Proceedings of the First World Conference on Organic Seed

Challenges and Opportunities for Organic Agriculture and the Seed Industry

July 5-7, 2004, FAO Headquarters, Rome, Italy

Food and Agriculture Organization of the United Nations
International Federation of Organic Agriculture Movements
First World Conference on Organic Seed

Challenges and Opportunities for Organic Agriculture and the Seed Industry

July 5-7, 2004
FAO Headquarters, Rome

Jointly organised by:
Food and Agriculture Organisation (FAO)
of the United Nations
International Federation of Organic Agriculture Movements (IFOAM)
International Seed Federation (ISF)

Conference Secretariat

Steering Committee:
Arturo Martinez, FAO
Nadia Scialabba, FAO
Bernard Geier, IFOAM
Bernard Le Buanec, ISF

Scientific Committee:
Thomas Osborn, FAO
Edith Lammerts van Bueren, IFOAM
Radha Ranganathan, ISF
Conference Goals

- Create a platform for international information and knowledge exchange between the organic movement and the "conventional" seed sector
- Focus on scientific/technical aspects related to organic seed issues
- Evaluate regulatory requirements and related issues for organic seed
- Provide a platform for networking and cooperation

About the Organisers

The **Food and Agriculture Organisation** (FAO) was founded in 1945 with a mandate to raise levels of nutrition and standards of living, to improve agricultural productivity, and to better the conditions of rural populations.

The **International Federation of Organic Agriculture Movements** (IFOAM) is the worldwide umbrella organisation for the organic movement. Its goal is the worldwide adoption of ecologically, socially and economically sound systems that are based on the principles of Organic Agriculture.

The **International Seed Federation** (ISF) is a non-profit organisation representing the main stream of the world seed trade and plant breeders community, and serves as an international forum where issues of interest to the world seed industry are discussed.
Foreword

Organic agriculture and an ever-green farm revolution

Monkombu Sambasivan Swaminathan
UNESCO Chair in Ecotechnology
M S Swaminathan Research Foundation, Third Cross Street, Taramani, Chennai 600 113, India
Email: msswami@mssrf.res.in

Abstract
Sustainable food and nutrition security, under conditions of diminishing per capita arable land and irrigation water resources, and expanding biotic and abiotic stresses, including potential changes in climate, calls for accelerated scientific efforts in the development of technologies and agronomic management procedures which can help to enhance productivity in perpetuity without associated ecological harm.

I coined the term, “ever-green revolution” about 15 years ago to emphasise the need for paying scientific and social attention to yield-enhancing approaches which can help to harmonise current and future needs of food and other agricultural commodities. Today, there are uncommon opportunities for fostering an organic farming revolution by harnessing the tools of frontier science.

Ever-green revolution, soil health cards, efficient micro-organisms, nutritious cereals and bio-happiness

Introduction
In January 1968, I made the following statement at the Indian Science Congress Session held at Varanasi in India, to emphasise the need for a proactive action-reaction analysis while bringing about changes in farming methods (Swaminathan, 1968).

“Exploitative agriculture offers great dangers if carried out with only an immediate profit or production motive. The emerging exploitative farming community in India should become aware of this. Intensive cultivation of land without conservation of soil fertility and soil structure would lead, ultimately, to the springing up of deserts. Irrigation without arrangements for drainage would result in soils getting alkaline or saline. Indiscriminate use of pesticides, fungicides and herbicides could cause adverse changes in biological balance as well as lead to an increase in the incidence of cancer and other diseases, through the toxic residues present in the grains or other edible parts. Unscientific tapping of underground water will lead to the rapid exhaustion of this wonderful capital resource left to us through ages of natural farming. The rapid replacement of numerous locally adapted varieties with one or two high-yielding strains in large contiguous areas would result in the spread of serious diseases capable of wiping out entire crops, as happened prior to the Irish potato famine of 1854 and the Bengal rice famine in 1942. Therefore the initiation of exploitative agriculture without a proper understanding of the various consequences of every one of the changes introduced into traditional agriculture, and without first building up a proper scientific and training base to sustain it, may only lead us, in the long run, into an era of agricultural disaster rather than one of agricultural prosperity.”

The term, “green revolution” implies advances in crop production through the pathway of productivity improvement and since this is the only pathway available to population-rich but land-hungry countries, I coined the term, “ever-green revolution” fifteen years ago, to stress the need for ensuring that productivity improvement today is not at the expense of possibilities for productivity improvement in the future (Swaminathan, 1996). For achieving such an ever-green revolution, there is need for greater scientific efforts in the development of eco-technologies based on appropriate blends of traditional ecological prudence and soil fertility replenishment and pest management methods with frontier science and technologies. E O Wilson (2002), supporting my concept of ever-green revolution, made the following remarks:

“The problem before us is how to feed billions of new mouths over the next several decades and save the rest of life at the same time, without being trapped in a Faustian bargain that threatens freedom from security. The benefits must come from an evergreen revolution. The aim of this new thrust is to lift food production well above the level attained by the green revolution of the 1960s, using technology and regulatory policy more advanced and even safer than now in existence”.

Challenges and Opportunities for Organic Agriculture and the Seed Industry
Science and Organic Seed
To ensure that organic farming leads to higher productivity per units of land and water, it is essential that research in the following areas is intensified.

Soil Health Management
The earlier methods of soil fertility management, like shifting cultivation, are no longer relevant today due to population pressure on land. Cereal-legume rotations or inter-cropping are important for replenishing soil fertility. Efficient green manure plants like the stem nodulating Sesbania rostrata and bio-fertilizers comprising efficient micro-organisms (Teruo Higa, 1998) have to be packaged in an integrated nutrient supply system, which includes the application of compost, organic manures and plant residues. Inputs are needed for output. For example, the rice plant needs for yielding a ton of rice at least 20 kgs. of nitrogen along with appropriate quantities of P, K and micro-nutrients. Research on soil health management in order to ensure adequate soil fertility for high productivity should receive high priority. The EM (efficient microorganisms) methodology of Higa needs greater emphasis.

All organic farmers should be provided with Soil Health Cards to monitor regularly the physics, chemistry, microbiology and erodability of their soils. Care of soil health is fundamental to a productive agriculture.

Sustainable organic farming will also need bioremediation agents which can help to improve soil health through the sequestration of salt, heavy metals and other yield reducing constraints. A consortium of micro-organisms each capable of performing important functions like nitrogen fixation, phosphorus solubilisation, and sequestration of salts and pollutants will have to be developed for each major agro-climatic and agro-ecological farming system.

The other area of research which is essential for sustained high productivity is integrated pest management, involving concurrent attention to pests, diseases and weeds. For this purpose, there is need for a biosecurity compact, which will help to manage not only pests, diseases and weeds, but also invasive alien species and mycotoxins in food. Sanitary and phytosanitary measures and codex alimentarius standards of food safety need to be integrated in organic production protocols.

As population pressure on land and water increases, there will be need for productive genotypes of crop plants which can perform well under conditions of soil salinity, alkalinity and acidity. Special Genetic Gardens will have to be established for halophytes and drought tolerant genotypes. Also, suitable donors for salinity tolerance and drought tolerance will have to be used in anticipatory breeding for adaptation to climate change and sea level rise. MSSRF scientists have been able to develop sea water tolerant genotypes of rice, mustard and legumes using the mangrove species, Aveininna marina as donor. Similarly, Prosopis juliflora is being used as donor of genes for drought tolerance. Such pre-breeding work needs to be integrated with participatory breeding with farm women and men so that location specific varieties can be developed. Genetic diversity is essential to avoid vulnerability to pests and diseases. Therefore, gene deployment strategies will have to be developed for each agro-ecological region jointly by scientists and farm families. Successful organic agriculture will need a paradigm shift from purely experiment station based research to participatory research in farmers’ fields.

Teruo Higa’s complex culture of naturally occurring beneficial microorganisms such as phytosynthetic bacteria, lactic acid bacteria, yeasts, fermentative fungi and actinomycetes has multiple uses. It can be used to purify water and sewage, solve sanitary problems, and improve the environment. There is need for more research on such consortia of micro-organisms.

Recent research at MSSRF by Drs Loganathan and Sudha Nair and has led to the isolation of a bacterial strain capable of fixing nitrogen and solubilising phosphate. This strain named Swaminathania Salitolerans gen.nov.sp.nov was isolated from the rhizosphere, roots and stems of salt tolerant wild rice associated with mangrove species. Field trials in rice using this microorganism are now in progress.

Sustainable organic agriculture will need more science and not less. Artificial barriers should not be created among scientific methods. What is important is to harness all the tools that traditional wisdom and contemporery science can offer in order to usher in an era of bio-happiness. The first requirement for bio-happiness is nutrition and water security for all and for ever. This is the challenge before all involved in organic farming and the seed industry.
The seed industry has a particularly vital role to play in ensuring genetic diversity in crop plants and to providing organic farmers with genotypes based on a pyramiding of genes for tolerance to major biotic and abiotic stresses. There is also need for greater attention to under-utilised or orphan crops, since many of them are not only nutritious, but also capable of performing well under fragile and rainfed environments. In order to change the mindset relating to nutritious millets, FAO should change the terminology from “coarse cereals” to “nutritious cereals”. The global food basket is getting narrow and there is need to enlarge the food basket by including in the diet a wide range of cereals, millets, grain legumes, vegetables and tubers. In the past, human communities depended upon several hundred species of plants for their nutrition and health security. Diversified farming systems and dietary habits are essential to confer benefits on both the producer and the consumer from organic farming methods.

Crop husbandry and forestry are the major solar energy harvesting enterprises of the world. An ever-green revolution will help to optimise the capture of solar energy and the production of farm commodities through a symbiotic interaction between solar and cultural energy. This is the pathway to sustainable food security and bio-happiness.

References
P Loganathan and Sudha Nair *Swaminathania salitoleraens* gen.nov., sp.nov., a *salt-tolerant nitrogen-fixing and phosphate-solubilizing bacterium from wild rice* *Portheresia coarctata* Tateoka (under publication)
Challenges and opportunities in organic seed production

Jan Velema
Vitalis Biologische Zaden B.V.
Hengelderweg 6, NL 7383RG Voorst, The Netherlands
Email: j.velema@vitaliszaden.nl

For every species, variety or other group of plants, there are always two reasons for seed production. In the first place it is the production of commercial seeds, the basic propagation material to grow the crop. But, contrary to any industrial production, the product itself is also maintained by seed production. Seed cannot be produced out of any raw element, only by reproduction of itself (in case of F1 hybrids through parent lines, but that is of no importance in this sense).

For that reason seed production cannot be regarded apart from maintenance and plant breeding.

Some difficulties or restrictions that can be encountered during seed propagation has an origin during earlier generations. In a wider perspective, the breeding methods used are not only determining the quality of the seeds, but also can influence, restrict or stimulate the sustainability of the maintenance of our cultivated crops as a cultural heritage.

Organic seed is a crucial link in the chain from research, breeding, seed production to organic production. The aim is to provide the grower with appropriate and healthy seeds at a reasonable price. With organic seed the grower can complete the chain with organic input; for seed companies organic seed is the start for selecting and breeding appropriate organic varieties.

In this presentation I will restrict myself to practical aspects of organic seed production, especially vegetable seeds.

Professional organic growers, just like their conventional colleagues, are making high demands on the quality of seeds. This means that seed production should take place under optimal and favourable conditions. Compared to conventional seed production there are several aspects that deserve extra attention.

Optimal Climate and Region
Since no treatment with chemicals is possible to control diseases or pests, it is important to find the optimal climate for a favorable development of the seed crop. For the same reason it can be a solution to find a region where the crop is not grown widely. Diseases and pests are then prevented because infection is unlikely.

Cultivation Methods
Depending the crop or species, a wide range of cultivation methods can be developed to improve seed production. Only a few examples are mentioned, like drip-irrigation in stead of watering over the crop, planting in a wider spacing for a drier microclimate in the crop, tying up the crop on poles for the same reason, moderate fertilisation to stimulate a generative plant development. Although these measures can vary strongly for each species, they are applied in order to improve the condition of the seedcrop.

Diseases and Pests
One have to distinguish between diseases, wich are affecting de seed crop, and diseases wich are seed tansmitting and therefore seedborn.

The first group can cause an increase of the quantity and/or quality of the seeds. The best way of precaution is to avoid a weak crop by improving cultivation conditions, like mentioned above. When diseases or pests appear, they can be treated with biological pesticides or predators, not different from organic production of vegetables. Sometimes, as far as the seeds are not affected, an infection of a seed crop is not as critical as with the vegetable crop. You can imagine that a light aphid infection does not harm the seeds, but makes a leafy vegetable unmarketable. The opposite case is when aphids can transmit seed-born viruses. Then the seeds are useless, while the vegetable could still be acceptable, at least partly.
Seed transmitted diseases are a serious problem, since disinfection afterwards is often impossible. Such diseases must be avoided. Sometimes the damage can be limited by harvesting the seed crop in parts. This is done for example in tomatoes by harvesting weekly and in celery by harvesting the upper part of the crop separately from the lower part (a higher risk of septoria). When seeds are nevertheless infected, disinfection of the seeds is in some cases possible by warm water treatment.

**Weeds**
Weed cannot be eliminated by herbicides, so they must be avoided or removed mechanical or by hand. Weeds have a negative influence in several ways. When there is much weed in the seed crop, the microclimate can get humid or oppressive, which causes fungal diseases like botrytis. Like a wider plant spacing, a well weeded seed crop improves the quality of the seed.

Secondly weed causes contamination with weedseeds in the harvested seed lot, which may be hard to clean. Especially here, prevention is better than cure.

**Seed processing**
Threshing, cleaning and grading organic seeds show no differences with conventional seeds, since only mechanical machines are used. For pelleting or priming seeds some specialized companies have developed certified organic procedures with only natural compounds and elements. With the exception of chemical treatments and coatings, almost all seed techniques are available for organic seed to meet the professional standards for high quality.

**Genetic or variety aspects**
Varieties are choosen and selected because they perform well at the organic vegetable grower. That will not mean that they always perform well during organic seed production. Some diseases are not of importance for the vegetable production, but can be a serious problem in seed production. This can be the case in some biannual crops and in some F1 hybrids.

Rust or mildew can cause damage in the second season, after bolting. The vegetable grower only grows the young plant and is harvesting the crop before bolting, so he is not faced with the disease.

Some hybrids have parent lines, which are inbred lines and weaker than the hybrid they are producing. Under organic conditions these parentlines are very hard to grow seed from. They might have a poor root system, or are susceptible for diseases (which is not expressed in the hybrid).

These examples show that a successful variety for the organic market should be adapted not only from seed to crop, but from seed to seed. Organic varieties, bred under organic conditions fulfill these conditions better than conventional bred varieties. In most cases however, seed for the organic market depends on conventional breeding. When organic seed producers and growers are involved in an early stage during breeding, it will also be possible to develop adapted and high performing conventional varieties for the organic market.
Putting organic seed production in perspective

Roland Peerenboom  
Chairman ISF Working Group Organic Seeds  
Enza Zaden B.V., Haling 162 1602 DB Enkhuizen  
The Netherlands  
Email: r.peerenboom@enzazaden.nl

Introduction:
At the end of the 1980’s when the public and political call for active promotion and support of organic agriculture and horticulture became louder, few of us in the seed-industry could have imagined what impact that would have on our industry.

What was and still is in the public eye is the farmer that would, like many hundreds of years ago, grow his crop or raise his cattle in an old traditional way by using only the natural resources at hand and by doing so would automatically have the sympathy (true) and the economic viability (not true) to earn a decent living.

Any knowledge with the general public, but also with the politicians, about what it would take to grow and survive as organic farmer in the current economic environment, is based on false assumptions and lack of understanding how the markets for agricultural and horticultural products work in reality.

I use this statement to illustrate that if it is already difficult for consumers and politicians to understand the economics of growing and marketing a viable and profitable crop let alone an organic crop, then it must be even more difficult to imagine for them what the implications would be for the seed-industry, which for most people is a very unknown industry, but who stands at the basis of any organic product.

In this session I would like to focus on some of the dilemma’s we are facing as seed-industry in the production of organic seeds.

In later sessions today or in the next days some of my colleagues will go into more detail about some of these specific dilemma’s.

The Markets:
Before going into more details about the seed-industry, I first would like to draw a picture about the different markets we are working in.
To understand the challenges we face as breeders and producers of (organic) seeds and as professional growers we first need to analyse the characteristics of the different markets.
This is sometimes forgotten.

As has been the set up of this congress, I make a distinction in:

- Vegetables
- Cereals
- Fodder/forage crops
- Potato

The characteristics of each section is as follows:

Vegetables:

- Fresh market ( incl. pre-cut market )
- Processed market 1: frozen and canned
- Processed market 2: soups and sauces
The fresh market is in terms of image and visibility the most important market, especially when it comes to organic product. It is also the most difficult market to supply because of image, profitability, volatility, shelf-life, diversity in supply, logistics and quality standards.

The processed market 1: frozen and canned, knows large identical volumes, fewer clients, straight forward logistics, and crops can better be planned.

The processed market 2: soups and sauces, knows large identical volumes, few clients, straight forward logistics, easier planning and greater tolerance in product appearance.

Cereals:

With the exception of sweet corn which is also consumed directly by consumers, cereals are processed and come into another than fresh form to the consumers. The way of growing and processing is then more industrial and more comparable to the processed market 2 as described earlier.

Fodder/Forage crops:

Purely intended for animal feeding, also these crops are grown and processed in an industrial form.

Potato:

- Fresh market (incl. pre-cut, pre-packed)
- Processed market

The fresh market has the same characteristics as mentioned under the vegetables, but there is less variability and longer storage-life, which makes planning and logistics easier.

For the processed market the same characteristics apply as mentioned earlier.

The Seed Industry:

The main elements of any integrated seed-company:

- Breeding (research and development)
- Seed production
- Seed-processing and treatment
- Logistics
- Quality control
- Marketing and sales
- Overall business control

The highlighted areas are very much affected for any seed-company involved in organic seeds.

Some of the main challenges of operating a seed company:

- Continuous development of new improved varieties to increase quality, performance and yield of crops (lengthy process with high investments)
- Long term planning in terms of seed-production and further steps in the seed-process
- Extensive and time consuming quality control process
- Subject to volatile market and weather conditions
- Protection of intellectual property issues
- Reduced chemical plant protection possibilities and at the same time increasing disease pressure (new agricultural areas)
- Last minute variety choice decisions by growers
Of course this list can be further extended, but I do not want to bother you with all other challenges we are facing in our business.

But, if these issues are already challenging enough for the main stream of our business you can imagine what influence the decision to enter into the organic seed-market can have on our operations.

As shown above it affects almost all elements of our current business operations, while it represents less than 1 percent (optimistic guess) of our total business.

From an economical and business point of view, and without making extensive studies, one can conclude that this part of our business by far does not bring the returns that are required to make this a firm part of our business.

To give you a few examples what impact organic seeds have on the operations of seed-companies:

- Due to limited demand (very) small batches
- Fewer qualified organic seed producers
- Separate seed-cleaning and handling
- Extra cost of transport
- Extra cost of storage
- Economical not yet interesting, therefor less attention
- Expensive to market due to the big number of smaller growers
- Product liability issues and insurance
- Etc.

Again, also here the list can be extended further.

*Given all these ‘headaches’ why would some seed-companies in the first place become involved in the production and marketing of organic seeds?*

1. Because they had (have) a vision, supported by the ideological and political will in the beginning, that this may become an interesting ‘niche’ seed-business to be involved in.
2. To learn from it and to use the new experiences in the breeding and production of standard seed as well.
3. To fill the demand for organic seed of farmers and growers.
4. To make it possible to grow an organic product from seed to final product, and thereby catering for the needs of the sensitive and critical consumer.

