*®). SEGES, the Technological Institute and local trial units are responsible for coordinating and performing trials. Post-registration testing takes place on-farm on four locations throughout Denmark. There is no general rule for number of varieties, number of replicants and duration of testing. Trials are mostly used to test varieties originating from conventional breeding for their suitability for OA. Due to the fact that breeders have to pay for the expenses of post-registration testing, mostly crops with major economic importance (oat, spring barley, spring- and winter wheat) are included. Other crops (faba bean, sunflower, clover, grass) are tested with developmental activities depending on project funding. Trials with vegetables have been abandoned due to high costs, combined with low interest from farmers to conduct national vegetable trials. Preliminary results of post-registration testing are disseminated on the website "Nordic Field Trial System". After statistical evaluation, results are available on the website "SortInfo". There is a strong focus on "online access to knowledge" (Kovács and Pedersen, 2019, p.48). All results are publicly available and actively used by the advisory services (Kovács and Pedersen, 2019).

Table 7: SWOT (strengths, weaknesses, opportunities, threats) analysis of the organisational structure and trial design of organic VCU (value for cultivation and use) and post-registration testing in Denmark.

Strengths	**Weaknesses**
▪ Separate organic VCU testing ▪ Possibility for organic post-registration testing ▪ Potentially all crops can be included in organic variety testing, if demand is sufficient ▪ Good statistical evaluation ▪ High value on transparency; online access to knowledge	▪ No separate category in national variety lists ▪ Breeders have to pay for the expenses of organic variety testing – a disadvantage if demand is not sufficient to be economic beneficial to breeders
Opportunities	**Threats**
▪ Separate organic VCU testing decreases price burden ▪ Regional recommendations ▪ Combination of organic and conventional trials can make testing system more efficient	▪ No trials with minor crops and vegetables due to high costs

Throughout the EU, not all Member States implemented organic VCU and/or organic post-registration testing (see Table 8 and Table 9). Among the countries who have implemented organic variety testing, there are different levels in organisational structure and trial design.

Hitherto, in Germany, Austria and Denmark, there is a possibility to test varieties originating from OPB or BFOA in separate organic VCU trials. France and Latvia have supplementary organic VCU trials. The organic market represents a niche sector for which breeders have little incentive to breed for, which, in turn, causes a low demand for organic VCU testing. In addition, financing and a lack of governmental support hampers with the development of organic VCU testing. Costs for separate organic VCU testing are normally the same as for conventional VCU testing. For supplementary organic VCU testing, expenses increase accordingly. In Austria, costs for organic VCU testing are lower than for conventional VCU testing due to governmental support. In Germany, VCU testing of winter wheat costs €3340 per year, in Austria €691.4 per year, in Latvia €242 per location and year

(usually done on two locations), and in Denmark around €2500 per year (Kovács and Pedersen, 2019). According to Osman et al. (2016), the costs represent a barrier to OPB activities. Thus, a precondition for more variety release of organic varieties is to lower costs of mandatory variety testing.

Post-registration testing of agricultural crops is more developed than vegetable trials in EU Member States. In descending order, wheat, barley, triticale and oat are the crop species which are mostly tested for their regional performance in OA (see Figure 10), indicating that it is most likely to set up organic trials for crops with a high economic importance. The complexity of trials differs among EU Member States. There is a wide range in regard to the number of locations, the number of repetitions, and the statistical set-up. Germany and Denmark are examples of rather complex trials with several repetitions and randomised block designs. In EU Member States, trials are conducted on-station and/or on-farm. Trials follow the conventional protocol, a simplified protocol, or an adapted protocol which includes specific traits of interest for OA (Kovács and Pedersen, 2019). Post-registration testing can be conducted by private or public institutions. Trials are funded by the government, projects, application fees, users or are based on voluntary work. Farmers, researchers, breeders, advisors and seed companies might be involved in the choice of varieties and assessments. However, only a few institutes involve farmers in the assessment (Kovács and Pedersen, 2019). For the development of variety testing in some species, it might be useful to include all actors along the value chain in the assessment (Lammerts van Bueren et al., 2003). Mostly, results are publicly available, but in some EU Member States, results are only issued within a closed network. Only France, Italy, Switzerland and Germany have official recommendation lists for varieties suitable for OA (Kovács and Pedersen, 2019). Post-registration testing of vegetables is not well-developed (see Table 10). Normally, trials are project funded and conducted privately by unofficial institutes, breeders or seed companies. Thus, there are no recommendation lists for vegetables. Different crop species can be subject to post-registration testing, but, due to its economic importance, tomato is most widely tested (Kovács and Pedersen, 2019).

Table 8: Overview of VCU (value for cultivation and use) testing in EU Member States, examined in the scope of the LIVESEED project, work package two (cf. Kovács and Pedersen, 2019).

EU Member State	Testing authority	VCU testing (conventional, supplementary, separate organic trials)	Species
France	GEVES (Variety and Seed Study and Control Group)	Supplementary	Winter wheat (for soybean two organic locations)
Greece		Conventional	
Austria	AGES (Austrian Agency for Health and Food Safety)	Separate organic Supplementary	Winter wheat Winter barley, winter rye, winter triticale, winter spelt, spring wheat, spring barley spring oat, potato
Hungary		Conventional	
Italy		Conventional	
Latvia	AREI (Institute of Agricultural Resources and Economics)	Supplementary	Spring wheat, spring barley, rye, oat, buckwheat
Netherlands		Conventional	
Poland		Conventional	
Romania		Conventional	
Switzerland		Conventional (low-input conditions, with one organic location out of nine)	Winter wheat, spelt
United Kingdom		Conventional (possibility to request for trials under organic conditions)	
Denmark	TystofteFonden; SEGES; Technological Institute and local trial units	Separate organic (possibility to request for any variety to be tested under organic conditions)	Winter wheat, spring barley
Germany	FPVO; Federal State Offices	Separate organic	Winter wheat, winter barley, spring wheat, spring barley, spring oat

Table 9: Overview of official and unofficial organic post-registration testing of agricultural crops in EU Member States, examined in the scope of the LIVESEED project, work package two (cf. Kovács and Pedersen, 2019).

EU Member State	Testing authority	Funding	Species
France	Collaborative network, coordinated by ITAB (Technical Institute for Organic Farming)	Public funding	Winter wheat, triticale, spelt, spring wheat
Greece	AEGILOPS (Network for Biodiversity and Ecology in Agriculture)	Project funding, user funding	Wheat (durum, bread, emmer, einkorn, spelt, compactum, turanicum), barley
Austria	AREC (Agricultural Research and Education Centre); AGES (Austrian Agency for Health and Food Safety); BIONET project	Public funding	Cereals, maize, field bean, soybean, lupin, sunflower, potato, poppy, oil flax, etc.
Hungary	MTA ATK (Centre for Agricultural Research of the Hungarian Academy of Sciences); ÖMKi (Research Institute of Organic Agriculture)	Project funding Project funding, user funding	Winter wheat, emmer, einkorn, soybean
Italy	CREA (Council for Agricultural Research and Agricultural Economics Analysis) under Ministry of Agricultural, Food and Forestry Policies; RSR (Rete Semi Rurali, Italian Farmers' Seeds Network)	Public funding Project funding, user funding	Durum and soft wheat
Latvia	AREI (Institute of Agricultural Resources and Economics)	Project funding	Winter wheat, spring wheat, oat, triticale, potato, pea, potato
Netherlands	LBI (Louis Bolk Institute)	Public funding	Spring wheat (until 2018)
Poland	IUNG-PIB (Institute of Soil Science and Plant Cultivation) under MARD (Ministry of Agriculture and Rural Development); University of Life Sciences in Lublin; IHAR (Plant Breeding and Acclimatisation Institute)	Public funding	Winter wheat, winter triticale, winter rye, spring wheat, spring barley, oat, blue and yellow lupin, field pea
Romania	NARDI (National Agricultural Research and Development Institute)	Public funding, project funding	Wheat, barely, oat, triticale, maize, millet, pea, lentil, lupin, soybean, sunflower, etc.
Switzerland	FiBL (Research Institute of Organic Agriculture); Agroscope	Public funding, user funding	Winter wheat, potato, maize
United Kingdom	ORC (Organic Research Centre)	Project funding	Winter wheat
Denmark	SEGES (Danish Agriculture & Food Council); Landsforsøgene® (The National Field Trials)	Application fees	Winter wheat, spring wheat, spring barley, oat, faba bean, sunflower, clover, grass, etc.
Germany	Federal State Offices	Public funding	Winter wheat, winter barley, winter rye, winter triticale, winter spelt, spring barley, spring wheat, etc.

Table 10: Overview of unofficial and official organic post-registration testing of vegetables in EU Member States, examined in the scope of the LIVESEED project, work package two (cf. Kovács and Pedersen, 2019)**.**

EU Member State	Testing authority	Funding	Species
France	ITAB (Technical Institute for Organic Farming); Local farmers' organisations	Public funding, private funding	Tomato, carrot, zucchini, celery, asparagus, potato, sweet potato, bean, spinach, aubergine, pumpkin, etc.
Greece	AEGILOPS (Network for Biodiversity and Ecology in Agriculture)	User funding	Tomato, aubergine
Austria	HBLF (Horticultural College and Research Institute); Arche Noah	Private funding, project funding, application fees	Different vegetable species, tomato Tomato
Hungary	ÖMKi (Research Institute of Organic Agriculture)	Private funding, user funding	Potato (until 2015), tomato (until 2016)
Italy	CREA-ORA (Council for Agricultural Research and Agricultural Economics Analysis-Research Unit for Horticulture); RSR (Rete Semi Rurali, Italian Farmers' Seeds Network)/Arcoiris	Project funding	Tomato
Latvia			None
Netherlands			Spinach (until 2009), onion (until 2004)
Poland	InHort (Research Institute of Horticulture)	Public funding	Carrot, cabbage, red beet, onion, tomato, cucumber, bean, pea, cauliflower, broccoli, radish, etc.
Portugal	LSSV (Living Seeds Sementes Vivas)	User funding, project funding, application fees, seed sales	Broccoli, kohlrabi, etc.
Romania	VRDS (Vegetable Research and Development Station)	Public funding, project funding, application fees	Tomato, hot pepper, bell pepper, aubergine, basil, thyme, onion, zucchini, carrot, parsnip, horseradish, cabbage, etc.
Spain	Network of farmers, farmers' organisations, university and seed bank; UPV (Universidad Politécnica de Valencia);	User funding, project funding	Tomato, pepper
Switzerland	FiBL (Research Institute of Organic Agriculture)	Project funding	Cabbage, old landraces and heirloom varieties
United Kingdom	NIAB (plant science organisation); HDRA (now Garden Organic); ORC (Organic Research Centre)	Public funding	Different vegetable crops (until 2006)
Denmark	AgroTech	Project funding	Carrot (until 2014), onion (until 2014), cabbage (until 2015)
Germany	Department for Horticulture of the Saxon Office for Environment, Agriculture and Geology; Bingenheimer Saatgut AG	Public funding Seed sales	Spring onions Organic open-pollinated vegetable varieties

6. CONCLUSION

In this master's thesis, an inductive approach is used to qualitatively analyse the challenges and restrictions of organic registration and post-registration testing of agricultural crops and vegetables. In contrast to quantitative contents, qualitative contents are subject to interpretation. The challenge of qualitative content analysis is to maintain trustworthiness throughout the procedure of preparation, organising and reporting. For this purpose, sampling size, and reliability and validity of the category system were carefully considered; and quotations and visualisations were used to support the analysis. From the analysis of eleven interviews with persons responsible for organic registration and post-registration testing and breeding, four discussion points arose:

(1) The definition of "organic varieties suitable for organic production", as postulated in the new organic regulation (EU) 2018/848, entails three points of which fundamental disagreement prevails. Firstly, the demand for a "high level of genetic and phenotypical diversity" excludes, to some extent, varieties with a high uniformity from OA and contradicts with current DUS requirements. Nevertheless, organic varieties are often embedded in a more diverse environment, and thus, might display a broader diversity which needs to be reflected in DUS testing. Secondly, the demand for varieties "organic breeding activities" is important to boost OPB but presupposes governmental support to ensure a broader variety assortment available to organic farmers. At the moment, due to a lack of OPB, it is necessary to keep the possibility to test conventional varieties for their suitability in OA. For some traits, selection under conventional conditions might be as effective as selection under organic conditions. Thus, BFOA and BFCA might produce varieties suitable for OA, if firstly, breeding goals are adapted, and if secondly, breeding techniques are transparent. Thirdly, the term "organic variety" contradicts with the UPOV definition of a variety, and thus, organic breeders cannot obtain PBR which makes organic breeding unattractive. To conclude, the definition of "organic varieties suitable for organic production", in the new organic regulation (EU) 2018/848, might represent an opportunity to strengthen the organic sector. Without clarification, the definition may restrict the number of varieties available to organic farmers. The current definition leaves freedom for interpretation and, thus, hampers with its uniform implementation throughout the EU.

(2) Organic breeders wish for variety testing under organic conditions. Representatives of testing authorities strive to combine organic and conventional trials, to more efficiently reach the same conclusion. Research suggests that yield, agronomic performance, and quality parameters can be influenced by G, M, E, and their interactions. Thus, post-registration testing is necessary to test the regional suitability of a variety, regardless of the management system. Nevertheless, for some traits, variety testing under organic conditions is indispensable. Hitherto, only a few EU Member States have established organic VCU testing and/or organic post-registration testing. The establishment of organic variety testing, especially for vegetables, is difficult due to a lack of financial resources and organically certified locations, and the specialised nature of vegetables. It is more likely that organic variety testing is established if the crop is of high economic importance in the respective EU Member State. Research on variety testing is scarce and focuses mostly on major crops such as wheat and barley. More research is needed to test species-specific and trait-specific derivations. Discrepancy exists in regard to the design of organic variety testing, i.e. origin of seeds, choice of reference varieties, and choice and number of testing locations. To conclude, variety testing under organic

conditions is necessary to identify some traits in agricultural crops and vegetables which are important for OA. Reduced-input conventional trials might provide valuable information for OA.

(3) Breeders have conflicting views in regard to the adaptation of DUS and VCU testing. Interviewed coordinators do not have a strongly biased view. Adaptation of DUS testing is more difficult than adapting the VCU system. Breeders criticise the low tolerance levels of DUS testing. Some breeders request a lower number of testing criteria, whereas others wish to include additional criteria. In general, interviewees do not criticise the DUS system per se, as it is important for identification of a variety and as it acts as a consumer protection law. DUS and VCU testing are in the farmer's interest as testing criteria ensure that the farmer cultivates a variety which displays an improvement compared to existing varieties in regard to yield, abiotic and biotic resistance and/or quality characteristics. Breeders wish to put more emphasis on VCU testing or wish for optional VCU testing, depending on the breeder's target group. In general, breeders ask for the inclusion of additional testing criteria to highlight the value of the variety for OA. Alternative registration options (organic heterogeneous material, conservation varieties, amateur varieties) are a possibility to bypass the DUS and VCU system, but they present restrictions themselves. One approach to include different opinions regarding DUS and VCU testing is to introduce a new category for niche varieties in the EU regulations which is less restrictive and in which breeders are responsible for describing the qualities of a variety. Nevertheless, there is the need for adaptation of DUS and VCU testing criteria for organic varieties for which variety protection is wanted. Current DUS and VCU protocols are designed for crops with major economic importance. The testing system needs to be adapted to support minor crops as well as alternative approaches to breed major crops in order to create incentives for breeding activities in that respect.

(4) Throughout the EU, variety testing takes place at different levels of organisational structure and trial design. More affluent countries, such as Germany and Denmark, have established a comprehensive variety testing system. However, in less affluent EU Member States with a smaller organic market share, there is a need for governmental support of variety testing and organic breeding activities. Furthermore, the current testing system supports cash crops and suppresses minor crops, thereby contributing to the loss of agricultural biodiversity. A separate category in national variety lists of EU Member States and the EU common catalogues would facilitate the identification of organic varieties. Additionally, breeding activities with organic varieties and minor crops often fall at the hurdle of costs, making governmental support indispensable. A harmonised implementation and standardisation of the EU regulation throughout the EU might help in increasing the volume of organic seeds and adapted varieties available to organic farmers. The LIVESEED project is a valuable starting point to foster cooperation among EU Member States and to strengthen the organic seed and breeding sector throughout the EU.

7. PERSPECTIVES

Organic agriculture is a holistic and sustainable approach to farming which creates the opportunity for resilience in the face of global challenges such as loss of agricultural biodiversity and climate change. Thus, the establishment of organic variety testing needs to be further explored in order to increase the volume of seeds and adapted varieties available to organic farmers, and thereby, strengthening the organic sector. In line with the holistic approach to OA, variety choice is one small building block in a system which relies on multiple, interconnected elements.

Within this master's thesis, the following research needs were identified: degree of combining organic and conventional breeding, degree of combining organic and conventional variety testing, and set-up of a breeding and testing system which supports minor crops. Within the LIVESEED project, further research is conducted in order to make guidelines for adapted protocols for organic DUS and VCU testing to feed into a temporary experiment.

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ANNEX

Table 11: List of institutions responsible for organic post-registration testing and respective link to results of variety trials and recommended variety lists for organic agriculture. Link to national and descriptive variety lists based on official DUS (distinctness, uniformity, stability) and VCU (value for cultivation and use) testing, issued by Federal Plant Variety Office.

Federal State	Institution	URL
Baden-Wuerrtemberg	Centre for Agricultural Technology Augustenberg (*Landwirtschaftliches Technologiezentrum Augustenberg*)	http://www.ltz-bw.de/pb/,Lde/Startseite/Arbeitsfelder/Versuchsergebnisse
Bavaria	Bavarian State Research Institute for Agriculture *(Bayerische Landesanstalt für Landwirtschaft)*	https://www.lfl.bayern.de/iab/landbau/030541/index.php
Brandenburg	State Office for Rural Development, Agriculture and Restructuring *(Landesamt für Ländliche Entwicklung, Landwirtschaft und Flurneuordnung)*	https://www.isip.de/isip/servlet/isip-de/regionales/brandenburg/landwirtschaft/landessortenversuche-neu-2
Hesse	Hesse Department of Agriculture *(Landesbetrieb Landwirtschaft Hessen)*	https://www.llh.hessen.de/pflanze/oekologischer-pflanzenbau/versuchswesen-oekologischer-pflanzenbau/
Mecklenburg-Western Pomerania	State Research Institute for Agriculture and Fisheries Mecklenburg-Western Pomerania *(Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern)*	https://www.landwirtschaft-mv.de/Fachinformationen/OekologischerLandbau/Sorten-und-Empfehlungen/
Lower Saxony	Chamber of Agriculture Lower Saxony *(Landwirtschaftskammer Niedersachsen)*	https://www.lwk-niedersachsen.de/index.cfm/portal/betriebumwelt/nav/328.html
North Rhine-Westphalia	Chamber of Agriculture North Rhine-Westphalia *(Landwirtschaftskammer Nordrhein-Westfalen)*	https://www.oekolandbau.nrw.de/fachinfo/pflanzenbau/ackerbau/, https://www.landwirtschaftskammer.de/Landwirtschaft/ackerbau/index.htm
Rhineland-Palatinate	Competence Centre Organic Agriculture Rhineland-Palatinate *(Kompetenzzentrum Ökologischer Landbau Rheinland-Pfalz)*	https://www.oekolandbau.rlp.de/Internet/global/inetcntr.nsf/dlr_web_full.xsp?src=5YFFWMK232&p1=1J255BJ61E&p3=6J1Y474WUL&p4=TT6A030J05
Saxony	Saxon State Office for the Environment, Agriculture and Geology *(Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie)*	https://www.landwirtschaft.sachsen.de/sortenempfehlungen-19902.html
Saxony-Anhalt	Agriculture and Gardening Office of Saxony-Anhalt *(Landesanstalt für Landwirtschaft und Gartenbau Sachsen-Anhalt)*	https://llg.sachsen-anhalt.de/themen/sortenpruefung/hinweise-zur-sortenwahl/
Schleswig-Holstein	Chamber of Agriculture Schleswig-Holstein *(Landwirtschaftskammer Schleswig-Holstein)*	https://www.lksh.de/landwirtschaft/pflanze/oekologischer-landbau/
Thuringia	Thuringia Regional Office for Agriculture and Rural Areas *(Thüringer Landesamt für Landwirtschaft und Ländlichen Raum)*	https://www.thueringen.de/th9/tlllr//wir/publikationen/voe/sortenratgeber/index.aspx
Germany	Federal Plant Variety Office (*Bundessortenamt*)	National variety lists: https://www.bundessortenamt.de/bsa/sorten/blatt-fuer-sortenwesen/ Descriptive variety lists:https://www.bundessortenamt.de/apps55/bsa_bsl/public/de

Table 12: Expert interview with Gerhard DENEKEN.

Gerhard DENEKEN is administrative manager at TystofteFonden and responsible for financial and quality management. TystofteFonden is the Danish testing authority for coordinating variety testing of arable crops and grasses and for implementing official trials for examination of DUS and VCU criteria.

What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?

(a): A variety could be suitable for organic production, but I have difficulties with the term "organic variety".

According to the UPOV convention 91, Variety definition VI, "variety" means a plant grouping within a single botanical taxon of the lowest known rank, which grouping, irrespective of whether the conditions for the grant of a breeder's right are fully met, can be

defined by the expression of the characteristics resulting from a given genotype or combination of genotypes,
Distinguished from any other plant grouping by the expression of at least one of the said characteristics and
Considered as a unit with regard to its suitability for being propagated unchanged;

"a variety must be recognizable by its characteristics, recognizably different from any other variety and remain unchanged through the process of propagation. If a plant variety grouping does not meet these criteria, it is not considered to be a variety within the UPOV system." It can be still regarded as a variety but does not qualify for plant breeders' rights (PBR).

To obtain PBR a variety suitable for organic production has to be uniform, distinct and stable over generations. The high level of genetic and phenotypical diversity contradicts to the variety definition of UPOV. This part of the definition is problematic for obtaining plant breeders' rights. There is no possibility in protecting your intellectual property rights which you put into a variety and there is no possibility for reflux of investment.

We have organic VCU trials with two varieties at the moment, and they are not characterised by a high level of genetic and phenotypical diversity.

Another simple but important aspect is maturity: How can you ensure an equal maturation if you have phenotypical diversity? A uniform maturation is the first prerequisite to achieve a good quality of the crop.

The high level of genetic and phenotypical diversity refers in my understanding to organic heterogeneous material.

What challenges do you experience in organic variety testing (financial, organisational, etc.)?

We only have a limited number of applications. Potentially, all crops can be tested in organic VCU trials, but we only have applications for organic winter wheat and spring barley. Our organic development is an ad-hoc development. We receive an application, we put together a testing system, trying to justify the variety suitability for organic production.

The biggest challenge is how to combine conventional and organic VCU testing in order to maximise knowledge benefit for both systems. There are points such as disease susceptibility or weed suppression, which could be combined.

Aspects from conventional testing in regard to malting quality, feeding quality, bread-making quality, or disease resistance, can be of benefit to organic farmers, too.

What are crop-specific challenges concerning DUS? Do you think that more or less testing criteria for DUS are needed for identifying varieties suitable for organic farming?

DUS is a generic system which qualifies the species and not the suitability for either organic or conventional production. The basic idea of DUS testing according to UPOV and the CPVO is to grant intellectual property rights. If you want to have intellectual property/protection of your plant material, there are certain requirements you have to fulfil. It is not possible to ask for fewer testing criteria in DUS testing. DUS testing is an internationally agreed concept and needs to be internationally harmonised.

In a simplified version of DUS testing, PBR cannot be obtained. If DUS testing is done solely for identifying a variety and not for distinctness, there is the risk of piracy.

Which testing criteria are important for organic agriculture or for climate-robustness?

In organic VCU weed suppression, quality of the crop, disease resistance or low susceptibility, and consequently yield is important. Some of these aspects can be measured under conventional conditions. For me, it is important to find a good testing system which gives reliable results for the tested parameters. For instance, if I can evaluate weed suppression under conventional conditions, it would give me more valuable results. Organic conditions can create noise in the trials. Conventional trials are efficient and should be used whenever they generate the same knowledge as organic trials. We do not test weed suppression in conventional VCU testing. We have done it previously, but it is too expensive compared to the differentiation we have seen between varieties.

In a good disease monitoring, it could be more valuable to use herbicides in order to eliminate the noise of weeds and to really see the susceptibility of the variety.

Our general testing system is constantly adapting to the environmental changes. We are constantly retesting the varieties. The testing system is set up to identify new and improved varieties also in regard to annual climate alterations.

Do you think it would be useful for organic farmers to have vegetables tested under organic conditions?

We do not have VCU testing for vegetables and it is not a requirement to get on the national list. I would expect that the quality of the crop would be of high importance. From a consumer standpoint, the quality of e.g. carrots is defined by uniformity. The concept of organic heterogeneous material in vegetables shows clearly why we work with uniform varieties. Organic agricultural farmers use the advisory testing/post-registration testing by SEGES in order to identify suitable varieties.
The Danish variety testing system is funded by breeders and seed companies. Thus, only varieties are tested where the demand is sufficient to cover the costs. Niche varieties might be suppressed. The German variety testing system is financed by the Federal States. They test several varieties with the possibility to test varieties with a smaller market share. Do you see any advantages/disadvantages in these systems? The disadvantage of the Danish variety testing system is that niche species such as grasses or vegetables are suppressed. Companies only pay for trials if there is a demand and we do not waste any technical infrastructure without applications. If the political wish is to develop varieties for the organic market there is the need for governmental support, especially in the beginning until it is possible for organic breeding to finance variety testing. Then it makes sense to have the technical infrastructure for organic variety testing.
Organic varieties (varieties bred and propagated under organic conditions) are often tested in comparison to conventional, untreated seeds and varieties originating from conventional breeding. Can significant results be obtained from trials under these conditions? In Denmark, the pre basic, basic and C1 generation can be under conventional conditions, with seed treatment. If the C2 generation is under organic conditions and without seed treatment, it is an organic seed. In the best of all worlds, seeds of the candidate variety and reference variety should be without seed treatment throughout the whole multiplication process. On the other hand, one generation of untreated seeds is the market requirement for organic seeds at the moment. The same reference varieties are used in organic and conventional VCU testing. In principle, organic varieties can be used as reference varieties, if they perform well, is well known and is in multiplication. We are using the same reference varieties in order to have a relation between the testing results of both trials. In relative figures it is possible to make comparisons of both trials. In conventional breeding, tools are used which are excluded in organic breeding like hybridisation or haploid production
What do you see as the next important step in order to develop/improve organic variety testing? Parameter optimisation such as potentially assess disease susceptibility using herbicides. For me, there is no exclusive organic track.

Table 13: Expert interview with Michael FLECK.

Michael FLECK is member of board and Executive Secretary of Kultursaat e.V. The association brings new vegetable varieties to official registration in representation for biodynamic plant breeders.	
With what material are you working with? For what kind of registrations do you apply? We are working in three different areas. Firstly, we register varieties as amateur varieties according to regulation 2009/145/EC which would have problems with homogeneity in DUS testing. Secondly, we register new crossings to DUS testing. Thirdly, there is the possibility to register as a new breeder for already registered varieties. This ensures that, if the actual breeder abandons the variety, seeds are still marketable. We do this with some well-established open-pollinated varieties from conventional breeding: we present our own propagation mechanism to the Variety Office, which conducts trials on one of their testing locations (if the trial results (of "our" sample in comparison to an original sample of the first breeder) are identical, we are included as a "further (conservation) breeder" in the national list and, thus, in the EU Plant variety database. Our main field of work, however, is the development of new crossings.	*Mit was für Material arbeiten Sie? Was für Zulassungen beantragen Sie?* Es gibt drei verschiedene Bereiche, in denen wir tätig sind. Zum einen melden wir Sorten als Amateursorten nach der Regelung 2009/145 EU an, die auf Grund der Homogenitätsregelung Schwierigkeiten hätten. Zweitens melden wir neue Züchtungen mit Registerprüfungen an, um diese der Zulassung zuzuführen. Drittens gibt es noch die Möglichkeit, dass man sich als Züchter für bereits zugelassene Sorten anmeldet, damit falls der Ursprungszüchter sich von dieser Sorte verabschiedet, das Saatgut dieser Sorte weiterhin vertriebsfähig ist. So verfahren wir bei manchen bewährten samenfesten Sorten aus konventioneller Züchtung: wir legen ein eigenes Vermehrungsmuster der Zulassungsbehörde vor, die dann eine Aufwuchsprüfung an auf einem ihrer Prüfstandorte durchführen lässt (und bei identischem Aufwuchsergebnis (der Pflanzen von „unserem" Muster im Vergleich zum Originalmuster des Erstzüchters) werden wir als „weiterer (Erhaltungs-)Züchter" in die Nationale Liste und damit in den Europäischen Sortenkatalog aufgenommen).

	Unser Hauptarbeitsfeld ist aber die Entwicklung von Neuzüchtungen.
Are there organic variety trials for vegetables? In vegetables, there is no organic cultivation in order to test and register varieties under the authority of a Variety Office (normally the FPVO). We ourselves work under certified, biodynamic conditions. To my knowledge, testing stations of the FPVO or of GEVES in France work under conventional conditions.	*Gibt es ökologische Sortenprüfungen im Gemüsebereich?* Es gibt im Bereich Gemüse keinen ökologischen Anbau, unter dem die Sorten im Auftrag der Zulassungsbehörde (bei uns i.d.R. vom BSA) geprüft werden, um sie zuzulassen. Wir selbst arbeiten unter zertifiziert, biologisch-dynamischen Anbaubedingungen. Die Prüfstellen vom BSA oder in Frankreich vom GEVES arbeiten meines Wissens ausschließlich unter konventionellen Bedingungen.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848? (a): Subitem (a) was developed through lobbying of individuals. There are some justifications for this definition but is not necessarily associated with an organic variety or organic breeding. For instance, it can be helpful if a variety from organic or conventional breeding has a high level of genetic diversity to help with robustness against aggressive and versatile pathogen (e.g., a fungi). This could, in particular, be a concept for self-pollinators to handle epidemics in practice on the field or under cover. On the other side, an organic variety does not necessarily need an intrinsic high degree of genetic and phenotypical diversity, to see a great manifoldness on-field. The definition would entail that breeding lines are excluded and that only populations are allowed on the field. Especially with self-pollinators, regardless whether they originate from organic or conventional breeding programmes, the level of diversity is rather small (b): I expect that organic varieties originate from organic breeding, i.e. a variety originates from a development project or programme which is consciously and decidedly oriented to the methodology and aim of OA.	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?* (a): Die Teildefinition (a) ist durch Interessensvertretung Einzelner eingeflossen und hat sicher auch ihre Berechtigung; sie ist aber nicht notwendigerweise mit einer ökologischen Sorte oder ökologischen Züchtung verbunden. Zum Beispiel kann es sehr hilfreich sein, wenn eine Sorte aus ökologischer oder konventioneller Züchtung, ein hohes Maß an genetischer Vielfalt aufweist, damit sie gegenüber einem sehr aggressiven und wandlungsfähigen Pathogen (beispielsweise einem Pilz) beständig sein kann. Das könnte insbesondere bei Selbstbestäubern ein Konzept sein, mit Epidemien in der Praxis auf dem Acker oder im geschützten Anbau umzugehen. Auf der anderen Seite muss es nicht notwendigerweise heißen, dass eine ökologische Sorte in sich genetisch und phänotypisch hochgradig variabel ist, so dass man auf dem Feld eine große Mannigfaltigkeit sieht. Die Definition würde Liniensorten per se ausschließen bedeuten, dass immer bloß eine große Population auf dem Feld steht und speziell bei Selbstbestäubern - egal ob aus ökologischen oder aus konventionellen Züchtungsprogrammen - ist das Level an Diversität nun einmal recht klein zu erreichen. (b): Ich erwarte von einer ökologischen Sorte, dass sie aus ökologischer Züchtung stammt. Darunter verstehe ich, dass die Sorte aus einem bewusst und dezidiert in Methodik und Ziel auf ökologische Landwirtschaft ausgerichteten Entwicklungsprojekt oder Programm stammt.
Are separate organic breeding programmes necessary, or can selection under conventional conditions be as effective, if certain properties are taken into account? As I understand, the question is, whether a selection leads to a variety, regardless from its environment. In our experience, the environment selects as well. Thus, there is the possibility for adapting to the management conditions, in particular for cross-pollinators. According to this theory, it makes sense that selection and breeding programmes at least take place under organic conditions. It would be better if the whole breeding programme is conducted under an organic regime. In additional, conventional breeding programmes are less concerned with crops with a minor financial return, i.e. companies reduce their breeding activities in "minor	*Sind separate ökologische Züchtungsprogramme notwendig, oder kann Selektion unter konventionellen Bedingungen ebenso effektiv sein, wenn bestimmten Eigenschaften mehr Aufmerksamkeit geschenkt wird?* Ich verstehe die Frage so, ob eine Selektion zu einer Sorte führt, unabhängig von der Umwelt. Unsere Erfahrung ist, dass die Umwelt mit selektiert. Das bedeutet, es gibt die Möglichkeit der Anpassung an die Anbaubedingungen, insbesondere bei Fremdbestäubern. Dieser Theorie folgend, ist es logisch, wenn zumindest die Selektion, besser noch ganze Züchtungsprogramme unter ökologischem Regime stattfinden. Zusätzlich bearbeiten konventionelle Züchtungsprogramme immer weniger die Kulturen, die einen geringen ökonomischen Rückfluss bedeuten, d.h. die

crops" and use their resources for crops which promise a high probability of refinancing.
OA is very diverse; thus, it is necessary to include minor crops in breeding which are not economically lucrative.
Following this, there are two explanations why separate organic breeding programmes are necessary: On the one hand, the environment selects as well and the organic environment is different from the conventional one; on the other hand, OA depends on a high diversity of crops – and these are not considered as much in conventional breeding in favour of cash crops.
Adding to this, there are certain consumer expectations and breeding goals, which are often not of interest in conventional breeding. One example is the taste which is often a purchase criterion for organic consumers and, thus, of high relevance for organic breeding.

