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Workshop on

Value for Cultivation and Use testing of organic cereal varieties
What are the key issues?

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Edited by F. Rey, L. Fontaine, A. Osman and J. Van Waes

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Introduction

Aart Osman, Johan Van Waes, Laurence Fontaine, Frederic Rey

These proceedings present the results of the workshop "Value for Cultivation and Use testing of organic cereal varieties" that was organised on 28 and 29 February 2008 in Brussels, Belgium, by Working Group Six (cereal variety testing and certification) of the research network SUSVAR (COST Action 860; www.cost860.dk) and the European Consortium on Organic Plant Breeding (ECO-PB; www.eco-pb.org). This workshop brought together invited plant breeders, members of organic institutes, officials of national variety testing institutes and staff of the European Commission with the aim to discuss key aspects related to the implementation of Value for Cultivation and Use (VCU) testing for organic agriculture. This document presents the abstracts of oral presentations and posters, as well as a summary of the discussions.

VCU testing is one of the steps required by the EU seed legislation for the obligatory registration of new varieties of arable crops (see the presentations of Dr. Foletto - DG SANCO and Dr. Van Waes - ILVO). VCU aims at only admitting new varieties to the market that are a "clear improvement' compared to the existing varieties. In order to test the suitability of new varieties for organic farmers, during the last decade a number of EU countries (e.g. Austria, Germany, Netherlands, Switzerland) have started to study the necessity to adapt the VCU protocol for cereals to the specific requirements of the organic sector. These needs include the evaluation of varieties for plant traits that are not regularly observed in VCU, but are of key importance for organic farmers, such as e.g. weed competitiveness and resistance to seed borne diseases, and conducting the trials in organic fields (see e.g. Levy et al., 2007). The status of organic VCU and the way it is implemented differs from country to country. Austria has adopted a specific VCU system for organic (see the presentation of Dr. Flamm – AGES), other countries, like Germany, are currently elaborating a new policy (see the presentation of Dr. Schnock - BSA), while in some countries it is still difficult to put this issue on the agenda.

A VCU system that also takes the needs of the organic sector into account is crucial for the further development of the organic sector. The absence of a procedure that makes it possible to register and market varieties, that are better suited to organic farming, may frustrate breeders who want to select for the organic sector. Indeed, for example in France, cereal breeder Lemaire Deffontaines, who started to select new lines for organic farmers, abandoned these efforts because it was not possible to release the varieties. The number of breeders that do invest in developing varieties for the organic sector is limited. This makes the decision of breeders to stop their efforts even more unfortunate.

Although the examples presented in this document show that the EU legislation is sufficiently flexible to allow specific organic VCU, the costs of having varieties tested is a major concern (see the abstract of Dr. Müller - Association of Bio-dynamic breeders). As the organic acreage still is relatively small, testing costs usually are not in proportion to the size of the seed market. Another issue discussed was the need to allow farmers to increase genetic diversity on their farm, like in the example of composite cross populations that was presented by Dr. Wolfe (Organic Research Center Elm Farm). While on the one hand governmental policies

encourage farmers to increase diversity, the current seed legislation impedes the marketing of varieties that are not uniform. Results of the discussions can be found in the final section of these proceedings.

The topics discussed are not only of relevance to the organic sector. Over the last years in Europe groups of consumers have emerged that are looking for more diverse and special foods with a better tastes and flavour or specific processing qualities. Examples are the increasing interest in regional products and the popularity of the Slow Food movement. For the farming community these developments offer opportunities to increase their income by producing specialties with an added value. To attend these consumer demands there is a need for a wider diversity of varieties. Like in the case of specific varieties for organic, regional varieties and varieties with special qualities will also be grown for a relatively small markets and hence the further development of such initiatives will face similar issues as discussed in this workshop.

Although originally not foreseen, the timing of this workshop coincided with an initiative of the European Commission to evaluate the existing seed laws. We hope that the results of this meeting also contribute to this exercise.

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Part I. Abstracts of oral presentations

European rules for registration of varieties on a national catalogue (and a recommended variety list) for cereals

Bruno Foletto
Unit E1 Biotechnology and Plant Health
DG Health and Consumer Protection
bruno.foletto@ec.europa.eu
Website: http://ec.europa.eu/comm/dgs/health_consumer/index_en.htm

EU legislation on the marketing of seed and propagating material

The EU legislation on the marketing of seed and propagating material covers the following groups of species: Agricultural species, Vegetable plants, Ornamentals, Fruit plants, Vine and Forestry plants.
The general aims for adopting an EU framework legislation are:

- The adoption of rigorous conditions in selecting those varieties which can be the on the market will bring profitable results in terms of productivity,
- The adoption of a uniform certification scheme will facilitate the trades throughout the Community and will provide more opportunities to farmers,
- The implementation of a unified system of certification will give the user of seed guarantees in respect of varietal identity and purity, germination capacity and specific purity as well as guaranteeing the seed bought from a plant health point of view.

As regards cereals two basic Directives cover the area:

- Council Directive 66/402/EEC of 14 June 1966 on the marketing of cereal seed
- Council Directive 2002/53/EC of 13 June 2002 on the common catalogue of varieties of agricultural plant species

The key elements of the seed marketing Directives are the listing of varieties to permit their marketing and the seed certification to permit their multiplication.
In the case of a genetically modified variety within the meaning of Article 2(1) and (2) of Directive 2001/18/EC, the variety shall be accepted only if all appropriate measures have been taken to avoid adverse effects on human health and the environment.
When material derived from a plant variety is intended to be used in food falling within the scope of Article 3, or in feed falling within the scope of Article 15 of Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed (1), the variety shall be accepted only if it has been approved in accordance with that Regulation.

In the interest of conserving plant genetic resources, the Member States may depart from the acceptance criteria set out by the relevant Directive in so far as specific conditions are established in accordance with the Comitology procedure considering the requirements set out by the Directive.

Member States must ensure that a variety is accepted only if it is **distinct, stable** and sufficiently **uniform.** n the case of agricultural plant species, the variety must be of satisfactory **value for cultivation and use**.
A variety shall be regarded as distinct if, whatever the origin, artificial or natural, of the initial variation from which it has resulted, it is clearly distinguishable on one or more important

characteristics from any other variety known in the Community. The characteristics of a variety must be capable of precise recognition and precise definition.
A variety shall be regarded as stable if, after successive propagation or multiplications or at the end of each cycle (where the breeder has defined a particular cycle of propagation or multiplications) it remains true to the description of its essential characteristics.
A variety shall be regarded as sufficiently 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.
The value of a variety for cultivation or use shall be regarded as satisfactory 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.

Member States shall provide that the acceptance of varieties be based on the results of official examinations, particularly growing trials, covering a sufficient number of characteristics for the variety to be described. The methods used for determining characteristics must be exact and reliable.
In order to establish distinctness, the growing trials shall include at least the available comparable varieties which are varieties known in the Community within the meaning of Article 5(1).
The following shall be fixed in accordance with the Comitology procedure, account being taken of current scientific and technical knowledge:

- the characteristics to be covered as a minimum by the examinations of the various species;
- the minimum requirements for carrying out the examination;
- the necessary arrangements for the growing trials to be carried out with a view to assessing the value for cultivation or use.

These arrangements may determine:

- the procedures and conditions under which all or several Member States may agree to include in the growing trials, by way of administrative assistance, varieties for which a request for acceptance has been introduced in another Member State,
- the terms of cooperation between the authorities of the participating Member States,
- the impact of the results of the growing trials,
- the standards relating to information on growing trials for assessment of the value for cultivation or use.

The characteristics as regards the examination of the value for cultivation or use are:

- Yield,
- Resistance to harmful organisms,
- Behaviour with respect to the factors in physical environment,
- Quality characteristics.

The VCU variety testing for agricultural crops in an European context

Johan Van Waes
Ministry of the Flemish Community- Department Agriculture & Fisheries
Institute for Agricultural and Fisheries Research - Direction
Burg. Van Gansberghelaan 96 box 1 9820 Merelbeke Belgium
johan.vanwaes@ilvo.vlaanderen.be

Key-words: variety testing, maize, recommended list, VCU-tests

Abstract

In the European Community, a new variety of an agricultural crop must submit official trials for DUS (Distinctness, Uniformity, Stability) and VCU (Value for Cultivation and Use) before registration on a national catalogue and commercialisation of seeds. In Europe the VCU trials are organised at national level while for a lot of crops DUS-tests are organised by bilateral agreements. The evaluation criteria for the VCU- tests are based on the most important quantitative and qualitative characteristics. New varieties were compared to standard varieties. A new variety can also be registered for a specific characteristic.

The registration of new varieties each year and the maintenance on the catalogue for at least 10 years results in a catalogue with many varieties after 10 years. A great number makes it impossible for the farmers to make a good choice. For this reason farmers need a brochure with neutral data in which all varieties are compared; the so-called descriptive and recommended variety list.

A well-considered variety choice is an important factor for the cost-effectiveness of the crops. Incorporation of new varieties in the culture plan is necessary because the best varieties stay at maximum 3 to 4 years at the top.

In this article different aspects of the VCU – testing procedure and the principles of the recommended variety list are presented. Furthermore an analysis of the VCU-system with evaluation of the costs vs. profits is presented. Maize (silage and corn) is chosen as an example crop.

Introduction -Variety research legislation in Europe

In the European Community, a new variety of an agricultural crop must submit official trials for DUS (Distinctness, Uniformity, Stability) and VCU (Value for Cultivation and Use) before commercialisation. The guidelines for those tests are summarized in the European directive 70/457/EU – 1970, revised 2002/53/EU –2002 (1).The aim of these directives is on one hand to protect breeding companies (breeders right) and on the other hand to protect the farmers (only varieties which are better than existing ones). A sufficient VCU-value is necessary for admission on a national variety catalogue. National admission means that from that moment the variety can be multiplied (seed production) and be marketed. With the recently adapted European regulation, once a variety is admitted onto the List of one Member State, it can be added to the European catalogue after a few months. This EU-registration offers the potential to market the variety throughout the whole European community.