Especially this last statement should be the underlying aim of the organic movement, because in my view the future of organic agricultural and horticultural products is determined by the integrity of this concept.

Organic product is not a matter of better taste or healthier product; many studies have shown that there is no difference in this respect.

It is a conscious consumer that makes a conscious decision to buy a in his/her view in an organic way produced product. (from start/seed to finish/product)

There is no room for error, because if the consumer loses the confidence that the organic products they are buying with serious organic claims (and they are asked to pay a bit more for that) then this organic business will very quickly disappear.

*What is needed for the seed-industry to continue and invest in the further development, including a bigger bio-diversity, of the organic seed market?*

Two things:
1. True commitment of all parties in the chain
2. Unambiguous and clear regulations.
The role of ISTA and seed science in assuring organic farmers with high quality seeds

Steven P.C. Groot1, Pieter Oosterveld2, Jan W.M van der Wolf1, Henk Jalink1, Cees J. Langerak1 and Ruud W van den Bulk1
'Corresponding author

1Plant Research International, Wageningen University and Research Centre, P.O. Box 16 6700 AA Wageningen, Netherlands, e-mail: steven.groot@wur.nl
2International Seed Testing Association (ISTA), P.O. Box 308, CH 8303 Basserdorf, Switzerland.
E-mail: ista.office@ista.ch

Abstract
Seed quality is of basic importance to farmers. The International Seed Testing Association aims at providing farmers and producers with uniform tests for analyses of seed quality, through accredited seed testing laboratories worldwide. To accomplish this ISTA has set up rules, standardises methods and provides training of seed testing staff. The main aspects of seed quality concern trueness of the variety, purity, germinability, vigour and health. For organic farming an additional aspect is the seed production under organic conditions. Unfortunately, at present, organic production bears a greater risk of contamination with weed seeds and infection with pathogens. Especially with certain biennial vegetable crops difficulties are encountered. These difficulties contribute also to higher seed production costs. In some cases disease-free production is not possible and additional non-chemical treatments are needed. These methods should eradicate the pathogens without harming the seeds. Sowing in organic fields can benefit from fast germinating seeds with high vigour, to increase uptake of nutrients from organic fertilisers and competition with weeds. An increasing number of researchers are contributing to improvement of organic seeds production, both from private and public institutions. Examples of this research, as performed at Wageningen University and Research Centre are presented. These examples comprise research on the epidemiology of seed borne diseases and its critical control points, alternative methods for treatments of infected seeds, seed sorting and seed priming.

Seed quality testing
High quality seed is the basis of crop production. Seed companies perform checks and treatments during seed production, and after harvest, to guarantee they provide their customers with good, germinating, healthy seeds. Many countries have established seed testing stations for certification and control of seed moving in trade. Quality of seeds has many aspects, these include trueness of the variety, purity of the seed batch, its germination and emergence potential (vigour) and seed health. Uniformity in seed quality testing is very important and the main aim of the International Seed Testing Organisation (ISTA). In ISTA 75 member countries work together in seed testing and 155 laboratories are member of this internationally operating association. ISTA publishes the International Rules for Seed Testing. Organisations like OECD, EU and ISF refer to ISTA rules in their standards and directives. In order to keep the rules and methods updated, ISTA has established a number of Technical Committees. Staff of seed testing laboratories is trained during workshops. More than 100 laboratories all over the world are accredited. The performance of these accredited laboratories is constantly be monitored through the international operating ISTA Proficiency Test. Every third year the laboratory will be visited by each a system and a technical auditor, who is an expert in the area of seed science and technology. The results of the testing of the seed lot are reported on the ISTA International Certificate. So, it is up to the seller and the buyer to agree on de officially reported quality of the seed. ISTA methods are applicable for all kind of crops, independent of the way of production. Therefore, ISTA facilitates also the production and trade of seeds, produced by and for organic farming.

Organic seeds
For organic farming additional aspects of seed quality are important, especially the production of seeds under organic farming conditions and the restriction in methods that can be used for the treatment of the seeds. Rules for organic crop production are made by international bodies such as the International Federation of Organic Agriculture Movements (IFOAM) and the European Union (Regulation 2092/91). Certification for organic production is performed by appointed national organisations, distinct from the above mentioned organisations that certify seeds on the quality aspects.
Production and treatment of seeds, bulbs or tubers under organic conditions puts additional challenges for obtaining high quality propagation material. Because of the constraints in the use of chemicals, organic production bears a greater risk of contamination with weed seeds or with seed contaminated with pathogens. On the other side, organic seeds are sown in an ecological richer soil, which might provide a natural buffering of pathogens unwillingly brought with the seeds or tubers. Sowing of seeds in soils with organic fertilisers that have slower mineralisation in spring, and weed competition may ask for seedlings with a faster growing root system: seeds with additional quality traits such as high seed vigour. Regarding purity, it is debated whether organic seeds need lower thresholds for contamination with GMO seeds than non-organic seeds.

**Organically produced propagation material**

For several crops, such as potato and tomato, production of organic propagation material goes reasonably well. For some other vegetable or arable crops, however, it is very difficult to produce organic seeds using the same quality standards as for conventional farming, while for ornamental crops there is hardly any organically produced propagation material available. Especially with biennial vegetable crops, as cabbages, carrot and onion, difficulties are encountered with production of high quality organic seeds. For these crops, the two seasons needed for seed production make the risk of diseases and pathogen contamination very high. With respect to cereals, organically produced wheat seeds are available, but the emergence of the seeds is often less than that of conventionally produced seeds, which most often are treated with fungicides. *Fusarium* infections are mostly causing this problem. Moreover, organic seed production is at this moment often more expensive than conventional seed production, varying from a few percent till three fold, among others due to losses during seed production or insufficient quality of some seed productions. Research is needed to tackle these problems and aid seed companies in improving their organic seed production and seed treatment methods.

The frequent lack of available organically produced propagation material made the European Commission to introduce a temporary derogation system, under which the use of conventionally produced non-chemically-treated propagation material can be allowed. This under the condition that no organically produced seed was available of the variety the farmer intended to grow. The deadline for this derogation system was set at 1 January 2004. Nevertheless, several companies have put large efforts in the optimisation of organic seed production, in several cases with success. Last year it became apparent that for various crops the supplies of organic produced seeds are still insufficient. The European Commission decided therefore that the deadline for derogation should be postponed again for some crops. Each EU country had to produce a national list of crops for which derogation of the use of organic propagation material is no longer allowed. In the Netherlands this list includes for 2004, for instance, wheat, oat, barley, ryegrass and potatoes, but for some vegetable crops derogations are still allowed. These ongoing derogations are not stimulating for seed companies to invest in organic seed production.

Fortunately, research aimed to improve the quality of organic propagation material is performed by an increasing number of researchers, as witnessed by this conference, both from public and private institutions. Several examples of this research are provided at the conference and listed in the proceedings. Here we also present a few examples, mainly related to the research performed at Wageningen University and Research centre (WUR).

**A healthy organic seed production**

As long as diseases resistant varieties are not available, a consequence of the omission of chemicals in the organic production system is the increased risk of the occurrence of diseases during production of some crops. This holds also for seed production, especially, for biennial crops, which are exposed to various diseases during two subsequent seasons. To find alternative measures for optimising organic seed production, we focus on gathering knowledge of “thresholds”, describing the link between measured seed contamination levels of a pathogen and the potential disease risk in practice. The host-pathogen combination *Daucus carota* - *Alternaria radicina* is used as a model. Heavy seed infections are mainly related to a bad emergence and occurrence of symptoms in the seedling stage and leaf stems. The slight seed infections, which can only be detected with sensitive methods, seem to be responsible for non-visible latent infections in the crown part of the carrot root. These infections may become visible as a black rot during maturation or during storage of the carrots. When young carrot plants or mature roots are vernalised in order to induce
flowering, latent infections mostly remain unnoticed. Such infections can finally result in infected flowers and diseased seeds, and may form a source of inoculum for secondary infection of seeds developing on healthy plants.

Consequently, organic seed production requires a high degree of sanitation, e.g. disease freedom of the basic seed, roguing in any stage of plant development and a stringent isolation of production fields from related species.

**Seed sanitation treatments**

Commercially produced seed is nowadays often treated with (synthetic) crop protection agents, in order to eliminate seed borne pathogens and to protect emerging seedlings from soil- and air-borne pathogens and insects. For organic seeds physical treatments can be used. Well known is the hot-water treatment, which was used already before the invention of synthetic fungicides. More novel methods concern the electron seed treatment and a treatment with hot moist air. The latter treatment was optimised in by the Swedish University of Agricultural Sciences and is commercialised by Acanova A.B. (Forsberg et al 2000). The seeds are treated with a mixture of air and steam, with a careful control of temperature, air humidity and treatment duration. This year a prototype device will treat tons of Swedish cereal seeds, also for conventional farmers that also prefer to reduce the use of pesticides on the seeds. The paper by Schmitt and coworkers in these proceedings provides examples of all three physical treatments, applied to vegetable seeds, in the frame of a European collaboration.

Physical treatments, however, involve the risk of seed damage. Our research on factors determining seed sensitivity, show that seed maturity is an important aspect. To reduce risks for seed damage in another way, we are developing a combination therapy, by combining milder physical treatments with treatments using compounds of natural origin.

Within this concept, different natural compounds are tested, including essential oils and organic acids. To evaluate natural compounds for activity against important seed transmittable plant pathogenic bacteria and fungi, we optimised *in vitro* microplate assays. From 30 essential oils tested, thyme oil exhibited the highest *in vitro* inhibiting activity against *Xanthomonas campestris* pv. *campestris* (Xcc) and *Clavibacter michiganensis* subsp. *michiganensis*. Thyme oil also showed an *in vitro* inhibiting activity against *Botrytis aclada* and *Alternaria dauci*. Strong synergistic effects were found by adding a chelator and a natural detergent to the oil. Treatment of cabbage seed with thyme oil results in a strong decrease of seed-associated bacteria (> 99%) and saprophytic fungi. However, a negative effect on seed germination is found with higher oil concentration and when applied for longer duration’s. Treatment with ascorbic acid also results in a strong decrease of seed associated bacteria without affecting seed germination.

An important aspect for implementation in practice is that also the use of these natural agents should be allowed according to the national and international regulations for crop protectants, even if they are already used in food products. Products that are not yet registered for use as a crop protectant will need the submission of new dossiers, often requiring costly toxicological studies that are not feasible for the small market of organic seed treatment. Next to that, they should also be allowed for use in organic production systems (EEC regulation 2092/91). In the Netherlands thyme oil fits both the criteria and may be used for treatment of seeds when mixed with water. Due to its hydrophobic properties treatments with thyme oil need to be further optimised. The use of ascorbic acid is presently not allowed for organic seed treatments, since it is not listed in annex IIB (EEC regulation 2092/91) describing the crop protection agents allowed for organic production. However, it is permitted as additive in organic food and fodder (annex IIC) and it could be worthwhile to submit a request to the EC to place this compound on Annex IIB as well.

**Seed priming**

Microbial activity is very important for the release of nutrients, when using organic manure. In the cold spring soil, microbial activity is low and nutrients become less readily available in comparison with the use of synthetic fertilisers in conventional farming. A vigorous seedling with a fast growing root system may improve the uptake of minerals and improve the establishment of the crop. In this respect vigorous, healthy seedlings may be even more important for the organic farmer than for the conventional farmer. Moreover, faster growing seedlings can improve competition with weeds for nutrients and light. The latter is relevant, because manual and mechanic weed removal are major costs in organic farming. Primed seeds have a faster
establishment compared to non-primed seeds. We expect that under less optimal conditions, for instance when the crop is attacked by diseases during the season, the initial faster growth of primed seeds can have strong benefits for the organic farmer. An example with sugar beet is presented elsewhere in these proceedings by Halmer and co-workers.

**New seed sorting technologies to improve the health and quality of seed lots**

As argued above, for organic farmers the use of seed lots with a high vigour may be even more important than for conventional farmers. During maturation, seeds reach optimal physiological quality. A major cause of the heterogeneity in seed vigour is the variation in maturity, resulting in a seed lot with an overall lower seed quality. Seeds, which are not completely mature, germinate more slowly, have a lower germination capacity, produce less normal seedlings, can have higher contamination levels with pathogens, and can be more sensitive to diseases. In this respect seed maturity has a large influence on seed vigour.

In general, after the filling of the seeds has completed the colour of the seeds slowly turns from green to a colour that varies with the species or cultivar, due to chlorophyll breakdown. The maturation of the seed can be distorted by poor plant nutrition, poor weather conditions, the presence of pathogens or an early harvest. These are all factors known to influence seed vigour. We have established a chlorophyll fluorescence (CF) sorting method that analyses the amount of chlorophyll in the seed by measuring the chlorophyll fluorescence signal in a very sensitive manner (Jalink et al., 1998). Using CF sorting, one measures the intensity of CF signal of each individual intact seed at high speed. Based on the magnitude of the chlorophyll fluorescence signal, the seeds can be sorted into various classes of maturity and linked to seed performance. Cabbage seeds with the lowest amount of CF, and hence the most mature, provide indeed the highest percentage of germination, a more uniform germination, a higher speed of germination, a higher percentage of normal seedlings, and a lower amount of pathogens. Seeds from the high CF fraction, involving less mature seeds, showed a lower germination capacity and were more heavily infected then the seeds from the low CF fraction (Jalink et al., 1998). For barley (Hordeum vulgare L.) seeds, a positive relation was observed between the CF signal and the level of contamination with Fusarium spp and Cochliobolus sativus pathogens (Konstantinova et al., 2002). CF sorting of barley seeds improved their germination quality by not only removing less mature seeds, but also by removing seeds with the largest fungal infection levels. This technology can therefore also contribute to improving the quality of organic seeds.

**International collaboration**

The need for a more sustainable agriculture is acknowledged world-wide and many governments support research for organic farming. Seed companies also invest in organic seed production, in spite of the general expectation that the organic seed market is hardly interesting for the main seed companies from a commercial point of view. Collaboration between private and public institutions is a must, bot on the national and international level. ISTA aims at stimulating research on methods for improvement and evaluation of seed quality and international standardisation. ISTA offers her network of expertise to take-up the challenges for providing organic farmers with the highest possible quality of seeds.

**References**


Seed quality: an important aspect of organic seed production and seed trade

Michael Abimbola Larinde
Seed and Plant Genetic Resources Service (AGPS), FAO, Rome
Viale Delle Terme di Caracalla, 00100 Rome, Italy
Email: m.larinde@fao.org

Summary
Seed quality parameters provide valuable information on the suitability of seed for planting purposes, particularly its potential to germination, emerge promptly in the field, establish uniformly, and produce healthy crop and good yield. Therefore in the seed industry, seed quality serves as the basis for price differentials in seed trade, facilitates the diagnosis of seed related problems and their probable causes; and provides seed producers with a decision tool for their various operations, including storage and marketing.

The parameters for measuring seed quality are called the seed quality attributes. These attributes are influenced, positively or negatively, by factors referred to as the determinants of qualities. However, there is an interaction between seed quality attributes and their determinants.

The concept of seed quality as it relates to organic seed is in its infancy and various elements of this concept are actively being researched. Efficacious substitutes for the inorganic chemical inputs of conventional seed crop production and improved agronomic practices to improve seed yield are being identified. There is a need to develop standards for the seed of various crops, whose organic seed are to be produced so that procedures can be worked out for their quality control. FAO could collaborate in this endeavour.

Introduction
In conventional seed, seed quality often poses more problems than its quantity because the concept of quality as applied to seed is still not clearly understood, especially in many developing countries. Consequently, wrong measures are often taken to solve seed quality problems. However, in organic seed production, the problem is both of quantity and quality (Bravi 1998) and they result from the procedure for organic crop farming. This procedure prescribes that: i) seed to be used for producing organic seed crop must be organic in nature i.e. non-chemically produced (there are presently some provisions); ii) only bio-fertilisers, instead of inorganic fertilizers may be used and iii) bio pesticide/instead of chemical pesticides may be used for control of pest and diseases (EU 1991). Generally, information on seed quality is important as it serves as the basis for price differentials in seed trade, facilitates the diagnosis of the source of seed related problems and provides seed producers with information required to correct seed quality problems.

Several studies are being carried out on ways to improve the seed crop yield and seed quality of organic seed crop. In order to lay a proper foundation for the understanding of seed quality, and how it can be enhanced, it is important to highlight what constitutes seed quality attributes and the factors that determine them.

Seed quality attributes and their determinants
Seed quality is measured by a set of parameters referred to as seed quality attributes while the factors, which affect these attributes – positively or negatively – are termed seed quality determinants. There is an interaction between seed quality determinants and attributes; and quite often than not, a determinant affects more than one seed quality attributes. Regulations for organic seed are relatively recent; hence procedures for ensuring high quality in organic seed production are still being progressively developed.

A list of what could be considered as constituting seed quality attributes for organic seed include: purity of seed lot; incidence of noxious weed; germination; moisture content; density; varietal purity; incidence of seed - borne disease; vigour; incidence of mechanical damage; effectiveness of seed treatment and absence of GMO contamination. Determinants of seed quality are similar to those of conventional seed and they comprise inheritance source of seed; field contamination growing conditions; post - maturation/pre - harvest conditions; harvesting; aeration and drying; handling; conditioning; seed treatment and storage.
Implications of organic seed crop production system on quality and quantity of organic seed
The regulations governing organic crop production imposes a number of problems as highlighted by Tosi (2001) in his paper titled “Still a lot of problems in organic seed production”. These problems include: a) shortage of organic seed resulting from lower yield of organic seed crop compared to conventional crop and limited source of supply (Kristensen 2003, Nielsen 1999 & Testori 2001); b) limited availability of organically bred variety with potential to counter environmental (biotic and abiotic) hazards imposed by organic seed crop production system (Leibinger et. al. 2002); and c) lower seed viability and vigor - largely a result of poor seed quality caused by both agro-ecological and biotic stress (Kristensen 2003).

Quality control procedures
In order to ensure that organic seed are of good quality, appropriate agronomic practices and pest control procedures should be adopted to circumvent the handicap posed by the organic seed crop production system. These practices should ensure that the genetic, physical and physiological integrity of the seed crop is maintained during the process of reproduction. These actions relate, amongst others, to the choice of production inputs including seed; careful selection of the plot of land to be used for organic crop production (for cleanliness from disease agents, fertility and absence of chemical residue carried over from previous crops); and appropriate procedures for handling the seed crop at the production and harvesting phases – all of which could be checked through seed quality control procedures called field quality control. When the crop is harvested it is subjected to laboratory quality control to determine - seed moisture content; purity (physical and varietal); viability; vigour; weed content; freedom from noxious weed seed and absence of inorganic chemical. The sum total of the results obtained from both the field and laboratory controls are used to certify the seed.

Selected key seed quality determinants affecting quality
Necessary precautions required in conventional seed are well known and these precautions apply to organic seed as well. There following peculiar problems of organic seed are therefore selected for some discussions.

Seed source
Seed source impacts on the purity of the seed lot, incidence of noxious weed seed, varietal purity of the crop, incidence of seed-borne diseases, effectiveness of seed treatment and seed vigour. A credible way to solve the problem of seed shortage will be through a programme of organic crop breeding, which will generate varieties that will be amenable to organic seed production practices and produce good quality seed with reasonable yield (Leibinger et al. 2002). Breeding approaches, taking into consideration both yield and quality constraints have been proposed for different crops, such as peas, beans, potato and cereals have been suggested (Leibinger et. al. 2002 and Testori 2001).

