



VARIETY TESTING FOR ORGANIC FARMING: CURRENT STATUS AND PROBLEMS IN EUROPE

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Conventional varieties have been developed with the aim of combining high productivity and standardized product quality under high-input conditions. Two main areas apparent where organic farming system differs most significantly from conventional farming systems: the soil fertility management and the disease and pest management. The varieties often perform differently in different environments due to genotype-environment interactions, therefore it is important to evaluate characteristics of varieties in conventional as well as in organic farming systems. Currently there is not obtained full answer yet - is the differences between the conventional and the organic growing systems large enough to justify breeding and testing of varieties in both environments. If it is so the main step is the work out the necessity requirements for development organic VCU. Therefore the main problem currently is the lack of information on the relative performance of modern crop species and varieties under organic conditions.

I. THE MAIN OBJECTIVES AND GOALS FOR ORGANIC VCU (VALUE FOR CULTIVATION AND USE) TEST

In EU countries trading seeds of varieties of arable crops (e.g. cereals, potatoes) is regulated through EU directive 70/457/EEC. According to this directive only varieties which are on the official National Variety List, the European List or a list of another EU member state can be sold. In order to get on one of these lists a designated institution should test the variety. This is done in the VCU trial. **VCU is conducted under conventional management practices and important traits for organic farmers are not assessed.** Under such circumstances there is not possible determine which varieties are suitable for organic.

Lammerts van Bueren, E.T. and K.P. Wilbous. Organic Seed Production and Plant Breeding – strategies, problems and perspectives – Proceedings of ECO-PB 1st International symposium on organic seed production and plant breeding, Berlin, Germany, 21-22 November 2002, European Consortium for Organic Plant Breeding, Driebergen/Frankfurt: pp. 46-49.

The main scientific project which works with the subject of organic cereal VCU now is COST Action project SUSVAR (Sustainable low-input cereal production: required varietal characteristics and crop diversity) (www.cost860.dk).

The main subjects of project regarding to issues of organic VCU are:

- Development of organic protocols for organic and low input VCU.
- Comparison of conventional and organic VCU testing for ascertains the differences and the parallelism of organic and conventional VCU testing in order to reduce costs.
- Define agroecological zones (climat, growing conditions in a broader sense) and study possibility of setting up international VCU for similar agro-ecological zones.
- Develop participation of farmers and breeders in VCU testing.
- Dealing with authorities to develop organic or low input VCU testing.

http://cost860.dk/workinggroups/WG6/doc/Minutes_WG6_Roskilde.doc

Concerning variety testing of winter wheat under organic conditions Swiss authorities offer a new possibility. With beginning in autumn 2001 and with a scheduled re-evaluation after three years the actual variety tests are declared as an official variety testing program. This means that in the future winter wheat varieties can be accepted for the Swiss national variety catalogue by passing successfully the organic variety testing. This proceeding is unique in Europe.

Menzi M., Anders M.(2002) Variety tests with winter wheat and winter barley under organic agricultural conditions, Agrarforschung (Journal of Swiss Agricultural Research), 9, pp.60-64.
www.sar.admin.ch/zs/afo/en/inh_det.php?id=10-8k

II CURRENT SITUATION IN ORGANIC VCU TESTING SYSTEM IN EU

The Netherlands. Since 2000 organic spring wheat VCU on a project basis (with public funding). Protocol of conventional spring wheat was adapted for organic VCU and approved by Plant Variety Board. 15 varieties were tested on 3 organic locations and 1 conventional location in order to investigate correlations. Suitable varieties may be introduced on the official recommended list 2005. After 2004 organic VCU trials ideally will be integrated in conventional VCU trials. Organic location(s) will be necessary in order to evaluate yield and weed competitiveness.

Austria. Organic variety testing since 1987. Separate organic VCU for winter wheat and spring barley since 2001. Breeders choose between organic and conventional on the VCU application form. The costs for both are the same. The fees cover about 25 % of the costs.

For organic VCU use such characteristic as:

- weed suppression
- N use efficiency and yield stability
- Drought tolerance

Denmark. Official VCU for organic cereals has not been implemented. Since 2002 several trials (e.g. on undersowing, mechanical weed treatment) have been carried out to use as a basis for a protocol of organic variety testing implementing in 2005.