Procedure for testing new varieties in Belgium

Opening of dossier

A breeder, or his representative, asks the Ministry of Agriculture (both regions) to test the new variety. A dossier is opened and the Technical Interregional Working Group (TIW) proposes to evaluate the variety in several trials. The breeder has to pay for each candidate variety to evaluate.

New varieties are compared with standard (control) varieties for the most important characteristics. Standard varieties are the best performing (actual) varieties of the national catalogue. There is a separate trial system for silage and grain maize. The testing cycle is at least two years with seven locations per year. Each year about 75 new silage and 25 new grain maize varieties are tested. A new variety can also additionally be tested for a specific characteristic. This characteristic has to be specified in the dossier.

At the end of each year a report for the TIW for the National Variety Catalogue is prepared. The TIW provides advice to the Minister of Agriculture. Based on this advice the Minister (of both regions) decides if new varieties should be admitted to the National Variety Catalogue.

Preparation of the seeds and sowing density

The general principle is to start with non chemically treated seeds, delivered by the breeders. All varieties are treated with the same products, a fungicide and a product to prevent bird damage. The sowing density is based on the germination percentage in a cold test (2). In general the sowing density is 15 % higher than the assumed plant density.

Organisation and execution of the VCU-trials

The VCU-trials are set up by the Section of Plant Variety Research of the ILVO - Plant Unit for all the trials in Flanders and the Department Crop Production (DPV-CRA-Gembloux) for the trials in Wallonia. The VCU –trials are situated in different agricultural regions in Belgium: sandy soils, the Polders, the Kempen, sandy-loam and loam soils, the Condroz.

Plant density

To attain the assumed plant density, a thinning takes place at the 2-3 leaf stage. For silage grain maize, the density is 100.000 and 90.000 plants per ha.

Evaluated characteristics during the growing season, just before and at harvest

During the growing season the following characteristics are evaluated: early vigour, flowering date, plant height (length of the total plant), and height of implantation of the ears.

Just before harvest the following observations are carried out: counting percentage of lodged plants and/or percentage of plants affected by stalk rot.

At harvest the fresh weight of the total plant (silage) or grains (grain maize) is noted per plot (3 replications per variety). A representative sample of 1.5 to 2 kg fresh material is taken to determine the percentage of dry matter.

Evaluated characteristics in the laboratory

After drying for at least 3 days at 70°C the samples were weighted again. The dry matter content of the total plant (silage) or grains (grain maize) is calculated from the fresh and dry weight. The samples for silage maize are grinded (sieve 1 mm) and the grinded material is used for the quality analyses (digestibility and starch).

Validity of the trials

The validity of the trials is based on the regularity in the field and on a statistical analysis of the parameters for yield and for dry matter.
The regularity in the field is mainly based on the plant density. Furthermore, growing conditions, for example problems of drought during the growing season, can have a negative influence on the regularity.
The statistical analysis of the yield parameters is done with the SPSS-software. Only trials with a low variation coefficient (below 8 % for yield and 5 % for dry matter) were maintained.

Evaluation system and conditions for admission

An index system, based on the most important quantitative and qualitative characteristics, is used. New varieties are compared with the 4 best standard varieties, taken out of 8 potential standards. At the beginning of the testing period, the criteria and the potential standard varieties are fixed. They can not be changed during the testing period. However, each year new varieties are introduced for the trials and at that time the standard varieties can change. These are generally the best recently admitted varieties. So the level for judging new varieties increases slightly every year. Furthermore a new variety can also be registered for a specific characteristic.
The selection procedure for new varieties for admission to the national catalogue is a step by step approach. On average, approximately 50 % of the varieties are refused for the second year (too low agronomical value). A new variety must be better than the average of the four best standard varieties for the total of all agronomical characteristics in the index. On average 10 % of the new varieties were admitted; this means about 10 varieties per year. Consequently the selection procedure is severe. A variety is registered for 10 years; it is possible to extend for 5 years if the breeder or his representative can prove that the variety is still cultivated.

Costs vs. profits of VCU –research

The aim of the VCU-tests is to predict the agronomical value of a new variety in comparison with standard varieties and this on a neutral and reliable way. Therefore a high number of trials (locations/years) are necessary which results in high experimental costs. These costs are partly paid by the Government (so indirectly by the taxpayer and the farmers in generally) and partly by the breeders. On the other hand only the best varieties are registered and recommended. Better varieties in the market offer possibilities for higher income for the farmers. Comparing the costs for a well-structured VCU-research with the expected profits results in strong differences between the crops. The most important factors, explaining these differences are: area of the crop, mechanisation of the variety testing (especially at harvest), number and type of analyses, number of varieties in the trials.

Variety research and interaction with agricultural practice and breeding

The progress in agriculture is due to: 1° better cultivation techniques (including seed quality), 2° selection of varieties with a higher potential (yield, quality, resistance to diseases) and 3° the interaction between 1° and 2°.
Variety research has a close interaction with agricultural practice and breeding. The evaluation criteria are based on the most important characteristics for agricultural practice. On the basis of criteria for release of new varieties, variety research can contribute to a sustainable and organic agriculture and/or anticipate new situations or be ahead of new quality criteria. New research/evaluation areas for introduction of new varieties for maize are:

lower input of fertilisers and herbicides (better early vigour), organic agriculture, cold tolerance in spring, quality characteristics and disease resistance. Before incorporation of new evaluation criteria in national listing, their impact on variety release has to be studied.

Necessity for a descriptive and recommended list

The registration of new varieties each year (± 10 per year) and the maintenance on the catalogue for at least 10 years results in a catalogue with at least 100 varieties after 10 years. This great number makes it impossible for the farmers to make a good choice for their conditions. For this reason, farmers need a brochure with neutral data in which all varieties are compared against each other. This document has been available for more than 15 years in Belgium; the so-called descriptive and recommended variety list. The research behind this document is one of the priorities of the variety research unit at ILVO(3). The information in this document is based on results from official variety trials in at least three testing years with 6 to 7 trials per year.
The results of all varieties the Belgian catalogue are presented and information on both new and old varieties can easily be compared.
Before varieties can be recommended, they must have a good score for the most important agronomical characteristics. There is a particular need for a recommended list for forage crops because the farmers can not estimate yield and quality for these crops when compared to cash crops (cereals, potatoes, sugar beets). The information in the recommended list is the only neutral basis for comparison of yield and quality for forage crops.

Evolution

Why must farmers regularly incorporate new varieties in the growing plan? The reason is that the best varieties only stay at the top of the list for a maximum of 3 to 4 years. So a change to new varieties is necessary to exploit the profits that can be made from progress in breeding.
Based on the results of the period 1989 – 2007 the evolution for several parameters was calculated. For this purpose the average of the 5 best varieties for yield per year was taken.
The increase for silage maize per year is: total dry matter yield: 0.85 % (rel.); total digestible organic dry matter yield: 1.2 % (rel.); dry matter content of the total plant: 0.8 % (rel.); resistance to lodging (scale 1-9): from 6.9 to 8.5; resistance for stalk rot (scale 1-9): from 7.0 to 8.9 .
The increase for grain maize per year is: grain yield: 2.8 % (rel.) ; dry matter content of the grains: 0.4 % (rel.); resistance to lodging (scale 1-9): from 7.0 to 8.2; resistance for stalk rot (scale 1-9): from 7.2 to 8.4 .
This evolution was due to progress in breeding; cultivation techniques were not changed during this period (4).

Variety choice at farm level

Before making a choice between the varieties of the recommended list at farm level, the following factors have to be taken into consideration: number of ha available for maize culture, type of live stock, availability of other forage crops, type of soil, ploughing and sowing date, field conditions at harvest and utilization of the maize (silage, grain, double use).
The best recommended varieties have a high performance capacity. This can only be attained if all other factors are optimal (choice of the field, fertilization, weed control, etc.).

Conclusion

In Belgium we have a wide official variety testing system to evaluate new types in comparison with the best standard varieties.
The criteria for evaluation are severe but this is in the farmers favour. Only the best varieties are admitted on the national catalogue. The average for maize is 10 %.
The evaluation criteria are based on the most important characteristics agricultural practice but a variety can also be registered for a specific character. New tendencies or shift in practice are translated into new evaluation criteria, so that the new admitted varieties will be adapted for specific (exploitation) conditions.
A well-structured variety testing system results in high experimental costs. By registering every year varieties with a higher performance farmers can attain a higher income.
For an informed variety choice, it is appropriate to use the descriptive and recommended list. This document compares data for all varieties on the Belgium catalogue. The data presented on the recommended list are based on the results of a wide testing network based on at least three years. Recommended varieties can be introduced in the growing plan without taken a great deal of risks.
A well-considered variety choice is an important factor for the cost-effectiveness of maize growing. Incorporation of new maize varieties in the culture plan is necessary because the best varieties only remain at the top of the recommended list for maximum 3 to 4 years before their agronomic performance is overtaken by new ones.

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Experiences with cereal variety testing under organic farming conditions in Austria

Clemens Flamm
Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH (AGES), Spargelfeldstraße 191, A-1226 Wien

Keywords: Variety testing, VCU, organic farming

Introduction

In Austria the organic farming has increased since the early 1990s. Especially between 2002 and 2005 many enterprises in the arable farm land changed from conventional to ecological farming. The total area cultivated under ecological conditions represented 371 000 ha (16 % of the agricultural area) in 2007. Some crop species are cultivated nearly exclusively under organic conditions (spelt wheat 81.4 %) and others at a high percentage (field beans 46.4 %, field peas 26.9 %, rye 24.2 %, oat 20.0 % and triticale 15.5 %). However, measured in hectares wheat stays the most cultivated crop in ecological farming (23 249 ha; 8.6 %).
In the beginnings organic farmers relied on untreated conventional seed. The EU regulation 2092/91 forced organic farmers to use organically produced seeds if possible. This was a reason for the rise of voices for distinct breeding programmes and special adapted varieties for the organic farming.
While many characters like disease resistance and some quality parameters are highly correlated between conventional and ecologic farming, yield (grading >2.5), ripening date and neck breakage are only moderately correlated between these two systems. The acceptance of results obtained out of conventional trails among the ecological farmers is very low in Austria.