Field contamination
Crop field contaminants include biotic and abiotic agents. These contaminants could be from the source of seed sown, volunteer plants of other previously grown crops kinds, crop pesticide residue in the soil, disease inoculums in the field and weed seed present in the piece of land being used for cultivation. Therefore, the history of land to be used as well as crop history is very important in taking actions to limit the extent of contamination.

It is clear that growing organic seed – with compost and bio-seed dressers may pose problems of unintentional propagation and spread of serious pest and diseases, particularly seed-borne diseases. To minimise this problem, Nielsen et. al. (1999) recommended that the seed to be used for organic crop should be thoroughly tested for pathogenic fungi and that seed lots with unacceptably high infections discarded and provision should be made for effective bio-chemical or heat therapy to control seed-borne diseases.

Biotic contaminants and Biological seed treatments.
Biotic contaminants of seed include pathogenic and non-pathogenic diseases and pests, whose location may endogenous or exogenous. In order to effectively replace chemical pesticides, the bio-pesticides must be able to eliminate and/or contain pathogens so as to facilitate normal growth of the seedlings/plants. Biological seed dressings have been developed and found to be effective in various crops (Jensen et. al. 2001, Montuschi et al.1996, Scheffer et al. 1994, Vakili 1992, Vannacci et al 1986). Montuschi et al. (1996) documented the use of strains of bacteria and yeasts as bio-seed dressers for the control of pathogenic fungi of seed comprising species of Fusarium, Alternaria and Stemphylium) on infested seed of radish and
parsley. Also Vakili 1992 obtained successful biological treatment of seed- and soil-borne fungi colonizing corn (Zea mays) kernel by using Mycopathogenic fungi (species of Exobasidium, Gliocladium, Gonatobotrys, Sphaeronaemella and Trichothecium). Biological seed treaters for cereals have been tried in Lithuania to control seed-borne pathogens and soil borne seed attacking fungi (Semaskiene 2000). Biological seed treatment of wheat for the control of seed-borne Fusarium culmorum of wheat was evaluated in northern Italy with success. In Denmark, several commercial and near-commercial microbiological products successfully controlled seedborne diseases in wheat. In Slovakia, biological seed treatment (Ekovort) was evaluated for the control of plant infection with Fusarium spp with positive results (Sekerkova 2001).

Control of Pythium seed rot and pre-emergence damping-off of cotton (Acala SJ-2) was obtained by E. cloaca and E. herbicola strains used as biological seed treatments on cotton (Nelson 1998). Two (2) isolates of Trichoderma harzianum and one of Chaetomium globosum gave promising results for control of infection by Dreschlera sorokiniana [Cochliobolus sativus] (Vannacci et.al. al. 1986). In Egypt, Trichoderma PROMOT (a biological seed treatment) applied after seed coat of mangrove (mainly Avicennia marina) was removal proved to be the best treatment for the control of six genera of fungi (Alternaria, Aspergillus, Cladosporium, Drechslera, Fusarium and Penicillium and Pseudomonas viridiflava and P. marginalis) on seeds(Abdelmonem et.al. al. 1997). Biological seed treatment for control of soil-borne plant pathogens using both biological and fungicidal seed treatment (seeds are first treated with Gliocladium virens (107 conidia/ml) and then with 0.1% carboxin) was effective in controlling several soilborne pathogens, including Sclerotium [Corticium] rolfsii, Rhizoctonia solani and Fusarium oxysporum in chickpea, lentil and groundnut (Mukhpadhyay 1992).

**Growing conditions (the use of organic fertilizer and residual bio- chemical residues from previous cultivation)**

Experimental works have been carried out to investigate the effect of the improvement of crop growing conditions on successful production of organic seed. Pauneroc (2003) reported that agro-ecological conditions of north-eastern of Buenos Aires, Argentina were adequate for organic seed production of leek (Allium porrum L.). Similarly, particularly in good weather, organic seeds of some selected and climatically adapted herb species - yarrow (Achillea millefolium), angelica (Angelica archangelica), dragonhead (Dracocephalum moldavica), anise hyssop (Agastache foeniculum) and hyssop (Hyssopus officinalis), chamomile (Matricaria chamomilla [Chamomilla recutita]), lovage (Levisticum officinale) and chervil (Anthriscus cerefolium) – could be produced in south Finland (Galambos et. al. 2001). Kristensen (2003) reported that in Spring barley environmental conditions of parent plants influence seed and seedling performance (maternal effects) and concluded that organic seed production should focus on other management efforts to compensate for the poorer germination and yield performance in seeds of organic origin.

**Conclusions**

In order to enhance organic seed industry, there will be a need to carry out thorough studies to identify suitable biotic substitutes of the normal inorganic production inputs that will be allowed for use in the production of organic seed. Also, appropriate seed standards for the different crops have to be developed and the necessary quality control developed.

**References**


The need for harmonization

Roland Peerenboom
Chairman ISF Working Group Organic Seeds
Enza Zaden B.V., Haling 1e 1602 DB Enkhuizen
The Netherlands
Email: r.peerenboom@enazaden.nl

Introduction
It should be simple: ‘for a product to be called and labelled organic it should have been produced from start (seed) until end (the product the consumer is buying) in an organic way’.

This should translate for the grower into: ‘to grow and market a product with an organic label one SHOULD use organically produced seeds’.

As mentioned already yesterday, I view organic production and organic products as a highly sensitive and emotional type of business.

A business the consumer could easily fall out with, if the consumer gets the feeling they are being “cheated” on.

I think this is an important statement to keep in mind in all our discussions about organics.

As I started with; it can be simple; but, we people, for all valid and not so valid reasons make our own life very difficult.

We think with our heart, but we act with our own interests in mind. (very human!)

When more than 15 years ago there was a call from the organic movement to become more serious about organic production, which soon after that was translated by the European politicians into an objective that by the year 2010 10% of all agricultural production should be from organic origin, then the real challenge started.

In 1991 it was stated in the European parliament that as from January 2001, one had to use organically produced seeds for organic production in the European union.

At the end of 1999, so about 15 months before the date that this regulation would become effective, it was decided that the effective date would move to the first of January 2004, because ‘it was apparent that not enough organically produced seed would be available’.

By the way I do not know of any study commissioned by the European Parliament that supports that statement.

Any way, here we were as seedindustry in 1999, without ever been consulted about the issue, with already ‘shaky’ regulations that looked doubtfull to come in place ever.

That situation was also the direct incentive to form at European (ESA), American (ASTA) and Worldlevel (ISF) the different working groups organic seeds.

The current situation

We can make a distinction in 3 group of organic seeds:

1. Organic seeds reproduced under license by the growers themselves
2. Organic seeds for bulk-items like fodder/forage crops
3. Organic seeds for smaller crops like vegetables

Ad.1. Clear and easy: the growers have already converted their land to organic growing and they reproduce their own organic seeds.

The process is controlled by the applicable local certification/auditing body.
Ad. 2. In view of the large volumes required and the time it takes to convert enough seedproduction land to organic; in some cases (like grasses) one choses a system in which it is stipulated that a certain minimum percentage of the (mixture) of seeds should come from organic seed-production. This minimum percentage will be increased every year. Also this process is controlled by an outside agency.

Ad.3. One deals here with smaller batches that because of climatological reasons are reproduced all over the world.

Both the seedcompany and the seed-reproducing company need to be certified by independent agencies. In principle the qualifications a company should have to produce organic seed are the same worldwide. However the more different inspection bodies are involved (and we are already talking about hundreds of inspection agencies), the more likely it is that the local interpretation of the organic certification regulations may differ from country to country and from location to location.

Look for example what is happening here in the European Union in the field of organic vegetable seeds. For years we have been talking about setting up a workable set of regulations for the use of organic seed. We have as seedindustry given our input and much of that was ignored in the final set up of the regulations. But anyway as per the 1st of january 2004 these regulations have come into force, and we can already conclude after 5 months that it does not work.

Each country has its own interpretation and some countries even openly admit that they will not apply the regulations because of various reasons.

So in stead of one applicable (and controllable) set of regulations valid in all member states of the European Union, the seedindustry is now faced with 25 different set of regulations.

The need for harmonization
I think what I just mentioned already illustrates clearly that we should go to a harmonization of regulations.

But to be realistic I think it will take still quite some time to come to a workable set of regulations, not only within the EU but also worldwide.

To illustrate this even further, let us look at what basically is asked from the seed-industry at this moment.

Whether one reads the NOP regulations or the regulations of the European Union one can summarize it as follows:
“The seedindustry is asked to provide a well balanced and sufficiently large range in the right quantities at the right time of organically produced seeds of suitable varieties.”

And here the fun really starts, because what is the right interpretation of:
- Well balanced
- Sufficiently large
- Right quantities
- Right time
- Suitable varieties

Each continent and each country within that continent makes her own interpretation of the regulations which makes it in the final end unworkable for the seedindustry and creates differences in competitiveness between organic growers.

One can make the comparison with the regulations on allowed and forbidden chemical treatments of plants in e.g. the European union. Also here one country is banning the use of a specific chemical, and therefore putting her growers in a competitive disadvantageous position, while in the neighbouring country the chemical is still used. The final product appears probably in both markets.

Let us translate this to organic seeds; in the one country one can easily obtain a derogation to use standard untreated seeds, while in the other country the grower has to use organic seed. On the shelf of the supermarket both endproducts are displayed and both are labelled organics.
How serious would this look to the conscious consumer about whom I talked in the beginning?

There are a couple of important reasons to simplify and harmonize the regulations:

1. To create a level playing field for the organic growers
2. To avoid confusion and loss of interest with the conscious consumer
3. To stimulate more seedcompanies to invest in organic seedproduction
4. To lower the administrative burden
5. To avoid having to set up expensive control mechanisms

“What happens if in the immediate future we do not come to not only harmonization of regulations but also to clear and unambiguous regulations?”

Then in addition to the now already limited number of seedcompanies engaged in the production of organic seeds, no new seedcompanies will enter this niche-market. Then also the widening of the organic seed supply base and the increase in variety choice (biodiversity) for the growers will not develop further.

And for those companies that have already invested in this segment, it will then become questionable whether they can continue under these circumstances.

“Who should take action that this negative scenario does not come true?”

That is a joint task of seedindustry, organic growers, national and international organizations. Although we should continue to ask the politicians to come up with workable and controllable regulations, the main task is to have a clear commitment of all parties involved that we should work quickly towards a situation in which it is no longer required to set up burdensome and costly administrative procedures, but that it is then feasible that:

“ONE USES ORGANIC PRODUCED SEED FOR ORGANIC AGRICULTURAL & HORTICULTURAL PRODUCTION“
The harmonization process of seed rules and regulations in the Southern African Development Community (SADC)

Mohammed Tazi
AGPS, FAO
Viale delle Terme di Caracalla
00100 Rome, Italy
E-mail: Mohammed.Tazi@fao.org

Summary
Seed legislation provides the legal framework for seed development including regulations of variety release, and seed certification, processing and distribution. The main features of a seed law include the policy objectives, definitions and the institutional framework. The purpose is to facilitate and regulate seed production and trade. It also includes phytosanitary aspects. While seed laws should be flexible and accommodating, they should not too lenient to the detriment of the farmers, nor should they be too rigid so that they block seed trade in and outside the country.

It has been recognized that the harmonization of seed laws encourage local production and regional seed trade. Although harmonization may help seed production and regional trade, it also enhances competition with positive and negative effects upon poorer farmers with less information and access to a wider choice of seed varieties. The first step towards harmonization is to carry out a survey concentrating on national policies and an analysis of the existing seed rules in different countries to identify those rules, which contribute to an enabling or constraining seed trade within and across borders.

FAO in dialogue with other organisations has initiated a harmonization process for seed regulations in the SADC that consists of 14 southern African countries. This process is now at an advanced stage. The expected outcomes are: shorter official evaluation trials; common seed certification standards and accreditation of activities; regional variety release and catalogue; quarantine pest lists based on science; Plant Variety Protection legislation; and an enabling environment established for development of seed markets and enterprises.

Introduction
Seed supply systems are generally influenced by general economic policies governing trade and investment and by regulatory policies specific to the seed sector. Access to quality seed of improved varieties by the small resource poor farmers has often been limited due to national policies that may hinder the appropriate development of the seed sector.

Due to the globalisation, countries are reviewing their seed policies as part of the wider process of economic liberalization and modernization of the agricultural sector at global level. The objective is to reduce the direct involvement of government in seed production and marketing, and to create a policy framework more favourable to the development of a more diverse and active private sector, by shifting the role of the public sector to be responsible of seed quality and access and for building capacity in technical and regulatory matters.

In the past decade there has been considerable interest in regional initiatives to assist seed sector development, particularly in Africa where, many regions are prone to climatic instability and a need for more attention to seed security. It is clearly helpful if seed can be moved quickly into areas where there has been a crop failure. Unfortunately, several factors related to the regulatory frameworks developed by each country have hindered the movement of seeds and varieties across national borders, limiting the investments by local and international seed companies and reducing the growth of regional seed trade.

Harmonisation of seed policies and regulations among the countries of a region could help establish a common regional market with an effective demand large enough to induce needed investment and create the competition required to establish a viable and efficient seed industry in the region. A number of initiatives are currently underway across various sub-regions of Africa to harmonise seed policies and regulations.
Food and Agriculture Organization of the United Nations (FAO) in dialogue with other organisations has initiated a harmonization process for seed regulations in the SADC aiming to minimise the barriers affecting the flow of seed in the region.

The purpose of this paper is to highlight the process that has been established by FAO and its partners in the harmonization of seed regulations in the SADC sub-region and provide lessons learned that will be relevant to the process of harmonization of organic seed regulations.

The seed regulatory frameworks
The development of a seed industry requires consideration of appropriate regulatory frameworks. According to Tripp (2003), the seed enterprises that we are cultivating need protection from unscrupulous or incompetent companies that can discourage farmers from buying seed and throw the entire industry into disrepute. Regulation is best seen as a response to insufficient information in a market, which may limit transactions. In these cases a third party, often a government regulatory agency, helps ensure that adequate information is available to guide market transactions or to enforce standards of public safety.

Seed regulations relevant to plant breeding, variety regulation and seed regulation which may influence seed supply in developing countries have been analyzed by Tripp et al. (1997). They suggested regulatory reforms which take into account the emerging role of the private seed sector and the alternatives presented by local seed supply systems. However, no direct reference is made to the effect of regulations on seed import - export and seed security issues. Of particular relevance to seed security are: (a) seed regulations prescribing field and seed standards for certification; (b) quarantine regulation for exclusion of exotic pests; (c) variety regulation for testing and protection; and (d) seed trade regulation setting requirements or restrictions on seed import/export (Louwaars, 1995, cited by Bishaw & Turner, 1998). These regulations may restrict the range of varieties, the quality of seed available and the movement of the seed within or across national boundaries, thus limiting opportunities for emergency seed supply. It is, however, logical to check some seed quality factors like germination to avoid risks associated with poor quality seed. Therefore, these regulations should be flexible, to cope with emergency situations at national level, and they should also be harmonized at the regional level.

The Seed harmonisation Initiative in the SADC
The Southern Africa Development Community (SADC) comprises 14 member countries; Angola, Botswana, Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Together, they cover a total area of 9, 277 million ha with a population of 195 million people. The countries are bound by the Declaration and Treaty of SADC launched at a Summit in August 1992 in Windhoek, Namibia. The theme was towards economic integration to stimulate regional trade and cross border investment for the benefits of the region.

Agriculture is a key sector in the economy of SADC member states, contributing significantly to the Region’s gross domestic product. The sector is dominated by small-scale farming and currently, 70-80 percent of the Region’s population depend on agriculture for livelihood. The challenges being faced in the region today is to increase food productivity. Seed availability has been recognized as an important precursor in this regard. However, a number of factors including restrictions due to fragmented national seed regulations limit seed movement and its availability. As a result farmers generally do not have access to improved and quality seed, thus limiting their food productivity resulting in food insecurity.

Harmonization of seed regulations
The seed industries in the region differ a great deal. While some countries within the region have well developed seed industries backed with legislation consistent with current liberalization policies others are still in their development stage. Some countries have seed Acts and their attendant regulations and have capacity to enforce them, others do not have or may have them but lack the capacity to enforce it (Zulu, 2002). The system of certification also varies and this causes problem especially with the nomenclature that is being used. Some countries are members of International Seed Testing Association (Malawi, South Africa, Zimbabwe and Zambia) and others are not and acceptance of seed from one country by the other is a matter that the harmonization process is trying to solve.
Since 1987, the harmonization issues in the SADC region have been discussed in many regional meetings affirming the value for policy and regulatory reform and harmonisation. FAO in dialogue with other organisations assisted these countries in developing a mechanism for such process aiming to:

- Reducing the official Evaluation Trial Periods,
- Establishing Common Seed Certification Standards,
- Establishing Quarantine Pest Lists Based on Science,
- Developing of Plant Variety Protection,
- Agreeing on Accreditation System for Seed Certification, and
- Developing an enable environment for seed market development that includes measures to foster small-scale rural enterprises.

This on-going harmonisation process has been a long and slow process and not well understood in the initial stages. For this reason, it requires substantial time and commitment in order to have a successful result. In this sense, the setting up of the SADC Seed Security Network to lead work in the activities of harmonization of seed regulations has been a milestone. The network has already taken a central role in these activities and has drawn up a road map towards completion and implementation. The strategy for the harmonization process is based on a series of technical meetings of experts from the public, private sector, regional and international organizations to bring out modalities or mechanics for implementation at the regional level on the following subjects:

- Formulation of regionalized variety release system for SADC,
- A regional system for Collaboration in Seed Quality Assurance and Certification, and
- A regional system for Simplified Phytosanitary, Quarantine regulations for seed and Tariffs.

**Lessons learnt**

The experiences in the ongoing harmonization process of seed rules in SADC suggests that for the process to move smoothly, the following factors should be taken into account:

- An enabling environment of transparency and clear understanding by all stakeholders of the process and the benefits to the seed industry both formal and informal that can accrue from harmonization,
- Involvement of all stakeholders in the process, ensuring that private and public sector forge a balanced partnership. The staff from the regional body should be associated from the start, invited to all the meetings and kept regularly informed on the progress being made including a good representation of the private sector and SADC Secretariat,
- Harmonization of the donors’ efforts. Earlier coordination of donors is essential,
- All activities should be conducted under/or in coordination with a regional institution to ensure full participation of concerned countries. This is essential to ensure the participation of ministries of trade as well as those of agriculture. In SADC this was addressed with the setting up of the SADC Seed Security Network linked with SADC secretariat through the Directorate of Food, Agriculture, and Natural Resources,
- Sustainable funding can be a major constraint. This can result in difficulties and delays in the harmonization process. Therefore, it is important to ensure that timely funds are available to undertake the process. There were funding problems at the early stages of the process in the SADC region but these have been overcome with the support of FAO, French and Swiss Governments.

**Towards compatibility of organic seed regulatory frameworks**

Common approaches are required to facilitate the movement of organic seeds and products among countries. A pragmatic approach calls for harmonization of technical methods, procedures and compatibility of regulations including through mutual recognition.

