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Environmental friendly food production system: requirements for plant breeding and seed production

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ENVIRONMENTAL FRIENDLY FOOD PRODUCTION SYSTEM: REQUIREMENTS FOR PLANT BREEDING AND SEED PRODUCTION

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PROJECT SUMMARY

General objective of ENVIRFOOD is to bring together plant breeders, seed producers, specialists of variety testing of Baltic countries (Estonia, Latvia, Lithuania) and organic agriculture experts from EU for facilitation the exchange of knowledge and expertise between conventional and organic plant breeding, variety testing, seed production and food processing in order to provide successful implementation of EU regulations 2092/91, 1257/1999 and 1452/2003 in the Baltic States.

Project will organise a 4-day seminar. The objective is to bring together the currently fragmented cereals research expertise in the Baltic State members of the EU (Estonia, Latvia, Lithuania). The workshop is intended to work out a scientific program for collaboration in plant breeding, variety testing and seed production for organic and low-input agriculture in the Baltic countries. It will also enable discussion and exchange of knowledge and expertise between conventional and organic plant breeding and seed production experts.

During this seminar plant breeders, agronomists and seed producers of Baltic States as well as some individuals from other EU countries with experience in organic agriculture will provide platform for discussion and exchange of knowledge and expertise between conventional and organic plant breeding, seed and food production. Representatives from each country will inform about the situation in each country in this area. Based on the results from national research and achievements to develop scientific concepts for breeding for organic agriculture, a network among breeders, researchers, seed and food producers in the Baltic States will be established. Successful joining of researchers of Baltic States whose unexploited knowledge would be transferred and expanded in European Research Area through 6 FP.

Dr. Prof. Ina Belicka,
Coordinator of ENVIRFOOD

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THE SIXTH FRAMEWORK PROGRAMME FOR FOOD QUALITY AND SAFETY

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In European Union the Framework Programmes (FPs) for the Research and Technological development have been implemented since 1984. Realization of these programmes plays the leading role in the initiation and organization of multidisciplinary research and cooperation inside Europe and beyond.

The aim of FP6 (2002-2006) is to make contribution to the creation of European Research Area. The main objectives of FP6 are to foster scientific excellence, competitiveness and innovation through the promotion of better cooperation and coordination between relevant actors at all levels. Economic growth depends on the development of research and many problems for industry and society cannot be solved at the national level only. FP6 will assign 17.5 billion euro to the institutions involved in the European research and technology development projects. The research projects in FP6 are implemented via certain "instruments" specifying how the work should be organized and funded. Each of FP6 activities is the subject of calls for proposals. After submission research proposals are to be evaluated by independent experts. On the basis of this evaluation the best proposals have been retained for EU funding.

FP6 has 7 thematic priorities. One of the thematic priorities of FP6 is "*Food quality and safety*". The agriculture and food sectors are vitally important to the European economy as whole. The initial budget for this priority is 685 million euro.

The primary objective of this priority is to improve health and well being of European citizens. It includes the development of higher quality food and improvement of control of food production and related environmental factors. The classical approach "from farm to fork" is readdressed to a new approach "**fork to farm**" that emphasizes the priority of consumer interests.

The thematic priority "*Food quality and safety*" includes the following areas:

- total food chain,
- epidemiology of food-related diseases and allergies,
- the impact of food on health,
- traceability processes along the production chain,
- methods of analysis, detection and control,
- more safe and environmentally friendly production methods and technologies, more healthy foodstuffs,
- impact of animal feed on human health,
- environmental health risks.

Results of the first two calls in thematic priority "Food quality and safety" show that in both calls together 385 proposals have been submitted. 80 from these proposals are in the short-list for funding, 55 of them are research projects and 25 – specific support activities (SSA).

Most topics of priority were effectively covered by successful projects. The topics of funded projects are many-sided. For example:

- risk analysis of practice for food safety,
- improving the food quality by ensuring the welfare of farm animals,
- studies on production, marketing and consumption of seafood,
- production of protein-rich legume crops for animal feeds,
- plant extracts as alternatives to antimicrobicals in feeds,
- enhancement and exploitation of soil biological control agents to prevent pests and weeds,
- assessment and critical evaluation of antibiotic resistance transferability in food chain,
- risk assessment and risk benefit analysis of novel foods,
- diet-based prevention of obesity,
- etc.

Information about thematic priority and successful projects is available on website: http://www.cordis.lu/food/home.html.

Among all of the above mentioned themes a certain position is occupied by **organic farming**. As recognized by the European Action Plan on Organic Food and Farming it is a very important sector in agriculture. Integrated project "*Improving quality and safety and reduction of costs in the European organic and low input supply chain*" (QUALITY LOW INPUT FOOD, http://www.qlif.org) is devoted just to this topic. This project involves 31 research institutions, companies and Universities throughout Europe. Project is focussed on cereal, vegetable, dairy, poultry and pork sectors. The aim of the project is to improve quality, ensure safety and reduce cost along the organic and "low input" food supply chains through research, dissemination and training activities. Project is coordinated by University of Newcastle upon Tyne (the United Kingdom).

The organic farming is growing fast, and coordination of national programmes is very important. Project "*Coordination of European Transnational Research in Organic food and farming*" (CORE Organic, http://www.core-organic.org) is funded under the FP6 activity area "Coordination of Research Activities" (http://www.cordis.lu/coordination/home.html). This project is initiated as a part of the European Commissions ERA-NET Scheme, which intends to step up cooperation between national research activities. The overall objective of CORE Organic project is to gather the critical mass and enhance quality, relevance and utilisation of resources in European research in organic food and farming. The final goal is to establish a joint research programme. CORE Organic initially comprises 11 countries, but is open to include all countries with a national research programme for organic food and farming. The coordinator of the project is Danish Research Centre for Organic Farming (DARCOF).

The researchers of Baltic countries have extensive experience and expertise in organic farming however, co-operation in research should be strengthened. The aim of SSA project "*Environment friendly food production system: requirements for plant breeding and seed production*" (ENVIRFOOD) is to bring together plant breeders, seeds producers, specialists of variety testing of Baltic countries (Estonia, Latvia, Lithuania) and organic agriculture experts from European Union to exchange knowledge and expertise. ENVIRFOOD is coordinated by State Stende Plant Breeding Station, Latvia.

Besides, all Baltic countries participate in the SSA project "*Opening channels of communication between associated candidate countries and the EU in Ecological Farming*" (CHANNEL). The objective of this project is to integrate Central and Eastern European countries in the international organic research community.
Participation in the above mentioned SSA projects devoted to organic farming will improve the experience of Baltic countries in FP projects and will foster the further involvement in research projects that will promote the integration of the Baltic region to the European Research Area.

ACHIEVEMENTS, PROBLEMS AND STRATEGIES IN PLANT BREEDING FOR ORGANIC CEREAL PRODUCTION

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Abstract
In this paper the achievements, problems and strategies to deal with the constraints of organic cereal production and breeding are discussed in a short-term, middle-long and long-term perspectives. The first step is to develop adequate organic seed production of conventionally bred varieties. The conclusion is that organic seed production is possible, but improvements of cultural practices are necessary and more attention is needed to deal with seed-borne diseases through resistant or tolerant varieties, adapted seed treatments and threshold values. To enhance the chance of release of better suitable varieties on the market it is important to adapt the protocols of official variety testing procedures. In the long run special organic breeding programmes are essential to optimise yield stability through classical line breeding or by broadening the genetic base by variety mixtures or composite crosses. With the limited organic acreage, a major constraint of organic breeding programmes will be the costs. This will demand search for alternative ways for socio-economic conditions.
Key words: *cereals, organic farming, organic breeding, organic seed production*

Introduction
The recent growth of organic agriculture in Europe offers a chance for new sectors such as the seed industry, to enter this market. For the organic sector itself it is an opportunity to close the production chain by replacing conventional produced inputs by organic produced inputs, such as seeds and varieties. This has become more urgent because the conventional seed industry is developing breeding and propagation methods that are not compatible with the ecological and ethical principles of the organic sector. For an organic farmer, adequate choice of varieties and the use of healthy seed are important, as he has few means to interfere and correct during the growing season. The development of varieties has become a specialisation of seed companies and is no longer in hands of the farmers. To guide the seed industry in developing suitable varieties it is necessary to establish a form of farmer

participation in setting breeding goals. In this paper we will first discuss the organic principles and the consequences for organic seed production and breeding programmes, followed by giving an overview of the achievements, problems and strategies in the field of cereal seed production and breeding.

Organic principles

Instead of external regulation through chemical protectants, organic farmers aim at managing the resilience and buffering capacity of their farm-ecosystem by stimulating internal self-regulation through functional agro-biodiversity in and above the soil. Building up soil fertility is one of the main concerns of an organic farmer to achieve a sufficient level of yield stability. The use of organic manure makes nutrient availability less controllable than with artificial, easy soluble fertilisers. As a result of this practice organic farming systems differ fundamentally from conventional systems in management of soil fertility, weeds, diseases and pests. The organic sector needs varieties, which are adapted to this type of management. The desired traits include adaptation to organic soil fertility management based on low(er) and organic inputs; better root system and ability to interact with beneficial soil micro-organisms; weed competitiveness; soil, crop and seed health; high product quality; high yield level; and high yield stability (Lammerts van Bueren et al., 2002).

The organic concept of ‘naturalness’ not only includes a non-chemical and an agro-ecological approach, but also an ethical aspect: the respect for the integrity of life (Verhoog et al., 2002). The consequences of applying the concept of integrity of life, lead to criteria for the assessment of breeding and propagation techniques (Lammerts van Bueren et al., 2003b). It implies that reproductive barriers should not be violated, in-vitro techniques are not desirable, cytoplasmic male sterility (CMS) without including restorer genes in the end product and patents on life will not be accepted. Techniques at DNA level are not compatible with the principles of organic agriculture. The use of molecular markers, which do not involve genetic modification, is not excluded according to this concept.

Since 2002 draft standards for organic seed production and breeding have appeared as part of the International Federation of Agriculture Movements IFOAM Basic Standards (see www.ifoam.org).When one follows these principles for cereal breeding, it means that hybrids of wheat and triticale, produced with gametozides, are not acceptable, but rye and barley hybrids are accepted if restorer genes, after the use of CMS, are included. More and more in-vitro techniques are applied in breeding programmes to produce double haploids. They may be accepted in organically propagated organic seed, but may not in future in an (certified) organic breeding programme.

The role of cereals in organic farming

All the main cereals (wheat, barley, rye and oats) in organic farming systems are not only grown for their grains for feed and human consumption. Cereals in general play a special role in the organic rotation system by contributing strongly to restoring and improving the soil structure through their deep and intensive root system, recycling of nutrients from deeper soil layers and building up the organic matter content with a large proportion of crop residues. The importance in maintaining soil fertility can be even higher when clover is undersown. Organic farms typically manage rotation schemes of at least six years, with one or two cereal crops within one cycle. Cereals are also important for straw production, which is a vital product for composting stable manure. Another important aspect for farmers is that cereals are not labour intensive and therefore fit nicely in the labour film of an organic farm. Special attention is needed to control weeds, not so much for the cereals itself but to avoid the development of a seed bank for the following crops in the rotation.

Constraints

An important first step to arrive at better-adapted varieties is a participatory approach involving organic farmers in the development of an ideotype for organic crops and the discussion with the seed companies on such an ideotype to get a better understanding of organic farming systems (Osman and Lammerts van Bueren, 2003).
The main constraints identified for organic cereal production are similar in most EU countries, although the priority order can differ per region (Osman et al., 2002):

- the limited availability of soil nutrients;
- insufficient competitiveness against weeds;
- susceptibility to *Fusarium* and *Septoria*;
- low yield stability;
- limited choice of suitable varieties;
- the need for organic baking quality standards;
- seed quality and the need for adapted organic standards for threshold value of seed-borne diseases;
- high demands for safe food and controlling of mycotoxin production by ear fungi.

Besides agronomic research, improvement of varieties can contribute to solving these mentioned problems. Therefore several strategies are being followed with a short-term (organic seed production and seed treatment), middle-long term (organic variety testing protocols) and long-term perspective (breeding and maintenance under organic conditions). These approaches will be discussed in the following paragraphs.

Seed production

According the EU regulation for organic agriculture cereal seed is regarded as organic seed, when it is produced organically for at least one generation. That implies that in principle conventionally produced basic seed, though as seed chemically untreated, can be used to produce organic commercial seed before it is sold to organic farmers for feed and food production. The risks of contamination with seed-borne diseases like common bunt (*Tilletia caries*); *Fusarium* and *Septoria* will require more attention to strategies to avoid seed-borne diseases. Related to the *Fusarium* contamination is the problem of mycotoxins. Although several studies conclude that organic farming does not lead to an increased risk of mycotoxin contamination, compared with conventional cereal production, the organic agriculture has the need to further reduce the risk of mycotoxins. Therefore more research is needed.
The general conclusion from the experience in the last few years is that organic seed production of cereals is possible. But the percentage marketable seed of sufficient quality largely fluctuates from year to year and from one seed lot to another, due to variation in weather conditions and the risk of contamination with seed-borne fungi. Optimisation of cultural practices of seed production includes actions regarding development of resistant or tolerant varieties, seed testing on all seed-borne diseases and adapted standards for organic cereal seed health quality (Lammerts van Bueren et al., 2003a).

Seed treatments and threshold values

In cases where the disease level is hard to control by cultural practices and resistant varieties are not available yet, development of post-harvest treatments is an important complementary measure. During the past 10 years many studies have been conducted in different European countries on alternative, post-harvest seed treatments to control common bunt and other cereal fungal diseases in organic farming with good perspectives. Many authors (see e.g. Lammerts van Bueren et al., 2004) mention several alternatives that have been effective with limited side-effects on seed germination in trials, like several different ways of using warm or hot water treatments, seed dressing with mustard flour or milk powder, acetic acid, etc. Grading can also be a way to limit the adverse effects of those kinds of fungi on cereal seeds by selecting seeds larger than 2.5 mm in diameter.

In some countries research is ongoing to adapt official seed health regulations for marketing organic cereal seed, because these are insufficient for the trading of undressed seeds (Girsch and Weinhappel, 2004).

Variety testing

To enhance the chance that better suitable varieties will be released on the market, the official variety testing (Value for Cultivation and Use – VCU- research) should be conducted under organic conditions because some traits important for organic farming, such as efficient use of nutrients from organic fertilisers, cannot be evaluated under conventional conditions. But there is also a need for additional criteria because important characteristics such as canopy characteristics and soil coverage are usually not observed in conventional VCU research.

In several European countries, like Austria, Germany, Switzerland and the Netherlands one has influenced the protocol for testing cereal varieties for organic farming systems by incorporating additional criteria and organising the testing under organic farm conditions (see the SUSVAR-project www.cost860.dk).

Breeding strategies

Some conventional breeding companies are interested in producing varieties for low-input and organic conditions (e.g. Kempf, 2003). These select for traits which are important for organic farming, but for economical reasons they do not conduct the whole selection programme under organic conditions.

The step to special breeding programmes for organic cereal varieties is a more long-term approach and is very costly, but in the long run necessary to improve the yield stability in organic farming systems. In the organic sector, some specialised organic plant breeders in Switzerland (www.peter-kunz.ch) and Germany (www.darzau.de) have established breeding programmes for winter wheat, spelt and barley varieties, but little attention has yet been given to the other cereals.

Improvements on the short-term managing specific fungal diseases are to be expected with the further development and application of variety mixtures (Welsh and Wolfe, 2003). This requires research to sort out the most effective combination of varieties in the mixtures.

Another approach is the broadening of the genetic base and by that enlarging functional biodiversity, e.g. through composite crosses (Wolfe, 2003). Out of the achieved populations, grown under organic conditions for several generations, further selection for adapted lines can follow for either new single varieties or for line mixture varieties.

An important viewpoint of organic farmers is not only to rely on genetic resistance traits for (ear) diseases. They desire broader field tolerance by demanding varieties with different plant architecture including traits like a longer stem, greater distance between the leaves, less compactness of the ear, but also a shorter flowering time (Osman and Lammerts van Bueren, 2003). From an organic point of view one would like to rely on as many defence mechanisms as possible, so combining resistance genes with morphological characteristics, in order to make the system less vulnerable to possible breakdowns of one of these defence mechanisms.
More research is needed and pilot studies are ongoing to develop a method to assess the relation between differences in growth dynamics and the adaptation to ecological environmental and quality aspects, like baking quality including sensory criteria of bread, and to find corresponding field selection criteria (Kunz, 2000).

Future outlook
Although considerable advances are to be expected with breeding efforts and variety evaluation for organic growing conditions, a major constraint from the breeders' side however are the costs, regarding the fact that organic agriculture is still limited. Another point is finding a sustainable way of funding organic VCU testing. In Austria this is subsidized by the national government. But in other countries the national government are subsidizing the development of organic VCU, but are not willing to bear these costs permanently (e.g. the Netherlands). The question is how such trials can be financed in the future. Both problems demand searching for alternative options for socio-economic conditions to breed and maintain such varieties and organise variety trials for instance by a participatory approach.

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CHARACTERISTICS OF SPRING BARLEY VARIETIES AND CROP DIVERSITY FOR ORGANIC FARMING AND VARIETY TESTING

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Abstract

Results from Danish spring barley variety trials including about 50-120 varieties and variety mixtures on three locations over three years under organic as well as conventional farming systems demonstrate the importance of genotype-environment interactions. This has implications for potential future organic VCU-testing; here results are shown for grain yield.

Further, grain yield results from of six variety mixtures and their 14 component varieties indicate that variety mixtures may be less influenced by genotype-environment interactions compared to pure line varieties.

Introduction

Modern varieties have been developed with the aim of combining high productivity and standardised product quality under high-input conditions. The organic growing system is a system where pesticides and inorganic fertilizers are generally not allowed. Hence, biotic and abiotic stresses have to be overcome by growing appropriate varieties and by practicing good farm management. An important question is whether modern varieties possess the right combinations of characteristics to ensure a stable and acceptable yield of good quality when grown under different organic growing conditions. It is well known that varieties often perform and yield differently in different environments due to genotype-environment interactions, so it may be important to evaluate characteristics of varieties in organic as well as in conventional farming systems. However, it remains unclear to date whether the differences between conventional and the organic growing systems are large enough to justify breeding and testing of varieties in both environments.

Despite quite intensive testing of varieties, predictions of future performance of varieties, when grown on specific locations, are known to be very difficult; this especially within organic growing systems, where no pesticides and fertilizers can help stabilize performance. Therefore, using mixtures of appropriate varieties might be a way to obtain more stable and acceptable yields. Variety mixtures have so far been studied especially in relation to effect of reducing disease severity under conventional farming conditions. Varietal characteristics and crop diversity in organic cereal production are considered in a Danish project on organic spring barley (BAR-OF, 2002) as well in a European COST Network on sustainable low-input cereal production (SUSVAR, 2004).

Cereal production is important for Danish agriculture constituting an area of about 1.5 million ha. The latest figures for the Danish organic cereal production areas (from 2003) is that 2.8% of the total cereal production area is organic, e.g., 2.6% of the total Danish spring barley of 580000 ha and 58.6% of the total Danish spring wheat area of 13000 ha. The varieties grown are of conventional origin and officially tested under conventional VCU-testing (Value of Cultivation and Use). Results from large variety trials in the BAR-OF project with 50 to 120 varieties and variety mixtures grown in different growing systems at three locations in three years will be considered here.

Danish spring barley field trials (BAR-OF trials)

Field trials were conducted on experimental research areas at three Danish locations: Jyndevad, Foulum and Flakkebjerg. Three different growing conditions were studied either resembling organic systems (i.e. no pesticides, weed harrowing or grass-clover undersown, and low input of organic fertiliser (e.g. slurry)) or conventional systems (use of herbicides and synthetic fertiliser according to local standards, however, without use of fungicides). All together, data were collected in five to six different environments (system x location) in each year 2002 to 2004. The conventional conditions were only applied on two locations in each of the years 2002 and 2003 constituting all together 4 of the 17 environments and the organic conditions with grass-clover undersown only on 2 locations in the year 2004. Many different disease- and growth characteristics were assessed (Table 1). Here we will focus on grain yield.

Table 1

Characteristics measured in BAR-OF variety trials

Agronomical traits	Disease, weed and grass-clover assessment	Yield and quality traits
▪ Plant emergence	▪ Powdery mildew	▪ Grain yield
▪ Plant density spring	▪ Barley leaf rust	▪ Protein content
▪ Date of heading	▪ Net blotch	▪ Starch content
▪ Culm length	▪ Scald	▪ Specific weight
▪ Lodging	▪ Ramularia	▪ Kernel weight
▪ Breaking of culm	▪ Species specific weed assessments	▪ Grading
▪ Breaking of ear	▪ Grass-clover assessments during/after harvest of cover crop	
▪ Date of ripening		
▪ Reflectance		
▪ Leaf Area Index		

More than 150 varieties and variety mixtures were included in the trials (not all varieties were studied each year) representing actual and coming new varieties with different expectations for performance in organic systems as well as varieties from other sources being potential 'organic' candidates. Among the variety mixtures six 3-component mixtures were specifically constructed based on information from official variety testing at the beginning of the project. These mixtures consisted mostly of high yielding varieties. They were made according to official certification requirements with respect to relative yield, disease resistance, and date of ripening. However, larger differences between component varieties than accepted according to the rules for culm length were introduced as this parameter is related to weed competitiveness and this trait have specific focus for organic farming.

Results and discussion

Sixty-six varieties from the BAR-OF variety trials were also tested in the Danish VCU testing in the years 2002-2003 (Anonymous, 2002, 2003). Relative grain yield data from the VCU testing was compared to the results obtained in the BAR-OF trials averaged over the three locations (Fig. 1). From this comparison it is seen that the relative yield of these varieties in the two types of system are related, i.e., high yielding varieties in the VCU testing are to a large extend also high yielding under organic conditions, e.g., the variety 'Simba' yielded the very best in both systems. However, large significant differences were found between the ranking of some of the varieties in the two systems. As an example the variety 'Danuta' is very well adapted to the organic conditions in the BAR-OF trials, e.g., it has high weed competitiveness, whereas it yielded very poorly in the VCU-testing.

The opposite is the case for the variety 'Lux' with very low culm length and high disease susceptibility. Further, for varieties with relative grain yield around 110 in the VCU-testing there is a significant difference between their grain yield under organic conditions. Therefore, information about performance under organic conditions is insufficient when using only conventional VCU-testing.

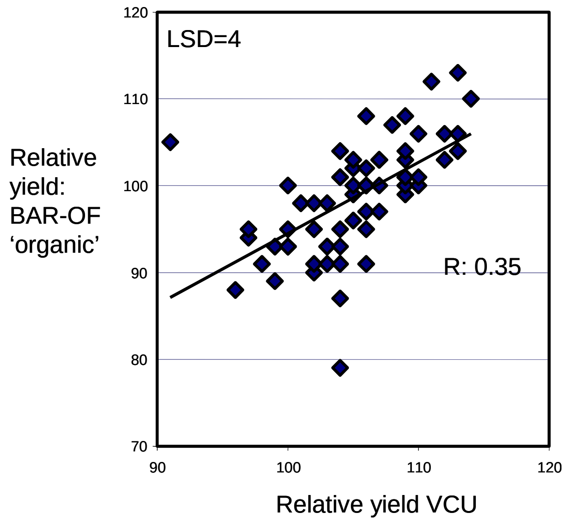

Fig. 1. Relative yield in 2002-2003 of 66 varieties from the VCU testing (100= 72.5 hkg/ha) compared to yields obtained in the BAR-OF trials (100=49.7 hkg/ha)

This conclusion is supported by an extensive statistical analysis of the predictability of conventional VCU-testing information on disease and growth characteristics for the grain yield of 50 varieties in either conventional systems or organic systems within the BAR-OF project (Østergård et al 2005). The varietal characteristics from VCU-testing consisted of 1) disease severity assessment for each variety to each of four prevalent diseases (barley powdery mildew, barley leaf rust, scald and net blotch) observed in official trials without fungicide treatment; and 2) other growth characteristics assessed in official trials with fungicide treatment: culm length, tendency to lodging, tendency to breakage of straw and ear, and date of ripening (Anonymous 2001,2002). In addition, a combined measure for the years 2002-2004 for competitive ability of each variety against weeds (Hansen, 2002) calculated from information on canopy height and Leaf Area Index from herbicide treated trials was included as a competition index. This index has been part of the VCU-testing since 2002. Using factorial regression analysis, the best model for predicting the observed grain yield each year from these characteristics the previous year was found. With this model, the residual variance component for varieties was lower for observations from the conventional growing system than from the organic growing system implying that the VCU-characteristics better predicted the observed grain yields from the conventional growing system.

Genotype-environment interactions between varieties and different growing conditions can be visualised graphically by bi-plots based on an AMMI (Additive Main effects Multiplicative Interaction effects)-analysis (Gabriel, 1971; Kristensen & Hill, 2002). Such an analysis of observed grain yield data for 82 varieties and variety mixtures from two locations, two systems and two years (2002-2003) are shown in Fig. 2. The lines represent the two growing systems ('organic' conditions and 'conventional' conditions) and point's different varieties and variety mixtures values corrected for year and location means. The length of a line indicates how much the varieties in total deviate from the variety means in this system. Varieties close to the origin are relative stable in yield between systems, whereas varieties that are far away from the origin show large deviations from the means in one or both of the two systems. According to the results (Fig. 2), some varieties yielded very different in the two systems, e.g. variety 'Troon' (19757) performing much better in the organic system than in the conventional system and the opposite for ‘Alexandra’ (19740) and a breeders line (20086). ‘Danuta‘(19459) being an outlier in Fig. 1 also in this analysis turned out to be badly adapted to the ‘conventional’ conditions in the BAR-OF trials and ‘Lux’ (17242) was about average in the conventional system but far below average for the organic conditions. The variety mixtures (e.g. 20187) tended to be located between the two lines indicating that their yield is not so much influenced by the differences between the growing systems. A detailed analysis of common characteristics of varieties in the same part of the graph as well as detailed characterisations of the different environments including abiotic and biotic stress factors as well as climatic data are waiting.

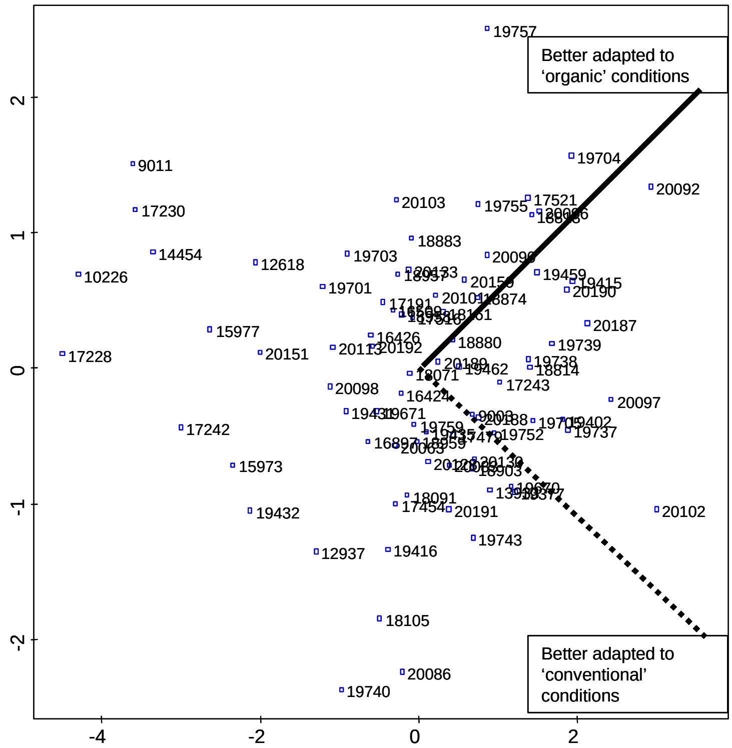

Fig. 2. Bi-plot showing for each variety and variety mixture the grain yield in a certain growing system, as deviation from overall grain yield average. The project-ion onto each line multiplied by the length of the line indicates the value of the deviation in the respective system in hkg/ha (bold line is ‘organic’ conditions, and broken line is ‘conventional’ conditions).

Yield stability is desirable and may be difficult to obtain in organic farming systems. As variety mixtures are known to reduce disease development and expected to be more efficient in using available nutrients and compete with weeds, we investigated the yield stability of six variety mixtures compared to their 14 component varieties over all 17 different environments. For three of the six mixtures, the grain yield was significantly higher than the average yield of its components; in none of the mixtures it was significantly lower. The variation in grain yield over environments of all variety mixtures was compared to the variation of all component varieties. The six mixtures had on average a better yield stability, i.e., were less variable over environments, than the 14 component varieties grown in pure stands with respect to actual yield as well as to rank values of yield (Østergaard et al 2005). Such results are important for the ongoing discussion in EU about marketing of conservation varieties (Council Directive 98/95/EC).

Conclusion

It has been unclear whether the differences between conventional and organic growing systems are large enough to justify breeding and testing of varieties in both environments. To investigate this we conducted large variety trials. Conclusions from such trials depend on the range of varieties tested as well as on the range of organic and conventional environments studied. Here, we have included a broad spectrum of varieties, however, most of the varieties were conventional varieties bred for high-input growing conditions. Further, the systems we have chosen to compare may be more similar than what is found between conventional high-input farms and certified organic farms. Therefore, even bigger genotype-environment interactions may be found in other studies. However, the final decision concerning implementation of organic VCU-testing is also based on economic possibilities and the establishment of organic plant breeding involves many other aspects relating to the organic principles, e.g., breeding techniques, specific traits, participatory aspects. By the end of this year a Danish protocol for spring barley variety testing for organic farming systems will be available. This protocol is developed on the basis of the trials in the BAR-OF project.

Acknowledgement

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VARIETY TESTING FOR CONVENTIONAL AND ORGANIC FARMING SYSTEMS – EXPERIENCE AND PROBLEMS

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1. Introduction
2. Testing for variety protection
3. Testing for variety registration
4. Testing for variety recommendation
5. Summary

1. Introduction

This presentation will focus on variety testing from a legal and institutional point of view because these aspects are very important for the understanding of the variety systems in the European Union. Technical aspects will only play a minor role. Principally, we can state that the same rules of variety testing apply for varieties for conventional as well as organic production. We may distinguish three basic intentions for variety testing:

- testing for variety protection
- testing for variety registration
- testing for variety recommendation

Variety protection is supposed to offer the breeder an incentive to invest private capital in plant breeding and variety development. Only protected varieties enable the breeder to earn a return on his investment in plant breeding. Variety protection is principally in the interest of the breeder.

Testing for variety registration and variety recommendation are means of consumer protection. The testing is supposed to make sure that the farmer receives varieties with high quality and superior performance.

Testing for variety protection and variety registration is done on the basis of EU legislation. Testing for variety recommendation takes place in the framework of national systems with little or no harmonisation between the member states.

This presentation does not deal with breeding methods. Our estimation would be that more than 97 % of the breeding work done in the European Union is conventional breeding. There are different sets of rules for organic breeding, but, as far as we know, there is not one clear definition. For our purposes, this does not really matter. Where our reflections start breeding is finished and the variety is ready for testing.

2. Testing for variety protection

In market economies private capital is invested in plant breeding and variety development. In Germany, for instance, more than 99 % of the breeding effort is privately financed (the only exception is the breeding of grape vine). Variety protection is the precondition that allows the breeder to earn a return on investment for his capital. The variety owner may define the conditions for the use of his protected variety. This will usually be the payment of a royalty by the farmer.

Of course, it is also possible that the state identifies plant breeding and variety development as a task in the public interest. The state can finance plant breeding from his budget as it was done in socialist economies.

The testing for variety protection usually takes two growing cycles. The protection is limited to 25 years (vine, potatoes, trees 30 years).
In order to receive protection a variety has to fulfil the following conditions:

- distinctness
- uniformity
- stability
- novelty
- variety denomination

Testing distinctness: For granting plant breeders rights, a variety must be clearly distinguishable from any other variety whose existence is a matter of common knowledge at the time of the filing of the application.
Testing uniformity: A variety shall be deemed uniform if, subject to the variation, which may be expected from the particular features of its propagation, it is sufficiently uniform in its relevant characteristics. To be considered uniform, the variation shown by a variety must not be such as to prevent the accurate description and an assessment of distinctness and must ensure stability.
Testing stability: A variety shall be deemed stable if its relevant characteristics remain unchanged after repeated propagation or, in the case of a particular cycle of propagation, at the end of each such cycle.
Novelty: A variety is considered new if propagated or harvested material has not been sold or otherwise disposed of to others by or with consent of the breeder

- earlier than one year within the state, where protection is asked for,
- earlier than four years (or six years for vines and trees) outside the state, where protection is asked for.

In addition to the above-mentioned criteria the variety seeking protection must be named by a variety denomination that may not be mistaken for any other variety name.
Variety protection, from our point of view, is the best option for protection of inventions in plant breeding. It allows for a strong protection but, at the same time, makes sure that protected varieties can be used for further breeding activities by the so called breeder's exemption.
National laws on variety protection are based on the international UPOV Convention. UPOV defines common rules for variety protection that are followed by all states having signed the Convention.
In the European Union it is possible to apply for EU protection at the Common Plant Variety Office (CPVO) that is valid in all EU member states. Alternatively, breeders can apply for national protection that is only valid in one member state. EU protection becomes more and more popular.
Problems: Some organic farmers ask for varieties that are not uniform but broader in the expression of their characteristics. They do not comply with the classical UPOV standards. This is a problem with regard to the variety protection system. If varieties are not uniform to

a certain extent, it is hardly possible to distinguish them from other varieties. The concepts of uniformity and distinctness are closely linked to each other and strong protection is only possible if varieties have a certain level of uniformity. And protection is necessary for the breeders of such varieties, since they also need to earn a return on their investment.

3. Testing for variety registration

While breeders can choose between EU protection and national protection, variety registration is a national affair. The national variety offices in the member states are in charge of variety registration. The member states notify the EU Commission of their registration decisions and by publication of the variety names in the Official Journal of the European Union the varieties can be marketed throughout the European Union. The publication is a purely formal matter that will take place a few weeks after the national registration of the variety.

In order to be registered the varieties must fulfil the conditions of distinctness, uniformity, stability and must have a variety denomination as described above. Novelty is not necessary.

In addition, varieties must have value for cultivation and use (VCU). The VCU requirement is defined in the Seed Directives of the EU Council and must be applied by all member states for variety registration. The application, however, is very different in the different member states. In Germany, for instance, it is rather difficult to fulfil the requirement of VCU. The German Seed Act gives the following definition:

"A variety is considered to be of value for cultivation and use, if – in comparison with similar varieties which are on the variety list – the total of its characteristics determining the value, clearly improve crop cultivation or utilisation of the harvested crop or any product obtained from such crops. The improvement shall be given at least in a defined region. Inferior charac-teristics may be disregarded where other superior characteristics are present."

This means, in practice, that a new variety has to be an improvement even to the best comparable variety on the national list.

The characteristics examined in VCU testing are yield, quality and resistance to diseases or abiotical stress. Testing takes two or three years and registration is valid for ten years (vine 20 years). Registration can be prolonged, if the variety still has market importance.

VCU testing clearly is a matter of consumer protection because it makes sure that only varieties with a high performance are registered and maybe sold to the farmers.

Problems: Varieties suited for organic production must also prove VCU, but usually the testing is not done under organic growing conditions. Even though these varieties may have a special value for organic production they may not be able to prove this under official testing conditions.

The German variety office (BSA) argues that the VCU testing is done without chemical treatment (fungicides, growth regulators) in order to test the disease resistance of the varieties. In addition, less fertilizer is used than in conventional farming. These testing conditions are considered not very different from organic production. Still, some organic farmers insist to have the variety tested under organic growing conditions.

Principally, in Germany it is possible to ask for special variety testing under organic growing conditions. This special testing, however, must be financed by the applicant and is rather expensive.

In Germany, we have a minister of agriculture that is a member of the Green Party that is very open to organic farming. Consequently, three research projects have been launched to analyse VCU testing under organic growing conditions. The projects deal with winter wheat, spring barley and potato. The objective is to find out whether the ranking of a given number of varieties is different if testing is done under the usual VCU testing conditions or organic growing conditions. It will be very interesting to learn about the results of those projects, which are expected two years from now.

4. Testing for variety recommendation

Two or three years of VCU testing results in the registration and description of the successful varieties. In many member states an additional recommendation system is in place. This is an additional tool of consumer protection designed to help the farmer to find the best variety for his regional growing conditions.

There is no EU legislation on recommendation trials but it is up to the member states to implement such trials. In Germany, the Bundesländer (regional administration) are responsible for recommendation trials. While VCU trials are operated with a low intensity (chemical treatment, fertilizer), recommendation trials take place under practical growing conditions. They are conducted for another two or three years.

Problems: Organic production represents a limited share of total plant production in the European Union. Consequently, there are only few variety trials under organic growing conditions.

Breeders are very much in favour of recommendation trials. Those trials put an emphasis on the importance of well-performing high quality varieties. They also strengthen the fair competition between breeders because the best varieties are recommended to the farmers. Recommendation trials are very important for a successful marketing of a variety, as farmers take the result very seriously. The problem is, however, that it becomes more and more difficult to secure the financial basis of the recommendation trials. In Germany, the Bundesländer need to cut down on their spending and they are looking for new ways to finance their advisory system for farmers.

Another problem is the long duration of variety trials. For cereals and rapeseed, for instance, there are three years of VCU trials. If you add another three years of recommendation trials it takes six years altogether before a variety is fully recommended and can be marketed on a big scale. The approach must be to use VCU results in connection with the results of the recommendation trials and have a (preliminary) recommendation after four years. Obviously, it is more difficult to earn a return on the investment if there is a long delay between the investment in and the marketing of the variety.

5. Summary

Variety testing is conducted for:

- variety protection,
- variety registration
- and variety recommendation.

Variety protection is the economic precondition for private plant breeding. It enables the breeder to earn money with his biological invention/intellectual property and gives an incentive to invest private capital in plant breeding and variety development.

Variety registration and variety recommendation are means of consumer protection. Only well-performing high quality varieties may enter the market and are recommended to the farmers.
The same principles apply to varieties for conventional and organic production.

Problems for varieties for organic production may arise:

- if varieties for organic production do not comply to classical UPOV standards. Especially uniformity may cause problems;
- if varieties for organic production cannot prove VCU and are not registered, because they are not tested under organic growing conditions.

The second problem can be solved quite easily. Either the ranking of the varieties is the same under conventional and organic testing conditions or special VCU testing has to be conducted under organic growing conditions.
The first problem, however, is a principal problem. The whole international protection system for plant breeding (UPOV) is based on the approach of distinctness, uniformity and stability (DUS). If there is not sufficient uniformity of the varieties, distinctness between varieties cannot be safeguarded. There will be no protection. This will be a problem for the breeders of organic varieties as they will not be able to earn a return on their investment in plant breeding and variety development.

CHALLENGES AND PROBLEMS OF ORGANIC SEED PRODUCTION IN THE EU – THE EU ORGANIC SEED REGULATION

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Abstract
On 1 January 2004 the regulation (EC) 1452/2003 of 14 August 2003 came into force and obliges EU Member States to set up data bases to display the availability of organic seed on their territory as a precondition to grant authorizations to use non-organic seed in organic farming. The so called organic seed regulation has not been equally implemented in the different EU Member States – a fact that may result in organic seed and organic food market distortions. This contribution briefly describes the legal background of the organic seed regulation, picks up some of the problems attached to the implementation of the new rules and gives an outlook on how the new European Member States may bypass some of these problems.
Key words: *regulation (EC) 1452/2003, organic seed regulation, organic seed, organic seed database*

Commission Regulation (EC) 1452/2003 add. to Council Regulation (EEC) No 2092/91
With the start of the year 2004 the regulation (EC) 1452/2003 of 14 August 2003 came into force. The purpose of this regulation is to maintain the derogation provided for in Article 6(3)(a) of Council Regulation (EEC) No 2092/91with regard to certain species of seed and vegetative propagating material by laying down further procedural rules and criteria relating to that derogation. The maintenance of the derogation to use non-organic seed in organic farming was necessary since it was obvious that for certain species there would not be adequate amounts of organically produced seed available after 31 December 2003. The main point in the procedural rules and criteria relating to that derogation is the obligation for the member states of the European Union to set up a computerized data base in order to make the availability of organic seed transparent to anybody requiring organic seed. Consequently, using non-organic seed shall in principle only be authorized when the variety the user wants is not registered or temporarily not available as displayed in the database. Beside this, the competent authorities of the EU Member States are allowed to grant general derogations for those species where usually no organic seed is available.