Austrian VCU-testing under ecological conditions

The Austrian official VCU testing reacted to these circumstances in 2001/02 with the implementation of a VCU testing under ecological conditions with a separate assortment on winter wheat and spring barley. Additionally other crops started to be tested with the same assortment at additional organic sites in the following years. Thereby varieties suitable for organic farming can be recommended.
In 2007/08 field peas and potatoes are tested additionally to all cereals (except durum wheat and maize) under ecological conditions in Austria. Concerning the testing of a separate assortment of winter wheat and spring barley, the interest of the breeders has changed during the last years. In 2004 fifteen new varieties of winter wheat and 9 varieties of spring barley were tested in the organic trials in order to receive the registration. In 2008 still 9 varieties of winter wheat but none of spring barley are tested. Possible reasons for the decreasing breeders' interest regarding spring barley may be the lower area cultivated and the smaller sale of organic seeds. As some feeding barleys for the ecologic agriculture had been released in the last few years the requirements are satisfied for the moment. The market for ecological produced malting barley is too small. That is the reason for missing breeders' efforts in this direction until now. By contrast special breeding programs exist for winter wheat in Austria and each breeder conducts ecological sites in order to select genotypes adapted to the ecological farming.
Nevertheless, some varieties have been registered exclusively based on results of organic farming: Winter wheat: Aurolus and Pireneo (2004), Stefanus (2005), Bitop, Indigo and Eriwan (2006) and Blasius (2007). Spring barley: Armada (2006) and Vienna (2007).

Additional characters are collected in the ecological VCU trials. Concerning weed competitiveness the canopy height is measured twice during stem elongation, the crop cover is estimated on different stages, the leaf inclination is estimated and the photosynthetic active radiation as well as the leaf area index is measured by the Sun Scan Canopy Analyses System. These and other results are published in the "Austrian Description List of Varieties".
Furthermore the nutrient efficiency of nitrogen is evaluated and the bread making quality of wheat varieties with low protein level is observed. In special trials with artificial infection the resistance of winter wheat varieties against common bunt (*Tilletia caries*) is elevated.

Conclusions

The ecological agriculture reached a certain amount of importance (16 % of the agricultural area) in Austria. This area may still increase in the next few years. Therefore it was important to adapt the VCU testing in implementing a testing under ecological conditions. A special VCU testing with separate assortment exists for winter wheat and spring barley. Furthermore additional ecological sites for other species were established.
Even though the interest of the breeders for testing new spring barley varieties decreased, these trials will not be abandoned in the nearer future, especially if new varieties will be applied next year.

VCU testing for acceptance in the National List and VCU testing under organic conditions in Germany

Results of methodical examinations with winter wheat and spring barley

Uta Schnock
Bundessortenamt, Osterfelddamm 80, 30627 Hannover, Germany,
uta.schnock@bundessortenamt.de

Abstract

Over the last years the importance of organic production in German agriculture has increased. For the procedure of variety testing for acceptance in the National List it is important to know whether varieties for organic production have to be trialled under organic conditions and according to specific technical guidelines. In 1999 the Federal Office of Plant Varieties (Bundessortenamt) launched a special trial series to test winter wheat varieties under organic conditions. In 2005 and 2006 additional research on the subject of testing varieties for organic production was carried out for winter wheat, spring barley and potato.

Before starting the research project the Federal Office of Plant Varieties 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 final report on the research project will be published in spring 2008. In the SUSVAR workshop the Federal Office of Plant Varieties will give a brief summary of the results and conclusions.

In general the comparison of the results from the VCU trial series of winter wheat, spring barley and potato under organic and conventional conditions 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. There is only one exception from this general statement. The results show that the baking quality of winter wheat varieties for organic production should be assessed on the basis of harvested material from organic production.

Genetically diverse wheat populations: their performance and use

Martin S Wolfe
The Organic Research Centre, Wakelyns Agroforestry,
Metfield Lane, Fressingfield, Eye, Suffolk, IP21 5SD, UK.
wolfe@wakelyns.demon.co.uk

Introduction

Rapidly increasing global climate change will amplify variability in crop performance in unpredictable ways in all types of farming. Options for dealing with such changes will be limited by the increasing costs of oil-based inputs, both fuel and chemicals.
For these reasons, we started a programme of population breeding in wheat based on Suneson's (1956) 'evolutionary breeding' in barley (Phillips & Wolfe, 2005; see also Goldringer *et al.*, 2006) in our Defra funded Wheat Breeding project. The principle is to inter-cross in all combinations a number of varieties with different useful characteristics to generate a complex segregating population. This is then exposed to natural selection at field sites to allow adaptation. The objective is to generate a reservoir of genetic variation that can buffer the crop against a wide range of environmental variation, more than would be possible from pedigree line varieties, or from physical mixtures based on single genotypes.
The programme is based on twenty parent varieties that have expressed high yield and/or quality (bread-making) potential over many years and large areas, or that have contributed significantly to the pedigrees of such varieties. Field trials from 2004 to 2007 generated data on the performance of the parent varieties, their mixtures and their populations.
The outcomes of the trials are sufficiently promising to justify a second project (Defra funded Wheat Breeding LINK) aimed towards gaining more practical experience by using the populations with different farmers in different environments. This leads on to the need to investigate the development of a legal framework for the registration and marketing of these populations. Such a framework should account for the contributions of both breeders and farmers to the performance of the populations.

Materials and methods

The F2 progeny from the original crosses were divided into three groups, Yield (Y), Quality (Q) and Yield/Quality (YQ), with a further set that included hybrids with four naturally-occurring male sterile genotypes. The Y populations were based on the nine varieties, Bezostaya, Buchan, Claire, Deben, HTL (High Tiller Line), Norman, Option, Tanker and Wembley, crossed in all combinations. The Q populations were based on the twelve varieties, Bezostaya, Cadenza, Hereward, Maris Widgeon, Mercia, Monopol, Pastiche, Renan, Renesansa, Soissons, Spark and Thatcher, also in a half diallel. The YQ populations were derived from all possible intercrosses between the Y and the Q parents. Controls were provided by the parent varieties and by physical mixtures of the relevant parents.
The populations, mixtures and parents were planted in randomised block field trials in the autumn of 2004, 2005 and 2006 at four sites in England. The sites comprised two organic (Sheepdrove, Berkshire and Wakelyns, Suffolk) and two non-organic (Metfield, Suffolk and Morley, Norfolk) sites. Each subsequent season, seed was harvested from the populations and mixtures and re-sown. In addition, some samples of populations were switched between sites each year to increase the range of selection on them.

Results

Performance of the populations, without or with male sterility, and the mixtures was compared with the relevant parent varieties both for yield and yield stability (Table 1, 2). Although the yield gains from the populations and mixtures are relatively modest for the three years (Table 1), they are consistent, with the larger gains tending to occur under organic conditions, as expected.

A further trend, which requires confirmation, is that under non-organic conditions, the mixtures tended to perform slightly better than the populations. This was reversed under organic conditions, with useful gains more evident from the populations. We assume that this difference under organic conditions was due to the greater genetic diversity in the populations compared with the mixtures. Under non-organic conditions, it may be that the amount of genetic variation in the populations is excessive in the sense that many genotypes fail to make a positive contribution in the more controlled non-organic environment.

With one exception (Q Organic, Table 2), the physical mixtures of varieties tended to be less stable (higher standard deviations) than the means of the relevant parents. The populations, on the other hand, tended to be as stable or more so than the means of the parents, particularly the YQ populations, which contain the largest number of parents and therefore the most crosses (93).

Some samples of the YQ population were exchanged between sites at the end of each year, either within or between farming systems (organic or non-organic).Where the exchange involved different farming systems, there was no significant change in yield in either direction. However, when populations were exchanged within a system there was a trend towards increasing yield in all cases. Within non-organic systems, the yield increased from 96% to 105% of the parent mean after three years whereas in organic systems, the yield increased from 97% to 118% of the parent mean.

Table 1. Mean yields for three years of the Y, Q and YQ populations, without or with male sterility, and the mixtures, relative to the appropriate parent means. Values of less than 3% above or below 100 are unlikely to be significant.

	Non-Organic			**Organic**		
	Y	**Q**	**YQ**	**Y**	**Q**	**YQ**
Population	103	103	101	102	103	109
Population with male sterility	101	99	100	107	105	104
Mixture	105	104	103	100	105	105

Table 2. Standard deviations (for three years) of the Y, Q and YQ populations, without or with male sterility, and the mixtures, relative to the appropriate parent means.

	Non-Organic			**Organic**		
	Y	**Q**	**YQ**	**Y**	**Q**	**YQ**
Population	101	102	49	111	104	63
Population with male sterility	87	185	85	80	116	79
Mixture	127	110	111	146	72	101

Discussion

In broad terms, the trials confirmed the hypothesis that composite cross populations of a range of wheat varieties, together with mixtures of the same varieties, should perform at least as well if not better than the means of the varieties involved, grown as pure stands. In practice there was a consistent improvement in yield, particularly for populations that were exposed to more than one site within a farming system. Furthermore, the mixtures and particularly the populations were stable in performance, tracking the yields of the relevant parent means. From previous work (Phillips and Wolfe, 2005), we would expect these advantages to improve over time, with further adaptation. In summary, for the risk averse farmer (and particularly the organic farmer), the use of these populations and mixtures should present a more practical and safe strategy than growing the whole range of parent varieties. Recent data from quality tests indicate that the quality populations may be more stable in quality than modern standards and less dependent on high nitrogen inputs.

However, farm use of these populations raises several questions. First, what happens if the future does present increasing environmental variation? In our view, the populations would still provide the best strategy for risk avoidance, based on their inherent genetic variation and their observed performance when grown at different sites. This is confirmed from the observation that a sample of the YQ population grown in Hungary produced a low yield in the first year because the severe winter conditions killed a considerable number of plants. However, the survivors were planted again in Hungary in the following autumn grew on to yield significantly more than the local control varieties.