Hungary. Trials of spring barley, oats, winter wheat, triticale and rye are planted on 4 locations in 3 replications during 3 years (2004-2006).

France. Organic trials are coordinated by ITAB (www.itab.asso.fr). Data on 30 winter wheat varieties can be found on the website. Organic trials with triticale were started in 2003. The tested varieties are mainly listed material. There is no relation with the official VCU testing of GEVES (Study and Control Group for Varieties and Seeds). Official VCU trials of cereals are carried out with and without fungicides. ITCF carries out organic and low input trials.

Poland. There is not VCU variety testing for organic farming yet.

Sweden. The government provides funding for a project on organic variety testing. In the South of country in 2004 is carried out 4 experiments on 4 locations with winter wheat, triticale and rye and 4 organic trials with spring wheat but in the North has 6 experiments with spring barley and oats.

Switzerland. The Swiss catalogue of 2004 includes 5 varieties for organic use. In 2004 10 organic varieties is included in the VCU trials.

Minutes working group 6 (variety testing and certification) COST Action 860-SUSVAR

http://cost860.dk/workinggroups/WG6/doc/Minutes_WG6_Roskilde.doc

Latvia. Official organic VCU testing is started in 2004. Eighteen varieties of four crops: oat, spring barley, spring turnip rape and potato. 4 locations, 4 replications.

Estonia. Not official organic VCU testing. The organic farming tests for varieties are made to a small extent by some interested groups of people. In these trials the amount of used varieties is small.

Lithuania. The tests on evaluation varieties suitable for organic farming carried out by Lithuanian State Plant varieties testing Center in 6 locations for different plant species.

Juciuvienė S. (2005) Plant varieties testing in Lithuania, Proceedings of seminar “Environmental friendly food production system: requirements for plant breeding and seed production” May 31-June 3, 2005, Latvia, *in publishing*
Kalinina S., Jegorova V., Katanenko S. (2005) Results of Value for Cultivation and Use testing for field crops for organic farming in Latvia in 2004. Proceedings of seminar “Environmental friendly food production system: requirements for plant breeding and seed production” May 31-June 3, 2005, Latvia, *in publishing*

Lauk T., Loper I. (2005) Variety testing under conventional and organic farming conditions in Estonia. Proceedings of seminar “Environmental friendly food production system: requirements for plant breeding and seed production” May 31-June 3, 2005, Latvia, *in publishing*

Germany. For the registration of a variety in the German national list the Bundessortenamt (Federal Office of Plant Varieties) with head quarter in Hannover is the responsible institution.

On order to be registered 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). According to the valid legislation varieties from organic breeding and/or for organic farming have to fulfill the same requirements for registration as other varieties.

Since spring 2004 the Federal Office of Plant Varieties has a research assignment for the installation and/or improvement of VCU guidelines of winter wheat, spring barley and potato.

Winter wheat. Since 1999 a VCU trial series under organic conditions is run for winter wheat additionally to the normal trial series. The trials are carried out

- on 9 locations which are representative for organic farming
- one factorial with 4 repetitions per variety.
- no chemical treatment or mineral fertilizer may be applied.
- the seed for the trials is not treated.

Additional to the usual notifications the mass in the beginning and the groundcover as indication for the weed competitiveness are observed.

The quality examinations are done as usual (Kjeldahl, Zeleny, Hagberg, Rapid Mix Test, milling quality). Additionally the gluten content is observed.

The organic VCU testing for a variety is run parallel to the conventional VCU tests (in 2005 the series holds 21 varieties, 8 varieties in course of registration). At the end of the three years the results of both series form the basis for the decision on the registration.

Because the results from the conventional and the organic VCU tests match very well a different description on basis of the different testing of the registered varieties was not necessary. The over-year results from winter wheat, rye and potato trials showed that the varieties express the characteristics similarly under the different conditions. On basis of the results one can say that the results from conventional testing are suited to choose a variety for the organic production. Nevertheless an extra description will be made up if the necessity arises.

Potato. The VCU tests are carried out on organic fields. The trial is onefactorial with 3 repetitions per variety. No fungicides - also no treatment on copper basis shall be applied. No insecticides shall be applied but in case of a beetle problem a Neem-product may be used. The observation of the susceptibility to phytophthora has to be done weekly.