Firmen reduzieren ihre Züchtungsaktivitäten in vermeintlichen „minor crops" und beschränken ihre Ressource auf die Kulturen, bei denen es eine entsprechend große Refinanzierungswahrscheinlichkeit gibt. Da der Ökolandbau sehr breit aufgestellt ist, ist es jedoch notwendig sich auch mit allen anderen Kulturen zu beschäftigen, die wirtschaftlich nicht lukrativ sind.
Es gibt also zwei Begründungen, wieso aus unserer Sicht separate ökologische Züchtungsprogramme notwendig sind: Zum einen züchtet die Umwelt mit und die ökologische Umwelt ist eine andere als die Konventionelle; zum anderen ist der Ökolandbau auf die Versorgung mit einer breiten Basis von Kulturen angewiesen - und die werden in der konventionellen Züchtungslandschaft zugunsten der „cash crops" nicht mehr so stark bearbeitet.
Dazu kommen bestimmte Verbrauchererwartungen und Zuchtziele, die in der konventionellen Züchtung selten auf Interesse stoßen. Ein Beispiel hierfür ist der Geschmack. Dieser ist oftmals ein Kaufkriterium für Bio-Kunden und hat eine große Bedeutung und Relevanz für die ökologische Züchtung.

Which testing criteria are important for OA or for climate-robustness?
To ensure that a variety is adapted to an organic management regime, it is necessary to test its agronomic properties, i.e. yield as well as yield stability. Hitherto, the FPVO conducts DUS testing with vegetables solely on one single location. A necessary addition is to collect data on more locations and over several years in order to illustrate, on this basis, a certain yield stability and stability of other properties.
Additionally, it is necessary to test the suitability of varieties under different conditions, for example, on lighter soils or clayey soils. This would help farmers to assess varieties for the suitability in their region.
In the last year, precipitation was sufficient in Southern Germany; however, over the course of the whole vegetation period, there was too little rain in Northern Germany. As a consequence, the FPVO faced problems and DUS testing on the location Dachwig (close to Erfurt) could not be evaluated in the testing year 2018. In the future, there will be most likely, more years like this. Thus, it is necessary that plants display a certain resilience. We cannot guarantee that a variety, which was developed under our organic conditions, is as robust in other situations.

Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?
Um zu überprüfen, ob eine Sorte für das ökologische Anbauregime geeignet ist, muss man die agronomischen Eigenschaften prüfen, d.h. Ertrag, aber auch Ertragsstabilität. Das BSA prüft Gemüse im Kontext der Registerprüfung bisher ausschließlich auf einem einzigen Standort. Es wäre eine hilfreiche Ergänzung, wenn Daten an mehreren Orten und über mehrere Jahre erhoben werden, um auf dieser Grundlage eine gewisse Ertragsstabilität bzw. Stabilität weiterer Merkmale abzubilden.
Dabei sollte die Anbaueignung unter verschiedenen Bedingungen geprüft werden, z.B. unter Bedingungen des leichteren Bodens oder tonigem Boden. Das würde dem Anbauer in seiner Region zu einer besseren Einschätzung der Sorte verhelfen.
Im letzten Jahr war in Süddeutschland der Niederschlag immerhin noch hinreichend, aber in Norddeutschland gab es über die gesamte Vegetationsperiode viel zu wenig Regen. Das hat selbst beim BSA zu Schwierigkeiten geführt und der Registerprüfanbau am Standort Dachwig (bei Erfurt) konnte im Prüfjahr 2018 kaum ausgewertet werden. In Zukunft wird es womöglich immer mehr solche Jahre geben. Es ist also eine gewisse Resilienz notwendig. Wir können nicht gewährleisten, dass Sorten, die unter unseren ökologischen Bedingungen entwickelt wurden, sich auch in allen anderen Situationen bewähren.

Which breeding goals do you pursue?
Our breeding takes place on organic farms under biodynamic conditions. On these farms, we do not have the possibility to use certain external resources, such is the case in CA – and we consciously choose not to use these. Due to this reason, we, however, face a certain pressure from, e.g., different fungi. Our breeding populations and lines have to cope with these conditions.

Welche Züchtungsziele verfolgen Sie?
Unsere Züchtung findet auf real existierenden Bio-Betrieben unter biodynamischen Bedingungen statt. In diesen Betrieben haben wir nicht die Möglichkeit, bestimmte Betriebsmittel anzuwenden, die in der konventionellen Landwirtschaft eingesetzt werden können – und das wollen wir auch ganz bewusst nicht. Deswegen haben wir allerdings einen bestimmten Druck z.B. von

We select for a certain aesthetic, i.e. apart from certain yield which is as high as possible, a variety shall have a nice harvest organ, which is preferably without external defects. This means that a variety, for instance a lettuce, does not necessarily need a full resistance but reaches an adequate harvesting rate. For us, OA and organic breeding do not mean 100% resistant varieties. Instead, healthy robust varieties are necessary, which can cope with the management conditions. We aim for horizontal resistances or differences in growth, which, for instance, ensure that a salad outgrows downy mildew (cf. completed and running projects by the Federal Office for Agriculture and Food).

verschiedenen Pilzen. Bei uns müssen sich die Zuchtpopulationen und -linien genau unter diesen Bedingungen bewähren.
Wir selektieren in Hinblick auf eine gewisse Ästhetik. Eine Sorte soll nicht nur gewisse und möglichst hohe Erträge, sondern auch ein schönes Ernteorgan hervorbringen, welches im Idealfall frei von äußeren Fehlern ist. Das bedeutet, bei uns ist eine Sorte, etwa ein Salat, nicht unbedingt vollresistent, sie erreicht aber trotzdem eine hinreichende Aberntequote. Ökolandbau und Ökozüchtung bedeutet für uns nicht, mit 100% resistenten Sorten zu arbeiten, sondern mit gesunden und eher robusten Sorten, die mit den Anbauverhältnissen auseinandersetzen und damit zurechtkommen. Wir streben vielmehr horizontale Resistenzen an oder ein Wachstumsverhältnisse, mit denen zum Beispiel ein Salat dem Falschen Mehltau davon wächst (vgl. abgeschlossene und laufende BLE-Projekte).

Which role does the farmer play regarding breeding of varieties adapted to organic conditions?

Within the last years, the term participatory plant breeding was published repeatedly. In practice of organic breeding, there are different levels of participation. Our breeders which are at the same time gardeners, are positioned on the first level. Our breeding is imbedded in biodynamic vegetable growing. From consumer feedback, breeders can estimate whether their variety is on the right track. A community of breeders is positioned on the second level. For instance, carrot breeders communicate and evaluate breeding goals, breeding progress or other projects with their colleagues. Ideally, this leads to an iterative process in which the approach to breeding is adjusted consistently. Sales partners are positioned on the next level. The latest at F4, they are asked for their assessment of existing varieties or breeding lines in comparison with existing varieties and whether the variety fills a supply gap. Additionally, on this level, we conduct public relations activities. Once or twice per year, we conduct breeding and variety days to boost communication with practitioners, which conduct professional cultivation.
The next step of participation would be, besides communication, to cooperate with practitioners. For instance, for the past two years we established a tomato network in Northern Germany. We include colleagues in selection activities and assessment of breeding lines, in early stages of breeding. We wish to extend and improve this intensive cooperation because we realised that we can learn from each other. Our gardeners can include aspects from their colleagues into their work, and practitioners can learn what is expected from breeding and what are the restrictions of organic breeding. This way, there is a mutual appreciation, exchange and further development of the management system, based on partnership, because not all problems in cultivation can and have to be solved through breeding.

Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?

Der Begriff der partizipativen Züchtung wurde in den letzten Jahren immer wieder publiziert. Tatsächlich finden in der ökologischen Pflanzenzüchtung verschiedene Level der Partizipation statt. Auf dem ersten Level befinden sich bei uns die Züchter, die gleichzeitig auch Gärtner sind. Das heißt unsere Züchtung ist eingebettet in den biologisch-dynamischen Erwerbsgemüsebau. Die Züchter können durch das Feedback ihrer Kunden einschätzen, ob sie mir ihrer Züchtung auf dem richtigen Weg sind. Auf dem zweiten Level befindet sich eine Gemeinschaft von Züchtern. Zum Beispiel tauschen sich Möhrenzüchter aus und evaluieren Zuchtziele, -fortschritte und Projekte im Kreise der Kollegen. So kommt es idealerweise zu einem iterativen Prozess, in dem die Vorgehensweise immer wieder angepasst wird. Auf dem nächsten Level werden Vertriebspartner mit einbezogen. Ab spätestens der F4 werden diese um ihre Einschätzung zu von Zuchtlinien im Vergleich zu bestehenden Sorten gebeten, ob die Richtung der Entwicklung stimmt, ob damit eine Angebotslücke gut gefüllt wird. Dazu gehört noch, dass wir Öffentlichkeitsarbeit machen. Ein- bis zweimal pro Jahr veranstalten wir Züchtungs- und Sortentage, um mit Praktikern, die professionellen Anbau betreiben, ins Gespräch zu kommen.
Ein nächster Schritt der Partizipation wäre, neben den Gesprächen, auch mit Praktikern konkret zusammen zu arbeiten. Zum Beispiel haben wir dies seit zwei Jahren in einem Tomatennetzwerk in Norddeutschland bereits etabliert. Wir beziehen Kollegen in der Selektionsaktivität und Beurteilung der Zuchtlinien bereits in frühen Nachkommenschaften mit ein. Wir wollen diese intensive Zusammenarbeit noch ausbauen und verbessern, weil wir gemerkt haben, dass wir dadurch gegenseitig viel lernen können. Unsere Gärtner können von Kollegen weitere Gesichtspunkte in ihre Arbeit einfließen lassen und die Praktiker können auf diese Weise früh lernen, was demnächst aus der Züchtung zu erwarten ist oder auch was die Begrenzung einer ökologischen Pflanzenzüchtung ist.

	Auf diese Weise kommt es zu gegenseitiger Wertschätzung, es entsteht partnerschaftlicher Austausch und eine Weiterentwicklung des Anbausystems, denn nicht alle Schwierigkeiten im Anbau können und müssen durch Züchtung gelöst werden.
What do you see as the next important step in order to develop/improve the variety testing trials? Variety testing of vegetables by the German FPVO as well as throughout Europe, is conducted under conventional conditions. It would help our work if variety testing is conducted under organic conditions as well, because this is the target environment for which we breed. A second demand, with which we do not agree 100%, is for a reduction of testing criteria in the catalogue, especially concerning homogeneity. From our viewpoint, this is not a necessity because luckily, there are different regulations for registration. If a candidate variety has problems with homogeneity, there is the regulation for amateur varieties to register these varieties. Some practitioners, however, have a stigma against this regulation, because amateur varieties are merely registered and not registered and officially tested by an authority. Additionally, packaging sizes for seeds are limited. In principal, this can be a difficulty, but has not been a big obstacle for our sales partners. The only thing we wish for is that variety testing takes place under organic conditions and, if possible, within Germany. For instance, five to six years ago, one of our zucchinis (today registered as the variety *Serafina*) was tested in Southern France, close to Avignon which is 1000 km from our breeding garden close to Frankfurt/Main. Thus, our breeder hat to plan a long journey on short-term notice, at the same time as varieties had to be assessed. Additionally, communication in English with the French-speaking auditors was difficult.	*Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?* Die Sortenprüfung des BSA, aber auch in ganz Europa, wird unter konventionellen Anbaubedingungen durchgeführt. Es würde unserer Arbeit entgegenkommen, wenn die Sortenprüfung auch unter ökologischen Anbaubedingungen durchgeführt würde, denn das ist nun einmal die Zielumwelt, für die wir züchten. Eine weitere Forderung, der wir uns nicht 100% anschließen, ist nach einer Reduktion des Kataloges an Prüfmerkmalen, insbesondere was die Homogenität angeht. Wir sehen aus unserer Sicht keine Notwendigkeit dazu, da es im Moment zum Glück diese verschiedenen Reglungen gibt. Wenn es Schwierigkeiten mit der Homogenität eines Sortenkandidaten gibt, dann gibt es die Amateursortenregelung, über die wir eine Sorte in die Zulassung bringen können. Die hat allerdings das Stigma für einige Praktiker, dass es sich lediglich um eine zugelassene und nicht um eine behördlich geprüfte Sorte handelt. Zudem sind die Verpackungsgrößen limitiert. Das ist eine prinzipielle Schwierigkeit, aber für uns und unsere Vertriebspartner stellte das bisher keine ganz große Hürde dar. Das Einzige was wir uns sehr stark wünschen ist, dass die Sortenprüfung unter ökologischen Bedingungen und möglichst innerhalb von Deutschland stattfindet. Zum Beispiel hatten wir vor fünf bis sechs Jahren eine Zucchiniprüfung (heute zugelassene Sorte *Serafina*), die in Südfrankreich in der Nähe von Avignon durchgeführt wurde. Das ist 1000 km von unserem Zuchtgarten in der Nähe von Frankfurt/Main entfernt. Das bedeutet, dass unser Züchter kurzfristig eine lange Reise einplanen muss, während der Aufwuchs gerade zur Beurteilung zur Verfügung stand. Zudem war die Kommunikation mit den französischen Prüfern auf Englisch kompliziert.
What kind of seeds (organic vs. conventional) do you send to variety testing? What are the advantages and disadvantages of organic seeds? We solely send organically propagated seeds to variety testing, since we work 100% organically. In seeds there is a value of origin, i.e. the intensive fertilisation during seed production can lead to vigorous seeds and more vigorous seedlings. We observe this when we buy conventional seeds as, e.g. reference varieties for our cultivation trials or starting material for new breeding projects. However, when the seed is propagated a few years under our conditions, this advantage becomes less dominant. However, to my knowledge, the origin of seeds does not represent a relevant disadvantage in variety testing according to DUS criteria.	*Welches Saatgut (ökologisch vs. konventionell) übermitteln Sie an die Sortenprüfung? Was sind die Vor- und Nachteile von ökologischem Saatgut?* Wir übermitteln ausschließlich ökologisch vermehrtes Saatgut, denn wir arbeiten 100% ökologisch. Beim Saatgut gibt es einen Herkunftswert, d.h. die intensive Versorgung beim Samenbaubestand kann zu kräftigeren Samen und damit kräftigeren Keimpflanzen im Nachbau führen. Das sehen wir auch, wenn wir konventionelles Saatgut einkaufen, z.B. als Referenzsorte für unsere Anbauprüfungen oder als Ausgangspunkt für Neuzuchtprojekte. Wenn die Sorte bei uns ein paar Jahre samenbaulich geführt wird, dann verwächst sich dieser Vorteil etwas. Soweit ich das aktuell überschauen kann, bringt die Herkunft des Saatguts aber keinen relevanten Nachteil für die Anbauprüfungen nach DUS Kriterien.

Do you produce organic varieties with a high degree of genetic diversity (according to the new definition, see below) that are not compatible with the existing DUS protocols?

It repeatedly happens, that breeding lines do not enter DUS testing. Instead, we use the regulation for amateur varieties 2009/145/EC for registration. This is often the case for fruit vegetables such as tomatoes, cucurbits, aubergines, and paprika, as well as broccoli. The main reason for rejection is lack of uniformity, either on a morphological or pathological level.

For instance, our broccoli often fails on the morphological level. On the one hand, there are not many open-pollinated broccoli varieties, which can be used as reference varieties. On the other hand, we did not manage to develop a "really uniformly" growing and open-pollinated broccoli variety, which corresponds to the demands of DUS testing.

Tomatoes, and sometimes paprika and aubergines, fail on the pathological level. For registration, it is necessary to classify resistances. Thereby, it is tested whether a variety is resistant or susceptible – forms which are in-between are not considered. The plants are sprayed with a single-fungal-suspension. If from 15 plants, five plants are susceptible, it is not possible to clearly classify the candidate regarding the criterion resistance. Resistances are often marked with a star, i.e. they have to be tested. Failing in this test leads to a rejection of a variety registration. Due to this reason, we often bypass DUS testing and immediately register the variety as an amateur variety, especially if tested for pathogens which are not relevant for OA and for which we cannot select in our breeding gardens.

Tomatoes are self-pollinators and, thus, are relatively homogeneous. However, since we do not conduct in-laboratory examinations of resistances, we do not know the specific resistance status, and which can be very variable. In our conditions, some fungi are not present. Consequently, we cannot select for these diseases systematically. Additionally, we do not have the resources to select for certain groups or races of fungi.

Since 2012, we use the regulation for amateur varieties, and since then 20 to 30% of our varieties were registered as amateur varieties, as we choose this path from the start. Due to this and due to the reason, we apply for fee-based pre-testing, the number of varieties which is rejected by DUS testing is significantly smaller.

Produzieren sie ökologische/biologische Sorten mit einem hohen Level an genetischer Diversität (gemäß der neuen Definition einer ökologischen/biologischen Sorte, siehe weiter unten), die nicht mit den aktuellen DUS Protokollen kompatibel sind?

Es kommt immer wieder der Fall vor, dass Züchtungen von uns nicht in die Registerprüfung gehen. Dann nutzen wir aber die Amateursortenregelung 2009/145 EU. Das kommt recht regelmäßig bei Fruchtgemüsen wie Tomaten, Kürbisgewächsen, Auberginen, und Paprika vor, aber auch beispielsweise bei Brokkoli. Die scheitern insbesondere an der Uniformitätshürde, entweder auf der morphologischen oder der pathologischen Ebene.

Bei Brokkoli steht die morphologische Ebene im Vordergrund. Zum einen gibt es nicht so viele nachbaufähige, offenblühende Brokkoli-Sorten, die als Referenzsorten gestellt werden können. Zum anderen ist es auch uns bisher nicht gelungen, „wirklich einheitlich" wachsende samenfeste Brokkoli-Sorten zu entwickeln, die in der Registerprüfung den Anforderungen der Prüfer entsprechen.

Tomaten, aber auch manchmal Paprika und Auberginen, scheitern auf der pathologischen Ebene. Zur Registrierung ist es notwendig die Einordnung von Resistenzen anzugeben. Dabei wird nur geprüft ob die Sorte resistent oder anfällig ist – intermediäre Formen sind dabei nicht vorgesehen. Wenn von 15 Pflanzen fünf Pflanzen, nach Besprühung mit Einzelpilzsuspension, anfällig sind, dann ist dieser Kandidat in dem Kriterium Resistenz nicht eindeutig bewertbar. Resistenzen sind oftmals Sternchenkriterien, d.h. sie müssen geprüft werden. Diese Teilprüfung kann dann zur Aberkennung/Nichtzulassung führen. Deswegen umgehen wir bei der Tomate die Zulassungsprüfung und gehen gleich den Weg über die Amateursortenregelung, erst recht, wenn es sich um Pathogene handelt, die im ökologischen Abbau weniger relevant sind, auf die wir in unseren Zuchtgärten dann auch nicht selektieren können.

Die Tomate ist ein Selbstbestäuber und deswegen eher einheitlich, aber da wir keine Resistenzuntersuchungen im Labor durchführen, kennen wir nicht den präzisen Resistenzstatus und dieser kann sehr variabel sein. Unter unseren Bedingungen treten verschiedene Pilze gar nicht in Erscheinung. Folglich können wir Resistenzen gegen solche Krankheiten nicht systematisch selektieren. Zudem haben wir nicht die Ressourcen, auf bestimmte Pilzgruppen oder -rassen zu selektieren.

Seit 2012 nutzen wir den Weg der Amateursortenregelung, und seitdem haben etwa 20 bis 30% unserer Sorten diesen Zulassungsweg genommen, da wir oftmals schon von vornherein diesen Weg wählen. Deutlich weniger Sorten werden bei den offiziellen Sortenprüfungen zurückgewiesen, auch deshalb, weil wir teilweise kostenpflichtige Vorprüfungen durchführen lassen.

Do you produce organic varieties with a low degree of genetic diversity that are not compatible with the existing DUS protocols?

Produzieren sie ökologische/biologische Sorten mit einem geringen Level an genetischer Diversität, die nicht mit den aktuellen DUS Protokollen kompatibel sind?

In the group of self-pollinators, the intrinsic genetic diversity is rather smaller. For instance, in lamb's lettuce, which is considered as highly self-pollinating, independent of the supplier, almost all plants look the same. Cross-pollinated varieties, which originate from our breeding work, have a higher level of variability. According to the definition of the EU regulation, organic breeding entails a high level of phenotypical as well as genetic heterogeneity. It is difficult to breed for heterogeneity within the group of self-pollinators. We regard the doctrine of the new EU regulation as not applicable for all crops. The definition can only be applied for cross-pollinators, but even here, heterogeneity should be an option for variety registration and not an obligation or precondition to obtain the label "organic variety".	In der Gruppe der Selbstbestäuber ist eine geringe Diversität innerhalb der Sorten vorhanden. Zum Beispiel gilt Feldsalat als hochgradig selbstbestäubend, und egal von welchem Anbieter, gilt hier: fast jede Pflanze einer Sorte ist gleich ausgestattet. Bei Fremdbestäubern sind Sorten, die aus unserer Entwicklungsarbeit kommen, mit einer größeren Variabilität ausgestattet. Laut der Definition der EU Verordnung bedeutet Öko-Züchtung, alles soll phänotypisch und auch noch genetisch heterogen sein. Bei einem Selbstbestäuber ist es schwierig, eine Heterogenität herzustellen, und sie steht sicher meist am Anfang eines Zuchtprojektes – nicht am Ende, also bei einer fertigen Sorte. Die Doktrin der neuen EU Verordnung halten wir für nicht allgemein übertragbar auf alle Kulturen. Wenn überhaupt, dann kann die Definition nur für Fremdbestäuber gelten, aber auch da nur als Möglichkeit für die Sortenzulassung und nicht als Zwang bzw. als Voraussetzung, um das Label „Öko-Sorte" zu erhalten.
Do you have suggestions for improvements for the DUS trials in some of the species you work with? We wish for variety testing under organic conditions and testing in the region of the breeding garden. Regarding testing criteria, we do not have major suggestions for improvements. We have an enormously good cooperation with the FPVO, and we wish to proceed with this cooperation. If problems appear, we were possible to find a solution by communicating with the authorities. For instance, if a variety is not adequately uniform compared to the reference varieties, we withdrew the variety and were able to market the variety using a different path. If the coordinator of the trials had a question concerning a plant characteristic, it was possible to find a solution with the breeder by visiting the testing location, and we agreed upon testing the development of the plant for a third year.	*Haben Sie Verbesserungsvorschläge für DUS Prüfungen, bei den Sorten, mit denen Sie arbeiten?* Wir wünschen uns Prüfung unter ökologischen Bedingungen und Prüfung in der Region des Zuchtgartens. Bezüglich der Prüfkriterien haben wir keine großen Verbesserungsvorschläge. Wir haben eine enorm gute Kooperation mit dem BSA, und die wollen wir auch gerne so fortsetzen. Wenn Probleme auftauchen, konnten wir bisher, dadurch, dass wir mit der Behörde im Gespräch stehen, Lösungen finden. Zum Beispiel wenn sich eine Sorte als nicht hinreichend einheitlich im Verhältnis zu den Vergleichssorten dargestellt hat, dann haben wir die Sorte zurückgezogen und auf einem anderen Weg vertriebsfähig bekommen. Wenn der Prüfer in einem Merkmal eine Frage hatte, konnte durch einen Besuch des Züchters am Prüfstandort eine Lösung gefunden werden und man hat zum Beispiel die Entwicklung der Pflanze noch ein drittes Jahr geprüft.
Do you wish for VCU testing with vegetables? It would be desirable, if criteria such as taste are tested. It would be useful to include taste in the DUS criteria catalogue in order to classify a special distinctness. This is especially of interest for us, because so-called taste selections are an essential part of our breeding activities and our varieties can normally reach good results in taste examinations. Due to financial reasons, we do not wish for VCU testing. It would take too long to establish the whole administration (again), necessary for VCU testing. Alternatively, interested parties/variety users could publish their own description/assessment of a variety.	*Wünschen Sie sich Wertprüfungen bei Gemüse?* Es wäre wünschenswert, wenn Kriterien wie Geschmack geprüft werden. Es wäre sinnvoll, wenn der Geschmack in den DUS Kriterienkatalog mit aufgenommen wird, um eine besondere Unterschiedlichkeit dieser Sorte zu katalogisieren. Das ist für uns besonders interessant, weil sog. Geschmacksselektion" wesentlicher Bestandteil unserer Züchtungspraxis ist und unsere Sorten i.d.R. auch geschmacklich gute Ergebnisse in Untersuchungen bringen. Wir wünschen uns aber aus Kostengründen keine Wertprüfungen mehr. Es würde relativ lange dauern, bis die gesamte Administration für Wertprüfungen (wieder) aufgebaut wird. Was es alternativ geben könnte, wäre eine Beschreibung/Einschätzung, die von den Interessenten/Sortennutzern selbst erstellt wird.
You said, that with some species, you bypass DUS testing and immediately choose to register the variety as an amateur variety. However, there are still cases in which varieties are rejected to due lack of fulfillment of DUS criteria. Is this not a high financial loss? What are the	*Sie sagen, dass sie bei bestimmten Arten, die Registerprüfungen umgehen und die Sorte direkt als Amateursorte registrieren. Es gibt trotzdem Fälle, in denen die Sorte durch die Registerprüfung fällt. Bedeutet dies nicht ein großer finanzieller Verlust für Sie? Was sind die*

advantages of official registration according to DUS compared to registration as amateur varieties, especially since official registration implies a higher economic effort? Within the last six years, we applied for registration of varieties of e.g. tomatoes, sweet corn and broccoli. They were rejected due to a lack of fulfillment of DUS requirements. Thereupon, we registered sibling lines as amateur varieties according to 2009/145/EG. Within the last five years, we frequently apply for pre-testing of e.g. aubergines and carrots (GEVES) which is conducted by the trial stations. Such a service is a bit cheaper compared to official DUS testing and gives an indication whether the candidate variety is able to pass DUS testing under the same conditions as DUS testing, but you lose one to two years until the introduction on the market. According to 2009/145/EG, packaging sizes of amateur varieties are regulated in which amateur varieties are allowed to reach commerce. This restriction in packaging size can be an obstacle for some crops. Another disadvantage is the designation of amateur variety which, for the uninformed customer, implies unprofessionalism or amateurism in the production process and does not stimulate to buy/use the variety. Regarding conservation varieties of cereals this corresponds to the stigmatising remark "intended for export outside contracting member states". As a consequence, in the legal sense, amateur varieties (as well as conservation varieties) are varieties of second class. They are not tested and approved by an authority, i.e. variety description is not nested over at least two growing cycles on an official trial location with variety comparison. Variety description is based solely on the description of the breeder. Thus, on the background of limited financial resources and a specialized market, we have to weigh whether to use the "easier" way of registration (but restricted marketing possibilities) or whether official registration is appropriate in regard to expected marketing results.	*Vorteile der regulären Zulassung gegenüber der Zulassung als Amateursorte, insbesondere da reguläre Zulassung einen größeren finanziellen Aufwand bedeuten?* Ja, das waren binnen der letzten ca. sechs Jahre z.B. Tomate, Zuckermais und Brokkoli. Bei diesen Arten hatten wir Kandidaten in die Registerprüfung geschickt, und die Prüfung führte zu einer Nicht-Zulassung. Daraufhin wurden Geschwisterlinien in die Anmeldung als Amateursorte gemäß 2009/145/EG gebracht. Wir lassen immer wieder auch Vorprüfungen von den Prüfstellen durchführen, z.B. von Aubergine und Möhre (GEVES) in den letzten ca. fünf Jahren. Eine solche Dienstleistung ist etwas günstiger als die offizielle Registerprüfung und gibt Hinweise, ob – unter den ansonsten selben Anbaubedigungen wie bei einem DUS-Test – der Kandidat die Prüfhürden wohl nehmen könnte. Aber dafür verliert man eben auch ein oder zwei Jahre zur Einführung auf den Markt. Bei Amateursorten sind die Verpackungsgrößen ("Nettohöchstgewichte für Verpackungen...") geregelt, in denen die als Amateursorten gemäß 2009/145/EG in den Handel gelangen dürfen. Diese Packungsgrößenlimits können für manche Kulturen ein Hindernis sein. Ein weiterer Nachteil ist die Bezeichnung "Amateursorte", die für den uninformierten Kunden "Unprofessionalität" und "Laienhaftigkeit" beim Herstellungsprozess bedeutet und damit nicht gerade zum Kauf / zur Verwendung stimuliert. Bei Getreide entspricht das dem stigmatisierenden Hinweis "Zur Ausfuhr außerhalb der Vertragsstaaten bestimmt" bei Erhaltungssorten. Amateursorten sind damit (ebenso wie Erhaltungssorten) im rechtlichen Sinne Sorten zweite Klasse, zumal sie nicht von den Zulassungsbehörden geprüft sind, die Sortenbeschreibung also nicht auf Grundlage einer mind. über zwei Anbauzyklen auf einem behördlichen Prüfstandort geprüften Anbauvergleich sondern auf Angaben des Züchters basiert. – Hier gilt es also bei limitierten finanziellen Ressourcen und einem Spezialmarkt abzuwägen, ob eine Sorte auf den „einfacheren" Weg der Zulassung gebracht werden soll (dafür aber im Vertrieb noch stärker begrenzt wird) oder ob die reguläre Zulassung probat ist im Verhältnis zu den erwarteten Vermarktungsergebnissen.

Table 14: Expert interview with Dr. Bertold HEYDEN.

Dr. Bertold HEYDEN is co-founder of the Keyserlingk-Institute which focuses on seed research and breeding of cereals under biodynamic conditions. All varieties are registered as conservation varieties which have a different registration procedure than pure breeding lines.	
What requirements are necessary to register conservation varieties? Which restrictions do you experience? After application for variety testing, a coordinator comes by to look at the crops. We have to specify some register characteristics and send in 50 ears. Not all culms have to be homogeneous, as it is the case with regular varieties. A certain heterogeneity is allowed, as long as the character of the variety is identifiable.	*Welche Anforderung werden an die Registrierung von Erhaltungssorten gestellt? Was für Restriktion erfahren Sie bei der Registrierung?* Nach der Anmeldung einer Sortenprüfung kommt Jemand und guckt sich den Feldbestand an und wir müssen noch ein paar Registermerkmale angeben und 50 Ähren einschicken. Beim Feldbestand muss aber nicht, wie bei einer regulären Sorte, ein Halm wie der andere sein. Jedoch muss der Sortencharakter deutlich erkennbar sein, wobei eine gewisse Uneinheitlichkeit gestattet wird.