A second question relates to the detailed management of the populations. So far, they have not been subjected to any form of imposed selection. This will change from 2008 with a comparison of the effects of no direct selection versus hand selection against 'poor' genotypes versus mass selection against excessive height and small grains. Whether or not such 'interference' proves helpful or not will probably depend on the severity of the applied selection rather than the particular form of selection.

A third question relates to the range of characteristics currently available in the populations. The parents used represent a wide range of successful genotypes from the Atlantic coast region of Europe. However, these genotypes gained their success over what will soon be recognised as a narrow range of environments as climate change develops. For the long term, we believe it is necessary to develop populations based on much wider genetic variation. In this context Kovacs (pers. comm.) suggests developing new lines of the parents and relatives of bread wheat which could then be inter-crossed to produce 'new' species and lines to form novel composite crosses. In our view, this approach merits serious consideration.

Application in commercial use

If such populations are to be used in practice, it is clear that they would not fit into the current legislative system for registration of plant varieties since they are designed, effectively, to operate in the opposite direction from the needs of the DUS system. Their performance across different environments depends on rapid shifts in their genetic complexity and constitution: there are, deliberately, no constant, stable or unique defining features. Consequently, if such an approach is considered to have potential value in a future of rapid environmental change, then we need to develop an alternative system for their legally defined use in practice to provide security for both the breeder and the farmer.

In this context, we have been discussing with the appropriate officials in the UK a simple alternative to DUS, which would be a register of traceability, together with VCU information. From such a register, any purchaser of seed would know: which parents were incorporated in the population, and when, how that incorporation was achieved and the environments to which the population had been subjected during its evolution.

There would need to be a minimum size of seed lot (25kg should be more than adequate) to avoid genetic drift, and an assurance that each crop had been generated from that minimum of 25kg. Since the full range of genetic diversity in a population develops through segregation at the same time as the original multiplication of the seed, it may be appropriate not to release such seed lots until the F7 generation, as a standard procedure.

Breeders, farmers or others may wish to add new crosses or varieties to update a particular population. This would change the designation of that population. Such modification would need to be recorded if the new population were to be sold or otherwise distributed.

A register of seed multipliers might be needed to reassure both breeders and producers of the quality of the material. Normal seed production regulations would also need to be applied.

The rights of breeders and farmers

The populations are, of course, modified in each growing season whether the grower is a breeder or a farmer, and irrespective of whether or not there is any form of imposed selection. Indeed, it can be argued that even if a population sample is held in store for one season, it will represent a different selection potential against a new environment than a sample of the same population which had not been stored. In other words, although the breeder may have a primary function in generating a population in the first place, subsequent development of the population may be regarded equally as a function of the farmer. These different activities need to be recognised in relation to rights.

In this sense, the major role of the breeder could be recognised by a licence for initial production of a particular population and the right to charge a royalty fee for *initial* cultivation of that population (e.g. for the F7 only, or for a later generation to allow for the breeder's *initial* seed multiplication).

One question would be whether the royalty fee for initial cultivation should reflect the type of population, number of parents, number of listed parents, and so on. This would probably be difficult to resolve because of the endless forms of population that are possible and easily generated. The simplest approach would be, therefore, an agreed flat rate. This rate should also reflect the fact that populations are considerably cheaper to generate, release and maintain than pedigree lines.

Following the initial release and royalty payment, there would be different views about the subsequent fee levels that might be set, ranging from the farm-saved seed level, to provide 'fair play' for the breeder, to some level of fee that should be payable to the farmer rather than to the breeder. Resolution of this difference might be impossibly difficult to negotiate. The simplest option might be to avoid the difficulty by agreeing to no extra charge in either direction in generations subsequent to the initial release, other than for the normal costs of seed production and a possible premium for the perceived value of different populations.

Because of the urgency, scale and unpredictability of likely environmental changes, we feel that major changes in the scale and methods of use of biodiversity are essential in contributing to the security of food production. Inevitably, this will need major changes in all of the ways in which the resulting crops are produced.

Acknowledgements

Thanks to Defra, John Innes Centre and our collaborating farmers.

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Part II. Poster presentations

Requirements of organic cereal breeders for VCU testing in Germany

Karl-Josef Mueller
Association of Bio-Dynamic Plant Breeders, Darzau Hof 1, 29490 Neu Darchau, Germany, Fon: +49-5853-1397, www.abdp.org

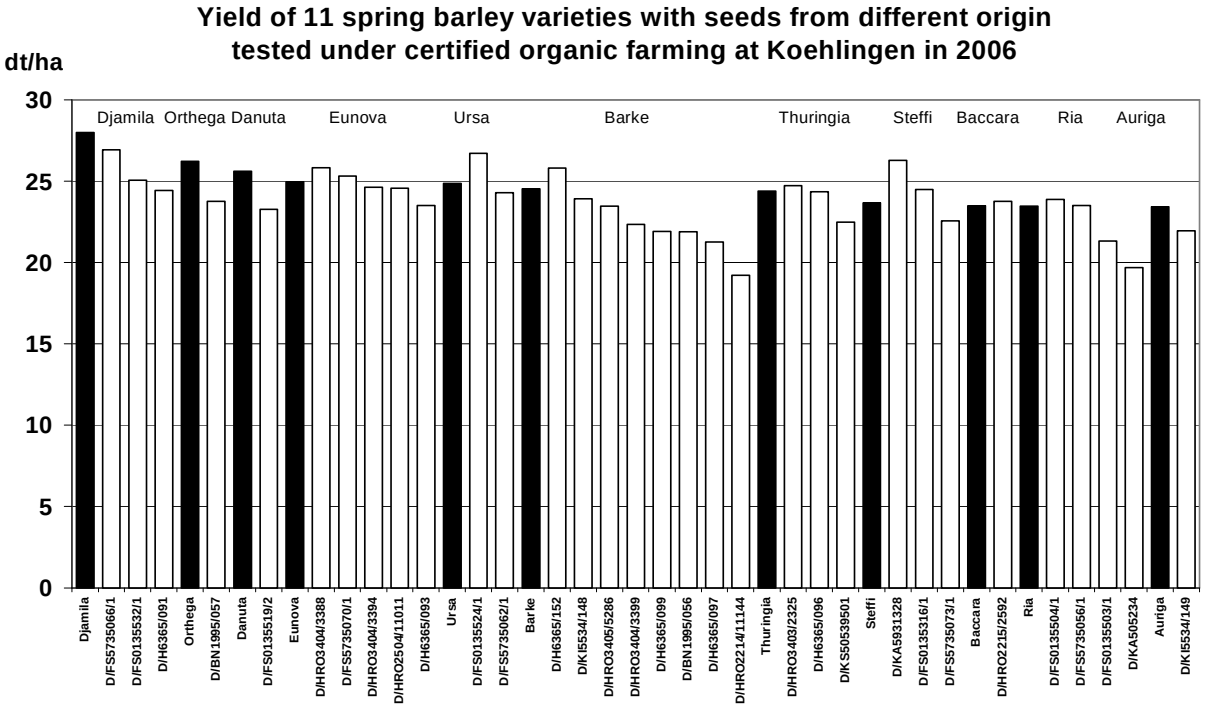
If an organic breeder in Germany wants to release a winter wheat variety, which was bred for organic farming of course, it has to be tested under conventional high input growing conditions for 11.605 €. Additional he can ask for testing under organic farming conditions, which costs 5.700 €. To get a payback only of these fees for releasing, an area of 1.000 ha has to be planted by the customers of the seed. During VCU-testing the new variety has to be better just under organic growing conditions and the conventional testing is only to make it easier for the staff of the Federal Seed Office to describe the variety related to the conventional released varieties in the recommended list. But it would be much more cheaper to make an additional page, leaflet or website with the describing parameters, which were received under organic testing. This would also be of more interest for organic seed multipliers and growers. Who else than these should use parameters of organic varieties from the recommended list? But because this is not done, the organic sector itself has to organize regional variety tests under organic farming. This means additional costs not only for the breeder, but also for any public or privat advisery service on a local level.

Another inaccuracy comes from the seeds, which are used for organic VCU-testing, because until now there is no demand for organic seed for organic variety testing in Germany. There is still no duty to use organic seed for organic VCU-testing, but more than 90% of the certified seed for organic cereal production in Germany is organic. Organically produced seed of new breeders lines are compared with conventionally produced seed of varieties, which are still used under organic farming. Nearly no farmer is allowed to use conventional seed under organic farming, but variety trials are done with them. During two years samples of all available lots of certified organic spring barley from Germany were compared to original, conventional breeders seed for trials of the same varieties at Cereal Breeding Research Darzau. The doped conventional breeders seed brought on average 5% higher yields related to the certified organic seed (Pic.1+2). This means a setback of 5% for organic seed of organic varieties. To meet the requirements for comparing varieties, at least the seeds for testing under organic growing conditions should be from a certified organic production.