What if a Member State fails to set up a database?
It was the commission's position that in those EU Member States that do not set up a database displaying the availability of organic seed no derogation shall be granted (cf. K.-P. Wilbois and E. T. Lammerts van Bueren, 2003). But it must be doubted that this became reality, since there are countries having high organic production in the EU without an equally high amount of organic seed on offer. A first chance for the commission to evaluate organic seed use and the number of granted authorizations in the different Member States will be given when the obligatory annual reports have been submitted. That is due to be done before 31 March each year. Besides the submission to the commission, the report has to be published in the respective national database. The statistics in the report ought to be classified by varieties, justification for authorization and total seed amount as well as total number of authorization issued.

What are the basic database requirements?
In a declaration released at the end of a Workshop held in 2003 in Frankfurt am Main, Germany, beforehand the organic seed regulation had been passed, representatives from the vast majority of the European Union (Union of the 15), wrote down basic criteria for the operation of organic seed databases in practice. Accordingly, a functioning organic seed data base should be: up-to-date, comprehensive, reliable, easy to use for seed suppliers and growers and providing detailed information on availability as well as recording properly data on derogations granted (E. T. Lammerts van Bueren and K.-P. Wilbois, 2003).

Looking at the situation today in the 15 old EU Member States one has to realize that (i) not each of those countries has established an organic seed database as required by EU law, (ii) big differences between the national databases exist and (iii) several databases miss the basic criteria given in the sited workshop declaration (see also next chapter).

In an earlier stage of the law making process a common database for the whole EU was envisaged but was given up during the political consultation process. Nevertheless, the EU Commission still seems to be convinced that a community-wide organic seed database may be a better approach tackling the organic seed problems in the long term: In the considerations of the regulation 1452/2003 it reads that "the system should be re-examined thoroughly after the first two years of experience in order to assess to what extent organically produced seed and vegetative propagating material have been used by the farmers. In this context the Commission should consider the opportunity of developing a database at Community level".

An attempt in the direction of common EU organic seed data base was OrganicXseeds, a multilingual internet based data base of FiBL Switzerland and FiBL Germany that was already in place for three years when the organic seed regulation was published. This data base has later on been adapted to the regulation and is now running in five different European countries as the official organic seed data base (Belgium, Germany, Luxembourg, Switzerland and United Kingdom).

What about harmonization of rules in a harmonized market?
Due to the fact that the regulation (EC) 1452/2003 gives room for national implementation the rules take effect quite differently in different EU Member States and a real harmonization within the European Union lies in far distance. Since organic seed is, dependent of the species in question, at considerably higher costs than non-organic, competitive distortions may result from non-harmonized implementation of the organic seed regulation.

Additionally, there is no common understanding of the functioning and functionalities of a "computerized database" as it is required by the organic seed regulation. For instance, some countries have static Web sites or pdf-files displaying available seed updated once a year whereas other countries implemented dynamic databases with many functions being user friendly and constantly up to date. Some of the data bases display seed of hundreds of different species each with sub groups with again several to many varieties while others have only few broadly used crops covered in their data base totally leaving for instance vegetable seed. Since the Regulation refers with regard to the term "availability" directly to the respective official national database it becomes clear that the implementation of the law depends highly on the setting up of the concerned database.

What can be expected for the future with respect to the organic seed regime?
The organic seed regulation mentions at several articles of the law an "Annex to this regulation" where species shall be listed that are not entitled to authorizations. This annex is as yet empty and shall be filled later on, provided that the Article-14-committee agrees on such a list with species for which in principle no derogation shall be granted in the entire European Union. Considering the availability of organic seed and the priorities of organic farmers with regard to demanded varieties in the different EU Member States an agreement on a common annex seems to be a mammoth task and is not likely to be introduced within the near future.

A chance to seek an agreement on species for the Annex of the Regulation coming up soon in 2006 when the Commission is going to start the re-evaluation of the effective implementation of the present regulation. As a step forward in the direction of a European Union wide annex with species for which no derogation shall be granted is the approach of some countries e.g. the Netherlands, Belgium that have establishing a so called 'national annex'.

What can new European Member States learn from this?
First of all it should be clear that organic farming means to also use organic seed and vegetative propagating material wherever this is available. Hence, there is a commitment of organic growers to use organic seed for their production and they seek to use organic seed provided this seed meets there quality needs. Similarly, it requires seed suppliers dedicated to produce seed according to the organic standards, however at higher costs. Both the organic seed demand and supply will develop interdependently. A precondition to safeguard a balanced increase of seed supply and demand is a high degree of transparency on the organic seed market. As the experiences from the European countries show so far Internet based databases are a most suitable mean to ensure this transparency at high degree. Even if not a majority of growers have access to the Internet and the database it can be a useful tool for advising and inspection bodies to lead organic farmers to organic seed.

In order to allow the organic seed demand and offer to grow in tune in new European Member State the organic sector in those countries should not wait for obligatory provisions with regard to an organic seed regime from Brussels but should use the time for consultation between organic seed suppliers and organic growers. Such consultation talks between organic seed supplier and growers, as two parts in the organic chain may lead to mutually understanding bypassing the problems the former EU countries face with organic seed.

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GRAIN QUALITY AS CRITERION FOR BREAD GRAIN PRODUCTION AS AFFECTED BY THE ZERO AND CONVENTIONAL FERTILISATION

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Abstract
Grain yield and baking qualities of three winter wheat cultivars grown without mineral fertilisers (zero fertilisation) versus conventional and intensive fertilisation were examined. The trials were conducted on a fertile light loam *Endocalcari - Epyhypogleyic Cambisol* after clover. Averaged grain yield of the three cultivars over three years at zero fertilisation amounted to 68 % and that of protein yield to 62 % of the conventional yields. Close to 10 % grain protein content obtained at zero fertilisation suggested that the amount of soil nitrogen

was sufficient, and grain wet gluten content below 22 %, and white flour/dough stability of 2-4 min. may require adaptation of formulas and procedures to obtain the optimum product. In the conventional fertilisation practice dough stability was 5-7 min. In zero fertilisation the differences in grain quality of cultivars with HMW subunits 5+10 or 2+12 were scarcely distinguishable.
Key words: *conventional, organic fertilisation, winter wheat, varieties*

Introduction

Crop productivity and quality depend upon factors such as favourable climate, soil fertility, and adequacy of water supply. Investigations on precision farming have indicated how variable is both the organic and mineral content of supposedly uniform fields (Trewavas, 2004; Smil, 2000). Soil diversity results in the variation of yield and quality of grain. Therefore, the grain yield of the Lithuanian winter wheat variety 'Širvinta 1' over 7 years on the same site ranged between 5.02-8.30 t ha $^{-1}$ (Mašauskienė et al., 2000). In one year the yield variation of this cultivar in the experimental plots was from 8.9 to 16.1 % according to the coefficient of variation (CV). Grain protein content varied in the range of CV 11.2-14.1 %, wet gluten content CV varied from 25.6 to 34.8 %. Bread making qualities of wheat are mainly related to the protein and gluten contents in grain and flour. Despite the fact, that protein and gluten content in the same type of processed flour was similar, the dough quality differed. The 550 C and D type industrial flour/dough stability varied in the range from 6.7 to 11.2 min. (Mašauskienė, 2003) over the 1997-2002 period. Baking quality is related with gluten protein HMW composition. Despite protein concentrations in grain being below 10 %, differences in bread-making quality between the varieties containing HMW-subunits 5+10 and 2+12 were scarcely distinguishable (Linnemann, 2001). To improve the quality of end product, millers and bakers use additives. Trewavs (2004) indicated the report of Farm and Food Society that at least 30 chemicals or additives are allowed and used for organic food processing. The economic viability of production is also linked with the quality. It is not common to encounter product specific standardization for the grain product quality in all cropping systems, would it be organic, low-input, conventional or intensive.

The aim of the study was to evaluate the yielding capacity and grain baking quality of three winter wheat cultivars differing in HMW-subunits under zero, conventional and intensive fertilisation practices.

Material and methods

The soil of the experimental site is light loam sod gleyic (*Endocalcari - Epyhypogleyic Cambisol)* with neutral reaction, medium to high in phosphorus and potassium. The Danish winter wheat variety 'Hereward', characterised by a good bread-making quality, and the Lithuanian variety 'Ada' and German variety 'Zentos' noted for the highest baking quality, were investigated. The cultivars (*Triticum aestivum* L.) differed in HMW glutenin composition: variety 'Ada' possesses subunits 1,7+9, 5+10, 'Zentos' possesses subunits 0, 7+9, 5+10 and variety 'Hereward' 0, 7+9, 2+12. Clover was the pre-crop in the trials, so it conferred particular benefit to soil fertility. According to the trial design wheat did not receive any fertilisation (zero); mineral complex fertilisers $N_{17-32}P_{15-35}K_{72-100}$ (P and K indicated in elements) were applied at sowing and N_{90} in the spring at BBCH 22-24 (conventional fertilisation). In the intensive fertilisation practice N_{30} was additionally broadcast at BBCH 31-32 and N_{30} at the BBCH 39-41. In 2002 and 2003 hot weather and shortage of rainfall during the period of grain milk ripening stage resulted in withering of leaves and stems and inhibited the flow of nutrients to the grain. In 2004 the cold and rainy weather delayed grain ripening. Grain protein content was determined by the Kjeldahl method, factor 5.7 (ICC 105/2), wet gluten content and gluten index by Perten (ICC 155). Grain was milled to 550 type of flour by Brabender Junior mill and flour was tested by Brabender farinograph (ICC 115/1). The experimental data were statistically processed using the software package *STATISTICA 6.0.*

Results and discussion

The data obtained demonstrated that on Central Lithuania's fertile soils grain protein content of winter wheat sown after clover and grown without industrial mineral fertilisers was in the range from 10.3 to 11.7 % in the years favourable for protein synthesis (2002 and 2003) (Tables 1 and 2). In the year 2004, when there were few sunny days in the after-anthesis period, the protein content of variety 'Zentos' grain was as low as 7.6 %, 8.7 % for variety 'Hereward' and 9.6 % for variety 'Ada'. This suggests that soil nitrogen supply was insufficient. In the year 2004 only intensively fertilised winter wheat grain accumulated 8.7–12.0 % of protein.

Table 1

The impact of fertilisation strategy on winter wheat variety 'Hereward' grain indirect bread-making quality

Variety	Indices	Fertilisation	2002	2003	2004	Average
'Hereward'	Protein, %	Zero	10.3	10.4	8.7	9.8
		Conventional	11.1	12.3	9.9	11.1
		LSD_{05}	0.77	0.97	0.48	0.70
	Wet gluten, %	Zero	20.6	22.6	16.4	19.9
		Conventional	21.8	27.3	21.2	23.4
		LSD_{05}	2.40	2.00	2.00	2.03
	Gluten index, units	Zero	79	66	81	55.3
		Conventional	78	59	54	63.7
		LSD_{05}	14.0	9.7	13.3	11.80

The highest gluten contents 22.4 % in zero and 26.9 % in conventional fertilisation practices were obtained for variety 'Ada'. The lowest gluten was identified for variety 'Zentos', 16.7 and 20.6 %, respectively. Variety 'Hereward' was not distinguished for wet gluten content among the other cultivars. Higher gluten index was always obtained at zero fertilisation compared with conventional or especially intensive fertilisation. Wet gluten content and its quality reflects glutenin / gliadin ratio in protein (Daniel, Triboi, 2000). The higher content of gluten in conventional fertilisation treatments could be the result of higher portion of glutenin in protein, but the better quality of gluten in zero fertilisation practices could be the result of long protein chains. Gluten index of variety 'Hereward' was lower compared with that of other cultivars. This suggests that cultivars possessing HMW- subunit 2+12 grown in zero fertilisation practice are likely to produce lower bread-making quality grain. The 550 type flour/dough mixing properties were strongly impacted by the cultivar peculiarities, weather conditions and fertilisation strategy. Dough stability time of variety 'Ada' was longer compared with that of variety 'Zentos' (Table 3). At zero fertilisation variety 'Ada' flour tended to meet the requirements of good quality flour more often, compared with variety 'Zentos'.

Table 2

The impact of fertilisation strategy on grain indirect bread-making quality of winter wheat varieties 'Ada' and 'Zentos'

Variety	Indices	Fertilisation	2002	2003	2004	Average
'Ada'	Protein, %	Zero	11.7	11.2	9.6	10.8
		Conventional	12.9	12.4	10.8	12.0
		Intensive	14.1	12.8	12.1	13.0
		LSD_{05}	1.27	1.03	0.62	1.01
	Wet gluten, %	Zero	26.7	22.0	18.5	22.4
		Conventional	30.8	27.2	23.2	26.9
		Intensive	30.3	29.6	28.3	29.4
		LSD_{05}	3.16	3.91	3.76	3.62
	Gluten index, units	Zero	44.7	86.5	76.4	69.2
		Conventional	42.0	79.0	61.3	60.8
		Intensive	48.4	69.5	53.0	57.0
		LSD_{05}	10.22	7.70	12.48	10.32
'Zentos'	Protein, %	Zero	11.0	11.0	7.6	9.8
		Conventional	13.0	11.3	8.7	11.0
		Intensive	14.4	12.5	10.0	12.3
		LSD_{05}	0.99	1.38	0.59	1.04
	Wet gluten, %	Zero	21.7	22.1	6.42	16.7
		Conventional	25.1	23.2	13.4	20.6
		Intensive	30.7	26.9	20.4	26.0
		LSD_{05}	2.86	2.89	2.87	2.87
	Gluten index	Zero	84.4	94.8	99.7	93.0
		Conventional	84.8	94.0	98.8	92.6
		Intensive	56.3	89.0	98.2	81.2
		LSD_{05}	11.55	2.83	1.48	6.92

On fertile soils winter wheat produced 4-5 t ha^{-1} grain without mineral fertilisation (Table 3), which was 36-44 % less compared with the conventional fertilisation treatments. In the year favourable for winter wheat the yield increase in the conventional or intensive fertilisation systems was 3-4 t ha^{-1} compared with zero fertilisation practices. According to 3-year averages, the grain protein yield per hectare at zero fertilisation amounted to 61-64 % of the conventional fertilisation system.
Among the grain/flour parameters obtained from farinograms the dough stability is subject to the strongest variability. Stability time above 10 minutes is characteristic of excellent quality flour, whereas below 3 minutes indicates a poor quality (Wheat, 2004). In our trial we identified the relationship between the dough stability and cultivar peculiarities. Dough of variety 'Ada' flour exhibited greater resistance to mixing compared with variety 'Zentos' (Table 4). In zero fertilisation plots grain/flour could be defined as having poor dough stability. The influence of weather conditions on the grain/flour dough stability was apparent. In the sunny summer of 2002 -2003 the winter wheat grain/ flour dough stability

was much better compared with that of grain, which matured in 2004 when cloudy weather prevailed.

Table 3

The impact of fertilisation strategy on grain and protein yields of winter wheat

Variety	Indices	Fertilisation	2002	2003	2004	Average
‘Hereward’	Grain yield, t ha^{-1}	Zero	5.37	4.37	5.71	5.15
		Conventional	7.47	7.82	8.74	8.01
		LSD_{05}	0.478	0.584	0.635	0.56
	Protein yield, kg ha^{-1}	Zero	553	454	497	505
		Conventional	829	962	865	828
		LSD_{05}	51.4	67.8	59.8	56.7
‘Ada’	Grain yield, t ha^{-1}	Zero	6.23	3.15	3.60	4.33
		Conventional	7.13	5.28	6.34	6.25
		Intensive	7.61	5.86	7.68	7.05
		LSD_{05}	1.22	0.68	0.76	0.92
	Protein yield, kg ha^{-1}	Zero	729	353	346	468
		Conventional	920	655	685	750
		Intensive	1073	750	930	916
		LSD_{05}	158.4	83.7	84.6	111.4
‘Zentos’	Grain yield, t ha^{-1}	Zero	7.47	4.06	4.76	5.43
		Conventional	8.76	6.17	7.68	7.54
		Intensive	8.47	6.27	8.54	7.76
		LSD_{05}	1.66	0.38	1.26	1.22
	Protein yield, kg ha^{-1}	Zero	822	446	362	532
		Conventional	1139	697	668	829
		Intensive	1220	784	854	954
		LSD_{05}	213.1	44.3	71.5	136.2

Table 4

The impact of fertilisation strategy on 550 type flour dough mixing properties of winter wheat varieties ‘Ada’ and ‘Zentos’

Variety	Indices	Fertilisation	2002	2003	2004	Average
‘Ada’	Stability, min	Zero	6.0	4.7	1.8	4.2
		Conventional	8.6	11.8	4.0	7.2
		Intensive	8.1	13.2	8.9	10.1
		LSD_{05}	2.74	3.87	2.00	2.90
‘Zentos’	Stability, min	Zero	2.5	3.6	1.0	2.4
		Conventional	10.4	4.5	1.3	5.4
		Intensive	7.9	6.8	2.6	5.8
		LSD_{05}	3.15	1.88	0.29	2.12

The data indicate that even in zero fertilised plots winter wheat variety ‘Ada’ grain/flour had a higher dough mixing stability compared with that of variety ‘Zentos’. To improve the quality of end product and meet the needs of the clients millers/bakers use additives. The question arose: should corn or other sort of gluten be prohibited since these might come from

intensive farms? The baker and writer Thom Leonard (2000) from the USA writes that it may be difficult to find the organic bread flour that will consistently meet a baker's quality requirements and organic flour may be more variable than conventional flour. Such flour may require adaptation of formulas and procedures to obtain the optimum product.
The low quality and productivity of organic agriculture is widely accepted as fact. Whether certified organic farming will survive and become a parallel production system to conventional one based on minimal compliance to standard remains to be seen.

Finesilver in 1989 in the report based on literature review on the comparative quality of organically versus conventionally grown food summarised that sufficient data do not exist to support or reject prediction that conventional fertilising practices can possibly result in higher protein content but poorer quality protein than organic practices. But it is unclear how many farmers actually choose to farm "by neglect" and advertise themselves as organic over the years (Kuepper, Gegner, 2004). Recent investigations demonstrated that organic yields are usually much lower but occasionally they can match conventional productivity in a single year (Trewavas, 2004). Generally, the alternative cropping systems on the Lithuania's soils produce 20 % lower yields compared with the conventional systems (Bučienė, 2003). Consequently, the viability of organic farming system is largely dependent on the public awareness of environmental issues and health concerns and agricultural policy promoting heavier investment in organic farming. However, Finamore et al. (2004) reported that there is no differences in the response of some functions of treated animals (rats) fed organic versus conventional wheat, under either well-fed or protein energy malnutrition. Stress, disease and hunger are among factors that impair everybody's ability to overcome exposure to food produced in conventional farming. In a democratic society those who wish to farm organically or to eat organic food have a perfect right to do so. However for traceability of means used on organic farming and processed products should have passed through a rigorously controlled, inspected and documented pathway.

Conclusion

Over three experimental years the grain yield of winter wheat varieties 'Hereward', 'Ada' and 'Zentos' grown after clover on a fertile Central Lithuania's light loam Endocalcari - Epyhypogleyic Cambisol at zero fertilisation amounted to 68 % and protein yield per ha to 62 % of the conventionally fertilised wheat. The grain protein concentration close to 10 % obtained at zero fertilisation suggests that the amount of soil nitrogen was adequate; while grain wet gluten content below 22 %, and white flour/dough stability of 2-4 min. indicated poor baking quality. In the conventional fertilisation practice the dough stability was 5-7 min. At zero fertilisation cultivars with HMW-subunits 5+10 or 2+12 practically did not differ in quality.

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ADVANTAGES AND DISADVANTAGES OF HULLESS BARLEY IN RELATION TO ORGANIC FARMING

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Abstract
Hulless barley (HB) is a relatively new cereal crop; the hulls of it can be separated from grain during threshing. HB has been recognised as being more valuable and economic in food industry than covered barley. Several studies show the positive influence of HB food products on human health; it can be utilized in many different food products. The use of HB for feeding of animals in organic farming may be preferable, because the availability of protein supplements of organic origin may be problematic; farmers will be able to produce higher quality feed on their own farm. Research results proved that hulless barley appeared to be less prone to accumulation of *Fusarium* mycotoxins in the harvested crop than covered barley. It could be explained with a considerable proportion of mycotoxins located in barley hulls. Disadvantage of HB for organic growing conditions could be susceptibility to loose smut. In Europe HB breeding for organic farming is carried out at Cereal Breeding Research Darzau (Germany). Breeding of hulless barley for food and animal feed was recently started at Priekuli Plant Breeding Station. Developing HB varieties useful for conventional and organic farming systems are envisaged.
Key words: *hulless barley, healthy food,* Fusarium *mycotoxins, loose smut*

Introduction

Hulless barley (HB) is a relatively new cereal crop, although in ancient times in some regions it was cultivated probably already before covered (hulled) barley. The hulls of HB are not knitted together with the grain, but they can be fully or partly separated during threshing depending on genotype, grain moisture and threshing quality. Intensive breeding work with HB was started in Canada in 1980-ties; initially it was done mostly for animal feed purposes.

HB has been recognised as being more valuable and economic in food industry than covered barley. The interest of consumers in health strengthening and promoting food products is increasing in the world and in Latvia as well. HB might be one of the ingredients in such products. Growing of hulless barley could open up new possibilities in use of barley species and increase the demand and interest of producers and growers including organic farming and organic products.

The main advantages of hulless barley are lower fibre and higher valuable nutrient content in grain, which is caused mainly by separation of hulls from grain. The value of hulless barley in feed and food has been proved; it is possible to use hulless barley successfully for various industrial purposes and in future also in beer production. The economical advantages of hulless barley are the high volume weight thus resulting in reduced area for storage; there is no need for mechanical separation of hulls in food production.

The yield of HB is usually lower than that of covered barley. It is understandable, because breeding efforts for a long time have been devoted to covered barley only. Another point is, that hulls are not included in the harvest of HB and it makes the yield lower. Yield should not be considered as limiting factor for growing HB under organic and low-input conditions. Literature findings indicate that HB lines in low-input conditions yield by 14 % more than covered barley varieties (Habetinek, Uhlik, 1993). In Europe HB breeding for organic farming is carried out at Cereal Breeding Research Darzau (Germany).

Breeding of hulless barley for food and animal feed purposes was recently started at Priekuli Plant Breeding Station. Developing HB varieties useful for conventional and organic farming systems for food and feed purposes are envisaged.

Potential for use in healthy organic food products

HB is an excellent ingredient for healthy food products, which is probably still underestimated in Europe. Unlike covered barley it is possible to use it in food products directly without de-husking. It makes possible inclusion in food also the outer parts of grain, which contain valuable essential amino acids and vitamins.

Results of several studies have shown the positive influence of HB food on human health. The ability of barley to reduce the blood cholesterol level has been explained by high content of soluble dietary fibre, particularly that of beta-glucan (Bhatty, 1999; Kalra, Jood, 2000; Ikegami at. al., 1996). When high beta-glucan HB diet was compared to wheat diet, the first one decreased the blood cholesterol by 12 %, but the second one increased it by 3 % (Newman et al., 1989). HB with waxy starch (high content of amylopectin) was described as most appropriate for food mostly because of high beta-glucan content (Fastnaught et al., 1996).

It is suggested to include barley in food also due to its low glycemic index. Higher vitamin E content in comparison to other cereals could be another reason for lowering blood cholesterol as well as lowering the risk of cancer and heart diseases.

HB can be processed in several food products. Bread recipes with 10 - 50 % HB flour content are available in scientific literature (Cavallero et al., 2000; Newman, Newman, 1991) and on the Internet (www.albertabarley.com etc.). Consumers have increasing interest in more dense, high in fibre breads. Berglund et al. (1992) reported evaluation results of different food products with HB flour (Table 1) and concluded, that waxy HB can be successfully used in many foods to produce higher fibre products. No significant difference in taste between products made with HB flour and thase made according to traditional recipes with wheat flour was detected. Other food products are: flakes, pearled barley, bran; simply cooked grain can be used as side dish or in salads.

Combining HB grain quality and health promoting traits with organically grown food quality may increase the value of this cereal.

Table 1

Evaluation results of products made with HB and wheat flour (**)
(adapted from Berglund et al., 1992)

Products	Flavour	Appear-ance	Texture
Bread (26 % barley flour)	6.58	6.62*	6.30
(26 % whole wheat flour)	6.61	6.87*	6.52
Carrot-spice bars (100 % barley flour)	6.52	6.57	6.73
(100 % wheat flour)	7.05	6.80	6.45
Blueberry muffins (70 % barley flour)	5.64	6.37	5.87
(100 % wheat flour)	5.66	6.46	5.62
Chocolate chip cookie (50% barley flour)	7.01	6.76*	6.40
100 % wheat flour)	7.19	7.03*	6.64
Noodles (75 % barley flour)	5.67	5.11*	4.94*
(100 % wheat flour)	5.17	6.56*	5.50*

*Difference significant with 95 % probability; **1 – like extremely, 9 – dislike extremely

K.J.Mueller (1992) believes that barley for food purposes has to be with hulless grain. One of the aims of his project at Cereal Breeding Research Darzau (Germany) is to develop criteria for breeding of hulless food barley for organic farming. Variety ‘Lawina’ with light coloured grain, good competitiveness with weeds and absolutely hull-free threshing was released (www.darzau.de). The variety was tested at Priekuli Plant Breeding Station under conventional growing conditions without chemical seed treatment and application of fungicides (Table 2). The yield of ‘Lawina’ did not significantly differ from that of the covered barley variety ‘Abava’, but it was strongly infected with loose smut.

Table 2

Testing results of HB genotypes, Priekuli, 2004

Variety, line	Origin	Grain yield		Length of vegetation, days	Lodging (9-no lodging; 1-strong lodging)	Plant height, cm	Loose smut, spikes per m^2	Protein, %	Starch, %	TGW, g	Volume weight, $g\ l^{-1}$
		$t\ ha^{-1}$	% to Abava								
Lawina	Germany	4.82	90	111	6.3	100	15.6	14.6	63.5	42.2	802
AC Alberte	Canada	4.67	87	109	7	95	18.4	14.9	63.0	44.6	824
CDC McGwire	Canada	4.87	91	109	7	106	3.3	13.2	63.6	35.7	790
CDC Gainer	Canada	4.92	92	109	5	98	7.0	12.6	64.1	38.6	794
CDC Freedom	Canada	4.31	80	107	6.3	102	0.7	12.7	64.4	38.1	780
Taiga	Germany	5.23	97	111	6.7	99	7.7	13.1	64.0	43.6	814
KM 2084	Czech R.	5.54	103	112	9	75	7.2	14.2	62.9	47.6	794
SW 1291	Sweden	6.00	112	110	8	96	8.3	12.7	65.6	42.5	818
Abava (covered)	Latvia	5.38	100	113	7	113	1.4	12.6	62.8	45.1	690
$LSD_{0.05}$		0.64									

Feed

The main advantage of HB for animal feed is significantly higher content of digestible energy if compared to covered barley, which is caused by separation of hulls containing mostly insoluble fibre. For example, experiments with pigs stated, that HB could be equal to wheat and corn (Wu, Cheng, 2000; Baidoo, Liu, 1998). Due to higher content of essential amino acids, protein supplements to animal feed can be reduced. However, high beta-glucan content is undesirable characteristics especially for chicks and young birds. It proves that HB breeding for animal feed and human food has to concentrate on different chemical compounds. The use of HB for feeding in organic farming may be preferable, because the availability of protein supplements of organic origin may be problematic; farmer will be able to produce higher quality feed in his own farm.

Lower accumulation of *Fusarium* mycotoxins in grain

The currently available information about differences in infection level with *Fusarium* head blight (FHB) and accumulation of mycotoxins in cereal grain in organic and conventional farming is contradictory. Some publications about wheat are available. Birzele et al. (2002) found, that organic farming systems in Germany has lower rates of infection with ear blight and lower grain contamination with mycotoxins than conventional farming systems. To the contrary, results of the study in France show, that higher level of deoxynivalenol is found in organic wheat if compared to conventional (Malmauret et al., 2002).

One of the objectives of 6th Framework Programme Quality Low Input Food is to identify potential impacts of components of cereal (model crop: wheat) production systems on the

risk of mycotoxin contamination of grain. Supposedly this programme will give more detailed and well-founded knowledge about this problem.
FHB and occurrence of mycotoxins is more related to wheat, but the experience in the world (e.g. USA, Canada) proves, that also barley grain may become completely unusable because of contamination with mycotoxins produced by *Fusarium* ssp. (Windels, 2000; McMullen et al., 1997).
Our study (Legzdina, Buerstmayr, 2004) compared the accumulation of mycotoxins in hulless and covered barley genotypes with equal disease severity under artificial inoculation. The results show that the mean deoxynivalenol, 3-acetyl-deoxynivalenol and 15-acetyl-deoxynivalenol content of covered barley is significantly higher than that of hulless barley (p<0.01), whereas for nivalenol the difference between the mean values of covered and hulless barley is not significant. The results support the hypothesis that hulless barley appears to be less prone to accumulation of mycotoxins in the harvested crop than covered barley. It could be explained with a considerable proportion of the mycotoxins located in the barley hulls. The importance of this statement may increase, if HB becomes more popular as ingredient for healthy food products.

Table 3

Infection severity (AUDPC) of hulless and covered barley genotypes with FHB and accumulation of mycotoxins in grain under artificial inoculation

Genotypes	n	AUDPC	Content of *Fusarium* mycotoxins, µg kg^{-1}			
			DON	3-Ac-DON	15-Ac-DON	NIV
Hulless	29	306.8	12963	144	585	237
Covered	29	296.5	15520	247	810	246
$LSD_{0.05}$		196.3				

Disadvantage: susceptibility to loose smut *(Ustilago nuda)*
In general HB is more susceptible to loose smut than covered barley, also there are HB varieties with resistance genes available (e.g. ‘CDC Freedom’). Since only organically grown seed will be allowed for organic farming in the future and the number of infected plants with loose smut is restricted by seed legislation, it is essential to breed varieties resistant to this disease. Seed pre-treatment with warm water followed by hot water treatment is reported to have 98 - 99 % efficiency in loose smut control for covered barley (Nielsen et al., 2000), but this method might be non-economical and reduce germination ability, especially for HB, which is more sensitive than covered barley. Until now there are no organic seed treatments appropriate for HB available, although research in this direction is carried out (K.J.Mueller, personal communication).

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RECENT KNOWLEDGE ON THE ECOLOGY OF PLANT-GROWTH-PROMOTING RHIZOBACTERIA HELPS TO DEVELOP NEW CONCEPTS FOR ORGANIC PLANT BREEDING

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Abstract

Plant breeding programs are more and more focused on new crop varieties adapted to sustainable low-input and organic production systems. This means that the natural roles of soil beneficial microorganisms, marginalised by conventional agriculture, will be finally rescued to a new life.

In order to rapidly achieve environmental friendly crop production systems, it is of crucial importance to utilise the plant genotype potential for improving the performances of varieties under low-input conditions. In this frame, recent knowledge about plant-microbial interactions can be fruitfully exploited in a breeding program aimed to maximise the beneficial contribution of rhizobacteria.

Published and unpublished findings led us to propose the development, by laboratory, field, and bio-statistic research, of a breeding strategy directed towards new crop varieties able to support large populations of indigenous beneficial rhizobacteria, as a new concept to the development of sustainable low input and/or organic production systems.

Keywords: *plant-growth-promoting* rhizobacterium*, plant genotype potential, plant breeding, heterosis, organic agriculture*

Introduction

The objectives of selection for the development of varieties for organic agriculture differ from those for conventional agriculture. Organic and low-input plant breeding programs are oriented to the selection of plants with both resistance to disease and an efficient nutrient assimilation, in order to keep the productivity, while improving quality and safety by reducing pesticide (Bradshaw et al., 2003) and fertilizer inputs (Gahoonia and Nielsen, 2004; Clarke and McCaig, 1993). Actually, organic and low input plant breeding programs have generally taken into account the capacity of plants to interact with rhizobial or mycorrhizal microsymbionts, in order to improve nitrogen and phosphorus acquisition (Rengel, 2002).

Instead, plant breeding programs have not yet taken into the right account the capacity of crop plants to interact with other beneficial soil microorganisms, such as plant-growth-promoting rhizobacteria, known to enhance plant growth (Kloepper and Schrot, 1978) by suppressing diseases (Andersen et al., 2003; Picard and Bosco, 2003a; Stutz et al., 1986), fixing atmospheric nitrogen (Iniguez et al., 2005), solubilizing phosphorus (Johansson et al., 2004), iron (O'Gara et al., 1986) and other nutrients, and producing bioactive compounds that stimulate root proliferation (Picard and Bosco, 2003b).

It is worth noting that recent literature on microbial ecology (Sen R., 2003) indicates that part of the resistance of plants to root diseases could be due to the presence and activity in soil of disease suppressive bacterial strains. In fact, numerous studies (cited above) have demonstrated the capacity of specific non-symbiotic rhizobacteria to protect roots from infection by plant pathogenic fungi. Among these, fluorescent *Pseudomonas* spp. with the capacity to produce the antibiotic 2,4-diacetylphloroglucinol (DAPG+fPs) have been shown to have a functional role in the biocontrol of a large range of plant pathogens, including bacteria, fungi, and nematodes (Raaijmakers et al., 2002).

Regarding plant genotypes, it is actually well known that they affect both the performance of root colonisation by DAPG+fPs and their biocontrol activity. For example, Smith et al. (1999) demonstrated that different recombinant tomato inbred lines differentially support the growth of a biological control agent in their spermosphere. Recently, Mazzola et al. (2004) showed that the genetic composition of a DAPG+fPs population, as well as the degree of protection obtainable by this beneficial bacterial population, vary in a wheat cultivar-dependent manner.

Previously, we gave evidence that hybrid maize supported a population of DAPG+fPs that was more numerous and genetically more diverse when compared with those supported by its parental lines (Picard et al., 2004). Furthermore, we also evidenced that the hybrid genotype is more colonized by fluorescent *Pseudomonas* strains with multiple beneficial functions (Picard and Bosco, 2005). By repeating our experiment twice on the same soil, but with different climatic conditions, we observed that climatic conditions did not significantly influence the *Pseudomonas* population supported by the hybrid genotype. Interestingly, the frequencies and main genomic groups of DAPG+fPs strains were very similar to those found within a DAPG+fPs population isolated from a different hybrid maize grown on a different type of soil, in different climatic conditions (Picard et al., 2000). The presence of very similar DAPG+fPs populations in the rhizospheres of hybrid maize grown in diverse soils and climatic conditions could be one of the factors which explain the stability of yield observed for hybrids across different environmental conditions (Hallauer and Miranda Fo, 1988).

In other words, the superior performances of hybrids, known as heterosis, could be due, in part, to the stable and ubiquitous presence of particular plant-growth-promoting rhizobacterial strains (Picard and Bosco, 2005). All these data suggest that plant root colonisation by rhizobacteria is an inherited trait (Picard et al., 2004; Smith et al., 1999), probably related to heterosis (Picard et al., 2004).

Our proposal

Published and unpublished findings, like those cited above, led us to propose the development, and the laboratory, field, and biostatistic experimentations, of a breeding strategy directed towards hybrids that support large populations of beneficial indigenous rhizobacteria, as a new approach to the development of sustainable low input and/or organic production systems.

The first step of such a research program should be aimed at evaluating genetic variability both for the crop plant, and for the rhizobacterial populations. This phase should be devoted to the screening of plant genotypes available for selection (genetic resources) and to the characterization of the biodiversity of the beneficial bacterial populations in the rhizosphere of such genotypes (Tanksley and McCouch, 1997). These evaluations should be performed in low-input environments in order to reveal the best plant-microbial interactions in limiting environments.

The knowledge about the available genetic variability should be then utilised for setting a selection procedure adapted for low input environments. This selection can be carried out with the conventional breeding procedures, or can be integrated with the use of molecular markers tool. In this case, with the information on the genetic resources, the genetic control of the interactions between the plants and the microorganisms can be analysed with the molecular markers. In fact, the quantitative trait loci (QTLs) underlying the plant ability to establish a favourable microbial population in its rhizosphere can be identified in a suitable mapping population (Gallais and Hirel, 2004).
The molecular markers associated with the QTLs responsible for this trait can be then used to set up a marker assisted selection (MAS) procedure for improving the plant-microbial interaction, and thus a better exploiting of the resources in a low-input environment (Ribaut and Hoisington, 1998).

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ORGANIC FARMING IN LATVIA

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History and development of organic farming in Latvia

The organised organic farming movement in Latvia started in 1989. The following landmarks can be highlighted:

- 1990 – Mr. W.Jorge, a German expert organized seminars in small villages for farmers (to present them the principles of organic agriculture).

- 1995 – Regional associations of organic farmers established Association of Latvian Organizations for Organic Agriculture - LBLOA (Association dealing with the preparation and disseminating information among farmers, representatives of public, education and advisory.)
- Since 2001 – the State support programme.
- Since 2003 – Action Plan for Organic Farming
- Since 2004 – Support from Agro environment programme (Rural Development Plan).

Statistics of certified organic farms

There are more than 1000 farms in Latvia, producing organic output (Table 1). The major agricultural sectors producing organic products are as follows: cereal growing, horticulture, dairy farming and apiculture. Still the amount and assortment of the organic products is insufficient.

Table 1

Number of organic farms and area under organic agriculture in Latvia

Year	Number of organic farms	Area under organic cultivation, ha	% from agricultural land
1998	39	1426	0.1
1999	63	1628	0.15
2000	78	4 400	0.17
2001	219	10 549	0.57
2002	352	16 934	0.68
2003	550	24 422	1.00
2004	1043	43 902	1.80

In Latvia, there are only four certified organic processing enterprises: 2 bakeries - SIA Zelta Kliņģeris and z/s Ķelmēni, 2 small slaughterhouses - „Zaubes kooperatīvs" and z/s „Sveķi", 2 milk processors – "Ķeipenes piensaimnieku kooperatīvā sabiedrība" and z/s 'Līcīši", honey processing company "Vinnis".

State Support

Since 2001 the organic farmers are eligible to receive subsidies. In 2001 support was given also for the development of the organic seed production system, and in 2003 support was envisaged for the market development of the organic products.
Organic farming measures will be not supported by the EU SAPARD programmes. Since 2004 organic farmers will be supported in accordance to Rural Development Plan according to the following sub-programme "Organic farming".
Till joining the EU the State support programme supported organic farmers (Table 2).

Table 2

State support to organic farms in Latvia

Year	State support, LVL (EUR)	Supported farms
2001	84 000 (126 000)	62
2002	276 000 (414 000)	120
2003	479 788 (709 000)	300
2004	170 200 (242 174) 3404000 (4843483)*	101 986

*Support from Rural Development program

Government policy

In 2003 Ministry of Agriculture prepared the Action plans for organic farming development.
In 2003 Ministry of Agriculture started preparing organic seed production system.
Since 2004 Ministry of Agriculture has started to support organic seed production.
Since 2004 Ministry of Agriculture has started to support verification of variety in organic farming.

Legislation

Latvia as a Member State into European Union obliges to implement in full the "acquis" in the area of organic farming. At present in the Republic of Latvia there are implemented EU organic farming requirements – the Latvian Law on Agriculture and Rural Development is framework law in this field, which provides a common base for transposition of EU legislation, related to organic farming products and indications referring on agricultural products and foodstuffs. Cabinet of Ministers (CM) Regulation No 414 "On order for Supervision and control of organic agriculture" (22.04.2004) is legal base for supervision, which nominate competent institutions and determinte their functions. Since 01.05.2004 Latvia is applying EU regulations directly in accordance with Rome treaty.

Certification

The certification of farms has taken place since 1990. Starting from 2001 certification is carried out by a public organization "Vides Kvalitate" and since 2003 also by a non-profit organisation, the state company "Certification and testing centre".
The following institutional system is in place for inspections, certification and surveillance of organic agriculture:

- Ministry of Agriculture – elaboration of policy and legislation, development of the sector strategy;
- The State Food and Veterinary Service - the competent authority;
- The State Plant Protection Service - the competent authority;
- Public organization "Vides Kvalitate" – control body;
- Non-profit organization, the state company "Certification and Testing Centre" – control body;

Organisation

In the field of organic farming 5 public organizations are functioning. Association of Latvian Organizations for Organic Agriculture is the umbrella organisation and deals with the preparation and dissemination of the information of the organic farming among farmers and representatives of public, education and advisory.

In 1995, an Association of Latvian Organizations for Organic Agriculture was established, its current membership amounts to 608 members. Association of Latvian Organizations for Organic [illegible] and approved logo of organic products.