Special attention is needed to phytosanitary requirements in line with the guidelines of the IPPC as well as variety release mechanisms, although other areas may also need specific effort, including seed certification and customs requirements.
National, regional and international associations can play an important role in facilitating developing compatibility of organic seed rules and regulations and to facilitate dialogue among stakeholders. FAO and other international organisations can play a key role in disseminating existing case studies and providing a forum to discuss these issues and promote political will, while ensuring participatory approaches. Proposals and guidance on ways of promoting such issues should be developed as stated by the IFOAM/FAO/UNCTAD\(^1\) International Task Force on harmonisation and equivalence in organic agriculture (UNCTAD, 2003), especially on:

- Opportunities for harmonising standards, regulations, and conformity assessment systems,
- Mechanisms for establishing equivalent standards, regulations, and conformity assessment systems,
- Measures to facilitate access to organic markets in developed countries, in particular by developing countries and smallholders,
- Designing, implementing, and enforcing national and regional standards, based on international standards such as the IFOAM Basic Standards,
- Promoting research into organic seeds, pest control and fertilizers adapted to local conditions,
- Capacity building in organic farming and organic seed production and information sharing on the organic standards.

**Conclusion**

Demand for certified organic food is growing throughout the world and cannot be met in most instances by current production. By promoting organic agriculture, governments can assist in the creation of specialized niche markets for biodiverse food crops and therefore contributing to the implementation of the Global Plan of Action on Plant Genetic Resources for Food and Agriculture (FAO, 1996). Such a program should include the establishment of standards and regulations and the identification in a transparent manner and the removal of systemic institutional barriers to organic agricultural production/marketing.

In the harmonisation of organic seed standards and regulations, possible implications for developing country exports should be taken into account. Examining and further exploring best practice in developing and implementing these regulations and standards may be useful. Also, due consideration must be given to how conformity can and will be assessed when promulgating new standards.

**References**


**References**

\(^1\) IFOAM: International Federation of Organic Agriculture Movements

UNCTAD: United Nations Conference on Trade and Development
From opportunity to commitment to dilemma

Henk Haitsma
Enza Zaden, Postbox 7,
1600 AA Enkhuizen, The Netherlands.
Email: h.haitsma@enzazaden.nl

The European government layed down a regulation towards the obligatory use of organically produced seeds for organic production (Council regulation (EEC) No 2092/91. Although the obligatory use of organic seeds had already been formulated before an extensively applied derogation system made it still possible to use conventional produced seeds.

The ESA (European Seed Association) did signalize that the formerly defined date of 2001 for the strictly use of organic seeds only would be postponed to 2004. A working group was formed within the vegetable section to deal with the subject. The participating integrated seed companies did consider it as a new opportunity to fulfill the developing demand of organically produced seeds according to the formulated rules. The ESA stated their commitment to the formulated principles of organic production with special regard to the organic produced seeds.

To anticipate to the newly defined date of the strict obligatory use of organically produced seeds from the first of January 2004 onwards an internal survey was set up in spring 2002 to investigate the expected availability of organic vegetable seeds of the seed companies (18) on the mentioned date. The survey was set up and carried out in close cooperation with the NAK-Tuinbouw, an independent organization in The Netherlands.

For this survey the vegetable seeds or crops were classified according to species covering the complete vegetable market. In total 77 species were classified. Further was taken into account the production circumstances (indoor vs outdoor cultivation), the suitability of growing in North/South Europe, the offer in biodiversity, the harvest season and the relevant position of the suppliers in the conventional seed market.

As it was assumed, that the market of organic vegetable seeds would be approximately between 2 and 5% of the regular seeds market, seed companies were asked to indicate if they would have more than 2 or more than 5% organic seeds available of their conventional seed market position. And if so, they were asked with how many different varieties.

The conclusions of the survey were:

1. For 57 out of 77 of the surveyed species there will be enough organic vegetable seeds (>5%) available in 2004 in sufficient choice (biodiversity).
2. For 12 species, mostly herbs, there will be organic seeds available (>2%) and for those species it will be easy to increase seed production on short term.
3. For 8 species no planned seed production is known and an exemption for further derogation may be necessary.
4. The earlier there will be clarity on the rules and regulations after 2004, the more chance there is that there will be sufficient organic seed in a wide enough choice for the growers.

The results of the survey were presented in early summer 2002 to the chairman of the appointed committee of the EC with explicitly mentioning of conclusion number 4.

The results did justify the opinion that the seedindustry was quite well prepared to the new regulation of the use of organic seed only for organic production.

At the same time the first draft working document appeared for the new EC regulation.
On the 1st of June 2002 ESA published a position paper (ESA_02.0060) on the EC’s working document (AGRI/02/61449.rev1_en) in which ESA stressed again the need for timely clear rules to continue the further preparation on (more) organic seed production. Strong question marks were mentioned with regard to the proposal of an Annex and a Database.

ESA expressed its concern that the current draft document failed to fulfil the aim of the Organic Farming Regulation which is the consistent and general use of organic seed for organic products and would like to discuss the issues with the EC committee.

Of crucial importance for the seed industry is a clear policy of the EC towards the use of organic seeds without the (former) possibility of having and getting derogations as common practice. A (almost) completed Annex with, in any case, the 57 mentioned species in the ESA survey would have been a positive signal to the seed industry to continue and to further invest in organic seed production. We were and still are convinced that a market driven demand and supply would regulate the availability of organic seeds itself in the same way as it does with conventional seeds.

Ultimately in the final commission regulation in August 2003 (AGRI/02/61449-EN-07-00:/61449-seed rev 7) an empty Annex was presented with mentioning that it would be completed at a later stage. Besides that, every memberstate was obliged to set up a national database as a mean to inform growers and other stakeholders which varieties of species were available in organic seeds. These national databases should be operational from the 1st January 2004 onwards. At this moment several from the existing EC memberstates don’t have an operational database; not to mention the 10 new EC memberstates from the 1st May. Remarkable in this aspect is that, as long as there isn’t an operational database, no derogations could be assigned.

In stead of a harmonized, common and clear EC policy towards the (further stimulation of the) use of organically produced seeds we (still) face a mainly national approach towards the item and expect that derogations will be granted again very easy.

This brings the seedcompanies to a true dilemma: What to do with their planned or already started organic seedproduction programs? Is it marketing-wise sensible to fill in (all) the databases?

Interesting, constructive and worthwhile to mention is the Dutch approach with the so-called ‘national annex’. We understood that there is some interest from neighbour counties to go for a similar situation. We will favour all the initiatives to come to a species based instead of a variety-wise derogation system. The sooner the annex will be completed the better.

The seedindustry isn’t and never will be the primary stakeholder for organically produced seeds. They, as has been stated before, want to fulfil the newly risen demand of organic seeds according to the formulated and subscribed principles of the organic seed production.

The primary interest has to come from the organic movement and then has to be laid down in clear governmental regulations.
Progress on harmonization of EU and US organic seed regulations

Frederick J. (Chip) Sundstrom
American Seed Trade Association
225 Reinekers Lane, Suite 650
Alexandria, Virginia, USA 22314-2875
Email: fjsundstrom@ucdavis.edu

I would like to divide this talk into two sections. First, I will discuss progress on harmonization of general EU and US organic regulations, and second I will discuss specific EU and US similarities and differences in organic seed regulations.

Harmonization of general EU and US organic regulations
With the passage of The Organic Foods Production Act in 1990, the Secretary of the United States Department of Agriculture (USDA) was mandated to develop a National Organic Program (NOP). To that end, the NOP Rule was officially implemented in the US in October 2002. The Rule was crafted with the intention of facilitating international trade of organic products. Within the Rule, § 205.500 addresses “Areas and duration of accreditation,” and states the following:

a. The Administrator shall accredit a qualified domestic or foreign applicant in the areas of crops, livestock, wild crops, or handling or any combination thereof to certify a domestic or foreign production or handling operation as a certified operation.
b. Accreditation shall be for a period of 5 years from the date of approval of accreditation pursuant to § 205.506.
c. In lieu of accreditation under paragraph (a) of this section, the USDA will accept a foreign certifying agent’s accreditation to certify organic production or handling operations if:
   1) The USDA determines, upon the request of a foreign government, that the standards under which the foreign government authority accredited the foreign certifying agent meet the requirements of this part; or,
   2) The foreign government authority that accredited the foreign certifying agent acted under an equivalency agreement negotiated between the United States and the foreign government.

Out of the General Agreement on Tariff and Trade (GATT) negotiations came the establishment of the World Trade Organization (WTO). The purpose of the WTO is to administer WTO trade agreements, provide a forum for trade negotiations, handle trade disputes, monitor national trade policies, provide technical assistance and training for developing countries and cooperate with other international organizations. The Agreement on Technical Barriers to Trade attempts to ensure that regulations, standards, testing and certification procedures do not create unnecessary obstacles to trade. This Agreement states that “members shall give positive consideration to accepting as equivalent technical regulations of other members, even if these regulations differ from their own, provided they are satisfied that these regulations adequately fulfill the objectives of their own regulations.”

Negotiations for reciprocal equivalence of the US NOP and EC Council Regulation (EEC) No. 2092/91 organic standards have been ongoing under the WTO for approximately 18 months. Equivalency seeks a commonality of objectives and not development of identical regulatory standards. Presently, most technical issues (acceptance of regulatory compliances) have been met (crop issues are further along than livestock issues) and it is hoped that reciprocal equivalence will be achieved in summer of 2004. Currently, the governmental organic programs of the United Kingdom, New Zealand, Denmark, and the Canadian provinces of British Columbia and Quebec are considered equivalent with the USDA NOP Rule. Mutual equivalency indicates that a foreign country’s organic product can be legally labeled and sold as organic in the States, and US organic product can be legally labeled and sold as organic in that foreign country.
Similarities and differences in organic seed regulations

Both EC and US organic standards require the use of organic seed for organic production when organic seed of an “appropriate”/“equivalent” variety, respectively, is available. Commission Regulation (EC) No. 1452/2003 establishes procedural rules and criteria related to permitted organic seed derogations in Council Regulation (EEC) No. 2092/91. As of 1 January 2004, all member states of the EU are required to maintain national databases of organic seed supplies with the following information:

1. The scientific name of the species and the variety name
2. The name and contact details of the organic seed supplier
3. The area where the seed supplier can deliver the seed to the user within a normal delivery time
4. The country or region in which the variety was tested
5. The date the organic seed will be available
6. The name of the certifier

European based organic seed suppliers are expected to immediately inform the national database managers if seed any of the registered varieties is no longer available (seed supplies have been exhausted). Seed suppliers must register varieties with the database manager in order to list their organic seed. Organic crop producers must use organic seed listed on the database unless:

1. Seed of the variety the grower desires is not listed on the database
2. The alternative registered varieties of the same species the grower desires to produce are not appropriate for the grower’s production system
3. No supplier is able to deliver the seed before the grower requires it (for sowing) when the grower has ordered with a reasonable lead time
4. The grower is conducting approved research trials

Exceptions to the use of organic seed are permitted in the EU provided that conventional seed is either untreated, or not treated with prohibited plant protection chemicals, and is produced without the use of prohibited genetically modified organisms. An Annex is also envisioned, either at the EC level or member state level that will contain a list of species that are not entitled to derogations. The Commission is currently investigating this issue with member states. Species with a sufficient number of organic varieties and sufficient organic seed supplies of those varieties will be moved to the Annex where there will be no authorization for derogations. Finally, each member state is expected to publish annually a national list of derogations to the use of organic seed.

Under the NOP Rule, USDA-accredited organic certifiers are permitted to grant exceptions/derogations for the required use of organic seed (§ 205.204 (a)2). Two phrases in the Rule have created confusion for certifiers and organic growers. The Rule states that one may use non-organic seed “when an equivalent organically produced variety is not commercially available.” There are many questions surrounding this wording such as, “how do you define “equivalent variety”, and what does “commercially available” (§205.2) truly mean?”

In the States, there presently is no national database, and as a result, certifiers and organic growers are having great difficulty identifying needed organic seed sources. Certifiers are allowing numerous exceptions to the required use of organic seed, and in some species and areas of the country, organic seed sales are beginning to languish. The American Seed Trade Association is working with the NOP staff in Washington to help develop a central clearinghouse for organic seed (possibly a national database of some sort), and help bring clarity to and uniform application of the terms “equivalent variety” and “commercially available.”
OECD schemes for the varietal certification of seed moving in international trade

Jean-Marie Debois

Head, Agricultural Codes and Schemes for International Trade
Directorate for Food, Agriculture and Fisheries, OECD
2 rue André Pascal, 75116 Paris, France
Email: jean.marie.debois@oecd.org

The views expressed in this paper do not necessarily represent those of the OECD or any of its Member countries.

Abstract
Over the last five decades, the OECD Seed Schemes have expanded from 17 to 52 participating countries covering 185 species and 33 000 varieties eligible for certification. Today, OECD certification is a globally-recognised instrument for both international and domestic trade. The Schemes have developed various tools to clarify and help resolve conventional seed trade issues and they are constantly evolving to respond to new challenges arising from plant breeding achievements and marketplace developments. This wealth of experience could make a valuable input to establishing a framework for organic seed certification, in particular in identifying and clarifying issues related to harmonisation and compliance in the face of different perceptions and requirements. A number of approaches could be envisaged: lending OECD varietal certification to recognised organic schemes; a sui generis mechanism; accreditation, or other types of co-operation. However, adding organic standards and requirements to the OECD Schemes will require a political decision. In this respect, the outlook for international trade in organic seed will be a key factor for OECD decision-makers.

Key words: OECD Seed Schemes; OECD Forests Scheme; list of varieties; accreditation.

Introduction to the OECD Seed Schemes
The OECD Schemes were established in 1958 for herbage seed among 17 countries who wanted a minimum guaranteed level of varietal identity and purity in their international seed transactions. The Schemes were established at the OECD because it could lend intergovernmental status to the rules and therefore enforce compliance. Participation in the Schemes was voluntary. Some OECD countries did not join due to a lack of interest or inability to deliver the guarantee and admission was open to non-OECD countries (in the early years, FAO was involved in non-OECD member admissions). Five decades later, a few numbers show how the Schemes have developed. Today, there are 7 schemes by groups of species, 52 participating countries (29 OECD, 23 non-OECD), 185 admitted species, and 33 000 varieties eligible for certification. The Schemes have spread throughout the world.

Output of the OECD Seed Schemes
The OECD Schemes provide a framework for official certification, implemented along the various stages of the seed multiplication process by national seed certification agencies in the participating countries, including: purity standards, time and space isolation criteria, previous cropping exclusions, a well defined and limited generation system for seed crop reproduction (pre-basic, basic and certified crop generations), maximum lot size and sampling procedures (usually with ISTA); and an official guarantee of maintainer from breeder to farmer. The Schemes have a number of listed ecotypes responding to minimum, nationally guaranteed identity and purity conditions. A major output is an extensive database on species, varieties and maintainers, which acts as a major reference source, facilitating cross-checking (Annual List of Varieties eligible for OECD Certification, www.oecd.org/seed).

However, the Schemes have a number of limitations. With the exception of basic seed for sugar beet, there are no minimum germination requirements. While all OECD certified seed lots are required to undergo an official laboratory test, with results published in an official bulletin, no standards are applied: fields, crops, and lots must be clean and healthy but OECD does not rule on this. Nor does OECD assume responsibility for variety ownership when one or more maintainers for a variety are indicated on the list. Yet coming at the end of the breeding process, OECD certification implicitly testifies to compliance with a number of prerequisites outside its jurisdiction.
OECD and organic seed certification
Diverging statements were heard from delegates at recent OECD meetings of national authorities (Bolivia, 2002 and Paris, 2003) where the issue was raised:

The technical viewpoint: “Organic certification and varietal certification of seed are entirely independent issues. If OECD deals with organic certification, it will be supplementary to its present work. Specialisation would ensure expertise and transparency.”

The economic viewpoint: “There is a rapidly developing international market for organic seed. It would help the process if OECD brought its expertise to this new field. OECD being as a whole for market access should get involved, all the more that a lot of experience has been achieved on the interplay between international seed trade and regulations for all these years.”

The management viewpoint: “Seed regulations become more and more complex. There is an urgent need to accommodate new concerns in a more rational way (whose endpoint is the much vaunted “one stop shop” principle). There are so many requirements to comply with or messages to deliver when supplying the goods. Just to name a few: organic, varietal, origin, land race, quality-declared, varietal association, mixtures, wild populations, traditional knowledge, freedom from GMOs, invasive species, LMO, inert matter, all pertaining one way or another to seed and certification. Any effort to better co-ordinate seed documentation would be welcome. Developing harmonisation processes between varietal and organic certification are a case in point.”

Criteria for OECD involvement in organic certification
The issues at stake are:

(1) The choice of criteria against which organic, in addition to varietal, certification can be granted in a sufficiently harmonized way across species and countries?

(2) Given that varietal identity, purity, and safety of seed remain essential elements, what would be the implications of organic certification? We should be cautious about relaxing identity, purity and safety requirements at the international level if our purpose is trade development because assurance of basic product characteristics is fundamental to building mutual confidence where supply and demand are remote from one another.

What can OECD offer?
First and Foremost, varietal guarantee, with official certification of identity, denomination, purity and quality of seed originating from all participating countries. The admission procedures to the OECD Seed Schemes are both an incentive to develop quality and truth in production for applicants, as well as a screening device for participants.

The List of Varieties could include a subsidiary list or attach organic symbols to identify varieties approved for organic seed production, i.e., officially approved or designated by the submitting participating country so as to grant eligibility both for varietal and organic definition. Eligibility is based on common rules or mutual recognition of different rules possibly backed by an assessment of conformity. To borrow from the IFOAM Standard, these varieties would be recognized as “varieties known to be suited to organic cultivation”.

Multiplication Agreements. OECD has a long experience of cooperation between national designated authorities. This experience would be a major benefit for importing and exporting countries in addressing organic aspects. Multiplication agreements supervised by OECD participating countries are ultimately inter-governmental.

Membership of northern and southern hemisphere trade-oriented countries with vastly different climatic conditions, where matching production conditions can easily be found. The OECD guarantee and simplified procedures could encourage trade in organically produced seed between North and South and East and West. Granting observer status to IFOAM at OECD meetings would be the logical consequence of fruitful co-operation.
Accreditation
In its capacity as an intergovernmental body, the OECD is in a position to require and authorise a variety of international or national accreditation schemes (the OECD Convention established in 1960 authorises national implementation). In this way, where considered necessary or valuable, the OECD has authorised experiments in derogation to the rules, or the licensing of official tasks to private bodies. Memorandums of understanding could be envisaged between IFOAM and OECD under which each party would retain full control of the choice of items subject to cooperation. This may help solve the institutional capacity building problem of some developing countries.

Guidelines
OECD has proven competence in developing guidelines for inspection, accreditation and control plot management. The OECD national designated authorities are experts in seed production and control, technically and institutionally.

The tools described above are currently used to clarify and help solve conventional seed trade issues between participating countries. How useful would they be in addressing issues related to organic seed certification? How can a clear distinction be drawn between varietal and organic certification aspects at the OECD? Given the complexity of current issues of seed and other derogation problems driven by organic seed scarcities and price differentials, responses are not easy. The considerable body of work already done under the aegis of IFOAM provides the required foundation for a preliminary assessment of the need and feasibility of harmonisation procedures, before a common approach to the listing of varieties, guidelines, country participation, accreditation, etc., can be agreed.

How can OECD contribute to solving the organic seed derogation issue?

Scarcity of organic seed
In principle OECD listing implies availability of seed. However, information on availability is not provided. In order to determine the availability of organic seed, coordination between countries would certainly be useful. Yet, the starting point would be consistency in scarcity criteria across countries. Should market information be the sole indicator (quantity and/or price variations)? Or should marketplace indicators be determined and endorsed by national authorities? If so, market access and preference issues enter the arena. It would be useful to address these multilaterally. The data issue should not be underestimated.