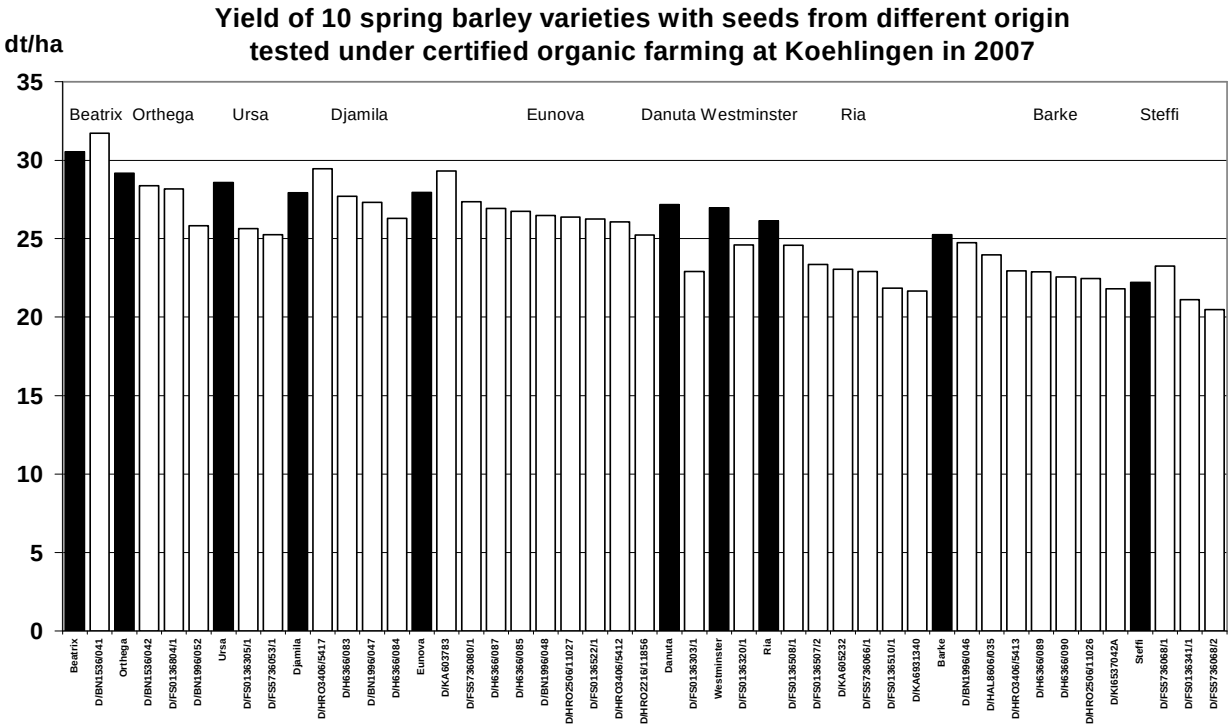
To find better adapted varieties for the organic sector the trials should take place under different regional organic farming conditions with seed from a certified organic production. A conventional variety testing could be avoided and given up. For the same costs it would be better to have one or two more potential lines to be tested for releasing for organic use than one variety tested additional under conventional farming only for tables of the Seed Office.

The alternative to this suggestion could be the same system like for carrots, which is one of the most important vegetables, and doesn't need a VCU-testing. With all the money the breeders have to spent for releasing, they can organise organic variety trials only under the environments and circumstances the variety was developed for. This would be much more efficient, because the breeders can develop their supply of varieties for very different organic farming situations all over the country much more rapidly, then by fulfilling the demands of the present official VCU-testing.

For this reasons organic cereal breeders of the Association of Bio-Dynamic Plant Breeders (ABDP) call for the possibility of only organic variety testing with solely organic produced seed under organic farming conditions for the organic market or an end of VCU-testing at all.



Pic.1: Conventional-Breeders-Seed for trials (black column) were compared to Certified-Organic-Seed of the same variety from different lots all over Germany (white columns beside) harvested in 2005 in a yield trial with three replications under organic farming near Darzau (Eastern Part of Lower Saxony/Germany) in 2006.



Pic.2: Conventional-Breeders-Seed for trials (black column) were compared to Certified-Organic-Seed of the same variety from different lots all over Germany (white columns beside) harvested in 2006 in a yield trial with three replications under organic farming near Darzau (Eastern Part of Lower Saxony/Germany) in 2007.

The evaluation of main traits of cereal varieties for organic farming in Latvia

Vija Strazdiņa, Ieviņa Stūrite
State Stende Cereal Breeding Institute
P/o Dizstende, Talsi region, LV-3258, Latvia
e-mail: stende.selekcija@apollo.lv

Introduction

In organic farming cereal varieties yield and quality is much more influenced by the interaction of genotype and environment than in conventional farming (Moudry, 2003). In Latvia like in other countries organic farmers have to grow cereal varieties bred for conventional farming. The objective of this work was to evaluate local cereal species and varieties bred for conventional agriculture in organic farming conditions according to official Value for Cultivation and Use (VCU) testing.

Materials and methods

Varieties of spring barley, oat, winter wheat and winter rye were tested in the fields certified for organic production in two locations in Latvia from 2004 to 2007. The evaluated traits for all cereals were grain yield, resistance to diseases, plant height, grain quality (TGW, Test weight, crude protein content), and lodging resistance; for oats husk and fat content; for winter wheat and rye winter hardiness and baking quality traits.

Results and discussion

All tested species and varieties grown in organic farming conditions showed about 30% lower yield than in conventional systems. Grain quality depended on climatic conditions in particular year and growing conditions. The most observed diseases for spring barley varieties were loose smut (Ustilago nuda), powdery mildew (Blumeria graminis), leaf rust (Puccinia hordei), net bloch (Phyrenosphora teres), leaf stripe (Phyrenosphora graminea). Results showed that loose smut was the most dangerous disease and affect the yield and quality. The VCU test showed that Latvian oat varieties have a good resistance to diseases (Puccnia coronifera Cda.f.sp.avenae, Ustilago avenae, Erysphe graminis DC.f,sp.avenae). The main diseases for winter wheat varieties were snow mould (Fusarium nivale), hard smut (Tilletia tritici, powdery mildew (Blumeria graminis f.sp. tritici), brown rust (Puccinia triticina), Fusarium spp., Mycosphaerella graminicola, Stagonosphora nodorum, Pyrenosphora tritici-repentis). The economical losses might arise high infection with hard smut. It seems that winter rye is one of the most suitable crop for organic farming in Latvia.
According the results, the duration of testing period have to be not less than three years because of high variation between years. Besides the traits evaluated in this VCU test it could be recommended to evaluate also capacity of tillering that is important trait particularly for barley varieties and pay more attention on root systems that are important in nutrient uptake.

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Variety testing and baking quality

*Geert Kleijer, **Lilia Levy (1)** , Ruedi Schwaerzel*
(1) Agroscope Changins-Waedenswil ACW, P.O. Box 1012, 1260 Nyon, Switzerland
lilia.levy@acw.admin.ch, www.acw.admin.ch

Key Words: VCU, recommended list, wheat, baking quality, low input, organic

Introduction

The Swiss variety testing has experienced important changes over the last years. This paper intends to explain the actual procedure and to clarify some research that have led to these changes.

Towards a new testing system

In order to highlight possible interactions, in particular between crop management systems and wheat varieties, Agroscope research stations have compared two separate networks of variety trials, under conventional (low input) and organic production conditions.
Rheological analyses showed generally lower scores for the varieties cultivated under organic conditions. Baking tests, however, produced nearly identical results. Correlation between results for baking quality of the two networks was very high and highly significant.

Swiss system of variety testing

Based on the agronomical appreciation (Schwaerzel et al., 2006) and on the evaluation of the baking quality (Kleijer and Schwaerzel, 2006) in both cropping systems, the Swiss authorities determined, that VCU test should be conducted in a mixed trial network composed of organic and conventional (low input) trials. New varieties, regardless of the selection environment, are tested during 2 years in a mixed trial network. The mixed network is nowadays composed of one organic and nine low input locations. This corresponds approximately to the proportion of Swiss cereal cultivation area in organic and in conventional low input production system. Once a variety is registered in the Swiss National Catalogue, it will be tested for its suitability for diverse crop management systems in 3 different testing networks, where specific observations can be done. In the organic trial network, it is for example possible to observe the resistance to curry-comb of a variety, as well as plant capacity to compete with weeds. The intensive trial network tests the plant response to an increased fertilisation or the supplementary benefit of growth regulators. In general, after 2 years of post-inscription trials, varieties can be inscribed on the Recommended Lists, that are regularly consulted by the farmers.

Conclusions

The studies indicate that there might be no difference in testing the varieties under low input or organic conditions for baking quality determination. No interaction between global appreciation of the varieties and crop management system could be detected. Thus, a mixed trial network matches the needs of VCU-testing. However, a post-inscription specific trial network is recommended for complementary observation for organic and intensive crop management systems.

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VCU Trials for national Listing in France
New system to assess the varieties of sorghum

*Bernard Aizac, Christophe Grizeau, **Gilles Malatier**,*
GEVES, UE Le Magneraud, 17700 BP 52 Surgères, France
gilles.malatier@geves.fr

Introduction

Sorghum is a tropical plant which comes from Africa and grows mainly in semi-arid areas of the tropics and subtropics. This culture is fifth in importance among the world's cereals and covers around 60 000 ha mainly in the South of France.
In areas where the water supply is limited, the culture of sorghum could be an alternative to maize in order to produce grains which have quite similar properties.
Thus, the new system for testing varieties of sorghum in the Permanent Technical Committee for Seeds (CTPS) framework would be an interesting challenge in the context of sustainable agriculture and an example for other species such as wheat, maize, etc.

Materials and methods

The French VCU network has from 7 to 12 locations mainly based in the South of France.
The experimental design is an alpha design with 4 replicates.
The trials are carried out in two cultivation conditions:
On the one hand in "conventional conditions"
On the other hand in "low input conditions":
- low sowing density : 30% less than in conventional conditions
- low nitrogen doses : 30% less than in conventional conditions
- no irrigation as against 120 mm in average in conventional conditions

Assessment of varieties
The trials results under the 2 different conditions are analysed to assess the variety.