The tendency to break off the shoots in case of presprouted potatoes shall be observed but the guideline for the assessment still has to be developed.

Spring barley. In spring 2005 an organic VCU trial with spring barley will be started and carried out in 2005 and 2006. The guidelines will be discussed with the interested circles in the course of winter.

The valuable characteristics of a variety are described on basis of the VCU tests after the two or three years of testing and the description is basis for the registration and later publication in the Descriptive Variety List. After registration in the national list all newly registered varieties are taken in variety trials done by the different German federal states. The federal states also have organic trials but up to now the data base has not been broad enough to issue a special description on basis of those results.

Uta Schnock, BUNDESSORTENAMT, VCU testing for registration and VCU testing for organic farming in Germany Focus Finding Workshop of COST 860 SUSVAR on 11 - 13 October 2004, Witzenhausen, Germany

Denmark. The overall responsible for the VCU-testing in Denmark is the Danish Plant Directorate. Responsibility for the technical approach of VCU testing has been assigned to the Danish Institute of Agricultural Sciences, Department of Variety Testing. The premises of VCU field trial are Department of Variety testing, Danish agricultural Advisory Service and breeders-representatives.

The overall decisions of acceptance for Danish National List are based on evaluation of yield, resistance to diseases, growth characteristics and quality. Since 2002, department of Variety

Testing has been participating in the project “Characteristics of spring barley varieties for organic farming”. One of objective of this project is to identify combinations of plant characteristics required for a barley crop to be successful in organic growing systems and develop methodologies for measuring these characteristics. Throughout project it is intended to make a VCU-protocol for the testing of spring barley within organic system. Final testing of these developed protocols will take place in 2005, while final implementation for VCU-purpose is expected for sowing in spring 2006.

Description of testing of cereals for Danish National List. <http://intra.cost860.dk/WG6>
Characteristics of spring barley varieties for organic farming. <http://www.darcof.dk/research/darcofii/vi2.html>

III PROJECTS REGARDING TO ORGANIC VARIETY TRIALS

Choice of variety is more critical in organic situations than for conventional crops. Therefore it is important to carry out trials with selected varieties and crops under organic growing conditions in order to produce information and advice on the most appropriate variety choice for high quality production and marketing.

Louis Bolk Institute (the Netherlands)

COST ACTION 860- SUSVAR WG 6: Variety testing and certifications. Working Group Leader is Aart Osman (A.Osman@louisbolk.nl). The main goal is to develop guidelines for setting up VCU testing for organic and low input agriculture.
<http://www.cost860.dk/workinggroups/WG6/>

ECO-PB coordinated trials 2001/02

The board of ECO-PB agreed that the research institutes amongst ECO-PB’s organizations shall proceed with a coordinated programme of cereal variety trials. The common trials started in 2001 with winter wheat (bread qualities). The variety trials are set up comparable in four countries (Denmark, Unite Kingdom, France, Switzerland, Germany).
<http://www.ecopb.org/08/trials0102.html>

The EFRC (Elm Farm Research Center, UK) 2000-2004

Varieties and mixed varieties of triticale, wheat, barley and oats, both winter and spring, were included in the trials with the aim to understand how the stability of different species and varieties, are effected across site and season. The four year of the project, six farms sites, all of them well-established organic systems have been used for the trials.

Organic Cereal Varieties: The results of four years of Trials.
http://www.ecopb.org/08/cereal_research_note082004.pdf

Riso National Laboratory (Denmark)

- Characteristics of spring barley varieties for organic farming
<http://www.darcof.dk/research/darcofii/vi2.html>

DEFRA (UK) projects regarding to organic variety testing

- Varieties of field vegetables and potatoes for organic production and marketing (2004 – 2007)
- Collation and dissemination of information on the performance of vegetable and cereal varieties under organic and non-organic conditions (COSI) (2004-2007)
- Continuing development of grass and white clover variety testing systems to predict performance under conventional, low input and organic livestock production (2003-2006)

http://www2.defra.gov.uk/research/project_data/projects.asp?SCOPE=1&M=CFO&V=NIAB

National Institute of Agricultural Botany (UK)

Evaluation of cereal varieties suitable for organic farming system

www.niab.co.uk

FiBL (Federal Research Institute of Organic Agriculture) (Switzerland)

Wheat variety trials.