In addition, we have to present the history of the variety. It is not possible to register new crossings as conservation varieties. The purpose of conservation varieties is to protect the biological diversity of farmer's varieties. In Baden-Wuerttemberg, there were no restrictions in registration. In the beginning, conservation varieties still needed to undergo variety testing, but in order to make registration easier and cheaper, they stopped variety testing. We ourselves are responsible for the quality of our varieties. Thus, the FPVO does not conduct any VCU trials, either.	Zudem müssen wir darstellen können wie die Sorte entstanden ist. Man kann keine neuen Kreuzungen als Erhaltungssorte registrieren lassen. Der Sinn der Erhaltungssorte ist, dass ältere Sorten, die noch irgendwo bei Bauern zu finden sind, erhalten werden, im Sinne der biologischen Vielfalt. Bei uns in Baden-Württemberg gab es bei der Registrierung keinerlei Hemmnisse. Am Anfang wurden noch richtige Registerprüfungen gemacht. Das wurde dann aber aufgegeben, um die Registrierung einfacher und günstiger zu machen. Wir sind selber für die Qualität der Sorten verantwortlich. Es werden also auch keine Wertprüfungen beim BSA durchgeführt.
With what material are you working with? For what kind of registrations do you apply? We are only working with wheat. We have one rye variety, which we did not register yet, because we are not satisfied with it so far. We are doing selections with older farmer's varieties, either with small bouquets or single ears. We have to do selections every year, in order to maintain the variety. The varieties have a relatively high homogeneity, but they do not reach the 100% homogeneity which is demanded of certified seeds.	*Mit was für Material arbeiten Sie? Was für Zulassungen beantragen Sie?* Wir arbeiten nur mit Weizen. Wir haben eine Roggensorte, mit der wir aber selber noch nicht zufrieden sind, deswegen haben wir die noch nicht angemeldet. Wir machen Selektionen aus älteren Hofsorten, entweder kleine Sträuße oder Einzelähren. Wir müssen jedes Jahr weiter selektieren, um die Sorte in dem Zustand zu erhalten. Die haben zwar eine relativ hohe Einheitlichkeit, aber nicht die 100%ige Einheitlichkeit, die bei Z-Saatgut gefordert wird.
Do you plan to develop new varieties based on the conservation varieties? In conservation varieties, single ears are selected. Sometimes, there are single ears, which are a bit different or a bit better. By selecting single ears, we were able to improve a variety, without the need for a new registration. However, the improved variety is only allowed to deviate to a certain degree, otherwise we need to create a new variety name. It is still considered a conservation variety, as long as only selections and no crossings are conducted.	*Planen Sie neue Sorten aus den Erhaltungssorten zu züchten?* Bei der Erhaltungszüchtung selektiert man einzelne Ähren. Man findet manchmal Ähren, die etwas anders oder etwas besser sind. Durch Auslese von Einzelähren, haben wir schon mal eine Sorte verbessert, ohne dass wir die Sorte neu anmelden mussten. Allerdings darf die neue Züchtung nur geringfügig abweichen, ansonsten müsste man einen eigenen Sortennamen kreieren. Es handelt sich immer noch um eine Erhaltungssorte, sofern es sich nur um eine Selektion handelt und nicht um eine gezielte Kreuzung.
Do you have suggestions for improvement, concerning the registration process of conservation varieties? All in all, I am satisfied with the registration procedure of conservation varieties. However, we are only allowed to do propagation of conservation varieties within Baden-Wuerttemberg. This represents a problem, because a variety can also be of interest in, for example, France. In such a case, propagation in France would be preferred. Principally, it is possible to apply for that, but we do not have any experience with that.	*Haben Sie Verbesserungsvorschläge, was die Registrierung von Erhaltungssorten angeht?* Ich bin eigentlich mit der Registrierung zufrieden. Allerdings dürfen wir die Saatgutvermehrung nur innerhalb Baden-Württembergs machen. Das ist ein gewisses Problem, da eine Sorte auch zum Beispiel in Frankreich Interesse finden kann. Dann wäre eine Vermehrung in Frankreich wünschenswert. Das könnte man im Prinzip beantragen, aber damit haben wir bisher noch keine Erfahrung.
What fees have to be paid for registering conservation varieties? I did not find the costs for the two registrations in accounting of 2016. The yearly costs of six varieties is €180.	*Wie hoch sind die Gebühren bei der Registrierung der Erhaltungssorten?* 2016 bei der Anmeldung von zwei weiteren Sorten kann ich in der Buchhaltung nichts finden. Es fallen jährliche Kosten von 180€ für sechs Sorten an.
Which testing criteria are important for OA or for climate-robustness? Normally, breeders aim to produce varieties for large-scale cultivation. This is easier in CA as the use of artificial fertilisers creates more uniform conditions. In OA, regional conditions are more important. We face the same problem. We have varieties which cannot be cultivated everywhere. For instance, we have relatively	*Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?* Normalerweise streben Züchter Sorten an, die sich großflächig bewähren. Das ist im konventionellen Landbau leichter, weil man dort Kunstdünger benutzt und so viel einheitlichere Bedingungen hat. Im Ökolandbau sind die regionalen Bedingungen sehr viel ausschlaggebender. Das ist auch unser Problem. Wir haben

tall varieties, which perform well on our location around Lake Constance. However, they lodge on the fertile soils of the Wetterau and are not suitable for the sandy soils of Northern Germany, as well.
We concentrate on regional conditions for cultivation. This should be considered in variety testing. Variety testing of the FPVO is conducted on different locations and on some, biodynamically bred varieties cannot display all their qualities. As a consequence, they might reach a lower score.
In my opinion, VCU testing is outdated. Seed laws were adopted to protect farmers from bad seeds. This is not necessary anymore, since breeders cannot afford to release bad varieties to the market, which could potentially ruin their reputation. Variety protection is ok, but VCU testing done by the State is not necessary anymore. (Breeders are responsible for VCU testing.) It is not necessarily bad, that breeders can get an official label for their varieties, but it should not be required.

Sorten, die nicht überall anbaufähig sind. Zum Beispiel haben wir relativ hochwüchsige Sorten, die für unseren Bodenseestandort sehr gut sind, aber die auf den guten Böden in der Wetterau flach liegen und auch auf den Sandböden in Norddeutschland nicht geeignet sind.
Wir konzentrieren uns stärker auf regionale Anbaubedingungen. Das sollte auch ein Kriterium für die Zulassung bei der Sortenprüfung sein. Bei den Sortenprüfungen vom BSA wird auch auf Standorten getestet, wo die biologisch-dynamisch gezüchteten Sorten ihre Qualitäten weniger entfalten können und eventuell schlechter beurteilt werden.
Meiner Meinung nach sind Wertprüfungen überholt. Die ganzen Saatgutgesetze sind mal gemacht worden, um die Bauern vor schlechtem Saatgut zu schützen. Das ist nicht mehr nötig, da sich kein Züchter mehr erlauben kann schlechte Sorten auf den Markt zu bringen, welche seinen Namen ruinieren. Der Schutz einer Sorte ist in Ordnung, aber die Wertprüfungen vom Staat sind nicht mehr nötig. (Für die Wertprüfungen ist der Züchter verantwortlich.) Es ist vielleicht kein Fehler, wenn sich der Züchter das staatliche Siegel holen kann, aber es sollte nicht vorgeschrieben sein.

Which role does the farmer play regarding breeding of varieties adapted to organic conditions?
We are lucky, that there are a lot of biodynamic farms in our region, and that there are bakers who use regionally produced cereals. For new breeding lines, we can do cultivation trials on small fields and baking tests at a befriended bakery.
Before conservation varieties were legally regulated, we had the problem, that we were not allowed to sell seeds. Therefore, we had a special arrangement with the FPVO, in which we were allowed to sell seeds within a producer association, on the condition that bakers in the region buy the harvested grains. For instance, we could register our wheat variety *Maxi* and our rye variety *Rolipia* as conservation varieties. However, we did not apply for registration yet, because we are not satisfied yet. On a very small scale we distribute seeds according to the old agreement on regional varieties, but there has been no new agreement with the FPVO.
The farmers are producing their own seeds. We are responsible for propagating seeds. The farmer sows and we harvest with our small plot thresher to ensure that the variety is pure. We ourselves do not have any fields. Farmers provide the fields for our variety trials (basic seeds, i.e. first propagation level of our registered varieties) and breeding yards (single ears to plots of 4 x 6 m^2). We have a very good cooperation with the farmers in our region.

Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?
Wir haben das Glück, dass wir in der Region viele biodynamische Höfe haben und, dass die Bäcker das Getreide aus der Region verarbeiten. So ist bei neuen Zuchtstämmen ein Versuchsanbau auf kleinen Flächen möglich und auch Backversuche bei einem befreundeten Bäcker.
Bevor Erhaltungssorten gesetzlich geregelt wurden, hatten wir das Problem, dass wir kein Saatgut abgeben durften. Das ging dann aber mit einer Sonderregelung mit dem BSA. Innerhalb einer Erzeugergemeinschaft durften wir Saatgut abgeben, wobei die Auflage war, dass die Ernte auch von den Bäckern abgenommen wird. Wir könnten z.B. unsere Weizensorte *Maxi* und die Roggensorte *Rolipia* auch als Erhaltungssorten anmelden. Ist bisher nicht geschehen, weil wir noch nicht zufrieden waren damit. In sehr geringem Umfang wird Saatgut im Sinne der alten Regionalsorten-Vereinbarung abgegeben. Das wurde aber mit dem BSA nicht neu verhandelt.
Die Landwirte stellen das Saatgut selber her. Wir sind für die Vorvermehrung zuständig. Der Bauer sät und wir ernten mit unserem kleinen Parzellendrescher, um zu garantieren, dass die Sorte sortenrein ist. Wir haben selber keine Flächen. Für unsere Sortenversuche (Basis-Saatgut, d.h. die erste Vermehrungsstufe unserer angemeldeten Sorten) (Einzelährenreihen bis Parzellen à 4 x 6 m^2) und Zuchtgärten bekommen wir Flächen von den Bauern gestellt. Wir haben eine sehr gute Zusammenarbeit mit den Bauern in der Gegend.

What do you see as the next important step in order to develop/improve the variety testing trials?
More detailed quality criteria, such as nutritional quality, should be considered in variety testing. However, it is not easy, to agree upon standards.

Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?
Feinere Qualitätsmerkmale, wie Kriterien der Nahrungsqualität, sollten berücksichtigt werden.

	Allerdings ist es nicht leicht, sich da auf Standards zu einigen.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848? (a): The high level of genetic and phenotypical diversity is not compatible with the demand for uniformity. Even within populations, the vegetative stronger varieties will prevail after some years. In the long run, a good selection is necessary. Diversity by itself is good, because completely homogeneous varieties are not interesting for the farmer. Our conservation varieties have a certain variability and, thus, ensure a certain adaptability to the farm. (b): It would be a dream, that all organic varieties origin from organic breeding. At the moment, all organic varieties have to origin from organic propagation. Especially regarding vegetables, it is still a long way to go until breeding takes place under organic conditions. Regarding cereals, it is almost possible. We have a lot of wheat varieties which origin from organic breeding, so that all farmers should be able to choose a suitable variety for their farm. However, to find a suitable rye variety is already difficult. The problem with conventional breeding is that they are normally not transparent. Especially with the new genetic engineering, it will become even more difficult to determine the breeding technology. It is necessary to create a positive list and to demand that breeders disclose that this new genetic engineering was not conducted.	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?* (a): Das hohe Maß an genetischer und phänotypischer Vielfalt ist mit den üblichen Anforderungen der Einheitlichkeit nicht möglich. Auch bei Populationen setzen sich die vegetativ kräftigeren Sorten nach ein paar Jahren durch. Auf Dauer kommt man ohne eine gute Selektion nicht aus. Vielfalt an sich ist gut, denn völlig homogene Sorten sind für den Bauer uninteressant. Unsere Erhaltungssorten haben noch eine gewisse Variabilität drin und dadurch eine gewisse Anpassungsfähigkeit an den Standort. (b): Es ist ein Wunschtraum, dass eine ökologische Sorte aus der ökologischen Züchtung kommt. Bisher ist es im Ökolandbau so, dass die Sorten nur aus ökologischer Vermehrung stammen müssen. Vor allem bei Gemüse ist es noch ein sehr weiter Weg, bis auch die Züchtung unter ökologischen Bedingungen stattfindet. Beim Getreide ist es vielleicht eher möglich. Beim Weizen haben wir eine ganze Menge Sorten aus der ökologischen Züchtung, wo eigentlich jeder Bauer was finden müsste, aber selbst beim Roggen wird es schon schwieriger. Das Problem an der konventionellen Züchtung ist, dass sie i.d.R. nicht offengelegt wird. Bei der neuen Gentechnik wird es noch schwieriger die Züchtungsmethodik nachzuweisen. Man kann eigentlich nur so vorgehen, dass man eine Positivliste macht und von den Züchtern verlangt die Züchtung offen zu legen bzw. zu versichern, dass diese neue Gentechnik nicht angewendet wird. Man kann eigentlich nur so vorgehen, dass man eine Positivliste macht und von den Züchtern verlangt die Züchtung offen zu legen bzw. versichern, dass diese neue Gentechnik nicht angewendet wird.

Table 15: Expert interview with Dr. Wolfgang KARALUS.

Dr. Wolfgang KARALUS is an advisor at the Saxon State Office for Environment, Agriculture and Geology (*Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie;* LfULG). He works in the department seed registration and variety trials (*Referat Saatenanerkennung, Sortenprüfung*) and is, inter alia, responsible for variety testing in OA in Saxony. He is coordinators for organic post-registration trials in the cultivation area with loess soil and weathered rocks (*Löss- und Verwitterungsstandorte*) in East Germany.	
Please define the tested crop species. In regard to organic variety testing we work with winter rye, winter wheat, winter triticale, winter spelt, oat, barley and spring wheat, as well as with grain peas, field beans and potatoes. The registration of the varieties by the FPVO or other European countries is a necessary precondition for testing the variety in our post-registration trials. The department for horticulture of the Saxon State Office for Environment, Agriculture and Geology is responsible for variety testing of vegetables. At the moment, they conduct variety trials under organic conditions solely with spring onions.	*Bitte definieren Sie die geprüften Fruchtarten.* Im Rahmen der Sortenprüfung im ökologischen Landbau arbeiten wir mit Winterroggen, Winterweizen, Wintertriticale, Winterdinkel, Hafer, Gerste und Sommerweizen, sowie mit Körnererbsen, Ackerbohnen und Kartoffeln. Die Zulassung der Sorten durch das BSA oder durch andere EU-Länder ist Voraussetzung, dass wir die Sorte in unseren Landessortenversuchen testen. Die Sortenprüfung von Gemüse fällt in das Aufgabengebiet der Abteilung Gartenbau des LfULG. Dort werden Sortenversuche im Öko-Anbau derzeit nur mit Sommer-Säzwiebeln durchgeführt.

Who was the initiatory for setting up the testing trials and what was the purpose/demand? Post-registration trials, carried out by the German Federal States, already exist for some time. In the 80s/90s, OA became increasingly important. Thus, the German Federal State Offices started to conduct variety testing under organic conditions as well. In Saxony, organic variety testing started within the 90s. At first, single arable crops were tested, such as winter wheat and later on potatoes. Gradually, further arable crops were tested under organic conditions. This development can be traced back to the increasing importance of OA. Additionally, organic farmers and farming associations requested varieties tested under the conditions of their agricultural system.	*Wer war der Initiator für den Aufbau der ökologischen Sortenprüfung und was war das Ziel/der Anspruch?* Landessortenversuche, die von den Landesdienststellen durchgeführt werden, gibt es schon seit längerem. Als Der Öko-Anbau in den 80er/90er Jahren an Bedeutung gewonnen hat, haben die Länderdienststellen angefangen auch Sortenversuche im ökologischen Landbau anzulegen. In Sachsen war das im Laufe der 90er Jahre. Es begann zunächst mit einzelnen Fruchtarten, wie dem Winterweizen und dann später mit Kartoffeln. Die Prüfungen wurden dann sukzessive auf weitere Fruchtarten ausgeweitet. Diese Entwicklung hat sich aus der zunehmenden Bedeutung des ökologischen Landbaus ergeben. Zudem haben Öko-Landwirte und Anbauverbände nachgefragt und wollten Ergebnisse aus ihrem Anbausystem haben.
What were the key elements that you needed in order to start variety trials (equipment, financial support, interest of the farmers, etc.)? When we started organic variety testing, the equipment, testing technology, and human resources for the plot trials were already available from the conventional variety trials. However, an organically managed area was necessary. At the moment, we have an organic testing field, on which also other plant cultivation tests are conducted. Furthermore, we conduct organic variety testing on an organic farm because we wanted to test oat, barley and spring wheat in another region, in the Ore Mountains.	*Was waren die wichtigsten Elemente, die für den Start der ökologischen Sortenprüfung von Nöten waren (Equipment, finanzielle Förderung, Interesse der Landwirte, usw.)?* Als wir mit den ökologischen Sortenprüfungen begannen, war das Equipment, die Versuchstechnik und das Personal für Parzellenversuche aus den konventionellen Sortenprüfungen bereits vorhanden. Jedoch war eine Öko-Fläche notwendig. Zurzeit haben wir ein ökologisches Versuchsfeld, auf dem auch andere pflanzenbauliche Untersuchungen durchgeführt werden. Daneben haben wir auf einem landwirtschaftlichen Öko-Betrieb Sortenversuche angelegt, da wir die Versuche mit Hafer, Gerste und Sommerweizen in eine andere Region, ins Erzgebirge, verlagern wollten.
What motivates farmers to conduct variety testing on their farms? The farmer gets financial compensation for the loss of agricultural area. Additionally, the farmer's motivation is to get results from the agricultural conditions of his farm.	*Worin besteht die Motivation der Landwirte, die die Sortenprüfungen auf ihrem Hof durchführen?* Der Landwirt wird für den Flächenausfall finanziell entschädigt. Zudem besteht die Motivation des Landwirts darin, Ergebnisse von seinen Flächen zu erhalten.

Who is participating in the variety testing initiative and what is the role of the different actors (farmers, researchers, breeders, processors, seed companies, etc.) involved?

The Saxon State Office for Environment, Agriculture and Geology orders the trials. I work in the department responsible for seed registration variety testing. The different arable crops are distributed among my colleagues. I am responsible for the organic variety trials.

The staff of the trial stations conduct variety testing. We have a close contact to the breeders, with whom we agree upon the varieties to be tested and who provide seeds for testing.

Furthermore, we have a close trans-regional cooperation with the neighbouring Federal States of East Germany. We have a communal cultivation area "locations with loess soil and weathered rocks in East Germany" (*Löss- und Verwitterungsstandorte in Ostdeutschland*) with Thuringia and Saxony-Anhalt. This enables us to have a better data basis, which is especially important for our variety trials, where we only have one to two locations per Federal State.

Responsible persons from all three Federal States jointly agree upon varieties to be tested (all test the same varieties), coordinate ordering of seeds from breeders, and jointly conduct trial evaluation (evaluation of all locations over several years). Additionally, we jointly agree upon varieties to be recommended for the cultivation area. Furthermore, a common dissemination of results takes place. We adapted this structure from the conventional sector for which, a few years ago, Germany was divided into different cultivation areas on the basis of similar pedo-climatic regions.

Wer nimmt an der Sortenprüfung teil und was sind die Rollen der unterschiedlichen Akteure (Landwirte, Wissenschaftler/Forscher, Züchter, Verarbeiter, Saatgutunternehmen, usw.)?

Das Sächsische Landesamt LfULG ist der Versuchsansteller. Ich bin im Referat für Saatenanerkennung und Sortenprüfung tätig. Die verschiedenen Fruchtarten werden auf die Kollegen aufgeteilt und ich bin für die Organisation der Sortenversuche im Öko-Anbau verantwortlich.

Mitarbeiter der Versuchsstationen führen die Sortenversuche durch. Wir haben einen engen Kontakt mit den Züchtern, mit denen die Prüfsortimente abgestimmt werden und die das Versuchssaatgut liefern.

Zudem besteht eine enge überregionale Zusammenarbeit mit den benachbarten Bundesländern in Ostdeutschland. So haben wir mit Thüringen und Sachsen-Anhalt ein gemeinsames Anbaugebiet „Löss- und Verwitterungsstandorte in Ostdeutschland". Gerade im Öko-Anbau, wo nur ein bis zwei Standorte pro Bundesland vorhanden sind, kann somit eine bessere Datengrundlage genutzt werden. Im Rahmen der Zusammenarbeit der Bundesländer findet eine Sortimentabstimmung statt (alle prüfen die gleichen Sorten), erfolgt eine koordinierte Saatgutbestellung bei den Züchtern und wird eine gemeinsame Versuchsauswertung vorgenommen (mehrjährige Auswertung aller Standorte). Auch die Sortenempfehlung für das Anbaugebiet werden abgestimmt. Darüber hinaus findet eine gemeinsame Veröffentlichung statt. Diese Struktur haben wir aus dem konventionellen Bereich übernommen. Man hat für die konventionellen Sortenprüfungen vor einigen Jahren Deutschland in Anbaugebiete auf der Grundlage von Boden-Klima-Räumen unterteilt.

What are the current communication practices between the actors involved in the initiative?

The communication mostly takes place via phone or mail.

In East Germany, in conventional variety testing, there are coordinators for each arable crop. For instance, there is one person from the Saxony State Office who is responsible for the variety trials of winter wheat in Federal States involved. I am the coordinator for all organic variety trials, except for spelt, in the Federal States of Saxony, Thuringia and Saxony-Anhalt.

Before seeding we have to agree upon varieties to be tested. After harvesting the data have to be evaluated, in order to give recommendations for the varieties, when the farmers want to order seeds. Especially in summer, there is a narrow time frame for this and requires an intensive coordination and cooperation. The communication among the Federal States and with breeders works well.

For the cooperation between the Federal State Offices and with the FPVO, we need uniform methods and standards. Furthermore, for exchange of data, it is important to have a common software. Therefore, all Federal State Offices and the FPVO use the programme PIAF.

Was sind derzeitigen Kommunikationspraktiken zwischen den involvierten Akteuren?

Die Kommunikation findet vor allem über das Telefon oder per E-Mail statt.

Im konventionellen Bereich gibt es in Ostdeutschland sog. Fruchtartenkoordinatoren. Zum Beispiel ist eine Person von der Länderdienststelle verantwortlich für die Sortenversuche von Winterweizen in den beteiligten Bundesländern. Ich bin der Koordinator für alle Öko-Sortenversuche bis auf Dinkel, für die Bundesländer Sachsen, Thüringen und Sachsen-Anhalt.

Vor der Aussaat müssen die Prüfsortimente abgestimmt werden und nach der Ernte müssen die Daten ausgewertet werden, so dass die Sortenempfehlungen fertig sind, wenn die Landwirte das Saatgut bestellen. Das kann gerade im Sommer ein enges Termingeschäft sein und erfordert eine intensive Abstimmung und Zusammenarbeit. Die Kommunikation der Bundesländer untereinander und die Kommunikation mit den Züchtern funktioniert gut.

Für die Zusammenarbeit zwischen den Länderdienststellen und dem BSA müssen einheitliche Methoden und Standards angewendet werden. Zudem ist für den Datenaustausch eine einheitliche Software von Nöten. Dafür verwenden alle Länderdienststellen und das BSA das Programm PIAF.

Who is choosing varieties that are tested and what are the criteria for variety assortment? What are the criteria for choosing reference varieties?

The Federal State Offices select the varieties to be tested. The coordinator makes a proposal and coordinates this proposal with colleagues from the other Federal States. For the decision-making it is crucial whether a new variety is suitable for the conditions of OA regarding yield, quality criteria and agronomic properties.

There is no completely new collection of varieties to be tested every year. The varieties are tested for several years. Two to three varieties, which lost importance, or which did not meet testing criteria, are exchanged by two to three new varieties. For newly registered varieties we ask breeders whether they are interested in testing their varieties for OA or breeders approach us.

As reference varieties we use so-called VRS. These are agreed upon by the Federal State Offices and the FPVO throughout Germany. Two to three varieties with major importance in cultivation are used as reference varieties. These can either be conventional or organic varieties. If a variety loses importance, they can be exchanged with other varieties. The FPVO is responsible for variety release. Candidates for variety registration are tested for DUS and VCU criteria. For ten years, breeders can apply for VCU testing under organic conditions. As the FPVO only owns conventionally managed testing stations, organic VCU testing is added to post-registration testing of the Federal States. Data of organic VCU testing are transferred to the FPVO and on the basis of this data

Wer sucht die zu testenden Sorten aus und was sind die Kriterien für die Sortenauswahl? Was sind die Kriterien für die Auswahl der Referenzsorte?

Die zu prüfenden Sorten werden von den Länderdienststellen ausgewählt. Der Koordinator macht einen Vorschlag und stimmt diesen mit den Kollegen und Kolleginnen der anderen Bundesländer ab. Entscheidend dabei ist, ob eine neue Sorte den Ansprüchen des Öko-Anbaus im Hinblick auf Ertragsvermögen, Qualitätseigenschaften und pflanzenbaulichen Eigenschaften entspricht.

Es wird nicht jedes Jahr das komplette Sortiment ausgetauscht. Die Sorten werden mehrere Jahre getestet. Die Sorten, die keine Bedeutung mehr haben oder nicht mehr gut abschneiden werden aus dem Sortiment genommen. Das sind pro Jahr in etwa zwei bis drei Sorten und dafür kommen zwei bis drei neue Sorten rein. Bei neu zugelassenen Sorten sprechen wir mit den Züchtern, ob ein Interesse an Prüfung im Öko-Anbau besteht bzw. die Züchter kommen mit ihren Wünschen auf uns zu.

Als Referenzsorte werden sog. VRS herangezogen. Diese werden nach Abstimmung zwischen den Länderdienststellen und dem BSA bundesweit festgelegt. Es handelt sich um zwei bis drei Sorten, die in der Praxis eine große Anbaubedeutung haben, so dass der Landwirt einen Vergleichsmaßstab zu diesen Sorten hat. Bei den zwei bis drei Sorten kann es sich sowohl um konventionelle als auch ökologische Sorten handeln. Bei diesen VRS ist auch immer ein Austausch möglich, wenn eine Sorte nicht mehr relevant ist. Für die Sortenzulassung ist das BSA zuständig. Die Zulassungskandidaten durchlaufen die Register- und Wertprüfung. Seit etwa zehn Jahren können Züchter beantragen, dass die Wertprüfung unter den Bedingungen

the FPVO decided whether a variety is registered. For VCU testing, the FPVO requires so-called VRS. VRS are three registered varieties, which are tested besides the candidate varieties. Normally, VRS are varieties which are important in cultivation. Each year, the FPVO agrees upon the VRS with the Federal States Offices. VRS are also used for regional post-registration trials, since those are transferred to the FPVO as well. The FPVO uses these data for adjusting the descriptive variety list, i.e. it is tested whether the criteria at variety release are up-to-date. For instance, if there is a resistance break down, classification of susceptibility in the descriptive variety list is adjusted.	des ökologischen Landbaus stattfindet. Da das BSA nur über konventionell bewirtschaftete Prüforte verfügt, werden die Öko-Wertprüfungen an Öko-Landessortenversuche der Bundesländer angehängt. Die Daten der Öko-Wertprüfungen werden an das BSA übermittelt und dienen dem BSA als Grundlage für die Entscheidung, ob eine Sorte eine Zulassung erhält. Für die Wertprüfungen benötigt das BSA sog. VRS Dabei handelt es sich um etwa drei bereits zugelassene Sorten, die neben den Stämmen geprüft werden. In der Regel handelt es sich bei den VRS um Sorten mit wichtiger Anbaubedeutung. Das BSA stimmt die Auswahl der VRS jährlich mit den Länderdienststellen ab. Auch in reinen Landessortenversuchen werden die VRS mit geprüft, da auch die Daten dieser Landessortenversuche an das BSA übermittelt werden. Die Daten der Landessortenversuche nutzt das BSA zur Fortschreibung der Beschreibenden Sortenliste, d.h. es wird geprüft, ob die bei der Zulassung festgelegten Merkmalseinstufungen noch aktuell sind. Kommt es z.B. bei einer Sorte zu einem Resistenzeinbruch bei einer Krankheit, dann wird die Einstufung zur Anfälligkeit bei dieser Krankheit in der Beschreibenden Sortenliste angepasst.
How many testing locations do you have? Do you conduct variety testing on-station or on-farm or both? What is the number of repetitions per location? Over how many years do you test varieties? On the cultivation areas with loess soil and weathered rocks (*Löss- und Verwitterungsstandorten*) in East Germany, we have, depending of the crop species two (rye, triticale, potatoes), three, or four locations. Every trial has four repetitions, i.e. the variety is tested on four plots. This is standard procedure in variety testing. Normally, the variety is tested for at least three years. After three years we decide whether we recommend the variety to the farmers and the variety is further tested. If a variety gets no recommendation, the variety is excluded from further testing.	*Wie viele Standorte haben Sie? Findet die Sortenprüfung in landwirtschaftlichen Betrieben und/oder in Versuchsstationen statt? Wie viele Wiederholungen finden pro Standort statt? Über wie viele Jahre dauert die Sortenprüfung?* Auf den Löss- und Verwitterungsstandorten in Ostdeutschland gibt es je nach Fruchtart zwei (Roggen, Triticale, Kartoffeln), drei oder vier Standorte. Jeder Versuch hat vier Wiederholungen, d.h. die Fruchtart wird auf vier Parzellen getestet. Das ist der Standard im Sortenwesen. Normalerweise werden Sorten mindestens drei Jahre geprüft. Nach drei Jahren wird entschieden, ob die Sorte eine Empfehlung bekommt. Dann wird die Sorte weiter geprüft. Wenn die Sorte nicht so gut abgeschnitten hat, wird sie aus der Prüfung genommen.
Are you looking for any specific attributes of these varieties that are important for organic farms or region/market/processing/consumer preference/ storage/resistance/climate change in your country? We have an extensive catalogue with testing criteria. This catalogue is determined in the joint guidelines for VCU testing and regional variety testing. For every crop species, there is a detailed list with testing criteria. In these guidelines, there are also the testing criteria listed, which are important for organic variety testing. Concerning cereals, there are two additional criteria, which are only of relevance under organic conditions: degree of soil coverage in spring and mass development in juvenile development stages. These criteria are important for weed suppression.	*Untersuchen Sie spezifische Sorteneigenschaften, die für den Ökolandbau oder für die Region/Markt/ Verarbeitung/ Verbraucherpräferenzen/Lagerung/Resistenz/ Klimawandel wichtig sind?* Wir haben einen umfangreichen Katalog mit Merkmalen, die getestet werden. Dieser ist in den gemeinsamen Richtlinien zur Durchführung von Wertprüfungen und Sortenversuchen festgelegt. Für jede Fruchtart ist genau aufgelistet welche Merkmale erfasst werden In diesen Richtlinien sind auch alle wesentlichen Merkmale erfasst, die für den Öko-Bereich wichtig sind. Bezüglich Getreide gibt es zwei zusätzliche Kriterien, die nur in den Öko-Versuchen erfasst werden: Bodenbedeckungsgrad im Frühjahr und Massenbildung in der Jugendentwicklung. Diese Kriterien sind wichtig in Hinblick auf Unkrautkonkurrenz.

Are you performing any nutritional analysis? If not: Do you think this would be something that would be important to develop in the future? The quality criteria which are tested in the organic variety trials are identical to the ones tested in conventional variety trials, with the exception of wheat. In conventional variety trials of wheat, we do not test for gluten because it has no relevance for conventional wheat. However, in organic variety trials, gluten is an important quality criterion. We communicate with producer organisations and commerce in order to be able to adapt quality criteria if necessary, but at the moment, with the exception of gluten content, the quality criteria are identical. However, individual criteria are partly valued differently, such as the crude protein content of wheat.	*Führen Sie Nährstoffanalysen durch? Wenn nein: Denken Sie, dass die Entwicklung von Nährstoffanalysen für die Zukunft wichtig sein könnte?* Die Qualitätseigenschaften, die getestet werden, sind identisch zu konventionellen Prüfungen, bis auf eine Ausnahme: Beim Weizen wird der Feuchtkleber in den konventionellen Landessortenversuchen nicht erfasst, weil er bei konventionell gehandeltem Weizen keine Rolle spielt, aber im Ökobereich ist das ein wichtiges Qualitätskriterium. Wir stehen im Austausch mit Erzeugergemeinschaften oder dem Handel, um Qualitätseigenschaften ggf. anzupassen, aber bis auf die Ausnahme vom Feuchtkleber sind die Qualitätseigenschaften identisch. Allerdings werden einzelne Kriterien teilweise unterschiedlich gewichtet, wie z.B. der Rohproteingehalt bei Weizen.
Are you or any other actors in the network (e.g., processor) performing an analysis of the products made out of these varieties (e.g., bread, pasta, juice, concentrate, etc.)? If not: Do you think this would be something that would be important to develop in the future? Normally, we test for all criteria, which are of relevance for commerce. Baking tests are beyond the scope of regional post-registration trials. Within the context of official VCU trials, quality criteria are assessed as well and there are additional baking tests with wheat, but these are ordered by the FPVO. The baking tests are conducted in the Federal Institute for Grain, Potato and Fat Research (*Bundesanstalt für Getreide-, Kartoffel- und Fettforschung*) in Detmold.	*Führen Sie oder andere Akteure des Netzwerks (z.B. Verarbeiter) eine Analyse des verarbeiteten Produktes der geprüften Sorte durch (z.B. Brot, Nudeln, Saft, Konzentrat, usw.)? Wenn nein: Denken Sie, dass die Entwicklung einer solchen Analyse für die Zukunft wichtig sein könnte?* Wir prüfen in der Regel die die Merkmale, die auch für den Handel relevant sind. Backversuche werden im Rahmen der Landessortenversuche nicht durchgeführt. Im Rahmen der Wertprüfung werden ebenfalls Qualitätsmerkmale erfasst und beim Weizen werden zusätzlich Backversuche durchgeführt, die aber vom BSA in Auftrag gegeben werden. Die Backversuche finden in der Bundesanstalt für Getreide-, Kartoffel- und Fettforschung in Detmold statt.
Are trials unbiased and results reliable? Are only "good" results published? What is the minimum number of the growing seasons to get reliable results? The trials are independent. An important precondition for regional post-registration trials is that trial fields are homogeneous to a large extent and that are varieties are treated equally. For the statistical evaluation we use analysis of variance to test for variation and significance of the results. It can happen, that we have some errors in the trials, if, for instance, there is rodent attack in some plots, because of weather events, or if the soil is inhomogeneous. This will become evident in the analysis of variance and a trial with a high variation cannot be evaluated because the difference between varieties does not correlate with varietal differences but with other effects. In such a case, the whole trial cannot be disseminated.	*Sind die Versuche unabhängig und die Resultate zuverlässig? Werden nur „gute" Resultate veröffentlicht? Was ist die minimale Anzahl an Vegetationsperioden, um zuverlässige Resultate zu erhalten?* Die Versuche sind unabhängig. Wichtige Voraussetzungen für die Landessortenversuche sind, dass die Versuchsflächen weitgehend homogen sind und dass bei der Durchführung alle Sorten gleichbehandelt werden. Wir führen die statistische Auswertung in Form einer Varianzanalyse durch, um zu prüfen wie hoch die Streuung ist und ob es signifikante Unterschiede gibt. Es kann passieren, dass ein Versuch nicht gelingt, z.B. auf Grund von Mäusefraß in einzelnen Parzellen, Witterungsereignissen oder der Boden ist inhomogen. Das zeigt sich dann in der Varianzanalyse und ein solcher Versuch mit einer hohen Streuung ist nicht bewertbar, da die Unterschiede zwischen den Sorten nicht auf Sortenunterschieden beruhen, sondern auf anderen Effekten. In einem solchen Fall wird der gesamte Versuch nicht veröffentlicht.