Input tolerance
Another derogation issue concerns the inputs allowed to enter the production process. In this case, a typology of organic production would be useful. OECD discussions of certification matters outside of the Seed Schemes have addressed organic certification in the same vein as issues related to landraces, traditional varieties, identity preservation, local cultivars, etc., all being understood as additional to the varietal identity and purity issues. Biodiversity and GMOs also give rise to concern because nature conservation is a basic principle of organic certification. Organic certification primarily implies a drastic reduction in the use of purchased inputs, i.e., a “without” connotation in relation to pesticides and fertilizers. The main difficulty is to distinguish between dual varieties which can be grown “with” or “without”, from those where the conventional input package is required and which are therefore not suited for organic production.

Certification of origin
Landraces and traditional varieties are site-specific. Organic certification could be associated with a geographical distinction, i.e., linked to the origin and delimitation of the seed production area. The OECD Schemes concept of local cultivar and ecotype would be useful in linking organic seed with location-bound DUS criteria.

Diversity and preservation
Biodiversity refers to maintaining as many species as possible in a given environment. It favors mixtures and natural pest control. OECD work on varietal associations of grass seed mixtures could be examined with a view to identifying similarities and differences between varietal and organic certification. Previous cropping requirements would be particularly important (fallows, diversity of previously grown species, association of
harvested species, smaller fields, lower purity requirements, etc.). This might be called “diversity preserving” certification, e.g., the co-existence of soil, climate, pests and diseases in a balanced eco-system consisting of a wide range of crops and varieties. Current OECD certification procedures and rules would need to be adapted.

**GM varieties and organic production**

GMO presence (purposeful or adventitious) has become the overriding ‘not organic’ criterion. This concept is misleading because conventional agriculture is also non-GMO. But is the criterion necessary? To the extent that the natural resistance of GM-exposed organic seed is weaker than chemical ones, yes it is. But not in absolute terms because certification schemes for conventional seed also require isolation either by distance or barrier. Organic production only requires careful separation rather than blanket exclusion of GM seed production. The OECD Schemes currently have no provision for adventitious GMOs or GM varieties. That is not to say that the issue is ignored. Ultimately, ongoing discussions may result in the partial inclusion of organic certification within the framework of “co-existence”.

**Organic seed production and the development of subsistence agriculture**

Subsistence farmers produce their own seed without any significant chemical crop fertilization or protection. Subsistence agriculture uses “traditional” or “farmer” varieties quite often in an environmentally diverse environment. It would seem that the way forward to start market production for this type of agriculture lies in organic food. In this case, seed input would be undisputedly organic. Such an approach is deceptively simple. Moving from subsistence to market production entails introducing careful input and produce identification and control at the technical and legal level, and traceable farm practices. Provided that seed identity can be ascertained through some kind of certifying mechanism, would organic seed production be in a position to enter domestic or international markets? A good indicator of varietal certification in the OECD sense would be helpful in establishing stable and growing market niches.

**Conclusion**

In conclusion, derogation or differentiation issues can be adequately identified and are urgent enough to warrant OECD participation in the organic seed debate, to which it can make a valuable contribution. The decision is up to the governments of participating countries which must take the views of all the stakeholders into account. In this respect, the international trade outlook for organic seed should be one of the key factors for initiating the debate at OECD. This would have the advantage of helping to provide the market with more diversified seed, better identified, purer and capable of responding to a wide range of demand. A clear distinction between distinctness and adaptability, uniformity and homogeneity, stability and robustness would permit varietal and organic certification to co-exist.

**References**


European Commission (1991 and various years) *Regulation 2092/91/EC, Brussels*

IFOAM (2002) *Basic Standard*, 2nd draft revision, IFOAM, Rome

ISTA (2004), *Seed Testing International*, ISTA, Zurich


OECD Schemes for the Varietal Certification of Seed Moving in International Trade, www.oecd.org/seed

OECD Scheme for the Control of Forest Reproductive Material, www.oecd.org/forest

*Seed World* (various issues), www.seedworld.com
The economic challenge for organic seed

Dick van der Zeijden
Bejo Zaden B.V., P.O. Box 50, 1749 ZH Warmenhuizen, The Netherlands
E-mail: d.vanderzeijden@bejo.nl

Statement
Any important organic seed programme for biennial crops, such as ours, will fail if the organic chain is not soon closed, by law and self regulation. Therefore the movement should concentrate on this problem.

Who is Bejo?
Bejo is a vegetable seed company, involved with breeding, production, processing, enhancement and sales. The company are specialists in hybridisation of biennial outdoor vegetable species and is market leader in Europe with carrot, onion and brassicas. In addition the company is active in 30 other species. Bejo was formed in 1978 by a merger of the two family companies Jacob Jong (1899) and Beemsterboer (1912). Nowadays Bejo has 18 companies world wide and is still family owned. To predict market requirements in time, Bejo attach much value to direct contact with growers and other partners in the marketplace.

Bejo Organic b.v.
The company has always had an impressive market share in the organic sector on the basis of non-chemically treated, conventionally produced seed. Anticipating changes in EU regulations by 2004, Bejo started their trial productions of organic seed in 1996. During the following years the organisation developed a specialised business unit purely involved in organics.

The Bejo Organic b.v. controls and organises the research, production, processing and sales of organic seed and uses skills and facilities of the Bejo company in a matrix structure. Since 2003 a growing range of organically produced varieties has been and is made available.

Boundary conditions for a successful organic seed programme

1) Legislation
2) Self regulation
3) Market size
4) Acceptance of increased price for biennials
5) IFOAM breeding context

1) Legislation

(EU) No 1452/2003 (add. To Council regulation (EU) No 2092/91)
The ‘new’ EU legislation is not very stimulating for the sales of organic vegetable seeds. The EU commission avoided precarious decisions and left the implementation of the new law up to the individual member states. A lot of things are still not clear:
- criteria for filling the Annex
- what’s an appropriate variety
- who will decide

The EU Annex is still empty in 2004. In Europe only the Netherlands filled a national Annex.

Another point is that the final date for full obligation of the use of organic seed in all crops (Annex) has disappeared.

As Bejo we support the Dutch initiative for a national Annex, but differences between EU member states should be equalised as soon as possible to provide equal opportunity. We noted with interest a proposal for a step by step approach to use an obligated percentage of organic seed per crop.

Outside the EU there is less obligation, therefore it’s still easy to avoid the use of organic seed.

Bejo’s dilemmas:
- Because of price difference for biennials, clear legislation is necessary
- Should we be on databases which can be used to avoid organic seed
- Big growers avoid organic seed if we offer market leading varieties
- Does the organic market really wants to use organic seed
- Impact and speed of implementation of legislation is totally unclear. We have already planned seed production for sales in 2007!

2) **Self regulation?**

At the moment the larger organic growers hardly use organic vegetable seed. The legislation doesn’t stimulate the use of organic seed. Therefore the organic movement should remind organic growers of the importance of using organic vegetable seed.

3) **Market size**

*Table 1: Market size illustration*

<table>
<thead>
<tr>
<th>Crop</th>
<th>Hectares EU</th>
<th>Market segments</th>
<th>Ha. per segment</th>
<th>Kg seed per segment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Organic 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brassica’s *</td>
<td>100.000</td>
<td>5.000</td>
<td>45</td>
<td>112</td>
</tr>
<tr>
<td>Carrot</td>
<td>75.000</td>
<td>3.750</td>
<td>30</td>
<td>120</td>
</tr>
<tr>
<td>Onion</td>
<td>100.000</td>
<td>5.000</td>
<td>35</td>
<td>140</td>
</tr>
</tbody>
</table>

* Exc. cauliflower and broccoli  Source ‘Total figures: FAO

A segment could be for instance, fresh early red cabbage or late white industry cabbage.

At first glance it seems impossible to run a profitable organic seed program. How then can a company develop and maintain 700 varieties for 97% of the market (conventional) of which approximately 450 are delivered inside the EU and yet run an organic seed program of over a hundred varieties for the remaining 3% (organic) market place?

1) **Acceptance of increased price for biennials**

**Price consequences**

Organically produced seed for biennial vegetable crops will cost more or less twice as much as conventionally produced seed. When we look at a organic carrot production the increased seed price will lead to an cost price increase per Kg. product of approximately 1,3 Euro cent, for onions it could mean a n increase per Kg. of 2.5 Euro cent.

**Steps in breeding and seed production of a hybrid onion variety**

1994: Breeding

2004: Basic seed production (inbred lines)

2005: Onion bulb production, selection and treatment (NL)

2006: Seed production, harvest and cleaning (Fr)

2007: Seed processing (NL)

2007/8: Seed treatment

2007/8: Seed quality control

2007/8: Packaging

2007/8: Sales and distribution

**Example cost increase (onion seeds)**

To explain the price increase of organically produced seeds we show you some tables.

We compare the production of 1000 kg conventional onion seed with the production of 1000 kg organic onion seed .

*Table 2: Onion seed production*

<table>
<thead>
<tr>
<th>Cultivation of hybrid onion seeds</th>
<th>Conventionally grown</th>
<th>Organically grown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net seed to produce (kg)</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Gross seed weight kg/ha</td>
<td>420</td>
<td>200</td>
</tr>
<tr>
<td>Hectares of seed production</td>
<td>2.4 ha</td>
<td>5 ha</td>
</tr>
<tr>
<td>Amount of bulbs per ha</td>
<td>8 ton</td>
<td>5.6 ton</td>
</tr>
<tr>
<td>Required amount of onion bulbs</td>
<td>19 ton</td>
<td>28 ton</td>
</tr>
<tr>
<td>(2nd year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onions bulb production (1st year)</td>
<td>0.44 ha</td>
<td>0.9 ha</td>
</tr>
<tr>
<td>Basic seed to produce onion bulbs</td>
<td>2.2 kg</td>
<td>4.5 kg</td>
</tr>
</tbody>
</table>
We produce less bulbs/ha and those bulbs need extra treatment before planting. When organically grown the production of seeds/ha appears to be more than 50% lower. The yield (seeds) per plant is lower, because we start with smaller sized onions. More hectares are used for organic seed production and we pay a higher price per hectare. Twice as much expensive basic seed is used to produce enough onion bulbs.

Table 3: Cost index hybrid onion seeds

<table>
<thead>
<tr>
<th>Cultivation of organic hybrid onion seeds</th>
<th>Organically grown Cost index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total up to and including seed production</td>
<td>3.05</td>
</tr>
<tr>
<td>Processing: cleaning, waste, NCT treatment, Quality control, packaging and logistics</td>
<td>0.15</td>
</tr>
<tr>
<td>Small scale effects and accreditation</td>
<td>3.20</td>
</tr>
<tr>
<td>Sales costs</td>
<td>0.15</td>
</tr>
<tr>
<td>Total</td>
<td>3.45</td>
</tr>
</tbody>
</table>

Most important cost increasing factors for the production of organic onion seed:
- We need more basic seed (200%)
- Higher price per hectare in the first year (+ 30%)
- More hectares needed (200%)
- Higher price per hectare in the second year (+ 30%)
- Lower seed production / more hectares needed (200%)
- Costs of processing
- Small scale effects

Some more cost index figures: carrot 2.3, brassica’s 2.3, cauliflower 1.7.

1) IFOAM breeding context

IFOAM Draft Plant Breeding
There may be a difference of opinion between the growers of organic produce and the regulators. Whilst the IFOAM is already looking ahead to topics such as fertile hybrids and organic varieties, many organic farmers may not yet be committed to the use of organic seed. Future implementation of IFOAM discussions will be very difficult and will lead to higher prices. This will make the economic base of an organic seed program even more uncertain.

Summary
1) Legislation:
   The legislation doesn’t stimulate organic seed production.
2) Self regulation:
   Growers hardly use organic vegetable seed.
3) Market size:
   Organic market should grow to 10%
4) Acceptance:
   Price of organic seed of biennial crops will be much higher.
5) IFOAM:
   Introduction of “organic varieties” leads to another price increase.
6) Obligation:
   EU draft doesn’t stimulate organic vegetable seed production.
   Growers hardly use organic seed.

Conclusion
Organic seed programmes such as ours will only have a future if the organic chain is closed by law and self regulation. Commitment of all parties is needed. If there will be no self regulation it will be difficult to maintain an expensive organic seed programme such as ours.
Challenges for developing countries’ access to equivalency with the main organic exports markets

Felicia Echeverria Hermoso
Manager of National Organic Agriculture Programme
Dirección de Protección Fitosanitaria
Ministerio de Agricultura y Ganadería
Barreal de Heredia, Costa Rica
Email: fecheverria@protecnets.go.cr

Abstract
Costa Rica is the second Latin American country to be included in the EU “third country list” and has made important advancements towards obtaining equivalency recognition from USA and Japan. Nevertheless, problems caused by the world’s lack of harmonization on private standards and official regulations still have strong negative impacts on the development of organic production and marketing for small farmers in our country. Some of these problems are mentioned in this article in an effort to put the discussions on possible compliance with the new EU organic seed regulation into this context. Since this regulation is very new and unknown for most people outside the EU, at present, there seem to be more questions than actual opinions from us on its implementation. These questions are exposed here in hope that the answers to them will be found in the discussions and, especially, that these answers will be reassuring that small organic farmers in developing countries will not lose their right to continue to rescue, reproduce, keep, exchange and use their own organic seed.

Background: Costa Rican context with regards to organic production and certification
Costa Rica, with a territory of 51.100 Km2 and a population of nearly 4 million people, dedicates 25.6% of its land to environmentally protected areas and 56% (2,845,000 has.) to farming. Of the land used in farming, 434,524 has. (15%) is used for crops and the rest is for livestock production.

With regards to organic agriculture, in 2003 there were 9,100 has. certified as organic at the registry of the Organic Agriculture Accreditation and Registry Office (GTRAO) of the Ministry of Agriculture and Livestock. This area represented 2.1% of total cropland for that year. The main organic products currently being exported include: banana (smashed for baby food and dried), cacao, coffee, blackberries, row sugar, mango, pineapple (fresh and dried), orange juice and concentrate, and passion fruit. For the national markets, in addition to these, it is possible to find a wide variety of products, for example: citruses, green vegetables, palm heart, pejibaye, plantain, potatoes, roots and tubers, spices and medicinal plants, rice, corn, cashew nuts, sweet pepper, tomato, onion, several tropical fruits, dairy products, chicken and others.

The organic movement at the national level, now called MAOCO ( Movimiento de Agricultura Orgánica Costarricense), has been growing for the past 10 to 15 years. As in many other countries around the world, the small farmers and NGOs were the first actors to get involved, supported by some people in the academic sector, and a few commercial intermediaries (mainly for the export markets). The local market is still very small, although it has slowly begun to grow during the past four or five years. Also, during this period of time, there has been a more active involvement from the governmental sector, as well as more openness to develop alliances among the different sectors involved, which has brought about a considerably stronger organic movement, as well as the development of a long-term action plan (the National Strategy for Organic Agriculture Promotion).

At the governmental level, there are currently two offices in charge of organic agriculture related issues. These are the National Organic Agriculture Programme (PNAO) and the GTARAO. Both these offices are under the Direction of Phytosanitary Protection in the Ministry of Agriculture and Livestock (MAG), although they both have quite different mandates.

PNAO’s main objective is to promote production, transformation, international trade and local marketing of organic products. It helps to identify national organic farmers’ needs and coordinates with the public and private institutions, as well as with the financial and technical cooperation organizations in charge of supporting agriculture, to see that they meet these needs in the same way as they would do for the conventional farmers.
On the other side, the national organic guarantee system is managed by GTARAO, which does this through:

1. Accrediting the certification bodies; 2. Keeping a registry of certification bodies, inspectors, certified farmers, processor and others; and 3. Supervising and auditing the whole system. To do this, GTARAO bases its work on the national legislation included in the following laws and regulations: Environmental Law No. 7554 of 1995; Phytosanitary Protection Law No. 7664 of 1997 and its Regulation; and the Organic Agriculture Regulation Decree No. 29782 of 2001/44

This Decree modifies No. 25834 of 1997 and 29067 of 2000.

Costa Rica was included in the “third country list” (section 1, article 11 of the CEE Regulation No. 2092/91) of the European Union (EU) on March 2003, which means that the EU accepts Costa Rican regulations and conformity assessment system as equivalent. As well, Costa Rica is on Switzerland’s third country list and the processes for equivalency recognition from USA and Japan are underway.

Currently, there are two national certification agencies (EcoLogica and AIMCOPPOP) and four international ones (BCS Oko Garantie, OCIA, Ecocert and SKAL) accredited by GTARAO. A national seal to back up the official certification system has been developed by the Ministry of Agriculture and Livestock and it may be used, at no charge, by those who are certified by any of the accredited bodies.

**Have the efforts to be on the “third country list” really paid off?**

The efforts to be on the “third country list” have meant much hard work, investments and capacity building activities for both the governmental officials in charge and the local certification bodies. Other sectors of the organic movement were also involved in the process: the regulations were reviewed by a national committee which included participants of all sectors (farmers, NGOs, academic sector, etc). The challenge then was to adapt the national regulation that already existed to suit the local conditions better and still comply with requirements from the EU. The discussions were intense and, in order to be “eligible” for the third country list, of course, some compromises had to be made in detriment of local farmers needs. To mention only one example, an issue that has become a strong limitation on local organic production and marketing, is the fact that organic certification has to be mandatory, even if the farmers are very small and sell at markets close to their farm were most people know them. (Certification is costly and the local consumers are not usually prepared to recognize an over price.)

When you ask a local certification body (CB) if the fact that Costa Rican guarantee system is now recognized as equivalent by the EU has brought about any advantages, the answer is yes. Mainly, the process for importing organic products from our country to the EU is less complicated and therefore importers are more interested. Also, some producers, who participated at BioFach 2003 and 2004, claim they got more attention from brokers because there is more confidence in our organic products now.

Nevertheless, when it comes down to farm and marketing reality, the fact is that our local certification bodies are not recognized in the EU markets and farmers are still asked to certify under different European certification bodies, depending on the client’s preferences. This, of course, continues to raise certification costs (sometimes as much as over 100% higher) for local farmers. This problem does not originate in the public sector but, rather, it is the result of alliances between brokers or importers and private European CB. It is important to mention that, even when there could be equivalency agreements between governments of all countries with fully implemented legislation, as long as there is not an effort to back up certification bodies from developing countries and to make them well know in the importing countries, this situation, quite unfair for organic farmers in developing countries, will continue to exist.

When it comes to the lack of harmonization, is “multiple certification” the main problem for organic agriculture in developing countries?

As I have mentioned before in this short presentation, the role of PNAO is not to deal directly with the national organic guarantee system, but rather with supporting and promoting organic agriculture development in our country. Therefore, our approach towards certification issues often has more to do with how these issues affect (negatively or positively) organic production and marketing, than with the activities involved in its implementation.
From this perspective and considering the reality that the majority of organic farmers in our country have to face, the answer to the previous question would necessarily have to be no. Even though, Costa Rican government and the organic movement have made great advancements towards the development of conditions for equivalency agreements that could facilitate better access to international markets, our farmers still “suffer” important limitations to access both the international and the national markets due to the lack of harmonization on legislation, accreditation and conformity assessment issues.

With regards to the international market, in addition to the “multiple certification” problem already mentioned, the lack of harmonization means also that farmers, wanting to be “potentially” able to export to several countries with different regulations have to comply, of course, with all aspects of those regulations (which may even be contradictory) at the same time. Let see an example: concerning manure utilization, the EU regulation indicates limits to the amount of nitrogen per year/hectare, forbids factory farming origin of manure and says that it should be composted but does not restrict in any way the composting method; while the USA regulation does not forbid factory farming origin of nitrogen use, but it gives very strict instructions on the composting method to be used.