<http://www.fibl.ch/engl.html>

Swedish Agricultural University (Sweden)

Organic variety testing of cereals, peas, oil plants and potatoes.

Improvement of barley for ecological production.

<http://www.slu.se>

Research Station for Ecological Agriculture Partala (Finland)

Potato varieties in organic farming

Development of new farming systems, which substitute traditional farmin (the aim-to assess the suitability of new and old cultivars for organic farming)

<http://www.mtt.fi>

Ludwig-Bolzmann Institut für biologischen Landbau (Austria)

Comparison of conventional varieties and those bred for organic farming system

Department of Bio-diversity of Farm Animals (Austria)

Comparison of intensive and extensive cereal varieties under the conditions of biological agriculture

<http://www.agrobio.bmlf.gv.at/deutsch/wels/welsallg.htm>

IV NECESSARY TRAITS INCLUDED IN THE PROTOCOLS OF ORGANIC VCU

VCU research protocols for organic spring wheat varieties, which was recognized by the Dutch Commission for the List of Recommended Varieties in 2001.

Research site – Managed organically, in accordance with EU regulation 2092/91, for at least three years.

Seed – not chemical treated

Crop husbandry – according to organic farm management practice

Plant characteristics, which are not observed in conventional spring wheat VCU – recovery from mechanical harrowing, tillering, speed of closing the crop, canopy density, canopy stay green index, distance of ear-flag leaf, compactness of the ear, resistance against sprouting, black molds in the ear.

Evaluation baking quality – evaluation on whole wheat bread without artificial bread improvers.

Lammerts van Bueren, E.T. and K.P. Wilbous. Organic Seed Production and Plant Breeding – strategies, problems and perspectives – Proceedings of ECO-PB test International symposium on organic seed production and plant breeding, Berlin, Germany, 21-22 November 2002, European Consortium for Organic Plant Breeding, Driebergen/Frankfurt: pp. 46-49.

In Denmark a preliminary protocol concerning the technical aspects of organic barley testing was developed and refined in 2003 (http://www.okoforsk.dk/projekt/vi2/fs_barof.pdf). VCU protocols from 2004 are found on http://www.okoforsk.dk/projekt/vi2FSPLANER_oko04.pdf. The final evaluation is managed in 2005.

The following characteristics is used for varieties evaluation in the trials:

- **agronomical traits** – plant emergence, plant density spring, date of heading, straw length, lodging, breaking of straw, breaking of ear, maturity, reflectance, leaf area index;
- **disease, weed and grass clover assessment** – Powdery mildew, barley leaf rust, net blotch, scald, ramularia, species specific weed assessments, grass-clover assessment during/after harvest of cover crop;
- **yield and quality traits** – yield, protein content, starch content, specific weight, kernel weight, grading;

<http://www.okoforsk.dk/projekt/vi2/stat04.pdf>

<http://okoforsk.dk/projekt/vi2/sortsforsoeg.html>

An approach to organic breeding in the Netherlands by the Louis Bolk Instituut involves organic farmers and grain buyers directly. The core of the approach is the development of ideotypes. Ideotypes are lists of characteristics that farmers and grain buyers desire in their ideal variety. To develop an ideotype, the Loius Bolk Instituut organizes a field visit to variety trials with farmers and buyers, asking them to evaluate the varieties represented. These evaluations are input for further discussions by the breeders themselves where the final ideotype is developed. In the next step, various plant breeders are invited to send in varieties that fit the ideotype. These varieties are grown in variety trials in organic farmers' fields. These variety trials are visited with farmers, buyers and breeders, triggering further discussions in which selections are made and the breeding process continues. Finally, the varieties developed from this program will enter the European Union's official organic variety testing system.

When it comes to organic farming are all crop varieties created equal?