How do you disseminate the results from the trials and who can access it? If results are available online, please indicate the link to the trial results.

The results are available online. Additionally, recommendations for varieties are send in pdf form to farmers and farming associations. Furthermore, results are disseminated in the agricultural professional press. With the dissemination of the most important trial results, recommendations for varieties are published. These are agreed upon with colleagues of the Federal States Offices involved.

https://www.landwirtschaft.sachsen.de/sortenempfehlungen-19902.html?_cp=%7B%22accordion-content-36831%22%3A%7B%221%22%3Atrue%7D%2C%22previousOpen%22%3A%7B%22group%22%3A%22accordion-content-36831%22%2C%22idx%22%3A1%7D%7D

Wie veröffentlichen Sie die Resultate der Sortenprüfungen und wer hat Zugang zu den Resultaten? Bitte fügen Sie den Link bei, falls die Resultate online zugänglich sind.

Die Ergebnisse werden ins Internet gestellt. Zusätzlich werden die Sortenempfehlungen als pdf an Landwirte und Anbauverbände gesickt und es erfolgt eine Veröffentlichung in der landwirtschaftlichen Fachpresse.

Mit der Veröffentlichung der wichtigsten Versuchsergebnisse erfolgt auch eine Veröffentlichung von Sortenempfehlungen. Diese sind mit den Kolleginnen und Kollegen der beteiligten Länderdienststellen im gemeinsamen Anbaugebiet abgestimmt.

How are trials for OA financed?

For conduction regional post-registration trials in Saxony, financial means of the Federal State of Saxony are used. Breeders provide seeds for variety testing for free. For every variety about 3 kg of grains are needed. It is important that seeds from breeders are used and not seeds from propagation facilities in order to give the breeder the possibility to provide seeds with a qualitatively high value for testing.

The collection of varieties used for testing, involves varieties from different breeders. The collection is transparent, i.e. when seeds are ordered, all breeders get the whole list with the tested varieties.

Wie werden die ökologischen Sortenprüfungen finanziert?

Für die Durchführung der Landessortenversuche in Sachsen werden Mittel des Freistaates Sachsen genutzt. Die Züchter steuern das Saatgut für die Sortenprüfungen umsonst bei. Pro Sorte werden in etwa 3 kg Getreide benötigt. Es ist wichtig, dass Züchtersaatgut und kein Z-Saatgut von einem Vermehrungsbetrieb verwendet wird. Somit hat der Züchter es in der Hand, dass qualitativ hochwertiges Versuchssaatgut geprüft wird.

Die Prüfsortimente, bei denen verschiedene Züchter beteiligt sind, sind transparent, d.h. wenn das Saatgut bestellt wird, bekommen alle Züchter die gesamte Liste von den Sorten, die geprüft werden.

Which testing criteria are important for OA or for climate-robustness?

The post-registration trials already test 95-99% of the properties, which are important for the farmer or for commerce. There might be some additional properties, which should be tested for. For instance, some breeders, especially biodynamic breeders, select for wheat varieties which are resistant to bunt. This testing criteria is irrelevant for conventional breeders who use dressed seeds. When no seed dressing is used, and instead, seed saving is practiced, which is favoured in biodynamic agriculture, a resistance against bunt is vital. This should be assessed in the context of official VCU trials, for which special infection trials are necessary.

Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?

Die Landessortenversuche decken bereits 95-99% von den Merkmalen ab, die für den Landwirt oder für den Handel relevant sind. Es gibt vielleicht das eine oder andere Merkmal, welches zusätzlich erfasst werden sollte. Zum Beispiel beim Weizen, sind einige Züchter dabei, v.a. im biodynamischen Bereich, Sorten zu züchten, die eine Steinbrandresistenz haben. Das ist ein Merkmal, was von den konventionellen Züchtern nicht beachtet wird, da das Saatgut gebeizt wird. Wenn aber nicht gebeizt wird, sondern Nachbau betrieben wird, was gerade im biodynamischen Bereich verbreitet bzw. erwünscht ist, dann ist eine Steinbrandresistenz wichtig. Dies sollte im Rahmen der Wertprüfungen miterfasst werden, wozu spezielle Infektionsversuche erforderlich sind.

What do you see as the next important step in order to develop/improve the variety testing trials?

More testing locations are necessary to improve data basis and in order to better evaluate varieties. Different soil and climate conditions have to be taken into account. This is a matter of capacity in research institutes.

Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?

Es sind mehr Prüfstandorte notwendig, um die Datengrundlage zu verbessern, so dass die Sorten besser eingeschätzt werden können. Es sollten verschiedene Boden- und Klimabedingungen mit getestet werden. Das ist eine Frage der Kapazitäten im Bereich des Versuchswesens.

What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?

(a): The definition is ok as long as new varieties with improved characteristics are released.

The indented audience of variety trials are farmers. The farmer asks for a sufficient yield, a sufficient quality,

Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?

(a): Wenn die Definition dazu führt, dass die Sorte in entscheidenden Kriterien besser ist als die vorhandenen Sorten, dann ist die Definition in Ordnung.

winter hardiness, low risk of lodging, high weed competitiveness, resistances, etc. (b): The definition is ok but should not result in the sole use of varieties from organic breeding. This restriction would be too large, because there are good varieties from conventional breeding. Both forms of breeding are legitimate. Solely propagation of organic varieties should be conducted under organic conditions.	Zielgruppe der Sortenprüfungen sind vor allem die Landwirte. Der Landwirt fordert einen ordentlichen Ertrag, eine ordentliche Qualität, Winterfestigkeit, Standfestigkeit, Unkrautunterdrückung, Resistenzen, usw. (b): Die Definition ist in Ordnung, sollte aber nicht dazu führen, dass im Öko-Anbau nur noch Sorten verwenden werden können, die aus ökologischer Züchtung kommen. Das wäre eine zu große Einschränkung, denn es gibt nach wie vor auch gute Sorten aus der konventionellen Züchtung. Beide Formen der Züchtung sind legitim, lediglich die Vermehrung der Öko-Sorten sollten in jedem Fall unter ökologischen Bedingungen stattfinden.
Is PIAF open to the public? Who has access to PIAF? Who has access to the crude data? In order to use PIAF, a license is necessary. The coordinators of the trials have access to their own data and after data exchange with the other cooperating Federal States, to their data.	*Ist PIAF öffentlich zugänglich? Wer hat Zugang zu PIAF? Wer hat Zugang zu den rohen Daten?* Um PIAF nutzen zu können, muss eine Lizenz erworben werden. Zugang zu den Daten haben die jeweiligen Versuchsansteller, zum einen für die eigenen Daten und zum anderen nach Datenaustausch auch für die Daten aus anderen Bundesländern, mit denen eine Zusammenarbeit stattfindet.
Are results published directly after harvest? How long does it take to publish results? The results of winter cereals are published in August and September, i.e. only a few weeks after harvest of trials. The results of spring wheat, grain legumes and potatoes are published in December and January. It is important, that results are available, when the farmer selects varieties for his farm.	*Werden die Resultate direkt nach der Ernte veröffentlicht? Wie lange dauert es bist zur Veröffentlichung?* Bei Wintergetreide werden die Ergebnisse im August und September veröffentlicht, also nur wenige Wochen nach der Ernte der Sortenversuche. Bei Sommergetreide, Körnerleguminosen und Kartoffeln erfolgt die Veröffentlichung im Dezember und Januar. Wichtig ist, dass die Resultate zu einem Zeitpunkt zur Verfügung stehen, ab dem die Landwirte die Sortenwahl für ihre Betriebe vornehmen.
Are the same VRS used in organic and conventional variety testing? What are the advantages/disadvantages of VRS? Partly, the same VRS are used and partly, other VRS are used. Varieties which were tested solely under organic conditions, i.e. varieties originating from organic breeding, are increasingly used as VRS. VRS are necessary so that the FPVO can use the data from VCU testing and from regional post-registration trials. Every year, the FPVO agrees upon VRS with the Federal State Offices separately for conventional and OA.	*Werden die gleichen VRS im den ökologischen und konventionellen Sortenprüfungen verwendet? Vor-/Nachteile von VRS?* Teilweise werden die gleichen VRS verwendet, teilweise sind es andere. In den Öko-Sortenversuchen werden zunehmend Sorten als VRS genutzt die nur in diesem Anbausystem geprüft werden, also z.B. Sorten aus ökologischer Züchtung. VRS sind erforderlich damit das BSA die Daten aus Wertprüfungen und aus Landessortenversuchen nutzen kann. Das BSA stimmt jährlich die VRS mit den Länderdienststellen ab (jeweils für den konventionellen bzw. ökologischen Anbau).
What compensation do farmers for on-farm variety testing? Are conventional variety trials conducted on-farm as well? Are conventional farmers compensated as well? The compensation is adequate. In Saxony, conventional variety testing is not conducted on-farm. In other Federal States, conventional variety testing can be conducted on-farm.	*Wie hoch ist die Vergütung der Landwirte? Werden konventionelle Sortenprüfungen auch auf landwirtschaftlichen Betrieben durchgeführt? Werden konventionelle Landwirte ebenfalls vergütet?* Die Vergütung ist angemessen. In Sachsen werden konventionelle LSV nicht auf landwirtschaftlichen Betrieben durchgeführt. In anderen Bundesländern ist dies aber der Fall.
What is the task of the farmer who conducts on-farm variety testing? Do you use the farmer's equipment, or do you have your own equipment? Farmers provide fields for variety testing. For the trial set-up and for harvesting, the equipment of the Saxon State Office for Environment, Agriculture and Geology is used.	*Was ist die Aufgabe der Landwirte, die Prüfungen auf ihrem Hof durchführen? Wird das Equipment der Landwirte benutzt oder eigenes?* Die Landwirte stellen ihre Flächen zur Verfügung. Für die Anlage und Ernte des LSV wird Versuchstechnik des LfULG verwendet.

Do you receive organic or conventional, untreated seeds? Do you use organic or conventional seeds for the reference varieties? We use organic as well as conventionally produced, untreated seeds.	*Erhalten Sie ökologisches oder konventionelles, unbehandeltes Saatgut? Wird ökologisches oder konventionelles Saatgut für die Referenzsorten verwendet?* Es wird sowohl ökologisches als auch konventionell erzeugtes ungebeiztes Saatgut verwendet.

Table 16: Expert interview with Dr. Niklas KÖRBER.

Dr. Niklas KÖRBER is lead breeder at HILD samen GmbH. HILD samen conducts breeding under conventional conditions and varieties are tested in conventional variety trials. Propagation of seeds is conducted under organic or under conventional conditions. Additionally, from almost all conventional seeds they offer seeds without post-harvest treatment.

Why do you contact breeding under conventional conditions and why do you apply only for conventional variety testing? Conventional breeding has certain advantages over organic breeding. There are more possibilities within the trials for selection of new material and conditions in conventional breeding can be better controlled. The main problem is, that the end user, either the consumer or the farmer, has to carry the additional costs of organic breeding. Additionally, to be able to make profits with organic breeding, the market has to be large enough. For us, organic breeding does not pay off yet. To my knowledge, there is no organic variety testing for vegetables.	*Wieso führen Sie Züchtung und Prüfung unter konventionellen Bedingungen durch bzw. lassen durchführen?* Konventionelle Züchtung hat gewisse Vorteile, gegenüber ökologischer Züchtung. Man hat mehr Möglichkeiten bei den Versuchen für die Selektionen neuen Materials und man kann die Bedingungen in konventioneller Züchtung besser steuern. Das Hauptproblem ist, dass man vom Endnutzer, entweder vom Verbraucher oder vom Landwirt, die Mehrkosten erstattet bekommen muss, die eine ökologische Züchtung mit sich bringt. Zudem muss der Markt groß genug sein, dass man an den Produkten, die man züchtet, etwas verdient. Aus unserer Sicht lohnt sich eine ökologische Zucht noch nicht. Es ist mir nicht bekannt, dass es ökologische Sortenprüfungen für Gemüse gibt.
Do you plan to convert to organic breeding? What are the requirements for converting to organic breeding? Until now, we do not have any plans to convert to organic breeding. We consider cost-benefit analysis, i.e. if the market is large enough and if we are able to make a profit, we would consider organic breeding. At the moment, we only breed conventionally, but we produce organic seeds which are bred under conventional conditions but propagated under organic conditions. The market for organic seeds is growing. Thus, we invest in organic seeds and produce more each year.	*Haben Sie Pläne in der Zukunft auf eine ökologische Züchtung umzustellen? Was wäre notwendig, dass Sie ökologische Züchtung durchführen?* Bis jetzt haben wir noch keine Pläne auf ökologische Züchtung umzustellen. Das ist immer eine Kosten-Nutzen-Abwägung. Wenn wir feststellen, dass der Markt groß genug ist, dass es sich für uns lohnt darin zu investieren und dass wir am Ende ein bisschen damit verdienen, dann würden wir uns überlegen in der ökologischen Züchtung tätig zu werden. Im Moment züchten wir nur konventionell, aber wir haben einen großen Bereich wo wir ökologisch produziertes Saatgut verkaufen, d.h. es wurde konventionell gezüchtet aber unter ökologischen Bedingungen vermehrt. Da dieser Markt wächst, investieren wir in ökologisches Saatgut und produzieren von Jahr zu Jahr mehr.
Do you plan to apply for variety testing under organic conditions? We test varieties internally for their suitability for organic cultivation. For the production of organic seeds, we need to know, how varieties perform under organic conditions. Variety testing under organic conditions is fine. Especially varieties, which were produced specifically for the organic market, require separate variety trials. The term uniformity has a different meaning in organic and conventional variety testing and other additional testing criteria are necessary. If we would sell more organically produced seeds or produce varieties specifically for the organic market, we would consider applying for organic variety testing in the	*Haben Sie Pläne Sorten unter ökologischen Bedingungen testen zu lassen?* Wir testen die Sorten intern auf ihre Eignung für den ökologischen Anbau. Für die Produktion von ökologischem Saatgut müssen wir wissen, wie die Sorten unter ökologischen Gesichtspunkten wachsen. Sortenprüfung unter ökologischen Bedingungen finde ich gut. Vor allem für Sorten, die speziell für den ökologischen Markt produziert werden, ist eine eigene Sortenprüfung notwendig. Der Uniformitätsbegriff ist ein anderer in der ökologischen Prüfung. Zudem gelten andere Prüfkriterien als im konventionellen Anbau. Wenn wir mehr ökologisch produziertes Saatgut verkaufen bzw. Sorten speziell für den ökologischen Markt

future. At the moment, our main market is the conventional market, but we are extending our organic section.

produzieren, könnten wir uns in Zukunft überlegen eine ökologische Sortenprüfung durchführen zu lassen. Momentan ist unser Hauptmarkt jedoch im konventionellen Bereich, aber wir bauen unseren ökologischen Bereich aus.

What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?

(a): The high level of genetic and phenotypical diversity depends on the respective crop. In OA, genetic and phenotypical diversity should be higher compared to CA, in order to balance out more difficult cultivation conditions. A lower level of genetic and phenotypical diversity increases the risk of losses due to infections.

(b): It would be appropriate that organic varieties originate from organic breeding. However, it should also be possible to sell conventionally bred varieties as organically produced seeds. There are farmers which ask for organically bred varieties, but there are also farmers who ask for organically produced seeds regardless of the breeding aspect. Organic and conventional breeding result in different products on the market. The products are suitable for different challenges.

Organic breeding has some disadvantages over conventional breeding, especially regarding biotic resistance breeding it is difficult to do without spraying. In organic breeding, it is more difficult to control trial conditions. That is why, in organic breeding, you have to make some compromises in some criteria, which you do not have to do in conventional breeding. Thus, in conventional breeding, a desired result is reached faster and more precisely.

Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?

(a): Das hohe Maß an genetischer und phänotypischer Vielfalt hängt von der jeweiligen Kultur ab. Im ökologischen Landbau sollte die genetische und phänotypische Vielfalt höher sein, als im konventionellen Bereich um schlechte Bedingungen im Anbau besser abfedern zu können. Bei einer geringen genetischen und phänotypischen Vielfalt ist die Chance höher, dass bei Befall ein höherer Verlust vorhanden ist.

(b): Es ist sinnvoll, dass ökologische Sorten aus ökologischer Züchtung stammen sollten. Auch konventionell gezüchtete Sorten sollen als ökologisch produziertes Saatgut verkauft werden können. Es gibt Anbauer, die Wert darauflegen, dass die Sorten ökologisch gezüchtet wurden, aber es gibt auch Anbauer, die Wert darauflegen, dass das Saatgut ökologisch produziert wurde, aber nicht so viel Wert auf den züchterischen Aspekt legen. Ökologische und konventionelle Züchtung bringen unterschiedliche Produkte auf den Markt. Die Produkte sind für unterschiedliche Herausforderungen geeignet.

Bei ökologischer Züchtung gibt es einige Nachteile gegenüber konventioneller Züchtung, vor allem im Bereich von biotischer Resistenzzüchtung ist es besonders schwer, wenn ich keine Spritzmittel in der Züchtung einsetzen darf. Bei der Anlegung von Versuchen in der ökologischen Züchtung können die Versuchsbedingungen nicht so gut gesteuert werden. Von daher muss man in ökologischen Züchtungsprogrammen bei bestimmten Punkten Abstriche machen, die man in konventionellen Züchtungsprogrammen nicht machen muss, so dass man in der konventionellen Züchtung schneller und gezielter zum gewünschten Ergebnis kommt.

Do you consider criteria in conventional breeding, which could be of interest for organic varieties? Do you consider criteria for climate-robustness?

We are selling more and more organic seeds. Thus, it is important that our varieties perform well under organic conditions. We are putting more emphasis on integrating biotic resistances in our breeding programmes, so that we can reduce the amount of spraying. This is also demanded by the conventional sector.

The variety has to look the same under organic and conventional conditions. Seed production under organic conditions is not as easy as under conventional conditions. The variety has to yield enough, so that we have enough seeds to sell. If we have a variety, which we bred under conventional conditions, but which does propagate and produce well under organic conditions, we are only able put it on the conventional market. It is a

Achten Sie in Ihren Züchtungsprogrammen auf Kriterien, die interessant für ökologische Sorten sein könnten? Beachten Sie bestimmte Kriterien der Klima-Robustheit?

Da wir mehr und mehr Saatgut im ökologischen Bereich verkaufen ist für uns wichtig, dass die Sorte auch unter ökologischen Bedingungen performt. Es wird mehr und mehr darauf geachtet, dass wir biotische Resistenzen integrieren, so dass weniger Spritzmittel benutzt werden müssen. Das ist auch etwas, was im konventionellen Bereich, vom Verbraucher gefordert wird.

Die Sorte muss unter ökologischen Bedingungen möglichst genauso aussehen, wie unter konventionellen Bedingungen. Die Saatgutproduktion ist unter ökologischen Bedingungen nicht ganz so einfach wie unter konventionellen Bedingungen. Die Sorte muss also genügend Ertrag produzieren, dass wir genügend Saatgut zum Verkauf haben. Wenn wir eine Sorte haben, die wir

clear negative if the variety does not propagate and produce well under organic conditions.
Climate-robustness plays a role in the conventional as well as organic sector. Abiotic and biotic resistance gain importance in both breeding systems. However, organic breeding has disadvantages regarding repeatability under stressful conditions. In conventional breeding, there are more control options.

unter konventionellen Bedingungen gezüchtet haben, aber die sich unter ökologischen Bedingungen nicht vernünftig vermehren und produzieren lässt, dann können wir die nur im konventionellen Bereich vermarkten. Wenn die Sorte nicht unter ökologischen Bedingungen vermehrt oder angebaut werden kann, dann ist das ein Minuspunkt für die Sorte.
Klima-Robustheit spielt im konventionellen und ökologischen Bereich eine Rolle. Abiotische und biotische Resistenzen gewinnen in beiden Zuchtbereichen mehr und mehr an Bedeutung. Die ökologische Züchtung hat jedoch Nachteile, bei der Wiederholbarkeit von Stresssituationen. Diese kann man in konventionellen Zuchtprogrammen besser kontrollieren.

Which testing criteria are important for OA or for climate-robustness?
In our breeding programs, we take care that the criteria of variety testing are met, so that our varieties do not fail the official variety trials. We try to include more and more resistances in our varieties, because they represent an additional value and are demanded by the market. Additionally, we test reproducibility. It does not make any sense to breed a variety of which we cannot produce seeds.
It happens, that a conventionally bred variety which is cultivated under organic conditions, does not perform as well as under conventional conditions. From these varieties it is more difficult or impossible to produce seeds. That is a criterium for or against a variety in organic cultivation. Organic seeds have disadvantages over conventional seeds, because the requirements of organically produced seeds are different. That is why it would be useful to conduct organic variety testing with organic seeds.

Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?
In unseren Züchtungsprogrammen gucken wir, dass die Kriterien der Sortenprüfung eingehalten werden, damit wir nicht durch die Sortenprüfung durchfallen. Wir versuchen mehr und mehr Resistenzen in Sorten einzuzüchten, da die einen Mehrwert der Sorte bedeuten und vom Markt mehr und mehr gefordert werden. Zudem überprüfen wir die Produzierbarkeit. Es nutzt uns nichts eine Sorte zu züchten, von der wir kein Saatgut produzieren können.
Es kommt vor, dass konventionell gezüchtete Sorten im ökologischen Anbau nicht so gut performen wie im Konventionellen. Von diesen Sorten kann man schlechter oder gar kein Saatgut produzieren. Das ist ein Kriterium für oder gegen eine Sorte im ökologischen Anbau. Ökologisches Saatgut steht im Vergleich zu konventionellem Saatgut schlechter dar, weil die Kriterien an ökologisch produziertes Saatgut anders sind. Das ist der Grund, wieso es sinnvoll ist eine ökologische Sortenprüfung mit ökologischem Saatgut zu machen.

Which role does the farmer play regarding breeding of varieties adapted to organic conditions?
We breeders are interested in the feedback of farmers or seed intermediaries. Variety trials in early stages are conducted externally, so that the consumer is included in the assessment of new varieties.
The farmer has to pay an adequate price for the additional value of a variety. Organically bred varieties have additional costs, which have to be paid by the farmer, so that it is profitable to conduct organic breeding. However, price pressure in agriculture is relatively high.

Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?
Wir als Züchter sind sehr an dem Feedback der Landwirte oder Saatgutzwischenhändlern interessiert. Versuche werden schon im relativ frühen Stadium extern gemacht, wo der Kunde eine Mitbewertung der neuen Sorten vornimmt.
Der Landwirt muss den angemessenen Preis für den Mehrwert der Sorte zahlen. Eine ökologisch gezüchtete Sorte hat Mehrkosten, die vom Landwirt gezahlt werden müssen, damit sich die Züchtung im ökologischen Bereich lohnt. Der Preisdruck in der Landwirtschaft ist jedoch relativ hoch.

What kind of seeds (organic vs. conventional) do you send to variety testing? What are the advantages and disadvantages of organic seeds?
We send conventional seeds to variety testing because they have lower infestation rates and perform better in uniformity. We want that a variety is approved by variety testing and not rejected. It would be disadvantageous to send in organic seeds if conventional seeds are available. The production of organic seeds is more laborious than of conventional seeds.

Welches Saatgut (ökologisch vs. konventionell) übermitteln Sie an die Sortenprüfung? Was sind die Vor- und Nachteile von ökologischem Saatgut?
Wir schicken konventionelles Saatgut ein, weil wir da sicherer sein können, dass wir geringeren Befall haben bzw. dass die Uniformität besser ist. Wir wollen in einer Sortenprüfung, dass die Sorte durchkommt und nicht durchfällt. Es wäre ein gewisser Nachteil, wenn man ökologisches Saatgut einschicken würde, wenn man auch konventionelles Saatgut hat. Die Produktion von

	ökologischem Saatgut ist aufwändiger als von konventionellem Saatgut.
What were the specific challenges concerning distinctness, uniformity and stability (DUS)? Sometimes, uniformity represents a problem, because it depends on the environment. If there are no extreme environments in the breeding programmes, but there are rare environments in variety testing, uniformity might suffer. For instance, some herbs are bred for outdoor cultivation or for pot cultivation. Varieties for pot cultivation have problems with uniformity under outdoor conditions if the environment is very challenging. However, it is possible to cooperate with the coordinators for variety testing and discuss on the testing conditions. That is why we do not have big problems with DUS testing.	*Was sind die Sorten-spezifischen Herausforderungen bezüglich Unterscheidbarkeit, Uniformität und Unveränderlichkeit (DUS)?* Die Uniformität stellt manchmal ein Problem dar, denn das ist von der Umwelt abhängig. Wenn man im Züchtungsprogramm keine extremen Umwelten hat, aber die Sortenprüfung in besonders seltenen Umwelten stattfindet, kann das auf Kosten der Uniformität gehen. Zum Beispiel werden Kräuter oftmals entweder für den Freiland- oder Topfanbau gezüchtet. Topfsorten haben unter Freilandbedingungen Probleme mit der Uniformität, wenn die Umwelt besonders anspruchsvoll ist. Das lässt sich dann meistens in Zusammenarbeit mit den Prüfern von Sortenprüfungen diskutieren. Deswegen haben wir eigentlich keine großen Probleme mit den Registerprüfungen.

Table 17: Expert interview with Dr. Karl-Josef MÜLLER.

Dr. Karl-Josef MÜLLER is head of Cultivari Cereal Breeding Research Darzau (*Cultivari Getreidezüchtungsforschung Darzau*) which develops criteria for breeding of cereals under biodynamic conditions.	
Do you produce organic varieties with a high degree of genetic diversity (according to the new definition, see below) that are not compatible with the existing DUS protocols? We do not have problems today. Our winter rye *Likoro* (*Lichtkornroggen*), which is released as a conservation variety, would make problems to be released with a higher demand of uniformity. I am also developing a spring rye, which cannot be released as a conservation variety and this might cause problems in about three years from now. Additionally, I will get problems, if there will be no extension of organic heterogeneous material from oat, barley, wheat, maize to other cereals like triticale.	
Did you apply for registration of varieties that were rejected due to lack of fulfillment of the DUS requirements? Yes, in the past our winter wheat *Sandomir* was rejected, because it had a little bit more differentiation in the waxy layer of the hulls and more differentiation in length under intensive growing at the seed office station, but not under our own organic conditions.	
What were the specific challenges concerning distinctness, uniformity and stability (DUS)? We had problems with plant lengths of crops and with the degree of ripeness. Both depend on the level of fertilisation and show not such big differentiation under normal organic conditions.	*Was sind die Sorten-spezifischen Herausforderungen bezüglich Unterscheidbarkeit, Uniformität und Unveränderlichkeit (DUS)?* Probleme gab es mit Pflanzenlänge oder Bereifungsgrad, die in Abhängigkeit vom Düngungsniveau deutlicher hervortreten und unter Öko oft gar nicht unterscheidbar sind.
Do you have suggestions for improvements for the DUS trials in some of the species you work with? Testing of DUS criteria should take place under organic conditions and not under conditions of high fertilisation and of course as close to the real growing conditions as possible. There should be an implementation of a new category for niche varieties with criteria similar to conservation varieties and heterogeneous populations related to inspection, threshold values for seed lots or yearly sold seed, and special threshold values for uniformity for niche varieties. However, there should be the possibility to get variety protection for niche varieties and the possibility for uses that have no widespread, but very interesting markets of diversity.	*Haben Sie Verbesserungsvorschläge für DUS Prüfungen, bei den Sorten, mit denen Sie arbeiten?* Nun, es wäre sinnvoll, wenn auch DUS unter ökologischen Anbaubedingungen stattfindet und nicht auf hohem Nährstoffversorgungsniveau.

Did you experience challenges when varieties were tested for value for cultivation and use (VCU)? The definition of VCU is not problematic because everything new is possible. Problematic is that we have to present the testing technologies to the FPVO. For instance, in Germany, the FPVO is not able to test for resistance against bunt disease, because they do not believe in any test. This example can be extended to other special parameters as well. This is why a regulation for niche varieties is needed, so that not everything has to be proven extensively to the FPVO, but by the market itself.	*Was sind die Sorten-spezifischen Herausforderungen bezüglich der Prüfung des landeskulturellen Wertes (VCU)?* Von der Definition her sind VCU eigentlich unproblematisch, denn alles Neue ist möglich. Problematisch ist es, dem BSA erst die Testverfahren beizubringen. In DE ist das BSA beispielsweise nicht in der Lage auf Stinkbrandresistenz zu testen, weil sie keinem Test glauben wollen. Das lässt sich natürlich beliebig auf alle ungewöhnlichen Parameter erweitern. Deshalb braucht es eine Nischenregelung (siehe unten), so dass man dem BSA auch nicht alles aufwändig beweisen muss.
Do you have suggestions for improved VCU trials? NO highly soluble mineral fertilisers, NO pesticides, organic locations which fit to the condition of the farm, and not too many additional criteria which all have to be paid.	*Haben Sie Verbesserungsvorschläge für VCU Prüfungen?* KEINE leichtlöslichen Mineraldünger, KEINE Pestizide, Praxisrelevante Ökostandorte. Und nicht zu viele Zusatzkriterien, die alle auch noch zusätzlich bezahlt werden müssen.
What kind of seeds (organic vs. conventional) do you send to variety testing? What are the advantages and disadvantages of organic seeds? ORGANIC seeds were sent to be tested, and this has only disadvantages, because it cannot easily be enriched with nutrients to get a higher grain weight or protein content. In addition, organic seeds always carry a background noise of seedborne diseases. Reference to:	*Welches Saatgut (ökologisch vs. konventionell) übermitteln Sie an die Sortenprüfung? Was sind die Vor- und Nachteile von ökologischem Saatgut?* ÖKOLOGISCHES und das hat nur Nachteile, da es nicht so leicht mit Nährstoffen angereichert und auf hohe Korngewichte gebracht werden kann. Oftmals auch noch die eine oder andere Schwäche aufgrund eines Grundrauschens an saatgutübertragbaren Krankheiten mit sich bringt. Verweis auf:
MÜLLER, K.J. 2009: Die Bedeutung der Saatgutqualität für Sortenvergleiche mit Sommergerste im ökologischen Landbau. IN: Mayer, J. et al. 2009: Werte-Wege-Wirkungen, Beiträge zur 10. Wissenschaftstagung Ökologischer Landbau, Zürich 11.-13.Februar 2009, Band 1, 244-247. MÜLLER, K.J. 2009: Umdenken bei Öko-Sortenversuchen. Zeitschrift bioland 01/2009, p7. MÜLLER, K.J. 2008: Herkunftswert von Sommergerstensaatgut (ökologisch vs. konventionell). Projektabschlußbericht, Getreidezüchtungsforschung Darzau.	
Which testing criteria are important for OA or for climate-robustness? Nutrient availability which depends on soil metabolism and associated nutrient efficiency (e.g., NUE), and resistance against seedborne diseases. Additionally, the weed competitiveness or ground covering in early development could be measured.	*Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?* Bodenstoffwechselbedingte Nährstoffverfügbarkeit bzw. damit einhergehende Nährstoffeffizienz (z.B. NUE) und Resistenzen gegenüber saatgutübertragbaren Krankheiten.
Which role does the farmer play regarding breeding of varieties adapted to organic conditions? We should not believe the farmers and their criteria too much. In the end, they mostly ask only for high yields. If yield can be combined with additional features, then their judgment is important	*Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?* Man darf ihnen nicht zu viel Glauben hinsichtlich ihrer allgemein vorgetragenen Kriterien schenken. Schlussendlich entscheiden sie fast ausschließlich nach Ertrag.
What do you see as the next important step in order to develop/improve the variety testing trials? Sole use of 'certified-organic' seeds in all testing stages. A broad variation of locations. Instead of using the best locations in the vicinity of 300 km, locations which achieve a yield typical for that region should be used. In particular when characters related to fertilisation level (baking quality) has to be described.	*Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?* Ausschließliche Verwendung von öko-zertifiziertem Saatgut für alle Prüfglieder. Eine breite Palette an Teststandorten und vor allem auch solche, die nicht die besten im Umkreis von 300 km sind, sondern mit regionaltypischem Ertragsniveau.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?*

To force diversity is as impractical as exclusion of diversity. If (b) is only applied when (a) is met, then it will be even more impossible to register varieties whose field of application is restricted. In the current system of registration, it is already too expensive to register special varieties for regions only or small areas or small markets For example, food barley for *Tsampa* cannot be measured using fodder barley as a reference, which is supposed to supply half of Europe. We need more than "heterogeneous populations", we need a regulation for "niche varieties". Niche varieties undergo an easier registration procedure to ensure variety protection, but their area of cultivation is restricted. Variety protection of niche varieties is necessary, otherwise, it would not make any sense to breed with anything else than the super crops (wheat, soy and maize).	Ein Zwang zur Diversität ist genauso lebensunpraktisch wie der Ausschluss derselben. Wenn also (b) nur zur Anwendung kommt, wenn (a) erfüllt ist, dann wird es noch unmöglicher Sorten mit eingeschränktem Verwendungsbereich überhaupt zugelassen zu bekommen. Es ist so schon viel zu teuer, Spezialsorten nach dem Standardverfahren bei Getreide zulassen zu müssen. Eine Speisegerste für *Tsampa* kann nicht an einer Futtergerste, die halb Europa abdecken soll, gemessen werden. Wir brauchen also viel mehr als „heterogene Populationen" eine Regelung für „Nischensorten" mit begrenztem Anbauumfang, die wesentlich leichter zugelassen, aber auch geschützt werden können. Sonst macht es keinen Sinn, sich mit etwas anderem als den Superkulturen (Weizen, Soja, Mais) zu befassen.
Gebhard Rossmanith has some ideas for DUS testing of organic vegetable varieties, as he wants to reduce the number of characteristics for the DUS test, to make it easier to register a variety, but I am not sure whether this will apply for arable crops. According to Beate Rücker, this approach will make it more difficult to have a variety approved, as her argument is that reducing the number of characteristics will make it harder to distinguish between different varieties, and hence it will be more difficult to get a variety approved. Do you have an opinion on this approach? It is related to the species, but also for the heterogeneous material, there could be some characters to be similar on the one hand and others with special frequencies like "from to" and those related to "with a special character at all" and "without".	