Logo

ORGANIC AGRICULTURE IN ESTONIA

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General information on the situation of agriculture in Estonia
The share of agricultural land in Estonia is rather low. At the beginning of 1999, the area of agricultural land was 1,433,100 hectares, and the area of arable land 1,119,800 hectares (24,8% of the total area). The situation of the agricultural sector is not good, salaries are only around half of the Estonian average, prices are unstable and sometimes lower than the own price of the product. This situation, combined with the still ongoing land privatisation process, are the main reasons for around 21% of the arable land being abandoned.
The present agricultural situation provides clear opportunities to develop organic sector.

History and development of organic agriculture
The organic farming movement in Estonia started with the establishment of the Estonian Biodynamic Association (EBA) in 1989. At the beginning of 1990-ies EBA organised in co-operation with Finnish, Swedish and German biodynamic and organic farming organisations several training courses. Also several farmers had 3-6 month practical training in these three countries. There were several local producer organisations established (e.g. in Võru, Saare and Lääne county). The foreign experts helped to advise and control the farms. In the middle of 1990-ies the development slowed down as well as the training activities. The next rise was starting from 1997-1998. In 1997 the Act on Organic Farming came into force and in 1998 according to this act the state label “MAHEMÄRK” was introduced. Since the beginning of the 1999 development of the organic sector has been more rapid.

Statistics on growth of organic area and number of farms

In 1999 there were 89 organic or transitional farms, 2 processors and 1 catering company, which were certified according to the requirements of the state label (label "MAHEMÄRK"; see standards and certification below). There were also 25 additional farms (with 600 ha of agricultural land), which were certified in accordance with Estonian Biodynamic Association standards (label "ÖKO"). In total there was around 4000 hectares of controlled agricultural land in 1999 (accounting for 0,4% of agricultural land in production).

In the year 2000 there are 238 farmers (including 172 transitional) with around 10 000 ha which had applied for the state label "MAHEMÄRK". The rapid rise was mainly due to the intensive promotion work by organic producers' organisations in 1999, the increased interest of the state in developing organic farming (including area support payments from 2000) and better training possibilities in the spring 2000. Most of the new farms are in the regions with extensive agriculture, although recently there are several larger farms and agricultural enterprises in the regions of intensive agriculture that have shown interest.

Organic Agriculture Organisations

There are three organic farming organisations:

- Estonian Biodynamic Association was established in 1989. By the end of 1999 there were 86 members from all over Estonia.
- Kagu-Eesti Bios was established in 1997. By the end of 1999 there were up to 60 members coming from the three Southeastern counties of Estonia.
- The Society of Estonian Organic Producers is newly (May 2000) established and involves mostly larger enterprises.

There are also several local producers' organisations – in Lääne, Saare and Viljandi counties.

Regional distribution of organic farms

Most of the organic and transitional farms are clearly concentrated into three regions - South-east Estonia (Võru, Põlva and Valga counties), Saaremaa island (Saare county) and West-Estonia (Lääne county). These areas have had traditionally extensive agriculture because of the natural conditions and therefore the transition to organic farming was relatively easy. There are also strong leaders who are promoting organic farming at a regional level. The most rapid growth in the number of organic farms is presently in South-east Estonia.

There are also several organic farms in other regions, but much less than in the three regions mentioned above. In 2 counties from 15 there were no organic farms in 1999.

Land use, animal husbandry

Most of the organic farms are mixed farms. But there are a few farms specialising in vegetable, herb and berry production or apiculture. In 1999 only one farm specialised in seed production.

The most common animals in organic farms are cows.

Standards and certification, state regulations

The first standards in organic farming were developed by the Estonian Biodynamic Association in 1990. According to these standards farmers may apply for the label "ÖKO".

The standards were based upon IFOAM basic standards. At present it is planned to add several amendments and in few years use the label for transition to biodynamic farming.
As well the control system needs amendments.
As already mentioned before, the state started to regulate organic farming from 1997 with the Act on Organic Farming. According to this act and related regulations, the state label "MAHEMÄRK" is given from 1999. State forwarded the right to give "MAHEMÄRK" to two organisations (Estonian Biodynamic Association and Kagu-Eesti Bios). These organisations are controlling farms twice a year. Certification is done under state supervision. There are two bodies responsible for state supervision – Estonian Plant Inspectorate (for production) and Estonian Veterinary and Food Inspectorate (for processing).
From the year 2001 this system is being changed and the new system will operate in accordance with EU requirements. The main constraint of the present system is that these two certification bodies are not yet accredited according to EU standard EN45011. Therefore state authorities Plant Production Inspectorate and Veterinary and Food Agency will be inspection authorities since there is not any accredited inspection body.
Both labels introduced are presented below:

State label (used from 1999)

Label owned by Estonian Biodynamic Association (used from 1990)

Implementation of EU regulation 2092/91

The present Organic Farming Act (passed in 1997) does not fully correspond to EU regulation 2092/91. By the January of 2001 this act and accompanying regulations are being harmonised with EU legislation in organic farming (including 1804/99).

State support, policy initiatives

Interest in organic farming has increased rapidly in the Ministry of Agriculture since 1999. A person responsible mainly for organic farming was employed and several support possibilities for the year 2000 were generated (e.g. co-financing of research and training projects). From the year 2000 the state is supporting organic farmers by paying area payments for both being transitional and organic agricultural land. Currently, the rate of the payment will be same for being transitional and organic land, however there is discussion to pay higher payment during the transitional period in the nearest future.

Implementations of Agenda 2000
Estonian Agri-Environmental Programme, which corresponds to the requirements of the new rural development regulation (EU Regulation 1257/99) is in preparation. This programme will include organic farming as one of the measures. But right now it is too early to tell whether before the EU accession the whole programme or only some measures will be implemented.

Marketing
The marketing of organic products is rather weakly developed. There are several new initiatives coming up presently but consumers still have difficulties to find any organic products in the shops.
The most common methods of the marketing are on-farm sales, selling to the hospitals, schools, kindergartens and local shops. There are relatively few farms selling processed products, although this presents one of the greatest possibilities for development. A relatively high share of organic products is not sold as organic (e.g. for the large dairies and therefore mixed up with conventional milk) or are sold without using organic label (even if the farm is certified and has the right to use label).
At the end of the 1999, Ministry of Agriculture ordered a consumers' survey. The survey showed clear interest to buy organic products and agreement to pay around 10% higher price for the products. But the present production quantities and range of products does not meet consumers' needs.

Training
Most of the training for farmers have been organised by the two producer organisations. Kagu-Eesti Bios has organised information days mostly in co-operation with Räpina Training Union. Estonian Biodynamic Association has training and information days for farmers every second month in different regions all over Estonia and in addition to this some training courses per year. In 1999 several of these training activities were supported by the Ministry of Agriculture.
Beside the above-mentioned organisations there are several training activities organised by Centre for Ecological Engineering.

In different years several agricultural schools have introduced basic principles of organic farming.

Estonian Agricultural University does not offer any specific courses in organic farming but a few courses include introduction of organic farming methods as part of the course (e.g. plant protection, animal husbandry). The only special course (one-week post-graduate course) in organic farming was organised in co-operation with Swedish Agricultural University, Centre for Ecological Engineering and Estonian Agricultural University at the beginning of 1999.

There is a great lack of appropriate information materials. Only few booklets are published.
From 1991- 1994 a newsletter on organic farming ("Elav maa" – living earth) was published by the Estonian Biodynamic Association. Since 1996 there is a journal on organic farming ("Mahepõllumajanduse leht") published by the Centre for Ecological Engineering. The journal publishes mainly articles on applied research and practical farming, country and farm overviews, news on organic farming and introduces the new literature published worldwide.

In 2000 there was planned to publish booklets introducing the basic principles of organic farming and start to compile the handbook in organic farming. The Ministry of Agriculture was supporting these publications.

Advisory service

There are only three accredited organic advisors in Estonia. Farmers' interest to use this service differs a lot. Farmers applying for the label from Kagu-Eesti Bios (South-Estonia) are pushed to use this opportunity because it is one of the prerequirements in applying. But the farmers in other regions of Estonia are not interested to make advisory contracts despite the fact that the state is co-financing dominating part of the contract cost.

Farmers who started organic farming more than six years ago and have got rather good training do not have the need for advice and they are often giving advice themselves to other farmers in the region.

There is great need for training some new advisors specialised in organic farming and introducing general principles of organic farming also to the conventional advisors. Some activities connected with this need were already planned for the year 2000.

Research

Relatively little organic farming research has been done but the great importance of the research is clearly recognised by several institutions dealing with organic farming.

The Estonian Agricultural University has had a few projects including organic farming, but most of these projects were connected with plant protection. Interest in developing research in organic farming exists, but finding the necessary financing is problematic.

The only pilot research project in organic farming was implemented by Danish Institute of Agricultural Sciences and Centre for Ecological Engineering in 1998. This project aimed to get the overview of the main problems in organic farms with special attention to dairy farms. It was planned to continue with the project in 1999 but financing needed from Estonian side was not found and project stopped.

Some vegetable and grain variety tests are made in South-east Estonia with initiative of the local trainers.

In 2000 there were some organic farming applied research projects started. The Ministry of Agriculture was supporting the implementation of these projects, e.g. on-farm research to find out appropriate crop rotations and grain varieties was started in April 2000 (managed by Centre for Ecological Engineering, supported by the MoA), study on finding out the appropriate potato varieties (managed by DIAS and Jõgeva Plant Breeding Institute) and few others.

Challenges and Outlook

Taking into account the present agricultural situation, development of the organic sector in 1999/2000 and consumers interest, there is great potential for the rapid development of the sector in close future. It is expected to have 50 – 100% increase in organic production per year during the next few years.

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OFFICIAL CONTROL OF FOOD SAFETY IN LITHUANIA

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Introduction

Lithuania is a small country at the Baltic Sea with a population of 3.6 million on the area of 65 000 square kilometres of picturesque landscape.

Upon the re-establishment of the independence in Lithuania, there was a great need for the new legislation and the Law on Veterinary Activities passed by the Seimas (parliament of the country) in 1992, was among the first legal acts of the young independent state. In the year 2000, upon the reorganisation of the State Veterinary Service of the time with its subordinated institutions, and also of the State Hygiene Service under the Ministry of Health and of the Inspection of Quality, a new institution - the State Food and Veterinary Service (SFVS) was established, which took over the functions of the mentioned authorities and has been effecting food control since in all the chains of food handling.

Organisation and structure

The central office of the SFVS has an administration headed by the director who is the chief veterinary officer (CVO) of the country and reports directly to the Prime Minister.

The system of the SFVS includes: the central office with the subordinate institutions: National Veterinary Laboratory, Border and Transport State Veterinary Service, State Inspection of Veterinary Preparations, also, 10 county SFVS, 4 city SFVS and 34 district SFVS.

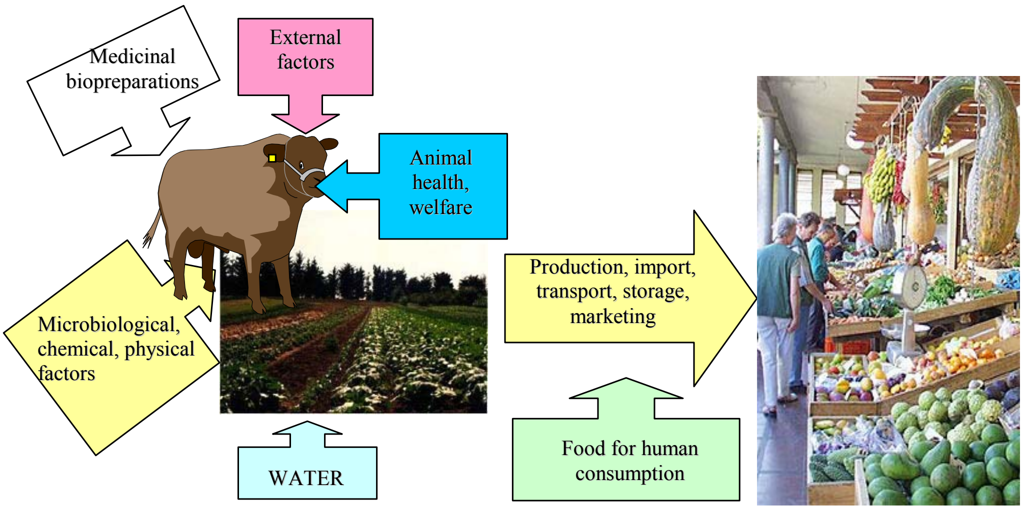
The director has 4 deputy directors. The central SFVS is composed of 9 departments. Internal activities of the SFVS are organized by department heads, which are directly responsible to director.

Tasks and responsibilities of the SFVS

Food safety is one of the first priorities of the government institutions of our country, as well as those of other European states. In this respect the SFVS of Lithuania performs an important role.

The main tasks of the SFVS are to:

1. Safeguard the interests of consumers in order to ensure that the food supplied on the domestic market and intended for export complies with the established mandatory requirements for safety, labelling and other mandatory indicators established by law.
2. Prevent the introduction of contagious animal diseases into the country, to protect the national animal population from infectious diseases, and to ensure the welfare of animals.
3. Ensure veterinary and hygiene control at all the stages of food handling (from crop and food animal production to supply of food to the consumer).
4. Implement and accredit the common EU policy and inspection in accordance with the European standard EN 45004 General criteria for the operation of various types of bodies performing inspection.



SFVS is responsible for control of food "from stable to table" – including animal health and welfare, medicines, bio-preparations, and "from field to fork" - physical, chemical, microbiological factors, water, production, transport, storage and marketing of food.

Food control organisation

Primary Lithuanian veterinary legislation is Law on Veterinary Activities – framework act, regulating all veterinary activities in accordance with international requirements, establishing state and private veterinary. Secondary legislation: government resolutions, orders by the State Food and Veterinary Service Director. Third – Food law, this food safety regulation has significant consequences for national food legislation, the safety of food products and beverages and the organisation of scientific food safety assessment. The regulation explicitly holds a company responsible for ensuring that its operations and products fulfil the legal requirements for food safety. Food Low will also influence supervisory methods with respect to tracing product and the way in which companies deal with production incidents. The new food hygiene regulations are expected to come into force in January 2006. The most important change concerns the comprehensive introduction of the HACCP principles in the whole food chain, with the exception of the primary agriculture and horticulture.

Central SFVS develops and coordinates control, and prepare analysis and assessment of data, issue requirements and instructions for common implementation of the policy. County SFVS coordinate and analyse activities of the district SFVS. District and city SFVS inspectors carry out an inspection, implement inspection programmes and perform official sampling. Official analysis of samples is carried out in the National Veterinary Laboratory, which is accredited according to LST EN ISO/IEC 17025.

Food supervision in Lithuania is based on:

- EU and national legislation,
- Risk analysis prepared by Risk and Quality Management Department,
- Sampling plan and Inspection plan drawn by the Food Department, according to resources, risk analysis, data of past years, new information, etc.

SFVS of the Republic of Lithuania have a good cooperation with European Commission. State Food and Veterinary Service makes analysis of inspection data and scientific risk assessment and receives scientific support from Lithuanian Veterinary Academy. LVA communicate with European Food Safety Authority.

According the risk assessment of the food products and establishments are broken into high, medium or low risk groups.

Food control is planned, on the basis of all factors and unplanned, too. Unplanned inspection depends on consumer complaints, rapid alert notifications, epidemiological situation, and information from the Ministry of Agriculture.

The SFVS is a strictly centralized service, independent of the regional mayor’s office. Therefore communication of information is highly important. Recently a good computerized system has been introduced. Each county and district have both Internet and intranet connection. The division of functions between the SFVS institutions is clearly defined. The control systems TRACES, RASFF and internal Lithuanian RASFF are in full operation and the food inspection system are in the way.

SFVS directly receives from the European Commission notifications on unsafe food and feed. Risk and Quality Management Department have specialists responsible for RASFF, who react promptly and forward notification to specialists of headquarters and regional SFVS. In a similar way notifications are sent to the European Commission.

In Lithuania, SFVS has an important role to public relations activities and to the build-up of consumer awareness. The round-the-clock hotline based at our service is used to receive information about the arising problems. Analysis of the complaints received from the consumers is made and the control measures are arranged accordingly. The activities of the

service are regularly highlighted in national and local mass media. As a result of combined measures we haven't had any major cases of poisoning with food or other hazards.
In the whole chain, inspectors are the most important factor. Considerable funds are allocated to the training of the staff. They should be well familiar with the HACCP and other systems. The EU has provided enormous support. During the eight years of integration, TAIEX office has held hundreds of seminars and workshops, and has offered 12 PHARE projects.
The staffs of the central office are greatly concerned about their own professional development and have a good motivation to cascade the knowledge they acquire in different ways, to the regional link of our service. Supply of information to the farmers is highly important for the progress of veterinary sector of the country. In the accession period, all the participants of the food chain – farmers, manufacturers, traders and veterinarians, had to use a lot of effort and knowledge in order to face the challenges, which the enlargement of the EU has posed to all the applicants.

CROP BREEDING FOR ORGANIC FARMING – CURRENT SITUATION IN LATVIA

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Abstract
Organic production, including organic farming, becomes significant in sustainable economic development of the state. Besides different research projects in organic farming, trials on different crop variety suitability testing was started in 2003 with support of the Ministry of Agriculture. Crop variety choice for organic farmers has to be extended. Plant breeders from Priekuli and Stende Plant Breeding Stations have worked out joint project "Evaluation criteria of field crop genetic resources in breeding for organic farming". The expected results could become basis for each of crop breeding scheme for organic farming. Conducting of breeders' opinion pool proved that Latvian field crop breeders understand the importance of the problem and are able to begin breeding of several crops for organic farming.
Key words: *breeding, organic farming, project*

The development of organic movement

The first significant activities in organic farming in Latvia started in early 1990ies. The significant influence of German organic and biodynamic farming was observed at that time. The Association of Latvian Organic Agriculture Organizations was established in 1995. It is a professional organization in the framework of which people producing, processing and selling organic agriculture products as well as people supporting organic movement have been united (http://www.ekoprodukti.lv). One of the aims of the association is to find ways of improving production system and providing education possibilities. The first 39 organic farms were certified in 1998 and their number increased to 1043 in 2004 being registered in

Veterinary and Food Department of the Ministry of Agriculture (http://www.pvd.gov.lv/doc_upl/KARTE_BL_2004.pdf). Regulations on organic product certification and turnover were elaborated and introduced by the Ministry of Agriculture (MA). The government has allotted subsidies to organic products producers since 2001. Requirements for EU regulations 2092/91 on organic production were enacted in Latvia from 1 May 2004. Organic production, including organic farming, has become important in sustainable development of the state economics.

The research trends

The development of organic farming system has raised a lot of questions regarding effective and qualitative organic crop production. The old traditional methods do not solve all problems, because technology is different today. The experience from abroad is not always suitable for local conditions. The necessity of research and trials in our country arose. Besides different investigation projects, one of the cases was choice of suitable varieties for organic growing conditions. First trials on different crop variety testing for suitability to organic farming were started in 2003 with support of MA. Conditions for plant growth in organic field are different from conventional one; the use of suitable variety more extensive rather than intensive was proved during these trials. The extensive type varieties are mostly old, out of use varieties or local varieties, which have not been registered and passed DUS test. There are not many extensive varieties in Plant Variety Catalogue and not every variety of extensive type satisfies consumers' requirements. In plant breeding for organic farming different traits and trait expressions may be needed for selection of appropriate genotypes. As it is known from breeding research, the most suitable for local growing conditions are locally bred varieties.

In 2003 MA accepted Organic Farming Development Programme for 2003 - 2006 (http://www.zm.gov.lv). A chapter about research on organic farming was included in this Programme. One of the planned activities was crop breeding and assessment of selection criterion for organic farming. The investigation was expected to carry out in Priekuli Plant Breeding Station. Unfortunately this activity was left without financing.

Crop breeding project

Presidium of the Latvian Academy of Agricultural and Forestry Sciences in January 2004 approved priority research trends for the years 2004 – 2006. One of the trends in crop production was crop breeding for organic farming.

The breeders from Priekuli and Stende Plant Breeding Stations have worked out joint project "Evaluation criteria of field crop genetic resources in breeding for organic farming" and submitted it into the Latvian Council of Science in June 2004.

The following field crops were expected for investigation: spring barley, spring oat, winter and spring wheat, winter rye, winter triticale, pea and potato.

The aim of the project was to determine the criteria for evaluation of field crop genetic resources considering genotypic diversity and genotype–environment interaction for ensuring stable and qualitative yields under conditions of organic farming.

The main tasks were to:

- Evaluate genetic resources of field crop species in relevance to utilization of fertilizing elements and stability of most important traits under organic conditions.

- Evaluate growing potential of various genotypes under the influence of biotic and abiotic factors.
- Determine the most important traits and optimum expressions to be utilised as selection criteria in plant breeding for organic farming.

The investigated traits would be related to:

- Ability of utilizing fertilizing elements in vegetation period (earliness, appropriate plant morphology) resulting in yield and quality of a crop.
- Plant competition ability with weeds (plant morphology, speed of development, tolerance to weeds).
- Resistance to most important diseases and pests.
- Stability of the main traits under varying environmental conditions.

The expected results could become a basis for each scheme in crop breeding for organic farming:

- Most important traits of field crop species in organic farming and optimum expressions of traits for application in selection could be defined.
- Relationships between traits to be investigated.
- Appropriate genotypes for starting a programme in plant breeding for organic farming would be identified.
- The obtained knowledge would be disseminated among organic farmers and agricultural students.

Nine researchers, including five persons having been awarded Doctor degree, four of them having defended PhD thesis during last three years, and one PhD student were planned to be involved in project. The work with breeding programmes was planned for three years.

The project was not accepted for financing in conformity with the Latvian Council of Science resolution Nr. 1-1-1 on 25 January 2005 (http://www.lza.lv).

Crop breeders' opinion

To clarify the opinion of plant breeders from Latvia regarding field crop breeding for organic farming, the inquiry was carried out. The answers were received from 19 breeders currently involved in crop breeding work. The breeders represented spring and winter wheat, winter rye, triticale, spring barley, spring oat, flax, perennial grasses, pea, potato and vegetable breeding programmes. The received answers indicated, that plant breeders have thought about this problem. There was a possibility to answer in questionnaire with "I don't know", but this opinion was not chosen at all.

The great majority of respondents were sure, that breeding for organic farming in Latvia was necessary. Only two breeders were of the opinion that foreign varieties and varieties bred earlier could meet the needs of producers.

Concerning currently used varieties in Latvia, most of breeders considered, that requirements of organic farmers and producers could be met only partly, one respondent was not sure, that these requirements could be met at all. These answers ascertained that crop variety selection for organic farmers have to be enlarged.

An interesting discussion rose when discussing most important and essential traits in breeding for organic growing conditions. All breeders were sure, that resistance to most dangerous diseases and pests was important for future organic varieties (Figure 1).

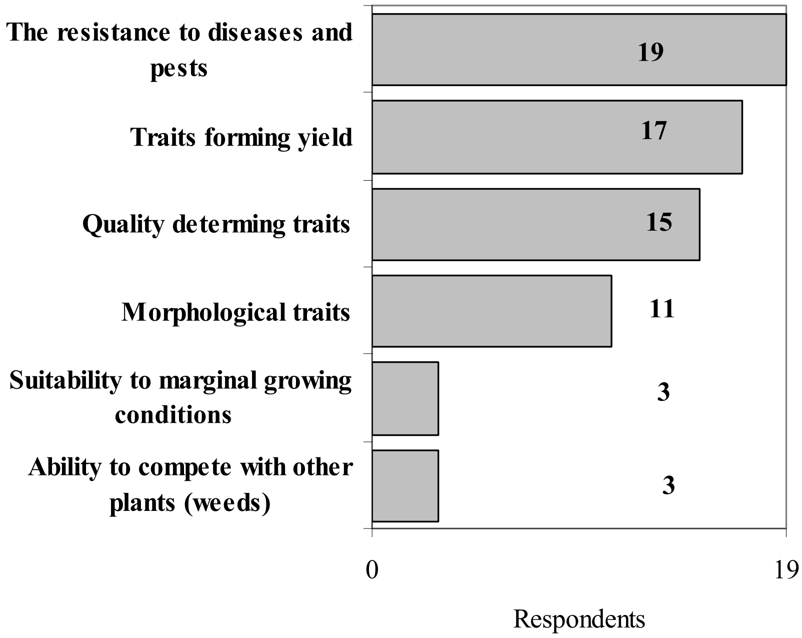

Figure 1. Importance of traits in breeding for organic farming as assessed by crop breeders

Crop breeders considered, that yield formation traits (for cereals – length of spike, kernel per spike, etc.) were more significant than quality determining traits (starch content, protein content, etc.), but both trait groups were assessed as important. Less attention was paid to morphological traits, however some of them (plant type, plant leave shape, etc.) could be crucial in competitiveness with other plants or in plant nutrient uptake, etc. Some breeders rated new varieties suitability to marginal growing conditions (drought, frost, etc.) or flexibility and plant ability to compete with other plants including weeds as very important traits. Some suggestions were added in questionnaires. High intensity of plant nutrient uptake, fast emergency, suitability to local growing conditions and suitability to variety mixes were considered as significant for organic farming.

How great is Latvian breeders' investment in undertaking breeding for organic farming? A half of respondents have acquainted themselves or have started acquainting themselves with scientific literature findings on this theme from Internet, books, scientific issues, etc. One third of breeders have taken part in scientific conferences, workshops and other international activities connected with organic breeding. Those people are informed and involved in ongoing processes in Europe and the world. More than half of breeders (67 %) have been involved in crop variety suitability testing for organic farming. Those respondents have practical experience in variety evaluation in organic field.

Three of respondents-breeders have started evaluation of selection criteria; two have started the breeding material evaluation in organic field and one has started assessment of breeding material according evaluated selection criteria. These activities are dependent only on breeder's own initiative and enthusiasm yet.

Organic farming is going to take a significant place in Latvian economy. The necessity of broader crop variety choice will develop in near future. Latvian field crop breeders are able to begin breeding of several crops for organic farming. Some contribution has been done in this direction, actually the financial support is significant for future work.

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PROBLEMS AND PROSPECTS IN PLANT BREEDING FOR ORGANIC FARMING IN ESTONIA

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Abstract
Organic farming is on the increase in Estonia. The varieties are grown in organic agriculture in completely different conditions compared to conventional management. Organic farmers value some specific characteristics of varieties like adaptability to lower soil fertility levels, yield stability, ability to suppress weeds, resistance to diseases and pests and quality characteristics. A number of varieties have been recommended for organic farmers on the basis of conventional trials at the Jõgeva Plant Breeding Institute from among the National List of Varieties. Barley varieties 'Anni' (Estonia), 'Esme' (Estonia) and 'Inari' (Finland), oat variety 'Jaak', spring wheat varieties 'Manu' (Finland), 'Helle' (Finland/Estonia) and 'Meri' (Finland/Estonia), winter wheat variety 'Ada' (Lithuania), winter rye varieties 'Sangaste', 'Viku' and 'Elvi' (Estonia), field pea varieties 'Mehis' and 'Kirke', winter turnip rape varieties 'Largo' and 'Prisma' (Sweden/Estonia) turned out to be more suitable for organic farming. Variety testing in organic conditions will be planned for more reliable testing of the suitability of present varieties for organic management. Special breeding programs are needed to breed varieties adapted for organic conditions.
Key words: *organic farming, varieties, testing, breeding*

Introduction
Organic farming has shown increasing popularity in Estonia during recent years. The acreage of arable land in organic tillage has been increased from 4000 ha in 1999 up to 46 000 ha in 2004. It takes about 5.5 % of the total agricultural land in Estonia. There were 810 organic farms up to the end of 2004 (Ader, 2004). Due to this, the question of the kind of varieties organic farmers should be using becomes increasingly important. Are the varieties used in conventional agriculture also suitable for use in organic management? What kind of specific traits should the varieties used in organic agriculture have?

Specific demands of organic farming to varieties
Conventional breeding efforts have largely developed in response to the demands of intensive agriculture production (i.e. increased yields through dependence on external inputs of synthetic fertilizers and pesticides). Alternatively, organic farming supports a philosophy of promoting the self-regulating principles of the soil, the plants, and the animals. Many inputs used in conventional farming are not permitted in organic farming (Singh, 2002). Many selection criteria, e.g. resistance to many pests and diseases and abiotic stress factors have similar importance in both organic and conventional breeding systems (Vogt-Kaute, 2001). But there are traits associated with conventional varieties, which are unsuitable for organic production system and certain traits required in organic farming systems are not present in recently developed "conventional" varieties (Singh, 2002).

Specific traits of organic varieties
Every field crop can have some specific qualities valuable in organic agriculture. This may be resistance to some disease or unique quality trait. There are some general properties organic farmers appreciate in most crops.
Yield and yield stability. Usually the yield has an over-riding priority in non-organic breeding programs but will often have a lower priority in organic breeding, relative to quality, for example (Wolfe, 2002). Organic farmers put more emphasis on higher yield stability over the years rather than on higher yields with the risk of losing the extra kilos because of disease susceptibility (Lammerts van Bueren, 2003). The varieties used in organic farms should be well adapted to specific conditions of this agriculture. Adaptation to low(er) and organic inputs; ability to cope with fluctuating N-dynamics (growth stability); efficiency in capturing water and nutrients; deep, intensive root architecture; ability to interact with beneficial soil microorganisms; efficient nutrient uptake; high nutrient use efficiency are the valuable traits of organic varieties (Lammerts van Bueren, 2002). The organic varieties should maintain steady plant growth without stress under fluctuating water and nutrient availability (Lammerts van Bueren, 2003).
Cereal varieties with longer straw have often got more root mass, so they have a better ability to take up nutrients (important under conditions of lower concentration of nutrients) (Vogt-Kaute, 2001). Also, yield stability can be raised by a better control of diseases and pests (Lammerts van Bueren, 2002). To get the best possible yields on a given site, growers use varieties that are adapted to that particular environment and to nutrient levels, which fluctuate with the seasons (Lammerts van Bueren, 2003).
Weed suppression ability. Weeds are often cited as the most significant problem in organic farming systems. The organic farmers require varieties that have a rapid juvenile growth and the ability to cover or shade the soil in an early stage of crop development to out-compete weeds for light. A denser crop canopy improves the crop's ability to compete with weeds (Lammerts van Bueren, 2002). For example many modern wheat varieties from conventional breeding start developing late in spring and give poor early growth (and tillering) under organic conditions. This gives unbalanced and open crops. The growth pattern of modern varieties results in reduced ground cover, which reduces the plants' ability to compete with weeds. (Lammerts van Bueren et al., 1998).
Ability resist to pests and diseases. Further optimisation of the organic production can be supported if the yield stability is raised through a better control of diseases and pests (Lammerts van Bueren, 2003). As organic farmers use prevention rather than control

measures to suppress pests and diseases, the resistance of the varieties should be effective and durable. The ability to resist pests and diseases is based on more than a plant's absolute resistance. Absolute, monogenetic resistance is likely to break down sooner or later. From an organic point of view, each of the varieties used in this way should have a broad-based resistance. In combination with management measures, such varieties should be adequately resistant to diseases and pests (Lammerts van Bueren et al., 1998).

Some diseases decrease in importance in organic management systems since disease pressure is generally lower in organic agriculture compared to the conventional management (Vogt-Kaute, 2001). Diseases that are common in conventional farming due to high crop densities and frequent nitrogen applications, such as mildew in cereals, are rarely a problem in organic farming. (Lammerts van Bueren et al., 1998).

Crop quality. Organic farmers pay much attention to quality characteristics such as taste, keeping quality, form, structure and color of a product. Quality is controllable when a farmer carefully selects variety characteristics, soil type and management strategy. Firmness and early maturity are important for a good quality product. Sometimes specific characteristics are important, baking quality in bread wheat, for instance, and malting quality in barley. For baby food and juice processors low nitrate levels in the end product are important. Food processors are increasingly looking for organic products and demand improved variety characteristics and optimised management measures (Lammerts van Bueren et al., 1998).

Development of organic breeding programs should also provide new opportunities. In breeding for quality, one aspect that might be included is breeding plants for human health. In addition to nutritional value (high protein, for example), some secondary metabolites may be valuable in resistance to human diseases (Wolfe, 2002).

Present varietal situation and the main problems of crops in Estonia from the organic point of view

Estonian organic farmers are using varieties bred out for conventional agriculture at the present time. These varieties are on the Estonian National List of recommended varieties. Some of them are of local origin, and others are included to the list from abroad. The suitability of these varieties for Estonian local conditions has been tested in conventional trials of official state testing. The plant breeding of most field crops grown in Estonia and some vegetables is carried out at the Jõgeva Plant Breeding Institute. Varieties of cereals (barley, oat, winter and spring wheat, winter rye), potato, winter turnip rape, field pea, forage grasses and legumes, vegetables (tomato, garden pea) are being bred here. Breeding work is mainly aimed towards conventional agriculture.

Field trials of cereals have been carried out at the Jõgeva PBI where varieties were grown in lower nitrogen levels and not treated with pesticides and fungicides. Variety comparison trials of tomato and potato have been carried out under organic conditions. A number of varieties have been recommended to organic farmers on the basis of these trials.

Barley. Most of the listed modern barley varieties have a short straw, weak weed suppression ability and quite high demand for nutrients. Barley in Estonia is susceptible to some diseases: net blotch (*Pyrenophora teres*), spot blotch (*Cochliobolus sativus*), scald (*Rhynchosporium secalis*), loose smut (*Ustilago nuda*), and barley leaf stripe (*Pyrenophora graminea*). Among these, net blotch is more widely spread. Barley has a shorter growing period compared to other cereals and it is a good cover crop. Barley can be grown after most of pre-crops. The more suitable varieties for organic farming can be ‘Anni’ (Estonia), ‘Esme’

(Estonia) and 'Inari' (Finland). 'Anni' has a good tolerance to drought and to abundance of moisture. This variety has a very good lodging resistance and it is not affected by loose smut. 'Anni' is suitable for growing in more fertile soils. 'Inari' has a high yield, average growing period and good lodging resistance. It is a good cover crop and suitable for growing in more acid soils. The straw length of 'Inari' is above average. 'Esme' gives a good grain yield on soils with lower fertility levels and has good yield stability over years.

Oat. Next to rye, oat is the most versatile of the cereals in regard to soil type. Almost any reasonably fertile, well-drained soil is suited to oat. Nutrient requirements for oat are less than those for wheat (Forsberg and Reeves, 1995). Oat is able to produce well with only moderate amounts of fertilizer (Schrickel, 1986). Taller varieties have good ability to suppress weeds. Oat is more sensitive to shortage of moisture than other cereals (Forsberg and Reeves, 1995). The crop has good disease resistance under Estonian climate conditions. Crown rust (*Puccinia coronata*) is the main oat disease in Estonia. Estonian variety 'Jaak' can be recommend for organic producers on the basis of the present trials. 'Jaak' has a stable and good grain yield, good lodging resistance, high 1000-grain weight with protein content above average and medium growing period. The straw length of 'Jaak' is taller than average. The variety is medium resistant to oat crown rust and resistant to cereal cyst nematode (Heterodera avenae).

Spring wheat. Wheat demands more fertile soil compared to barley and oat. Wheat suffers from a number of diseases: septoria (*Septoria tritici, Septoria nodorum*), powdery mildew (*Blumeria graminis*) leaf rust (*Puccinia triticiana, Puccinin recondita*), stinking smut (*Tilletia caries*), loose smut (*Ustilago tritici*). The varieties 'Manu' (Finland), 'Helle' (Finland/Estonia) and 'Meri' (Finland/Estonia) can be recommended for organic farmers. 'Manu' has tall straw, good baking quality, medium resistance to diseases. The advantages of 'Helle' are good baking quality, short growing season, very good lodging resistance and good resistance to mildew. The variety has an average yield potential. 'Meri' has good baking quality and lodging resistance as well as good resistance to mildew. The yield potential of the variety is above average and straw length on the average level.

Winter wheat has better nutrient uptake and ability to suppress weeds compared to the spring wheat. Disease resistance is an important factor in the selection of varieties similar to spring wheat. Additionally, winter wheat suffers from snow mold (*Mographella nivalis*). 'Ada'(Lithuania) will be potentially more suitable variety for organic agriculture. The variety has good baking quality, above average straw length, good disease resistance and winter hardiness.

Winter rye is well suited for organic agriculture. Due to deep and large root system, the crop is able to grow well at low fertility levels and successfully survive dry periods. Tall straw gives the rye a good ability to suppress weeds. The crop has a good tolerance to diseases. Snow mold (*Mographella nivalis*), and ergot (*Claviceps purpurea*) are the main diseases of rye. Estonian varieties 'Sangaste', 'Viku' and 'Elvi' can be recommended for organic agriculture. 'Sangaste' is the oldest variety in Estonian variety list and is well adapted to local conditions. It has been bred out 130 years ago when artificial fertilizers and chemical treatment were not used. The variety is unpretentious of growing conditions and gives a normal yield in low fertile soils as well. 'Sangaste' has a tall straw (up to 180 cm) and it gives the variety a very good ability to suppress weeds. Variety is well adapted to surviving the hard Estonian winter. 'Viku' is bred out for soils with low fertility levels. The variety has good winter hardiness, average grain yield and straw length. 'Elvi' is a variety with good grain yield, quality, resistance to diseases and winter hardiness. The straw length of 'Elvi' is on the average level.

Field pea is a valuable crop in organic agriculture due to its ability to supply the soil with nitrogen. Due to this property, it is a good pre-crop for cereals and potato. Field pea is also a valuable source of protein. Main shortages of the crop are its weak ability to suppress weeds due to slow initial development, lodging, diseases and pests. In Estonia, field pea suffers mainly from Ascochyta blight (*Aschocyta pisi*) and attacks by pea moth (*Cydia nigricana*). 'Mehis' (Estonia) can be recommend as food and 'Kirke' (Estonia) as feed variety for organic producers. 'Mehis' has a very good taste, average yield and disease resistance. The protein content of the variety is above average. 'Kirke' has an average seed yield, good green forage yield, and high protein content. Variety is well suited for growing in cereal mixtures.

Winter turnip rape is less demanding of soil fertility than spring rape or spring turnip rape. The crop has a good ability to suppress the weeds due to early spring development. It doesn't suffer seriously from diseases and pests. Alternaria leaf spot (*Alternaria brassicae*) can damage the winter turnip rape to some extent. The yields of winter turnip rape are unstable over years due to weak winter hardiness of the crop. Varieties 'Largo and 'Prisma' (Sweden/Estonia) are on the Estonian National List. 'Largo' has a yield potential above average, good ability to suppress weeds, average oil content. 'Prisma' has average yield and superior oil content compared to 'Largo'. Both varieties can produce successfully without treatment with pesticides, herbicides and fungicides. 'Largo' and 'Prisma' have shown good yield in lower fertilizer levels in conventional trials.

Future prospects

The recommendations for the selection of varieties made to organic farmers on the basis of conventional trials could only be an initial solution. The organic farming system differs fundamentally from conventional agriculture in the management of soil fertility, weeds, diseases and pests. Organic farmers require varieties better adapted to organic farming systems for further optimisation of organic agriculture (Lammerts van Bueren, 2002). The suitability of existing conventionally bred varieties for organic agriculture can be evaluated reliably only under organic conditions. Next steps will be planned at the Jõgeva PBI to better satisfy the needs of organic farmers for adapted varieties:

- Testing the listed varieties under organic conditions.
- Testing the older local varieties under organic trials.
- Starting limited breeding programs for organic farming.

Evaluation of existing varieties under organic conditions will give more reliable information on the suitability of these varieties for organic farming. Organic breeding programs will give an opportunity to breed for specific characteristics valued in organic farming, like high nutrient use efficiency, ability to suppress weeds etc. The possible amounts of organic breeding will be limited due to the little share of organic farming in total agriculture. The start of variety testing and breeding programs depends a lot on finding necessary financing.

Conclusions

The conditions in organic farming system are fundamentally different from those in conventional management. For this reason, organic farmers require varieties with specific characteristics, which are adapted to these conditions. A number of varieties of barley, oat, spring and winter wheat, winter rye, field pea and winter turnip rape have been recommended for Estonian organic farmers at the Jõgeva PBI on the basis of conventional trials. More reliable evaluation of the suitability of the present varieties for organic agriculture needs special trials under organic conditions. Organic breeding programs need to be created for breeding specific traits valued in organic breeding.