<http://www.umanitoba.ca/afs/fiw/020926.htm>

Before reaching the market all varieties of grassland go through a series of tests and it was the Value for Cultivation and Use (VCU) test. VCU trials play an important role in directing the forage grass and clover breeders by determining the type of varieties added to the UK National List. **Persistency** was the most highly valued trait for herbage seeds mixture (especially if also described as ground cover), followed by **total annual yield, early spring growth, digestibility, mid-season growth** and **heading date**. This accords with the current weightings for VCU decisions. Early spring growth, viewed by many as an important characteristic is currently given no weighting in grasses and only a low weighting in white clover. The most important characteristics for grazing and silage-organic are total yield, disease resistance, early spring growth, ground cover, heading date, digestibility, mid season growth, late season growth, persistence.

(Heather McCalman, Institute of Grassland and Environmental Research (IGER)

Plas Gogerddan, Aberystwyth, Ceredigion, SY23 3EB, UK, What do organic farmers want from herbage seeds?
<http://www.iger.bbsrc.ac.uk/Practice/GTT/OrganicFarmers.htm>)

With the design of the organic VCU the first question is raised: **which variety characteristics are wanted by the organic sector?**

Dutch researchers from Luis Bolk Institute with the help of farmers and traders created ideotype of organic spring wheat with the following characteristics:

- **Good baking quality** - Hagberg Falling number, Zeleny Value, Protein content, Specific Weight, Good grain yield.
- **Efficient use of (organic) manure.**
- **Reducing risk of diseases** – long stem, ear high above flag leaf, ear not too compact, last leaves green for the longest time possible.
- **Resistance against** - Yellow rust (*Puccinia striiformis*), Brown Rust (*Puccinia recondite*), leaf spot (*Septoria* spp), Mildew (*Erysiphe graminis*).
- **Supporting Weed Management** – good recovery from mechanical harrowing, good tillering, rapid closing of canopy, dense crop canopy.
- **Reducing risk at harvest** – stiff stem, early ripening, resistance against sprouting.

Lammerts van Bueren, E.T. and K.P. Wilbous. Organic Seed Production and Plant Breeding – strategies, problems and perspectives – Proceedings of ECO-PB 1st International symposium on organic seed production and plant breeding, Berlin, Germany, 21-22 November 2002, European Consortium for Organic Plant Breeding, Driebergen/Frankfurt: pp. 46-49.

At the ECO-PB coordinated trials 2001/2002 a series of core assessments that are equally carried out on each trial. There are a number of optional assessments that can be made deliberately. The following assessments for varieties of winter wheat were made: **plant emergence, plant survival over winter, shoot density, crop ground cover (5), weed ground cover, disease (stripe, brown rust, Septoria, fusarium, mildew), straw yield, lodging, earliness of ear emergence, distance from flag-leaf to ear, ear number, yield, grain qualitative characteristics (Hagberg falling Number, Protein content, Zeleny value, Hectoliter weight, baking test).**

<http://www.ecopb.org/08/trials0102.html>

Forum On Seed for a Sustainable Environment (FOSSE) paper No 1 one of the covered topics was about additional 'sustainable' VCU characteristics:

- **Growth habit for weed suppression** – prostrate early growth
- **Early vigour** – to outcompete weeds
- **Long straw** – to outcompete weeds
- **Tolerance of competition** – ability to tolerate non-crop plants that sustain beneficial insects
- **Suitability for late autumn sowing** – to avoid weed, pest and disease build up.

Changing the balance of VCU towards more sustainable qualities www.defra.gov.uk/plant/pvs/FOSSE/fosse02.pdf

The main objective of Department for Environment Food and Rural Affairs (DEFRA) (UK) project “Assessment of varietal characters required for sustainable agriculture” was to identify changes that could be introduced into the VCU system for cereals, oilseeds, pulses and potatoes, in the context of the projected development of sustainable agricultural practices. The system needs to facilitate delivery of an appropriate, possibly broader range of new varieties including those with 'sustainable' characters. The main objectives were:

- An assessment of relative variety performance under different levels of input for each crop, embracing both results from field studies and predicted responses based on current knowledge of physiology and performance.
- Identification of appropriate sustainability criteria and development of a method of assessment.
- Review with stakeholders of VCU characters in relation to identified sustainability criteria.
- Develop cost-effective proposals for revised protocols for VCU testing, facilitating assessment of all potential new varieties with the type of characters that are needed for current and sustainable systems. This will include an indication of characters to be assessed, both new and existing, with an evaluation of their contribution to sustainability criteria.