The result is, as one can imagine, that our farmers end up having to comply with the most restrictive aspects of both regulations. This is only considering what happens with governmental regulations but, if then it so happens that the buyer in one of the importing countries asks for an specific CB, new complications may come along as private CB may have their own standards with regards to the same issue, restricting more and more the technologies that a farmer can use.

For most small farmers in our country, other negative aspects associated with the organic guarantee system as it operates at present are: high costs, which are both direct and indirect (inspection costs, farmers training, time dedicated to record keeping, administrative costs of the internal control system – ICS- for groups); discouragement because of “too much complication and not enough retribution”, specially during the transition period (complicated regulations to learn and follow, too much detail in record keeping, long transition period with no price premium); and lack of appropriate technical assistance (CB tell them what they are not allowed to do but they cannot tell them how to fix it, while most local technicians find it hard to follow up on the immense variety of regulations and standards).

Very often, we receive calls or hear complaints from groups of farmers who say they see no rationality in all this. It is very common that farmers see the certification system as an imposed burden they find unfair and disproportionate to their capacities. Unfortunately, many are just not willing to go into so much complication and abandon organic production when it comes to the point where they would have to certify in order to be in the market, or they may quit even some time after the first certification.

When speaking about the local or national markets, the problem is even more serious. For individual farmers or very small groups, certification costs are just not worth it, since local consumers are usually not in the position to pay an overprice. On the other hand, farmers who are not certified cannot advertise their products as organic and therefore, production and market growth are limited. Currently, a working group of NGOs, farmers and others from MAOCO are trying to find alternative ways of certification for the local market, but the task has been quite hard since, the fact that our legislation was made to comply with EU requirements does not give too much room for other alternatives.

Is the new EU organic seed Regulation (1452/2003) going to become an extra “burden” on developing countries organic agriculture development?

The answer to this question is probably not clear for most people attending this conference and it is definitely an important issue for small farmers in developing countries, although most of them do not even know of the existence of this new regulation yet. The issue of organic seed availability is becoming more and more a crucial one for small organic farmers groups in developing countries, although under a totally different approach than what is usually discussed in developed countries.

Mainly, small organic farmers realize that ecological and economic sustainability of their organic farming systems is very much based on the possibility of using local and farm resources to produce their own
inputs, including seed. Also, the better performance on organic production of local genetic materials (already adapted to local conditions and kept by many generations), as well as the fear of massive GM seed production in the future (which would make it more difficult and expensive to find organic or non-GM seeds), are strong reasons for farmers motivation to develop local organic seed reproduction and exchange networks.

Therefore, in the specific case of Costa Rica, if the case was that we had to comply with this new EU Regulations to maintain equivalency recognition, other important questions that need to be answered would be: Are small farmers going to be able to reproduce and exchange organic seeds for their commercial organic production? What if seeds are sold/exchanged among groups of organic farmers from different regions in the country? Will they be allowed to do this? Do these seeds need to be registered, in order to be recognized as organic, for farmers who want to be certified? Do the seeds need to be certified too? If so, would it be by the National Seed Office5 or by an organic CB? How much is this going to add to the already high direct and indirect costs of organic production certification?

Further, even when not speaking about seed reproduction and exchange networks, and considering that our country imports most of the seeds used for farming, will we then be indirectly forced to import organic seeds? Will our farmers be obligated to used expensive imported organic seeds if available in our market? How could we be sure the varieties that will be imported are suited for our climate conditions, when it is known that organic seed varieties currently available are rather few and expensive? Will we be able to find financial cooperation to set up the needed research and validation projects? Will we have to set up a computerized database, or will this regulation work only for countries that are seed producers?

Hopefully, before this new regulation is fully implemented, there should be spaces to discuss the answers to these questions, always bearing in mind that the right of small farmers to rescue, keep, reproduce, exchange and use their own organic seed should not be limited or made difficult in any way. Not paying attention to the preservation of this right would be very contradictory to the values of life and biodiversity celebration that have always been fostered by the organic community worldwide.

Final remarks
The lack of harmonization in private standards and official regulations for organic certification is a problem that needs urgent solution. If no changes in the current situation occur in the near future, more and more small organic farmers from developing countries (the thin part of the rope) may drop out of certified organic markets as the price premium is not enough to compensate the difficulties faced to comply. Of course, this could stop others from converting to organic, at least when a certified organic market is the main motivation. With this situation, obviously, everybody loses: farmers, consumers, brokers, retailers and CB.

Therefore, while the complicated situation regarding harmonization opportunities is not solved (and it will surely take quite some time), much care should be taken to make sure that any new regulations implemented at the main organic markets countries do not represent a new “burden” for small farmers in developing countries.

Furthermore, in the case of organic seeds availability, specifically, what most small organic farmers from developing countries claim they need is support for the development and strengthening of local organic seed rescue, reproduction, exchange and use networks, and not so much the existence of certified organic seeds at the local market.

References
1 3906.700 according to the last national survey on 2001
2 Gerencia Técnica de Acreditación y Registro de Agricultura Orgánica del Ministerio de Agricultura y Ganadería
3 Programa Nacional de Agricultura Orgánica del Ministerio de Agricultura y Ganadería
4 This Decree modifies No. 25834 of 1997 and 29067 of 2000.
5 Oficina Nacional de Semillas.
Organic seed systems in response to agro-chemical deficit in Cuba

Humberto Rios Labrada
National Institute of Agriculture Sciences
Ave. 27, #4223 apto 3A, entre 42 y 44
Playa, Cuidad Habana, Cuba
Email: burumbun@yahoo.com

Abstract
Nowadays one of the most discussed themes in agriculture is the relationship between agrobiodiversity and crop yield, frequently conventional agriculture increase yield by agrochemical inputs, however it seems to be possible to increase yield widening genetic diversity in the farm. The formal agricultural research and development sector in Cuba has been considerably curtailed by budget cuts (American dollars). One of the consequences of the economic crisis that Cuba is experiencing has been the rapid deterioration of the conventional centralized seed production improvement and distribution system. At the same time, also as another consequence of the crisis, agricultural production in the country was moving away from an export-oriented, monoculture based and high- input dependent system, to a more diversified, low- input and local-market oriented production. Together, these dramatic changes are opening up the space for paying attention to participative seed improvement and distribution practices under organic and low input agriculture. Participatory Plant Breeding in Cuba have been filling gaps in decision making and knowledge diffusion (moving to farmers), there are some advances on farmers empowering as: a wider varieties access, strong participation in decision making at community level, less external input dependency, higher yield, increasing knowledge exchange and agrobiodiversity in different crops. There are interesting results on the economic benefits in farmers selecting varieties from a wide genetic diversity on farms.

General adaptation associated with “scientific progress”.
In order to accomplish food security statement, wide geographical adaptation was encouraged by policy makers, with most Cuban governmental organizations providing incentives to scientists involved in releasing a variety for use over large area (Rios, 1999, 2002). “The sciences need to be located all over the place”

When a research institute had a relevant variety with general adaptation, they send this to the Scientific Forum (Consejo Cientifico) at the national level. This Forum checked its scientific validity and, if it is approved, they sent it to an Expert Group, consisting of researchers, teachers and production directors. If this Group approves the result it is then sent to the Vice-Minister of Diverse Crops (Vice-Ministro Cultivos Varios). This Minister will send the results to the provincial delegations, who implement them into their production plans, and this means that producers have to adopt them as an order. This procedure takes a top-down approach without consulting the producers. Some researchers do visit farms, but still the research areas and problems come from the decisions of the researchers. Further, the Scientific Forum only evaluates the scientific content and not its applicability, and therefore they may reject good techniques and accept those that are unsuitable for producers (Trinks and Miedema, 1999:116).

At the beginning of the 1990’s, yields decreased exponentially for most of the major crops in Cuba. This was caused by the collapse of the major agrochemical input providers: the Socialist countries, which were supplying more than 75% of the agrochemicals used by Cuba (Rosset and Bourque, 2002). Once the Socialist Bloc collapsed, a strong budget limitation curtailed the official research network in Cuba. In the same way, the centralised national seed system suffered from serious limitations with respect to input supply. Partly because of this, seed production passed from large seed state enterprises to cooperative or private seed growers and seed production under external low input agriculture took place all over the island.

Diversity and Crops Yield. The Farmer’s experimentation role
In order to face the limitations of conventional seed systems in Cuba, Participatory Plant Breeding (PPB) have been making use of the space opened up by the economic crisis. Through out diversity seed fair, hundreds of farmers accessed to a wide genetic diversity in tomatoes, beans, maize, wheat, cowpea, sorghum, cassava, plantain, bananas, potatoes, soybeans, and rice. Varieties from formal and informal seed systems are sown under semi-organic or organic conditions of rural and urban area. Farmers, plant breeders, extension agents and police makers had the possibility to see and choose several options at the local level.
Actually diversity seed fairs supported by farmers’ experimentation allowed plant breeders and other stakeholders a better understanding of farmers’ conditions and demand under the new circumstances of Cuba. Interestingly, farmers are rediscovering culinary properties and desirable bean shape and colour. So a complementary decentralised seed management system filled the gaps part of the project participant seed demand. Seed diversity facilitated by PPB project was given space for distribution and for farmers’ validation of varieties from formal and informal seed sectors.

Once farmers selected in the diversity seed fair, they carried out field trials on their own farms. Farmers in collaboration with scientists designed the experiments. Scientists explained experimental design principles to the farmers who then made their own design according to particular farm characteristics.

Organic agriculture is closely articulate with different cropping systems. Usually technology change abruptly in few meters, then genotype- environment- technology interaction become significantly relevant (Ortiz, et al., 2004) that is way farmers could be able to select different varieties. Through out experimentation they were capable to know which varieties are fitting better under its own context, in the same way the crops yield increase exponentially by optimising specific adaptation. In practice farmers in front of a wide diversity showed skills in obtaining yield advance (Table I)

Table I. Estimation of farmers genetic advance obtained by selection under organic conditions. (Ríos et al., 2004)

<table>
<thead>
<tr>
<th></th>
<th>Farmers participating in selection</th>
<th>Number of farmers with positive selection advance</th>
<th>Number of farmers with negative selection advance</th>
<th>Effectiveness*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (within 54 varieties)</td>
<td>84</td>
<td>76</td>
<td>8</td>
<td>90.5</td>
</tr>
<tr>
<td>Bean (within 54 varieties)</td>
<td>68</td>
<td>59</td>
<td>86.7</td>
<td></td>
</tr>
<tr>
<td>Rice (within 80 varieties)</td>
<td>41</td>
<td>32</td>
<td>78</td>
<td></td>
</tr>
</tbody>
</table>

86 percent of farmers with genetic advance positive.

At the same time farmers accessing to diversity and experimenting with increased exponentially diversity in terms of number of varieties (Table II) and new crops (6 new crops in 4 years) in participant farming systems. Actually farmers applied experimentation method to different issues on farm. Farmers’ field school for implementing diversity fair, experimental design, discussing results and generating strategy for minimizing agrochemical have been successful approach in Cuba.

Table II. Effects of beans participatory selection on variety number under organic conditions. (Modified from Ríos, et al., 2003)

<table>
<thead>
<tr>
<th>Location</th>
<th>Bean area production unit in the main season (average in 5 farms)</th>
<th>Number of varieties before intervention in 10 participant farmers</th>
<th>Number of varieties after 6 selection cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>La Palma. Pinar del Río Province. (nine farms average)</td>
<td>Less than 0.6 ha</td>
<td>5-6</td>
<td>70</td>
</tr>
<tr>
<td>La Havana. Cooperative Gilberto León</td>
<td>More than 13 ha</td>
<td>2-3</td>
<td>8-9</td>
</tr>
</tbody>
</table>
Refocusing plant breeding to strengthen local seed system. Organic production is not merely concerned with a product (seeds), but also with the whole system used to produce and deliver the product to the ultimate consumer (Scialabba and Hattman, 2002). Actually while conventional plant breeding in the public sector is splitting out roles and specialising functions, local seeds systems collaborating with professional plant breeders are concentrating roles.

For instance, commonly farmers participating in PPB are able to test wide genetic diversity, to build up a new variety, to multiply seeds on farm and disseminate genetic materials at local level. In practice the selection under target environment is more profitable (Table III), due to optimisation of specific adaptation. In the same way that crops breeding process is part of the farming systems breeding cost seems to be reduced.

Table III. Economic impact of pumpkin breeding under organic conditions. (Modified from Ríos, et al., 2002)

<table>
<thead>
<tr>
<th>Indicators (calculated as averages)</th>
<th>Varieties bred under high input conditions sown in organic conditions</th>
<th>Varieties bred and sown under organic conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ha$^{-1}$ under low input condition (Cuban pesos)</td>
<td>702.3</td>
<td>708.3</td>
</tr>
<tr>
<td>Fruit yield (tons ha$^{-1}$)</td>
<td>1.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Total income (0.16 Cuban pesos kg$^{-1}$)</td>
<td>240</td>
<td>1080</td>
</tr>
<tr>
<td>Net income ha$^{-1}$ (Cuban pesos)</td>
<td>-462*</td>
<td>372</td>
</tr>
<tr>
<td>Benefit/cost ratio</td>
<td>0.34:1</td>
<td>1.5:1</td>
</tr>
</tbody>
</table>

*average net loss

Frequently farmers introduce varieties labelled as high yielding varieties and sometimes they have not idea on the real output under low input agriculture. Indeed, the situation that occurred in Cuban crops breeding seems an example of the possible negative economic effects when varieties are selected in an environment not representative of the target area. The occurrence of a cross-over response (Ceccarelli et al., 1998) point out the importance of having a realistic view about who will be using the products of plant breeding. In the case of pumpkins, the effect of sowing in organic conditions varieties selected under high-input conditions, with the genetic consequences, has meant an inefficient use of energy as well as an economic loss (Ríos et al., 2002).

The opportunity to observe and choose a wide genetic diversity under organic conditions gives more options to farmers to select better and different options. Genetic diversity access to local seed systems provoked stakeholders attitude changes towards encourage agrobiodiversity and local participation That is way new organisations are emerging and conventional institutions have been refocused.

Lessons learnt

Before Socialist countries collapse (subsided agriculture) the advantage of scientific knowledge was associated to disseminate a narrow genetic diversity with a particular technological package all over the place. Nowadays the scientific knowledge advantage is more associated to disseminate a wide genetic diversity, enhancing farmer’s participation in varietals selection and specific technology making under organic agriculture.

Unfortunately local stakeholders’ empowerment is a medium and long term process (Vernooy 2003); however it seems to be successful to build up capacities to improve local seed systems in connection with national and international seed sector systems.

Encouraging diversity and participation to strengthening to local seed systems become crops breeding more energetically efficient, socially available and more profitable.
National Crops Breeding institutions focused in agrobiodiversity, facilitation, encouraging farmer’s experimental network and capacity building at local level have more impact in economical terms, technological transference, food production and social recognition.

Diversity seed fair, farmers experimentation associated to farmer’s field school meant backbone for local stakeholders’ empowerment and participatory plant breeding up scaling.

Acknowledgements
The author want to thanks to Canadian Embassy in Havana, Switzerland International Cooperation in Havana, International Development Research Centre and Higher Education Ministry of Cuba for its advisory and funding support

References


The International Treaty on Plant Genetic Resources for Food and Agriculture and organic agriculture

Clive Stannard & Álvaro Toledo
Secretariat of the Commission on Genetic Resources for Food and Agriculture.
Food and Agriculture Organization of the United Nations (FAO)
Viale delle Terme di Caracalla, 00100 Rome.
Emails: Clive.Stannard@fao.org and Alvaro.Toledo@fao.org

Introduction

Plant genetic resources for food and agriculture are the biological basis of world food security, and, directly or indirectly, support the livelihoods of every person on earth. In an increasingly interdependent and globalized world, the policy and regulatory frameworks on biodiversity for food and agriculture are assuming ever more crucial importance in achieving food security for all and sustainable agriculture.

Agro-biodiversity is of particular significance to organic farming. The FAO/WHO Codex Alimentarius ‘Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods’ recognizes that an organic production system is designed, inter alia, to enhance biological diversity within the whole production system\(^1\), and the Basic Standards for organic agriculture developed by International Federation of Organic Agriculture Movements (IFOAM) include the maintenance of genetic diversity within the agricultural system as one of the twelve basic aims of organic farming\(^2\).

Certified organic agriculture farms some 15.8 million ha globally. It is thought that the future growth of organic agriculture will rely, at least over the medium term, more on the supply constraints than on demand increase, and in developing countries expansion will greatly depend on technological innovations\(^3\). Organic agriculture relies on the intensive use of a vast portfolio of plant genetic resources\(^4\). The capacity to effectively manage agricultural biodiversity is a key factor conditioning the sustained expansion of organic agriculture. While some breeders increasingly target their programmes to improve the varietal performance in organic farming, this production system also serves as a niche for local varieties developed by farmers.

Agricultural biodiversity is more than a production factor in organic farming: it also provides ecological services, through the agro-ecological management of pests and diseases, the improvement of soil fertility, the enhancement of stability in food production, and the reduction of the negative effects of agriculture for wildlife within the agro-ecosystem and damage to surrounding ecosystems, through, for example, run-off containing agri-chemicals.

Policy questions related to plant genetic resources for food and agriculture will be crucial for the future development of organic agriculture. The new International Treaty on Plant Genetic Resources for Food and Agriculture, which enters into force on 29 June, will now be the principle framework for cooperation for the management of plant genetic resources for food and agriculture. Before describing it, I should like to address a basic question: what makes plant genetic resources for food and agriculture so different from wild biodiversity that they deserve a specific international agreement?

The special nature of plant genetic resources for food and agriculture

Some 10,000 years ago, agriculture began, with the Neolithic revolution. This was, in some ways, the most inventive time in human history. As Claude Lévi-Strauss used to say, we are still coasting on the Neolithic. In what the great Russian botanist, Nikolai Ivanovich Vavilov, called the ‘centres of origin’, the key plants on which we now depend for our survival were domesticated. There were a number of Neolithic revolutions: barley and wheat were domesticated in the Near East, rice in South-East Asia, the potato in the Andes, millet and sorghum in Africa, and maize in Meso-America. Local farming communities applied invention to the most promising local wild plants, and substantially added value to them. They Selected within the genotypes of these plants, substantially altered their nature, and created crops. They had, for example, to stop the seed-heads ‘shattering’ and scattering their seed before harvest. It is not surprising that many domesticated plants cannot survive in nature: maize, for example, with its very tight ears, cannot seed itself. If you compare it to wild teocinte from which it originated, maize is almost unrecognisable.
Crops and animal domestication made settled life possible, and human populations grew enormously, in many places leading to cities, and with cities, civilisation. Population expansion spread crops into new environments, where they were readapted to new stresses, climates and needs, in this way always increasing intra-specific diversity. New crops were developed: rye, for example, is a weed which went with farmers to the north, and there proved more productive than the Fertile Crescent cereals.

From the beginning, farmers swapped their crops and ‘landraces’. Agriculture has always been based on access and exchange, not on exclusivity. Even at the most local level, farmers breed exotic material into their crops, in order to avoid productivity declines. From the end of the fifteenth century, the crops of the Incas and the Aztecs — maize, potato and tomato and many others — came to Europe, Africa and Asia, while the crops of these regions enriched South America. New centres of diversity also grew up outside the centres of origin: South American beans have a secondary centre of diversity in central Africa.

Paradoxically, crops often do better outside their centres of origin, because the complexes of parasites and pathogens do not always travel with them, until these catch up with them: take the Irish potato famine on the 1830s. Only limited diversity had come with Europe’s first potatoes from the Americas. When phytophthora arrived, famine decimated the Irish population and sent a great stream of starving emigrants to the United States. Only when resistances were found in South America could the European potato recover.