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ORGANIC PLANT BREEDING: SKETCH IN STARTING POSITIONS

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Abstract

According to the long-term national agricultural development strategy, the area under organic farming should account for about 15 % of the total cultivated area by the year 2015. This means that 120 - 150 thousand ha of cereals; 50 - 60 thousand ha of grasses will be grown following the requirements for organic or sustainable farming. The annual demand for organic seeds of cereals will amount to 24 - 30 thousand t, of grasses 180 - 200 t. The breeding efforts should be aimed at the development of new plant types the style and growth

patern of which are more suited for organic conditions. Breeding and selection must be carried out under organic growing conditions at the level, so that varieties can optimally adapt to organic conditions related to soil, climate disease pressure, and weed prevalence.
Key words: *plant breeding, organic, breeding strategy*

Organic farming systems should be supplied with varieties better suited for the new conditions that arise due to the new approach to plant management.
Up-to date agronomic practices are aimed to develop as much as possible favourable plant nutrition level, high nitrogen supply combining with other macro and micro elements, effective disease, weed, and pest control etc. The plant construction of the novel varieties has been targeted for intensive farming: erect leaves are able to intercept high levels of active solar radiation, short stemmed plants are resistant to lodging at high nitrogen application rates. Seed treatment prevents seed borne diseases. Fungicides, insecticides, and herbicides applied several times per growing season provide sufficient disease, pest and weed control.
According to the long-term national agricultural development strategy, the area under organic farming should account for about 15 % of the total cultivated area by the year 2015. This means that 120 - 150 thousand ha of cereals, 50 - 60 thousand ha of grasses will be grown following requirements for organic or sustainable farming. The annual demand for organic seed of cereals will total 24 - 30 thousand t, of grasses 180 - 200 t (Vasiliauskiene et al., 2002). Therefore breeding of varieties, suitable for organic farming is economically reasonable. This is vital in consideration of Regulation 2092/91/EC, which states that, as of 1 January 2000, all propagating material used in organic production must be of organic origin.
What breeding strategy should be chosen to achieve the desirable results?
To develop and release a plant variety it takes about 11 - 12 years. Employment of the biotechnological methods (anther culture and others) allows plant breeders to shorten this period to 8 - 9 years. Plant breeding is a time-and labour–consuming activity.
Nevertheless, the first varieties adapted to organic farming should be selected much earlier since farmers cannot afford to wait for 10 or more years. Therefore breeding time strategy can be divided into two parts:

- selection of promising lines and breeding numbers from the existing germplasm;
- development of new lines from special crosses.
- Selection of promising lines from the existing and specially developed material should conform to the following requirements:
- resistance to seed borne diseases;
- resistance to leaf diseases;
- effectiveness of nitrogen utilization;
- the plant structure and plant canopy should prevent the weeds from intercepting solar energy;
- good plasticity and genotype-environment interaction;
- rapid growth in spring and early summer period;
- quality characteristics;
- root development and mineral absorption efficiency;
- yield etc.

Old type varieties can be included in the crossing program by combining them with the new material, generally more resistant to plant diseases. The old varieties were developed under the conditions of low soil nitrogen level and thus they are likely to use soil nitrogen more effectively.

The recommendations regarding breeding techniques for organic breeding systems suggest that suitable are combination breeding, crossing varieties, backcrossing hybrids. Not suitable, but to be provisionally allowed embryo culture, ovary culture, *in vitro* pollination. Not suitable are mutation induction, genetic modification, CMS hybrids without restorer genes.
The vision on organic plant breeding can be summarized as follows (Lammerts van Bueren et al., 1999):

- Organic agriculture has a different concept of a plant health. Breeding efforts should not concentrate on adding one or more characteristics to the existing varieties, but on developing new plant types the style and growth pattern of which are more suited to organic conditions. The criteria of organic plant breeding are:
- Breeding and selection must be carried out under organic growing conditions at the level, so that varieties can optimally adapt to organic conditions related to soil, climate, and disease pressure and weed prevalence.
- Organic plant breeding may not affect a plant's potential for natural reproduction to ensure the sustainable development of the plant.
- There should be maximum functional genetic diversity in a variety and homozygosity should be limited to the minimum required for modern practice, so that resilience and adaptive capacity are retained.
- Organic plant breeding should be more interactive than conventional breeding to ensure that the wishes of farmers and industry are included in the breeding goal and to ensure an optimal use of all available knowledge and experience.
- As long as organic agriculture only serves a small market, other sources of funding will need to be developed to ensure that there is a greater diversity of varieties for organic market.
- Legislation (registration requirements, farmers privilege) must be amended.
- Genetic diversity can be maintained and developed if there is adequate diversity in breeding program.

The organic crop ideotype and variety concept may benefit not only organic farming systems, but in future also conventional systems moving away from high inputs of nutrients and chemical pesticides.

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RESULTS OF VALUE FOR CULTIVATION AND USE TESTING IN FIELD CROPS FOR ORGANIC FARMING IN LATVIA IN 2004

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Abstract
In 2004 eighteen varieties of four crops: oat, spring barley, spring turnip rape and potato were tested for yield ability, maturity, lodging and disease resistance and quality in Value for Cultivation and Use (VCU) for organic agriculture.
Key words: *organic farming, varieties, VCU testing, yield, quality*

Introduction

Consumers demand for organic agricultural products and foodstuffs has increased recently. Until now seed material used in conventional agriculture could be used in organic agriculture as well, but from 2006 seed material produced under organic agriculture conditions will be used. Testing for suitability of varieties for organic agriculture has been started in 2004 therefore one-year test results are presented.

Materials and methods

Value for Cultivation and Use (VCU) testing has been done at four test sites on the Biological Sertificate crop rotation fields for four agricultural crops: spring barley, spring turnip rape and potato varieties at the LUA Skriveri Research Center (Skriveri), Aizkraukle district, oat and spring turnip rape varieties at Priekuli Plant Breeding station (Priekuli), Cesis district, oat and spring barley varieties at the LUA Study and Research Farm "Vecauce" (Vecauce), Dobele district, potato varieties were tested at the State Stende Plant Breeding Station (Stende), Talsi district.
Soil conditions were quite variable (Table 1).

Table 1

Soil conditions in trial sites

Parameters	Skriveri	Priekuli	Vecauce	Stende
Soils	Sod-podzolic sandy clay	Sod-podzolic sandy loam	Sod-gleysolic sandy clay	Sod-podzolic sandy loam
Humus, %	3.63	2.7-2.9	3.2	2.3
pH_{KCl}	6.40	5.7-6.2	6.8	6.0
P_2O_5, mg kg^{-1}	148.0	141-137	91	200
K_2O, mg kg^{-1}	149.2	110-122	79	155

For VCU testing varieties of crops were recommended by the Association of Latvian Organic Agriculture Organizations. Six spring barley varieties ('Abava' (standard), 'Sencis', 'Ruja', 'Rasa', 'Malva' and 'Idumeja'), 4 oat varieties ('Laima' (standard), 'Stmara', 'Liva' and 'Arta'), spring turnip rape ('Valo' (standard) and 'Kulta'), 2 mid-

early potato varieties ('Sante' (standard) and 'Lenora'), and 4 mid-late potato varieties ('Brasla' (standard), 'Zile', 'Bete' and 'Magdalena') were used.
VCU testing for four agricultural crops was done according to approved VCU methods for conventional agriculture. Seed and tuber material was not treated and chemical fertilizers were not applied. In 2004 crop varieties were seeded in the following dates: barley on 15 April in Vecauce and 30 April in Skriveri, oats on 26 April in Priekuli and 15 April in Vecauce, spring turnip rape on 5 May in Priekuli and 30 April in Skriveri. Potato varieties were planted on 8 May in Stende and 14 May in Skriveri.
Meteorological conditions in 2004 were quite variable.

Results and Discussion

Obtained results showed a high yielding capacity of oat varieties under organic conditions (3.62 – 6.20 t ha^{-1}) (Table 2). The highest average yield was obtained with the standard variety 'Laima' (5.37 t ha^{-1}). Grain crude fat (CF) and starch contents were high - 7.1 % and 49.06 %, respectively (Table 3).
The early-maturing variety 'Arta' had high crude protein content (14.1 %) and low husk (21.5 %). This variety had low levels of oat diseases.

Table 2

Characteristics of oat varieties in 2004

Variety	Yield, t ha^{-1}			Lodging, 1-9 scale	Vegetation period, days	Plant height, cm	Volume weight, g l^{-1}
	Priekuli	Vecauce	average				
Laima, st.	4.53	6.20	5.37	9	111	131	505
Stmara	4.24	5.22	4.73	9	112	140	502
Liva	4.09	5.96	5.03	9	113	141	514
Arta	3.62	4.63	4.13	9	106	131	508
$LSD_{0,05}$	0.90	0.65					

Table 3

Oat grain quality in 2004

Variety	TKW, g	Crude protein, %	Husk, %	Crude fat, %	Starch, %
Laima, st.	32.9	12.0	25.0	7.1	49.06
Stmara	35.2	12.8	24.8	6.6	47.00
Liva	34.2	12.8	23.7	5.1	47.88
Arta	32.3	14.1	21.5	6.2	47.97

In spring barley, obtained yield results were different between test sites. In Vecauce spring barley yielded twice as much as in Skriveri (Table 4). This could be explained with differences sowing time: in Vecauce sowing was performed 15 days earlier than in Skriveri. So the plants were into different stages of growth and the influence of spring frosts (-5-6 ^oC in the third decade of May) on spring barley plants was different. The average coefficient of productive tillering was 1.9 in Vecauce and 1.4 in Skriveri. Dough development stage coincided with that of ripening therefore barley vegetation period was approximately by 20 days shorter in Skriveri.

The highest grain yield was achieved with variety 'Rasa' (average 4.04 t ha^{-1}) surpassing the standard variety by 0.42 t ha^{-1}.

Yields about 3.8 t ha^{-1} were produced by other varieties. The early maturing 'Idumeja' (6 days earlier vs 'Abava') had the highest TKW – 43.03 g. 'Ruja' and 'Rasa' had the lowest protein content and highest extract d. s. fine (Table 5).

Varieties had different resistance to diseases. More resistant to *Ustilago nuda* were 'Abava' and 'Rasa' and to *Blumeria graminis* – 'Sencis' and 'Malva'. In 2004 there was observed high level of infection with *Dreshlera teres* (up to 100 %) and low level with *Puccinia hordei* (0 - 2 %).

Table 4

Characteristics of spring barley varieties in 2004

Variety	Yield, t ha^{-1}			Lodging, 1-9 scale	Vegetation period, days	Plant height, cm
	Vecauce	Skriveri	average			
Abava, st.	5.01	2.22	3.62	9	105	88
Sencis	5.36	2.37	3.87	8	101	77
Ruja	5.71	1.90	3.81	9	106	83
Rasa	5.53	2.55	4.04	9	102	82
Malva	5.49	2.08	3.79	8	104	75
Idumeja	5.36	2.30	3.83	9	99	73
$LSD_{0,05}$	0.47	0.34				

Table 5

Grain quality of spring barley varieties in 2004

Variety	TKW, g	Volume weight, g l^{-1}	Crude protein, %	Extract d. s. fine, %	Starch, %
Abava, st.	39.10	641	11.6	79.17	62.0
Sencis	36.66	644	11.3	80.21	62.9
Ruja	41.78	637	10.6	81.12	63.2
Rasa	36.42	642	10.8	81.25	62.5
Malva	36.14	635	11.4	78.71	62.5
Idumeja	43.03	611	10.9	80.22	62.7

Characteristics of the spring turnip rape varieties 'Valo' and 'Kulta' was very similar for all parameters (Tables 6, 7). Therefore we did not make any conclusions. The yield of these spring turnip rape varieties in Skriveri was three times less than that in Priekuli.

Table 6

Characteristics of spring turnip rape varieties in 2004

Variety	Yield, t ha^{-1}			Lodging, 1-9 scale	Weight of 1000 seeds, g	Volume weight, g l^{-1}	Vegetation period, days
	Priekuli	Skriveri	average				
Valo, st.	2.01	0.73	1.37	9	2.3	633	86
Kulta	2.28	0.70	1.49	9	2.4	637	86
LSD $_{0,05}$	0.33	0.11					

Table 7

Grain quality of spring turnip rape varieties in 2004

Variety	Plant height, cm	*Alternaria brassicae*, %	Crude protein content, %	Oil content, %	Oil, t ha^{-1}
Valo, st.	98	0	21.2	46.1	0.58
Kulta	95	0	20.8	47.8	0.64

Table 8

Potato yields produced in 2004

Variety	Yield, t ha^{-1}			Ware yield					
				Stende		Skriveri		average	
	Stende	Skriveri	average	t ha^{-1}	%	t ha^{-1}	%	t ha^{-1}	%
Mid-early varieties									
Sante (N), st.	5.19	8.00	6.60	4.47	86	7.10	88	5.79	87
Lenora (N)	6.33	10.40	8.37	3.03	48	9.30	89	6.17	69
LSD $_{0,05}$				0.84		1.00			
Mid-late varieties									
Brasla (N), st.	4.77	9.80	7.29	2.56	54	9.10	93	5.83	74
Zile (N)	5.99	12.30	9.15	2.05	34	12.00	97	7.03	66
Bete	6.59	11.80	9.20	4.39	67	11.20	95	7.80	81
Magdalena(N)	6.79	11.20	9.00	5.66	83	10.30	92	7.98	88
LSD $_{0,05}$				0.75		0.75			

Table 9

Quality characteristics of potato varieties produced in 2004

Variety	Vegetation period, days	Weight of one potato, g	Taste properties, 1-9 scale	Dry matter, %	Yield of starch, t ha^{-1}	Sugar content, %	Starch content %
Mid-early varieties							
Sante (N), st.	65	50	6	20.8	0.9	1.28	14.6
Lenora (N)	63	50	7	22.7	1.3	0.96	15.6
Mid-late varieties							
Brasla (N), st.	68	67	6	24.1	1.2	1.07	16.9
Zile (N)	68	69	6	23.0	1.5	0.76	15.8
Bete	67	66	5	17.8	1.0	1.83	10.9
Magdalena (N)	67	61	6	20.9	1.3	0.57	14.6

The gross yield for the tested potato varieties was 8.37 - 9.20 t ha^{-1} (+1.23 - 1.91 t ha^{-1} vs standard varieties). Ware yield was 6.17 – 7.98 t ha^{-1} (+0.38 - 2.15 t ha^{-1} vs standards), but expressed in percentage it was best for ‘Magdalena’ (88 %), ‘Sante’ (87 %) and ‘Bete’ (81 %) (Table 8).
The highest starch content (Table 9) in tubers was observed in the standard variety ‘Brasla’ (16.9 %), but the highest starch yield was achieved with variety ‘Zile’ (1.5 t ha^{-1} or 15.8 %), ‘Magdalena’ (1.3 t ha^{-1} or 14.6 %) and with mid-early variety ‘Lenora’ (1.3 t ha^{-1} or 15.6 %).
Potato variety ‘Lenora’ had better taste properties compare to other varieties (7-point scale) (Table 9).
Tubers of early-maturing potato ‘Lenora’ were less affected by infection with *Phytophtora infestants, Streptomyces scabies* and *Rhizoctonia solani* compared to standard and other varieties.

Results reported in the scientific literature are different from our results obtained in test sites.
In Priekuli highest yield from 6 spring barley varieties tested was attained with the standards ‘Abava’ and ‘Ruja’ (3.8 t ha^{-1}), but lowest from ‘Rasa’ (3.16 t ha^{-1}) (Legzdina, 2004).
In Stende among 10 spring barley varieties tested in 2003 highest yield was obtained with the variety ‘Gate’ (3.9 t ha^{-1}) but three test years gave the following results: ‘Malva’ – 4.24 t ha^{-1}, ‘Klinta’ – 4.05 t ha^{-1}, ‘Sencis’ – 4.01 t ha^{-1} and ‘Ruja’ – 4.00 t ha^{-1}. For oat varieties, ‘Kirovec’ gave 4.18 t ha^{-1} and ‘Laima’ 3.87 t ha^{-1} (Strazdina, Bleidere and Gruntina, 2004).
In Skriveri more suitable for organic agriculture were the following crop varieties: spring barley ‘Sencis’, ‘Abava’, ‘Rasa’; oats ‘Laima’ and ‘Mara’; potatoes ‘Brasla’ and ‘Bete’ (Vigovskis, 2004).
In Vecauce there were reached high oat yields – 4.16 - 5.34 t ha^{-1} (‘Liva’ gave the highest yield). Potato yields produced ranged from 23.1 to 34.3 t ha^{-1}, highest yield was attained with the variety ‘Bete’ (ware yield to 31.9 t ha^{-1}), however it had very low starch content (11.02 %). Other tested varieties provided starch content from 15.68 to 18.68 % (Gaile, 2004).

Varieties in VCU test for organic agriculture were only for one year and this is preliminary presented information. Variable meteorological conditions (spring frost, rainfall, fluctuations in temperatures) exerted the greatest influence on crops in test sites in different locations.

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VARIETY TESTING UNDER CONVENTIONAL AND ORGANIC FARMING CONDITIONS IN ESTONIA

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Abstract
The paper presents an overview about the variety research in Estonia. Official variety testing was conducted under conventional farming conditions as normal agriculture practice. The plant characteristics important in organic farming were not observed. The organic farming tests for varieties were made to a small extent by some interested groups of people. However in these trials the amount of used varieties was small.
Key words: *VCU tests, organic tests, cereals, varieties*

Introductions

In Estonia the Variety Testing under conventional conditions is carried out in the official VCU trials for entrance of variety to the National List. We don't have organic VCU trials in Estonia because of lack of interest. But in recent years the number of organic producers and area devoted to organic farming are rapidly increasing. The land used by organic farms is about 46 000 hectares today, which is about 5.8 % of the total agricultural area. In Estonia there are some institutions, which are interested in organic farming and have also made different studies.
In this paper we present the Estonia Variety Testing System and some organic studies made by Estonian Agricultural University (EAU).

Variety testing under conventional conditions

The overall responsible for the conventional VCU-testing in Estonia is the Variety Control Department of Plant Production Inspectorate (PPI). The technical approach of conventional VCU testing is under responsibility of the Viljandi Variety Testing Centre (VVTC) of Agricultural Research Centre (ARC).

The protocols and applications for VCU-testing are coming from Variety Control Department of PPI. VVTC has 4 locations over Estonia were cereal trials are carried out. The VCU testing takes usually 2 years. In trials we use fertilissers and do weed control as in conventional agricultural practice, but we don't use growth regulators. Three years ago we started treatment of seeds. From cereals only oat seeds are untreated before sowing. Last year we started to use fungicides. Insecticides may be used as necessary. The trials were designed as randomised blocks with four replications. Disease control we made for two replications.

In VCU trials the candidate varieties are compared with control varieties, which are already on the National List, thus they are widely marketed and with good performance. In Estonia 30 % of testing costs are covered by applicants and the others 70 % by the State Budget.

The overall decisions of acceptance for National List are based on evaluation of yield, disease susceptibility, growth characteristics and quality. The plant characteristics like recovery from mechanical harrowing, tiller stage, speed of closing the crop canopy etc., which are observed in organic farming are not assessed in these trials.

The Variety Control Department of PPI receives annually approximately 50 applications for Listing, and approximately 50 % of them are finally listed.

Last year we started to make the VCU trials for the Recommended List. We use the same conventional VCU protocols for varieties, which are under testing for Variety List. The protocols are prepared by administrative service, which every year have discussions with the representation of all the persons interested. The normal duration of the Recommended Variety List for cereals is at least three years. In the Recommended List the candidate varieties are compared with all the recommended varieties, which are all grown in the trials.

Variety Testing under organic farming conditions

Variety research under organic farming has been made by Estonian Agricultural University and Centre of Ecological Engineering.

Winter rye varieties testing results under organic conditions

Under variety testing was three Estonian winter rye varieties ‘Sangaste’, ‘Vambo’ and ‘Elvi’. The common methods of soil sampling and soil profile description were used. Traditional soil management methods were used. Weeding technologies were not used. Results:

- Highest average yield, number of tillers, winter hardiness and competition ability with weeds were reached with winter rye variety ‘Vambo’.
- Highest disease-resistance was observed in the variety ‘Elvi’.
- Highest 1000-grain weight showed the variety ‘Sangaste’.

Obtained results indicate, that the best variety for organic farming could be the variety ‘Vambo’ that gave higher grain yield in all pedo-climatic conditions. The variety ‘Sangaste’ was useful on automorphic or well-drained soils due to low winter hardiness on waterlogged soils. The variety ‘Elvi’ had predominantly lower results in all measured parameters as two other varieties.

Grain yield and quality of oats, barley and spring wheat varieties on different soil conditions in organic farming

The 3 selected farms are situated in different Estonian regions, where organic farming is more developed. The main purpose was to find the best varieties of spring cereal crops for organic farming in different regions of Estonia. Each variety was sown on the area of 0.5 hectares. Under testing were oat varieties 'Jaak', 'Jumbo', 'Miku'; barley varieties 'Anni', 'Inari', 'Mette' and spring wheat varieties 'Manu', 'Satu', 'Tjalve'. The data of the first research year showed that the best oat variety in all climatic and pedologic conditions was 'Jumbo'. The barley had not clear difference in yield and quality of grain between varieties. The highest yield gave the spring wheat 'Manu', but grain quality was more dependent on farming conditions than on the variety. The number of productive tillers (m^{-2}) in all farms was lower than the normal level in conventional farming.

Conclusions

The present VCU testing procedure does not allow the introduction of varieties suitable for organic farming. We have to give an official status for organic VCU testing and together with breeders and organic researches develop the organic research protocols. We must organize one organic VCU trial site to get information about varieties, which are most suitable for growing in Estonia.

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PLANT VARIETIES TESTING IN LITHUANIA

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Lithuanian State Plant Varieties Testing Center (hereinafter referred to as the ″Center″) is an official institution responsible for the maintaining the Lithuanian National List of Plant Varieties (hereinafter referred to as the ″List of Plant Varieties″) and for protection of new plant varieties in Lithuania in compliance with the Law on Seed Cultivation and the Law on Plant Variety Protection of the Republic of Lithuania. The Centre is an independent authority under the supervision of the Ministry of Agriculture.

The breeder or his authorised representative seeking to enter variety into the List of Plant Varieties, shall submit a written application and a Technical Questionnaire of the variety to the Center.
A plant variety shall be included into the List of Plant Varieties, if:

1) the tests on the distinctness, uniformity and stability (hereinafter referred to as the ″DUS″) of the variety have been performed;
2) the suitable denomination for variety is given;
3) the tests specified by the Minister of Agriculture on the value for cultivation and use (hereinafter referred to as the ″VCU″) of plant genera and species have been performed;
4) State Board on Evaluation of Plant Varieties shall propose that a variety can be included into the List of Plant Varieties.

DUS tests for new plant varieties are conducted in Poland in compliance with bilateral agreement between our institution and Polish Research Centre for Cultivar Testing (COBORU).
VCU trials are conducted in 9 plant varieties testing stations (hereinafter referred to as the ″Station″) located in 3 different nature and climatic zones in Lithuania.
First – Lithuanian West Zone:

- Plungės and Šilutės Stations – varieties of agricultural plants are tested;
- Rietavas Station – varieties of potato, fodder beet, fruit and vegetables are tested.
- Second – Lithuanian Middle Lowland Zone:
- Kaunas Station - varieties of agricultural plants and vegetables are tested;
- Pasvalys Station - varieties of agricultural plants are tested.

Third - Lithuanian East Zone:

- Vilnius and Utena Stations - varieties of agricultural plants are tested;
- Vilnius Horticulture Station – fruit varieties and vegetables are tested;
- Kaišiadoriai Station – varieties of turf grasses and ornamental plants are tested.

The annual testing activity (depending on the number of applications) covers about 300 – 400 varieties. Normal duration of VCU tests is 2 years, and 3 years for winter crops and perennial grasses. The test of all varieties is performed in four replicates, i.e. for every test there are 4 distinct plots, 25 sq. meters each. The quality of the harvested material is examined and the field tests are accompanied by various laboratory tests depending on a crop: proteins, gluten, sedimentation, falling number, sugar or starch content.
If variety meets all requirements it is registered in the List of Plant Varieties and from May 2004, notified (reported) to the European Commission to be added to the Common Catalogue, excluding varieties of fruit plant material. Listing is valid for a period of 10 years. A prolongation is possible as well.
List of Plant Varieties of the year 2005 covers 505 varieties of agricultural plant species, 128 varieties of vegetables and 156 varieties of fruit plants. Approximately 150 varieties are marked with star. It means that adaptation period of 3 years is established for these varieties regarding uncorformity requirements of EU – they are without DUS tests.
Searching for cereals varieties suitable for use in organic farming it emerged that varieties with short straw are not suitable for organic farming, because they cannot suppress weeds and by that reason yield is stingy. In this case we need to choise varieties, which could

suppress weeds and increase yield. The main requirements to varieties suitable for organic farming are the following:

- variety must satisfy conditions of soil and climate;
- priority is given to domestic varieties;
- variety must be resistant to diseases and pests.

I would like to present data of tests on evaluation of varieties suitable for organic farming carried out in Lithuania. Varieties were evaluated according rate of value typical for different plant species. Tests were carried out in Stations located in Kaunas, Pasvalys, Plungė, Šilutė, Vilnius and Utena.
Varieties of spring cereals were evaluated depending on harvest of grains, weight of 1000 grains and percentage of proteins in grains. Content of gluten and lesion of septorium of plant leaves is evaluated in spring barley additionally.
Varieties of winter cereals were evaluated according the following main rates: harvest of grains, height of plants, weight of 1000 grains, and resistance to wintering. Winter wheat was evaluated regarding percentage of proteins and content of gluten additionally. Percentage of proteins is important for evaluation of winter triticale varieties, too.
Peas were evaluated according harvest of grains, weight of 1000 grains and resistance to lodging and percentage of proteins.
Varieties of very early and early potatoes were evaluated according marketable harvest, procentage of starch and dry material.
Main rates for evaluation of perrenial grasses were: harvest of dry material, resistance to wintering, height of plants, percentage of fibre and proteins in dry material.
Regarding to tests we could propose the following varieties listed in the List of Plant Varieties of the year 2005 and suitable for use in organic farming:

Plant species	Varieties suitable for use in organing farming
Spring barley	'Aura'* (LT), 'Justina' (DE);
Oat	'Migla'* (LT), 'Belinda' (SE), 'Freddy' (DE);
Spring wheat	'Ismena' (PL), 'SW Kungsjest' (SE);
Winter wheat	'Širvinta 1' (LT), 'Olivin' (FR), 'Vergas' (DE), 'Zentos' (DE);
Rye	'Joniai' (LT), 'Fernando' (DE), 'Matador' (DE);
Field pea	'Hardy' (DE), 'Madonna' (DE), 'Tinker' (DE);
Potato	'Beluga' (DE), 'Sinora' (NL), 'Vivaldi' (NL), 'Vitara' (DE);
Legume grasses:	
lucerne	'Birutė'* (LT), 'Malvina'* (LT);
red clover	'Arimaičiai'* (LT);
white clover	'Birutė'* (LT), 'Malvina'* (LT);
Timothy	'Žolis' (LT).

Notes:
Varieties * are in second year for DUS testing;
Country codes: DE – Germany; NL – Netherlands; LT – Lithuania; PL – Poland.
Center will continue tests on identification of most suitable varieties for organic farming in future. It would be useful to enter suitable varieties in the Common Catalogue with the remark 'organic variety' in future as well.

SITUATION DESCRIPTION AND FUTURE PROSPECTS FOR QUALITY ORGANIC SEED AVAILABILITY IN LATVIA

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Abstract

The importance of seed quality cannot be evaluated too high for obtaining reasonable yields of crops with appropriate quality for consumer. Position of IFOAM (International Federation of Organic Agriculture Movements) is following and unambiguous: organic product must start with the organic seed. Now it is still allowed in Latvia to use for organic farming untreated seeds and vegetative propagation material produced conventionally, but organic farmers in Latvia should be ready to use only organically produced seed starting with the year 2006. This date is very close, and within this paper we try to describe the current situation in Latvia and set up some proposals for future. With the help of questionnaire we tried to clarify organic seed use in Latvia. The situation seems not so bad in terms of organic seed use, but questionnaire confirms conditions that home saved seed quality is tested unsatisfactorily. Understanding of seed quality importance is the question of farmers' education. Two possibilities are offered for education in organic agriculture including organic seed production: by Latvia University of Agriculture and by Latvian Rural Advisory and Education Centre. Polling of different bodies involved in seed business in Latvia allows conclusion that double certified organic seed supply is insufficient at present, but companies, both foreign as well as national ones are ready to do something for organic agriculture, but until clear demand is not appeared from organic farmers, the process is ticking over. Position of IFOAM that organic product must start with the organic seed must be enacted.

Key words: *organic agriculture, organic seed, seed quality, seed availability, Latvia*

Introduction

The importance of seed quality cannot be evaluated too high for obtaining reasonable yields of crops with appropriate quality for consumer. "Seeds are magic" - not without return said Gunnar Rundgren, President of IFOAM, during his address in the 1st World Conference on Organic Seed in Rome, 2004. In this simple sentence he included different aspects such as biological diversity, role of seeds as bearer of culture, seeds as packs of information about particular ecosystem and food traditions, seeds as power that includes force of big corporations selling not only seeds, but as well the whole package of inputs used by farmers (Rundgren, 2004). Quality of seeds taking into account characteristics such as variety and seed purity, germination ability, seed vigour, seeds health etc. should be added to this testimonial (Larinde, 2004). Position of IFOAM is following and unambiguous: organic product must start with the organic seed. It is declared first in the Codex Alimentarius (2001) and later in Regulations of EU № 2092/91 and EC № 1452/2003, which are valid for Latvia since May 1, 2004, too. At present the situation in EU is different: farmers from "old" EU countries have to use organically produced seed since January 1, 2004, but Latvian side considering the objective situation has overtaken derogation from above mentioned regulation up to January 1, 2006. This derogation is fixed in so called "Pact of Joining to EU" (2004). Now it is still allowed to use for organic farming untreated seeds and vegetative propagation material produced conventionally. But, of course, use of different origin seed bring different matter into the term 'organic product', and organic farmers in Latvia should be ready to use mainly organically produced seed starting with the year 2006. After this date the user of conventional seed will be obliged to apply for an authorisation to State Plant Protection Service (SPPS). Authorisation to use seed obtained with other than organic production method will be granted only in cases if organic seed chosen by a farmer is not available (id est. - registered in the database). This date is very close, and within this paper we try to describe the current situation in Latvia and set up some proposals for future.

Seed used in organic agriculture in Latvia

To trace back of used seed, questionnaire on this topic was spread among organic farmers during the late 2004 and early 2005. Since part of questionnaires were spread during one of the Regional Year Conferences of Organic Farmers Association, but for other farmers it was published in the Bulletin of the Association of Latvian Biological Farming with the request to fulfil it and send back to the President of Association. Activity of farmers was not very high, but some information these questionnaires gave for us. Up to mid February 2005 we got back 64 applicable questionnaires fulfilled by farmers from 16 Latvian regions. Six from 64 respondents were not designating the current situation of a farm, but 24 respondents were from certified organic farms, 13 – from 2nd year transitional, 18 – from 1st year transitional, and 3 – from mixed farms, id est., part of farm is certified organic, but part – 1st year transitional, and the like. Mainly these were small or average size organic farms, 3 respondents had not shown the size of a farm (Table 1).

Table 1

The farm size of a respondent

Less than 5 ha	5.1 – 20.0 ha	20.1-50.0 ha	50.1 – 100.0 ha	More than 100 ha
1	16	25	10	9

Organic farmers in Latvia are growing a very diverse assortment of field and vegetable crops as well as fruit and ornamental crops, and vulnerary plants. 64 different species belonging to the following groups are mentioned by respondents: small grain (6 species including buckwheat), tuberous plants (potato and Jerusalem artichoke), grasses, legumes and silage crops, vegetable crops (16 species mentioned), spice plants, nectar plants, vulnerary plants, fruit trees and berries, oil plants, annual flowers and root-crops. What kind of seed do they use? The situation is very different: one and the same farm sometimes use home-saved seed for some crops, certified organic – for some other and certified conventional - for any other. Totally 56 farms use home-saved seed for some crops, including 30 farms that use home-saved potato seed material. Clear negative answer to the question on testing of home saved seed gave 32 from 56 farmers, consequently 57 % of home saved seed are of unknown quality. Only 14 or 25 % of respondents answered clearly, that they had tested their home saved seed. Others gave mixed type answers – seed quality of some crops they had tested, some will start testing with the year 2005 etc. 38 farms answered that for some crops they had bought certified conventional seed, including 11 farms, which had bought seed potato.

Only 18 farms from 64 (28 %) answered that for some crops they had used double certified seed, id est., certified according to Seed Circulation Law of Latvia and Regulations of Cabinet of Ministers on Seed Growing and Seed Trade and grown in organically certified field. The main mentioned crops were cereals, potato, grasses and some vegetables. In addition, 21 respondent had bought organically produced seed from other organic farmers, but of unknown quality, because quality had not been tested. Most of Latvian organic farmers know, that from the year 2006 they will have to use only organically produced seed (Table 2).

Table 2

Opinion of Latvian organic farmers on the starting year of using only organically produced seed, % from respondents

2004	2006	2008	2010	One does not know
3.13	68.75	20.30	4.69	3.13

It is not said in regulations that used organic seed must be only double certified organic and due to this situation in Latvia seems not so bad in terms of organic seed use. But, of course, no matter on what seed is story - conventional or organic – seed must be of good quality, and we can get to know it only after testing this quality. Our questionnaire confirms conditions, that home saved seed is tested at unsatisfactory level, and it could affect ill results of organic production.

Education in organic agriculture

Understanding of seed quality importance is the question of farmers' education. Unfortunately, in Latvia farm holders involved in agricultural production are not demanded high school or university level education in agriculture. They have to obtain only the first level certificate in agriculture and then only in cases when farmers want to get government subsidies. People, starting organic farming, usually want to acquire much knowledge, including knowledge in seed turnover, which is provided by the Latvia University of Agriculture and Latvian Rural Advisory and Education Centre. Chapter "Organic seed multiplication and seed turnover" is included into elective study course 'Organic field crop production and gardening' for students of the Faculty of Agriculture of the Latvia University of Agriculture. Since 2002, 20 full-time and 94 part-time students have got a taste in organic seed growing. Unfortunately only some of them are actually involved in organic farming. The second opportunity to familiarize with organic seed is given by Latvian Rural Advisory and Education Centre, which organizes a licensed study course 'Professional perfection education in organic agriculture', including organic seed production. Since 2002, 516 farmers audience from 12 Latvian regions have completed this course, including chapter 'Organic seed production', and obtaining certificates (Source: Gatis Kaimins, Latvian Rural Advisory Centre). Due to farmers great interest training at present is continued again in 12 regions of Latvia. It means that there is an opportunity to get feeling about importance of quality seed and ways how to produce it, but at the same time this is a topic that needs yet more work in near future.

Information availability and possibility to buy certified organic seed

Visualize the situation that all organic farmers would like to use organically produced seed, and at least part of them – to buy double certified seed. Is it roughly possible now? Up to now, Seed growers and Seed producers Register held by SPPS presents only 14 organic seed producers. To buy seed, a farmer must have information on organic seed supply in market. Up to now, such information mainly was available in advertisements of already mentioned Bulletin of the Association of Latvian Biological Farming. Since May 2004, according to Commission Regulation (EC) № 1452/2003, each Member State has to ensure establishment of computerised database listing varieties for which certified organic seed are available on its territory. Our database is set into home page of State Plant Protection Service of Latvia: www.vaad.gov.lv/sēklukontrole/bioloģiskosēklu datu bāze. Unfortunately, only 8 seed suppliers have sent information up to February 28. Now there are offered the following amount of double certified seed: 3 t of oats, 25 t of potatoes, produced in Research and Study farm "Vecauce" of the Latvia University of Agriculture (LUA). In addition, we have asked opinion and future prospects of some companies involved in seed business. The only one national seed company "Latvijas šķirnes sēklas" ("Latvian sorted seeds"), admitting that organic seed production in Latvia is only in initial stage of development, informed that they will not offer organic seed for the season 2005. However they are starting to be aware of the need for such a seed for the season 2006 looking for co-operation partners among our organic farmers as well as among organic seed companies abroad. Mainly these are cereals, grasses and legumes, but demand will determine offer (source: Iveta Gutmane, "Latvian sorted seeds"). Four Latvian research institutions - Stende Plant Breeding Station, Priekuli Plant Breeding Station, Agency of LUA Research Institute of Agriculture and Research farm "Vecauce" are involved in variety testing for organic agriculture and at the same time they already produce or design to produce in future some amount of double certified seed. Here again we speak about cereals, grasses and legume, potato, oil seed rape and lupine, yet amount of seed produced will be really small: from some hundred kilograms to 20 (for potato) tonnes per variety (data source: executives from above mentioned institutions). In addition, 4 foreign companies involved in seed business in Latvia were asked about organic seed offer: A/S LATFOOD, KESKO AGRO, Kemira Grow-How, a representative of Swalof-Weibull (SW). A very honest and exhaustive answer was received from Dr. Ilgvars Krumins from A/S LATFOOD. As it tells a lot on seed business in Latvia, we would like to cite it fully: "What regards biologically grown potato and potato seed, A/S LATFOOD has not paid any attention to it up to now, but our mother company CHIPA ABP on Aland islands has limited production of such a product. We are not planning to start produce biological seed in the nearest future due to the following reasons:

- Seed business is unstable in Latvia for conventional seed.
- Biological potato seed business is even more unstable as regards not only sales, but also production; we are not sure about stable demand of reasonable quantities.
- We expect biological seed could be more expensive than conventional.

Farmers in Latvia are not used to pay for certified conventional seed, 95 % for planting use just seed size ware potatoes, they expect certified seed price also to be close to small size table potato price. Seed certification also means variety protection and royalty payments. We could be ready to import biological seed on customers' request."

Other three companies answered that they had not thought about organic seed offer due to non- demand before. Demand creates offer and situation that quality organic seed is not utilized by all of the farmers. Lack of demand means that organic farmers have insufficient education in terms of seed quality importance or they are short in funds and cannot buy double certified organic seed. Kemira Grow-How (Aiva Kupfere) and SW mission in Latvia (Dzintars Jaks) are of the following opinion in case of real seed demand:

- Import of foreign seed, but it could be disproportionate expensive way for our farmers.
- Import of small quantities of B or C category seed and activity on our organic farmers' part to go into seed multiplication business themselves and in co-operation with above mentioned companies produce seed of suitable varieties.

Since Latvian organic farmers are growing a lot of vegetables two companies offering vegetable and flower seeds in Latvia were asked to tell their opinion on organic seed supply: "Kurzemes sēklas" ("Seeds of Courland") and "Vidzemes sēklas" ("Seeds of Vidzeme"). Up to 28 February 2005 we got an answer only from the company "Seeds of Courland". At present they offer wide assortment of organic vegetable seeds from "Bejo Zaden", the Netherlands. Organic seed price is by 150 - 200 % higher than that of conventional seed. Some amount is sold in Lithuania, too. Seed has to be ordered before. Unfortunately, the demand of Latvia's organic farmers is light in weight (Data source: Maris Grinvalds from "Seeds of Courland").

Results of the study lead to the conclusion, that certified organic seed supply is insufficient at present, but companies, both foreign as well as national ones are ready to do something for organic agriculture, but until clear demand has not appeared from organic farmers, process is ticking over. We can only support the opinion of Dick van der Zeijden (2004) that "Any important seed programme will fail if the organic chain is not soon closed by law and self regulations". It means that position of IFOAM that organic product must start with the organic seed must be enacted.

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ORGANIC SEED PRODUCTION IN ESTONIA

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Abstract
Estonia has harmonised its legislation with the respective EU regulations governing the production and use of organic seed and propagating material. In practice however, the progress has been slow. Organic seed of oats and tomato and vegetative propagating material of strawberries have been available during recent years. Although Estonia has a potential (land resources, adapted varieties, previous research on intercropping, various subsidies) for success in organic seed production, organic farming will likely rely on imported seeds since 2006, when current derogation allowing the use of conventional seed will terminate.
Key words: *organic seed, seed health, intercropping*

Introduction
Estonia is a relatively heterogeneous country in respect to soil types and production systems. Therefore the producers are used to sow a number of species, varieties and their mixtures. In organic production systems it is important to have a wide range of varieties in order to support biodiversity. Organic agriculture is impossible without organic seed and propagating material, but these have been occasionally produced in Estonia and have not been imported. The derogation allowing the use of conventional seed was due to be lifted on January 1, 2004, but it has continued. Before July 31, 2006 the European Commission will examine the availability and use of organic seed or vegetative propagating material and the effective implementation of the present regulation and will, if necessary, make the appropriate amendments.