A broad specification of the research and trials programme that will be needed to determine the impact of proposed changes to current systems and the likely efficiency of those changes.

Assessment of varietal characters required for sustainable agriculture (2003)

http://www2.defra.gov.uk/research/project_data/More.asp?I=VS0128&SCOPE=0&M=CFO&V=NIAB

There can be significant genotype-environment interactions for some characteristics, it is important that the remaining trial sites are representative of the range of locations where the variety is likely to be grown.

Failure to identify those conditions under which a variety is likely to perform at its best would result in inappropriate variety recommendations.

The observations made on Value for Cultivation and Use characters under one management regime might not be relevant to other systems. The use of varieties with good resistance to pests and diseases is, for example, an essential element of Integrated Farming Management. The variety must also have a growth habit that can compete well with weeds or are suitable for mechanical weeding. Except for disease tolerance, such traits would not be considered under an intensive management system, which is a serious gap. It is also crucial to test yield performance under alternative management as this is one of the key factors determining variety acceptance by farmers.

(Angela Bush (2003) Review of UK National List (NL) and Plant Breeders Rights (PBR) Testing Services and Fees Structure, Department for Environment Food and Rural Affairs (DEFRA), UK www.snh.org.uk/pdfs/strategy/PS107-03.pdf)

V ECONOMIC ASPECTS AND PROBLEMS OF ORGANIC VCU

The economic aspects of VCU are an important constraint because the organic sector is also unable to bear the costs of a complete VCU system for all arable crops. This has to be taken into account when designing an organic VCU system.

Luis Bolk Institut and Arable Crop Research (PPO-AGV) began implementing the organic VCU in 2001. They compare organic VCU with testing the same varieties in conventional fields. This is to determine if conducting VCU on organic fields makes a difference and also whether a combination of organic and conventional VCU is possible. It could be that for some characteristics evaluating in a conventional or organic field gives the same results. In that case organic and conventional VCU could be combined.

Lammerts van Bueren, E.T. and K.P. Wilbous. Organic Seed Production and Plant Breeding – strategies, problems and perspectives – Proceedings of ECO-PB 1st International symposium on organic seed production and plant breeding, Berlin, Germany, 21-22 November 2002, European Consortium for Organic Plant Breeding, Driebergen/Frankfurt: pp. 46-49.

Difference between conventional and organic VCU. The organic sector is of the opinion that the conventional research on Value for Cultivation and Use (VCU) do not bring the best varieties for organic crop growing. The trials take place conventional conditions and researchers often pay less attention to the characteristics which can be of special importance to organic breeder.

In 2001 remarkable differences were seen between the trial fields, particularly with regard to disease pressure and lodging. On the organic field the diseases manifested themselves later, but mildew did not occur at all. Many of varieties, which did not have problems in the organic conditions regard to lodging, lodged on the conventional fields. The differences have their origin in a lower nitrogen input with the organic trials.

Aart Osman and Lubbert van den Brink. Results of first of official VCU trials in the Netherlands with spring wheat 2001. www.eco-pb.org/09/vcu_05_02.pdf

Comparing the organic vs conventional for most characteristics there is found a high correlation ($>0,85$), but for yield $0,73$ (LSD $0,01$)

Summary of presentation of participants COST 860, Michael Oberforster (Austria)
http://cost860.dk/workinggroups/WG6/doc/Minutes_WG6_Roskilde.doc

A comparison of two systems after 2 years showed that the yield in the low input system was 20-25 % lower, the plant length 7-10 cm shorter, the protein lower, the hectoliter weight similar and the quality 5-10 points lower (on a 1-200 scale) than in the conventional system.

Summary of presentation of participants COST860, Lukas Barth (Switzerland)
http://cost860.dk/workinggroups/WG6/doc/Minutes_WG6_Roskilde.doc

The main problems with organic Organic Variety Trials could be:

- organic variety trials have suffered from being too few in number of sites and years;
- a lack of consistency in design;
- a lack of scientific rigour in design and implementation relating to choice of site, particularly of from and position in the rotation and its management;
- unsatisfactory statistical treatments.

Organic Cereal Varieties: The results of four years of Trials. Technical Note. August 2004, (EFRC, UK).
http://www.ecopb.org/08/cereal_research_note082004.pdf