I have tried to draw attention to what are some of the distinctive features of plant genetic resources for food and agriculture:

First, value in agriculture lies at intra-specific, not inter-specific level, that is, within crop diversity. That value is maintained by farmers within farming systems. If we do not conserve this diversity ex situ, it often dies when farming systems die.

Second, the fact of exchange, from which all eventually benefit, has always been the reality of agriculture. Our enormous and growing world population will only be fed if we continue to draw freely on the widest possible range of resources at all times.

Third, and as a result, countries and regions are inter-dependent. That is, all depend very largely for their food and agriculture on crops that originated elsewhere. None can hope to do well with their own resources alone.

Fourth, most genetic diversity lies in the tropical and semi-tropical countries.

**The International Treaty on Plant Genetic Resources for Food and Agriculture**

On 3 November 2001, the FAO Conference adopted by consensus the legally binding International Treaty on Plant Genetic Resources for Food and Agriculture. Its objectives are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable benefit sharing arising from their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The Treaty’s scope is all plant genetic resources for food and agriculture.

Separate articles deal with conservation and sustainable use, and with international cooperation. Contracting Parties will cooperate to ‘promote an integrated approach to the exploration, conservation and sustainable use of plant genetic resources for food and agriculture’. Plant genetic resources must be conserved, in farmers’ fields, and in genebanks, when they are at risk. But this is not enough: they must be characterized, evaluated and documented. We conserve them not for conservation’s sake, but because we need them. If we lose the rich portfolio of plant genetic resources that were developed in traditional farming systems, we will not be able to face changing human needs and physical changes, such as global warming, or provide the raw material that organic and other forms of agriculture need.

An article on Farmers’ Rights recognises ‘the enormous contribution that the local and indigenous communities and farmers of all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic
resources which constitute the basis of food and agriculture production throughout the world’. The responsibility for realising these rights lies with national governments, which may take measures to protect and promote Farmers’ Rights, including (a) the protection of relevant traditional knowledge, (b) the right to participate equitably in sharing benefits, and (c) the right to participate in relevant decision-making. This is the first time that such rights have ever been recognised in a binding treaty. Clearly, Farmers’ Rights are not intellectual property rights, but the basis for the recognition of the collective innovation on which agriculture is based.

The Treaty also establishes a Multilateral System of Access and Benefit-sharing, applied to a list of crops established on the criteria of food security and inter-dependence. They cover about 80% of the world’s food calorie intake from plants. Contacting Parties will bring into the Multilateral System all such resources that are under their management and control and in the public domain. They will encourage natural and legal persons within their jurisdiction to include the resources they hold in the Multilateral System. Those held by the Consultative Group on International Agricultural Research will also be brought in, by agreements which they are invited to sign with the Treaty’s Governing Body.

The Treaty lays out the conditions of access, for the ‘utilization and conservation in research, breeding and training for food and agriculture, provided that such purpose does not include chemical, pharmaceutical and/or other non-food/feed industrial uses’. Access shall be accorded expeditiously and free or at minimal cost, without tracking individual accessions. ‘Recipients shall not claim any intellectual property or other rights that limit the facilitated access to the plant genetic resources for food and agriculture, or their genetic parts or components, in the form received from the Multilateral System’: this text was the subject of intense negotiation and compromise.

Access to plant genetic resources under development, including material being developed by farmers, shall be at the discretion of their developers. Access to plant genetic resources protected by intellectual and other property rights shall be consistent with relevant international agreements, and with relevant national laws. Resources accessed under the System, and conserved, must continue to be made available by the recipients.

These provisions, and those regarding benefit-sharing, will be contained in a standard Material Transfer Agreement to be agreed by the Governing Body. Because these plant genetic resources are treated, in effect, as a pooled good, there is no individual owner with whom individual contracts for access and benefit-sharing must be negotiated. A standard agreement cuts out negotiation, legal and other transaction costs. And because the individual genetic resources from the multilateral system are delinked from an individual contract with benefits going back to the provider, they must be shared in multilateral ways.

The Treaty recognises that access itself is a major benefit. Other benefits include the exchange of information, access to and transfer of technology, and capacity-building, partnerships and collaboration. The standard Material Transfer Agreement will provide ‘that a recipient who commercializes a product that is a plant genetic resource for food and agriculture and that incorporates material accessed from the Multilateral System, shall pay […] an equitable share of the benefits arising from the commercialization of that product, except whenever such a product is available without restriction to others for further research and breeding, in which case the recipient who commercializes shall be encouraged to make such payment’. The Governing Body, at its first meeting, will determine the level, form and manner of the payment, in line with commercial practice. These innovative provisions provide benefit-sharing on commercialization, without deriving these benefits from individual negotiations between the provider and the user of these resources.

These mandatory payments form part of the Treaty’s funding strategy, whereby the Governing Body periodically sets a funding target, within which to mobilise funds from a wide variety of sources for agreed projects and programmes aimed particularly at farmers in all countries, especially in developing countries, and countries with economies in transition, who conserve and sustainably utilise plant genetic resources for food and agriculture.
Conclusion
The subject of our meeting is organic seeds. How is the Treaty of relevance?

· It establishes a major new forum in which agriculturalists from North and South can shape solutions to their needs regarding plant genetic resources.

Organic agriculture aims at local adaptation: the Treaty both facilitates access to the resources that organic farmers need and all will benefit from their work in creating new adapted varieties, which add to the world’s plant genetic resource portfolio.

Governments have engaged themselves to promote an integrated approach to the exploration, conservation and sustainable use of plant genetic resources for food and agriculture. The focus on the farmer’s right to participate in relevant decision-making is, I feel, is of key importance, not least for organic farmers.

The Treaty will contribute to the full implementation of the Leipzig Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture, which provides a coherent framework, *inter alia*, for capacity-building, technology transfer and exchange of information.

The Treaty’s funding strategy aims to mobilise funds from a wide variety of sources for agreed projects and programmes, aimed particularly at farmers in all countries, especially in developing countries, who conserve and sustainably utilise plant genetic resources for food and agriculture. We should remember the growing importance of organic farming in developing countries, both for local markets and for export earnings, whom we hope this will directly benefit.

In fact, all will benefit from the International Treaty, in a variety of ways: farmers and their communities, through Farmers’ Rights; breeders and the scientific community, through access to the plant genetic resources crucial for research and plant breeding; consumers, because of a greater variety of foods, and of agriculture products, as well as increased food security; the International Agricultural Research Centres, whose collections the Treaty puts on a safe and long-term legal footing; and both the public and private sectors, which are assured access to a wide range of genetic diversity for agricultural development. It will also help conserve the genetic diversity necessary to face unpredictable environmental changes, and provide for future human needs.

References
2 http://www.ifoam.org/standard/
On-farm seed production:
integrity of organic farming system and biodiversity safeguard

Cristina Micheloni and Andrea Giubilato
Italian Association for Organic Agriculture/AIAB
Via Ponte Muratori 6, I-41058 Vignola, Italy
Email: c.micheloni@aiab.it

Abstract
If organic farmers intends to respect basic values they often face the dilemma of choosing between integrity and biodiversity safeguard and agronomic proper choice: to use organic seeds of a variety that do not fulfils cultivation nor market requests nor biodiversity safeguard goals or to use an adapted, sometimes local, variety that properly fits to their farming system and market but comes from conventional source.

The solution can only partly come from seed industry because it is clear that economically organic seeds market will never support such a strong development in terms of variety offer.

The other way to solve the dilemma is to promote and technically support on-farm seed production. It is already working for heritage and local varieties but also for speciality crops (radicchio) and common varieties, where experienced farmers run the selection and multiplication phase resulting in perfectly fit ecotypes, varieties or selections that fulfil all basic values demands and have adequate market satisfaction and economic result.

The issue of organic farming basic values and cultivation practices
Among ethical values Organic Farming (OF) is based on, as stated in IFOAM Basic Standards as well as EU Regulation 2092/91, principal ones are biodiversity promotion and safeguard and production process integrity. From agronomic point of view to use crops and varieties adapted not only to climatic and edaphic local conditions but also to specific farming practices - as develop by single farmers- is a base of sound farming systems that perfectly tunes to organic method and fulfils market demand. This is true not only for heritage varieties, that, with the exception of few cases, have little space in professional farming, but also for commercial varieties.

On the other hand, especially on consumers perspective, integrity is as well an important issue that grants transparency and reliability to the system. To fulfil integrity request all inputs used in OF should come from OF sources (manure, animal feed, plants, ...). This means that seeds as well should preferably come from organic systems.

But often organic farmers face the dilemma of a choice between biodiversity safeguard (and proper agronomic variety use) and integrity: to use an adapted variety that fits to local farming systems and is requested by the market but whose seeds are not available as certified organic or to use certified organic seeds of a variety not particularly adapted to local conditions and not specifically requested by the market? The situation is due to the reduced range of varieties of certified organic seeds available at present and it is not likely to change significantly in the near future because of economic constrains linked to limited market potential for such seeds.

Moreover it is often unclear which criteria seed producers use to select the varieties to multiply organically, because for certain species (i.e. beans) none of the varieties available in organic fulfil Italian organic farmers demands in terms of product quality, productivity, plant growth and cultivation technique.

Italy as an example
OF in Italy is at present an important reality with numbers of farms and hectares that bring it in leading position in Europe: total number of organic operators is 55.902 (49.489 of which are producers) cultivating 1.168.212 ha of crops as specified in tab. 1.
Tab. 1: Organically grown crops in Italy and relative surface by Dec. 2002

<table>
<thead>
<tr>
<th>crops</th>
<th>ha (organic and conversion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cereals</td>
<td>227.948</td>
</tr>
<tr>
<td>pulses</td>
<td>44.052</td>
</tr>
<tr>
<td>potato</td>
<td>23.411</td>
</tr>
<tr>
<td>Industrial arable crops (sugar beet, processing tomato etc.)</td>
<td>25.131</td>
</tr>
<tr>
<td>herbs</td>
<td>1.896</td>
</tr>
<tr>
<td>Vegetables (open field and green-houses)</td>
<td>13.323</td>
</tr>
<tr>
<td>ornamentals</td>
<td>228</td>
</tr>
<tr>
<td>fodder</td>
<td>289.009</td>
</tr>
<tr>
<td>Seeds and multiplication material</td>
<td>1.012</td>
</tr>
<tr>
<td>Fruit trees (citrus and nuts included)</td>
<td>66.089</td>
</tr>
<tr>
<td>Olive trees</td>
<td>102.055</td>
</tr>
<tr>
<td>Grape-wine</td>
<td>37.380</td>
</tr>
<tr>
<td>Pasture and meadow</td>
<td>261.263</td>
</tr>
<tr>
<td>other</td>
<td>76.530</td>
</tr>
<tr>
<td>total</td>
<td>1.168.212</td>
</tr>
</tbody>
</table>

Source: MIPAF 2004

An important percentage of them, especially the ones producing vegetables and fruit, sell on local markets (farm-gate selling, village/city markets, farm restaurants etc.) where local, heritage or simply “old” commercial varieties are requested and find good market opportunities.

But besides the lack of certified organic seeds for heritage and local varieties or ecotypes that account for a niche market and can easily be derogated, commercial varieties too show a significant reduced availability.

We consider four important crops for Italian organic production as durum wheat, common wheat, processing tomato and corn. Using data from annual (conventional) variety testing (Informatore Agrario, 2003) and data from organic seed database (ENSE, 2004), integrated by farmers information, we compare the number of varieties an organic farmer can use respect to a conventional one:

Tab. 2: Availability of varieties for organic vs conventional farmers

<table>
<thead>
<tr>
<th>crop</th>
<th>Varieties commonly available to conventional farmers</th>
<th>Varieties available in organic</th>
<th>Varieties requested for derogation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durum wheat</td>
<td>35</td>
<td>28</td>
<td>80</td>
</tr>
<tr>
<td>Common wheat</td>
<td>35</td>
<td>15</td>
<td>65</td>
</tr>
<tr>
<td>Processing tomato</td>
<td>60</td>
<td>7</td>
<td>n.a</td>
</tr>
<tr>
<td>corn</td>
<td>56</td>
<td>6</td>
<td>n.a</td>
</tr>
</tbody>
</table>

n.a.= not available
Among variety requested for derogation about 25% are produced in organic too but not in sufficient amount. Considering other crops the situation is more difficult to evaluate because no official data are available but for fodder crops such as Lucerne only 7 varieties are available in organic while 38 have been requested for derogation; for fresh marketed vegetables we estimate from data gathered from inspection bodies, consultants and farmers that about 60% of used seed is conventional.

What farmers usually claim as a derogation request are:
- available varieties do not fit to their agronomic system;
- available varieties do not fit to market request;
- available varieties do not perform good in terms of production;
- available varieties do not respect variety standards;
- available varieties have not sufficient quality (germinability, pureness, vigour...);
- sanitary status of available varieties is not adequate.

Besides that often even nationally available varieties are not sufficient in quantity and not everywhere available (if a variety is available in Bologna a farmer from Sicily cannot use it).

**Derogation regime in Italy**
Italian organic farmers twisted between integrity and biodiversity must cope with the national database for organic seeds and multiplication materials, that is the legal instrument for the implementation of derogation regime as established by EU Reg. 2092/91.

Italian organic seed database is managed by ENSE (Ente Nazionale Sementi Elette) that is annually publishing a report on derogation requested (accepted or denied) and some more information on variety requests and availability.

ENSE report on agricultural year 2003-2004 (from July 2003 to February 2004) shows that 30.815 requests for derogation have been submitted and the majority was accepted (87,3%). But from those data it is not possible to calculate which percentage of farmers is requesting a derogation or, how many hectares of organically cultivated land is sown with conventional “derogated” seed. To obtain more precise data to evaluate it tab. 3 can be considered.

**Tab. 3:** Amount of seeds requested for derogation (year 2003-2004) in kg

<table>
<thead>
<tr>
<th>herbs</th>
<th>Sugar beet</th>
<th>Cereals</th>
<th>fodder</th>
<th>Oil and fibber crops</th>
<th>ornamentals</th>
<th>vegetables</th>
<th>potato</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>695</td>
<td>573</td>
<td>11.266.278</td>
<td>4.728.833</td>
<td>95.223</td>
<td>25</td>
<td>201.877</td>
<td>1.721.372</td>
<td>18.014.876</td>
</tr>
</tbody>
</table>

Source: ENSE 2004

Considering that, on a rough average, 170 kg of cereal seeds are used per hectare it appears that about 66.272 ha of organic cereals were sown within the derogation regime. It represents approximately 25% of cereal surface. To that some other 25% of own seed use should be considered, especially concerning winter cereals. As already mentioned it is far more complex to evaluate the surface of derogated seed use for vegetables, considering the extreme variation in terms of seed weight and seeding density among different species and systems, but as already stated about 60% of organic vegetables come from conventional “derogated” seed.

**On-farm seed production: the only way to combine integrity with agronomy and biodiversity**
What organic farmers need to perform their job fulfilling OF basic values and with agronomic and economic good results is a wide range of adapted varieties, so wide to grant each farmer to find his/her choice for his/her farming system and market. Such a solution seed industries will never be able to offer because of economic constrains, or their contribution can only partly help to problem solution.
Complete and practicable answer can only come from on-farm seed production if scientifically supported. In Italy, especially in traditional vegetable or cereal growing areas, there are skilled and knowledgeable professional farmers and consultants with all practical knowledge to run selection and multiplication of varieties. At the same time in those areas still existing, even if endangered, genetic materials can offer the basis for the selection.

To farmers run selection and multiplication activity scientific support for sanitary improvement and control should be granted in order to avoid seed born diseases transmission, but all selection activity should stay in the hands of farmers, who, driven by agronomic experience and consumers demand have the possibility to widely differentiate varieties use and develop proper genetic material for organic farming. It does not mean that each farmer should select his/her own seeds but the most skilled farmers of an area can produce seeds for all the others and, if needed, establish a network for seed exchange. If scientific support is granted even legal constrains and requirements can be fulfilled allowing legal seeds trading.

**On-going activities and projects**

On-farm seed production as described above is already running, both in conventional and organic, for “niche” heritage varieties such as Quarantina Bianca and Cannellina Nera potato varieties in Liguria mountains (Angelini and Lovatti, 2000) but also for “special” crops such as all radicchio types (Radicchio di Treviso tardivo and precoce, Radicchio di Verona, Radichiodi Chioggia, Radicchio di Lusia, Radicchio di Castelfranco) produced by highly professional farmers (9.056 ha in Veneto Region and 15.707 ha in total in Italy). Among Veneto radicchio profesional producers about 60% is using on-farm produced seed, other 40% comes from seed companies but is used only for lower value products (sold in supermarket or in ready-for-eating packaging).

Few organic farmers started to run similar systems also for less “special” crops such ad fennel, beans, spelt, wheat or fodder crops, starting from commercial varieties but selecting within their own population the plants that better fit to their systems and the product that have higher market recognition and value.

Some guidelines on how to multiply seeds on farm have been published some years ago in Tuscany (Vazzana and Cerretelli 1997) and recently AIAB magazine (Bioagricultura) published some specific guidelines for professional organic farmers on how to select seeds on-farm (Giubilato and Micheloni 2003 and 2004).

In order to evaluate organic farming dependance on conventional seeds and multiplication material starting from the state of the art of organic seeds offer, and how it is percived within the framework of OF basic ethical values a workpackage of an EU project is just starting. The project is named “Research to support revision of the EU Regulation on organic agriculture”, it is a VIFP under priority 8.1, co-ordinated by the Danish Institute for Organic Farming (DACROF/DIAS) and AIAB leads the work-package concerning seeds and multiplication materials. Further information will be available at [www.organicrevision.org](http://www.organicrevision.org)

**References**


Informatore Agrario; 2003: Supplementi prove varietali n. 6, 8, 34 and 36. Ed. Informatore Agrario, Verona.


Vazzana C, Cerretelli G; 1997: Manuale di autoproduzione delle sementi. ARSIA, Florence
Plant breeding and diversity in seeds

Bernard Le Buanc
International Seed Federation
Chemin du Reposoir 7
1260 Nyon, Switzerland
Email: b.lebuanc@worldseed.org

Summary
The judgement on the evolution of diversity in most cultivated crops depends on the assessment criteria. When using genealogical indicators, analyses of morphological characteristics and indices of gene frequencies, there is no evidence of diversity erosion. The number of distinct varieties available on the market is increasing steadily.

Several experiments suggest that modern varieties are well adapted to harsh environments and present a good level of disease resistance, frequently higher than the one of old varieties and landraces.

A short-term possibility for organic farmers would be to screen the many existing varieties against their production conditions to find adapted ones. A further step could be to participate in participatory selection at an earlier step of the plant breeding process.

The impact of modern plant breeding on seed diversity in general has been discussed several times and opinions diverge depending on how we measure diversity. More recently the availability of seeds in terms of diversity and quantity has become a concern for the organic agriculture organizations, due to the specificity of this mode of production and its relatively low acreage compared to other types of agriculture. What is the situation and how to improve it in the future?

Modern plant breeding and seed diversity
The divergence of opinions regarding the impact of modern plant breeding on seed diversity is mainly based on the fact that the criteria used for measuring this diversity differ from one author to another. Many statements on the decrease of diversity within a crop are based on the number of landraces available to farmers and, indeed, this number is still decreasing. However, whether this criterion is relevant in terms of diversity is disputable. Indeed defining terms and using them appropriately across disciplines is a problem (Smale, 1995). Social scientists use numbers of cultivars, the proportion of area planted to cultivars and the rate at which farmers are switching from one cultivar to another. Biological scientists tend to use genealogical indicators, analyses of morphological characteristics and indices of gene frequencies measured by biochemical molecular markers. Not only do these indicators measure different phenomena, the empirical relationship between them is also sometimes weak.