Regulations
EU regulation No. 2092/91 governing organic farming across Europe stipulates that organic seed and other plant propagating material must be used in organic production. Organic seed production implies that the mother plant of an annual crop has been produced according to the organic production method for at least one generation. For vegetative reproductive material and perennials the criterion is at least two seasons. The regulation No. 1452/2003 requires, that each member state operates a computerized database of organic seed availability and approved derogations. Once crop species appear on the annex and are judged to be adequately available the derogation would be lifted.
The current derogation allows for the use of non-organic seed when the supply of organically grown material runs out. The end of this derogation means that growers unable to obtain organic seed would be prevented from growing there preferred variety or species. It might happen that the species not available in sufficient quantities or species that are difficult to produce organically would be subject to a general derogation and would not require individual derogations from certification bodies.
It is presumed that organic seed must comply with minimal national seed quality standards. These are identical for the seed coming from either non-organic or organic production. Current threshold values set in some countries for seed-borne diseases may need

readjustment for organic production. With regard to vegetative propagating material, other than seed potatoes, this falls under the discretion of the member states, until appropriate criteria can be adopted at EU level.

Plant Production Inspectorate (PPI) is authorised as the only inspection and certification body in Estonia, which coordinates the inspection work and keeps a register of all organic farmers. PPI can approve the use of conventional chemically untreated seed or vegetative propagation material.

Current situation and demand for organic seed

There is a large gap between the quantities of organic seed (oats and tomato) and propagating material (strawberries) ever produced in Estonia and estimated organic seed requirement in 2004 (Table 1). Organic and conventional farmers do not grow the same choice of varieties. The varieties grown by organic farmers tend to be a compromise between robustness and acceptance on the market. There is a need for dialogue between producers and seed industry. Seed producers need assistance in reducing the uncertainty of organic production by identifying varieties and strategies that will provide a greater possibility of producing high quality seed.

Table 1

Necessary quantities of organic seed based upon the acreage of organic production in Estonia in 2004

Crops	Cultivation area, ha	Seed demand, t	Crops	Cultivation area, ha	Seed demand, t
Cereals	**5421.93**	**1205**	**Forage crops**	**28209.15**	**595**
Spring wheat	537.07	135	Clover	2803.32	40
Winter wheat	268.88	60	Lucerne	959.89	20
Winter rye	580.20	115	Other legumes	623.56	5
Spring barley	1383.80	305	Grasses	12916.10	270
Oats	1953.63	450	Mixed grasses and legumes	10906.28	195/65
Mixed pulses and cereals	377.99	65/50			
Other cereals	320.36	90	**Green manure**	**72.02**	**2**
Pulses	**253.69**	**90**	**Vegetables on the field**	**56.21**	**0.55**
Industrial crops	**54.38**	1.1	Cabbage	5.08	0.25
Oilseed rape	35.47	0.4	Cucumber	1.00	0.01
Turnip rape	14.20	0.1	Carrot	11.30	0.03
Oilseed flax	1.80	0.2	Onion	2.66	0.15
Other	2.91	0.4	Beet	4.23	0.04
Potato	**280.65**	**840**	**Fodder roots**	**6.77**	**0.07**

Expected problems and perspectives

Organic seed and vegetative propagating materials are generally more difficult and costly to produce than conventional. Organic crop growers will prefer the cheaper non-organic seed if the controlling body does not enforce the request on the use of organic seed.

An average crop yield reduction of 20 % has to be accepted compared to the conventional system (Do…, 2003). Potato tuber yield reduction is most severe. Greater proportion of small tuber classes distinctive to organic farming is a minor problem in seed potato. Organic potato is highly susceptible to fungal diseases and pests. One possibility to improve the production would be resistant varieties, but consumers are very conservative in the selection of varieties. Early date green crop lifting could be practiced to forestall the disease as this may reduce the yield of seed potatoes only by 14 %. Therefore, it is important to check for organic potato seed production the alternatives, which will reduce the cultivation risk, guarantee a high quality of tubers (virus-free and healthy seed) and increase the fraction of seed potatoes.

Organic vegetable seed can be up to thrice as expensive as conventional because the cultivation process is characterized by a high input of mechanical and manual work. By now the percentage of failed organic seed fields has dropped from 80 to 50 (Dossier…, 2005). The problem with seed vigour and other quality aspects as well as the selection of appropriate varieties are more relevant with high price crops like vegetables. Current certification standards do not ensure that the seed has the highest quality. There is a need to define improved quality standards for organic vegetable seed, including seed health. The production of seed of the varieties actually used is the key obstacle for the use of organic seed in the vegetable sector. There is an urgent demand for improved cooperation and communication between vegetable growers and seed producers.

Winter wheat yields decline by 11-14 % under organic conditions compared with conventional system (Do…, 2003). With the cereals and pulses the health issue is essential. Organic seed on the market has to be certified by both the seed certification system and the organic inspecting system, but there are no special requirements for the quality of the organic seed. The Council directives on seed state that the infection level of seed borne diseases in general must be as low as possible. With cereals and pulses, there is a need to include definitions on seed health in the criteria for the list of available organic seed, as well as put more focus on the control of seed borne diseases. As organic seed is not treated with fungicides, up to 90 % of the seed lots of winter cereals and pulses exceeding the threshold could be discarded in Denmark in some years (Borgen, 2002). This makes the organic seed production less profitable. Possible control measures exist, but only a few are used at present. The most effective preventive method for control of seed borne diseases is to introduce healthy seed into the cultivation system.

Unharvestable mixes are the ones containing two or more species of cereals, pulses, grasses and clovers or brassicas etc. sown for harvesting together for forage use. The progress in seed production of the mixture components will be influenced by the prescribed percentage of the organic ingredient.

Perennial grasses and clovers for seed production are normally established at low plant densities, which are found to encourage higher seed yield, however, this also leaves more room for weeds. The slow establishment also results in weak competitiveness. Organic seed has to meet EU quality standards of germination and purity. Due to the above-mentioned factors weed control in seed crops is one of the most essential management aspects in organic forage seed production. Although the climatic conditions of Estonia are generally favourable for grass and satisfactory for the seed production of forage legumes, even conventional domestic seeds are often in scarce. The organic farming is dependent on conventional seeds. Transition to organic seed production of forage crops needs expertise and in some cases investment the new machinery. As the grass seed is a perennial crop it is necessary to plan ahead for what the organic requirement will be after 2-4 years. Organic seed production of forage crops is more risky than the production of cereals and fodder, but good production results are likely in red clover, timothy, meadow fescue, perennial ryegrass and Italian ryegrass. More problems are seen in white clover, smooth-stalked meadow grass, red fescue and lucerne. Supply of some minor forage crops, e.g. *Phalaris arundinacea* L., *Alopecurus pratensis* L. and *Bromus inermis* Leyss. Will be problematic in Estonia because they come from very small pools.

Most grass and clover seed in modern agriculture is sold as mixtures. At present, no single ingredients are available in Estonia as organic quality. It is a problem for the farmers if they must make themselves the appropriate mixtures, based on few imported species and varieties or out of domestic small quantities that will be available in organic quality. It is estimated that organic grass seed mixes would be about double the cost of conventional ones, and therefore gradually increasing the percentage of organic ingredient may save the organic farmers from paying too much. Moving from 50 to 60 % has been suggested in UK (Working…, 2004). Yet, the percentage approach could cause problems. The required proportion can often be achieved with organically produced ryegrasses, which are available on international market in large quantities (Boelt, 2003). Other conservation type grass species and clovers might then be less likely to be used. This is not advisable if the farming should go more down the environmental route.

There are some positive developments in Estonia. Organic seed producers can apply for up to five different subventions: an overall subsidy based on cropped area, an agro-environmental subsidy for organic farming and subsidies for the certified seed production of forage crops, for less favourable areas and Natura areas with imposed environmental restrictions.

Running of a database open to organic farmers, seed producers looking to sell certified organic seed and certification bodies to help authorize possible derogations is an important step in improving the availability and use of organic seed in Estonia. Whilst not wishing to put organic farmers at a financial disadvantage to their counterparts in other EU member states, Estonia has to ensure the continued credibility of the organic movement by making sufficient organic seed of all major species available as soon as possible. Placing species quickly on the database and strict rules are the most powerful tools.

The arable land of Estonia has been steadily diminished during the past decade. Agricultural production attained its peak in 1990, when the crops were cultivated on 1.1 million ha vs. 461.5 thousand ha in 2003. Hence the country has plenty of land that could potentially be converted into organic. Besides, there were 490 ha of organic land set aside in 2004.

Knowledge gained from conventional seed production as well as the results of relevant research conducted abroad could be taken over if applicable. Intercropping of major forage legumes, forage (Korjus, 1958) and turfgrasses (Korjus, 1970) has been studied at Jõgeva Plant Breeding Institute decades ago. The know-how could be developed further and adapted to the modern cultivation techniques.

Conclusions

The future of organic seed production will depend on the scenarios of European Commission, possible derogations on certain species and financial support. Potential organic seed producers in Estonia are planning for availability in 2006 and their level of investment will be highly influenced by the nature of legislation. Estonia is not yet in a position for lifting of the derogation across all species. There is only one season left before use of organic seed for all crops becomes compulsory. It is likely that after 2006 Estonia has to import organic seed and propagating material. Imported seed from different ecological conditions could neither perform well in Estonia nor be accepted by the local crop producers and consumers. Use of less adapted seed or planting material could enhance the risk of crop damage, especially when pesticides are excluded. Push to widespread use of organic seeds may lead to a (temporary) narrowing in genetic diversity. It is not common that the same seed company can offer 3-4 varieties with similar characteristics in sufficient quantities in organic quality.

It is essential for the development of the organic seed sector that improved inspection systems are implemented in certification programs. To minimize the risk of seed borne diseases thresholds should be discussed and possibly defined for the relevant diseases. Diseases should be included in the seed certification standards. Development of new techniques for seed sanitation and the control of seed-borne diseases is urgent and of interest to both producers and users of organic seed.

It is a complicated task to encourage the development of organic seed sector and to create a system that utilises a good proportion of the organic seed which is available, whilst does not burden the farmers with overly high costs. Organic variety mixtures can base on the same principles as used for composition of partly (e.g. 50 %) organic forage seed mixtures. Derogations should be lifted for species or groups for which an expert panel has decided that adequate organic seed of an appropriate range of varieties is available.

Although organic seed or propagating material of just three species has been available in Estonia so far, the potential to increase the organic seed production is great. Large area of abandoned arable land not fertilized for years can be rather easily converted into organic.

Foundation of cooperatives on the basis of little farms would facilitate the production of bigger organic seed lots, strengthen the farmers' position at negotiations and marketing. The members can get higher income and the cooperatives are capable for new investments.

Increased demand is leading to increased choice and availability of organic seed. As the demand is low at present, it will take many years to develop a well functioning market for organic seeds in Estonia.

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ORGANIC SEED PRODUCTION IN LITHUANIA

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Abstract
A program for organic seed production is prepared in Lithuania. In order to improve the qualification of organic seed production experts, a special training program and a publication on organic seed production farm certification as well as main requirements are prepared.
On purpose to select the most suitable cereals varieties for organic farms, research was carried out in LUA, in the organic farm of Agroecology Centre. 43 cereal varieties were tested: 18 of winter cereal and 25 of summer cereal. The research results revealed the most suitable varieties for organic farms, in particular winter wheat varieties 'Residence', 'Ada', 'LZI 5294', summer wheat varieties 'Monsun' and 'Ismena', summer barley varieties 'Aidas' and 'Luoke', oat varieties 'Migla' and 'Deresz'.

Introduction
Developing demand for organic products increases the number of organic farms. In 2004 there were 1200 organic farms occupying 43 000 ha of land property. All the farms use seed grown in conventional farms. Pursuant to the EU directives, starting from 1 January 2006 organic farms will have to sow seed grown in organic farms exclusively, therefore the first link in organic plant production has to be nurture of organic seed. The majority of growers lack knowledge on organic seed production because organic seed nurture is a new branch in science and production, therefore there are also a limited number of scientific publications on these issues. Organic farms are fundamentally different in terms of fertilisation, plant protection and other plant growing conditions, therefore productivity of grown varieties often decreases and the quality of cereal deteriorates. Separate cereal kinds and varieties are different in terms of genotype and respond differently to changed growing conditions (Gaile et al., 2004; Strazdina and Bleidere, 2004). Therefore it is of the utmost importance to select plant varieties with genetic potential best expressed under conditions of organic farming. Our earlier research determined the more suitable new winter wheat varieties (Sliesaravicius and Kucinskas, 2001). Some countries have two separate lists of varieties intended for conventional and organic farms. In Germany in 2003 there were 31 out of 105 varieties of

winter wheat recommended for organic farms, 16 out of 27 varieties of winter rye for organic farms (Vogt-Kaute, 2004).

In Lithuania, research on organic seed production has been carried out since 2002 mainly by scholars of the University of Agriculture and currently the program for organic seed production is prepared (Sliesaravicius and Rutkoviene, 2004).

The goal of our research is to prepare the system of organic seed production and to select the most suitable cereal varieties.

Research conditions and methodology

In order to select the most suitable cereal varieties, research by the organic farm of Agroecology Centre was carried out in cooperation with Kaunas Plant Varieties Testing Centre. There were 43 cereal varieties tested: 18 of winter cereals and 25 of summer cereals. Research field area was 30 m^2. In the testing site semi heavy loams prevailed, deeper there were saturated Eutri – Hypogleyic Albeluvisol – PLB – g^4 (Endohypogleyic – Eutric Planosols – Ple – gln – W), with natural reaction (pH 6.9), high in phosphorus (270.0 mg kg^{-1}), potassium content (175.0 mg kg^{-1}), average humus content(2.25 %). Preplant for winter crop was oat – pea mixture for seed, and for summer cereals - oat for seed. Protein amount was calculated on the basis of common nitrogen amount determined using the method of Kjeldahl, multiplied by 5.7. Sedimentation was determined using the methods of Zeleny and Pumpianskis. The degree of disease effect was characterised by disease development (P) and disease intensity (R).

During vegetation period plant growing conditions were unfavourable. Average temperature in May was lower than long-term averages, then frost began, which delayed plant growth and touched the leaves. In June and July the temperature was similarly 1.3 and 0.9 ^oC lower than long-term averages temperature. Given excess irrigation and temperature lower than long-term averages temperature as well as low number of sunny days, resneted in conditions to grow good quality cereals.

Research results

In order to create a system for organic seed production, primarily considering the sufficient necessary area of arable land, equipment for seed cleaning and storing, crop rotations used and the condition of crop and farm distribution in separate Lithuanian regions, 8 demonstration organic seed production farms and institutions organising seminars and discussions of encountered problems were selected.

On purpose to improve the qualification of organic seed production experts, a special training program and a publication on organic seed production farm certification, as well as main requirements were prepared.

It is important to be aware of organic product demand and supply. In accordance with our estimations, considering the general usage of certified seed, the demand for organic seed would be around 40 000 tons per year. On purpose to have information on seed quantities and seed growers, a database is formed in the internet site, which is updated with new data on seed movement and seed growers every year.

Having tested the varieties, it was determined that the reaction to organic growing conditions was different. The varieties under research yielded different results in terms of cereal fertility, their quality and the intensity of the effect of plant diseases. Out of 11 winter wheat varieties the most productive were ‘Residence’ and ‘LZI 5294’ (Table 1). The varieties ‘Alma’ and ‘Ada’ showed the highest sedimentation indicators (Table 1).

Table 1

Productivity and quality indicators of winter wheat varieties, LUA Agroecology Centre, 2004

Variety	Productivity t ha $^{-1}$	Protein %	Sedimentation cm ^{3}	Wet gluten, 14 % moisture level	Gluten deformation index, units
Alma	3.5	10.4	2.9	21.3	65
Ada	4.1	10.2	2.6	17.6	75
LZI 5294	5.5	8.8	2.0	14.6	72
Sirvinta I	3.7	9.6	2.3	18.2	70
LŽI 3448	4.0	8.6	2.0	10.5	60
Cardos	3.0	10.0	2.4	18.2	60
Residence	5.4	8.3	1.7	16.1	62
Lars	4.6	8.9	2.4	18.1	67
Zentos	3.4	9.6	2.4	15.8	60
Milda	4.1	9.6	2.6	17.9	57
Baltimor	4.3	8.3	2.2	13.6	60
Rs_{05}	**0.5**				

Summer wheat varieties accumulated significantly more proteins and showed twice as high sedimentation indicators. The summer wheat variety ‘Monsun’ was distinguished by productivity (Table 2).

Table 2

Productivity and quality indicators of summer wheat varieties, LUA Agroecology Centre, 2004

Variety	Productivity, t ha $^{-1}$	Protein %	Sedimentation cm ^{3}	Wet gluten, 14 % moisture level	Gluten deformation index, units
SW-Kungsjet	3.8	12.2	4.9	27.1	75.0
Picolo	4.1	12.4	4.2	14.1	97.2
Monsun	5.8	12.5	4.9	20.0	96.1
Nandu	3.2	12.4	4.4	16.6	97.6
Koksa	3.8	12.3	4.5	20.8	96.2
Ismena	4.4	12.2	4.5	16.5	97.6
Taifun	4.3	12.6	5.0	20.8	92.6
Hena	4.7	12.2	4.5	19.3	96.4
Estrad	3.6	11.7	4.2	20.9	93.4
Opatka	3.9	-	-	-	-
Rs_{05}	**0.8**				

Having completed the records on winter wheat diseases it was determined that the most widespread was tan spot and powdery mildew. The least affected by the diseases were the varieties 'Ada', 'Alma' and 'Residence' (Table 3).

Table 3

Winter wheat as affected by diseases, LUA Agroecology Centre, 2004

Variety	Powdery mildew		Tan spot		Septoria leaf blotch	
	Disease development, % (P)	Disease intensity, % (R)	Disease development, % (P)	Disease intensity, % (R)	Disease development, % (P)	Disease intensity, % (R)
Cardos	32.22	3.85	25.55	1.5	5.55	0.14
Milda	36.66	2.30	12.22	0.21	0.0	0.0
Alma	20.0	2.00	16.66	0.61	3.33	0.12
Ada	14.44	1.33	22.22	0.44	0.0	0.0
LZI 5294	27.80	1.50	8.88	0.88	5.55	0.14
LZI 3948	42.22	2.05	6.66	0.15	0.0	0.0
Lars	28.88	1.77	56.66	5.50	0.0	0.0
Sirvinta I	47.77	4.33	34.44	3.45	6.66	0.24
Zentos	30.0	3.68	53.33	3.46	0.0	0.0
Residence	20.0	1.11	7.77	0.16	0.0	0.0
Baltimor	30.0	3.44	11.11	0.73	16.66	0.64

Summer wheat were most affected by powdery mildew and wheat tan spot. The least affected by wheat tan spot was the variety SW Kungsjet (Table 4).

Table 4

Summer wheat as affected by diseases LUA Agroecology Centre 2004

Variety	Powdery mildew		Tan spot		Septoria leaf blotch	
	Disease development, % (P)	Disease intensity, % (R)	Disease development, % (P)	Disease intensity, % (R)	Disease development, % (P)	Disease intensity, % (R)
Monsun	31.11	2.44	24.44	1.36	0.0	0.0
Ismena	8.88	0.31	24.44	2.0	7.77	0.3
Nandu	64.44	6.13	27.77	3.07	8.88	0.42
Estrad	7.77	0.46	50.0	4.05	11.11	0.63
Opatka	8.88	0.64	60.0	3.02	13.33	0.5
Puicolo	22.22	3.38	41.11	20.8	0.0	0.0
Koksa	18.88	1.2	31.11	2.2	16.66	0.64
Taifun	54.44	5.38	34.44	1.88	0.0	0.0
SW Kungsjet	0.0	0.0	23.33	1.05	16.66	0.7
Hena	45.55	4.64	32.22	2.04	7.77	0.25

Out of 10 summer barley varieties under research, the most productive were 'Aidas' and 'Luoke', and those of oat were 'Migla' and 'Deresz'. 3 winter rye varieties showed little difference in productivity of cereal (3.1 – 3.8 t ha $^{-1}$).

Conclusions

1. The system of organic seed production was prepared in Lithuania.
2. According to research results, the most suitable for organic farms are winter wheat varieties 'Residence', 'Ada', 'LZI 5294', summer wheat varieties 'Monsun' and 'Ismena', summer barley varieties 'Aidas' and 'Luoke', and those of oat 'Migla' and 'Deresz'.

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EVALUATING SUITABILITY OF RYE VARIETIES TO ORGANIC FARMING

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Abstract

Two different sowing rates - 400 and 500 viable seeds per 1m^2 and influence of biopreparation 'BioMikss' on yield of grain and quality of winter rye variety 'Kaupo' were investigated in the year 2003 at Priekuli Plant Breeding Station. Suitability of four winter rye varieties – 'Kaupo' (Latvia), 'Duoniai' (Lithuania), 'Valdai', and 'Voshod 1' (Russia) to organic farming was evaluated in the year 2004. No significant influence of sowing rate and treatment with 'BioMikss' was observed on the yield and quality of grain. The best varieties for organic farming were 'Kaupo' and 'Valdai'. 'Duonai' had a good resistance to lodging, but due to late maturity and lower grain quality it was not recommended for organic farming.

Key words: *rye, organic farming, varieties, sowing rate*

Introduction

Optimizing organic farmin system requires use of suitable varieties. The most of varieties offered by conventional seed companies are developed for farming systems in which artificial fertilizers and agricultural chemicals have been widely used. Organic farming, however, aims at a 'natural' way of farming, refraining from agricultural chemical inputs and applying agro-ecological strategies (Lampkin, 1990). For further optimization of organic product quality and yield stability new varieties are required that are adapted to organic farming systems (Lammerts van Beueren, 2002). Because the breeding of varieties suitable for organic farming is started currently, it is necessary to select the best varieties available among existing (conventional) ones.

Due to good competitiveness with weeds, resistance to different diseases, yield stability, good adaptation population rye is a good species for organic farming. The suitability of rye varieties to organic farming as well as different seed rates and the effect of biological pesticide for plant protection were studied at Priekuli Plant Breeding Station during 2003 – 2004.

Materials and methods

The field experiments were established at Priekuli Plant Breeding Station during 2003-2004. The soil at the site is sandy loam. The pre-crop was pea for green crop. The test plot size was 28.8 m^2 sown in 4 replications. The influence of two different sowing rates - 400 and 500 viable seeds per 1m2 and bio-preparation 'BioMikss' treatment on grain yield and quality of winter rye variety 'Kaupo' was investigated in the year 2003. Winter rye 'Kaupo' was sown in 24 September 2002 with a sowing machine to a depth of 3-5 cm with 17 cm spacing between rows. Grain was harvested in 7 August 2003.

Suitability of four winter rye varieties – 'Kaupo' (Latvia), 'Duoniai' (Lithuania), 'Valdai', and 'Voshod 1' (Russia) to organic farming was evaluated in the year 2004. The sowing time was 20 September 2003. The sowing rate was 400 seeds per m^{-2}. Grain was harvested in 19 August 2004. The total grain yield of the plots was determined and converted to 86 % dry matter content. Suitability of the following traits were evaluated in both trial years: winterhardiness - % survived plants, number of ear-bearing tillers per m^2, *Rhynchosporium secalis* and *Puccinia recondita* area of infection on the plants, crude protein content (determined by Kjeldahl method, N x 5.7), falling number (by Pertens Falling Number 1500, LVS 274), and thousand kernel weight.

Preparation 'BioMikss' is produced in Latvia by company 'Bioefekts' and is notified as a biological preparation for plant protection. It contains: *Azotobacter chroococcum*, *Polyangium cellulosum*, *Pseudomonas putida*, *Rhizobium meliloti*, *Streptomyces cellulosae*, *Streptomyces griseoviridis*, *Trichoderma harzianum*, *Trichoderma viride*.

Results and discussion

In winter rye, the most important traits for organic farming were evaluated in this study. Due to low atmospheric temperatures in winter 2003/2004, conditions for plant survival were hard. However winter rye 'Kaupo' showed acceptable winterhardiness (Table 1). No significant influence of different sowing rates and 'BioMikss'treatment on winterhardiness of winter rye 'Kaupo' was found. The autumn of 2002 was very short and cold, and these weather conditions were not suitable for optimal function of biopreparation.

No significant influence of sowing rates and 'BioMikss' treatment was observed on the grain yield, resistance to *Rhynchosporium secalis* and Puccinia graminis and grain quality. So it was not necessary to increase the sowing rate in biological farming. It was not possible to make conclusion about the effectiveness of preparation 'BioMikss' due to extreme weather conditions in winter 2002/2003.

Table 1

Effect of different sowing rates and preparation 'BioMikss' on grain yield and other traits of winter rye 'Kaupo

Varia-nt	Yield, t ha^{-1}	Winter-hardi-ness, %	*Rhynchosporium secalis* infection %	*Puccinia graminis* infection %	Number of ear-bearing tillers per m^2	Protein, %	Falling number, s	TKW, g
400*	2.71	80.3	47.5	87.5	415	9.62	233	32.8
400B	2.51	76.1	37.5	100	380	9.69	214	32.1
500	2.73	77.6	55.0	92.5	435	9.68	264	32.4
500B	2.69	73.2	50.0	100	405	9.29	272	33.0

*400, 500 – number of viable seeds per 1m^2,
B – 'BioMikss' application

Four varieties - 'Kaupo', 'Valdai', Duoniai', 'Voshod I' were tested for suitability to organic farming in 2004 (Table 2). Weather conditions in winter 2003/2004 were good and all winter rye varieties showed good winterhardiness. One of most important traits for rye varieties under Latvias conditions is time of heading and maturity, because it is found, that earliness of crop has a positive influence on grain quality (falling number, less infection with ergot). The late variety 'Duoniai' had lover falling number than earlier varieties.
The highest grain yield was reached with the varieties 'Kaupo' and 'Valdai'. Infection with diseases was not high for all of the tested varieties.
The best winter rye varieties for organic farming were 'Kaupo' and 'Valdai'. 'Duonai' had a good resistance to lodging, but due to late maturity and lower grain quality it was not recommended for organic farming.

Table 2

Suitability of winter rye varieties to organic farming

Varieties	Yield, t ha^{-1}	Heading, date	Maturity, date	Winter-hardiness %	Lodging, points1-9	Falling number, s	TKW, g
Kaupo	5.38	24.05	15.08	94.1	8	251	38.9
Valdai	4.95	24.05	15.08	88.3	8	202	39.6
Duoniai	4.39*	2.06	20.08	92.4	9	148	39.4
Voshod I	3.82*	29.05	15.08	93.0	8	220	36.2

*Significant difference with 'Kaupo' at P>0.05

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TESTING OF FORAGE GRASSES AND LEGUMES SUITABLE FOR ORGANIC FARMING AND SEED PRODUCTION

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Abstract
During the years 2003 - 2004 the Research Institute of Agriculture of the Agency of the Latvia University of Agriculture (LUA) established experiments in organic farming fields.
The aim of these experiments was to clarify most suitable legume and forage grass varieties and their mixtures for seed production under organic farming conditions.
The test results proved the following: under unfavourable weather conditions lucerne variety 'Skriveru' gave the seed yield 79 kg ha^{-1}. The new meadow fescue variety 'Silva' produced seed 312 kg ha^{-1}. The hybrid ryegrass 'Saikava' grown in the sowing year side by side with annual lupine 'Danko' presented the seed yield of 581 kg ha^{-1}. Better yields were obtained when forage grasses were grown in mixture with legumes: red clover 'Skriveru agrais'+ timothy 'Teicis'- 201 kg ha^{-1}, and alsike clover 'Menta'+ timothy 'Teicis'- 244 kg ha^{-1}. In pure sowings all these varieties produced relatively lower yields.
Key words: *organic farming, seed production, forage grasses, legumes, varieties*

Introduction

In Latvia, the area devoted to organic farming cover about 1.5 % of total agricultural land. In 2003, there were 550 organic farming enterprises managing 24 480 ha of land. Organic farming is gaining popularity both in Latvia and the world.
In many areas of Europe numerous research projects and reviews on agronomic and environmental consequences of organic agriculture were carried out. In the Baltic states, much of research has not been done in the field of organic farming, but the high importance of research is clearly recognised by several institutions dealing with organic farming. It is especially needed to find out appropriate crop rotation and varieties for this farming (Geherman and Ellermae, 2002).
Legumes as a source of cheap biologically fixed nitrogen are very important both in organic and conventional farms (Baars and Veltman, 2000).
Legumes fixing atmospheric nitrogen completely supply themselves with this plant food element and also contribute to companion forage grasses (Slepetis, 2003).
Latvia and other countries of Europe miss experience and scientific research on forage grasses and legume seeds in organic farming fields.
The average seed yield of forage grasses and legumes produced in conventional farming is about 500 kg ha^{-1} and 100 kg ha^{-1} respectively with large variations between production years. It depends on agro climatic conditions of the year, and soil fertility. Experiments conducted on forage grass seed production for organic farming purposes are not sufficient enough.
The objective of this paper was to analyse the forage grass seed yields produced without using mineral fertilizers, but applying the legume effect to fix biologic nitrogen.

Materials and methods

Research Institute of Agriculture in Skriveri started to test more suitable varieties. The tests were carried out in a certified organic farming field in the spring of 2003.

The soil at the site is sandy loam with organic matter content 3.5 %, pH_{KCl} 5.8, K_2O - 155 mg kg^{-1}, P_2O_5 - 84.4 mg kg^{-1}.

The following varieties of legumes were estimated: 2 varieties of early ripening red clover ‘Skriveru agrais’ and ‘Arija’, mid-early ripening red clover ‘Dizstende’, alsike clover ‘Menta,’ and lucerne ‘Skriveru’. The seed rate for all legumes was 8.0 kg ha^{-1}. Two forage grasses were estimated in pure sowing: cocksfoot ‘Priekulu 30’ and meadow fescue ‘Silva’, the seed rate was 15.0 kg ha^{-1}, as well as 5 mixtures of forage grasses and legumes (two components) were used: red clover ‘Skriveru agrais’+ timothy ‘Teicis’ (5+5 kg ha^{-1}), alsike clover ‘Menta’+ timothy ‘Teicis’ (5+5 kg ha^{-1}). Meadow fescue ‘Silva’, hybrid ryegrass ‘Saikava’ and cocksfoot ‘Priekulu 30’ were sown in mixture with annual lupine ‘Danko’. The aim of the research was to elucidate whether biologic nitrogen fixed by lupine could influence the forage grass yield and, if so, to which extent as compared to grasses grown in pure sowing.

Trials were established in randomised complete blocks in four replications. Meteorological conditions were different during experimental years. In June 2003, when trials were established, the average temperature was by 0,7 ^{0}C degree below the norm, but the amount of precipitation made 75 % of the norm. July with average temperature 19 ^{0}C was the warmest summer month.

During the vegetation period 2004 meteorological conditions were extremely bad. The spring was late and cold resulting in delayed plant development. In May frequent and strong spring frosts occurred: both forage grasses and legumes were injured by frost. The summer was cool and rainy. Meteorological conditions were represented by increased rainfall during flowering time of legumes and in autumn during harvesting of seeds. Both during the sowing year and the year of seed yield phenological observations were performed, and the yield calculation, too. All the variations and mixtures were sown in plots of 2.0 x 5.0 m in size in 4 replications. The preceding plant was bare fallow. Lucerne and annual lupine seeds were treated with appropriate microbial strains using nitragine produced by ‘Bioefekts’ and active microbial strains obtained from LUA Plant Biology and Protection Department collection.

The seed yield was gathered at complete ripeness phase using combine ‘Sampo 130’.

Data obtained were processed by a mathematical method.

Results

In the test year (2003) sprouts covered all the fields, and on July 21 they were cut down. Shortly before winter, on November 12, there were made measurements: the number of plants on one metre (Table 1).

In general, meteorological conditions during the vegetation period 2004 were extremely unfavourable for seed yield and good harvest, especially in the case of legumes. On May 13, cocksfoot grass was frozen dead, also lucerne and clover got frozen. During flowering period there was abundant rainfall, the pollination of legumes was hindered bringing low seed yields.

The varieties can present their positive effect mostly within specific environment for which this variety is developed. The field plant varieties grown under local conditions are potentially more elastic, more fruitful, and more resistant. The test data testify this as well.

Higher seed yields were obtained with a new alsike clover variety ‘Menta’, in mixture with a new timothy variety ‘Teicis’- 244 kg ha^{-1}. Red clover ‘Skriveru agrais’ in mixture with timothy ‘Teicis’ yielded 201 kg ha^{-1} of seed. In these unfavourable for seed growth conditions pure legume sowings provided satisfactory seed yields: lucerne ‘Skriveru’ gave 179 kg ha^{-1}, red clover ‘Dizstende’- 93 kg ha^{-1}, red clover ‘Arija’ 87 kg ha^{-1}. Treatments with forage grasses sown in mixture with annual lupine ‘Danko’ and cut down during flowering phase provided significantly higher seed yields than in the case of being grown in pure sowings. The highest seed yield was presented by hybrid ryegrass ‘Saikava’- 581 kg ha^{-1}, since it could nicely use the accumulated by annual lupine nitrogen.
Relevant seed material indicator is the seed coarseness, which is testified by the weight of 1000 seeds. The data presented in Table 1 testify that growing crop varieties in the organic farming field, the seed coarseness compared to commercial agriculture did not decline being 3.84 g for hybrid ryegrass ‘Saikava’, 2.18 - 2.34 g for red clover, and 1.82 g for lucerne.

Table 1

Evaluation and productivity of forage grasses and legumes in pure sowing and mixtures

Variety/ grass mixture	Number of plants on 1 metre in autumn of sowing year	Flower time in 1st year of sward use	Harvest time in 1st year of sward use	Seed yield, kg ha^{-1}	*$RS_{0,05}$*	Weight of 1000 seeds, g
Lucerne ‘Skriveru’	14	3 July	13 October	179.0		1.82
Alsike clover ‘Menta’	34	22 June	26 August	78.0		0.80
Red clover ‘Arija’	34	20 June	26 August	87.0		2.34
Red clover ‘Dizstende’	32	30 June	10 September	93.0	*17.0*	2.18
Red clover ‘Skriveru agrais’	32	20 June	26 August	82.0		2.20
Cocksfoot ‘Priekulu 30’	26	19 May	3 August	16.0	*14.0*	1.32
Meadow fescue ‘Silva’	48	15 June	19 July	312.0	*20.7*	2.08
‘Skriveru agrais’+ ‘Teicis’	28+ 26	20 June	26 August	201.0	*49.0*	2.18/0.48
‘Menta’+ ‘Teicis’	20+ 22	22 June	26 August	244.0		0.80/0.50
‘Silva’+ annual lupine ‘Danko’	36	15 June	19 July	387.0	*20.07*	1.88
Hybrid ryegrass ‘Saikava’+ Danko’	30	22 June	03 August	581.0		3.84
‘Priekulu 30’+ ‘Danko’	32	19 May	13 August	24.0	*14.0*	1.28

Conclusions

All varieties of grasses that were grown in the test fields could also be grown in organic farming fields for seed growing needs since they did not require high fertilizer input, were more resistant to plant diseases and pests, and were satisfactory in terms of yield.

For seed production purposes most appropriate were forage grass-legume mixtures that presented higher yields.

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ASSESSMENT OF POTATO VARIETIES' SUITABILITY TO ORGANIC FARMING

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Abstract

The suitability of potato varieties for organic farming was evaluated in certified organic fields. Two medium early varieties ('Sante', 'Lenora') and four medium late varieties ('Brasla', 'Bete', 'Zile', 'Magdalena') were estimated during two years. The tests were carried out in Priekuli, Vecauce, and Skriveri. The influence of growth conditions and variety were significant on potato tuber yield. There were not observed significant differences in yields of medium early potato varieties at trial sites during both test years. The highest average yield among medium late varieties was obtained with 'Bete'. Resistance of medium early potato 'Lenora' to late blight (*Phythophthora infestans* (Mont.) de Bary) surpassed that of potato 'Sante'. Medium late varieties 'Bete' and 'Zile' showed comparatively high resistance to late blight. The starch content of the variety 'Brasla' was exceeding 15 % (acceptable for starch production) in each test site during both years. Comparatively less common scab (*Streptomyces scabies* (Thaxter) Waksman and Henrici) damages were observed on tubers of the potato 'Lenora'and black scurf (*Rhizoctonia solani* Kuhn) blemishes on tubers of the potato 'Sante'.

Key words: *Potato, organic farming, variety*

Introduction

Organic agriculture in Latvia as in other European countries is developing quite fast recently. Farmers – organic product producers are looking for productive crop varieties, suited to their local climatic and soil conditions and that are resistant to disease and pest attacks. Actually organic agriculture standards recommend the cultivation of site adapted crop varieties (El Hage Scialabba and Hattam, 2002). Before producing commercial potato seed for organic farmers, the most suitable varieties have to be chosen (Bonnel, 2004; Koppel, 2001). The most important traits for a suitable potato variety in organic farming are: stronger rooting system, quicker haulm development, stability of yielding, stable and high starch content, durable resistance to main diseases (Haase et al., 2002; Koppel, 2001).

Materials and methods

The suitability of potato varieties for organic farming was evaluated on certified organic fields during 2003 and 2004.

Two medium early potato varieties: 'Sante' (the Netherlands) and 'Lenora' (Latvia), and four medium late varieties: 'Brasla', 'Zile', 'Bete', 'Magdalena' (all from Latvia) were included in trials.

The main emphasis in potato evaluation was put on crop yielding capacity, starch content and resistance to main diseases.

The growth methods were used according to regulations on organic agriculture set by the Latvian Council of Ministers. The tests were carried out in test sites located in Priekuli, Vecauce and Skriveri. Soil parameters were acceptable for potato growing in each test site. The weather conditions differed between test sites each year. The average daily temperatures did not differ significantly between test sites each year, but the temperatures in 2004 were lower during growing period than in 2003, except August. It influenced potato growth; development of plants in 2004 was slower than those in 2003. The least rainfall was observed in Vecauce in 2003, the rainfall in Priekuli was twice of that in Vecauce in July 2003. Abundant rainfall in August made potato harvest difficult in 2003. High rainfall and low temperatures in May in Priekuli contributed to disease development at the beginning of growing period in 2004. Wet conditions prevailing in June and heavy soil texture in Skriveri resulted in exceedingly high soil moisture content that delyed development of plants in 2004.

Results and discussion

The influence of variety and growth conditions on potato yield was significant in both test years ($p<0.01$), except variety influence in 2004 ($p=0.03$). It proved the necessity of selecting proper variety and place of growth, but did not deny the role of weather conditions.

The growth conditions, mainly weather conditions, were not so favorable in 2004 as in the previous year. The average potato yield was 19.6 t ha^{-1} in 2004, compare to 26.1 t ha^{-1} in 2003. In 2003, the highest potato yield was obtained in Priekuli – 28.6 t ha^{-1}, but the lowest in Skriveri – 22.9 t ha^{-1}. Differences in potato yields between places of growth in 2004 were significant and high: 28.0 t ha^{-1} in Vecauce, 20.5 t ha-1 in Priekuli and more than two times less – 10.4 t ha^{-1} in Skriveri. Abundant rainfall resulted in very wet soil making it unsuitable for potato plant development in Skriveri.

The average potato yields between varieties differed significantly ranging from 19.9 to 34.3 t ha^{-1} in 2003 and 7.8 to 34.8 t ha^{-1} in 2004 (Figure 1). Highest average yield was attained with medium late variety 'Bete' in both experimental years. There was not observed significant yield difference between medium early 'Lenora' and 'Sante' in each test year. The yields produced by varieties 'Brasla' and 'Zile' were not significantly different in each test year. The lowest yield was obtained with variety 'Magdalena' in both test years.