Table 18: Statement by Uta SCHNOCK.

Uta SCHNOCK is head of section, responsible for VCU testing and for the descriptive variety lists of the Federal Plant Variety Office (*Bundessortenamt*).
Testing of value for cultivation and use (conventional and organic), registration in the national list, recommendation to the farmer and descriptive variety list in Germany For the acceptance of a variety in the German national list the Federal Plant Variety Office (Bundessortenamt) is the responsible institution. In order to be listed a variety has to be distinct, uniform and stable (DUS), it has to have a name and in case of agricultural species it has to be of value for cultivation and use (VCU). Distinctness, uniformity and stability (DUS) of varieties are tested on one or two locations of the Federal Plant Variety Office and follow the technical guidelines of CPVO or UPOV. The normal duration of the value tests is two years, three years in cereals and winter oilseed rape. A trial series is run on 14 to 20 locations distributed in Germany. In all species VCU testing is done without fungicides or growth regulator to find out the genetic characteristics of the varieties. In cereals and sugar beet a two-factorial trial with two intensity levels is done. 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. 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. According to the legislation varieties from organic breeding and/or for organic production have to fulfill the same requirements for acceptance as other varieties. VCU testing of varieties for organic production from 1999 to 2011 was done as follows: Varieties for which the applicant indicated that they shall be tested under organic conditions were tested in the conventional VCU test and additionally they were tested in a series under organic conditions. At the end of VCU the variety could be described on basis of 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. For the organic VCU testing the same fee has to be paid as for VCU in conventional testing. The decision on the value for cultivation and use of a variety is based on the results from the organic trials. 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.

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".
Beside varieties for organic production also important and interesting varieties from conventional breeding and production are included by the Federal States in the organic testing network and can be described in their valuable characteristics on basis of those results. Thus quite a few varieties are described once on basis of results from the conventional and once on basis of the results from the organic network.

VCU trial protocol for varieties for organic production

The basic principles for variety trials are the same for conventional and organic trials. Nevertheless, there may be a necessity for additional notifications or tests in one or the other. The trial protocol is set up together with the stakeholders before starting the trial.
The Federal Plant Variety Office took part in the **COST860 – SUSVAR** Action (Chair Hanne Ostergard, 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).

VCU trial protocol for cereals

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.
The organic VCU trial is one-factorial with four replications.
Organic trials are planted on organic fields. No chemical treatment, no mineral fertilization. Seed should preferably be from organic production and is not treated.
The organic VCU trial series is carried out on 14 locations.
The trial protocol for observations and measurements in the field is the same as in conventional VCU. Under organic conditions additionally following observations are made:
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 on basis of 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 *Pseudocercosporella*, 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 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.

Other species than cereals

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.

Background information on the history and development of testing of varieties for organic production in Germany

For the procedure of variety testing it is important to know whether varieties for organic production have to be trialed under organic conditions and according to specific technical guidelines.
In order to solve this question, the Federal Plant Variety Office has carried out several research projects since the 1980s in different species, the last of those was carried out in 2004 to 2006 for potato and 2005 and 2006 with winter wheat and spring barley.
Before starting the last research project, the Federal Variety Office organized two workshops on "Breeding for organic farming (2002)" and on "Variety testing for organic farming (2003)" with the interested circles 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 the workshops.
The major results of the workshops were as follows:
The results of the conventional value tests and the variety description in the descriptive variety list give important information for the selection of varieties for organic production. In cereals for organic production it would be helpful to have additional information on the weed competitiveness, the suitability to harrowing, the susceptibility to seed-borne diseases and the nutrient-use efficiency.
The guidelines for the value tests within the research project were set up on basis of these results with certain restrictions. 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.

Research project 2004 to 2006

The research project on winter wheat and spring barley was carried out in 2005 and 2006. All varieties in the project were tested under conventional and under organic conditions. The organic trial series was carried out on 9 locations. No chemical treatment or mineral fertilizer was applied. The seed for the trials was not treated. Additional to the usual observations the mass in the beginning, the ground cover, plant height and the inclination of the flag leaf as indication for the weed competitiveness were observed. The processing quality for milling and baking (wheat) and brewing (barley) purposes was tested.

The comparison of the results from the conventional and organic VCU trial series of spring barley show that the relation of the varieties in their characteristics for cultivation, susceptibility to diseases, yield and quality remains the same in both production systems. The additional observations for weed competitiveness showed only a small differentiation. The results show that it is not necessary to carry out an extra trial series to judge a spring barley variety for its suitability under organic conditions.

The comparison of the results from the conventional and organic VCU trial series of winter wheat show that the relation of the varieties in their characteristics for cultivation, susceptibility to diseases and yield remains the same in both production systems. The additional observations for weed competitiveness show a good differentiation. A description of these characters would be possible.

The results from the quality examinations show that the quality of winter wheat varieties expresses differently under conventional and organic conditions. Dependent on the gluten quality and the ability to produce either yield or protein from limited nitrogen the varieties have more or less suitability for their utilization in organic production. That means that the baking quality of winter wheat varieties for organic production should be assessed on the basis of harvested material from organic production.

The comparison of the results from conventional and organic VCU in potato also did not show a different relation of the varieties.

The results of the research project can be forwarded on request (German text).

Conclusions

Together with the stakeholders and the Federal States the principles for testing varieties for organic production were further developed.

All results from the conventional and organic VCU trial series show that the relation of the varieties in their characteristics for cultivation, susceptibility to diseases and yield remains the same in both production systems. The same is true for quality with the exception of the baking quality of wheat. Nevertheless, results from conventional trials do not find enough acceptance in the interested circles. A variety description will only be fully accepted if it is based on results from organic production.

Additional arguments for a trial series under organic conditions are 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.

On basis of these arguments the Federal Plant Variety Office judges the value of cultivation and use of varieties for organic production as far as possible on the basis of results and characteristics important in organic production.

Table 19: Expert interview with Gebhard ROSSMANITH.

Gebhard ROSSMANITH is chief executive officer of Bingenheimer Saatgut. In close cooperation with Kultursaat e.V. and Saat:gut e.V., where breeding of vegetable varieties under biodynamic and organic conditions are done, Bingenheimer Saatgut supports and conducts breeding of new varieties and amateur varieties.

What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?*
(a): A phenotypical diversity does not define a variety. A variety has to be uniform at a sufficient level and within this uniformity has to be distinct and stable. These are the standard DUS criteria. A variety is distinct if it can be described in its essential properties. A variety is stable if it can be described with the same properties each year. These criteria are also in the interest of the customer. We, in contrast to other actors in the informal seed system, are not opposed to the DUS system.	(a): Eine phänotypische Vielfalt macht eine Sorte nicht zur Sorte. Eine Sorte muss soweit uniform sein und in der Uniformität eine Unterscheidbarkeit und Stabilität haben. Das sind die klassischen DUS Kriterien. Eine Sorte ist unterscheidbar, wenn man sie in den wesentlichen Merkmalen gut beschreiben kann. Eine Sorte ist stabil, wenn sie jedes Jahr durch die gleichen Merkmale beschrieben werden kann. Diese Kriterien sind auch im

Genetic diversity of a variety is important, while, simultaneously, the phenotype is reduced from a population to a variety within the breeding process. Cross-pollinators, not self-pollinators, have to carry a high degree of genetic diversity, since, otherwise, inbreeding depression occurs.
In the new organic regulation, the same wording is used for defining two different groups, for organic heterogeneous material and for organic varieties.
(b): An organic variety has to originate from organic breeding. We are thankful that there is a definition of organic breeding, even though it is not a very good definition. We wish for a clearer differentiation from biotechnological methods and genetic engineering. A relevant part of the definition has to be that organic varieties are bred under organic conditions as defined in the organic regulation. This definition goes in line with the IFOAM standards, which exist since several years. This puts an end to the discussion in which conventional breeding companies claim they would do organic breeding.

Interesse der Kunden. Wir, anders als andere Akteure in der informellen Saatgutszene, sind keine Gegner des DUS Systems.
Die genetische Vielfalt einer Sorte ist wichtig, bei gleichzeitigem möglichst engem führen der jeweiligen Ausprägungen einer Population hin zu einer Sorte, die dazu führt, dass die phänotypische Vielfalt reduziert wird. Fremdbefruchter, nicht Selbstbefruchter, müssen immer ein hohes Maß an genetischer Vielfalt in sich tragen, ansonsten entstehen Inzuchtdepressionen.
In der neuen Öko-Verordnung wird der gleiche Wortlaut für die Definition von zwei unterschiedlichen Gruppen genutzt, von heterogenem Material und von ökologischen Sorten.
(b): Eine Öko-Sorte kann nur aus ökologischer Züchtung stammen. Wir sind dankbar, dass es eine Definition von ökologischer Züchtung gibt, auch wenn sie nicht besonders gut ist. Wir hätten uns eine deutlichere Abgrenzung zu biotechnologischen, gentechnischen Methoden gewünscht. Ein maßgeblicher Teil der Definition muss sein, dass ökologische Sorten unter ökologischen Bedingungen wie sie in Öko-Verordnung dargelegt sind, gezüchtet werden. Diese Definition folgt den IFOAM-Standards, die schon seit Jahren existieren. Damit ist die Diskussion erledigt, dass konventionelle Züchterhäuser sagen, sie würden auch ökologische Züchtung betreiben.

Which breeding goals do you pursue?
It is necessary to consider the inherent nature of plants. Plants are restricted to one location and cannot flee from unfavourable conditions. Thus, the plant has a high level of interaction with its environment. An intensive exchange takes place below ground as well as above ground. The root system is the most important organ of the plant for sensing and interacting. In the present conventional economy, we experience a strong distanciation from these interrelations. An extreme example is the cultivation in nutrient solutions. In an organic context, the plant has to actively work in order to reach nutrients. The task of OA is merely to support the plant's work, as Steiner said: Fertilisation means to increase the vitality of the soil and not to stuff plants with nutrients. The plant is fertilised by using the soil as a bypass. This is the foundation of biodynamic agriculture. Today we have intensive systems in OA, which follow the same fertilisation regime as in CA by just replacing artificial/synthetic fertilisers with natural ones. This is not sustainable and not quality-oriented. Organic breeding means to make a plant fit for its interaction with the environment. In breeding, one should never lose sight of this interaction, since it leads to robustness.
Organic breeding always has a regional character. Here in the Wetteraue, the plant is conditioned on loess loam and not so suitable for the sandy soil of Brandenburg. Conversely, a plant which is bred for the conditions in Northern Germany – unfertile soils, a soil value (*Bodenpunkte*) of 25, cool climate – is maybe not suitable for our conditions. All regions need their own varieties. We do not want to sell our varieties globally. Instead, we

Welche Züchtungsziele verfolgen Sie?
Man muss sich das Wesen einer Pflanze anschauen. Sie ist standortbezogen und kann einer unangenehmen Standortsituation nicht entfliehen. Das heißt, dass die Pflanze ein hohes Maß an Interaktion mit der Umwelt hat, indem ein intensiver Austausch, sowohl unter der Erde als auch über der Erde stattfindet. Das Wurzelsystem ist das wichtigste Wahrnehmungs- und Interaktionsorgan, was die Pflanze hat. In der heutigen konventionellen Wirtschaft haben wir ein starkes sich von diesen Zusammenhängen Entfernen erlebt. Ein Extrem-Beispiel ist die Nährlösungskultivierung. Im ökologischen Zusammenhang hat die Pflanze aktiv Arbeit zu leisten, um an Nährstoffe heranzukommen. Der ökologische Anbau unterstützt dies, wie Steiner definiert hat: Düngung heißt den Boden verlebendigen, nicht die Pflanze stopfen. Über den Umweg über den Boden wird die Pflanze optimal versorgt. Das ist das Grundprinzip der biodynamischen Arbeit.
Wir haben heute Hochleistungssysteme im Ökolandbau, die das Versorgungssystem aus der konventionellen Landwirtschaft übernommen haben, nur nicht mit künstlichen/synthetischen, sondern mit natürlichen Düngemitteln. Das ist nicht besonders nachhaltig und qualitätsorientiert.
Bei der Öko-Züchtung geht es darum, dass man die Pflanze fit macht für die Interaktion mit ihrer Umwelt. Diese Interaktion darf in der Züchtung nie aus dem Auge verloren werden, denn daraus entsteht Robustheit.
Ökozüchtung hat immer einen regionalen Charakter. Hier in der Wetteraue ist die Pflanze konditioniert für Lößlehm-Böden und nicht für den Sandboden in Brandenburg.

want that, for example, Spain or England develop their own breeding projects. However, this implies, that the business model of breeding cannot go in the direction of cash crops. Food quality is essential for organic breeding. Food quality such as taste is as important as the yield and the interaction with the environment.	Umgekehrt ist eine Pflanze, die fit gemacht wurde für die norddeutschen Bedingungen – magere Böden, 25 Bodenpunkte, kühles Klima – nicht so sehr geeignet für unsere Bedingungen. Die Regionen brauchen ihre eigenen Sorten. Wir wünschen uns, dass wir nicht unsere Sorten überall hin verkaufen, sondern, dass z.B. in Spanien oder England eigene Züchtungsprojekte entstehen. Das bedeutet aber, dass das Businessmodell dahinter niemals Richtung Cash Crops geht. Die Lebensmittelqualität ist für die Ökozüchtung elementar. Die Lebensmittelqualität wie der Geschmack ist genauso wesentlich wie der Ertrag der Pflanze und wie die Interaktion mit der Umwelt.
Which testing criteria are important for OA or for climate-robustness? Do you wish that criteria such as food quality or taste are included in the criteria of variety testing? Food quality and taste is experienced subjectively and depends on the specific environmental conditions. Therefore, they should not be used for variety testing. Variety testing is conducted under conventional conditions. There is no organic variety testing for vegetables. It is important to test the regional suitability in order to assess its suitability for OA and its climate-robustness. We wish that organic varieties are tested under organic and regional conditions. However, it is an illusion that variety testing of vegetable will every take place under organic conditions. There are almost no locations for variety testing anymore. When I started in Bingenheim, 18 years ago, there were five locations for variety testing for vegetables, distributed throughout Germany. Today, we have one location, of which only a small part is used for variety testing. The remaining part is outsourced with joint venture agreements. A lot of trials are conducted in France, some in Hungary and Scotland. This is not suitable for our varieties. If they grow in other regions, they might display different phenotypical characteristics. This is especially a problem with some crops, and we face the problem of varieties which are rejected due to an insufficient homogeneity or due to phenotypic characteristics which are not distinct enough to other varieties. An additional problem is, that there are almost no vegetable breeders in Germany anymore, and especially no organic breeders. Consequently, it is of no surprise, that the FPVO, has only one location on which not all crops are tested, and trials are only conducted under conventional conditions. We wish for organic variety testing, even though, we know that our request will not be met. Thus, we wish for more acceptance in variability, in stability, and in homogeneity. If the FPVO does not have locations on which the plant can optimally grow, we ask for more tolerance in the testing process.	*Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit? Wünschen Sie sich, dass die Lebensmittelqualität oder der Geschmack bei den Sortenprüfungen mitberücksichtigt werden?* Lebensmittelqualität und Geschmack ist sehr subjektiv und hängt von den jeweiligen Umweltbedingungen ab. Daher sollten sie nicht für die Sortenprüfung herangezogen werden. Die Sortenprüfungen werden auf konventionellen Feldern durchgeführt. Im Gemüsebau gibt es bisher keine Öko-Prüfung. Die Testung auf regionale Eignung ist wichtig für den Ökolandbau und für Klima-Robustheit. Unsere Forderung ist, dass Öko-Sorten unter ökologischen und unter regionalen Bedingungen geprüft werden. Es ist jedoch eine Illusion, dass es jemals Sortenprüfungen für Gemüse unter ökologischen Bedingungen geben wird. Es gibt fast keine Standorte für Sortenprüfungen mehr. Als ich bei Bingenheim angefangen habe, vor 18 Jahren, gab es in Deutschland fünf Sortenprüfstandorte für Gemüse über die Republik verteilt. Heute haben wir nur noch einen Standort, der aber nur noch auf einem kleinen Teil Gemüsekulturen prüft. Der Rest ist fremdvergeben, mit Joint Venture Verträgen. Sehr viel wird in Frankreich geprüft, manches in Ungarn, manches in Schottland. Das macht unseren Sorten zu schaffen. Sie reagieren mit anderer phänotypischer Ausprägung, wenn sie in fremden Regionen wachsen müssen. Bei manchen Kulturen ist das besonders schwierig und es gibt immer wieder Fälle, in denen Sorten durchfallen, weil sie als nicht genügend homogen bezeichnet werden oder Ausprägungen zeigen, die keine Differenzierung zu anderen Sorten ermöglichen. Das Problem ist auch, dass es kaum noch Gemüsezüchter in Deutschland gibt und erst recht keine Öko-Züchter. So wundert es nicht, dass das BSA für Gemüse nur noch einen Standort hat, auf dem nicht alle Kulturen geprüft werden und Prüfungen nur unter konventionellen Bedingungen stattfinden. Wir fordern ökologische Sortenprüfungen, wohlwissend, dass wir es nicht bekommen und wir fordern es deshalb, weil sich eine andere Forderung daran anschließt: mehr Akzeptanz in der Variabilität, in der Stabilität und in der Homogenität. Wenn das BSA keine Standorte hat, an denen sich die Pflanze optimal zeigen kann, dann fordern wir mehr Toleranz im Prüfprozess.
Which role does the farmer play regarding breeding of varieties adapted to organic conditions?	*Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?*

The interaction of actors is an essential part of breeding. At the moment, we develop the classical part of breeding, i.e. the scientific background and knowledge about genetics. Our breeding, and organic breeding in general, originates from organic farming. Practitioners started to conduct breeding. Gardeners and farmers know what they need and, thus, are good in selecting plants. However, they often do not know the genetic consequences of their crossings.
Breeding requires the farming/gardening element, distributors and processors, and scientific knowledge about the genetic theory. This can be summarised under the term of "participatory plant breeding".

Die Interaktion zwischen den Akteuren ist ein elementarer Bestandteil. Wir bauen gerade den klassischen Teil Züchtung, d.h. die naturwissenschaftliche Grundlage und Kenntnis der Genetik, auf. Unsere Züchtung und die Öko-Züchtung generell kommt aus dem Öko-Landbau. Praktiker, haben angefangen zu züchten. Gärtner und Landwirte wissen genau was sie brauchen und können deswegen gut selektieren. Was sie nicht gut können ist zu wissen was eine Kreuzung an Folgen im genetischen Zusammenhang hat.
Züchtung benötigt das bäuerliche/gärtnerische Element, Händlern und Verarbeitern und naturwissenschaftliche Kenntnisse über Vererbungslehren. Man kann das unter dem Begriff „partizipatives Züchten" zusammenfassen.

What kind of seeds (organic vs. conventional) do you send to variety testing? What are the advantages and disadvantages of organic seeds?
Seeds are a vital part of plants and the so-called plant diseases are part of the inherent nature of plants. Actually, they are not diseases, but part of a natural process. Every plant, after seed set, is supposed to wilt, and, thus, organisms are needed for decomposition. These so-called diseases are the natural selection media of nature. In our cultural landscape, we face the problem of homogeneous crops which have to stay healthy to be able to be sold.
In organic production of seeds, it is normal to have fungal spores of, for instance, *Alternaria* in carrots. If these seeds enter testing and spread under testing conditions, we have a problem. Our conventional colleagues do not have this problem because they use pesticides and therefore are able to provide clean and pure seeds.
However, we also have methods to produce seeds which are close to germ-free. Especially the so-called hot water treatment is used.

Welches Saatgut (ökologisch vs. konventionell) übermitteln Sie an die Sortenprüfung? Was sind die Vor- und Nachteile von ökologischem Saatgut?
Saatgut ist ein lebendiger Teil der Pflanze und die sog. Pflanzenkrankheiten gehören zum Wesen der Pflanze dazu. Das ist eigentlich keine Krankheit, sondern ein natürlicher Vorgang. Jede Pflanze, die ihre Samen gebildet hat, soll auch wieder vergehen und dafür braucht es diese Organismen. Diese sog. Krankheiten dienen der Natur als natürliches Selektionsmedium. Wir in unserer Kulturlandschaft haben das Problem, dass wir einheitliche Bestände haben wollen, die gesund bleiben müssen, damit wir sie verkaufen können.
In der ökologischen Produktion von Saatgut ist es erstmal normal, dass z.B fast. immer Pilzsporen von Alternaria bei der Möhre gefunden werden. Wenn die in die Prüfung gehen und sich unter den Prüfbedingungen ausbreiten, dann haben wir ein Problem. Das hat der konventionelle Kollege nicht, der Pestizide einsetzt und so sein Saatgut quarantänerein liefern kann.
Wir haben aber auch Maßnahmen, um Saatgut nahezu keimfrei zu bekommen. Hierbei kommt insbesondere die Warmwasserbehandlung zum Einsatz.

What were the specific challenges concerning distinctness, uniformity and stability (DUS)?
The DUS system in general is ok. We are criticising the narrowness of the DUS system. This narrowness results from a one-key-several-doors system. In DUS testing, varieties are not only tested for descriptiveness and distinctness, they are also tested for the possibility of variety protection. The question of variety protection influenced the Variety Office's freedom of interpretation. The definitive distinctness is meticulously tested.
The Seed Marketing Act is a consumer protection legislation, whereas variety protection is a private law. Normally, these things have nothing in common, however, they were combined in variety testing. As a result, variety protection is the leading element of variety testing. It might be possible that, the seven-years-temporary-experiment i.e. adapted DUS criteria for organic varieties, will fail due to the connection of variety testing and variety protection.
For instance, in variety testing of zucchini, 64 criteria are tested. It is impossible that an open-pollinated zucchini

Was sind die Sorten-spezifischen Herausforderungen bezüglich Unterscheidbarkeit, Uniformität und Unveränderlichkeit (DUS)?
Das DUS System ist generell in Ordnung. Wir kritisieren die Auslegungsenge des DUS Systems. Diese Enge resultiert aus dem one-key-several-doors System. In der Registerprüfung einer Sorte wird nicht nur die Beschreibbarkeit und Unterscheidbarkeit einer Sorte geprüft, sondern gleichzeitig wird die Möglichkeit zum Sortenschutz geprüft. Die Sortenschutzfrage hat die Auslegungsfreiheit der Sortenämter beeinflusst. Es wird akribisch darauf geachtet, die definitive Unterscheidbarkeit zu gewährleisten.
Das Saatgutverkehrsgesetz ist ein Verbraucherschutzgesetz und der Sortenschutz ist ein Privatrecht. Normalerweise haben diese Bereiche nichts miteinander zu tun, wurden aber in den Sortenprüfungen zusammengeführt. Dies führte dazu, dass das führende Element der Sortenschutz ist. Es ist durchaus möglich, dass das seven-years-temporary-experiment, also angepasste

reaches homogeneity in all 64 criteria, if it is compared to a standard defined by hybrids. In order to describe and distinguish zucchini 30 criteria are sufficient. These are the criteria which are relevant for the farmer, the processor and the end consumer. For variety protection, however, more criteria have to be tested, so that distinctness of varieties is legally watertight. There are around 100 hybrid varieties of zucchini and they are all phenotypically almost the same. They are only distinct because they are described using 64 criteria and within these criteria no deviation is possible.

One of our principals is that varieties are of cultural value. We do not protect our varieties. We ask for a reduction of criteria on a reasonable level and, at the same time, more tolerance in diversity. I do not refer to the phenotypical diversity of the EU definition, but, to a healthy level of diversity which corresponds to the population of a cross-pollinated species.

We do not have any problems with diversity in self-pollinators, but we do have problems with cross-pollinators, such as cabbage, carrots, beetroot, zucchini, etc. In order to meet the DUS requirements, we have to conduct single plant selection which leads to a genetic constriction. As a result, the plant is more homogeneous, but the constriction in genetic variability can result in a reduction of performance. The plant is able to pass variety testing, but nobody wants to buy the variety. Thus, year-long breeding was for nothing.

DUS Kriterien für Ökosorten, im Zusammenhang mit dem Sortenschutz nicht gelingt.

Zum Beispiel werden bei Zucchini 64 Merkmale abgeprüft. In 64 Merkmalen eine ausreichende Homogenität von offenblühenden Zucchini zu erreichen ist ausgeschlossen, wenn die Zucchini mit einem Standard verglichen wird, der von den Hybriden definiert wird. Zur Beschreibung und Unterscheidung bei Zucchini reichen 30 Merkmale aus und zwar die, die relevant sind für den Anbauer, den Vermarkter und den Endkunden. Für den Sortenschutz muss man noch mehr Merkmale hinzunehmen, damit die Unterscheidbarkeit juristisch wasserdicht ist. Es existieren um die 100 Hybridsorten bei Zucchini und die sind äußerlich fast gleich. Sie sind nur dadurch unterscheidbar, dass man mit 64 Kriterien arbeitet und die Kriterien so eng fasst, dass kaum eine Abweichung möglich ist.

Eins unserer Prinzipien ist, dass Sorten Kulturgut sind. Wir lassen unsere Sorten nicht schützen. Wir möchten eine Reduktion der Merkmale auf das vernünftige Maß bei gleichzeitiger Toleranz einer stärkeren Diversität. Damit meine ich nicht die phänotypische Vielfalt der EU-Definition, sondern ein gesundes Maß, welches der Population einer fremdbefruchteten Art entspricht.

Wir haben keine Probleme mit der Diversität bei Selbstbefruchtern, aber wir haben Probleme mit Fremdbefruchtern, wie Kohl, Möhre, Rote Bete, Zucchini, usw. Um den Anforderungen der heutigen DUS Standards zu genügen, müssen wir Pflanzen durch das Nadelöhr führen, d.h. durch Einzelpflanzenselektion genetischen verengen. Die Pflanze wird dadurch zwar homogener, aber bei der Verengung der genetischen Bandbreite kann gleichzeitig eine Reduktion der Performance auftreten. Die Pflanze kommt dann vielleicht durch die Prüfung, aber niemand will sie haben. Das bedeutet, dass die jahrelange Züchtung umsonst war.

Did you apply for registration of varieties that were rejected due to lack of fulfillment of the DUS requirements?

Our zucchini variety *Serafina* was rejected two times. *Serafina* was tested in Cavaillon, South-France under Mediterranean conditions – different light conditions, different soil conditions, different climate, different season. As a result, our *Serafina* displayed slightly different characteristics. Additionally, *Serafina* was evaluated as insufficient homogeneous.

We learned, that *Serafina* was always compared to hybrids which require an absolute homogeneity according to UPOV protocols, i.e. only one outlier of 100 is accepted. This is impossible to fulfil with open-pollinated varieties. For open-pollinated varieties, UPOV normally demands relative homogeneity. Relative homogeneity means that the variety is put in relation to existing varieties and gives auditors a certain leeway. After the third trial year, the auditors came from Cavaillon to Bingenheim to inform us about the change of UPOV protocols regarding relative homogeneity for open-pollinated varieties and that *Serafina* is the most

Haben Sie Registrierungen für Sorten beantragt, die auf Grund Nichterfüllens der DUS Kriterien abgelehnt wurden?

Unsere Zucchinisorte *Serafina* wurde zweimal abgelehnt. Sie wurde in Cavaillon, Süd-Frankreich unter mediterranen Bedingungen geprüft – andere Lichtverhältnisse, andere Bodenverhältnisse, anderes Klima, anderer Jahreszeitraum. Die Folge war, dass unsere *Serafina* sich leicht verändert gezeigt hat, mit Merkmalen, die wir gar nicht kannten. Zudem wurde sie als nicht genügend homogen bezeichnet.

Dann haben wir mitbekommen, dass *Serafina* immer mit Hybriden verglichen wurde, bei denen das UPOV Protokoll eine absolute Homogenität in allen 64 Merkmalen vorsieht, d.h. es wird nur ein Ausreißer von 100 akzeptiert. Das ist für samenfeste Sorten unmöglich zu erreichen. Für samenfeste Sorten sieht UPOV normalerweise die relative Homogenität vor. Relative Homogenität heißt in Relation zu bestehenden Sorten, und damit haben die Prüfer ein gewissen Spielraum. Nach dem dritten Prüfjahr kamen die Prüfer extra aus Cavaillon nach Bingenheim und haben uns informiert, dass das UPOV

homogeneous variety within his scope. Even though *Serafina* was tested in 64 criteria, which do not have to meet absolute homogeneity anymore, it was possible to reach a sufficient homogeneity with a proper selection. However, yield performance was moderate. Our hypothesis is, that if *Serafina* was not bred for homogeneity, performance would have been better. For the aim of the seven-years-temporary-experiment to ease marketing of organic varieties, it is necessary to reduce testing protocols and to admit more tolerance in homogeneity. This would allow us to concentrate on plant properties in the selection process which are of importance for the farmer and processor, and we would not need to focus on homogeneity of properties which are just tested for distinctness. We could allow cross-pollinators more leeway in their natural aspirations for diversity. As a result, the plants are more vital and productive.

Protokoll dahingehend verändert wurde, dass bei samenfesten Sorten nun die relative Homogenität gilt und dass *Serafina* die homogenste Sorte in diesem Spektrum ist.
Obwohl noch 64 Merkmale geprüft werden, aber nicht mehr mit dem Absolutheitsanspruch, war es möglich durch eine gute Selektion ausreichende Homogenität zu erreichen. Allerdings ist die Ertragshöhe mäßig. Unsere Hypothese ist, dass wenn *Serafina* nicht so oft auf Homogenität gezüchtet worden wäre, dann wäre die Performance besser.
Für das Ziel des seven-years-temporary-experiment zu dem vereinfachten Inverkehrbringen ökologischer Sorten ist es notwendig das Prüfprotokoll runter zu fahren, bei gleichzeitiger stärkerer Toleranz im Homogenitätsbereich. Damit können wir uns bei der Selektion auf die Merkmale konzentrieren, die für den Anbauer oder Verarbeiter wichtig sind und müssen keine Homogenitätsbemühungen bei Merkmalen anstreben, die nur für die Unterscheidbarkeit geprüft werden. Dann könnten wir der natürlichen Vielfaltsbestrebung von Fremdbefruchtern Freiraum geben. Dadurch bleibt sie vitaler und leistungsfähiger.