– Rules and thresholds for a variety to be registered after 2 years:
Variety index >= 102% average standards in one of the cultivation conditions and
>95% average standards in the other cultivation conditions

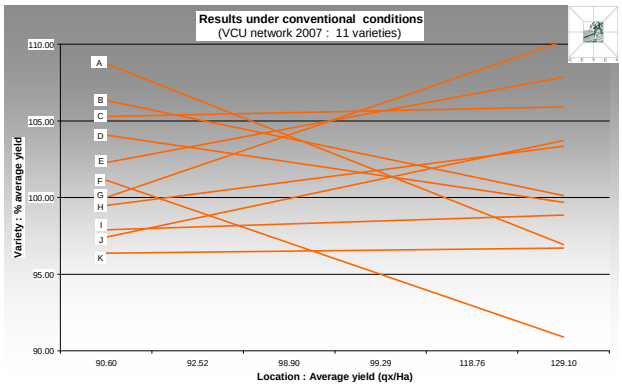
– Rules and thresholds for a variety after 1 year:
Variety index >= 98% average standards in the 2 cultivation conditions

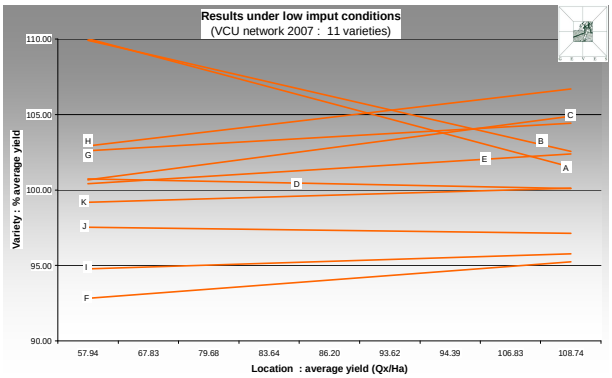
$$Variety\ index = yield_v / yield_{std} + 0.66*(flower.date_{std} - flower.date_v) + 1.33*(moist._{std} - moist._v)$$

with : $yield_{std}$: standard varieties yield
flower.date : flowering date
moist. : moisture

The grain yield adjustment by the earliness goes on the assumption that an earlier variety which has a lower grain yield than a later variety mustn't be penalized in the registration framework. For the farmer, the grain moisture level at harvesting is a more important characteristic than the flowering date (interesting characteristic for water needs) because it will decrease his drying costs and therefore will increase his payments. That's the reason why the adjustment in the formula is higher (*1.33) than the flowering date adjustment (*0.66). The choice of a grain yield adjustment level of 2 (1.33+0.66) was taken from a study showing the same relation between earliness and grain yield (Linear Regression method).

Comparatives Graphs with varieties of sorghum results under the 2 cultivation conditions :





Despite the cultivation conditions in 2007 which were not optimal to assess the varieties in low input conditions (a lot of rainfall in the summer), we can clearly see on these graphs that the variety rank under the 2 cultivation conditions is quite different. A and B varieties have performed very well in less average yield trials, their grain yields have decreased significantly in conventional conditions and in high average yield locations in low input conditions which were not representative of we had expected. Their results in 2008 will be impatiently waited for to see if they confirm their 2007-year-performances in hydric stress and low input cultivation conditions.

Conclusion

Since the new rules came into effect, the 1st variety of sorghum was registered on the French national list in January 2008 (E variety on the graphs). VCU experts will examine the effects of the new system after a 5-year-experimentation period to study whether it will be necessary to change the assessment thresholds. These studies are being attentively observed for the other species within the CTPS framework.

Comparing organic and conventional vcu testing for spring wheat in the Netherlands

Aart Osman[1], *Lubbert van den Brink*[2], *Edith Lamerts van Bueren*[1]
[1]*Louis Bolk Instituut, Hoofdstraat 24, 3972 LA Driebergen, The Netherlands, a.osman@louisbolk.nl*
[2]*Applied Plant Research (PPO-WUR), PO Box 430, 8200 AK Lelystad, The Netherlands*

Protocol for organic VCU

In a pilot research in 2000 we revised the conventional VCU protocol for spring wheat and compared this with a crop ideotype, that we had designed with organic farmers and traders (Table 1). We hypothised that conventional VCU was not able to select varieties that complied with the ideotype because:

- a number of key traits are not evaluated in conventional VCU (e.g. weed competitiveness)
- bread quality is evaluated in an industrial baking test with white bread and additives, while the organic market requires whole wheat bread and prefers to refrain from additives
- varieties are evaluated in conventional fields with a high level of nitrogen fertilizer

Table 1. The ideotype of Dutch organic spring wheat

Characteristics	Minimum	Ideal	Priority
Good Baking Quality		Optimum profit. This is yield (in kg) times the premium price for baking quality as high as possible	
• Hagberg Falling Number	260 s[1]		++
• Zeleny Value	35 ml[1]		++
• Protein Content	11.5 %[1]		++
• Specific Weight	76 kg/hl[1]		++
Good Grain Yield	Lavett = 100 (+ 6500 kg/ha)		++
Efficient use of (organic) manure	…..[2]	Desired profit to be gained with as low manuring level as possible	++
Reducing Risk of Diseases			
• Long stem	+ 100 cm (Lavett)	+ 100 cm (Lavett)	+
• Ear high above flag leaf	+ 20 cm	…..	++
• Ear not too compact	…..[2]	….[2]	+
• Last leaves green for the longest time possible (# days before harvest) = stay green index	….[2]	…[2]	++
Resistance against			
• Yellow Rust *(Puccinia striiformis)*	6[3]	8	++
• Brown Rust *(Puccinia recondita)*	7[3]	8	++
• Leaf spot (*Septoria* spp.)	6[3]	8	+
• *Fusarium* spp.	….[2]	…….[2]	++
• Mildew (*Erysiphe graminis*)	8[3]	8	
Supporting Weed Management			
• Good recovery from mechanical harrowing	…..[2]	…[2]	+
• Good tillering	…..[2]	…[2]	++
• Rapid closing of canopy	Like Lavett	Better than Lavett	++
• Dense crop canopy	Like Lavett	Better than Lavett	++
Reducing risks at harvest			
• Stiff stem	7	8	++
• Early ripening	Mid august	First week of August	++
• Resistance against sprouting	7	7	++

[1] Based on the bonus system of Agrifirm (trader of +/- 75% of the Dutch organic wheat production)

[2] No values were given, because there was no quantitative information available on the item

[3] Based on the values for the variety Lavett in the Dutch Recommended List of Varieties of 2000 (Ebskamp & Bonthuis, 1999)

Based on these conclusions we elaborated a VCU protocol for organic spring wheat (Table 2).

Table 2: Differences between organic and conventional VCU protocol for spring wheat.

	Organic Protocol	Conventional Protocol
Trial site	managed organically, in accordance with EU regulation 2092/91, for at least three years	application of mineral fertilisers and herbicides; no growth regulators are applied and part of the trial is conducted without fungicides
Seed	not chemically treated	chemically treated
Additional plant traits traits that are not observed in conventional spring wheat VCU	• recovery from mechanical harrowing	• not observed
	• speed of closing the crop canopy	• not observed
	• canopy density	• not observed
	• distance of ear-flag leaf	• not observed
	• compactness of the ear	• not observed
	• resistance against sprouting	• not observed
	• black molds in the ear	• not observed
Evaluation of baking quality	evaluation on whole meal bread without artificial bread improvers	evaluation on white bread with addition of ascorbic acid

The research

From 2001 to 2004 we conducted variety trials at three organic locations. To compare possible differences in ranking between organic and conventional, at one site we conducted a trial in an adjacent conventional field. Dutch seed companies were asked to provide varieties, from their own programme and from foreign companies they represented, that fitted the organic ideotype. Varieties that were tested included existing varieties and new lines that were submitted for regular VCU, in the Netherlands or another country.
The research followed a new organic VCU protocol, that was endorsed by the official Plant Variety Board. Baking test were carried out by a test baker, who also works for the traditional Dutch millers. A large conventional milling factory did additional tests on a voluntary basis.
Each year fields were demonstrated to farmers, breeders and processors and results were discussed with interested stakeholders in the winter season.

Results and discussion

Testing under organic conditions

The comparison of the organic trial with the conventional trial showed high genetic correlations between cropping systems for most traits (Przystalski et al., in print). A few individual varieties deviated from this general trend, though.
From the above one can conclude that for the evaluation of most traits it is not necessary to set up organic trials. However, for detecting varieties with poor baking quality it is essential to have trials under low fertility conditions, because under high fertility conditions the majority of tested varieties showed adequate baking quality. Furthermore, results show that traits like leafiness and ground cover are easier to evaluate in organic fields because differences between varieties are larger and visible for a longer period.

Including additional plant traits in the protocol
Including additional plant traits in the protocol stimulated breeders to submit varieties that on average were taller and more competitive against weeds than the varieties in the regular section of the Dutch variety list. However, none of the new varieties was equal or better in baking quality than the organic standard variety.

Importance of using non-chemically treated seeds
Seed health is important for organic farmers. Using non-chemically treated seeds had an important effect on the results. In some years some varieties showed bad germination in the organic trials, while in the conventional trial with seed treatment there was no problem.

Organic section in the Dutch variety list
Results of the project were included in the Dutch variety list in a separate section on spring wheat varieties for organic farming (Bonthuis et al., 2004).

Conclusions and Future of Organic VCU

To make sure that the VCU system also selects the best varieties for the organic sector we propose:

- a combination of conventional trials with a limited number of additional organic trials
- inclusion of traits of key importance to the organic sector in the research protocol

The future of both conventional and organic VCU depends on the financing. This project was financed by the Dutch Ministry of Agriculture, Nature and Food Quality and Product Board for Arable Farming, but the organic VCU was discontinued after the project stopped. Conventional VCU is financed for 50% by breeding companies and for 50% by farmers. Due to the small organic spring wheat acreage (about 2000 ha) breeders are not willing to invest in organic VCU. The fact that the current research did not result in varieties with a better baking quality did not convince organic farmers to continue financing.

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VCU for Organic Farming in Latvia:
Current Situation and Problems from Breeder's Point of View

Linda Legzdina, *Ilze Skrabule*
State Priekuli Plant Breeding Institute
Zinatnes str. 1a, Priekuli, LV-4126, Latvia
lindaleg@navigator.lv

Introduction

Official VCU (Value for Cultivation and Use) testing of field crops for organic farming was started in 2004. Breeders had the possibility to include in trials already registered varieties which could be appropriate for organic farming. Testing was subsidized by Latvian Ministry of Agriculture. Four research institutions are involved in carrying out the trials. From 2008 there will be no special subsidies for organic VCU any more and breeders will have to cover the expenses for the testing.