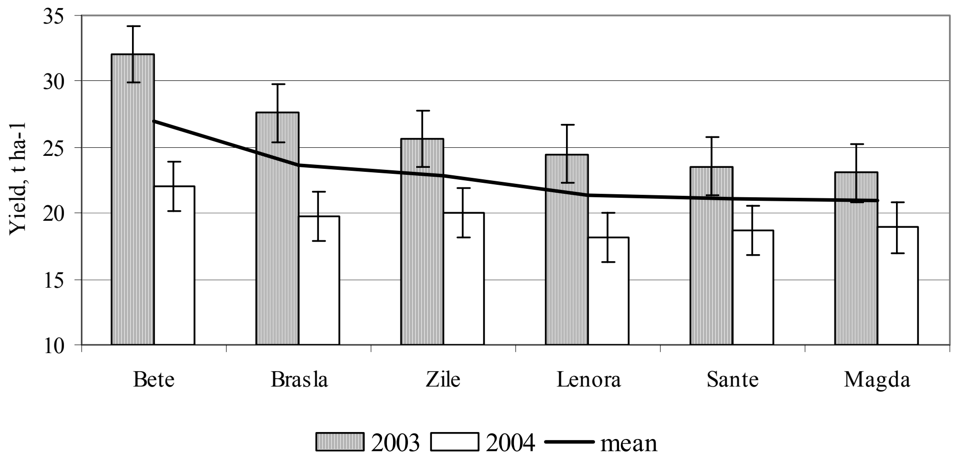

Figure 1. The average yield of potato varieties in 2003 and 2004

The influence of the potato variety on starch content was significant ($p<0.01$) during test. The test years influenced potato starch content with 82 % maximum probability. The influence of test site in 2003 was significant with more than 99 % probability, but in 2004 – 66 % maximum probability. These results prove importance of the variety choice for obtaining recommended starch yield. The average starch content varied between varieties from 10.9 % to 16.9 % in 2003 and from 10.4 % to 17.4 % in 2004. The starch content of medium early potato varieties differed insignificantly in each test year. The highest starch content from medium late varieties was detected for variety 'Brasla' in both test years (17.2 % on average in 2003-2004), starch content produced by variety 'Zile' was lower in both test years (average 16.6 % in 2003-2004, $\gamma_{0.05} = 3.9$ %), but this difference was not significant. In potato 'Bete', starch content was the lowest in both test years (mean in 2003-2004: 10.7 %); the difference with other varieties was significant.

Resistance to late blight (*Phythophthora infestans* (Mont.) de Bary) in all test sites was similar in 2004 (Table 1). Among medium early varieties less damage was observed for variety 'Lenora'. Varieties 'Bete' and 'Zile' were more resistant to late blight than other medium late varieties. Averagely, less disease caused damage on tubers was observed in 2003 than in 2004. More resistant to black scurf (*Rhizoctonia solani* Kuhn) were both medium early varieties and medium late variety 'Brasla'. The variety 'Lenora' had less common scab (Streptomyces scabies (Thaxter) Waksman and Henrici) damage than other varieties. Very few late blight caused damage was observed on tubers during investigation. The average amount of healthy tubers was similar in both years; between varieties it varied from 22 % to 52 %.

Table 1

The average main diseases damages of potato varieties

Disease, damage	Year	Varieties, maturity						Mean
		Sante ME	Lenora ME	Brasla ML	Zile ML	Bete ML	Magdalena ML	
Late blight, % of damaged leaf area in the middle of epidemic	2003	93	65	85	52	32	87	-
	2004	97	57	65	22	22	80	-
Black scurf, % of damaged tubers	2003	15	21	13	10	9	38	18
	2004	14	25	25	48	27	41	30
Common scab, % of damaged tubers	2003	25	4	7	15	13	11	13
	2004	21	9	24	20	17	15	18
Late blight, % of damaged tubers	2003	0	0	0	0	0	0	0
	2004	0.5	0.15	0	0.2	0.4	0	0.2
Healthy tubers, % of totally tested	2003	25	43	43	41	35	22	35
	2004	46	52	37	29	43	23	38

Conclusions

Most suitable for organic farming were medium early variety ‘Lenora’ and medium late variety ‘Zile’, but for specific utilisation purposes (starch production or cookery) ‘Brasla’ and ‘Bete’ were acceptable. The yield level of two varieties - medium early variety ‘Sante’ and medium late ‘Brasla’ – was acceptable in spite of responsiveness to late blight; these varieties could be used in organic farming, if plant protection measures were applied.

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VARIETY TRIALS OF CEREALS, OILSEEDS AND POTATOES IN ORGANIC FARM

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Abstract
Field trials were carried out on organic farming fields at the Research Institute of Agriculture of the Latvia University of Agriculture (LUA). The suitability of six spring barley varieties: 'Abava' (standard), 'Rasa,' 'Ruja', 'Sencis', 'Idumeja', 'Malva', four oat varieties 'Laima' (standard), 'Arta', 'Liva', 'Mara', two winter rye varieties: 'Duoniai', 'Valdai', four winter triticale varieties: 'Michas', 'Falmoro', 'Ulrika', 'Prego', two spring turnip rape varieties: 'Valo', 'Kulta' for organic farming were evaluated during 2003-2004. The grain yields of spring barley were in the range of 2.00 - 2.69 t ha^{-1} during 2003-2004. The highest grain yields were obtained with 'Sencis' and 'Rasa'. The grain yields of oats were in the range of 3.14 - 4.02 t ha^{-1}. The highest yields were obtained with varieties 'Laima' and 'Mara'. The grain yields of winter rye varieties did not differ significantly and were 3.35 - 3.65 t ha^{-1}. The grain yields of winter triticale varied from 4.04 – 4.63 t ha^{-1}. The highest yields in the group of medium early varieties were obtained with 'Sante' but in the group of medium late varieties with 'Brasla' and 'Bete'. The total non-standard product was 9-11 %. The seed yields produced by the spring turnip rape were low - 0.73 and 0.70 t ha^{-1} for the variety 'Valo' and 'Kulta', respectively.
Key words: *organic farming, variety, cereals, turnip rape, potato*

Introduction
Organic farming is one of the key issues in reorganizing Latvian agricultural policy. Healthy, strong seeds of suitable varieties are an indispensable basic condition for successful organic agriculture. Breeding, variety testing and seeds quality assurance are the main instruments of a purposeful promotion of the organic farming by agricultural research and development activity (http://www.aramis-research.ch/d/15980#organisations). Research on suitability of modern varieties to organic farming in Latvia is important goal for diversification of agriculture and development of organic farming. The most important properties for a suitable variety in organic farming are: stronger rooting system, quicker haulm development, and stability of yielding and durable resistance to main diseases.
The aim of experiments was to evaluate varieties of cereals, potatoes and oilseeds for organic farming.
The field trials were partially supported by the State Plant Protection Service and Latvian Agricultural Advisory and Training Centre.

Materials and methods
The suitability of spring barley, oilseeds and potatoes were evaluated on certificated organic farming fields. The field trial was carried out on sod-podzolic soil: pH_{KCl} – 6.4-6.7, P_2O_5 – 14.8-16.2 g kg^{-1}, K_2O – 12.8-14.9 g kg^{-1}, organic matter content – 33-36 g kg^{-1} of soil.

1. Spring barley

In 2003, four spring barley varieties 'Abava' (standard), 'Rasa,' 'Ruja', 'Sencis' and six spring barley varieties in 2004: 'Abava' (standard), 'Rasa,' 'Ruja', 'Sencis', 'Idumeja', 'Malva' were included in the trials.

Pre-crops: fallow + green manure (in 2003) and winter rye (in 2004). The seed rate of spring barley was 500 germinating seeds per m^{-2}. Sowing dates were 23 May 2003 and 30 April 2004. The number of replications was four, random plot design, the plot size - 30 m^{-2}. The crop was harvested on 3 September 2003 and 16 August 2004.

2. Oats

Four varieties: 'Laima' (stand.), 'Arta', 'Liva' and 'Mara' were tested. The seed rate was 500 germinating seeds per m^{-2}. Pre-crops: fallow + green manure.

3. Winter cereals

Two winter rye varieties: 'Duoniai', 'Valdai' and four winter triticale varieties: 'Michas', 'Falmoro', 'Ulrika', 'Prego' were tested. Pre-crop: potato. The seed rate was 500 germinating seeds per m-2. The sowing date was 15 September 2003, the date of harvest 18 August 2004.

4. Potatoes

Two medium early varieties: 'Sante' (standard), 'Lenora' and four medium late varieties: 'Brasla '(standard), 'Zile', 'Bete', 'Magdalena' were tested during 2003 - 2004.

All tested varieties are resistant to nematodes. Potatoes were planted on 21 May 2003 and 14 May 2004. The planting rate was 50 000 potato tubers per hectare. The crop was harvested on 11 September 2003 and 28 September 2004. Pre-crops: winter rye (for trials in 2003) and oat (for trials in 2004).

5. Spring turnip rape (*Brassica campestris*)

Two spring turnip rape varieties 'Kulta' and 'Valo' were tested. The seed rate of spring turnip rape was 120 germinating seeds per m^{-2}. The sowing date was 30 April 2004. Pre-crop: oats. The number of replications was four, random plot design, the plot size - 30 m^{-2}. The crop was harvested on 18 August 2004.

Meteorological conditions were different during testing period. The year 2003 was very favourable for the growth and development of spring barley. April was rainy and cold, which delayed sowing. In May the temperature raised gradually, at nights the temperature was below 10 ^{0}C, and frosts were frequent on the soil surface. In June, the average temperature was by 0.7 degrees below the norm, but precipitation was 75 % of the norm. July with average temperature 19 ^{0}C was the second warmest mid-summer month during last 80 years in Latvia.

In April 2004, the average temperature was by 1.7 ^{0}C higher than the norm. The first decade of May was one of the warmest decades during last 80 years in Latvia. The second decade of May was by 3.1 ^{0}C but the third decade – by 3.6 ^{0}C lower than the norm. At this time frost was frequent on the soil surface. In May the precipitations was 80% of the norm. In June, the average temperature was by 1.3 ^{0}C lower than norm but the precipitation was 152 % of the norm. Very wet conditions were observed in the third decade of June (223 % of the norm). In August, the average temperature was by 1.7 ^{0}C higher than the norm.

ANOVA (one and two factor with replication) was used for data analysis.

Results

The grain yields of spring barley varied between 2.00 - 2.69 t ha^{-1} during 2003-2004. The highest grain yields were obtained with the varieties 'Sencis' (2.69 t ha^{-1}) and 'Rasa' (2.60 t

ha^{-1}). The yields of these varieties were higher than that of the standard variety 'Abava' but did not differ significantly in both testing years.
The weight of a thousand grain (TGW) varied from 34.22 to 40.27 g and was characterized as medium in 2004 (Table 1). The influence of variety was significant (p-value <0.05; η= 97 %). The TGW of variety 'Idumeja' (40.27 g) was significantly higher compare to the standard variety 'Abava'. The lowest TGW was obtained with the variety 'Malva' – 33.07 g.

Table 1

The quality of spring barley grain, 2004

Variety	Origin	TGW, g	Grain volume weight, g l^{-1}	Crude protein, %	Starch, %
Abava (stand.)	Latvia, Stende	37.27	612	10.8	62.4
Sencis	Latvia, Stende	34.22	613	10.6	63.0
Rasa	Latvia, Stende	34.25	611	9.8	63.0
Ruja	Latvia, Priekuli	38.74	596	10.0	62.8
Malva	Latvia, LUA	33.07	599	10.6	62.2
Idumeja	Latvia, Priekuli	40.27	579	10.0	62.7

Depending on the variety, the 1000 grain weight varied from 33.5 to 38.4 g and was characterized as medium. The influence of the variety was significant (p-value <0.05; η= 98 %). The grain volume weight of the varieties 'Sencis' and 'Rasa' did not significantly differ from the standard variety 'Abava'.
The content of crude protein varied from 9.8 to 10.8 %. The lowest content of crude protein was obtained with the variety 'Rasa' – 9.8 %. The content of starch varied from 62.2 to 63.0 %.
The varieties of oats were tested in 2003. The grain yields were in the range of 3.14 - 4.02 t ha^{-1}. The highest grain yield was obtained with the standard variety 'Laima' – 4.02 t ha^{-1}. The grain yield produced by 'Mara' did not differ significantly from the standard variety 'Laima' but differed significantly from yields produced by 'Liva' and 'Mara'. The lowest grain yield was obtained with the variety 'Arta' – only 3.14 t ha^{-1}.
Testing of winter rye and winter triticale started in 2004. The average grain yields between varieties of winter rye did not differ significantly. The highest grain yield was obtained with the variety 'Valdai' – 3.65 t ha^{-1}.
The average grain yields of winter triticale were in the range of 4.04 - 4.63 t ha^{-1}. The variety influenced grain yields (p-value 0.02 < 0.05). The grain yields of 'Michas', 'Ulrika' and 'Prego' did not significantly differ. The grain yield of 'Falmoro' was significantly lower than those of other varieties.
The influence of variety (p-value < 0.05, η = 10 %) and testing year (p-value<0.05, η = 79 %) on the potato was significant during testing years. The range of yields was 18.38 - 27.30 t ha^{-1} in 2003 and 7.84 - 11.64 t ha^{-1} in 2004. The highest yields in the group of medium early varieties were obtained with the variety 'Sante' but in the group of medium late varieties – with 'Brasla' and 'Bete'. The total non-standard product accounted for 9 - 11 %. The testing year significantly influenced the total non-standard produce of potatoes (p-value = 0.03 < 0.05, η = 49 %). The highest losses of yields were observed in the year 2004.
The starch content varied between varieties from 10.63 % to 16.64 % in 2004. The highest starch content between medium early varieties was produced by 'Lenora' – 15.58 %, and

between medium late varieties with 'Brasla'. The lowest starch content was obtained with the variety 'Magdalena' – 10 %.
The testing of turnip rape (*Brassica campestris*) was started in 2004. Produced seed yield was low for the varieties 'Valo' and 'Kulta'– 0.73 and 0.70 t ha^{-1} respectively. Plant height was 75 cm, and the lodging resistance was good (9 points) to both varieties. The obtained seed was of good quality – 1000 seed weight was 2.2 - 2.3 g and seed volume weight – 665–666 g l^{-1}.

Conclusions
Results of testing suggest that most suitable for organic farming were:

- spring barley varieties: 'Abava', 'Sencis' and 'Rasa';
- oat: 'Laima' and 'Mara';
- winter rye: 'Valdai'and 'Duoniai';
- winter triticale: 'Michas', 'Ulrika', 'Prego';
- potato 'Brasla' and 'Bete';
- spring turnip rape: 'Kulta' and 'Valo'.

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CEREAL VARIETIES FOR ORGANIC PRODUCTION: FIELD TRIALS OF WINTER CEREAL CROPS UNDER ORGANIC CONDITIONS

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Abstract
Organic agriculture is a growing sector and needs variety improvements for further optimisation of its farming system. The first step is to identify the best existing, conventionally bred varieties for organic practices and for organic propagation. During 2004 year cereal crop varieties were evaluated for organic agriculture in Lithuanian Institute of Agriculture. Having assessed 18 varieties of winter cereals under organic farming conditions some varieties were distninguished as possessing important and valuable traits for practical use in organic farming: rye – 'Rūkai' – high yieldinging capacity, winterhardiness, high grain quality; 'Joniai' – resistance to powdery mildew; wheat – 'Alma' – early maturity, high grain quality; 'Bill' – high yield, resistance to lodging, powdery mildew and bunt; barley – 'Tilia' – high yield, early maturity; triticale - 'Tornado' and 'Fidelio' – high yield,

winterhardiness, resistance to lodging and diseases. All these varieties will be further assessed for morpho – physiological parameters and other traits.

Key words: *organic agriculture, cereal crop, conventional varieties*

Introduction

Organic agriculture is a growing sector. On a world scale, 17 million ha are seeded organically. Australia is leading with 7.7 million ha, followed by Argentina (2.8 million ha) and Italy (1 million ha) (Yussefi and Willer, 2002). The area (ha) with organic agriculture in Europe has grown by 1300000 ha between 1998 and 2001. The average of the proportion of the organic area in total agricultural land use among the EU countries was 2.8%. For Lithuania, it was 42961 ha in July of 2004. As most European governments strive for a growth in organic agriculture of up to 10% by 2010, there is a need for improvement of varieties, not only by improving organic seed production but also through the development of organic plant breeding programmes for better adapted varieties (Lammerts van Bueren, 2003).
Organic farmers profit from the improvements of conventional breeding, but this does not imply that those are the best varieties for use in organic farming systems. Varieties supplied by conventional breeding are developed for farming systems in which high levels of artificial fertilisers and agro-chemicals are applied. The organic farming system differs fundamentally from conventional agriculture in the management of soil fertility, weeds, diseases and pests. Organic farmers depend greatly on conventionally bred and produced varieties, but require varieties better adapted to organic farming systems for further optimisation of organic agriculture. This includes a greater need for varieties contributing to higher yield stability.
Consequently, the first step in plant breeding for organic farming systems is organic propagation of the most suitable, existing varieties. First of all, there is a significant lack of information in Lithuania on the relative performance of modern crop species and varieties under organic conditions. Institutions such as the Lithuania University of Agriculture (LUA) and the Lithuanian Institute of Agriculture (LIA) have carried out some variety trials before. The first variety testing for organic farming at the LIA was conducted during the 1997-1999 period. The testing involved more than 157 varieties in low-input farming conditions without fertilisers and agro-chemicals of which 29 varieties were recommended for organic farming after evaluation, namely: 3 winter rye, 9 winter wheat, 5 spring barley, 3 oats, 5 peas, 2 faba bean and 2 vetch varieties. These varieties are characterised by high yielding capacity and quality, disease tolerance, lodging resistance (Rekomendacijos žemdirbystei, 2000).
Important varietal characteristics for organic agriculture are as follows: nutrient acquisition ability (root morphology, nutrient uptake and use efficiencies, low-nutrient tolerance, symbioses); competitive ability (morphology, weed tolerance, growth rate, allelopathy); ecological combining ability (good performance in variety and species mixtures); disease resistance (morphology, specific and non-specific resistance properties, disease tolerance); other characteristics, including tolerance to attacks by pests and tolerance to climatic induced stress (water, temperature).
There is no doubt that varieties or lines with appropriate characteristics exist among current and older collections of varieties, in breeding programmes and in gene banks in different countries. There is a pronounced need to develop a research network to identify such lines either for direct use or as potential parental lines in breeding programmes (COST Action 860, 2004).

The objective of this study was to evaluate conventional varieties of winter cereals for organic agriculture, to determine their yielding potential and impact of plant species and variety on yield and quality, and to identify the most appropriate varieties for organic farmers.

Materials and methods

During the year 2004, 18 Lithuania-registered varieties of winter cereals were evaluated for organic agriculture at the Lithuanian Institute of Agriculture: barley (*Hordeum* L.) - 'Carola', 'Tilia'; rye (*Secale* L.) – 'Rūkai' (tetr.), 'Duoniai', 'Joniai', 'Lietuvos 3'; wheat (*Triticum* L.) – 'Širvinta', 'Ada', 'Seda', 'Tauras', 'Alma', 'Milda', 'Lina', 'Bill', 'Lars', 'Zentos'; triticale (*Triticosecale* Wittm.) – 'Tornado', 'Fidelio'. The varieties were sown in 5x1.5 m^2 plots in 3 replications. The soil of the experimental site is Endocalcari-Epihypogleyic Cambisoil (CMg-p-w-can) light loam. The preceding crop was fallow. The field was certified for organic agriculture. No agrochemicals and fertilizers were used. In the trials we assessed the period of maturity (days), plant height (cm), grain yield (t ha^{-1}), main yield components, 1000 kernel weight (TKW) (g), volume weight (VW) (g l^{-1}). Statistics on yield and competitive factors was made.

Results

In 2003-2004 conditions for wintering were favourable for the crops. The winterhardiness of most tested varieties was scored by 8-9 points (Table 1). The mean value of winterhardiness for all crops was 8.5 points. The summer of 2004 was variable in terms of temperature and precipitation distribution: at the beginning cool and rainy, afterwards quite wet but sufficiently warm. The plant growing period extended by about two weeks, and some varieties lodged. Lodging resistance ranged from 4.3 to 9 points (within scale 1-9, where 9 - very resistant). Wheat 'Bill' and triticale 'Tornado', 'Fidelio' had the best lodging resistance (9 points). Because of the rainy weather all plants were 10-15 cm taller than usual. Plant height ranged from 85 (wheat 'Bill') to 173 cm (rye 'Lietuvos 3'). The complete maturity was observed for most of the varieties on 3-8 August. Maturity time ranged between 207 and 219 days. Varieties of winter barley matured very early (207-208 days) (Table 1). All rye varieties matured later than the other crops (220 days).

All crops were harvested on 13 August. Varieties produced high yields under organic conditions. The trial mean was 7.71 t ha^{-1}. The winter wheat produced a wide range of yields, some reaching 9.23 t ha^{-1} while other barely 6.00 t ha^{-1}. 'Bill' was the best performing wheat variety, while 'Alma' performed worse. The yield statistically significantly differed from the trial mean only for those two varieties (Fig. 1).

The winter rye produced yields from 8.57 to 5.92 t ha^{-1}. 'Rūkai' and 'Joniai' were the best performing rye varieties, while 'Duoniai' and 'Lietuvos 3' performed worse. The differences between the varieties and the trial mean for the 'Rūkai' and 'Joniai' were not statistically significant, while the differences were significant for 'Duoniai' and 'Lietuvos 3' (Fig. 2).

The two registered spring barley varieties produced a yield from 6.27 to 6.55 t ha^{-1}. Only the variety 'Carola' produced a statistically significantly lower yield than the trial mean. The yields of triticale varieties ranged between 9.59 - 10.19 t ha^{-1}. 'Tornado' and 'Fidelio' showed the highest yields (about 10 t ha^{-1}) among the varieties of winter cereals. They had statistically significantly higher yields compared with the trial mean (Figure 3).

Table 1

Agronomic traits of winter cereal crop varieties for organic agriculture, LIA, 2004

Variety	Crop	Winter-hardiness*	Lodging resistance*	Plant height, cm	Maturity, days	VW, $g\ l^{-1}$	TKW, g
Širvinta	wheat	9	4.3	128	215	817	52.0
Ada	wheat	9	8.7	112	217	823	40.0
Seda	wheat	9	6.3	116	217	767	52.8
Tauras	wheat	9	6	113	216	783	45.5
Alma	wheat	9	5.6	114	215	805	43.5
Milda	wheat	9	7	113	217	821	43.0
Lina	wheat	9	5	109	217	807	46.8
Bill	wheat	7.7	9	85	218	789	46.3
Lars	wheat	8.7	8	102	217	811	46.8
Zentos	wheat	8.3	6.7	115	218	799	45.0
Rūkai (tetr.)	rye	9	6.3	133	220	695	41.0
Duoniai	rye	7.3	8.7	133	220	711	44.8
Joniai	rye	8	7.3	135	220	733	40.0
Lietuvos 3	rye	9	5.3	173	220	719	41.0
Carola	barley	7.7	7.7	109	207	595	43.8
Tilia	barley	7.7	8.7	105	208	565	44.0
Tornado	triticale	8.3	9	110	214	753	49.3
Fidelio	triticale	9	9	106	219	735	44.5
Trial mean		**8.5**	**7.1**	**117**	**216**	**752**	**45.0**
LSD_{05}		**1.18**	**1.35**	**8.43**	**1.47**	**7.8**	**1.28**

* - scale 1-9, where 9 - very resistant

Many foliar fungal diseases (powdery mildew in cereals, many soil borne diseases) are of minor importance in organic farming systems, because disease preventive agronomic measures (use of resistant cultivars, suitable rotations and nutrition balance management) prevent disease development. However, some foliar and post-harvest diseases can cause significant economic losses in organic farming systems. The consequences of losses due to pests and diseases in organic farming systems differ considerably, depending on region, crop, farm structure or market demands. In general, yields in organic agriculture are 20% lower due to a lower nitrogen input (up to 50% less nitrogen) and in some cases due to pests and diseases (Mäder et al., 2002). The powdery mildew in 2004 infested winter wheat, rye and barley. More resistant to mildew were wheat 'Bill', rye 'Joniai', 'Lietuvos 3' and barley 'Tilia'. The variety 'Lars' was distinguished for better resistance to tan spot,

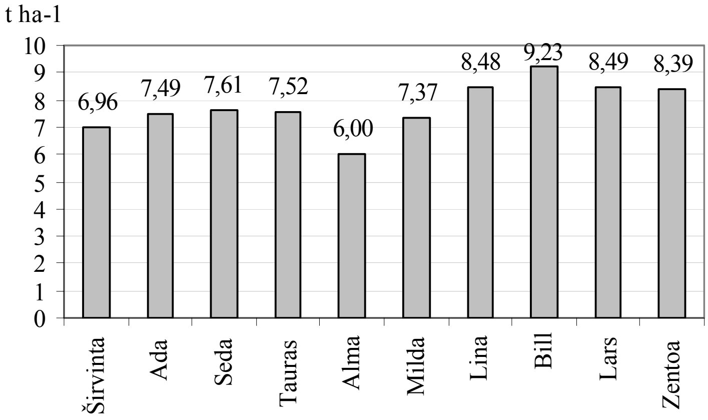

Figure 1. The yield (t ha^{-1}) of winter wheat varieties, LIA, 2004

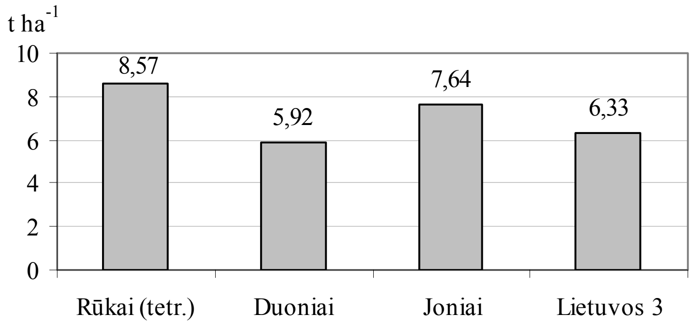

Figure 2. The yield (t ha^{-1}) of winter rye varieties, LIA, 2004

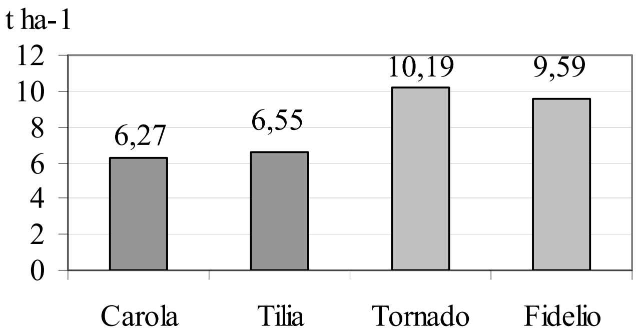

Figure 3. The yield (t ha^{-1}) of winter barley (*Carola, Tilia*) and winter triticale (*Tornado, Fidelio*) varieties, LIA, 2004

caused by *Pyrenophora tritici-repentis*. Of the two triticale varieties 'Fidelio' was found to be more resistant to leaf diseases (tan spot and septoria). The rye variety 'Lietuvos 3' was more severely infested by rhynchosporium and brown rust. The tested barley varieties were highly susceptible to leaf diseases, and 'Carola' also to powdery mildew. Of all the tested wheat varieties only varieties 'Seda' and 'Bill' were resistant to common bunt (*Tilletia tritici*).

Conclusions

Having assessed 18 varieties of winter cereals under organic farming conditions some varieties were distinguished as possessing important and valuable traits for practical use in organic farming: rye 'Rūkai' – high yielding capacity, winterhardiness, high grain quality; 'Joniai' – resistance to powdery mildew; wheat – 'Alma' – early maturity, high grain quality; 'Bill' – high yield, resistance to lodging, powdery mildew and bunt; barley 'Tilia' – high yield, early maturity; triticale 'Tornado' and 'Fidelio' – high yield, winterhardiness, resistance to lodging and diseases.

All these varieties will be further assessed for morpho – physiological parameters and other traits.

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PERFORMANCE OF LATVIAN SPRING BARLEY (*HORDEUM VULGARE* L.) VARIETIES AND BREEDING LINES UNDER ORGANIC FARMING CONDITIONS

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Abstract

Organic farming is a comparatively new and growing direction of agriculture in Latvia. Expansion of the area of agricultural land, which is certified for organic farming from 1 % to more than 3 % in the year 2010 is envisaged by the plan. The choice of varieties is

significant for farmers. In order to recommend the most appropriate spring barley varieties, trials in certified fields for organic farming were carried out in several Latvian research institutions. The poster presents summarised data on yield, grain quality, plant height, the length of vegetation and infection with diseases in six registered Latvian barley varieties recommended by breeders as suitable for growing under organic farming conditions, which were tested in 2003 (2 test sites) and 2004 (4 test sites). Significant differences were not observed between mean grain yields of the tested varieties (P-value= 0.67 and 0.12 in 2003 and 2004 respectively). The influence of the test site on grain yield was not significant in 2003, but it was significant in 2004. The highest seedling emergence was registered for the variety 'Sencis', but it was lower for 'Idumeja'. A useful trait for organic farming could be earliness because of rapid development of plants, which could be related to a better competition ability with weeds and use of nutrients from soil, as well as earlier grain harvest and longer growing period for the following crop (e.g. green manure). The duration of vegetation for the variety 'Idumeja' was on average by 7 days shorter than that of the check variety 'Abava'. The highest mean TGW was estimated for the varieties 'Idumeja' (47.0 g) and 'Ruja' (46.7 g). None of the varieties exceeded the mean grain volume weight of the check variety 'Abava' (679 g l^{-1}). There were not observed significant differences between the content of crude protein among the varieties detected. Serious problems for seed certification in organic farming could be caused by loose smut (*Ustilago nuda*). None of the varieties showed complete resistance to this seed-born disease, but the lowest infection level was detected for the varieties 'Malva' and 'Idumeja', which could be recommended for organic farming from this point of view. Testing of advanced barley breeding lines for organic farming was started at Priekuli Plant Breeding Station in 2004. None of the tested 11 lines had lower yield compared to the check variety 'Abava', but 5 lines gave significantly higher yields. In terms of yield, the tested breeding lines did not significantly surpass the variety 'Ruja'. Two resistant lines and a line with a low level of loose smut infection were selected for further testing. Although a special breeding program for organic farming will apparently not be started in Latvia in the nearest future, several registered varieties could be recommended to organic farmers and testing of appropriate breeding lines under organic conditions might be a useful tool for the selection of new varieties. A new variety with resistance to loose smut could be applied for official testing in the nearest years.

Key words: *spring barley, varieties, organic farming*

THE TEST RESULTS OF WINTER WHEAT VARIETIES SUITABLE FOR ORGANIC FARMING IN LATVIA

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Abstract

Winter wheat varieties capable of producing high yields and quality of grain considering prospective kind of use are indispensable for organic farming system. Due to lack of winter

wheat varieties suitable just for growing under organic farming conditions in Latvia, testing suitability of conventionally grown winter wheat varieties to organic conditions of growth is necessary. Eight of these varieties were tested at the State Stende Plant Breeding Station.

Key words: *winter wheat, organic farming, varieties*

Crop production results and profitability are characterized by produced tonnes and quality of grain both in conventional and organic farming. The right crop variety is of very great importance in organic management system. Cereal crop variety, which is plastic enough, capable of utilizing natural soil fertility, competitive with weeds, resistant to diseases and lodging, is able to provide yield and stable quality of grain under diverse conditions of growth.

Winter wheat is one of most demanded crops. Successful cultivation requires sufficient soil natural fertility level to provide acceptable yields and quality of grain. Winter wheat variety testing was established on a field with 1st year red clover as previous crop. The field was sown to winter wheat in autumn between 5 and 10 September. The seeding rate was 550 germinating seeds per 1 m^2. Optimum time and rate of seeding as well as proper crop rotation is even more significant in organic management system than in conventional farming. Good winter survival and high yields in the following autumn are reached through strengthening of plants, accumulation of nutrients and sugars. Too early seeding (prior to 1 September) of winter cereals usually develops healthy green herbage, which is a good food basis for development of diseases (snow mould, mildew, brown rust, septoriosis). Sowing too late usually results in good over-wintering, however in spring development of plants is delayed compare to plants seeded in optimum seeding time.

Variety testing of winter and spring cereals has been established in State Stende Plant Breeding Station already for several successive years. During 2002 – 2004, 8 winter wheat varieties: 'Krista', 'Sakta', 'Banga' (Latvia), 'Pamjati Fedina' (Russia), 'Ibis' (Germany), 'Cobra' (Poland), 'Belina', 'Garmonija' (Belorus) were tested. In the year 2002 the grain yield varied from 4.74 t ha^{-1} ('Pamjati Fedina') to 6.24 t ha^{-1} ('Banga') (Table 1). The crude protein content was not on the high level, and the grain quality requirements were achieved only with a few varieties - 'Sakta' (12.5 %) and 'Garmonija' (11.5 %). In 2003, winter wheat grain yields varied from 2.99 t ha^{-1} ('Cobra') to 3.99 t ha^{-1} ('Krista') but crude protein content was higher ranging from 11.59 % ('Pamjati Fedina') to 13.38 % ('Krista'). In 2004 obtained winter wheat grain yield was lower varying from 1.91 t ha^{-1} ('Banga') to 4.40 t ha^{-1} ('Garmonia') but crude protein content was from 10.45 % ('Kobra') to 12.45 % ('Pamjati Fedina'). The 3-year results could lead to the conclusion that local varieties of mid-intensive type, such as 'Krista' and 'Sakta', characterized with good winter hardiness, grain yield and stable quality were suitable for growing under organic conditions.

Winter wheat varieties 'Krista', 'Sakta', 'Pamjati Fedina' and Garmonia' could be recommended for use in organic farming as human food.

Winter wheat 'Banga' is more suited for animal feed; it has rather coarse grain (1000 kernel weight 47.5 g in 3 years average), crude protein content in grain - 12.70 – 13.02 %.

When growing winter wheat under organic conditions, one should attentively follow the health of plants avoiding threat to *Tilletia caries*, as well as most dangerous leaf diseases – *Erysiphe graminis*, *Puccinia* spp., *Septoria* spp. and other leaf and ear spot. Effective plant protection means, seed dressers and fungicides are offered for use in conventional agriculture, in organic farming in its turn only natural preparations are allowed though not always they successfully cope with disease agent. For that reason proper crop rotation and use of other agro-technical measures are of great importance. When selecting crop variety, plant height should be long enough to compete with weeds.

Table 1

Grain yield (t ha^{-1}) of winter wheat in organic field, Stende, 2002 - 2004

Variety	Grain yield, 2002, t ha^{-1}	Grain yield, 2003, t ha^{-1}	Grain yield, 2004, t ha^{-1}	Mean grain yield, t ha^{-1}
Krista	5.58	3.99	3.38	4.32
Sakta	5.17	3.68	1.96	3.60
Banga	6.24	3.47	1.91	3.87
Pamjati Fedina	4.74	3.91	3.26	3.97
Ibis	6.16	3.10	3.63	4.30
Bilina	4.93	2.52	3.46	3.64
Garmonia	4.94	3.02	4.40	4.12
Kobra	5.33	2.99	4.22	4.18

At present in Latvia more than twenty winter wheat varieties are recorded in Plant Variety List yet none of them are completely resistant to *Tilletia caries*. Grain infected with *Tilletia caries* is unfit for use both as human food and animal feed.

In autumn 2004, trials with winter wheat aimed at testing seed dresser *Silgard* produced by joint-stock company "Biolat" and use efficiency of various fungicides and repellents in fields sown to winter cereals were established to develop their use recommendations in organic sowings.

YIELD AND DISEASE RESISTANCE OF THE SUPERIOR LAST TOMATO VARIETIES IN AN ORGANIC TRIAL IN ESTONIA

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Abstract

In 2001 were started organic tomato trials at Jogeva Plant Breeding Institute to find high yield and disease resistant varieties for growing under organic conditions. Data were collected from 2001 to 2004 in an unheated plastic greenhouse. Growth substrate was soil fertilized by with cattle manure. 50 tomato varieties - 42 indeterminate, 2 semi-determinate and 6 determinate were tested during the trial years. The tomato varieties originated from several countries, among them 10 from Estonia, one from Latvia and one from Lithuania. Early yield (till July 31), total yield ripened on plants, yield of fruits damaged by diseases such as grey mould (*Botrytis cinerea*) and late blight (*Phytophthora infestans*) were measured. The results showed that the superior tomato varieties were different every year

according to weather conditions. Higher early yield was mainly obtained with Estonian early-ripening varieties. The superior one was determinate ‘Mato’ with the highest early yield (3.8 kg/m^{-2}) in 2002. Variation among tomato varieties in total yield was greater than that in early yield. In warmer summers some later foreign varieties produced superior yields. The highest total yield gave indeterminate ‘Suso’ F1 (10.5 kg/m^{-2}) in 2002. The most disease resistant variety was cherry type ‘Garten Freude’.

Key words: *tomato, yield, diseases, grey mould, organic cultivation*

Introduction

Tomato breeding at Jogeva commenced in 1945. There are 11 Jogeva varieties in cultivation nowadays. During these years there have been studied tomato cultivation problems hand in hand with breeding work. In 2001 there was started an organic tomato trial at Jogeva Plant Breeding Institute to find varieties with high yield and disease resistance for growing under organic conditions.

Material and methods

The data were collected in an unheated plastic greenhouse (9x26 m) from 2001 to 2004. The growth substrate was soil fertilized with cattle manure. Soil layer 10-15 cm deep was removed every autumn before manure spreading in order to decrease occurrence of plant diseases. Subsurface irrigation was used. The surface of the soil was dry throughout the tomato–growing period to minimize diseases. Tomatoes were planted in the middle of May. Plants were grown without any mineral fertilizers and pesticides.

50 tomato varieties - 42 indeterminate, 2 semi-determinate and 6 determinate ones were tested during trial years. Two varieties were cherry type. According to ripening time one half of the varieties were of early ripening and the other late ripening. The origin of all tomato varieties is not clear, but among them there were varieties from the Netherlands, Denmark, Lithuania, Latvia and Estonia. In 2001 there were 28, in 2002 – 30, in 2003 – 28 and in 2004 – 23 varieties used in the trials. Out of them 15 varieties were used in the trial every year.

Early yield (till July 31), total yield ripened on plants and yield damaged by diseases (grey mould and late blight) were measured.

Results and discussion

The production and quality of yield were influenced by weather conditions. Growing period of tomato plants can be calculated from the middle of May to the middle of September. The severest diseases infection occurred mainly in August and September. The greatest damage was caused by grey mould. At present completely resistant cultivars are not available (Egashira et al., 2000), but some of them are more tolerant than others. 3-5 varieties having less than 1% of damaged fruits occurred every year. Incidence of late blight was rare.

In the warm year of 2001 the early-ripening Estonian varieties ‘Valve’, ‘Maike’ and ‘Mato’ gave the highest early yield (till 31 July). ‘Valve’ and the Netherlands ‘Resyset’F_1 and Danish ‘Garten Freude’ produced higher total yield than other varieties (Table 1). Three disease resistant varieties were found as early-ripening - cherry tomato type ‘Garten Freude’ and late ripening ‘Gardenes Delight’ and Danish ‘Goldene Gönigin’.

The early–ripening varieties had lower total yield than the late-ripening ones under favourable conditions. Higher early yield was produced by the two early-ripening varieties ‘Mato’ and ‘Maike’ and cherry tomato variety ‘Garten Freude’ in extremely warm and dry growing period of 2002. Late-ripening varieties ‘Suso’ F_1, the Netherlands ‘Ildiko’ F_1 and

cherry tomato 'Sun Baby' produced the highest total yields. There was no disease infection observed in 2002.
In 2003 with warm summer and September the early-ripening Estonian variety 'Koit', foreign 'Idol' and 'Mato' gave higher early yields. Late-ripening 'Ildiko' F_1, 'Brooklyn' F_1 and 'Cronos' F_1 (all from the Netherlands) produced higher total yield. Diseases damaged few varieties like 'Garten Freude', 'Sun Baby' and Estonian 'Vilja'.
The trials at Jõgeva have shown that early-ripening varieties survived better under unfavourable weather conditions and gave even higher total yields than the late-ripening ones. In 2004 with cool and rainy summer only early-ripening varieties gave higher total yields compare to other varieties. 'Maike', 'Malle' F_1 (Estonian) and 'Mato' had higher early yield and 'Erk' (Estonian), 'Malle' F_1 and 'Mato' had higher total yields than other varieties. 'Valve', 'Malle' F_1 and 'Garten Freude' were less damaged by fruit diseases.