How do you assess the financial expense for new registrations and registrations of conservation and amateur varieties, respectively?
The registration of cereals as conservation varieties is an enormous bureaucratic effort with a lot of restrictions. Nobody is happy with this regulation, including the FPVO.
The registration of amateur varieties is easier. The only restriction is the packaging size, but there are no restrictions in total quantity of marketing and area of cultivation. Thus, amateur varieties are not such an enormous bureaucratic effort as conservation varieties. However, the small packaging sizes of e.g. 25 g for zucchini is, for us whose focus is professional organic vegetable cultivation, a problem. This is not a problem for hobby gardeners or small direct marketers.
For instance, zucchini has a thousand kernel weight of up to 400 g. If you have to pack zucchini seeds in packages of 25 g, a farmer who wants to order 2000 plants loses interest.
The amateur variety regulation does not solve all problems. We want unlimited packaging sizes and unlimited marketing possibilities within Europe, such is the case in the standard DUS testing. That is why we pay willingly for the standard DUS testing, if it is fairly constructed for our varieties and if it meets the demand of our customers.

Wie bewerten Sie den finanziellen Aufwand für Neuregistrierungen und Registrierung von Erhaltungs- bzw. Amateursorten?
Erhaltungssorten bei Getreide ist ein riesiger bürokratischer Aufwand mit sehr vielen Beschränkungen. Damit ist niemand glücklich, auch nicht das BSA.
Bei Amateursorten sieht es besser aus. Die sind nur in der Packungsgröße beschränkt, aber nicht in der Gesamtmenge der Vermarktung und nicht in der Fläche. Dadurch stellen Amateursorten nicht so einen bürokratischen Aufwand dar. Allerdings ist die kleine Packungsgröße von z.B. 25 g bei Zucchini für uns, die ihren Schwerpunkt im professionellen ökologischen Gemüsebau haben, ein Problem. Das ist kein Problem für Hobbygärtner oder für kleine Direktvermarkter.
Zum Beispiel hat Zucchini eine Tausendkornmasse von bis zu 400 g. Wenn man da Päckchen mit 25 g machen muss, dann hat ein größerer Betrieb der 2000 Pflanzen stellen will, kein Interesse mehr.
Die Amateursortenregelung löst also nicht alle Probleme. Wir möchten unbegrenzte Packungsgrößen und unbegrenzte Vermarktungsmöglichkeiten im europäischen Raum, so wie das in der klassischen Registerprüfung der Fall ist. Dafür bezahlen wir auch gerne die klassische Registerprüfung, wenn sie entsprechend fair für unsere Sorten gestaltet ist und dem Bedarf unserer Kunden gerecht wird.

Do you wish for VCU testing with vegetables?
We do not want obligatory VCU testing because in VCU testing a variety has to be at least as good as existing varieties. This might have been a necessary criterion in times of hunger, but today, to always reach an improvement does not correlate with the aim of OA of a sustainable and stable agricultural system.

Wünschen Sie sich Wertprüfungen bei Gemüse?
Wir wünschen uns keine obligate Wertprüfung, da in der Wertprüfung eine Sorte mindestens so gut sein muss, wie die schon bestehenden Sorten. Das war vielleicht ein notwendiges Kriterium in Zeiten des Hungers, aber in der heutigen Zeit ständig eine Verbesserung zu erreichen dient nicht dem, was der Ökolandbau als Gesamtziel haben muss: eine nachhaltige, stabile Landwirtschaftsform.

We vegetable breeders conduct VCU testing, as in the sense of describing the value. It would be a benefit, if next to DUS testing, the value of a variety is defined, however, without it being a criterion of exclusion. The definition of value of a variety has to be left to the farmer. There is already concealed VCU testing in vegetables. In DUS testing, varieties are compared to the standard of existing varieties. Thus, value is defined as homogeneity, and a new variety is not allowed to fall below this homogeneity. This makes no sense in our point of view.	Wertprüfungen, im Sinne von der Beschreibung des Wertes, das tun wir Züchter im Gemüsebau. Es wäre eine Unterstützung, wenn neben der Registerprüfung gleichzeitig die Werthaltigkeit der Sorte definiert würde, aber ohne Ausschlusskriterium. Die Definition des Wertes der Sorte muss dem Anbauer überlassen werden. Eine verdeckte Wertprüfung gibt es bereits beim Gemüse. Bei der Registerprüfung gilt der Standard der bestehenden Sorten. Wert wird hier also definiert als Homogenität und eine neue Sorte darf diese Homogenität nicht unterschreiten. Das macht in unseren Augen keinen Sinn.

Table 20: Expert interview with Dr. Hartmut SPIEß.

Dr. Hartmut SPIEß is head of research and breeding at Dottenfelderhof in Bad Vilbel, Hesse. Breeding of cereals and vegetables is conducted under biodynamic conditions. For cereal breeding, Dottenfelderhof cooperates with Cultivari Cereal Breeding Research Darzau (*Cultivari Getreidezüchtungsforschung Darzau*), Cereal Breeding Peter Kunz (*Getreidezüchtung Peter Kunz*), and Keyserlingk-Institute. For vegetable breeding, Dottenfelderhof cooperates with Kultursaat.	
Do you produce organic varieties with a high degree of genetic diversity (according to the new definition, see below) that are not compatible with the existing DUS protocols? For me, varieties with a high degree of genetic diversity are populations. Since at least 12-13 years, we are developing populations which are not compatible with the current DUS protocols. Our main business is the development of breeding lines, and these have to be compatible with the DUS criteria, otherwise, we have to register them as conservation varieties. When conservation varieties were introduced into the regulation, it was still necessary to conduct DUS testing to register conservation varieties. Nowadays, the description by the breeder is sufficient for registration.	*Produzieren sie ökologische/biologische Sorten mit einem hohen Level an genetischer Diversität (gemäß der neuen Definition einer ökologischen/biologischen Sorte, siehe weiter unten), die nicht mit den aktuellen DUS Protokollen kompatibel sind?* Sorten mit einem hohen Maß an genetischer Diversität sind für mich Populationen. Seit mind. 12-13 Jahren entwickeln wir Evolutionsramsche bzw. Populationen und diese sind nicht mit den aktuellen DUS Protokollen kompatibel. Unser Hauptgeschäft besteht in der Entwicklung von Liniensorten und diese müssen kompatibel mit den DUS Kriterien sein, oder wir lassen diese als Erhaltungssorten registrieren. Zu Beginn der Erhaltungssortenregelung wurden noch Registerprüfungen durchgeführt. Inzwischen reichen die Angaben des Züchters für eine Zulassung aus.
Do you produce organic varieties with a low degree of genetic diversity that are not compatible with the existing DUS protocols? If I understand the question correctly, varieties with a low degree of genetic diversity are conservation varieties of self-pollinators which can be registered without fulfilling DUS criteria. The genetic diversity of these varieties is restricted because they have to be traced back to an old/older variety to preserve biodiversity. We developed and distributed conservation varieties.	*Produzieren sie ökologische/biologische Sorten mit einem geringen Level an genetischer Diversität, die nicht mit den aktuellen DUS Protokollen kompatibel sind?* Wenn ich die Frager richtig verstehen, sind unter solchen Sortentypen vor allem Erhaltungssorten von Selbstbefruchtern zu verstehen, die ohne DUS-Kriterien zugelassen werden. Da diese auf eine alte/ältere Sorte als erhaltenswerte Biodiversität zurückgehen müssen, dürften diese nur eine begrenzte genetische Diversität aufweisen. Ja, wir haben Erhaltungssorten entwickelt und vertreiben diese auch.
Did you apply for registration of varieties that were rejected due to lack of fulfillment of the DUS requirements? Up to now, none of our varieties was rejected due to lack of fulfillment of DUS criteria. However, we are putting a lot of effort into our varieties, to ensure that they fulfil DUS criteria and are accepted. Otherwise, we would spend a lot of money for nothing. We have difficulties of registering cross-pollinators, such as maize and rye because they do not meet the necessary criteria of uniformity. The problem is, that they are	*Haben Sie Registrierungen für Sorten beantragt, die auf Grund Nichterfüllens der DUS Kriterien abgelehnt wurden?* Bisher wurden sind noch keine unserer Sorten an den DUS Kriterien gescheitert. Allerdings betreiben wir auch großen Aufwand, damit die Sorten diese Kriterien erfüllen und zugelassen werden, da ansonsten viel Geld umsonst ausgegeben wird. In Hinblick auf Fremdbefruchter, wie z.B. Mais und Roggen, gibt es auf Grund nicht ausreichender Homogenität manchmal Probleme. Das Problem ist, dass

compared to F1 hybrids as reference varieties. This is why, it was not possible for us yet, to register rye and maize according to DUS criteria. Registration took place as conservation varieties.
With conservation varieties, we face the problem of quantitative restriction regarding area of cultivation and marketing of seeds. The regulation of amateur and conservation varieties is a regulation of prevention, i.e. the regulation prevents, that certain varieties are placed on the market in sufficient quantities.

diese mit den F1 Hybriden verglichen werden. Deswegen haben wir bisher weder Roggen noch Mais nach DUS zulassen können. Die Zulassung ging dann über die Erhaltungssortenregelung.
Bei Erhaltungssorten haben wir allerdings das Problem der Flächenrestriktion und der begrenzten Mengen an Saatgut, die in den Verkehr gebracht dürfen, einzuhalten. Die Amateursorten- und Erhaltungssortenregelungen sind Verhinderungsregelungen, d.h. mit dieser Regelung wird verhindert, dass Sorten in ausreichender Menge in Verkehr gebracht dürfen.

What were the specific challenges concerning distinctness, uniformity and stability (DUS)?
We have about ten registered wheat varieties and varieties which are about to be registered. With these varieties we did/do not have any problems regarding registration. Sometimes we received a warning, that more than three of 1000 plants show deviations. In this case, we were able to do the necessary adjustments within one selection. To reach homogeneity is an enormous effort and we do not think that this requirement is justified.
With oat, it is a bit more complicated to reach homogeneity because there is white and yellow oat. It is very problematic, if a mixture of white and yellow oat occurs. For purity of seeds, sorting machines and a lot of effort is needed for registration and seed production.

Was sind die Sorten-spezifischen Herausforderungen bezüglich Unterscheidbarkeit, Uniformität und Unveränderlichkeit (DUS)?
Wir haben fast zehn zugelassene Winterweizensorten, bzw. Sorten die kurz vor der Zulassung stehen. Mit denen hatten/haben wir keine Probleme bei der Zulassung. Wir haben ab und zu einmal einen blauen Brief bekommen, d.h. es wurden mehr als drei Abweichler von 1000 Pflanzen gefunden. Das konnten wir aber dann innerhalb eines Selektionsschrittes bereinigen. Homogenität zu erreichen ist ein wahnsinniger Aufwand und wir halten diese Regelung als nicht gerechtfertigt.
Bei Hafer ist es schwieriger die Homogenität einzuhalten, da es Weiß- und Gelbhafer gibt. Wenn es da Vermischungen auftreten, ist das sehr problematisch. Das kann man nur noch mit Farbauslesern und großem Aufwand bereinigt werden. Das ist nicht nur bei der Zulassung so, sondern auch bei der Saatgutproduktion.

Do you have suggestions for improvements for the DUS trials in some of the species you work with?
It is necessary to discuss with the FPVO about the very small number of allowable deviations. If other criteria of VCU testing, i.e. yield, health, etc., are improved, a smaller homogeneity should not be an exclusion criterion by the FPVO. A bigger emphasis should be put on certain VCU criteria, which are of importance to OA, such as plant health. A smaller emphasis should be put on DUS criteria. For instance, seedborne diseases, except for *Fusarium*, do not play any part in the registration procedure. Resistances against bunt and loose smut should be a strict part of organic variety trials.

Haben Sie Verbesserungsvorschläge für DUS Prüfungen, bei den Sorten, mit denen Sie arbeiten?
Man sollte sich mit dem BSA diskutieren, ob man diese sehr geringe Anzahl von Abweichungen nicht ändern sollte. Wenn alle anderen Kriterien der Wertprüfungen, sprich Ertrag, Gesundheit, usw. gesteigert sind, sollte eine geringere Homogenität der Sorte kein Hemmschuh für die Zulassung einer Sorte durch das BSA sein. Bestimmte Kriterien des landeskulturellen Wertes, die für den ökologischen Landbau von Bedeutung sind, wie Pflanzengesundheit, sollten einen höheren Stellenwert als die DUS Kriterien haben. Zum Beispiel spielen saatgutübertragbare Krankheiten, mit Ausnahme von *Fusarium*, bei der Zulassung keine Rolle. Resistenzen gegen z.B. Steinbrand oder Flugbrand müssten bei der Prüfung von Ökosorten unbedingt gefordert werden.

Did you experience challenges when varieties were tested for value for cultivation and use (VCU)?
For VCU testing by the FPVO, a factor of yield and plant health of the reference varieties is calculated and set to 100. New varieties have to exceed a factor above 100 for them to be registered. For instance, our varieties receive a registration because they have new properties such as resistance against bunt and loose smut, even though, they might have a 5% lower yield. For organic variety trials it is important, that an emphasis is put on these criteria.

Was sind die Sorten-spezifischen Herausforderungen bezüglich der Prüfung des landeskulturellen Wertes (VCU)?
Bei den Wertprüfungen des BSA wird ein Faktor aus Ertrag und Pflanzengesundheit von Vergleichssorten berechnet und gleich 100 gesetzt. Neue Sorten müssen einen Wert über 100 erreichen, um zugelassen zu werden. Zum Beispiel werden unsere Sorten zugelassen, obwohl sie z.B. einen 5% geringeren Ertrag haben, da sie eine neue Eigenschaft, wie die der Steinbrand- oder Flugbrandresistenz, haben. Solche Eigenschaften sollten einen höheren Stellenwert in ökologischen Sortenprüfungen haben.

Do you have suggestions for improved VCU trials? In variety testing, nutritional quality is not considered. However, in organic breeding and cultivation, nutritional quality is of major importance. It is necessary to develop and validate methods for testing of nutritional quality, so that the FPVO considers nutritional quality in their trials. Apart from that, VCU trials are ok. All diseases are evaluated, the plant height is measured, and the development stages in regard to their competition capacity is scored. However, there are probably one to two criteria per crop, which could be included in order to assess their suitability for OA.	*Haben Sie Verbesserungsvorschläge für VCU Prüfungen?* Bei den Prüfungen spielt die Ernährungsqualität keine Rolle, aber in der Praxis der Biozüchtung und des Anbaus im Ökolandbau ist die Ernährungsqualität ein wesentlicher Gesichtspunkt. Damit das BSA die Ernährungsqualität mit einbezieht, müsste man Methoden zur Prüfung der Ernährungsqualität entwickeln und validieren. Ansonsten sind die Wertprüfungen in Ordnung. Es werden alle Krankheiten erfasst, es wird die Wuchslänge gemessen und es werden Bonituren zu den Entwicklungsstadien in Hinblick auf die Konkurrenzfähigkeit gemacht. Es gibt bestimmt pro Pflanzenart ein bis zwei Kriterien, die man zusätzlich bonitieren könnte, um ihre Eignung für den ökologischen Landbau zu überprüfen.
What kind of seeds (organic vs. conventional) do you send to variety testing? What are the advantages and disadvantages of organic seeds? We send organic seeds which are sufficiently homogenous for variety testing, i.e. seeds which originate from at least F8 because it has a homozygosity of 99,2%. We have to send at least 35 kg seeds to variety testing. This can be an obstacle, if we want to register a variety of which we do not have sufficient seeds yet. Varieties are tested on 14 locations throughout Germany. For us, seed quality has top priority. That is why we breed for resistances against loose smut, bunt and *Fusarium* species. These fungal diseases affect seed quality and represent a major problem in seed production. In CA, these resistances, with the exception of *Fusarium*, are not necessary, due to the use of chemical seed treatments in seed production.	*Welches Saatgut (ökologisch vs. konventionell) übermitteln Sie an die Sortenprüfung? Was sind die Vor- und Nachteile von ökologischem Saatgut?* Ökologisches Saatgut, welches hinreichend homogen ist, wird an die Sortenprüfung übermittelt. Das heißt, es handelt sich um Saatgut aus frühestens F8, da dieses 99,2% Homozygotie aufweiset. Für die Prüfung werden mind. 35 kg Saatgut benötigt. Das kann eine Hürde darstellen, wenn man Sorten anmelden will, aber noch nicht genügend Saatgut hat. Die Sorte wir auf 14 Standorten bundesweit geprüft. Für uns ist Saatgutqualität oberstes Gebot. Deswegen züchten wir auf Flugbrand-, Steinbrand- und Fusariumresistenz. Diese Pilzkrankheiten beeinträchtigen die Saatgutqualität und sind vor allem bei der Saatguterzeugung ein Problem. Im konventionellen Landbau sind diese Resistenzen, mit Ausnahme von *Fusarium*, nicht notwendig, da chemische Beizmittel bei der Saatguterzeugung eingesetzt werden kann.
Which testing criteria are important for OA or for climate-robustness? Especially in OA, resilience of a variety to extreme weather events associated with climate change is important. Resilience describes the buffering capacity or yield and health stability. For instance, with climate change, it is expected that there will be more black rust. In conventional breeding, they breed for monogenetic resistances. In organic breeding, we try to breed for polygenetic resistances, which are more stable but also more complicated to breed for. However, we need stability in yield, health and quality. That is why we also develop populations, which have a higher chance of resilience. Reference to scientific investigation of winter wheat and climate change.	*Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?* Insbesondere im Öko-Landbau ist die Resilienz der Sorte gegenüber den Witterungsextremen des Klimawandels wichtig. Resilienz bezeichnet das Puffervermögen bzw. die Ertragsstabilität, auch Stabilität im Gesundheitsstatus. Zum Beispiel wird mit dem Klimawandel mehr Schwarzrost erwartet. In der konventionellen Züchtung legt man da gerne monogene Resistenzen an. In der ökologischen Züchtung versuchen wir polygene Resistenzen zu verankern, die stabiler, aber auch komplizierter zu erreichen sind. Wir benötigen Ertrags-, Gesundheits- und Qualitätsstabilität. Deswegen entwickeln wir auch u.a. Populationen, die viel stärker die Möglichkeit der Resilienz aufweisen. Verweis auf wissenschaftliche Untersuchung von Winterweizen und Klimawandel.
https://www.uni-goettingen.de/de/3240.html?id=4946, https://www.topagrar.com/acker/news/neue-winterweizen-sorten-bluehen-frueher-9844742.html	
Which role does the farmer play regarding breeding of varieties adapted to organic conditions? If we do not communicate with farmers, we breed without regard for the market demand. Farmers want varieties with the highest yield and the best resistances.	*Welche Rolle spielen Landwirte bei der Züchtung von ökologisch angepassten Sorten?* Wenn wir uns nicht mit den Landwirten unterhalten würden, dann würden wir am Markt vorbei züchten. Die Landwirte wollen Sorten mit den höchsten Erträgen und mit den besten Resistenzen.

We not only communicate with farmers; we communicate with all actors along the value chain. For us, the social construct within and outside of breeding is important. For instance, we discuss with doctors and nutritional experts about allergies in cereals, and we talk to commerce, propagation companies and processors. If we do not value communication, we would risk to spent €600 000 to €1 million for the development of a variety while breeding without regard for the market demand. That cannot happen. Due to this reason, for us, communication has highest priority.

Wir kommunizieren aber nicht nur mit den Landwirten, sondern mit allen Akteuren entlang der Wertschöpfungskette. Für uns ist das soziale Gefüge innerhalb und außerhalb der Züchtung sehr wichtig, d.h. wir sprechen zum Beispiel mit Ärzten und Ernährungsfachleuten über Allergien in Getreide und wir diskutieren mit dem Handel, Vermehrungsorganisationen und Verarbeitern. Wenn wir keinen Wert auf Kommunikation legen würden, hätten wir vielleicht 600 000 € bis 1 Millionen € für die Entwicklung einer Sorte ausgegeben und womöglich am Markt vorbei gezüchtet. Das darf nicht passieren! Deswegen hat die Kommunikation höchste Priorität.

What do you see as the next important step in order to develop/improve the variety testing trials?

For variety trials for registration with testing of DUS criteria, we have to pay around €25 000. This restricts our possibility to breed for new varieties with special properties. For instance, if a pasta company requests biodynamic durum wheat with a special anthocyanin colour or with a special health benefit, we have to go through the whole registration procedure including all costs, even though cultivation would be small-scale for only this pasta company. We cannot register the variety as a conservation variety because conservation varieties have to originate from old varieties. We organic breeders want to have a regulation similar to the regulation for niche varieties in Switzerland. These niche varieties do not have to origin from older varieties and can be registered as new varieties, but for a smaller demand. It is not necessary to go through the effort of the registration procedure and it is possible to keep down the registration costs. However, these niche varieties, as well as the conservation varieties cannot be registered for variety protection, which is demanded by most organic breeders. This is why niche varieties should be introduced as a new category in the EU regulation.

Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?

Für die Zulassungsprüfungen nach den üblichen DUS Kriterien müssen wir rund 25 000€ bezahlen. Diese Kosten begrenzen die Möglichkeit, Sorten zu züchten, die besondere Eigenschaften aufweisen. Zum Beispiel, wenn eine Nudelfirma einen biodynamischen Hartweizen haben möchte, die eine besondere Anthocyan-Färbung aufweist oder einen besonderen Gesundheitswert hat, müssen wir den gesamten Registrierungsprozess mit allen Kosten durchlaufen. Dabei wäre der Anbau nur sehr kleinflächig für diese eine Nudelfirma. Wir können die Sorte auch nicht als Erhaltungssorte anmelden, da man Erhaltungssorten auf eine alte Sorte zurückführen muss. Wir Ökozüchter möchten eine Regelung haben, wie in der Schweiz mit den Nischensorten. Diese Nischensorten müssen nicht auf eine frühere Sorte zurückgehen, können also als neue Sorte registriert werden, aber für einen kleineren Bedarf. Man muss also nicht den Aufwand betreiben und kann die Zulassungsgebühren klein halten. Allerdings können auch diese Nischensorten, wie auch die Erhaltungssorten nicht zum Sortenschutz angemeldet werden, was jedoch von den meisten Bio-Züchtern angestrebt wird. Das ist ein weiterer, evidenter Punkt, dass Nischensorten in der EU als neue Kategorie eingeführt werden sollten.

What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848?

(a): At the moment we are gathering professional aspects for the revision of the EU regulation. The high degree of genetic and phenotypical diversity refers to populations. The definition misses breeding lines with DUS criteria. When we breed for pure breeding lines, they show a high degree of genetic homogeneity. However, according to the formulation of the definition, only populations would be available for OA.

Nevertheless, it is necessary to reduce the strict regulation of homogeneity for breeding lines.

(b): Associations like demeter state that organic varieties have to originate from breeding, i.e. breeding is conducted under organic conditions from the very beginning. The breeding process is very important and not equivalent to conventional breeding. Organic variety

Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?

(a) Wir sind gerade dabei fachliche Gesichtspunkte zu liefern für die Überarbeitung der neuen EU Regulierung zu liefern. Mit dem hohen Maß an genetischer und phänotypischer Vielfalt sind Populationen gemeint. In der Definition fehlen die Liniensorten DUS Kriterien. Wenn wir Liniensorten züchten, dann haben die ein hohes Maß an genetischer Einheitlichkeit, aber gemäß der Formulierung der Definition, würden dem Ökolandbau dann nur noch Populationen zur Verfügung stehen.

Allerdings sollten die strengen Richtlinien für die Homogenität von Liniensorten herabgesetzt werden.

(b): Die Verbände wie demeter haben in ihren Richtlinien stehen, dass eine Öko-Sorte nur dann eine Öko-Sorte ist, wenn sie von Anfang an unter Ökobedingungen entwickelt und gezüchtet wurde. Der Züchtungsgang ist ganz

testing of conventional varieties cannot be certified as organic varieties. That would be misleading.	wesentlich und nicht gleichwertig mit der konventionellen Züchtung. Die ökologische Sortenprüfung von konventionell gezüchteten Sorten, kann nicht als Öko-Sorte zertifiziert werden. Das wäre Irreführung.
Are there official tests for testing of resistances against bunt and loose smut? Yes, there are, but only in scientific literature. The FPVO does not do any tests for resistances against bunt and loose smut. We test ourselves, according to scientific literature, resistances against bunt (*Tilletia caries*) in winter and spring wheat, as well as loose smut (*Ustilago tritici, U. nuda, U. avenae*) in winter and spring wheat, winter barley and oats.	*Gibt es offizielle Tests zur Prüfung von Steinbrand- und Flugbrandresistenz?* Ja, die gibt es, aber nur in der wissenschaftlichen Literatur. Das BSA führt keine Prüfungen durch. Wir prüfen nach Angaben der wissenschaftlichen Literatur sowohl die Steinbrand (*Tilletia caries*)-Resistenz bei Winter- und Sommerweizen als auch die Flugbrand (*Ustilago tritici, U. nuda, U. avenae*)-Resistenz bei Winter- und Sommerweizen, Wintergerste und Hafer.
You mentioned that there are one to two additional criteria per crop, which should be scored as well. Do you have examples? These would be the above-mentioned criteria. Additionally, we score the "general leaf health" which included leaf area duration, and "qualitative ripeness".	*Sie sagen, dass es ein bis zwei Kriterien pro Pflanzenart gibt, die man zusätzlich bonitieren könnte. Haben Sie dafür ein Beispiel?* Das wären die zuvor genannten Kriterien. Zudem bonitieren wir die „allgemeine Blattgesundheit", welches die Blattflächendauer einschließt. Auch haben wir „qualitative Reifebonituren" durchgeführt.

Table 21: Expert interview with Dr. Peer URBATZKA.

Dr. Peer URBATZKA is coordinator of organic variety testing at Institute for Organic Farming, Soil and Resource Management, as part of the Bavarian State Research Centre for Agriculture (*Bayerische Landesanstalt für Landwirtschaft; LfL*).	
Please define the tested crop species. I am responsible for arable crops, i.e. we are testing field beans, blue lupins, forage peas, potatoes, corn, spring barley, spring oat, spring triticale, spring wheat, spelt, winter barley, winter rye, winter triticale, and winter wheat. At the moment, soybeans, sun flower and winter oilseed rape are not tested under organic conditions in regional post-registration trials.	*Bitte definieren Sie die geprüften Fruchtarten.* Ich bin zuständig für den Ackerbau, d.h. wir testen Ackerbohnen, Blaue Lupine, Futtererbsen, Kartoffel, Mais, Sommergerste, Sommerhafer, Sommertriticale, Sommerweizen, Dinkel, Wintergerste, Winterrogen, Wintertriticale und Winterweizen. Soja, Sonnenblume und Winterraps werden aktuell im Öko-Landessortenversuch nicht geprüft.
Who was the initiatory for setting up the testing trials and what was the purpose/demand? The purpose of organic variety trials is to be able to give recommendations to organic farmers. In the beginning of the century, a comparative study was conducted to compare conventional and organic varieties. In this study, triticale and rye were used in order examine whether organic varieties can be derived from conventional variety trials. The study concluded that organic variety trials are necessary.	*Wer war der Initiator für den Aufbau der ökologischen Sortenprüfung und was war das Ziel/der Anspruch?* Das Ziel von Prüfung von Sorten unter ökologischen Bedingungen war den Landwirten des Ökoanbaus Empfehlungen geben zu können. Anfang des Jahrtausends, gab es eine vergleichende Untersuchung zwischen konventionellen und ökologischen Sorten. In der Studie hat man an Triticale und Roggen untersucht, ob man Sorten geeignet für den Ökolandbau aus konventionellen Sortenprüfungen ableiten kann. Man ist zu dem Schluss gekommen, dass ökologische Sortenprüfungen notwendig sind.
What were the key elements that you needed in order to start variety trials (equipment, financial support, interest of the farmers, etc.)? The first obstacle was the organic field and the question: How do I control weeds? Apart from that, organic variety trials use the same machinery and the same evaluation as conventional variety trials. Solely the matter of cultivation is different. When selecting testing locations, it is important that they are as homogeneous as possible, because under organic conditions different soil conditions immediately become	*Was waren die wichtigsten Elemente, die für den Start der ökologischen Sortenprüfung von Nöten waren (Equipment, finanzielle Förderung, Interesse der Landwirte, usw.)?* Die erste Hürde war die Ökofläche und die Frage: Wie kriege ich das Unkraut unter Kontrolle? Ansonsten werden bei der ökologischen Prüfung gleichen Maschinen. und die gleiche Auswertung, wie bei der konventionellen Prüfung angewendet. Lediglich in der Frage der Pflege besteht der Unterschied. Bei der Auswahl der Versuchsfläche ist es wichtig, dass sie möglichst homogen ist, da im Öko alles an

visible. Under conventional conditions, different soil conditions can be concealed by using fertilisation and spraying. A homogeneous field is important in order to identify differences among varieties. If the field is not homogeneous enough, the error in the trial is rising. In the worst case, in repetition one, variety A is better than variety B, whereas in repetition two, the opposite effect takes place. As a consequence, in the statistical evaluation no result can be observed.	Bodenunterschieden durchschlägt. Im Konventionellen kann ich zumindest einen Teil durch Düngungs- und Spritzmaßnahmen kaschieren. Eine homogene Fläche ist notwendig, um Sortenunterschiede zu identifizieren. Wenn die Fläche nicht ausreichend homogen ist, dann steigt der Fehler im Versuch. Im Extremfall ist in Wiederholung eins die Sorte A besser als die Sorte B und in Wiederholung zwei ist das anders herum. Bei der statistischen Berechnung bekommt man dann kein Resultat.
What motivates farmers to conduct variety testing on their farms? Variety testing is done for farmers. If variety testing is conducted on organic farms, the farmers act as target group and host.	*Worin besteht die Motivation der Landwirte, die die Sortenprüfungen auf ihrem Hof durchführen?* Sortenprüfungen werden für den Landwirt durchgeführt. Falls die Sortenprüfung auf ökologischen Betrieben stattfindet, ist der Landwirt sowohl Zielgruppe als auch Gastgeber.
Who is participating in the variety testing initiative and what is the role of the different actors (farmers, researchers, breeders, processors, seed companies, etc.) involved? Actors of the working group responsible for variety testing agree upon the varieties to be tested. There is one working group for seeding in autumn and one working group for seeding in spring. The trial set-up is entered into the database. The Central Trial Department orders the trial and prepares a template in PIAF. PIAF is a software which is used throughout Germany. It is used to enter, manage and share trials with the FPVO and other Federal State Offices. The trial team gets access to the trial set-up and receives the seeds from the breeders. They are responsible for conducting, taking care, scoring and harvesting of the trial. They enter the results in PIAF and pack samples for grain and quality analysis. In most cases, working groups of the State Research Centre for Agriculture conduct the grain analysis as well as processing of maize and potatoes. The quality analysis is conducted in an in-house laboratory. All results are entered into PIAF. The Central Trial Department is responsible for statistical evaluation and, most of all, examines the reliability and validity of the trial.	*Wer nimmt an der Sortenprüfung teil und was sind die Rollen der unterschiedlichen Akteure (Landwirte, Wissenschaftler/Forscher, Züchter, Verarbeiter, Saatgutunternehmen, usw.)?* Bei der Sortenauswahl stimmen sich die Akteure im Arbeitskreis Sortenwesen auf Sorten ab. Es gibt einen Arbeitskreis für die Herbstaussaat und einen Arbeitskreis für die Frühjahrsaussaat. Die Versuchsplanung wird in eine Datenbank eingegeben. Die Zentrale Versuchsabteilung bestellt den Versuch und bereitet eine Vorlage in PIAF. PIAF ist ein deutschlandweites Programm, auf der die Versuche eingetragen und verwaltet werden. Zudem werden über PIAF die Versuche mit dem BSA und anderen Länderdienststellen ausgetauscht. Die Versuchsmannschaften bekommen Zugang zur Versuchsplanung und erhalten das Saatgut von den Züchtern. Sie sind verantwortlich für die Durchführung, Pflege, Bonitur und Ernte des Versuchs. Sie tragen die Ergebnisse in PIAF ein und packen die Proben für Korn- und Qualitätsuntersuchungen ab. In den meisten Fällen werden von den Arbeitsgruppen der LfL die Kornuntersuchungen durchgeführt oder auch die Verarbeitung von Mais oder Kartoffeln. Die Qualitätsanalysen werden in einem internen Labor durchgeführt. Alle Ergebnisse werden in PIAF eingetragen. Die Zentrale Versuchsabteilung führt die statistische Versuchsauswertung durch und prüft vor allem die Wertbarkeit des Versuches.
What are the current communication practices between the actors involved in the initiative? PIAF is a software for entering, managing and evaluating results. Further communication is done in person or via mail and mobile phone. The Central Trial Department is the contact person for the trials. They are responsible for preparing the template for PIAF, ordering seeds, assigning the laboratory with which testing criteria to analyse, and determining reliability/validity of the trials.	*Was sind derzeitigen Kommunikationspraktiken zwischen den involvierten Akteuren?* PIAF ist die Datenbank zur Eintragung, Verwaltung und Auswertung der Ergebnisse. Weitere Kommunikation geschieht persönlich oder über Mail- und Handy-Verkehr. Die Zentrale Versuchsabteilung ist Ansprechpartner für die Versuche. Sie ist verantwortlich für die Erstellung der PIAF Formatvorlagen, Bestellung des Saatguts, Beauftragung des Labors mit zu testenden Analysekriterien und Feststellung der Wertbarkeit des Versuches.