Materials and methods

Basically the same methodology as in conventional VCU was adapted for organic growing conditions. The trials were arranged in fields certified for organic production; appropriate crop rotations with green manure crops were established. No seed treatments were used. The weed control was done by harrowing. The observations and evaluated traits were not different from conventional testing. The test is performed for two growing seasons in two locations.

Results and discussion

The varieties recommended for growing in organic conditions (Table 1) are marked in Latvian Catalogue of Plant Varieties with letter "B".

Table 1. Number of tested cereal varieties in organic VCU during 2004-2007

Species	Number of tested varieties	Number of varieties recommended for organic farming*
Spring barley	9	2
Oat	6	5
Winter wheat	7	
Winter rye	4	1

*the evaluation of 2007 is not done yet, few more varieties could be recommended

New spring barley variety 'Rubiola' was the first one entered for organic VCU in 2007 as especially suitable for organic farming. 'Rubiola' was selected mainly because of its resistance to loose smut, which is particularly problematic seed born disease in organic farming. It performed acceptable in organic growing conditions, but provided no superior traits for conventional conditions. The legislation was not prepared for such situation and the breeder was asked to enter the variety for conventional VCU at the same time as the Plant Protection Service was not able to perform only organic VCU without simultaneous conventional testing. Later changes were made in Regulations of Latvian Catalogue of Plant Varieties and since July 2007 it is possible to test new variety under organic conditions or both organic and conventional conditions depending on breeder's desire.
Changes are required in methodology of organic VCU. First of all, evaluation of additional traits with importance for organic farming has to be introduced. Those are traits related to weed suppression ability, nutrient use efficiency, and resistance to seed born diseases and other pests. Use of organic seed for trials should be considered.

Part III. Summary of Discussions and Conclusions

During the workshop the following three items were identified for discussion in small groups:

1. **What are the possibilities to organise VCU for organic agriculture in such a way that costs are in proportion to benefits?**
2. **What would happen in the absence of VCU? – The opportunities and the threats.**
3. **How can we fit adaptive populations into a wider interpretation of the regulations?**

In this section we present a summary of these discussions and general conclusion.

What are the possibilities to organise VCU for organic agriculture in such a way that costs are in proportion to benefits?

After discussions 2 scenarios were conceived:

1st scenario

Registration will be based exclusively on DUS (Distinctiveness, Uniformity and Stability, see presentation of Van Waes for an explanation). In this scenario breeders will provide their experimental data of the variety. As they know their varieties the best, but are also the most interested in selling them, standards (the same for all "experimenters") will be fixed for reference. They will follow the same overall procedure. A further important point is labelling: seed bags should carry special labels stating that the registration was done without VCU. Furthermore these varieties should only be used for the organic market. This might produce supplementary control costs. This procedure however would not be necessary, if the variety has already passed the conventional VCU. Post-registration description would still be necessary and quality test would still have to be done.

2nd scenario

Only a basic VCU will be done that is the same for every variety. VCU will be based on 4 important characteristics: grain yield, quality, resistance against biotic and against abiotic factors. If the variety does not achieve the required scores in one of the characteristics, article 5.4 of the "Council directive 2002 on the common catalogue" will be applied. It says "…Where other superior characteristics are present, individual inferior characteristics may be discarded." This scenario consists mainly on an overall application of the existing directives.
However, additional adapted tests, specific for organic farming systems, are necessary to provide farmers with information on the varieties. In this scenario these tests are not a pre-requisite for registration though. Tests might be financially supported by the EU.

What would happen in the absence of VCU? - The opportunities and the threats.

VCU tests have two main roles: as a performance testing system, which supplies variety marketing information; and a pre-condition for the marketing of a variety. It is the effect of VCU as a barrier to variety commercialisation that will be considered further in this discussion. Should VCU be a statutory requirement?

The process by which breeders submit varieties for the VCU trials acts to provide the first phase of variety screening. This is because the testing of varieties is expensive, and a breeder will only be able to justify the submission of a small number of varieties for testing in any one year. In the absence of VCU, and its associated costs, it may be argued that the market would be flooded by inferior varieties. However, in the United States where there is no statutory performance testing, the responsibility of variety selection is shifted from the testing authority to the applicant. The breeders submit a limited number of varieties for testing principally because market forces dictate varieties should only be trialled if there is some chance of commercial success. Also, the breeders wish to preserve their brand and their reputation by being associated with good varieties.

In comparison to the VCU system of Europe, the testing of variety performance in the United States is carried out by breeders at universities. The assessment protocols integrate a range of the standard parameters that exist in the VCU tests but there is no performance threshold. This system allows a greater flexibility in the release of varieties for specific purposes, such as lower yielding varieties that possess excellent processing characteristics in a particular niche market.

The American farmers reference the regional testing data for their variety selection. It may be argued that this system provides more valuable data for farmers; particular those in organic systems, by taking into account the variability in regional environments. In contrast the European national lists (NL) data, which integrate the output from the national VCU trials, do not provide any information relating to the genotype by environment interaction (G x E).

The cost of VCU trials vary significantly across European countries as a result of differences in the subsidisation by the Government and the overheads of the testing authority. If VCU becomes non-statutory, the out-sourcing of performance testing may provide major costs savings as a result of competitive market forces. This potential reduced price, combined with the sharing of such testing between all stakeholders could provide a more holistic and relevant range of performance tests.

In summary, no clear points were identified that justified obligatory VCU tests, but a number of advantages were identified that supported the notion VCU should be voluntary. The American systems provides a model by which an improved system could be developed in Europe providing more valuable data for farmers, a more flexible system for niche varieties and potential costs savings in the trials themselves.

How can we fit adaptive populations into a wider interpretation of the regulations?

Adaptive populations such as composite cross populations (see presentation of M. Wolfe) do not fit into the DUS system as they build on genetic diversity instead of uniformity and stability. The current aim of the DUS system is to get varieties described and registered according to the DUS criteria to reassure farmers that they get what they expect to have bought and to set standards for seed quality (purity etc) and seed health, and to provide breeders the means to receive royalties to finance their breeding programs. So the question is how to design standards to serve the needs of farmers and breeders?

There has been the experience with barley mixtures for malting in East Germany before 1989 which was a cooperation of the whole production chain to keep high quality. The lesson learned from this is that it only worked in the context of a committed production chain.

The production costs are relatively low as the populations are easy to produce: several intercrosses, trial fields for 7 generations of multiplication. There is always a need for pure lines for future breeding of new composite cross populations.

VCU does not necessarily have to be conducted in the traditional way. The populations are not stable so the predictive value of the traditional VCU will be less. The Value for Cultivation or Use can also be evaluated by on-farm experiences. Which means monitoring, analyzing and prediction by interpreting on-farm data. So, to evaluate the Value for Cultivation or Use one can organize farmer groups/clubs in a region who interact with each other and even exchange between groups in other regions. In fact we deal here with on-farm breeding over time and there is, therefore, a need to collect on-farm VCU data to analyse the optimum treatment for different populations. There is a need to provide a protocol for data collection and publication on a website to serve the information needs of new farmers. There are such examples of farmer groups breeding cattle according the 'family-breeding system' and who exchange their data and bulls.

How to deal with differences in maturity dates of genotypes? There is the experience from trials with mixtures that the maturity dates of different genotypes in a mixture or population somehow synchronize to a certain extent. Also the harvest dates chosen by the farmers will adjust the selection into a certain direction.

Will the quality concept change with adaptive populations? In line with market and food chain diversification, there will be a need to adapt the protocol for testing quality according to the different technical processes of bread making or malting and brewing. This will provide opportunities for new citizen groups or markets.

Will seed quality testing change? This will depend on the rules for seed quality, partly related to DUS (purity) or to seed health. This last element should be in compliance with the current standards. There might be a larger range of seed size and germination energy.

How to deal with risk of degradation? This will require continuous monitoring of seed health and performance within the chain. There should also be a kind of maintenance breeding. Farmers can also hold back a seed lot from each previous generation. M. Wolfe has experienced exchange of the populations to Hungary where a severe winter destroyed many

genotypes. A second year, seed saved from the remaining genotypes out-yielded local varieties in field trials. Samples from these trials were sentback to the UK for comparison with the original population and were found to have decreased by only 10% in yield relative to the same population maintained in the UK.

Our conclusions are:

1. There are possibilities to deal with necessary standards for farmers and breeders. But it can only work with a commitment of the whole production chain from breeder to farmer to end-user to citizen.
2. DUS needs to be replaced by a traceability system which needs to be developed (e.g. parents used and the full history of the population) including seed quality.
3. VCU testing requires commitment from a self regulating system within the production chain, including a local and internal feed-back system to farmers and breeders. The conditional elements are:
    a. Breeders: need for new concepts for improvement, such as shuttle breeding, farmers participation for on-farm breeding, continuous monitoring.
    b. Farmers: building a network within and between regions, to include shuttle selection.
    c. Millers/maltsters/pasta makers: should set quality criteria and related testing methods.
    d. Citizens: standards for food health (e.g. gluten allergy)

4. Financing breeding programs: it requires a different way of financing, for example, through levies in the production chain (see Osman et al., 2007).
5. Authorities should act as animators not as restrictors: self-regulation by the user groups within a production chain.
6. Adaptive populations can lead to a more stable concept of production with respect to more exposure to environmental variation through organic, low-input farming systems and through climate selection.

Reference

Osman AM, Lammerts van BuerenET, Almekinders C (2007). Mobilising chain partners to stimulate spring wheat breeding for organic farming. In: Osman AM, Müller K-J, Wilbois K-P (Eds). Different models to finance plant breeding. Proceedings of the ECO-PB International Workshop on 27 February 2007 in Frankfurt, Germany. European Consortium for Organic Plant Breeding, Driebergen/Frankfurt, pp. 27-30

Conclusions of the discussion sessions

The following points summarise the major issues discussed.