Table 1

Superior tomato varieties used in organic trial in 2001-2004

Year	Early yield		Total yield		Most resistant to diseases
	variety	kg/m^2	variety	kg/m^2	
2001	Valve	1.9	Valve	9.3	Gardenes Delight
	Maike	1.7	Resyset F_1	8.0	Garten Freude
	Mato	1.4	Garten Freude	7.6	Goldene Gönigin
2002	Mato	3.8	Suso F_1	10.5	x
	Garten Freude	3.7	Ildiko F_1	9.4	x
	Maike	3.1	Sun Baby	8.7	x
2003	Koit	2.3	Ildiko F_1	7.7	Garten Freude
	Idol	2.2	Brooklyn F_1	7.6	Sun Baby
	Mato	1.9	Cronos F_1	7.1	Vilja
2004	Maike	0.4	Erk	6.2	Valve
	Malle F_1	0.4	Malle F_1	5.2	Malle F_1
	Mato	0.2	Mato	4.7	Garten Freude

Conclusions

The results of 4-year trials showed that the superior tomato varieties yielded differently according to weather conditions.
Higher early yield mainly was obtained with Estonian early-ripening tomato varieties. The superior one was determinate 'Mato' providing highest total yield of 3.8 kg/m^{-2} in 2002.
Variation among tomato varieties in total yield was greater than that in early yield. In warmer summers late-ripening foreign varieties produced higher total yields. The highest total yield was produced by indeterminate 'Suso' F_1 - 10.5 kg/m^{-2} in 2002.
The most disease resistant variety was cherry type tomato 'Garten Freude'.

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THE EFFECT OF GREEN MANURE ON SOIL ORGANIC MATTER

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Abstract
The research was conducted at the experimental station of the Institute of the Agricultural and Environmental Science of the Estonian Agricultural University.
Before 1990, sown areas contained 6-8 tons of new organic matter (plant residues, organic manure) per hectare, now the respective amount is less than 4-5 t ha^{-1}. As the humus reserve is 60/90 t ha^{-1} and every year 1-3 % of this reserve is mineralised, the humus balance is clearly negative. One of the most important tasks would be settling the structure of sown area, which means increasing the amount of manure and improving the crop rotation with crops that would affect the humus balance positively. As the number of livestock is steadily decreasing resulting in decreased amounts of manure, the main emphasis would be put on fertilizing with green manure. In organic farming, growing legumes would be the main method of enriching soil with nutrients, especially nitrogen. The ploughed down green mass would improve the soil organic matter content resulting in microbiological activity and release of nutrients available to plants.
Key words: *red clover, lucerne, birdsfoot trefoil, organic matter, humus*

Introduction

Green manure is a valuable, natural fertiliser and soil conditioner and has an important part to play in organic farming. In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and fertilized to ensure its long-term productivity and stability. Regular additions of organic matter or the use of green manure crops can increase soil aggregate stability, soil tilth, and diversity of soil microbial life. A major benefit obtained from green manures is the addition of organic matter to the soil. Fertilization has direct and indirect effects on the humus content of soil. The direct effect is related to the use of manure, compost and green manure, but the indirect effect applies by regulating the nutritional regime of the soil, causing not only the crop increase, but the amount of plant residues increase in soil as well.

One of the key problems in agriculture is faced here, and that is breakdown of soil humus and its quality deterioration, which is determined by the reduction of organic carbon and total nitrogen content (Powlson et al., 1998).

Various legume plants have a diverse effect on the agrochemical properties of clay loam soil. The highest content of humus and nitrogen is found after sown lucerne. In clay loam soil humus is rather stable, however a slightly higher mobile humic acids content is found when winter wheat was grown after lucerne as a preceding crop and organic manure is applied (Maiksteniene and Arlauskiene, 2004).

The research was conducted at the experimental station of the Department of Field Crop Husbandry of the Estonian Agricultural University. The purpose of the experiment was to determine effects of various green manure crops on supplementing soil with organic matter.

Materials and methods
The test was performed on trial fields of the Institute of Agricultural and Environmental Science in Eerika.
The green manures were tested in the experiment:

- main crop (red clover, lucerne, hybrid lucerne, birdsfoot trefoil),
- cover crop (red clover, lucerne, hybrid lucerne, birdsfoot trefoil),
- fertilizer with barley (N50, N100),
- barley N0 as control.

The test was performed in 4 trials. The samples for evaluating biomass were taken before harvesting barley, 0, 25 m^2 frame was used on surface level and mass of roots was sampled with a 10*25*10 cm probe 60 cm deep. In all tests, barley straw and biomass of legumes were ploughed down in the soil. Dispersion analysis was used for data evaluation.

Results
Organic matter application had a positive effect on the soil biota and biological activity of the soil. It has been established, that growing legumes biennially is not enough for adding sufficient amount of organic matter to the soil. Red clover and lucerne, sown as main crops, produced about 4 t ha^{-1} of dry mass annually.
The yield of above surface organic matter produced by birdsfoot trefoil was about 2.5 tons per hectare. The yield of obtained root dry mass was as follows: 2.2 t ha^{-1} for birdsfoot trefoil and 4.9 t ha^{-1} for hybrid lucerne (Figure 1). Due to powerful roots, hybrid lucerne produced more organic matter and nitrogen than other tested legumes.

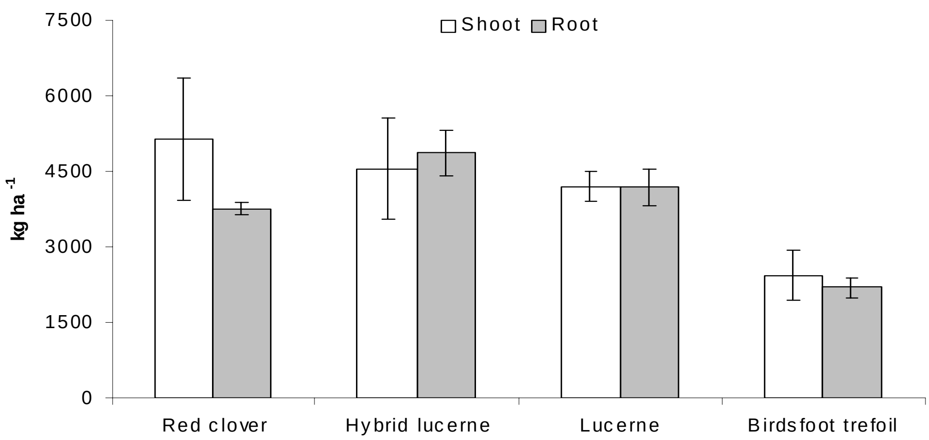

Figure 1. Amount of organic matter delivered to soil, produced by pure legume crops

When legumes were grown as cover crops for cereals, the organic matter delivered to soil was highest with clover and lucerne (Figure 2). Birdsfoot trefoil was not suitable for growing as a cover crop for barley. As a cover crop, birdsfoot trefoil remained in lower plant layers and produced organic matter 265 kg ha^{-1}.
Pure crops of barley were not significantly different in the production of above ground organic matter, because barley sowin without fertilizer and having smaller straw was more

weed-infested. Obtained dry mass of roots was highest in barley N100 treatment (Figure 3). Yield of barley with legumes as cover crops was by 340-360 kg ha^{-1} (Figure 2, 3) more than N0 crop without a cover crop. In barley and legume mixtures amount of organic matter above ground was twice smaller than that in pure crop sowings.

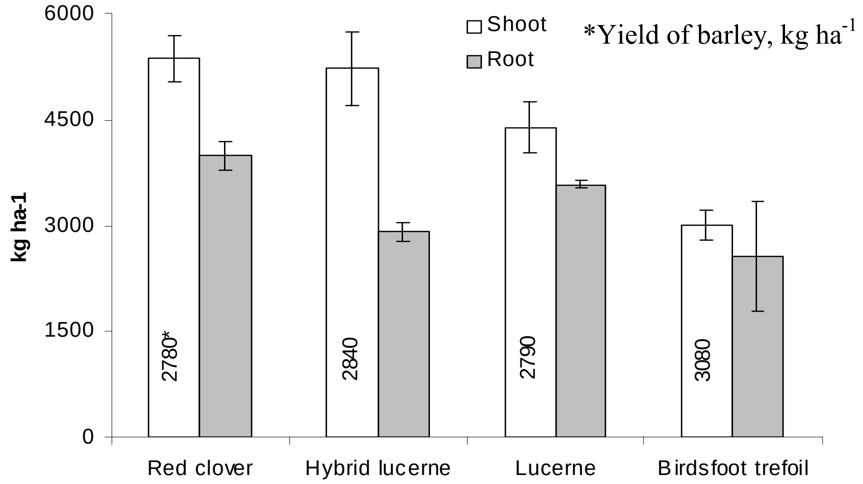

Figure 2. Amount of organic matter delivered to soil with different legumes as cover crops

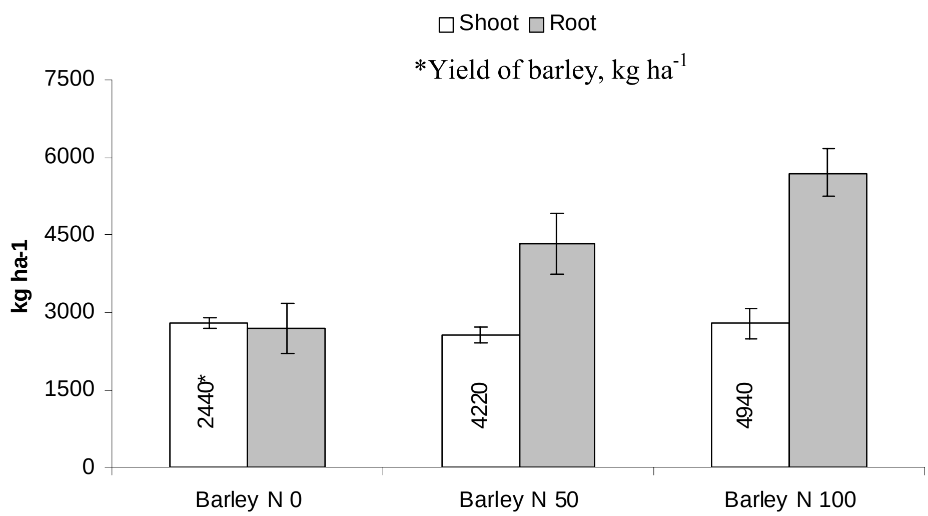

Figure 3. Amount of organic matter delivered to soil from barley with fertilizers

Conclusions

Research results suggest the following conclusions.

Legumes contributed to enriching the soil with ploughed down organic matter. Higher organic matter yields were obtained with red clover and lucerne grown as cover crops or in pure sowing.

Due to slow growth in the first year birdsfoot trefoil was not suitable asa cover crop for barley. Plough-down of green manure crop enriched the soil with organic matter resulting in microbiological processes contributing to release of plant available nutrients.

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POSSIBILITIES OF USING ECOLOGICALLY GROWN SPRING WHEAT FOR FOOD

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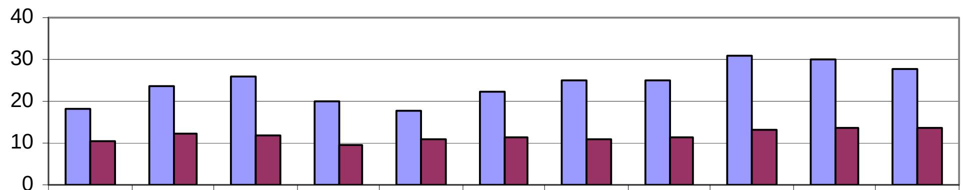
Abstract
In the Department of Field crops of the Estonian Research Institute of Agriculture the factors influencing the quality of spring wheat were studied for a long time. The field trials were established on sod-calcareous soil, preceding crop was potato.
The protein content of different varieties in the grain yield remained from 11.5 % ('Mahti') to 13.2 % ('Helle') and gluten content from 23.2 % ('Mahti') to 28.1 % ('Helle') as the average of the compared years (1998…2003). Protein content in 6 ecologically grown spring wheat different varieties exceeded 11.3 % in 33 cases among 42 trials carried out in 11 years. The highest value was 15.3 %. In the same trials the gluten content was above 22.3 % in case of 32 trials.
Key words: *spring wheat, grain quality, food, ecological farming*

Wheat is a very old cultivated plant. The first data about wheat growing come from South-west Asia 7000-6000 B.C., from Danubian countries - 6000, from China, South Scandinavia and Denmark 3000 B.C. In Estonia wheat has been grown since 2000 B.C.
Under Estonian weather conditions spring wheat is of high food quality as a rule. Since we don't have varieties bred especially for ecological cultivation the qualities of some mostly grown varieties have been compared below. In the Department of Field crops of the Estonian Research Institute of Agriculture the factors influencing the quality of spring wheat were studied for a long time. Since there was always an unfertilised variant in the trial, the results of 0 variant by different varieties have been used onward. The average humus content of soil was 2.8 %, P_{-93}…128 mg kg^{-1} and K_{-73}…132 mg kg^{-1}. The field trials were established on sod-calcareous soil, preceding crop was potato.
The trials with some varieties were carried out in different years, so the following data are incomparable in absolute figures but characterise the variety qualities to some extent. The spring wheat 'Satu' was in the trials for the longest period. The main demand for growing this variety was that the soil should not be acid. 'Satu' gave quite high yields even under

relatively low soil fertility conditions. The variety gave good assurance of yield, i.e. it gave satisfactory stable yields in both wet and dry years and quality indicators and baking qualities were at the same time satisfactory to good. The Figure 1 enables to assess the changes of gluten and protein content of the spring wheat 'Satu' by different years. Among these years there is not a single year where both the average air temperatures of these months and the amount of precipitation would be close to long-term averages. The observed trial years could conditionally be divided into the following groups:

- rainy and cool – '93, '96, '98
- rainy and warm - '95, '97, '01
- cool and dry - '94, '02, '03
- warm and dry - '99
- cool, precipitation within the rate - '00

Protein content of the spring wheat 'Satu' on the background of N0 varied between 9.5 % (1996) and 13.8 % (2003). The lowest gluten content was 17.1 % in 1997, the highest in the rainy and warm year of 2001 – 30.9 %. Among the observed years the gluten content remained below 20% only in three years. The yearly average protein content of the spring wheat 'Satu' was 11.7 % and gluten content 24.1 %. The grain yields of 'Satu' remained between 1867 kg ha^{-1} in 2003 and 3370 kg ha^{-1} in 1997, the trial years average being 2751 kg ha^{-1}.

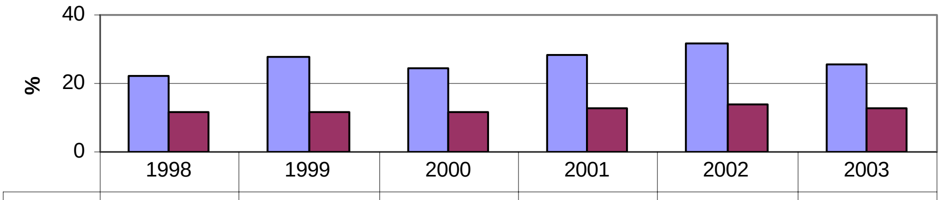


	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gluten	18,4	23,6	26	19,9	17,7	22,2	25	24,9	30,9	30,1	27,8
Protein	10,3	12,3	11,6	9,5	10,7	11,4	11	11,4	13,1	13,6	13,8

Figure 1 Gluten and protein content of spring wheat 'Satu'

The spring wheat 'Manu' was in the trials since 1995. Compared to the variety 'Satu' the advantage of the variety 'Manu' is the ability of standing also acid soils. In droughty years the grain remained fine but at the same time this variety had quite high quality indicators and baking qualities. The protein content of 'Manu' remained between 11.3 % (1996) and 15.3 % (2003) (Figure 2). The lowest gluten content was 23.1 % obtained in 1997 and the highest in 2003 – 30.0 %. In all trial years the gluten content of 'Manu' was above 23 %. The annual average gluten content was 26.7 %. The lowest grain yield - 1520 kg ha^{-1} was received in 1995 and the highest - 3085 kg ha^{-1} in 2001, the average of trial years being 2281 kg ha^{-1}.

By years the protein content of the spring wheat ‘Helle’ was from 11.6 % (1998) to 14.5 % (2003). The annual average protein content was 13.2 %. The lowest gluten content was in 1998 – 18.6% and the highest in 2001 – 35.0%, the annual average being 28.1%.



	1998	1999	2000	2001	2002	2003
Gluten	22,3	27,8	24,5	28,1	31,9	25,8
Protein	11,5	11,9	11,4	12,9	13,9	12,7

Figure 3 Gluten and protein content of spring wheat 'Meri'

The grain yields of ‘Helle’ ranged from 1686 kg ha^{-1} in 2002 to 2870 kg ha^{-1} in 1999, the annual average being 2349 kg ha^{-1}. Finnish-Estonian joint varieties ‘Meri’ (Figure 3) and ‘Helle’ were also in the trials. Both varieties were relatively indulgent to growth conditions. The variety ‘Mahti’ suitable also for growing on clay soils was also used in the trials. By years the protein content of the spring wheat ‘Mahti’ was from 9.4 % (1998) to 15.4 % (2002). The annual average protein content was 11.1 %. The lowest gluten content – 17.1 % was obtained in 1997 and the highest – 35.8 % in 2001, the annual average being 21.8 %. The grain yields of ‘Mahti’ ranged from 1308 kg ha^{-1} (2002) to 3630 kg ha^{-1} (1997). The average yield of ‘Mahti’ was 2716 kg ha^{-1}, protein content 11.1 % and gluten content 21.6 %.

Summing up, we can say that:

- When growing spring wheat without mineral fertilisers, the protein content of different varieties in the grain yield ranged from 11.5 % (‘Mahti’) to 13.2 % (‘Helle’) and gluten content from 23.2 % (‘Mahti’) to 28.1 % (‘Helle’) as the average of the compared years (1998…2003).
- Protein content of ecologically grown spring wheat of 6 different varieties was over 11.3 % in 33 cases among 42 trials carried out in 11 years, the highest being 15.3 %. In the same trials the gluten content was over 22.3 % in 32 cases. These indicators let us assume that ecologically grown spring wheat meets the requirements of food wheat quality sufficiently (Hagel, Schnug, 1997).
- The above-mentioned quality indicators (protein over 11.5 % and gluten more than 28.1 %) depended to some extent on weather conditions. These indicators were higher when the year was sunny, dry and warm.

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POSSIBILITIES OF GROWING *CAMELINA SATIVA* IN ECOLOGICAL CULTIVATION

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Abstract

Growing cruciferous crops in ecological crop rotation is important since cruciferous crops stop the developmental period of cereal pathogens and restrain from spreading of diseases by soil. When compare, *Camelina* had some advantages over rape. *Camelina* was a good supporting crop for pea. In case of sowing pea 60 germinating seeds per m^2 and *Camelina* the yield 1768 kg ha^{-1} was produced by the mixture.

Key words: Camelina sativa*, ecological crop rotation, seed grain and quality*

The plant is native to southeast Europe and southwest Asia. It occurs mostly as the weed accompanying flax. As a cultivated plant it is known for about 4000 years. In Europe it was spread as an oil plant in the time of the ancient Greeks and Romans and in the Middle Ages. It was sown purely or in mixtures with other crops. The main growth area was from East Europe to Central Asia. Its growth spread during and after the wars. In the 20th century the biggest producer was the Soviet Union where in 1950 the growth area of *Camelina sativa* reached up to 300 thousand hectares.

Camelina sativa is an oil plant of cruciferous family. *Camelina* is suitable for growing on less fertilised relatively drier soils with light texture, clay soils are not suitable. The sowing can be performed rather early, the seeds are capable of germinating at +1…+20 °C and young plants resistance to night frosts is good (they stand -2…-100 °C). After coming up the plant forms quickly a thick rosette, the main stems start growing in about a month after seeding. The plant is about 50…100 cm high with a smooth stem, which becomes lignified at the time of ripening. It has arrow-shaped leaves 5…8 cm long, the stem branches in the upper third of the plant. On the top of the branches there is a clustery inflorescence with pale yellow flowers. The plant is self-fertilising, the flowering period lasts for about two weeks. The fruit is about 7…10 mm long, a pear-like pod with 8…10 seeds. The seeds are yellow or brownish yellow, very small in size, the 1000-seeds weight is about 1 g. The seed is not dribbling. The plant grows fast, in 80…100 days from seeding to harvesting. Its yield level can be compared to spring rape, predominantly 1100…1300 kg ha^{-1}.

Camelina is suitable for growing in ecological production. The impact of cruciferous crops is considered to be especially important for decreasing the infection level of cereals root rot. In addition, the cruciferous crops bring by the long taproot the nutrients from the lower soil layers to the upper ones, which are well assimilated by the following crops. *Camelina* is better suited to growing in ecological crop rotation since the occurrence of pests typical of rape is insignificant (free from *Phyllotreta* spp., *Meligethes* spp. appears to a very small extent). Therefore in ecological production *Camelina* gives significantly higher yields compare to rape (Makowski, 2003). The same rape diseases endanger Camelina. The greatest danger can be caused by *Sclerotinia sclerotiorum*, *Verticillium longisporum* and *Plasmodiophora brassicae*. In ecological crop rotation it is possible to avoid these diseases especially by long crop rotation. *Camelina* gets contaminated with *Peronospora parasitica*

/*camelinae*/, *Botrytis cinerea* and *Alternaria brassicae* to some extent. Contamination by *Phoma lingam*, *Cylindrosporium concentricum* and *Mycosphaerella brassicicola* is insignificant. Inclusion of *Camelina* in crop rotation and frequent growing increase the danger caused by diseases and pests.

Camelina oil is being used mostly for industrial purpose: by good energetic characteristics it is well suitable for making biodiesel fuel. For making paints and linoleum it is being used together with other plant oils. It is also used for making green soap. Some parts of oil and oil-free meal composition (eicosenoic and erucic acid, glucosinolates) restrict its use for human food and animal feed. Recently its development has achieved good results in eliminating eicosenoic acid content. The use of *Camelina* oil is limited by high content of unsaturated fatty acids although the oil contains several natural protection means against oxidising – antioxidants, e.g. tocoferol. The fatty acid consistence of *Camelina* oil is shown in Table 1 (Makowski, 2003). The high consistence of linolenic and eicosenoic acids make the taste unsatisfactory.

Table 1

Fatty acids composition of *Camelina* and spring rape, %

Fatty acids	Camelina		Spring rape
	average	in trials (ERIA)	
Oil content	35-40	36-37	40-45
Palmitic (C16:0)	5-8	6.07	3-6
Stearic (C18:0)	2-3	2.54	1-3
Oleic (C18:1)	13-21	13.2	55-65
Linoleic (18:2)	15-20	20.8	20-25
Linolenic (18:3)	30-40	35.5	6-14
Eicosenoic (20:1)	13-20	12.35	0-2
Erucic (22:1)	3-4	3.6	0-2

Camelina growing is generally carried out according to the same principles as growing rape. Perfect soil tillage together with ploughing has to provide weed control. Pre-sowing soil tillage favours germination of weed seeds and the shoots are damaged in the last pre-sowing tillage. Since the seed is small, it is particularly significant to form good seed basis, which is providing low sowing and soil moisture. Pre-sowing rolling tightens the soil loosened by cultivating-harrowing. The soil being rolled must not be wet. For early sowing the soil tillage has to be started possibly early. Clover should be used in ecological crop rotation thus enriching the soil with biologically fixed atmospheric nitrogen meeting *Camelina* requirements for N in soil. Clover is an important crop in the control of perennial weeds. The recommended sowing time is similar to that of cereals or immediately after that. *Camelina* comes up fast, earlier than major weeds. Relatively high density of plants per m^2 and narrow-rowed sowing are important primarily for fighting with annual weeds. Due to rapid primary development *Camelina* suppresses annual weeds. In pure sowing *Camelina* plants are not competitive with weeds; *Camelina* cannot compete with perennial weeds, either. In ecological production trial the harrowing of pea and *Camelina* mixture damaged *Camelina* plants and the mixed sowing remained sparse.

In the trial carried out in the Estonian Research Institute of Agriculture the seeding rates 4.0 kg ha^{-1} (400 germinating seeds per m2) in a pure stand and in mixtures with the pea 'Majoret' 3.0 kg ha^{-1} (300 germinating seeds per m2) were used. The average humus content of soil was 3.0 %, P 102 mg kg^{-1} and K 182 mg kg^{-1}. The field trials were conducted on sod-calcareous soils with spring barley as preceding crop. It was sown with a narrow row space. In pea-Camelina mixtures, the pea additionally fixed the atmospheric nitrogen in the soil (60 kg ha^{-1}), which covered the growth-time need of nitrogen for *Camelina*. *Camelina* is a good supporting crop for pea. It is significant to find the suitable sowing density of pea in the mixed sowing of pea and *Camelina*. When seeding pea 80 germinating seeds per m^2 and gold-of-pleasure 300 germinating seeds per m^2, there was a competition between plants, which was also reflected in the yield (Figure 1). The total yield of pea and *Camelina* 'Ligena' was 1307 kg ha^{-1}. In case of seeding pea 60 germinating seeds per m^2 and *Camelina* 300 germinating seeds per m^2 the obtained yield was 1768 kg ha^{-1} (LSD 95%...161.7 kg ha^{-1}). The protein yields produced by the mixture of pea (60 g.s.) and Camelina overcame those by 83.5 kg ha^{-1} obtained from pure pea stand. In the mixed sowings the protein content of pea was somewhat lower than that in the pure stand (in mixtures 21.5 % vs. 22.5 % in pure stand). The protein content of *Camelina* in the trial was 24.4 % and the oil content 37.1…38.3 %.

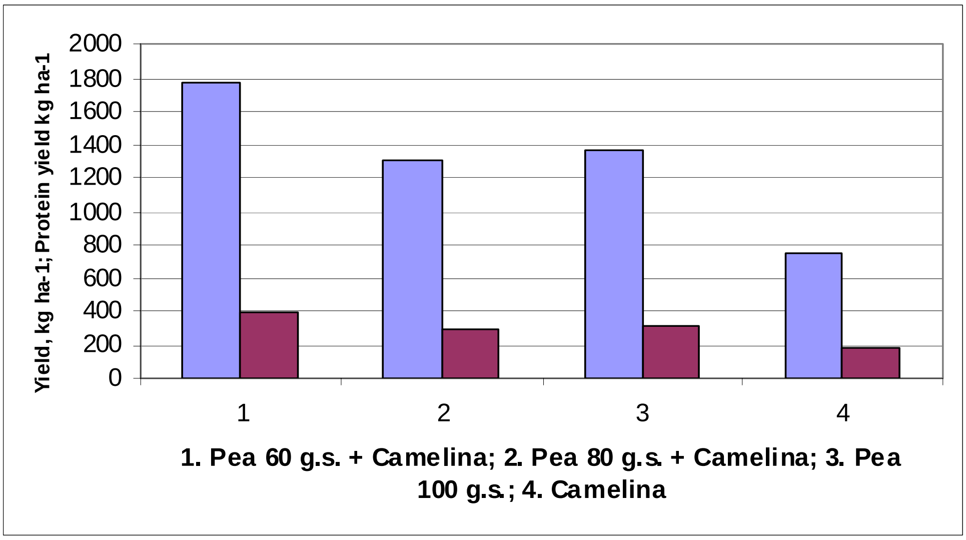

Figure 1. The seed and protein yields produced by *Camelina* and pea mixtures and pure stands

Summary

- *Camelina sativa* is a cruciferous crop, which is suitable for ecological cultivation since the danger of diseases and pests is relatively small.
- Agro-technology of *Camelina* (soil tillage) is similar to that used in rape cultivation.
- The method of weed eradication in ecological cultivation – harrowing – is not suitable in early stages of *Camelina* growth.
- By sufficient growth density *Camelina* plants can suppress weeds.
- Growing in mixture with pea, *Camelina* is a good supporting crop for pea. Pea fixes atmospheric nitrogen thus meeting nitrogen requirement during *Camelina* growth.

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IMPORTANCE OF CROP ROTATION IN ORGANIC SEED PRODUCTION

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Abstract
In Priekuli Plant Breeding Station since 1958 on the basis of fertilizing background with stable manure 10 and 20 t ha^{-1} the influence of five crop rotations on yield and quality of cereals was studied. Since the beginning of experiments one of the main tasks was to find ways that promoted the health and vigour of the crop plants to provide profitable yields and quality, and to reduce weed pressure without pesticides use. Data obtained allowed conclusions regarding capability of main field crops in Latvia to provide weed suppression in a long-term period. Data shows that crop rotation had a considerable impact on yields and quality of cereals: barley, rye and wheat, and potato. The greater the differences between crops in a rotation sequence, the better yield quality was fixed.
Key words: *crop rotations, field crops, yield quality*

Introduction
The choice of crop rotation is fundamental to the success of sustainable organic system. The rotation, in particular the ratio of soil fertility building to fertility exploiting cropping phases has a major influence on the yield of cereals and other crops. Crop rotation offers the most effective, indirect method of minimizing pest, disease and weed problems and maintaining and enhancing soil structure and fertility (Jordan, 1992). When crops are rotated, yields are usually 10 to 15 % higher than when they grow in monoculture (Reganold et al., 1990).
Although research efforts on ecological farming have started to become active in Latvia recently, farmers have always evaluated the role of qualitative seed material. Both for organic and conventional farming systems the basis for stable and high production of field crops is high quality seed material. Apart from good agronomic management of the crop, seed production differs from grain production on the following key issues: land requirement, isolation, rogueing, and prevention of contamination and limitations of generations. Another difference is that seed crops must meet specific quality standards determined by the national seed regulations. The technical, administrative and legislative control by the certification agency provides guidelines that have to be followed to produce good quality seed that meets the standards (3).
In organic agriculture, the level of yield in organic produced cereals is normally 20–30 % less than in conventional production (Nielsen, 1997), and it can often be a problem getting

enough seed of good quality. Organic farmers must use organic seed material if such seed are available. Only a few countries in the EU have an organic seed production able to supply the market for organic seed material. Also in Latvia there are no resources to guarantee necessary demand for the present. However there exist in the country possibilities based on special long- term experimental data to develop recommendations for organic seed producers in advance. This report presents information on the influence of crop rotations on yield and quality of the main cereal crops without using of pesticides in Vidzeme region.

Material and methods

The experiment is located in Priekuli (57^{o}19'N, 25^{o}20'E) on a sod-podzolic sandy loam soil with the following characteristics in the year of establishment (1958): organic matter content (Tyurin's method) 2.1 %, soil pH_{KCl} 5.8 to 6.1, available phosphorus (DL-method) 80-100 mg kg^{-1}, available potassium (DL-method) 100-120 mg kg^{-1}. The mean temperatures varied from -6.2 ^{0}C in January to 16.7 ^{0}C in July. The mean annual rainfall was 691 mm.
The experiment included five different rotations:

- Barley - potato - barley or oat
- Barley – clover - rye – potato
- Barley - clover - barley - rye - barley – potato
- Barley - clover – potato
- Barley - clover - clover - rye - barley – potato.

The red clover was used in rotations, and was established as an under-sowing crop in barley. Fertilisation background - stable manure: from 1958 to 1980 - 10 t ha^{-1}, from 1981 - 20 t ha^{-1}. The average content of plant nutrients in the farmyard manure was as follows: N-68, P-38, and K-58. No pesticides were used. The area of common trial plots was 5900 m2. In 1959, 22 t ha^{-1} of lime were given. Measurements of soil nutrient content and crops yields were performed every year. Plant available P was determined by Egner, H.-Riehm, H or DL method, where the soil was extracted by calcium lactate solution.

Results and discussion

Data show that during a more than 40-year period on a stable manure background of 20 t ha^{-1} and without pesticides use in the vegetation period high cereal yields were not obtained in Vidzeme region (Table 1). Extra low yields were obtained in 2002 for the barley variety 'Idumeja' when crops suffered from hard frosts a month after sowing and severe attack of aphids in June. Nevertheless, the yield was in fact higher than expected. At the same time there were observed sharp differences in 1000-kernel weight recorded between variants that point on the marked influence of crop rotation. In all cases for barley the preference of crop rotations with inclusion of clover were found and positive effect of largest crop sequence fixed.

Table 1

The influence of crop rotation on yield and quality of cereals

Yield and quality	Crop rotation				
	B- P-B	B- C/g-P	B- C/g- B- R- B-P	B- C/g- C/g- R- B- P	B– C/g- R- P
Barley					
Yield, t ha^{-1}					
'Balga', 2000	2.0	***	2.7	2.9	***
'Balga', 1999	1.8	2.7	***	***	***
Barley 10th rotation	1.6	2.5	***	***	2.9
'Idumeja', 2002	1.3	1.4	1.3	1.3	1.3
($RS_{0.05}$ = 0.14-0.16)					
1000 kernel weight, g					
'Balga', 2000	36.2	***	35.4	37.9	***
'Balga', 1999	34.7	36.9	***	***	***
Barley, 10th rotation	35.2	36.5	***	***	36.9
'Idumeja', 2002	42.8	45.7	47.3	47.0	46.4
Rye 'Priekulu' (3 rotations on average)					
Yield, t ha^{-1} *($RS_{0.05}$ = 0.38)*	**	**	3.8	3.7	***
1000 kernel weight, g	**	**	40.9	42.5	***
Wheat 'Mironovskaja- 808', 1999					
Yield, t ha^{-1} *($RS_{0.05}$ =0.14)*	**	**	3.10	3.11	**
1000 kernel weight, g	**	**	39.4	42.0	**

Designations: * B - barley, P - potato, R - rye, C/g - clover/grass, W- wheat.
** Not included in crop rotation. ***Not grown in the corresponding year.

Winter rye is the most competitive field crop and is effective in controlling weeds. Rye growth and competitive ability suppresses weeds and reduces seed production by annual weeds and root growth of perennial weeds (Zarina, 2005). There were no fixed yield differences in both six-field crop rotations in 3 rotations on average, whereas 1000 kernel weight was highest in crop rotation with inclusion of two fields of clover/grass mixture. A study in Priekuli indicated that fertilizer background 20 t ha^{-1} of stable manure applied for winter wheat was too low to obtain economically based yield level. Similar situation was observed in rye and in winter wheat 1000 kernel weight was higher in crop rotation with two-fields clover/grass mixture.

Also potato yield formation and quality was sharply affected by crop rotation (Zarina, 1999; Zarina et al., 1999). The highest amount of tuber fraction 45-55 mm (recommended for seed material) was recorded in both six-field crop rotations.

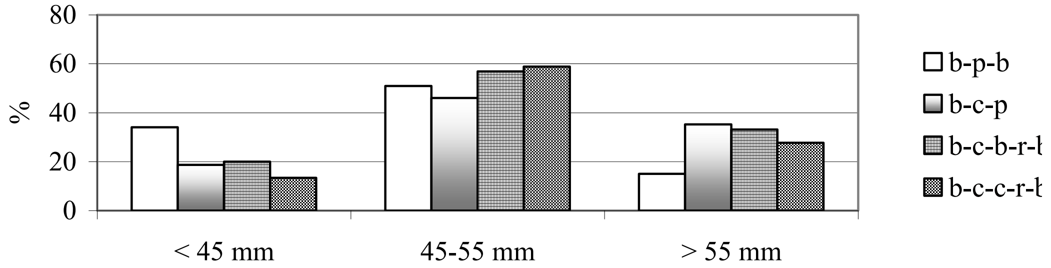

Fig. 1. The influence of crop rotation on structure of potato yield

The significance of inclusion of clover in one or two fields was not found. Significantly lower amount of potato seed fraction was recorded in both three-field crop rotations. Besides, there was found high significance of inclusion of clover-grass mixture in crop rotation that show that crop rotation was a major component of all sustainable farming systems. As indicated by crop rotations, different in the proportion of soil fertility building crop (grass/clover) in the rotation was one of the main tasks of investigations, long- term results approved it.

Conclusions

Selection of suitable crop rotation provided output of good quality yield on a base of low input fertilisation and without use of pesticides therefore crop rotation could be considered the key to sound organic farming practice, including organic seed production.

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RESISTANCE OF LITHUANIAN WINTER WHEAT LINES AND VARIETIES TO *TILLETIA TRITICI* BERK

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Abstract
To meet organic farming requirements, it is necessary to develop winter wheat varieties very resistant or resistant to common bunt. For this purpose, the breeding lines developed at the Lithuanian Institute of Agriculture (LIA) were investigated during 2001 - 2004 using artificial inoculation with *Tilletia tritici* spores. The findings obtained in 2001-2004 suggest that resistance to *Tilletia tritici* is problematic. It was found that between advanced breeding lines in 2001 there were 0.4 %, in 2002-1.7 %, in 2003-4.2 %, and in 2004-5.2 % lines resistant to common bunt. Most lines were infected from 10 to 50 %. To enhance common bunt resistance, a special breeding program should be developed, since in the conventional breeding program intended for intensive agriculture, there was found a small share of *Tilletia tritici* resistant lines. Such amount of lines is insufficient to select competitive commercial cultivars. The winter wheat varieties developed at LIA: 'Sirvinta 1', 'Ada', 'Seda', 'Lina', 'Tauras', 'Milda', and 'Alma' are moderately susceptible to Tilletia tritici. Infection level of these varieties was found to amount to 12.0-26.4 %. The average infection rate of the check variety 'Zentos', which is widely grown in Lithuania, was 19.5 % (±6.46).
Key words: *winter wheat, common bunt, varieties*

Introduction

Common bunt caused by *Tilletia tritici* Berk. Syn. T.caries D.C. was one of the most destructive diseases in winter wheat before the introduction of seed treatment in agricultural management practices. In organic farming common bunt is one of the most important diseases due to its ability to build up devastating levels within 1-2 years (Borgen, 2000). During the past 10 years many studies have been conducted on alternative ways to control common bunt in organic farming (Becker and Welzien, 1993, Borgen et al., 1994, Kristien and Borgen, 2000) but so far there are no reliable large scale and organically appropriate control methods.

The seeds can be contaminated with common bunt spores at harvesting, as well as soil borne spores may be a source of inoculum for wheat (Yarham, 1993). The fungus grows systemically in wheat plant (*Triticum aestivum* L.). Instead of normal kernels in the spikes the kernels develop into bunt balls filled with fungus spores. During harvest the bunt balls break and spores attach to the healthy seeds. When contaminated seeds are sown, the spores germinate simultaneously with the kernels and infect the growing plants systemically and thereby close their life cycles. The spores stink due to the release of simple nitrogen components like tri-methyl-amine, and this has given the disease the synonym stinking smut. In organic farming where no seed treatment is normally used, the increasing seed borne pathogen pressure causes severe problems, especially by reducing the quality of grain and in some cases also the yield (Borgen, 2000). In order to overcome this problem, a special wheat-breeding program should be carried out aimed at development of lines resistant to common bunt. A number of designated Bt genes for resistance to *Tilletia tritici* are available

in wheat, but many have overcome by virulent races of the pathogen (Hoffman, 1982). Broadening of the genetic base of cultivated wheat by the introgression of resistance genes from related species or genera may provide additional value sources of resistance to disease (Rubiales and Martin, 1996). It is important to screen the infected plants and populations at early breeding stages using rapid PRC method (Laroche, 2000; Kochanova, 2004) or use this method for study of *Tilletia* species (McDonald et al., 2000). It is reported that winter wheat lines, infected by common bunt generally have lower frost resistance (Weisz et al., 2000). Therefore promising lines should be tested for winter hardiness.
Our experimental evidence shows that one of the most effective ways to control *Tilletia tritici* in organic farming system was to develop disease resistant winter wheat varieties.

Materials and methods
The experiments were carried out at the Lithuanian Institute of Agriculture during 2001-2004 in an artificially inoculated nursery. The soil of the experimental site is Endocalcari-Epihypogleyic Cambisoil (CMg-p-w-can), with the following agrochemical characteristics: humus content 2.1-2.4 %, pH_{KCl} 6.2- 6.3, P_2O_5 164-170 mg kg^{-1}, K2O 153-180 mg kg^{-1}. The advanced breeding lines from the LIA winter wheat breeding program were investigated. The plants were grown on plots 1 m^2 of size. The artificial inoculation of *Tilletia tritici* spores was applied. For the preparation of inoculum the spores were collected in the local wheat fields. The tested winter wheat plots were sprayed with this inoculum. Assessments of *Tilletia tritici* incidence were performed after harvest, and the percentage of affected plants was calculated.
The lines and varieties were inoculated each year with 5 g/1000 g of dry spore mixture obtained form bunt-infected ears form commercial wheat fields and experimental nurseries in Lithuania. When the weather became conducive to bunt development, 300 seeds were sown per plot in 2 row plots 1 m in length with a total plot area of 0.5 m^2 on a fallowed area. 90 kg ha^{-1} N, 60 kg ha^{-1} P and 60 kg ha^{-1} K active agents were applied. Susceptibility was estimated after harvesting as the number of infected ears of the total ears were counted. The following scale was used to determine the resistance of the varieties: Infected ears 0.0 = very resistant; 0.1 - 5.0 = resistant; 5.1 - 10.0 = moderately resistant; 10.1 - 30.0 = moderately susceptible; 30.1 - 50.0 = susceptible; 50.1 - 100.0 = very susceptible.