Who is choosing varieties that are tested and what are the criteria for variety assortment? What are the criteria for choosing reference varieties?

We select varieties of which we expect a suitability for OA. We assume that all varieties from organic breeding have a suitability for OA. The FPVO has a small list with varieties tested under organic conditions.

Concerning varieties from conventional breeding, we look at disease resistances and yield on level one. We ask colleagues from conventional variety testing for their assessment and whether a variety is potentially suitable for OA.

In Bavaria, we use the mean value or average of the varieties as a reference variety. All other Federal States use some so-called VRS as reference varieties which have a long-standing significance for OA in the Federal State. They can originate from organic as well as conventional breeding. These VRS are tested for VCU and all new varieties have to be compared to this reference. In Bavaria, VRS are only used for official VCU testing by the FPVO.

Wer sucht die zu testenden Sorten aus und was sind die Kriterien für die Sortenauswahl? Was sind die Kriterien für die Auswahl der Referenzsorte?

Es werden Sorten ausgesucht, von denen eine Eignung für den Ökolandbau erwartet wird. Bei der Ökozüchtung wird unterstellt, dass die Sorte für den Öko-Anbau geeignet ist. Das BSA hat eine kleine Sortenliste mit Sorten „im ökologischen Landbau geprüft“ erstellt.

Bei den Sorten aus der konventionellen Züchtung werden sich Krankheitsresistenzen und das Ertragsniveau auf Stufe eins angeschaut. Man fragt vorab die Kollegen aus den konventionellen Sortenprüfungen nach einer Voreinschätzung, ob die Sorte was für den Öko-Anbau sein könnte oder nicht.

In Bayern benutzen wir das Sortenmittel bzw. den Versuchsdurchschnitt als Referenzsorte. Alle anderen Bundesländer nehmen einige VRS als Referenzsorte. Das sind Sorten, die langjährig in dem Bundesland für den Öko-Anbau empfohlen werden. Die Sorten können sowohl aus der ökologischen als auch aus der konventionellen Züchtung sein. An diesen werden die neuen Sorten verglichen. In Bayern werden bei den Wertprüfungen des BSA VRS genutzt.

How many testing locations do you have? Do you conduct variety testing on-station or on-farm or both? What is the number of repetitions per location? Over how many years do you test varieties?

We have converted one trial station to organic and one trial station is located at the Technical University of Munich. The rest, i.e. 80-90% of the trails, take place on-farm. In total, we have 22 locations. The number of locations per variety differs (for harvest 2018):

- Winter barley and spring wheat are tested on two locations
- Oats, winter rye, spelt, peas, field beans, silage maize, grain maize, blue lupin and potatoes are tested on three locations
- Winter triticale and spring barley are tested on four locations
- Winter wheat is tested on six locations

Because maize and potatoes are the most laborious, we are doing three repetitions. We are working with the so-called lattice. According to the statisticians, three repetitions are enough for statistical significance. For the other crops, we are doing four repetitions and we are working with the so-called Latin square design. With the Latin square we can correct for soil differences in two directions.

Normally, variety testing is conducted over three years. After three years we decide whether a variety receives recommendation. In exceptions, it can happen that we test a variety for only one or two years, if, for example, wheat is very susceptible to yellow rust or maize is very susceptible to stem rot.

Wie viele Standorte haben Sie? Findet die Sortenprüfung in landwirtschaftlichen Betrieben und/oder in Versuchsstationen statt? Wie viele Wiederholungen finden pro Standort statt? Über wie viele Jahre dauert die Sortenprüfung?

Wir haben nur eine Versuchsstation auf Öko umgestellt. Eine Station ist auf der technischen Universität München. Die restlichen Prüfungen, d.h. 80-90% der Versuche, finden auf landwirtschaftlichen Betrieben statt.

Insgesamt haben wir 22 Standorte. Die Anzahl der Standorte pro Kulturpflanze ist unterschiedlich:

- Wintergerste und Sommerweizen werden auf zwei Standorten getestet
- Hafer, Winterroggen, Dinkel, Erbsen, Ackerbohnen, Silomais, Körnermais, Blaue Lupine und Kartoffeln werden auf drei Standorten getestet
- Wintertriticale und Sommergerste werden auf vier Standorten getestet
- Winterweizen wird auf sechs Standorten getestet

Mais und Kartoffel sind am arbeitsaufwändigsten. Deswegen werden hier drei Wiederholungen durchgeführt. Da wird mit sog. Gitteranlagen gearbeitet. Laut den Statistikern reichen hier drei Wiederholungen. Ansonsten arbeiten wir mit vier Wiederholungen und mit dem sog. lateinischen Rechteck. Das hat den Hintergrund, dass wir mit dem lateinischen Rechteck den Bodentrend in zwei Richtungen nachgehen können.

Die Sortenprüfung dauert in der Regel drei Jahre. Danach wird entschieden, ob die Sorte empfohlen wird oder nicht empfohlen wird. In Ausnahmen werden auch Sorten nach einem oder zwei Jahren nicht weiter geprüft, wenn z.B. der Weizen hochgradig Gelbrost anfällig ist oder eine Maissorte Stängelfäule hat.

Are you looking for any specific attributes of these varieties that are important for organic farms or region/market/processing/consumer preference/storage/ resistance/climate change in your country?

First, we look at yield and quality. This is the same as in conventional variety testing. The more yield, the better. Quality criteria are valued differently in conventional and organic variety testing. For instance, regarding backing quality, baking volume of organic wheat is pivotal, whereas for conventional wheat, crude protein content is pivotal. Regarding brewing quality, conventional barley has to reach the highest brewing quality, whereas a good brewing quality is sufficient for organic barley.

Regarding agronomic properties, organic variety testing differs significantly from conventional variety testing. Mass development, plant height and plant density are valued higher in organic variety testing because it gives an indication on the ability to compete with weeds, whereas resistance to lodging and stability of the culm/ear is more important in conventional variety testing.

Resistance against diseases is more important in organic variety testing. If pesticides remain such a problem in CA, resistance against diseases might become more important for conventional variety testing as well. In Bavaria, within the last five years, resistance against diseases already became more important.

We do not test for properties, which might be important for climate change. Normally, variety testing is conducted over three years. Within these three years, the variety has to cope with the weather events. We do not take into consideration, whether these were three dry or three wet years. Regarding grain legumes, however, we do take the time of rainfall into consideration, since grain legumes are very susceptible to rainfall.

Untersuchen Sie spezifische Sorteneigenschaften, die für den Ökolandbau oder für die Region/Markt/Verarbeitung/ Verbraucherpräferenzen/Lagerung/ Resistenz/Klimawandel wichtig sind?

Das erste was wir uns anschauen ist Ertrag und Qualität. Das deckt sich mit den konventionellen Prüfungen. Beim Ertrag gilt je mehr, desto besser. Die Qualität wird im Detail etwas anders gewichtet. Zum Beispiel ist bei der Backqualität von ökologischem Weizen das Volumen ausschlaggebend, während es im Konventionellen der Rohproteingehalt ist. Bei der Brauqualität ist im Konventionellen eine höchste Brauqualität nötig, während im Öko eine gute Brauqualität ausreicht.

Die agronomischen Eigenschaften von Öko-Sorten unterscheiden sich deutlich vom Konventionellen. Die Massenbildung, Pflanzenlänge und Bestandsdichte werden höher gewertet, weil damit eine gute oder schlechte Unkrautunterdrückung attestiert wird. Standfestigkeit und Strohstabilität (Halm- und Ährenknicken) sind hingegen im Konventionellen wichtig.

Resistenzen gegen Krankheiten werden ebenfalls höher gewertet. Vielleicht wird das zukünftig auf konventionelle Sortenprüfungen ausgeweitet, wenn sich Spritzmittel auch weiterhin als problematisch darstellt. In Bayern wurden in den letzten fünf Jahren Resistenzen gegen Krankheiten in konventionellen Sortenprüfungen bereits stärker gewichtet.

Im Sortenwesen werden keine Eigenschaften, die hinsichtlich des Klimawandels von Bedeutung sein könnten, geprüft. Wir prüfen in der Regel drei Jahre. Mit der Witterung in diesen drei Jahren muss die Sorte dann zurechtgekommen sein. Es wird nicht geschaut, ob das drei trockene oder drei feuchte Jahre waren. Bei zum Beispiel Körnerleguminosen, die stark von Niederschlägen beeinträchtigt werden, beziehen wir den Zeitpunkt der Niederschläge mit in unsere Bewertung ein.

Are you performing any nutritional analysis? If not: Do you think this would be something that would be important to develop in the future?

Depending on the crop, different quality analyses are conducted. In organic and conventional variety testing, the same grain and quality analyses, but with a different weighing of the criteria, are done.

- Identical analyses: barley, oats, triticale, peas, field beans, maize, blue lupin
- Rye: Difference in falling number and amylogramme values. Some organic processors demand a lower falling number because they associate a better baking quality. This is especially the case for bread baked without form, such as rye and sourdough bread. Thus, after consulting with marketing organisations, we adapted our testing criteria and recommendations.
- Wheat: Baking volume and gluten content is more important in organic variety testing, whereas crude protein content (sedimentation value) is more important in conventional variety testing.

Führen Sie Nährstoffanalysen durch? Wenn nein: Denken Sie, dass die Entwicklung von Nährstoffanalysen für die Zukunft wichtig sein könnte?

In Abhängigkeit der Kultur, werden unterschiedliche Qualitätsanalysen durchgeführt. Es werden die gleichen Korn- und Qualitätsanalysen, wie bei der konventionellen Sortenprüfung durchgeführt, aber mit unterschiedlicher Gewichtung.

- Identische Analysen: Gerste, Hafer, Triticale, Erbse, Ackerbohne, Mais, Blaue Lupine
- Roggen: Unterschied in Fallzahl und Amylogramm. Einige Verarbeiter im Öko-Bereich fordern eine geringere Fallzahl, da damit eine bessere Backfähigkeit attestiert wird. Dies gilt insbesondere bei freigeschobenen Roggen- und Sauerteigbroten. Entsprechend wird das in unserer Empfehlung berücksichtigt. Die Prüfungskriterien werden mit regionalen Vermarktungsorganisationen besprochen.
- Weizen: Backvolumen und Feuchtkleber hat einen größeren Stellenwert im Öko. Rohproteingehalt (Sedi) hat einen größeren Stellenwert im Konventionellen.

- Spring malting barley: In organic variety testing, the share of whole grains, i.e. grains which are bigger than 2.5 mm, is given more importance because organic varieties have a higher heterogeneity than conventional varieties.
- Spelt: Spelt has a minor role in CA. There is a standard baking test for wheat, but no standard baking test for spelt. At the moment, we try to develop a baking test for spelt with the baking laboratory.
- Potatoes: In organic variety testing, we pay more attention to *Rhizoctonia* than in conventional variety testing.

- Sommerbraugerste: Im Öko wird ein größeres Augenmerk auf Vollgerstenanteil gelegt, sprich auf die Sortierung größer 2.5 mm, da sich die Sorten im Ökolandbau stärker unterscheiden, als im Konventionellen.
- Dinkel: Dinkel spielt im Konventionellen nur eine untergeordnete Rolle. Es gibt einen standardisierten Weizenbacktest, aber keinen für Dinkel. Es wird momentan versucht einen Backtest für Dinkel mit den Backlaboren zu entwickeln.

Kartoffel: Es wird verstärkt nach *Rhizoctonia* geschaut, was im Konventionellen nicht der Fall ist.

How do you disseminate the results from the trials and who can access it? If results are available online, please indicate the link to the trial results.

All results are available online on the website of the Bavarian State Research Centre for Agriculture. There are some consultants and marketers who receive results in advance. My working group is responsible for the list with recommended varieties. Andrea Winterling's working group is responsible for the list with grain legumes.

https://www.lfl.bayern.de/iab/landbau/030541/index.php

Wie veröffentlichen Sie die Resultate der Sortenprüfungen und wer hat Zugang zu den Resultaten? Bitte fügen Sie den Link bei, falls die Resultate online zugänglich sind.

Die Resultate werden alle im Internet, auf der Seite der LfL, veröffentlicht. Einige Berater und Vermarkter, die sich im Sortenwesen auskennen, kriegen die Ergebnisse vorab mitgeteilt. Meine Arbeitsgruppe ist für die Erstellung der Sortenliste verantwortlich. Die Arbeitsgruppe von Andrea Winter ist für die Erstellung der Liste der Körnerleguminosen zuständig.

How are trials for OA financed?

Organic variety testing is financed by the state. All trial teams are state offices. Me and my colleagues, we are financed by the Federal State Bavaria.

The farmers, which provide their land for variety testing, are compensated, so that they don't have any economic losses.

Seeds are provided for free by the breeder.

Wie werden die ökologischen Sortenprüfungen finanziert?

Die ökologischen Sortenprüfungen werden vom Staat finanziert. Die ganzen Versuchsmannschaften sind staatliche Stellen. Ich und meine Kollegen werde vom Freistaat Bayern finanziert.

Die Landwirte, die ihre Flächen für Sortenprüfungen zur Verfügung stellen, werden vergütet. Das Ziel ist, dass die Landwirte plus minus null raus gehen.

Das Saatgut wird vom Züchter kostenfrei bereitgestellt.

What are crop-specific challenges concerning DUS and VCU criteria?

In order to describe or identify a variety, homogeneity and distinctness is necessary. Nonetheless, the release of populations is now permitted. Populations are like a colourful bouquet of flowers, who have certain advantages in OA.

When the farmer is regarded as a consumer, then the DUS criteria can be regarded as a consumer protection legislation, which ensure, that the farmers buys a certain quality. In the private sector, which takes place on a smaller level and is based on trust, it could be ok to forego DUS trials. However, considering the size of the market, it is not possible to rely on trust.

Was sind die Sorten-spezifischen Herausforderungen der DUS und VCU Testkriterien?

Um eine Sorte zu beschreiben und zu identifizieren muss sie unterscheidbar und homogen sein. Nichtsdestotrotz sind Populationen jetzt zugelassen. Populationen sind wie ein bunter Blumenstrauß, die im Ökolandbau gewisse Vorteile mit sich bringen könnten.

Wenn der Landwirt als Verbraucher angesehen wird, dann sind die DUS Kriterien ein Verbraucherschutzgesetz, welches versichert, dass der Landwirt eine gewisse Qualität kauft. Es kann in Ordnung sein auf DUS Prüfungen zu verzichten, wenn es sich um privatwirtschaftliche Geschichten handelt, die auf einer kleineren Ebene stattfinden und die auf Vertrauen basieren, aber bei der Größe des Marktes, kann es nicht über privatwirtschaftliche Vertrauensgeschichten gehen können.

What do you see as the next important step in order to develop/improve the variety testing trials?

Not all varieties, which have relevance for OA, are tested under organic conditions such as grass-clover, i.e. red clover, white clover, lucerne, and grasses. These are only tested under conventional conditions, and the results are used for assessment whether the variety is suitable for OA. At the moment, we are testing whether such a

Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?

Es werden also noch nicht alle Kulturen geprüft, die eine Relevanz für den Ökolandbau haben, wie das Kleegras, sprich Rotklee, Weißklee, Luzerne und Gräser. Diese werden in konventionellen Sortenprüfungen getestet und die Ergebnisse dann auf den Ökolandbau abgeleitet. Wir

derivation is valid. In addition, we are thinking about establishing organic trials for soybeans. Other than that, we are testing most properties, which are important for OA. There are some exceptions, such as the baking quality. For instance, it would be desirable to perform develop baking trials for rye, but we do not have the necessary equipment for that. At the moment we are scoring visually at the field. Maybe it would be possible to automatically score the trials, using, for instance, a photometric methodology.	haben eine Versuchsserie aufgebaut, um zu überprüfen ob diese Ableitung stimmt. Zudem denken wir gerade über eine Sojaprüfung nach. Ansonsten werden zum größten Teil die wichtigsten Eigenschaften, die für den Ökolandbau von Bedeutung sind, bei den Sortenprüfungen abgeprüft. Es gibt jedoch auch Ausnahmen, wie bei der Backqualität. Es wäre zum Beispiel wünschenswert, wenn wir auch Roggenbackversuche durchführen könnten, aber wir haben nicht die entsprechende Ausstattung. Zurzeit wird im Feld visuell bonitiert. Vielleicht ist es möglich, dass die Bonitur irgendwann automatisiert ablaufen kann, also z.B. durch photometrische Auslese.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848? (a): Genetic diversity can be understood twofold. On the one hand, a variety has a genetic diversity, because it was selected from various varieties. On the other hand, populations have a genetic diversity and, thus, they might be more adaptable. I cannot answer, whether this process takes place within two to three years. Landraces are selected over ten to 30 years which results in adaptation to the specific environment of the farm. However, this also involves narrowing down of genetic diversity. For instance, if I do not have problems with brown rust on my farm, then resistance against brown rust is not interesting and this property will be lost probably from the variety. This genetic restriction will also take place in populations, where I select certain properties from the colourful bouquet of flowers, which are interesting for my farm. The question is, whether new varieties have an advantage over landraces or populations. Breeding progress will rather be found in newly released varieties. A further question is, whether we always have to talk about higher yield or whether, at one point, we are satisfied with a certain yield.	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?* (a): Genetische Vielfalt kann man auf zwei verschiedene Art und Weisen verstehen. Zum einen, steckt in einer Sorte viel genetische Vielfalt drin, da diese aus mehreren Sorten gezüchtet worden ist. Zum anderen haben Populationen eine genetische Vielfalt und sind so vermutlich anpassungsfähiger. Ob dieser Prozess tatsächlich nach zwei bis drei Jahren stattfindet kann ich nicht beantworten. Anders ist das bei dem sog. Hofsorten-Konzept, wo ich eine Sorte zehn bis 30 Jahre selektiere und so an meinen Standort anpasse. Jedoch handelt es sich hierbei auch um eine genetische Einengung. Wenn ich zum Beispiel keinen Braunrost-Standort habe, dann ist eine Braunrost-Resistenz uninteressant und dann wird diese Eigenschaft vermutlich aus der Sorte herausfliegen. Diese genetische Einengung findet auch bei Populationen statt, wo ich aus dem bunten Blumenstrauß bestimmte Eigenschaften selektiere, die für meinen Hof von Interesse sind. Die Frage ist nur, ob man nicht besser mit einer neuen Sorte fährt. Der Zuchtfortschritt wird eher in Neuzulassungen sein und nicht in Populationen oder in einer Hofsorte. Die Frage ist auch, ob wir immer über steigende Erträge reden müssen oder ob man irgendwann sagt: Der Ertrag X reicht mir.

Table 22: Expert interview with Ludwig WATSCHONG.

Ludwig WATSCHONG is responsible for organic seed propagation and breeding at Dreschflegel. Dreschflegel produces organic seeds for organic varieties suitable for private gardens and self-sufficiency. They work mostly with landraces and old vegetable varieties which are compatible with self-reproduction. Varieties are registered as amateur varieties.	
With what material are you working with? We are working with amateur varieties which we produce for private persons.	*Mit was für Material arbeiten Sie?* Wir arbeiten mit Amateursorten, welche wir für Privatpersonen produzieren.
What breeding criteria do you take into account? For us, a long harvesting period is important. This is considered as a disadvantage in industrial agriculture. Farmers want to be able to harvest everything at once in order for them to prepare the field for the next crop. A gardener, who only cultivates for self-sufficiency, requires, for instance, Brussel sprouts which were common in the past, i.e. Brussel sprouts which ripen from	*Was für Züchtungskriterien beachten Sie?* Wir beachten lange Ernteperioden. Das wird von der industriellen Landwirtschaft nicht gewünscht. Diese wollen ihren Acker auf einmal abernten, fertig machen und dann neu bestellen. Ein Gärtner, der für sich selber anbaut, der will zum Beispiel einen Rosenkohl haben, wie er früher üblich war, d.h. die Röschen reifen von unten nach oben ab. Diese Eigenschaft wurde in der Züchtung in den letzten

the bottom to the top. This property was not considered in breeding within the last 50 years. Consequently, in new varieties all sprouts ripen at the same time. Commerce requires tomatoes with a certain firmness and carrots with a certain form, which has the same thickness on the bottom as on the top which makes stacking more efficient. For self-sufficiency, suitability for storage in earth cellars is more important, whereas, in the industry, cooling chambers with perfect conditions, stable temperature and humidity, make properties such as robustness in storability redundant.	50 Jahren nicht beachtet. Deswegen gibt es bei den neuen Sorten fast nur noch Rosenkohlsorten, bei denen alle Röschen gleichzeitig abreifen. Der Handel wünscht sich Tomaten mit einer bestimmten Festigkeit und Möhren mit einer bestimmten Form, die oben genauso dick wie unten ist, um die Möhren besser zu stapeln. Dem Selbstversorger ist eher die Lagerfähigkeit in Erdkellern wichtig, während man in der Industrie perfekt eingerichtete Kühlkammern hat, die die richtige Temperatur und Feuchtigkeit halten. Eigenschaften wie Robustheit bei der Lagerfähigkeit spielen deswegen in der Züchtung keine Rolle mehr.
Which testing criteria are important for OA or for climate-robustness? Climate-robustness is the basis for our breeding. We are distributed throughout Germany and conduct breeding on different soils and in different climatic conditions. Over the years, by breeding and propagating in specific locations, the variety is able to adapt to the conditions. Consequently, the customer receives varieties, which are adapted to conditions similar to theirs.	*Welche Testkriterien sind Ihrer Meinung nach wichtig für den Ökolandbau und für Klima-Robustheit?* Klima-Robustheit ist Grundlage von unseren Züchtungen. Wir sind auf ganz Deutschland verteilt und führen Züchtungen auf verschiedenen Böden und in verschiedenen Klimabedingungen aus. Durch die Züchtung und Vermehrung an bestimmten Standorten, kann sich die Sorte, im Laufe der Jahre, an die Bedingungen anpassen. Auf diese Weise bekommen Kunden Sorten, die an Standorte angepasst sind, die ihren Verhältnissen ähnlich sind.
What do you see as the next important step in order to develop/improve the variety testing trials? In variety testing, criteria, which we regard as important for our customers, are not considered. Lobby associations decide on the criteria to be tested. In addition, we are fighting against genetic engineering and patents on life. For our varieties, we do not necessarily require official registration. For us, it is important, that marketing of variety diversity is enhanced and facilitated. At the moment, the access of certain varieties to the market is restricted and every restriction entails loss of diversity. In general, marketing of all varieties should be legalised, as long as criteria such as purity of seeds and germination capacity are considered.	*Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?* In Sortenprüfungen finden die Kriterien, die wir für unsere Kunden als wichtig erachten, keine Beachtung finden. Die Testkriterien werden von Lobbyverbänden entschieden. Zudem kämpfen wir gegen Gentechnik und Patente auf Leben. Wir benötigen nicht unbedingt eine offizielle Zulassung für unsere Sorten. Für uns ist wichtig, dass der Verkehr von Sortenvielfalt erweitert und erleichtert wird. Zurzeit wird der Zugang von bestimmten Sorten zum Markt eingeschränkt und jede Einschränkung ist ein Verlust von Vielfalt. Grundsätzlich sollte jede Sorte in den Handel kommen können, solange Dinge beachtet werden wie Sortenreinheit, Keimfähigkeit, usw.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848? (a): For us, in general, diversity is very important. In breeding, we try to use as many parental varieties and populations as possible. (b): Organic breeding is very important. Additionally, conservation breeding, i.e. a permanent organic reproduction should take place.	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?* (a): *Grundsätzlich ist uns Vielfalt sehr wichtig. Wenn wir züchterisch arbeiten, dann versuchen wir möglichst viele Ausgangssorten oder Ausgangspopulationen heran zu nehmen.* *(b): Ökologische Züchtung ist sehr wichtig. Zudem sollte Erhaltungszüchtung, d.h. permanenter ökologischer Nachbau der Sorte stattfinden.*
Did you experience restrictions/challenges in registering amateur varieties? No	*Erfahren Sie Restriktionen/Herausforderungen bei der Registrierung von Amateursorten?* Nein
Did you experience rejection of the registration of amateur varieties? Yes, because it did not adhere to the competition law. One variety had to get a different name to be registered.	*Wurde in der Vergangenheit die Anmeldung von Amateursorten abgelehnt?* Ja, weil es nicht mit dem Wettbewerbsrecht übereinstimmte. Eine Sorte musste einen anderen Namen bekommen, dann war es in Ordnung.

What do you think about variety protection? Do you ask for variety protection for your amateur varieties? Variety protection is ok, but on no account, it should be replaced by patents on life. We are strictly against patents on life. We, ourselves, do not register for variety protection.	*Was halten Sie von Sortenschutz? Wollen Sie Sortenschutz für Ihre Amateursorten?* Sortenschutz ist in Ordnung, er darf aber auf keinen Fall vom Patentrecht ersetzt werden. Patent auf Leben lehnen wir strikt ab. Wir selber melden keinen Sortenschutz an.

Table 23: Expert interview with Carolina WEGNER.

Carolina WEGNER is coordinator of organic variety trials at the State Research Institute for Agriculture and Fishery (*Landesforschungsanstalt für Landwirtschaft und Fischerei*) in Mecklenburg-Western Pomerania.	
Please define the tested crop species. Winter cereals: winter barley, rye, triticale, winter wheat, spelt (tested from 2015 to 2018). Spring cereals: spring barley, oat, spring wheat. Grain legumes: lupins (many years of testing with Blue and Yellow Lupins, from this year on additionally White Lupins), field peas (tested until last year), soybeans (tested this year for the last year), sunflowers (since last years), maize (from this year on). Normally, we go by the list of the FPVO which publishes newly registered organic varieties, bred by Darzau or Dottenfelderhof, each year. Varieties which went through organic VCU testing, will definitely be tested in our variety trials. In conventional varieties we look at the criteria more in-depth. There are crops with a wide variety range, such as winter wheat, and crops with a narrow variety range, such as rye. In the latter case, we use material from Poland or Czech Republic. The same applies for field peas and lupins. There are no registrations for Yellow Lupins in Germany, thus, we use varieties form Poland.	*Bitte definieren Sie die geprüften Fruchtarten.* Wintergetreide: Wintergerste, Roggen, Triticale, Winterweizen, Dinkel (geprüft von 2015 bis 2018). Sommergetreide: Sommergerste, Hafer, Sommerweizen. Körnerleguminosen: Lupinen (langjährige Sortenversuche mit Blauen und Gelben Lupinen, ab diesem Jahr zusätzlich Weiße Lupinen), Futtererbse (geprüft bis letztes Jahr), Soja (wird dieses Jahr das letzte Jahr geprüft), Sonnenblumen (seit letztem Jahr), Mais (ab diesem Jahr). In der Regel richten wir uns nach den Listen des BSA, die jedes Jahr die neu registrierten ökologischen Sorten von Darzau oder Dottenfelderhof veröffentlicht. Die Sorten, die durch die Öko-Wertprüfung gelaufen sind, kommen auf jeden Fall in unsere Sortenversuche. Bei den konventionellen Sorten schauen wir uns die Kriterien genauer an. Es gibt Kulturen mit einem großen Sortenspektrum, wie dem Winterweizen und Kulturen mit einem geringerem Sortenspektrum, wie dem Roggen. Im letzteren Fall greifen wir dann auch auf polnisches oder tschechisches Material zurück, welches dort neu zugelassen wurde. Das Gleiche ist der Fall bei Futtererbsen und Lupinen. Bei den Gelben Lupinen gibt es überhaupt keine Zulassungen in Deutschland und da benutzen wir auch polnische Sorten.
Who was the initiatory for setting up the testing trials and what was the purpose/demand? All responsible persons from the Federal States meet once per year in a working group "trial coordination in organic agriculture". Due to the fact, that all Federal States had responsible persons for OA and due to the fact, that we came into contact by meeting in the working group, we agreed upon developing variety testing under organic conditions in order to make regional assessments for OA. The system of conventional variety testing was used as a starting point for the development of organic variety testing.	*Wer war der Initiator für den Aufbau der ökologischen Sortenprüfung und was war das Ziel/der Anspruch?* Es gibt einen „Versuchsansteller im ökologischen Landbau", wo sich alle Verantwortlichen aus den einzelnen Bundesländern einmal im Jahr treffen. Dadurch, dass die Bundesländer eigene Öko-Verantwortliche hatten und man durch das Treffen in Kontakt kam, hat man sich dazu entschieden Sortenprüfung unter ökologischen Bedingungen zu entwickeln, um regionale Aussagen für den Ökolandbau zu treffen. Bei der Entwicklung hat man sich an die bereits bestehenden konventionellen Sortenversuche angelehnt.
What were the key elements that you needed in order to start variety trials (equipment, financial support, interest of the farmers, etc.)? Infrastructure, such as machines, were already existing. The challenge was to find organically managed fields for variety testing. Some Federal States conduct their variety trials on organic farms. We also have one organically managed and certified field on-station (Gülzow).	*Was waren die wichtigsten Elemente, die für den Start der ökologischen Sortenprüfung von Nöten waren (Equipment, finanzielle Förderung, Interesse der Landwirte, usw.)?* Die Infrastruktur, wie die Maschinen (Parzellendrillmaschine) gab es bereits. Die Herausforderung war ökologisch bewirtschaftete Flächen für die Sortenversuche zu finden. Manche Bundesländer machen ihre Sortenversuche hauptsächlich auf landwirtschaftlichen Flächen. Wir haben auch an unserem Standort (Gülzow) ein ökologisch bewirtschaftetes und zertifiziertes Feld.

What motivates farmers to conduct variety testing on their farms?

On the one hand, the farmer can test varieties under the conditions of his location in order to select varieties, since our recommendations are based on several locations. On the other hand, our work creates publicity. Once per year, together with the farmer, we make an event with presentations, field visits and barbeque. Over the years, we developed a relationship to the farmer based on trust. The trials are conducted on the farm since 2010.

Worin besteht die Motivation der Landwirte, die die Sortenprüfungen auf ihrem Hof durchführen?

Zum einen kann der Landwirt die Sorten bei sich auf dem Standort testen, um für sich eine Auswahl zu treffen, da unsere Empfehlungen mehrere Standorte mit einbeziehen. Zudem ist die gemeinsame Arbeit öffentlichkeitswirksam. Wir machen einmal im Jahr mit dem Landwirt zusammen eine Veranstaltung, mit Vorträgen, Feldbesuchen und Grillen. Es handelt sich auch um ein Vertrauensverhältnis, welches sich mit der Zeit aufgebaut hat. Die Versuche werden seit 2010 bei dem Landwirt durchgeführt.

Who is participating in the variety testing initiative and what is the role of the different actors (farmers, researchers, breeders, processors, seed companies, etc.) involved?

Germany is divided into cultivation areas. The locations which we include into our evaluation include cultivation area one (Mecklenburg-Western Pomerania and Brandenburg) and a part of cultivation area two (poor regions of Lower Saxony and Schleswig-Holstein). Twice per year we meet with seed propagators and agree upon the varieties to be tested. Seed companies and breeders contact us beforehand to inform us about new varieties.

Variety testing on the external location are conducted through a service company. The service company has the necessary machines and equipment to set up, sow and harvest small-scale trials. The farmer is responsible for marking and harrowing the field. The trial is set-up in a way that the wheels of the farmer's harrow do not destroy the plots. We conduct the scoring on the fields of the farmer ourselves.

I receive data from the locations of the Federal States which we include in our variety recommendations. I calculate the results from all locations and publish mean values for all varieties. The yield is calculated over several years and several locations to guarantee a validity of results. Quality values are normally calculated only from our locations.

Wer nimmt an der Sortenprüfung teil und was sind die Rollen der unterschiedlichen Akteure (Landwirte, Wissenschaftler/Forscher, Züchter, Verarbeiter, Saatgutunternehmen, usw.)?

Deutschland ist in Anbaugebiete eingeteilt. Die Standorte, die wir mit in unsere Auswertung reinnehmen, sind Anbaugebiet eins (Mecklenburg-Vorpommern und Brandenburg) sowie einen Teil von Anbaugebiet zwei (leichten Standorte in Niedersachen und Schleswig-Holstein). Wir treffen uns zweimal im Jahr mit Vermehrern und stimmen über das zu testende Sortenspektrum ab. Saatgutunternehmer bzw. Züchter kontaktieren uns vor unseren Treffen und informieren uns über neue Sorten.

Die Sortenversuche am externen Standort werden durch einen Dienstleister durchgeführt. Der Dienstleister hat die Parzellendrillmaschine und kann kleinflächige Versuche anlegen, aussäen und ernten. Der Landwirt steckt die Fläche ab und übernimmt das striegeln, d.h. die Versuche sind so angelegt, dass die Räder seines Striegels nicht durch die Parzellen fahren. Die Bonituren führen wir beim Landwirt selber durch.