Loss of diversity

There was a general concern on the loss of diversity in agriculture. Especially, for crops that do not occupy large areas (e.g. traditional vegetables like parsnips, scorzonera) or are of minor economic importance like leguminous and cover crops, only few breeding programmes are left and consequently the number of available varieties is low. The major cause for this loss is the general economic trend of scaling up, that leads to the disappearance of smaller breeding companies. A number of participants saw a role for the national governments to promote breeding of these crops.

Registration of adaptive populations

Besides diversity between crops, also diversity within crops may contribute to more stable agricultural systems. Examples are adaptive populations and composite crosses. Under the current legislation these populations can not be registered and consequently not exchanged between farmers or marketed. The group that discussed this topic concluded that registration should not follow the current procedures, because these populations will not comply with the DUS requirements. For these populations they propose a registration regime that is based on traceability within the whole production chain (from breeder to processor). Within this system there would still be a need for VCU, but this should not be obligatory and could be arranged by the chain partners themselves.

VCU for organic and other small markets

Remarkably all three discussion groups proposed the possibility of non-obligatory VCU-systems. All acknowledged the need of the farming community to obtain independent information on the performance of varieties, but this variety testing should not necessarily lead to the exclusion of varieties from the market. All groups saw a bigger responsibility for breeders to provide information on varieties under the guidance of an authority or commission. Also, more collaboration within the production chain could lead to a less costly VCU system, which would be able to better deal with specific regional requirements.

Evaluation of the current EU seed legislation by the European Commission

Members of the EU commission expressed that the meeting had given them valuable information. The moment of the meeting has been timely, because the EU just started an evaluation process of the current seed legislation, which will lead to a report by the end of 2008. Persons responsible for the evaluation attended this workshop and the proceedings of this meeting can be used as input for this evaluation.

Final summary

Johan Van Waes
Ministry of the Flemish Community- Department Agriculture & Fisheries
Institute for Agricultural and Fisheries Research - Direction
Burg. Van Gansberghelaan 96 box 1 9820 Merelbeke Belgium
johan.vanwaes@ilvo.vlaanderen.be

Obviously I will not repeat all proposals – good ideas that were worked out. I will only give some general conclusions of this COST-Meeting.

In the opening session on the 28th of February we had a very good overview of the COST-Action SUSVAR, especially for the WG6 of which Aart Osman is the driving motor.
This opening was followed by interesting lectures, both from the side of the EU (regulation) and of official institutes and their experience with Value for Cultivation and Use (VCU) trials under organic or conventional conditions. Additional information was given in 6 posters, either coming from variety testing institutes or from breeding companies.
During the general debate, leaded by Klaus Peter Wilbois a lot of items to discuss were proposed. To remember from this discussion: a) there is not one unique VCU- testing system and in many countries there is the possibility for national listing, based on a specific characteristic or specific conditions who can be optimal for the variety performance (e.g. organic farming conditions); b) there is a great loss in genetic diversity, especially in conventional farming; a task for the government could be to invest in research for more genetic diversity; the use of different species and varieties in organic farming is such an example.
Based on this general discussion the proposition was made to discuss the following four questions in small groups on the 29th of February:

1. How can genetic diversity (e.g. CCP, adaptive populations) fit in the VCU system
2. What happens in a situation without a VCU: chances and threats?
3. What are possibilities to organize VCU for OA in such a way that costs are in proportion with benefits?

On the 29th of February there was first a presentation by Martin Wolfe about the possibilities of populations and mixtures.
Then the four questions were discussed. This was followed by a summary from each group in a plenary session, leaded by Edith Lammerts- von Bueren.

Finally I would like to refer to the expected output : "***The meeting will end in proposals and possible actions that are needed to improve the applicability of VCU testing results to organic cereal cropping systems. Results of the meeting will be published in proceedings that will be made available as a file in pdf-format"***

Have we reached this output?
In this workshop we brought together people from the EU (regulation – DG Sanco), official variety institutes, breeding companies, institutes dealing with organic research, administration of Ministry of Agriculture and others. All those groups are in one way or another involved in the topic of organic farming. In my opinion the exchange of ideas was very fruitful. A lot of questions were raised. A lot of answers and possible solutions for problems were proposed.

But still a lot of questions were not yet answered. I feel that in different area further research will be necessary. But also a well-structured exchange of data between the different partners, as well as for regulation as for research in the field, can help to better understand the different points of view and to work out sustainable solutions. Agriculture is standing for a big challenge in the near future. First of all there will be a great competition for land use for production of food and feed on one side and for biofuels on another side. Secondly due to the climate exchange we will be confronted by a change in crops in several regions. Thirdly the conventional agricultural systems of the past decades have lead to less plant diversity, small rotations resulted in higher pressure of diseases, pests and weeds in several crops, but also to a loss of the "good quality" of many soils. A better understanding of the soil complex, the basis for our productions, can lead to new alternative crop rotations. The principles of the organic farming system, with good adapted varieties, and the priority in that system of a good knowledge of the soil can be very useful for implementation in conventional agriculture.

Finally I wish to thank you all for your participation at this meeting and the fruitful discussions. Especially I wish to thank the co-organisers for the preparatory work, the speakers of the presentations and the moderators for the different sessions. As in variety testing for agricultural crops, where one condition for listing of a variety is having a "satisfactory" value for cultivation and use I can say that this meeting has given me "satisfaction".

Annex 1 - Program

28th of February 2008

14.00 - 14.15 Welcome by the Chairman of WG6 ***Aart Osman*** (The Netherlands)
14.15 - 14.45 European rules for registration of varieties on a national catalogue and a recommended variety list (***Bruno Foletto*** - DG SANCO)
14.45 – 15.15 The VCU variety testing for agricultural crops in an European context (***Johan Van Waes***- Belgium)
15.15 – 15.30 Short discussion with previous speakers

15.30 - 16.00 Coffee break

16.00 – 16.45 Experiences with variety testing for organic systems (20 - 25'/lecture)
An example from Austria (***Clemens Flamm*** - AGES)
An example from Germany (***Uta Schnock*** - BSA)
16.45 – 18.00 Plenary Discussion (moderator: ***Klaus-Peter Wilbois*** - ECO-PB)
What can we learn from these and other experiences and what are the key issues for VCU testing for organic agriculture?
Can these rules be used for organic/low input conditions or are there necessary adaptations?
18.00 End of first day
19.00 Dinner (facultative)

29th of February 2008

08.30 – 08.45 Wrap up of discussion of previous day
08.45 – 09.15 Registration and testing of diverse populations; ongoing discussions in UK (***Martin Wolfe*** - UK)
09.15 – 10.30 Discussion in 3-4 groups on key issues that were identified previous day

10.30 – 11.00 Coffee Break

11.00 – 12.00 Plenary discussion on conclusions of each group (moderator: ***Edith Lammerts van Bueren*** – Louis Bolk Institute)
12.00-12.30 Conclusions and closure of Workshop – ***Johan Van Waes***
12.30-13.30 Lunch
13.30 End of meeting

Annex 2 - List of participants

Title	First Name	Name	Organisation	e-mail
Mr.	Riccardo	Bocci	Italian Association for Organic Agriculture	r.bocci@aiab.it
Mr.	Henk	Bonthuis	Naktuinbouw/Raad voor plantenrassen/Dutch Plant Variety Board	h.bonthuis@minlnv.nl
Ms.	Julie	Dawson	Washington State University	jcdawson@wsu.edu
Mr.	Walter	De Backer	European Commission - DG SANCO	walter.de-backer@ec.europa.eu
Mrs.	Mia	Defrancq	Agency for Agriculture and Fisheries	mia.defrancq@lv.vlaanderen.be
Mr.	Jozef	Dermaut	Semzabel	Research@Clovis-Matton.be
Mr	Clemens	Flamm	AGES	clemens.flamm@ages.at
Mr.	Bruno	Foletto	European Commission - DG SANCO	bruno.foletto@ec.europa.eu
Mrs.	Laurence	Fontaine	ITAB (Institut Technique de l'Agriculture Biologique)	Laurence.fontaine@itab.asso.fr
Mr.	Edward	Gacek	COBURO (National Variety Office)	e.gacek@coboru.pl
Mrs.	Hannah	Jones	Organic Research Centre, Elm Farm	hannah.j@organicresearchcentre.com
Mrs.	Edith	Lammerts van Bueren	Louis Bolk Institute/ECO-PB	e.lammerts@louisbolk.nl
Mrs.	Linda	Legzdina	State Priekuli Plant Breeding Institute	lindaleg@navigator.lv

Title	First Name	Name	Organisation	e-mail
Mrs.	Lilia	Levy	Agroscope Changings-Wadenswill	lilia.levy@acw.admin.ch
Mr.	François	Lhopiteau	ITAB (Institut Technique de l'Agriculture Biologique)	francoislhopiteau@wanadoo.fr
Mr.	Gilles	Malatier	GEVES	gilles.malatier@geves.fr
Mr.	Karl-Josef	Müller	Association of bio-dynamic plant breeders (ABDP) Cereal Breeding Research Darzau	k-j.mueller@darzau.de
Mr.	Aart	Osman	Louis Bolk Institute	a.osman@louisbolk.nl
Mr.	Frederic	Rey	ITAB (Institut Technique de l'Agriculture Biologique)	Frederic.Rey@itab.asso.fr
Mrs.	Uta	Schnock	Bundessortenamt	uta.schnock@bundessortenamt.de
Mrs.	Vija	Strazdina	State Stende Cereal Breeding	vijastrazdina@inbox.lv
Mr.	Daniel	Traon	Arcadia International	daniel.traon@arcadia-international.net
Mr.	Herman	Van Boxem	European Commission - DG AGRI	Herman.Vanboxem@ec.europa.eu
Mr.	Johan	Van Waes	ILVO	johan.vanwaes@ilvo.vlaanderen.be
Mr.	Klaus-Peter	Wilbois	FiBL Germany/ECO-PB	Klaus.Wilbois@fibl.org
Mr.	Martin	Wolfe	The Organic Research Centre	wolfe@wakelyns.demon.co.uk