Results and discussion
The results obtained in 2001-2004 indicated that the resistance to *Tilletia tritici* was problematic. It was found that among advanced breeding lines in 2001 there were 0.4, in 2002 - 1.7, in 2003 - 4.2, and in 2004 - 5.2 % lines very resistant, and 0.8, 3.1, 4.9 and 29.7 % resistant to common bunt. Most lines were infected from 10 to 50 % (Figs. 1-4). The breeding experience of LIA showed that it was feasible to select a competitive variety of winter wheat from 50 - 100.000 lines. The annual wheat breeding program of the Lithuanian Institute of Agriculture included 14 - 15.000 lines. Therefore for practical solution to the problem of common bunt it was necessary to develop 25 – 30 % of lines, characterised by high *Tilletia tritici* resistance.
The investigations of common bunt showed that the resistance breeding was a time consuming activity because the year affected response of the genotypes. In some years, for example, 2004 (Fig. 4) too optimistic results could be obtained due to adverse conditions for disease development. The infection level was the lowest that year. It was found that 5.2 % of

breeding lines were very resistant, 29.7 % resistant, and 27.1 % moderately resistant (Fig. 4). The selection for common bunt resistance in such situation would be ineffective.
On the other hand, a slightly higher *Tilletia tritici* resistance of the breeding material might have resulted from inclusion of more resistant parent varieties in the crossing programme.

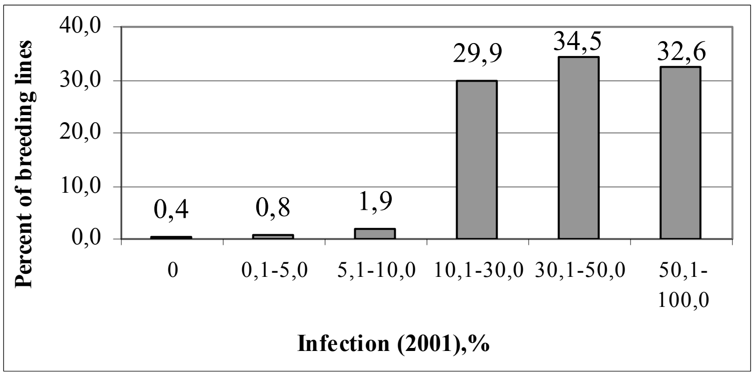

Fig.1. Resistance of winter wheat lines to common bunt in 2001, n=261

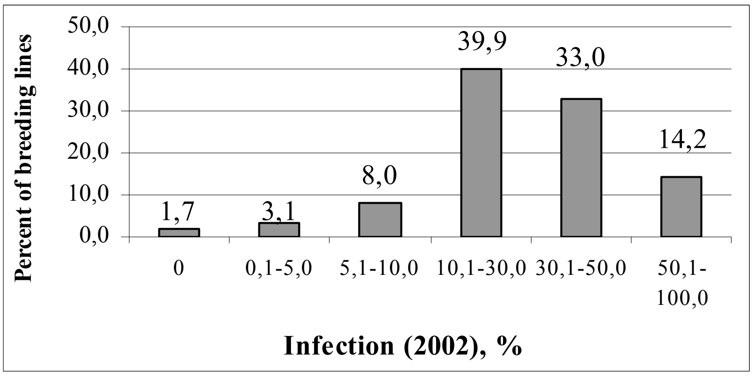

Fig.2. Resistance of winter wheat lines to common bunt in 2002, n=288

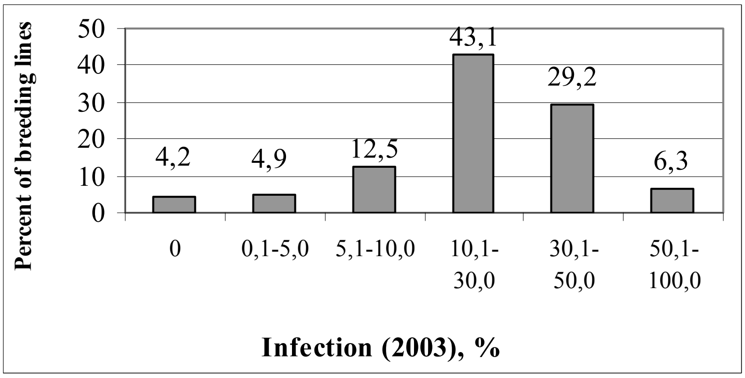

Fig.3. Resistance of winter wheat lines to common bunt in 2003, n=288

The investigations of Lithuanian winter wheat varieties, done during the pre-registration period showed that infection (%) of common bunt was as follows: 'Zentos' (standard variety) 19.5 (±6.46), 'Sirvinta 1' 24 (±4.55), 'Ada' 19.2 (±5.87), 'Seda' 14.7 (±4.77), 'Lina' 12.0 (±4.10), 'Tauras' 26.4 (±5.62), 'Milda' 26.4 (±10.21), 'Alma' 15 (±3.78). This suggests that all Lithuanian varieties are moderately susceptible to *Tilletia tritici* as well as the check variety 'Zentos'.

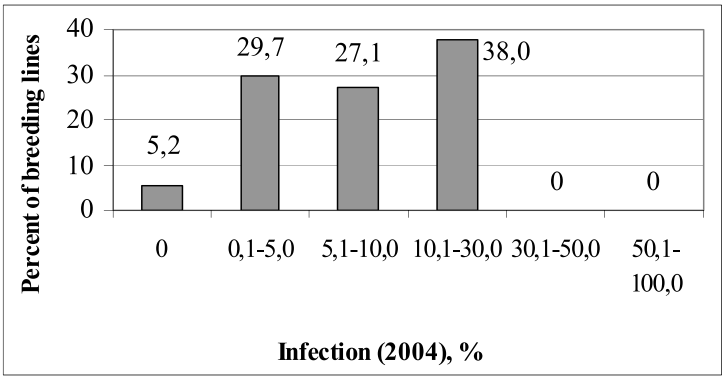

Fig.4. Resistance of winter wheat lines to common bunt in 2004, n=192

Conclusions

To meet organic farming requirements, it is necessary to develop winter wheat varieties very resistant or resistant to common bunt. A special breeding program should be designed for this purpose, since in the conventional program, intended for intensive agriculture there were found as little as 0.4 - 5.2 % lines resistant to *Tilletia tritici*. Such small amount of lines is insufficient to select a competitive commercial cultivar. Varieties developed at the Lithuanian Institute of Agriculture are characterised as moderately susceptible to common bunt.

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BREEDING RED CLOVER VARIETIES FOR CONVENTIONAL AND ECOLOGICAL FARMING SYSTEMS IN LITHUANIA

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Abstract
Red clover is a major perennial forage legume grown on arable land for forage in Lithuania. In terms of productivity and forage quality it does not lag much behind lucerne. The following red clover varieties were bred in Dotnuva and registered in Lithuania: early diploid 'Liepsna' (1957), late diploid 'Kamaniai' (1959), early tetraploid 'Vyliai' (1990), semi-late diploid 'Arimaičiai (1996), late tetraploid 'Kiršinai' (1996), and early diploid 'Vyčiai'. These varieties are noted for productivity and high forage quality and are successfully grown in both conventional and ecological farming systems. The old varieties 'Liepsna' and 'Kamaniai' produce lower yields than the latest varieties, however, during long cultivation period they have adapted very well to the local agro-climatic conditions. Of special importance in ecological farming is the red clover variety 'Arimaičiai', which produces a high yield for 2-3 years of use and can well withstand continuous growing. The tetraploid clover varieties 'Vyliai' and 'Kiršinai' are valuable, too. However, the low seed yield produced by these varieties prevents their spread in the large-scale production areas. Another two valuable varieties of red clover will soon be transferred to the State Variety Testing Trials. Thus there is a rather vast choice of varieties of red clover for growing both in conventional and ecological farming. Since 2003 most of the listed varieties have been tested for DUS in Poland.
Key words: *red clover, varieties, yield, resistance, diseases, quality*

Introduction

The beginning of clover breeding is related with the establishment of the Dotnuva Breeding Station in 1922. No red clover varieties were developed in Lithuania until the Second World War. The first early red clover diploid variety 'Liepsna' was released in 1957, late diploid variety 'Kamaniai' in 1959, early tetraploid variety 'Vyliai' in 1990, medium-late diploid variety 'Arimaičiai' in 1996, late tetraploid variety 'Kiršinai' in 1996 and early diploid variety 'Vyčiai' in 2001.

The above-listed varieties are well adapted to Lithuania's agro-climatic conditions and spread successfully in the country. Red clover breeding is continued at the Lithuanian Institute of Agriculture. The institute's best red clover varieties are currently being tested for distinctness, uniformity and stability (DUS testing) in Poland.

Experimental conditions and methods

Clover breeding as well as breeding of other perennial legumes is conducted at the Lithuanian Institute of Agriculture's experimental department in the fields of six-course crop rotation of forage grasses. The soil of the experimental site is Endocalcari-Endohypogleyic Cambisol RDg 4-K2 with pH 7.3, P_2O_5 and K_2O – 140 and 178 mg kg^{-1} respectively, humus content – 2.46 %). Clover is sown after a black fallow without a cover crop. Breeding nurseries and variety testing trials of perennial legumes are used for two years. NPK fertilisers and pesticides were applied only to the cereals grown in the crop rotation therefore the developed varieties were also well suited to ecological farming.

The following methods were used in red clover breeding: mass, individual, and family selection, polyploidy, poly-cross, top-cross, inter-varietal crossing, recurrent selection and others (Svirskis,1995; Кильчевский and Хотылева,1997; Sprainaitis et al., 2003).

Experimental results and discussion

Red clover is affected by about 100 various diseases (Strukčinskas, 1974). Diseases and adverse agro-climatic conditions determine not only yield and quality of clover but also longevity. Quite often clover persists for only one – two years. As a result, in the development of new clover varieties we used various methods of natural and artificial infection in the infection nursery established in 1973, where clover selection was conducted on the backgrounds of artificial clover rot (*Sclerotinia trifoliorum* Erikss.) and root rot infection and continuous growing. In the crop rotations the red clover variety 'Arimaičiai' is characterised by a high dry matter and seed yield for 2-3 years of use, can well withstand continuous growing and is especially suited for ecological farming, where clover is re-seeded every 2-3 years in the crop rotation (Kadžiulienė, 2004).

Tetraploid clover 'Vyliai' and 'Kiršinai' are high yielding and possess a rather high disease resistance. The greatest drawback of these varieties is a low seed yield. For example, in the year 2004, which was unfavourable for seed clover, 'Vyliai' and 'Kiršinai' matured as little as 100 kg seed per 1.5 ha area, whereas 'Arimaičiai' produced 400 kg of seed of the 1st grade on the same area. The old and stable varieties 'Liepsna'' and 'Kamaniai' that have passed a long natural selection and adaptation to local agro-climatic conditions, are also valuable, especially in ecological farming.

The tetraploid breeding line No. 31 (Sadūnai) has been passed on to the State Variety Testing (Official Testing) this year. It is a hybrid population of very early plants, selected from various varieties in breeding nurseries and freely cross-pollinated in the infection nursery. The data from two experiments suggest that this breeding line surpasses the standard variety 'Arimaičiai' in dry matter yield by 16.7 % and in terms of persistence and resistance is only slightly behind continuous growing (Table 1).

Table 1

Average yield data of the three promising breeding lines of red clover, sowing years 2001 and 2002, Dotnuva, 2001-2004

Varieties and promising lines	Plant height, cm			Herbage yield		DM yield	
	1st crop	2nd crop	3rd crop	t ha^{-1}	%	t ha^{-1}	%
1 Arimaičiai 2n	38	42	22	40.1	100.0	11.4	100.0
32 promising line 2n	34	45	23	40.5	101.0	12.2	107.0
31 Sadūnai 4n	43	51	26	45.8	114.2	13.3	116.7
33 promising line 2n	42	49	24	41.9	104.5	12.4	108.8
LSD_{05}				5.0		1.6	

A rather promising and homogeneous is the breeding line No. 32. It is a productive early, diploid clover population. The initial breeding material was collected in Noreikiškiai vicinity (Kaunas district), and mass selection was performed in the infection nursery. These numbers are characterised by a good chemical composition and digestibility (Table 2).

Table 2

Chemical composition (%) of red clover 'Arimaičiai' and 3 promising lines, Dotnuva, 2002

Variety and promising lines	NIRS				Chemical analysis	
	crude protein, %	digestibility PCDigest	fibre, %	digestibility enzymatic b.	crude protein, %	fibre, %
1st crop (beginning of flowering)						
Arimaičiai, standard	17.96	68.44	19.69	71.8	17.4	23.42
33 promising line, 2n	19.10	70.20	20.18	79.0	18.6	18.90
31 Sadūnai, 4n	19.33	67.22	20.56	78.0	17.6	20.71
32 promising line, 2n	21.25	66.46	27.09	76.7	21.9	24.66
2nd crop						
Arimaičiai, st.	19.53	61.87	20.30	72.1	18.5	19.75
33 promising line, 2n	19.35	70.40	20.51	69.4	18.4	19.44
31 Sadūnai, 4n	17.34	57.59	26.52	68.2	16.6	24.12
32 promising line, 2n	16.69	58.08	27.48	66.2	16.1	26.46

Analyses were done at LIA's analytical laboratory.

Conclusions

Lithuania-bred red clover varieties are characterised by a high productivity, resistance to diseases in adverse agro-climatic conditions, different growth rhythm and they can be grown in crop rotations and grasslands in various mixtures with grasses and fully meet the growing needs of intensive and ecological contemporary animal production.

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PROSPECTS FOR SOME NONTRADITIONAL PLANT SPECIES ON CONVENTIONAL AND ECOLOGICAL FARMS IN LITHUANIA

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Abstract
Collections of nontraditional plants were investigated at the former Dotnuva Breeding Station, later with breaks at the Institute of Agriculture. During the period 1998-2004, 13 amaranth, 3 proso millet, 24 foxtail millet (chumiza), 6 soybean varieties and breeding lines were investigated. In this paper we present the findings of selected amaranth, millet and soybean genera investigation. Varieties of amaranth ‘Raudonukai’, ‘Geltonukai’ and ‘Rausvukai’ were registered in Lithuania in 2001.
The investigated proso millet and foxtail millet varieties and populations differed in origin, plant height, shape of panicles and color, length of vegetative growth season, and, naturally, in seed yield, size and color. There were selected 3 prospective proso millet and 2 foxtail millet lines, which could be successfully grown for seeds in Lithuania’s agro-climatic conditions in ecological and conventional farms.
Earliest soybean varieties ‘Alta’ and ‘Korada’ (Canada) also could be grown under agro-climatic conditions of the Baltic region and produced 1-3 t ha^{-1} seed yield. It is necessary to continue selection of the mentioned species and varieties best suited to local conditions and investigate possibilities for use of their green material and seed for food, fodder and energy production. Cultivation and management peculiarities of these plants in order to increase the yield need further and more comprehensive investigation.
Key words: *millet, amaranth, soybean, varieties, yield*

Introduction
About 1800 plant species are grown on Lithuania’s territory 400 of which are cultivated plants. However, only a few dozens have been used on a wider scope so far. Widening the list of plant species is very important in ecological farming systems, which are rapidly expanding in the Baltic countries. Collections of rare plants were investigated with breaks at

the former Dotnuva Breeding Station, later at the Institute of Agriculture. The most abundant collections were investigated in 1980-1990 in close cooperation with the former All Union Plant Production Institute (VIR). Small seed samples were obtained from there and short reports were submitted to them. In 1999 investigations of these collections were resumed. 21 amaranthus, 3 proso millet, 24 foxtail millet (chumiza), 6 soya varieties and breeding lines were investigated during 1999-2004.

One of the most promising species to be introduced in Lithuania's agriculture could be amaranth (*Amaranthus* spp.). This genus consists of about 60 species of plants, most of which are wild (Stallknecht &Schultz – Schaeffer, 1993; Skorniakov, 1985). Amaranth is spread in all continents and is characterized by a good adaptability. 5 amaranth species are found in Lithuania (Vilkonis, 2001). Some of the species are found on barren land, grown in flower gardens as flowers, whereas *A. retroflexus* L. is a weed. Amaranth has been cultivated by Aztecs before 5 to 7 thousand years. Later on amaranth was forgotten (Arrowhed mealls, 1993; Meyers, 1996). In recent decades amaranth has been rediscovered, and its cultivation and breeding have been started in the continent of America and many European, Asian and African countries (Breus, 1997; Nalborczyk et al., 1994; Svirskis, 2003).

Proso millet (*Panicum miliaceum* L.) belongs to the genus *Panicum* L. Botanists know more than 400 species and subspecies of this broad category of smallseeded grasses. In China millet was grown already 5000 year ago and in Lithuania it was grown already at the end of the New Stone Age (Lazauskas, 1998). The area sown with the plants belonging to millet genus covers over 65 million ha worldwide (Elagin, 1976; Anderson, 1999; Wilson, 2000).

The soybean originated in China where it was domesticated at least by the 11th Century, B.C. Nowdays soybean is one of the mostly cultivated plant species in the world from which about 20000 of different food and industry products are produced. Soybeans contain approximately 40 % protein and 20 % oil on a dry matter basis. Although the oil is used primarily in edible products such as margarine and cooking oil, it is used industrially in such products as high grade paints and pharmaceutical products. The soybean oil meal that remains after the oil is extracted is almost all used as high protein livestock fodder but the meal can be further refined to have various protein extracts for direct human consumption etc. (Upfold and Olechowski, 1994). In Lithuania soybeans are trying to be introduced for about 80 years, but unsuccessfully. Appearance of new varieties will help to do it. In 1997 there was registered an early variety 'Progres' (Poland).

Materials and methods

The experiments of 1998-2004 with nontraditional plant sowing and investigation of breeding nurseries were carried out at the Lithuanian Institute of Agriculture (Dotnuva) in fields of perennial grasses crop rotation after ploughed-up first-year clover sown into a black fallow. The soil of the experimental site is calcareous, gleyic (RDg 4-K2), medium heavy, drained with a thickness of ploughlayer of 25-30 cm, pH_{KCl} values 6.7-7.5, humus content 1.7-3.3 %, total nitrogen 0.15-0.26 %, mobile phosphorus and potassium contents 201-270 and 101-175 mg kg^{-1} of soil, respectively. In spring the soil was harrowed, and before sowing it was cultivated with a Germinator and rolled. In the experiments plants were sown into 50 x 50 cm row spacing by hand, or by the hand-operated sowing machine „Senjor". Each plot consisted of 2 row band 7-20 m in lenght. There was one meter distance between the bands. The trials involved 3-4 replications. After the rows of emerged plants became visible, the soil was loosened for 1-2 times by a four-row rototiller. Pesticides were not used.

Weeds were pulled out by hands in the trials. The combaine „Sampo 130“ harvested the seed. Weather conditions during the study period was different and reflected average climatic conditions of Lithuania.

Results and discussion, Amaranth

Table 1

Average 4-year yields of amaranth varieties registered in Lithuania
Dotnuva, 1998-2001

Variety	Plant height, cm	Herbage yield		Seed yield	
		t ha^{-1}	%	t ha^{-1}	%
Raudonukai, standard	132	22.5	100.0	1.35	100.0
Geltonukai	135	23.2	103.1	0.99	73.3
Rausvukai	146	26.7	118.7	0.70	51.1
R_{05}		2.6		0.14	

Small collections of amaranth (*Amaranthus* spp.) have been tested at the Lithuanian Institute of Agriculture since 1978. For majority of accessions vegetation period of Lithuania was too short. Three amaranth varieties that are able to mature seed under Lithuanian agro-climatic conditions have been selected and from 2001 registered. Experimental findings suggest that when amaranth is grown after clover it is feasible to obtain a seed yield of 1-2 t ha^{-1} even in a cool year without any extra fertilisation and pesticides (Table 1).
The greatest seed yield was produced by the earliest variety ‘Raudonukai’ (vegetation period 100-120 days, black seeds), lowest – by ‘Rausvukai’ (vegetation period 120-150 days, white seeds). Most prospective for food was ‘Geltonukai’ due to gold-yellow attractive seeds and chemical composition (Table 2). From 2003 we are testinga new, very promising amaranth collection from Iowa State University (USA).

Table 2

Chemical composition of dry matter of two amaranth varieties,
Dotnuva, 1998-2001

Variety or plant fraction	DM %	Crude protein, %	Crude fibre, %	Crude fat, %	Digestibility *in vitro, %*
‘Raudonukai’					
Total	19.5	11.7	31.5	-	60.0
Stems	15.5	7.1	37.0	-	57.6
Inflorescences	19.1	19.6	26.9	-	58.5
Leaves	18.4	20.3	14.1	-	71.0
Seeds	11.0	15.1	17.7	5.28	-
‘Geltonukai’					
Total	17.5	11.3	25.9	-	63.5
Stems	16.7	5.9	31.7	-	62.2
Inflorescences	19.1	19.3	28.3	-	60.9
Leaves	19.5	19.9	18.6	-	70.4
Seeds	11.0	15.4	5.8	6.48	-

Proso and foxtail millet

3 proso millet varieties were included in the variety testing trials in 1999-2004. 'Rudes' and 'Gelsvės' were selected from the collection breeding lines obtained in 1984-1990. Selection was based on such traits as earliness, productivity, panicle shape, seed color and resistance to loose smut of individual biotypes. 'Juosvės' was re-bred from commercial seed imported into Lithuania as feed for ornamental- and songbirds. It is longer in hight, earlier than another 2 varieties and resistant to loose smut and can successfully be grown in ecological farms. An undesirable character of this variety is uneven ripening of seed. 'Rudės' and 'Gelsvės' matured similar seed yields (Table 3). From 2002 'Rudės' are registered in Lithuania.

Table 3

Some investigations and seed yield data of 3 proso millet varieties (5-year averages), Dotnuva, 1999-2003

Variety	Plant height, cm	Ripening data	Seed yield	
	average and variability		$t\ ha^{-1}$	%
Rudės, standard	82 80-88	09.16 09.02-09.26	2.1	100.0
Juosvės	121 116-130	09.07 09.02-09.10	1.95	88.3
Gelsvės	78 78-86	09.14 09.08-09.25	2.20	99,6
RS_{05}			0.23	

The investigated of 24 foxtail millet varieties and breeding lines differed in their origin, height, shape of panicles and color, length of vegetative growth season and, naturally, in seed yield, seed size and color. After many years of breeding there were bred two earliest and highest in seed yield varieties 'Rudukės' and 'Auksės'. They out-yielded the standard variety by 39.8 and 29.6 % respectively (Table 4).

Table 4

Seed yield and some investigation data of prospective foxtail millet varieties, Dotnuva, 2002-2003

Variety	Plant height, cm		Ripening data		Seed yield					
					2002		2003		average	
	2002	2003	2002	2003	$t\ ha^{-1}$	%	$t\ ha^{-1}$	%	$t\ ha^{-1}$	%
Ukrainskaya 7, standard	60	62	09.01	09.16	2.12	100.0	2.00	100.0	2.06	100.0
Rudukės	61	64	09.01	08.25	3.08	145.7	2.67	133.3	2.88	139.8
Auksės	78	82	09.10	09.20	2.83	133.9	2.50	125.0	2.67	129.6
RS_{05}					0.19	10.4	0.26	15.0	0.23	12.9

Rather good chemical composition showed foxtail millet compare to proso millet (Table 5).

Table 5

Chemical composition of selected proso and foxtail millet varieties (% in DM), Dotnuva, 2001

Variety	Crude protein	Crude fat	Crude fibre	Ash
Proso millet ‘Rudės’	14.2	3.66	8.7	2.59
Proso millet ‘Gelsvės’	10.6	3.76	12.2	2.98
Proso millet ‘Juosvės’	12.3	4.12	10.2	3.07
Foxtail millet ‘Rudukės’	17.6	4.07	8.4	3.29

Soybean

In choosing soybean variety, selection of early, with good seed yield, and also GMO free variety is of great importance, because growing roundup ready soybeans is forbidden in ecological farming. During 1999-2004 we tested 3 Hungarian and 3 Canadian soybean varieties. Most promising were earliest Canadian varieties ‘Alta’ (2450 heat units are needed for ripening) and ‘Korada’ (2600 heat units are needed). Without any fertilization (only inoculiation with soybean rhizobia) and pesticides use it is possible to mature 2-3 t ha^{-1} soybean seed (Table 6).

Table 6

Some investigation results and 6-year average seed yield of 3 soybean varieties, Dotnuva, 1999-2004

Varieties	Variability of flowering date	Average plant height, cm	Variability of ripening date	Seed yield	
				t ha^{-1}	%
Progres, standard	06 28-07 10	46	08 20-10 01	1.77	100.0
Korada (Canada)	06 30-07 20	59	09 01-10 23	2.45	138.4
Alta (Canada)	06 30-07 20	63	09 04-10 23	2.95	166.7
RS_{05}				0.43	18.1

Conclusions

There are many possibilities to expand range of cereals by introducing millet, amaranth and soybean into ecological farms of Lithuania and other Baltic countries. Further selection of the mentioned crop species and varieties best suited to local conditions and investigation on their possible use as green material and seed for food, fodder and energy production needs continuation. Cultivation and management peculiarities of these plants in order to increase the yield also need further and more comprehensive investigation.

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ORGANIC FARMING DEVELOPMENT AND PROBLEMS IN KURZEME REGION OF LATVIA

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Organic farming traditions and the history of farming in Kurzeme neighbourhood are lasting for the second decade. Interest in organic movement started in 1989 when the agricultural researcher Imants Heinackis and a group of farmers from Latvia visited German Federal Republic, acquainted themselves with the life of German agriculturalists, listened to their opinion about regularities in nature and biodynamic farming methods. This visit resulted in cooperation with the German farmers V. Jorge, J. Fetcher and F. Hergarten who, in the course of many years, came to Latvia, met with a lot of Latvian farmers and shared experience with them. The year 1989 was transitional period in the society, the beginning of national awakening and restitution of land to private owners. People having insufficient knowledge in agriculture were engaged in agriculture. All information coming from the west was caught with great enthusiasm and without any criticism. In the following years seminars and training which were organized in Kazdanga, Grobina, Renda and somewhere else in Kurzeme were well-attended by people and the ideas offered caught with great enthusiasm. Farmers who had started independent farming willingly chose to go organic. However lack of sufficient fundamental knowledge in agriculture using only some elements of biodynamic farming did not provide the expected results. The new farmers had different attitude to course of events - some was disappointed and abandoned management for good, returned in towns and cities and found a pleasing job. Others abandoned biodynamic method of management and returned to conventional methods. However those having strong willpower remained and continued to gain knowledge and skills.

Since 1989 I. Heinackis had been engaged in research on organic farming possibilities in Latvia. He established practical experiments, studied methods and cultivated plants and their adaptation to Latvia's conditions. He reminded everybody that many conclusions regarding biological management have been found in classical agronomy and read in reports written by Latvian agricultural researchers. However, the life of I. Heinackis was suddenly broken off and results of his recent years' research remained non-summarized and unpublished. So nobody managed to take over his research and results obtained by him.

In 1990, farm "Izriedes" owned by J. Rubezis was organized as an agricultural support and training farm, which is still existing. At the same time Latvia's biodynamic agriculture, anthropozophic medicine and Valdorfpedagogical research society was organized in Liepaja district. The members of this society were already beforehand mentioned J.Rubezis, I.Heinackis as well as J.Pakalns, J.Runds and others.

In the 90-ies, biological management ideas were spreading slowly in Kurzeme. In 1992 a group of like-minded persons was organized in Kuldiga district with support farm "Upmali" in Renda parish. Seminars and practical training for all interested persons coming from the nearest and remote surroundings were organized there.

In 1992 farms located in Liepaja and Kuldiga districts, which felt ready for it, began certification according to "Demeter" association standards. Expenses connected with the activities of the specialists from German Certification institutions were covered by Heinrich Bell granted project for the development of East Europe. Practically there were no such farms in other districts of Kurzeme or their number was small. I have no exact data at my disposal, but by the year 1998 there were about 40 farms which had been certified according to "Demeter" and EU Organic farming standards, however only six of them had the right of using "Demeter" ware mark.

Cereals, potatoes, vegetables both in open field and in area under glass (Grobina and Kazdanga), apples and berries were grown according to organic and biodynamic methods. Cheese making was organized in "Izriede". The produced output was sold in markets, small shops, delivered to consumers at their request as well as sold in common agricultural products¢ market. Due to more stringent sanitary norms in the food chain introduced in the year 2000, cheese making was stopped in "Izriede" as well as selling organic milk to schools and kindergartens. Development of supermarket network resulted in the decrease of small shops from which organic food products reached consumers.

In 1998, certification opportunities were changed. With the termination of the project funding service rendered by "Demeter" association became too costly for farmers. In Latvia, organic farming certification system was in the stage of development. Those farmers who had reached conformity to "Demeter" mark considered it a fall backward, however they had not any other possibility as joining in the newly developed system.

Since 1995 Green certificate established by the Environment Protection club was taking effect as well. Using this mark of recognition, several farms in Kuldiga district as well as in Ventspils, Talsi and Saldus districts became organic farms. Organic farmers continued certification and use of ware mark “Latvia’s eco-product”. It could be said that the new Organic farming recognition system was developed on its basis.

At present many things regarding to organic farming in general and its acknowledgement have been put in order on a state scale. Going organic is gradually becoming honourable business and number of persons interested in it is growing. One cannot deny that ever growing interest in organic mode of management is favoured by comparatively good EU financial support.

At the end of 2004, there were 125 certified organic farms in Kurzeme (Kuldiga, Liepaja, Talsi, Tukums, Saldus and Ventspils districts). The greatest number of farms (32) was recorded in Liepaja district, the smallest (only 9) in Ventspils district. 29 organic farms were registered in Tukums district, 23 in Kuldiga district, 20 and 10 organic farms in Talsi and Saldus districts respectively. The size of farms and direction of their specialization vary in a wide range. Farms managing comparatively small area, without specialization according to the principle “a bit from everything”, are prevalent. There are occurring fruit-growing farms with the area not exceeding 10 ha, and farms the managed territory of which are measured in several hundred hectares. Farm “Valti” with the area of about 500 ha of agricultural land and specialization in beef cattle breeding is one of the greatest biological farms in Kuldiga district, a limited liability bakery “Zelta klingeris” (Golden Twist of Bread), where bread is baked from biologically grown grain and which is gradually setting in order processing and packaging of other cereal products. Research and variety testing are organized in Stende Plant Breeding station since 2002.

In Kurzeme, number of organic farms is growing slowly compare to other districts of Latvia. To my mind, it could be explained with the critical approach to all things what is characteristic to the inhabitants of Kurzeme. Gains and losses are thoroughly weighed and nobody knows why the losses are prevailing. An unsuccessful organic farmer in the nearest neighbourhood remains in memory of others for a long time and effort of convincing others that this way of management is prospective and profitable is hard. People lack unity “to conquer” together their place in the nearest city or food market in Liepaja and Ventspils. All attempts made are failure though some farms are successful in selling their agricultural produce there. It could be true that all failures are due to arrogant and querulous nature of the inhabitants of Kurzeme.

There is hope that everything is not so hopeless. Organic food production conference organized by Organic Farming Association of the Kurzeme zone in 5 November 2004 in Skrunda proved it. The event passed on a positive atmosphere and was well attended. There was a wide range of products both for show and sale. Agriculturalists from other districts saw much interesting and edifying things in other farms of the Kurzeme district not only in “Izriedes” and “Upmali” but in “Kudraji”, “Valti”, “Zageri” and elsewhere as well. It is just possible that up to now there had not been organized common activities uniting people. Now it is common learning both in project “Environment health farms” and in groups in training programme organized by the Latvian Agricultural Advisory and Training Center. In these activities there are involved less people as it is in Latgale and Vidzeme. Training groups are organized in Liepaja, Tukums and Talsi. In Kuldiga, local farmers are learning and those from Saldus and Ventspils districts as well. Such common learning contributes to development of mutual connections not only among people but also between groups of district activists both in political and economic respect.

Number of certified farms is gradually increasing, however slow is the increase of biologically grown products and their assortment. Nearly half of all certified farms, as it could be said, are extended household farms supplying family with food products and selling the rest of products as standard produce.
Crop products as organic food are sold in Riga in "Green market" under the farm¢s name "Kudraji" from Aizpute district, bread, rye flakes and other products produced from grain bred in Kurzeme are sold by limited liability company "Zelta Klingeris", tea plants and medicinal plant cushions under the name of farm "Upmali" from Renda. Eco-kitchen in Riga is supplied with potatoes and vegetables from Kurzeme. Regrettable is situation in processing of animal products. Organic milk ("improves") total flow of milk processed by "Rigas Piensaimnieks", "Rigas piens (Riga milk) integrated plant and others. Till now, dialogue hasn¢t between established between the limited liability company "Elpa" in Kazdanga and biological milk producers in neighbourhood resulting in lack of specific milk products with eco-product mark. The situation with meat is even more regrettable. Cattle bred organic are taken to the only organic slaughterhouse in Zaube, or animals get to the common meat processing network. Problems in slaughtering and meat processing of pigs have not been solved in Latvia up to now.
The "green" apiarists are found in Kurzeme as well. Farm "Bitenieki" with 400 bee families in Ventspils district is an example to it. Smaller apiaries are found in Tukums and Talsi districts. It does credit to apiarists that they are not ashamed of their own product when marking it as eco-product.
State legislation is being put in order in favour of organic farmers at the same time requesting to revise their production possibilities and searching for the solution of problems. An example is cultivated plant seed material, permission to use untreated, conventionally grown seed and planting material by 1 January 2006. At present there are no seed breeding farms for the production of cereals and legume seeds. "Valti" is a seed production farm, which has been registered in Seed Producers Register. I have no information regarding farm "Izriedes". Production of seeds requires serious knowledge and resource base as well. And what will happen with the seed of vegetables? We know skilful farmers in Kurzeme, who are able to grow beet and carrot seeds in small amounts. Fruit growing is considered a promising branch of horticulture. However at present we cannot name any tree nursery in Kurzeme. Yet we must hope that organic experiments in horticulture will raise interest in this field. It should be admitted that recognized horticulture specialists are not positively oriented to organic horticulture. Yet the Danish managers in Liepaja district have already planted and continue planting of black current plantations (total area 70 ha) managed by organic methods. Last year the first yield was gathered and realized in Europe.
Hope is cherished on home-industry law, which shall allow production for output realization under home conditions. Meeting the farmers, this theme has always been touched when it will be allowed to work and sell products the way it is done in Europe (home small shops and rooms for processing needs). We must hope this dream will come true and then new, tasty and healthy food products will appear in the market. Now organic farming is chosen by prompt clever and skilful people, which are able to fascinate others, to show their choice and mode of life as the best and worth of imitation.

DEVELOPMENT OF ORGANIC FARMING IN VIDZEME AND LATGALE REGIONS OF LATVIA

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My name is Inta Serge. I am occupied in Gulbene Agricultural Advisory office as a plant production specialist, but I am busy with popularizing the idea of organic agriculture production in Vidzeme and Latgale regions. I am learning myself and advising farmers.

My first contiguity with organic agriculture was in 1992 when the courses in organic agriculture were organized in Kazdanga, Liepaja district.

The passed years were full with persistent explanation work talking both with farmers and my colleagues.

When starting activities in biodynamic agriculture (1993) the situation in Gulbene district was as follows:

There was only a group of interested persons in Liepaja, and Imants Heinackis in Grobina. He was the man easy to get on the telephone even in the middle of the night to size up an indistinct situation, and Liga Drozdovska in Environment Protection Club who broke through the overall indistinctness wall. Skaidrite Albertina in Latvian Agricultural Advisory centre was taking up this question organizing Ogre Innovation centre. In this centre monthly lectures in sustainable agriculture were organized for several years, and a representative from each district agricultural advisory office was participating there. For some time in Latvia there were two projects in operation: one dealing with biodynamic agriculture in Liepaja district extending its activities as far as Gulbene district, and the other project was coming from America (Osiei) and through Ogre Innovation centre was realized in Vidzeme and Latgale parts. Certification of farms was taking place, but with projects coming to an end certification of farms was ended too. However seed was sown in fertile soil and farmer's interest in organic agriculture did not cease in spite of the fact that nobody paid more for the product and farmers did not get any support from the State. Collaboration with foreign countries and getting investment for education resulted in the first organic agriculture certification institution - the present-day "Environment quality" established by Skaidrite Albertina and Liga Drozdovska (now in the Ministry of Agriculture).

More rapid turning to organic agriculture was favoured by the State support since 2001, when organic movement advanced eastwards resulting in rapid increase of biological agriculture farms just in Latgale districts.

Registration and activities of Latvia Organic Agriculture Organizations Association are connected with the year 1997. Now this organization has become stronger and can influence decision-making connected with biological agriculture as well as problems connected with products realization and processing.

Project on health farms are operating in Latvia. This project has good chances in varying farmers' business. Activities educating farmers in healthy food, bathhouse knowledge, giving short medicinal courses, training in tourism and others are organized in the framework of the project.

Knowledge in biological way of management is of great importance and is ensured by the Latvian Agricultural Advisory and Training centre. "Training program in biological agriculture" was elaborated in 2002. In 2003 this program was accredited. Now a lot of organic farmers and groups of interested people in districts are acquiring knowledge according to this program.

The opportunity of getting financial support from EU for use in organic agriculture resulted in increased number of transitional period farms in 2004 in Aluksne, Balvi, Gulbene, Limbazi, Valmiera, Madona, Rezekne, Preili, Daugavpils and Kraslava districts, and in 2005 great interest in organic farming is shown by farmers in Jekabpils and Ludza districts. In 2004, the area of organic and transitional period farms occupied 46 000 ha or 2 % of agricultural land.

Both many-branched farms and those specializing in crop production go organic. These farms produce significant amount of agricultural output, which is still disappearing in total mass of agricultural products due to different obstacles and lack of understanding, and products processors lack motivation for organic products processing. Delay in adopting law on domestic industry is limiting realization of home-processed product. However, it should be admitted that organic farmers are supplying themselves and their relatives in towns and cities with healthy food, and it is much.

It's the last time to develop organic seed production system to obtain home-produced seed of cereals, grasses, vegetables and potatoes.

For the present we lack information regarding the necessary amount, crop and variety seed material. Initial organic seed breeding is taking the first steps, and farms capable of PB seed multiplication for commercial sowings are hesitating in ignorance how to realize the produced seed or is seed breeding profitable and so on.

We lack a coordinator who would know offer and demand of the seed material. We cannot speak about area to be sown annually due to lack of information. For that reason I can present information about Gulbene district and a little about districts in which I had certified farms.

In Gulbene district the following farms are engaged in organic seed production: rye "Kaupo", oat "Laima", buckwheat "Anita Beloruskaja", clover "Priekulu 66" are bred in farm "Sopoli". Seed of clover, sweet clover and small amounts of pea-oats mix (Vitra+Laima) for production sowings are possible to obtain in farm "Kelmeni", but growing of winter wheat and barley is stopped for the time being due to lack of grain dryers and seed cleaners in farm "Siliesi."

Seed production farm "Viesturi" in Kraslava district Robeznieki parish are growing oat "Laima", barley and potatoes are bred in farm "Miezisi", but oat and oilseed rape in farm "Lesnicevka".

Organic seed production possibility is weighed up in farms "Pukudruva" in Daugavpils region and "Kotini" in Balvi district, besides the latter farm wants to specialize in field beans, but buckwheat seed could be realized by farm "Klimpas" in Valmiera district Jeru parish.

There are problems arising not only in seed production. There is annual increase in need for organic fodder grain or concentrated feed composed of different grain mix. Farms, which are able specializing in fodder grain production lack organic seed material for variety sowings renewal.

In Gulbene district, fodder grain realization is allowed to limited liability company "Brivzemnieki". It may sell the seed of pea-oat mixed, small amounts of vetch mix may be realized by the farm "Birznieki", and barley by the farm "Siliesi". Different cereal grain and pulses mix are grown and realized by farm "Aizsili" in Daugavpils district.

Big animal farms are trying to supply their herds with forage grain, however a part of these farms are considering the possibility of purchasing fodder grain better than growing, as it is less costly. Small farms, which are not supplied with the corresponding machinery or have out-of-date equipment, are readily purchasing grind fodder grain mix.
If farmers perceive the idea of cooperation with great excitement then informal cooperation between farms in fodder grain production already exists.
These are my observations regarding organic agriculture development in Latvia.

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