Ich bekomme Dateien von den Standorten der Bundesländer zugeschickt, die wir miteinbeziehen, damit ich sie mit meinen Standorten verrechnen kann und einen Durchschnittswert für einzelne Sorten ausgeben kann. Der Ertrag wird über mehrere Jahre und über mehrere Standorte verrechnet, um eine Sicherheit der Aussage der Werte zu garantieren. Qualitäten nehmen wir fast nur von unseren Standorten.

What are the current communication practices between the actors involved in the initiative?

Twice per year, we meet the coordinators from the Federal States of our cultivation area (Brandenburg, Schleswig-Holstein, Lower Saxony and Mecklenburg-Western Pomerania) as well as seed propagators (*Gut Rosenkrantz, Öko-Korn-Nord, Bioland Markt, Naturland Markt, VGS-Bioland SH, Ceresaaten)*. We agree upon the varieties to be tested.

For data exchange we use PIAF. In PIAF, site maps, varieties and scored values are collected. On the one hand we exchange PIAF documents with other Federal States; on the other hand, we send our data to the FPVO, so that the FPVO can adjust their own variety lists, such as in the case of diseases events.

We can publish PIAF data in excel tables, but they are not open to the public. All Federal States pay into a fund

Was sind derzeitigen Kommunikationspraktiken zwischen den involvierten Akteuren?

Wir treffen uns zweimal im Jahr mit den Koordinatoren der Bundesländer aus unserem Anbaugebiet (Brandenburg, Schleswig-Holstein, Niedersachsen und Mecklenburg-Vorpommern) sowie Saatgut-Vermehrern (Gut Rosenkrantz, Öko-Korn-Nord, Bioland Markt, Naturland Markt, VGS-Bioland SH, Ceresaaten). Wir sprechen uns über das zu prüfende Sortenspektrum ab.

Zum Datenaustausch benutzen wir PIAF. In PIAF werden Lagepläne, Prüfglieder und Boniturdaten gesammelt. Auch Serienverrechnungen über Jahre und Standorte können über PIAF harmonisiert/zusammengeführt werden. Verrechnet werden die Daten über PIAF Stat. Zum einen tauschen wir PIAF Daten mit anderen Bundesländern und zum anderen schicken wir unsere Daten ans BSA, damit das BSA seine eigene Sortenliste

which is used to further develop PIAF, and which allows the Federal States to use PIAF. Service companies have to pay for a PIAF-license.	immer wieder validieren kann, zum Beispiel bei Krankheitsereignissen. Wir können die PIAF Daten in Excel-Tabellen ausgeben, aber die sind nicht öffentlich zugänglich. Für PIAF zahlen die Bundesländer in einen Fond zur Weiterentwicklung des Programmes ein und können das Programm nutzen. Firmen, wie z.B. Dienstleister müssen für eine PIAF-Lizenz zahlen.
Who is choosing varieties that are tested and what are the criteria for variety assortment? What are the criteria for choosing reference varieties? For variety selection, the yield is important. On the conventional variety list of the FPVO, we look for high grades in yield, whereas in conventional variety testing, medium values are sufficient. Crop height does not play a major role in variety selection anymore; diseases, such as yellow rust, are still important. In the organic VCU testing of the FPVO, new criteria are included such as mass development and ground cover, since these are important criteria for evaluating weed competitiveness. The FPVO only conduct organic VCU testing with barley, wheat and oat. Whether quality is important for variety selection depends on the crop. Storability is very important for us, since we do not spray any growth regulators. In Northern Germany, winter hardiness is an important criterion. Two years ago, we were not able to assess winter cereal due to a frost incidence. Regarding rye, we always discuss, whether to include hybrids, because many farmers and propagators are against the use of hybrids. Due to this reason, the rye collection consists mostly out of populations. We test three hybrid rye varieties, which statistically yield more, but are problematic in sales. In barley and wheat, we do not test any hybrids. Our reference varieties are varieties which have been tested over many years but at least three years. In VCU testing, VRS are used as reference varieties throughout Germany. In a working group, all persons of the Federal States responsible for OA agree upon reference varieties which they present to the FPVO. The responsible persons have to agree upon varieties, which are of importance on all locations in Germany. We try to include varieties with high quality values as well as high yield values.	*Wer sucht die zu testenden Sorten aus und was sind die Kriterien für die Sortenauswahl? Was sind die Kriterien für die Auswahl der Referenzsorte?* Bei der Sortenauswahl ist der Ertrag wichtig. Auf der Sortenliste des BSA für konventionelle Sorten wollen wir Boniturnoten, die im Ertrag hoch sind, während sich die konventionelle Sortenprüfung mit mittleren Erträgen zufriedengibt. Pflanzenlänge hat keinen so hohen Stellenwert mehr; Krankheiten, wie Gelbrost, sind immer noch wichtig. Bei den Öko-Wertprüfungen des BSA gibt es neuen Kriterien wie Massebildung und Bodenbedeckung, da dies wichtige Kriterien zur Einschätzung der Unkrautunterdrückung sind. Beim BSA gehen nur Gerste, Weizen und Hafer durch eine Öko-Wertprüfung. Qualitäten sind in Abhängigkeit von der Kultur wichtig. Lagerfähigkeit ist bei uns wichtiger, da wir keine Halmverkürzer spritzen können. Auswinterung ist bei uns im Norden ein wichtiges Kriterium. Vor zwei Jahren konnten wir das Wintergetreide auf Grund von Frost nicht auswerten. Beim Roggen findet immer die Diskussion statt, ob wir Hybride mit einbeziehen, aber das wird von den Landwirten und vielen Vermehrern nicht gewünscht. Deswegen besteht das Roggensortiment größtenteils aus Populationssorten. Wir haben drei Hybridsorten beim Roggen, die statistisch gesehen höhere Erträge bringen, aber beim Verkauf Probleme machen. Bei Gerste und Weizen prüfen wir bisher keine Hybride. Unsere Referenzsorten sind die Sorten, die bei uns langjährig geprüft wurden, also mindestens drei Jahre. Bei den Wertprüfungen werden VRS genutzt, welche deutschlandweit einheitlich sind. In einem Arbeitskreis, in dem alle Öko-Verantwortlichen der Bundesländer sitzen, wird über einen Vorschlag abgestimmt, der dem BSA zur Bestimmung der VRS vorgelegt wird. Dabei muss ein Konsens über Sorten gefunden werden, welche an allen Standorten von Bedeutung sind. Wir versuchen Qualitäts- und Hochertragssorten mit einzubeziehen.
What kind of seeds do you use for variety testing and reference varieties? We order seeds from the breeder. Normally, we receive conventional, untreated seeds, except when they originate from an organic breeder. We order seeds from the breeder, in order to guarantee to use the same starting material in the trials throughout Germany. For the VRS of VCU testing, we receive seeds from the FPVO. The FPVO receives seeds directly from the breeder.	*Welches Saatgut verwenden Sie für die zu testenden Sorten und Referenzsorten?* Das Saatgut bestellen wir beim Züchter. Normalerweise bekommen wir konventionelles, ungebeiztes Saatgut, außer wenn es sich um einen Öko-Züchter handelt. Wir bestellen beim Züchter, um deutschlandweit einheitliche Partien in den Versuchen gewährleisten zu können. Für die VRS der Wertprüfungen bekommen wir Saatgut vom BSA. Das BSA nutzt das Saatgut direkt vom Züchter.
How many testing locations do you have? Do you conduct variety testing on-station or on-farm or both?	*Wie viele Standorte haben Sie? Findet die Sortenprüfung in landwirtschaftlichen Betrieben und/oder in*

What is the number of repetitions per location? Over how many years do you test varieties?

We have one testing location on-station in Gülzow and one testing location on-farm in Southeast of Mecklenburg-Western Pomerania.

The location on-farm has a soil value (*Ackerzahl*) of 22, i.e. poor location with sandy loam. We can only test crops, which are suitable under these conditions: winter barley, winter rye, winter triticale, oats, lupins. We do not always have all varieties on-farm, since we are restricted financially. The remaining varieties are tested in Gülzow. Additionally, we include the locations of the other Federal States into our evaluation: depending on the crop we have three locations in Brandenburg, one location in Lower Saxony, one location in Schleswig-Holstein, and for some crops we have one location in Saxony-Anhalt.

For some crops and in some years, Gülzow is our only testing location. For instance, we were the only location for field peas for several years, since the other locations had a too wide variation. We statistically evaluate varieties (t-Test). The variation of values indicates how many percent of the results correlate with the variety and how many percent correlate with environmental influences. Since the location has a big influence on the results, we plan our results with four randomised repetitions. With the statistics programme (PIAFStat), we are able to adjust for soil differences.

The programme creates soil maps, on which the variation of values on the single plots is visible.

Normally, we have four repetitions. Due to lack of space, we have three repetitions in maize. Variety testing per variety is conducted over three years, so that extreme years (such as 2017 and 2018) do not have a big influence on the results. After a variety is recommended, we proceed with testing this variety. We always try to have three varieties, which are tested more than five years to have a reference.

Versuchsstationen statt? Wie viele Wiederholungen finden pro Standort statt? Über wie viele Jahre dauert die Sortenprüfung?

Wir haben einen Versuchsstandort in Gülzow und einen Betrieb im Süd-Osten Mecklenburg-Vorpommerns, bei dem wir Sortenversuche haben.

Der Standort beim Landwirt hat eine Ackerzahl von 22, d.h. es handelt sich um einen sehr leichten Standort. Dort werden nur die Kulturen überprüft, die für leichte Standorte geeignet sind: Wintergerste, Winterroggen, Wintertriticale, Hafer und Lupine. Wir haben nicht immer alle Sorten dort stehen, da wir auf Grund von finanziellen Mitteln eingeschränkt sind. Die restlichen Sorten stehen in Gülzow.

Zudem beziehen wir in unsere Evaluierung Standorte von anderen Bundesländern ein. In Brandenburg gibt es drei Standorte je nach Kultur, in Niedersachsen haben wir einen Standort, in Schleswig-Holstein haben wir einen Standort und für manche Kulturen haben wir einen Standort in Sachsen-Anhalt.

In manchen Kulturen und Jahren haben wir Gülzow als einzigen Standort. Zum Beispiel waren wir bei Futtererbsen mehrere Jahre der einzige Standort, weil die anderen Standorte eine zu große Streuung hatten. Wir verrechnen die Sorten statistisch (t-Test) und bekommen eine Streuung der Daten, die aussagen, wie viel Prozent der Ergebnisse der Sorte zugeschrieben werden können und wie viel Prozent Umwelteinflüsse sind. Der Standort hat einen großen Einfluss, weswegen wir unsere Versuche mit vier randomisierten Wiederholungen planen. Mit dem statistischen Programm (PIAFStat) können anschließend Bodentrends raus gerechnet werden.

Das Programm erstellt Bodenkarten, an der man die Streuung der Werte auf den einzelnen Parzellen erkennen kann.

In der Regel haben wir vier Wiederholungen. Bei Mais haben wir, aufgrund von Platzmangel, nur drei. Die Sortenprüfung dauert pro Sorte drei Jahre, damit extreme Jahre (wie 2017 und 2018) keinen zu großen Einfluss nehmen. Nach einer Empfehlung werden die Sorten noch weiter geprüft. Wir versuchen immer drei Sorten zu haben, die mehr als fünf Jahre geprüft wurden um, eine Referenz zu haben.

Are you looking for any specific attributes of these varieties that are important for organic farms or region/market/processing/consumer preference/storage/ resistance/climate change in your country?

We conduct the standard tests, as stated in the catalogue of the FPVO. In our recommendations, we consider special marketing possibilities. For instance, we recommend niche varieties such as *Lichtkornroggen*, which is specifically demanded by bakers, even though, these varieties do not have any added value from a conventional standpoint.

We do not consider storability, since we do not have the possibility for testing. Resistances against diseases are very important. Two years ago, the falling number was an important criterion, due to the wet weather. This is

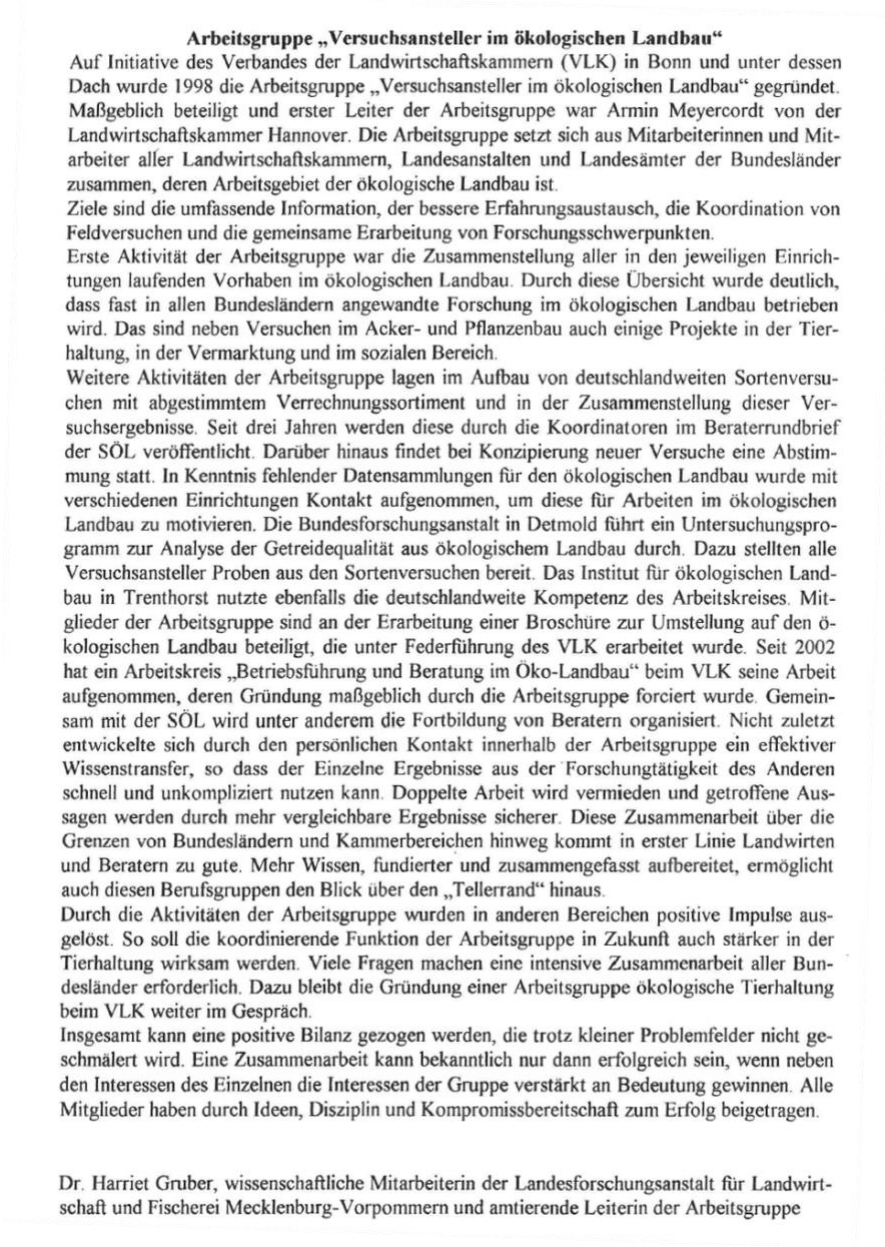
Untersuchen Sie spezifische Sorteneigenschaften, die für den Ökolandbau oder für die Region/Markt/Verarbeitung/ Verbraucherpräferenzen/Lagerung/ Resistenz/Klimawandel wichtig sind?

Die Standardbonituren die wir durchführen, sind die, die auch im Katalog des BSA stehen. Wir schauen in der Empfehlung auf besondere Vermarktungsmöglichkeit. Zum Beispiel empfehlen wir Nischensorten wie den Lichtkornroggen, aufgrund spezieller Nachfrage von Bäckern, obwohl diese unter konventionellen Gesichtspunkten keinen Mehrwert bringen würden.

Ansonsten beziehen wir die Lagerung nicht mit ein, weil wir dafür keine Möglichkeiten haben. Resistenzen gegen Krankheiten sind sehr wichtig. Die Fallzahl, war besonders vorletztes Jahr ein wichtiges Kriterium, als es so nass war.

also important in conventional variety testing, but not as significant. Since we do not use treated seeds, it is important that the varieties emerge uniformly. Besides that, we do not examine specific variety characteristics.	Das ist im Konventionellen auch ein Thema, wenn auch nicht so stark. Da wir kein gebeiztes Saatgut haben, ist es wichtig, wie gleichmäßig die Reihen aufgelaufen sind. Ansonsten untersuchen wir keine spezifischen Sorteneigenschaften.
Are you performing any nutritional analysis? If not: Do you think this would be something that would be important to develop in the future? We test qualities, which have an influence on the products, but we do not perform an analysis of the products. Depending on the crop, quality analyses are criticised, since they are not significant for the quality of the processed product. We conduct quality analyses in our own laboratory. We do not analyse any further criteria, such as milling yield. In OA, it is more difficult to maintain qualities, especially on poor locations.	*Führen Sie Nährstoffanalysen durch? Wenn nein: Denken Sie, dass die Entwicklung von Nährstoffanalysen für die Zukunft wichtig sein könnte?* Wir testen die Qualitäten, die Einfluss haben auf die Produkte, aber wir testen nicht die verarbeiteten Produkte. Je nach Kulturart stehen die Qualitäten in Kritik, da sie nicht soviel über die Qualität des verarbeiteten Produktes aussagen. Wir führen die Qualitätsanalysen vor Ort in unserem Labor durch. Wir analysieren keine zusätzlichen Kriterien, wie die Mehlausbeute. Im ökologischen Anbau ist es schwieriger die Qualitäten zu halten, gerade auf den leichten Standorten.
How do you disseminate the results from the trials and who can access it? If results are available online, please indicate the link to the trial results. We communicate the results mostly via our website. During and after harvest we disseminate preliminary results in table-form. The table includes the yield of the current year, as well as one row with mean values over several years. Especially in winter, ordering of seeds takes place while we still compile and calculate. On the website we disseminate our recommendations. Additionally, we have a variety booklet with all scoring values and variety data, in order to give a more detailed overview. After sowing, we publish the variety assortment to provide information on the varieties tested in the current trials. Varieties are presented at our field days in Gülzow and on the trial plot on-farm. https://www.landwirtschaft-mv.de/Fachinformationen/OekologischerLandbau/	*Wie veröffentlichen Sie die Resultate der Sortenprüfungen und wer hat Zugang zu den Resultaten? Bitte fügen Sie den Link bei, falls die Resultate online zugänglich sind.* Die Ergebnisse kommunizieren wir vor allem über unsere Internetseite. Da werden während und nach der Ernte als erstes die Vorinformationen in Tabellenform dargestellt. Die Tabelle beinhaltet die Erträge der Versuchsstandorte des aktuellen Jahres, sowie eine Zeile mit mehrjährig verrechneten Daten. Gerade bei der Winterung ist die Bestellung schon am Laufen, während wir noch die Ergebnisse zusammenstellen und verrechnen. Auf der Internetseite geben wir auch unsere Empfehlungen aus. Zudem haben wir ein Sortenheft wo alle Boniturdaten und Sortendaten aufgelistet sind, um sich ein genaueres Bild zu machen. Nach der Aussaat stellen wir zudem die Sortimente ins Internet, um einen Überblick über die aktuellen Sorten in den Versuchen zu geben. Die Sorten werden auf unseren Feldtagen in Gülzow und auf dem Betrieb im Versuchsfeld vorgestellt.
How are trials for OA financed? Financing takes place via our internal budget. Testing stations are financed with our own budget. We are paid for conducting VCU testing. The money from VCU testing is included in our budget. The farmer is not compensated for variety testing. A service company conducts variety testing on the external location. The service company is paid with our own budget, and by the farming association Biopark e.V. and by the regional farmers' association Uecker-Randow.	*Wie werden die ökologischen Sortenprüfungen finanziert?* Bei uns läuft die Finanzierung über den internen Haushalt. Die Versuchsstation wird aus unseren Haushaltsmitteln finanziert. Für die Wertprüfungen werden wir bezahlt. Das Geld fließt in unsere Haushaltskasse. Der Landwirt bekommt nichts für die Sortenversuche. Die Sortenversuche an dem externen Standort werden durch einen Dienstleister durchgeführt. Die Finanzierung des Dienstleisters erfolgt teilweise aus Mitteln aus unserer Forschungseinrichtung und teilweise vom Anbauverband Biopark e.V. und vom regionalen Bauernverband Uecker-Randow.
What are crop-specific challenges concerning DUS and VCU criteria? We do not conduct VCU testing with winter wheat anymore, since the variation on our location is too wide. Winter wheat is not a suitable crop for poor soil. I do not see any challenges in DUS testing.	*Was sind die Sorten-spezifischen Herausforderungen der DUS und VCU Testkriterien?* An unserem Standort werden keine Wertprüfungen für Winterweizen mehr durchgeführt, da die Streuung an unserem Standort zu groß ist. Winterweizen ist nicht die optimale Kultur für unsern leichten Boden.

	Ich sehe keine Herausforderungen bei den Registerprüfungen.
What do you see as the next important step in order to develop/improve the variety testing trials? At the moment, I experience a lot of change. The interest in OA, even from big conventional breeders, is growing. We are well-functioning. The regular meetings enable a good communication. For instance, we discuss whether we should permit an organic seed treatment or whether we test spelt without husks. We jointly take decisions, to make uniform statements throughout Germany. This is a big added value and eases the procedure.	*Was ist Ihrer Meinung nach der nächst wichtigste Schritt, um ökologische Sortenprüfungen zu entwickeln/verbessern?* Gerade merke ich, dass viel Bewegung stattfindet. Das Interesse am Ökolandbau, auch der großen konventionellen Züchter, wächst immer mehr. Wir sind gut eingespielt. Durch die regelmäßigen Treffen ist eine gute Kommunikation möglich. Zum Beispiel diskutieren wir, ob wir eine Öko-Beizung zulassen oder ob wir beim Dinkel entspelztes Saatgut prüfen. Wir treffen diese Entscheidungen deutschlandweit, damit wir einheitliche Aussagen treffen können. Das ist ein großer Mehrgewinn und macht die Durchführung leichter.
What is your opinion on the new definition for "organic variety suitable for organic production" according to regulation (EU) 2018/848? (a): Important to be able to market not-defined varieties such as composite cross populations, which have the potential to adapt to environmental conditions. (b): In organic breeding, criteria such as yield and quality are important as well, since most farmers are paid for these criteria. However, robustness against environmental conditions plays an increasingly important role, since, in the last years, extreme weather events were more frequent and will be more frequent in the future, according to prognoses. Before that, criteria such as the ability to save seeds, and robustness against diseases, etc., were already important. In our variety testing, we have many conventionally bred varieties, as these varieties might be of interest for OA as well. The requirement to use organically propagated seeds and the inclusion of crops into category I promotes variety selection of organically propagated varieties.	*Was halten Sie von der neuen Definition „für die ökologische/biologische Produktion geeignete ökologische/biologische Sorte" gemäß Verordnung (EU) 2018/848?* (a): Wichtig um nicht definierte Sorten wie Composite Cross Populationen vermarkten zu können, welche ein Potential zur besseren Umweltanpassung haben. (b): Auch in der ökologischen Züchtung sind Kriterien wie Ertrag und Qualität wichtig, da viele Landwirte danach bezahlt werden. Jedoch spielt die Widerstandsfähigkeit gegen Umwelteinflüsse eine immer größere Rolle, da Extremwetterereignisse in den letzten Jahren vermehrt auftraten und laut Prognosen auch in Zukunft stärker auftreten werden. Kriterien wie Nachbau und Widerstandsfähigkeit gegen Krankheiten, etc., waren auch vorher schon wichtig. Wir haben bei uns in den Sortenversuchen viele konventionell gezüchtete Sorten, da diese auch für den ökologischen Anbau interessante Sorten haben. Die Sortenauswahl ökologisch vermehrter Sorten wird durch die Vorgabe der Nutzung ökologisch vermehrten Saatguts unterstützt und durch die immer weitere Aufnahme einzelnen Kulturen in Kategorie I bekräftigt.



Arbeitsgruppe „Versuchsansteller im ökologischen Landbau"

Auf Initiative des Verbandes der Landwirtschaftskammern (VLK) in Bonn und unter dessen Dach wurde 1998 die Arbeitsgruppe „Versuchsansteller im ökologischen Landbau" gegründet. Maßgeblich beteiligt und erster Leiter der Arbeitsgruppe war Armin Meyercordt von der Landwirtschaftskammer Hannover. Die Arbeitsgruppe setzt sich aus Mitarbeiterinnen und Mitarbeiter aller Landwirtschaftskammern, Landesanstalten und Landesämter der Bundesländer zusammen, deren Arbeitsgebiet der ökologische Landbau ist.

Ziele sind die umfassende Information, der bessere Erfahrungsaustausch, die Koordination von Feldversuchen und die gemeinsame Erarbeitung von Forschungsschwerpunkten.

Erste Aktivität der Arbeitsgruppe war die Zusammenstellung aller in den jeweiligen Einrichtungen laufenden Vorhaben im ökologischen Landbau. Durch diese Übersicht wurde deutlich, dass fast in allen Bundesländern angewandte Forschung im ökologischen Landbau betrieben wird. Das sind neben Versuchen im Acker- und Pflanzenbau auch einige Projekte in der Tierhaltung, in der Vermarktung und im sozialen Bereich.

Weitere Aktivitäten der Arbeitsgruppe lagen im Aufbau von deutschlandweiten Sortenversuchen mit abgestimmtem Verrechnungssortiment und in der Zusammenstellung dieser Versuchsergebnisse. Seit drei Jahren werden diese durch die Koordinatoren im Beraterrundbrief der SÖL veröffentlicht. Darüber hinaus findet bei Konzipierung neuer Versuche eine Abstimmung statt. In Kenntnis fehlender Datensammlungen für den ökologischen Landbau wurde mit verschiedenen Einrichtungen Kontakt aufgenommen, um diese für Arbeiten im ökologischen Landbau zu motivieren. Die Bundesforschungsanstalt in Detmold führt ein Untersuchungsprogramm zur Analyse der Getreidequalität aus ökologischem Landbau durch. Dazu stellten alle Versuchsansteller Proben aus den Sortenversuchen bereit. Das Institut für ökologischen Landbau in Trenthorst nutzte ebenfalls die deutschlandweite Kompetenz des Arbeitskreises. Mitglieder der Arbeitsgruppe sind an der Erarbeitung einer Broschüre zur Umstellung auf den ökologischen Landbau beteiligt, die unter Federführung des VLK erarbeitet wurde. Seit 2002 hat ein Arbeitskreis „Betriebsführung und Beratung im Öko-Landbau" beim VLK seine Arbeit aufgenommen, deren Gründung maßgeblich durch die Arbeitsgruppe forciert wurde. Gemeinsam mit der SÖL wird unter anderem die Fortbildung von Beratern organisiert. Nicht zuletzt entwickelte sich durch den persönlichen Kontakt innerhalb der Arbeitsgruppe ein effektiver Wissenstransfer, so dass der Einzelne Ergebnisse aus der Forschungtätigkeit des Anderen schnell und unkompliziert nutzen kann. Doppelte Arbeit wird vermieden und getroffene Aussagen werden durch mehr vergleichbare Ergebnisse sicherer. Diese Zusammenarbeit über die Grenzen von Bundesländern und Kammerbereichen hinweg kommt in erster Linie Landwirten und Beratern zu gute. Mehr Wissen, fundierter und zusammengefasst aufbereitet, ermöglicht auch diesen Berufsgruppen den Blick über den „Tellerrand" hinaus.

Durch die Aktivitäten der Arbeitsgruppe wurden in anderen Bereichen positive Impulse ausgelöst. So soll die koordinierende Funktion der Arbeitsgruppe in Zukunft auch stärker in der Tierhaltung wirksam werden. Viele Fragen machen eine intensive Zusammenarbeit aller Bundesländer erforderlich. Dazu bleibt die Gründung einer Arbeitsgruppe ökologische Tierhaltung beim VLK weiter im Gespräch.

Insgesamt kann eine positive Bilanz gezogen werden, die trotz kleiner Problemfelder nicht geschmälert wird. Eine Zusammenarbeit kann bekanntlich nur dann erfolgreich sein, wenn neben den Interessen des Einzelnen die Interessen der Gruppe verstärkt an Bedeutung gewinnen. Alle Mitglieder haben durch Ideen, Disziplin und Kompromissbereitschaft zum Erfolg beigetragen.

Dr. Harriet Gruber, wissenschaftliche Mitarbeiterin der Landesforschungsanstalt für Landwirtschaft und Fischerei Mecklenburg-Vorpommern und amtierende Leiterin der Arbeitsgruppe

Figure 13: Statement about initiation of working group 'trial coordination in organic agriculture' on 04/04/2002 by Dr. Harriet Gruber, research assistant at the State Research Institute for Agriculture and Fishery (*Landesforschungsanstalt für Landwirtschaft und Fischerei*) in Mecklenburg-Western Pomerania (provided by WEGNER).

"The initiatory German Chambers of Agriculture founded the working group 'trial coordination in organic agriculture' in Bonn, 1998. Armin Meyercordt of the Chamber of Agriculture in Hannover was involved in the foundation and was the first head of the working group. The working group consists of employees from all Chambers of Agriculture, Regional Offices and State Offices of all Federal States that are involved in organic agriculture. Objective of the working group are comprehensive information, exchange of experience, coordination of field trials and the joint development of research focuses. First task of the working group was to assemble all planned projects in organic agriculture of all institutions. This overview indicated that almost all Federal States conduct applied research in organic agriculture, including arable and plant production, projects in husbandry, marketing and social aspects.Further activities of the working group were the development of variety testing throughout Germany with joint reference varieties and the compilation of testing results. In the past 3 years, these results were published by coordinators in counselling newsletters of the Foundation Ecology & Agriculture (*Stiftung Ökologie & Landbau, SÖL*). Furthermore, new trials are jointly coordinated. Due to the lack of data collection for organic agriculture, different institutions were contacted to motivate these for working in organic agriculture. The Federal Research Institute in Detmold is conducting research on analysing the quality of cereals from organic agriculture. For this purpose, all coordinators offered samples from variety testing […]" (own translation).

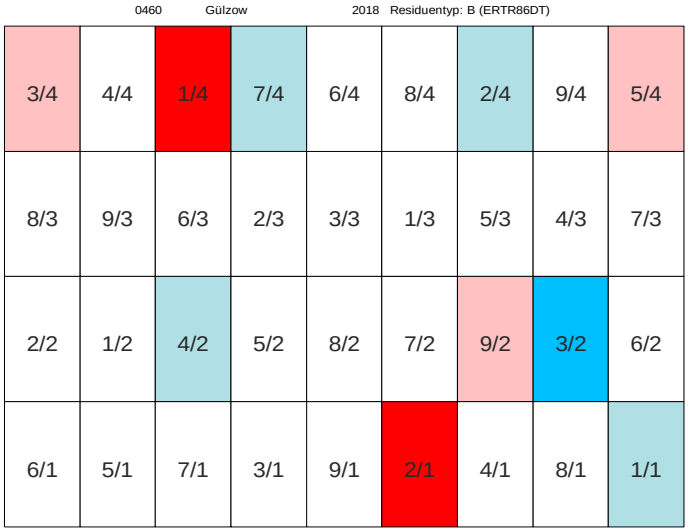


Figure 14: Illustration of plots in Gülzow. *Residuentyp B* illustrates results of blocking (formation of blocks with homogeneous trial units). Soil differences are adjusted and not visualised. For visualisation of soil difference see soil map (provided by WEGNER).

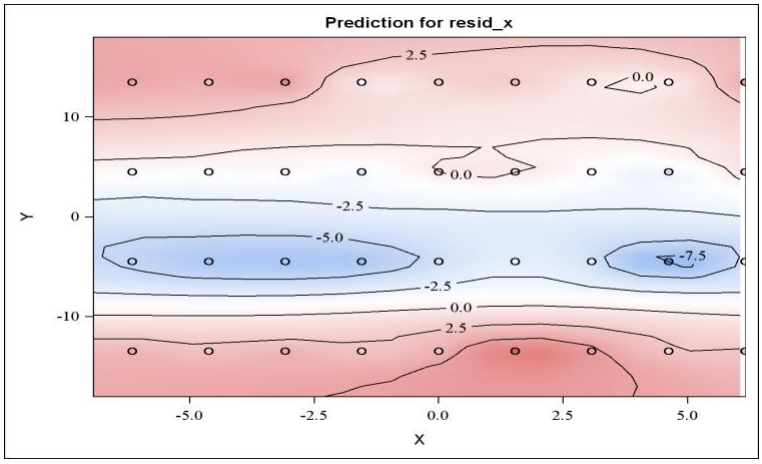


Figure 15: Soil map of Gülzow, illustrating soil differences. Soil map is based on residues (*Einzelwert-Ismean*) and *Autokorrelations-Modell (SPH).* Very positive residues are illustrated in red and very negative residues are illustrated in dark-blue (provided by WEGNER).