The evolution of wheat varieties in France and Germany provides interesting examples: in the early 1930s several European countries decided to establish variety catalogues to clarify the situation of seed production. In 1935, in the German Catalogue (Official List of German Varieties, 1935) the number of wheat varieties dropped from 454 varieties and landraces to 17 accepted cultivars and 54 ‘cultivars with reservation’. According to the German Authority, the decrease was mainly caused by name redundancies or the absence of distinctness. In France (Simon, 1999) in 1933, the total number of varieties was 562, including 393 landraces and derived cultivars. In 1937, after examination of the varieties, that number dropped to 170 and, in 1945, to 40. In addition the parents of varieties in the market today are more diverse than in the past. Parents derived from exotic germplasm represented less than one third of the parents used in breeding programs in the 1960s but represented almost 50% in the 1980s. Similar results have been found for wheat in India (Smale, 1995). A biomolecular approach in the United Kingdom (Law et al., 1998) on the main crops (wheat, spring barley and oilseed rape) shows that modern plant breeding, Plant Breeders’ Rights and the ‘Recommended list’ system have not resulted in any statistically significant narrowing of overall levels of genetic diversity on those crops over the past 60 or 70 years. This is illustrated by the following graph related to oilseed rape (Fig. 1).
Finally it is interesting to note that every year around 3’000 new distinct varieties of field and vegetable crops are protected in the UPOV member states with a total of 59’200 protected varieties, all species included, in 2002. The 2003/2004 OECD list of cultivars that are traded internationally, mainly field crops, comprises around 33’000 distinct cultivars.

**Varieties for organic agriculture**

Organic farmers are concerned that plant breeders are not developing varieties that are suitable for organic agriculture. It is interesting to analyze the situation more carefully and to check the existing varieties for the prerequisites of organic agriculture, such as lower level of easily mineralizable nutrients and non use of synthetic crop protection compounds or herbicides.

**Modern varieties and low potential environment**

Recently fourteen cultivars introduced between 1946 and 1992 were compared during two years, 1994-1995, at five locations, two levels of fungicide and two levels of nitrogen fertilizer (Brancourt-Hulmel et al., 2003). The results show that it is possible to find modern cultivars that outyield old cultivars, even in low input agriculture. One of the explanations is that modern cultivars use nitrogen more efficiently than their predecessors. Similar conclusions were obtained with landraces and modern varieties (Grignac et al., 1981) and (Jonard & Koller, 1951).

The situation in semi-arid and tropical conditions is not different (Le Buanec, 1999).

In northern Syria and Lebanon, ICARDA has compared during five cropping seasons in two environments, one with less than 250 mm of annual rainfall and one with 250-400 mm of annual rainfall, three traditional populations with pure lines selected from the populations and mixtures of those lines (ICARDA, 1996). The results indicate that:

- The most heterogeneous mixture (75 lines) does not have a better yield stability than the less heterogeneous one (5 lines).
- The best mixture has no advantage over the best pure line.
- The initial local variety has lower results than the pure line.

In Malawi (Rusike & Eicher, 1995), trials were conducted from 1980 to 1992, comparing the yield of local maize varieties, composites and hybrids under local farming rain-fed conditions. Over that period the composites have always outperformed the local varieties and the hybrids the composites. It is also interesting to note that the yield stability, measured by the coefficient of variation, is the lowest for the hybrids.

In West Africa (Jones & Diallo, 1995), upland local rice varieties and improved lines were compared under farmer’s conditions, with and without added mineral nitrogen. Interpretable results were obtained in 198 farmers fields, in 16 different environments. The results show that in the range of the tested environments, the improved line was always better than the local variety chosen by the farmer, even in a low potential environment (Fig. 2).
Disease resistance
One of the main objectives of plant breeders has always been, and still is to develop varieties that exhibit resistance to diseases and pests. It is the case of all crops but particularly for vegetables. It is the reason why modern varieties, when they are put on the market are generally more resistant than the previous ones. Many examples illustrate this situation.

In France, the five most cultivated cultivars from 1959 to 1998 were checked for their resistance to three main diseases: brown rust, powdery mildew and eyespot (Darrozes, 1997). The brown rust resistance and the powdery mildew have been improved significantly over the period. The powdery mildew resistance has remained stable. Similar results had been obtained earlier (Jonard & Koller, 1951).

In South Africa, trials were conducted in 1995-1996 in five locations to evaluate the resistance of hybrids, new and old open-pollinated varieties to the maize streak virus (Du Toit, 1996). Results indicate that some of the hybrids are significantly more resistant than the old or selected open-pollinated ones.

A recent evaluation of the genetic progress measured in the French CTPS trials (Liciani, 2004) compares the results of varieties of wheat and barley with or without fungicide treatment. It is interesting to note that such a comparison is done systematically since the early 1980s, inciting breeders to become even more active on disease resistance. The results show that on average some of the tested varieties present smaller differences between treated and non-treated plants than others, with a variation for instance in 1992 for 800 kg to 2500 kg per ha, for an average level of productivity of 9'000 kg, in spring barley the progress in non-treated plots is very significant and the new non-treated varieties yield better than the treated check.

On average the progress made in non-treated plots is the same as in treated plots, showing the good behaviour of modern varieties without fungicide protection.

Of course it is important to note that these trials, as it is often the case for organic agriculture production, were done under a low-disease pressure, due to the importance of the conventional agriculture environment. Should the organic agriculture acreage increase, the pressure would probably become higher and the results could be different.

High weed pressure
Competition with weeds is a major criterion in organic agriculture, in particular for some crops like forage but also in general. It is probably the area where breeders have been less active over the past 50 years. Further investigation will certainly be necessary.

The way forward
The difficulty to have an adequate assortment of varieties for organic farming is due to the still very limited area devoted to organic agriculture, despite its increase over the past years. Today (Willer & Yussefi, 2004) the total acreage of organic agriculture represents 24 million hectares with about half in pastoral land for extensive grazing in Australia (9 to 10 million ha) and Argentina (3 million ha). Organic agriculture represents 11 to 12 million hectares of non-permanent agricultural land, i.e. less than 1% of the world arable land. Even in Europe, where organic agriculture is relatively well developed, it represents 3.9% of agricultural lands.
The market is too small to have non-subsidised specific plant breeding programs and it is likely that the situation will continue in the near future.

The solution is certainly to tap the very broad assortment of varieties existing on the market, screening them in organic agriculture environment. As it has been shown earlier, several varieties will certainly give good results.

A further step could be to implement with interested plant breeders a participatory variety selection program at an earlier stage of the plant breeding process. But this could be done only if the breeders were confident in the respect of the intellectual property right, needing probably contractual agreements. However I am not convinced that the results would be better than tapping the large number of varieties released every year and that the additional cost would be justified. Some initiatives are presently going on and it will be interesting to analyze their results.

The production of organic seeds from the selected varieties will remain more difficult than in conventional agriculture and this will also be a factor limiting the number of varieties available to organic farmers. A solution to increase the assortment would be to use non-treated seed of a wider range of varieties considered as adapted to organic agriculture and available in large quantities, but this is another debate.

References

Official List of German Varieties. Situation as at June 1st, 1935. Translated from German.


The Seeds of Life: food safety, local community development and organic seeds in Tucumán, Argentina

Asociación de Técnicos de Programas y Proyectos Sociales (ATPPS)
Jujuy 982 – CP 4000 – San Miguel de Tucumán – República Argentina
Email: atppstuc@arnet.com.ar

Abstract
The province of Tucumán, Argentina, has been in economic difficulty for years with high unemployment, low wages, a poorly educated population and increasing inequality. Growing food insecurity for low income households is one outcome of this process – to confront which, with government support, 27,000 low income families have developed organic family farms “huertas” throughout the province. These families rely on their “huertas” for fresh daily food. They exchange food, share it with neighbours, and sell it locally. But their farms are unsustainable if they cannot become self-sufficient in vital inputs such as seeds – which once they were and feel they could be again. Meanwhile, these families live in one of the most biologically diverse locations in the region, and a wealth of traditional and indigenous practice to “preserve, produce and exchange” seeds for home farms lies unsupported in these poor communities.

In this context ATPPS manages the project: “The Seeds of Life”. Since May 2002 is cofinanced by Shell Foundation, the Red Orgánica Solidaria de Tucumán (ROST), INTA-PROHUERTA, the London School of Hygiene & Tropical Medicine (LSHTM), the Universidad Nacional de Tucumán, the Provincial Government and Shell CAPSA.

“The Seeds of Life” addresses the lynchpin of sustainable, organic community agriculture and local food security by supporting community-based seed production and distribution. It seeks to preserve biodiversity in order to guarantee availability and accessibility of local organic seeds and technologies to low income families for community level organic production.

It has been establishing a system of sustainable community micro-industry for the preservation, interchange and development of local food seeds/germplasm and appropriate technologies, through capacity-building and community projects amongst 7000 low-income small-scale family-based organic farms in the province of Tucumán.

Keywords: Organic seeds, biodiversity, food safety, community development, low income families.

“The Seeds of Life” rationale
Presently Argentina, although still considered a “rich” country, is immersed in a total economic crisis, increasing inequality and poverty. Key problems are unsustainable development models and lack of opportunities for the urban and rural poor. The province of Tucumán is facing a severe social and economic crisis with high levels of unemployment and low salaries, and an increase of inequality and social network disintegration. One of the most severe impacts of this process is critical food insecurity in low income households, which in the last years has worsened, provoking a nutritional crisis in Tucumán.

The Province of Tucumán spans 22,000 km² with eleven micro climates and extensive biodiversity, from the low plains to high valleys of the Calchaqui. The population is 1,331,000 with some of the worst indicators of poverty of the country: unemployment runs at 19.8%; 17% of the populations live with less than $2 per day and 28% live without basic needs.

These extremely poor conditions have worsened considerably due to global agricultural factors, and the national economic crisis. Global competition has led producers to lower costs leading to more local unemployment, less work and more inequality. The national crisis exacerbates local poverty, but for low income families the situation has been grave for some time. One of the consequences of this situation is its impacts on family food security, affecting most gravely women and children. Infant mortality now runs at much higher than 22.5/1000¹, related to malnutrition, infectious disease and poor living conditions. Against this backdrop, many poor families, in old plantation towns, in remote mountain areas and low income urban areas, are reliant on small-scale farming and home gardens for fresh food and nutrition. In

 Challenges and Opportunities for Organic Agriculture and the Seed Industry 55
Tucumán, with government support, 27,000 of these low-income families, assisted by “promotores” from the same communities, and a small team of community-based agronomists, developed small-scale organic family farms (huertas) for fresh food and improved diets (PROHUERTA).

The development of family farms has not been simple. In the low income urban areas, many families have migrated in recent years from rural areas and had forgotten how to farm their small patches of land. Many families live on low quality land with limited water supplies. For rural huertas, the process has been different. Here one still finds traditional agricultural methods, and the problem is the increasing lack of work for young people. In addition, these small-scale farms, like many internationally, have become reliant on expensive, externally supplied seeds stocks, while traditional seeds and technologies are being lost. Prices of these seeds are increasing annually. Many of these seeds are reliant on expensive agri-chemicals to produce yields and the growing organically becomes harder every year. Ironically, farmers are aware that many of the important food staples now sold back to them, derive originally from traditional seed and germoplasm of the region that thrived and was cultivated “organically” and more cheaply (for example maize, beans, manioc, potato). It is this trap that is the core issue that this project addresses for the communities of Tucumán.

The families feel more strongly than ever that they cannot develop their self-sufficiency in food, nor help other families, if they are caught in dependency on increasingly expensive seed inputs to sustain their agriculture. In recent years families have tried to devise informal ways of propagating and exchanging local seeds, and regenerating traditional technologies to avert dependence on outside inputs. Provincial biodiversity has, for centuries, supported highly diversified community agriculture. Many farmers still keep seed banks, based on traditional and indigenous practice, that focuses on “produce, preserve and exchange” of seeds and germoplasm between communities in their bio-niche across Tucumán. Farmers across the province and the North West share technologies and products when they can (at fairs etc). They share food produced between families and communities and have a strong spirit of solidarity and collaboration. Now these families want to formalise and extend this attempt to develop sustainable community agriculture through this project for the consolidation of a system of community documentation of local seed sources and traditional technologies; followed by setting up systems of seed propagation, demonstration micro-project seed banks and technology sharing. They believe this will have a number of benefits:

- It releases families from dependency on external seeds for their huertas and important food sources
- It preserves biodiversity on their organic gardens
- It preserves and develops local, replicable technologies
- It preserves community intellectual property rights over the genetic material of traditional agriculture of the province
- It builds self-sufficiency of community agriculture and allows its development
- It ensures availability and accessibility of seeds for family farms
- It enhances food security and access to organic local food
- It provides a replicable model for other communities locally and internationally

We developed this project with 17 cooperatives throughout the province and they highlighted their key concern. A team of community promoters, agronomists and academics looked for support for this initiative. The idea was developed originally between 1992 and 2001 in 20 meetings of 500 promoters and families in which the recurrent theme was autosufficiency in seeds and sustainable local technologies. The workshops were supported and driven by the Red Orgánica Solidaria de Tucumán (ROST) (the Solidarity Organic Network of Tucumán).

**The project objectives and strategy**

**The objectives**

The overall objective of the project is to contribute to the sustainability of organic, healthy food production at family level for the poorest communities of Tucumán through strengthened local organic seed production. The project purpose is to establish a system of sustainable community micro-industry for the preservation, interchange and development of local food seeds/germplasm and appropriate technologies, through capacity-building and community projects amongst low-income small-scale family-based organic farms in the province of Tucumán.
Beneficiaries
The primary beneficiaries of this project are the low-income families who currently have organic family “huertas” and are recognised by the government as living with unsatisfied basic needs. These families include unemployed ex-sugarcane workers, communities in remote valleys, isolated families in subsistence agriculture and low income families in urban areas. All families rely on their farms for daily fresh food. Overall indicators of the families who will be involved in the project: 40% have not completed primary education; 51% are unemployed or in temporary employment; all live in precarious housing and all have been classified as lacking basic needs. In the course of the project a total of 7,000 low-income families will benefit directly, either through their own micro-projects, by learning from micro-projects, by receiving seeds or by learning new technologies. At present 14 community fund-holding families and groups are generating demonstration micro projects. We are training “trainers” in a one to one relationship of selected community promooters, with highly trained community agonists. Third, the overall group of 7000 primary beneficiaries will gain access to distributed seeds and shared technology and learning, and will gain training and technical support by participation in project events and fairs. In addition, we have established a community council to act as a steering committee over the project, and to select the micro-projects.

Key outputs
The principal outputs of the project address a core problem of disempowerment and dependency. They are:

- Empowerment of communities through the establishment of a system of participative project management, and capacity-building in micro-industry for seed germplasm production.
- Development and interchange of examples of local seeds/germplasm and micro-industry technologies for organic seed reproduction
- Generation of guaranteed availability of local seeds and technologies to low income families and communities for community level organic production
- Generation of guaranteed accessibility of local seeds and technologies to low income families and communities for community-level organic food production.
- Generation of information and dissemination of results of this model of community micro-industry for access to and ownership of local seeds and germplasm for sustainable agriculture.

Activities
Investigation and registration of existing seeds, germplasm and technologies and Training Materials
During the first year the team has worked with families to create an inventory of local seed and technology resources used in low income families in Tucumán. We have identified 65 species held by the communities and have established a catalogue of 57 species and varieties that can be developed, preserved and multiplied in the microprojects. This catalogue is in the process of validation in the communities and microprojects for later wider publication. At the same time we have developed a manual of “good practice” of traditional organic production, which will be developed in the microprojects.

On the basis of the investigations above, we have developed audio visual training materials about the production of seeds based on the experience of the key informants.

The way we guarantee availability and accessibility of local seeds and technologies to low income families and communities for community level organic production.

In the second and third year, the families are developing microprojects of seed production and seed banks in their communities. A Community Council has selected these projects prioritising those which meet the general objective of the project. Each microproject is developing also training for members of the community (we have already trained 563 families).

The seeds and technologies in the microprojects have become demonstration models and the seeds are exchanged in fairs organised at provincial level. The 14 microprojects have allocated at least 20% of their production of seeds for a seed bank to be exchanged with other families through a system of “trueque” or traditional barter.

Seeds and fitogenetic materials of native species, landraces and adaptes varieties produced by microprojects have just been distributed to 3000 poor families (pumpkin & squash – Cucurbita sp.-, tomato – Lycopersicum esculentum-, hot pepper – Capsicum sp.-, peas – Pisum sativum-, bean – Phaseolus spp., lettuce – Lactuca sativa-, swiss chard – Beta vulgaris-, beetroot – Beta vulgaris var rapa-, basil – Oxinum basilicum, carrot

With this scheme we believe we will empower the families who can develop and try out their own ideas, at the same time providing support to their development of the microprojects as micro-industry.

Participative project management and communities empowerment

We designed the project led by communities, through a community council and supported by technical staff – community agronomists (ATTPS) and university academics (UNT y LSHTM). The promotores have an important role: their skills will be upgraded not just for techical management of seeds but also in project management with the aim that they will be the future support to their communities.

ATTPS is responsible for day to day management of the project. The Community Council’s role includes to design project policy, control implementation of the project, define criterion for selection of microprojects and oversee their management. The CC also defines the policies for relations with other public and private organisations, and supervises the management team.

Finally we planned to empower the families through the development of a participatory evaluation of the project. Thus in the first year, parallel to the seed inventory, a team of promoters has been trained in evaluation and has worked with UNT and LSHTM to form a team of project evaluation. Through participatory evaluation methods this tema assists the design of the project and gives another strong output: a group of low income families learn how to evaluate systematically their own work.

In this way the communities support the project but they more importantly own it, through the system of community management. Through all these strategies we believe this is an highly innovative project, both in its goal to address a critical issue of sustainable agriculture and food security in Argentina, and in its process of community empowerment. No other project in the region is attempting the recuperation of genetic material and traditional technologies in North West Argentina. Nor is any other project undertaking such a process with reference to nutritional needs and food production of low income farm families. This project then aims at two national and international problems: food security and loss of biodiversity, with a community driven project focused on sustainable food production for community consumption from locally and community produced and owned seeds.

**The future**

The project has received so much attention in Argentina over the last year because it addresses at the core the problems of unsustainable agriculture and food insecurity at household level. Communities in Buenos Aires, Catamarca and Santiago del Estero want to replicate the project as do others.

We hope that the micro-projects will have spawned local micro-enterprises and taught others how to do the same. We are designing an Organic Seed Virtual Bank, to further offer at internet the proyect stock on organic seeds for the world.

In that way we are finding other alternatives with national partners and we’re looking for future actions with “Cocina de la tierra”, a proyect that is working on promotion and revaluation of local cultures through a new concept of native food that supports the social and economic development of our communities.

**References**


2 For example 97% of 27,000 families engaged in organic agriculture consume their own produce, but also 50.6% of families periodically give some of their food production to their neighbours and to community kitchens, schools and creches; 14% exchange food in barter “trueque”; 18% sell food locally and 20% make preserves (PROHUERTA records 2001)

3 As defined by INDEC (2001) ibid

4 Source: PROHUERTA data 2001
Use and availability of organic vegetable seed

Dr. Paul Rubitschek
HILD samen gmbh, Kirchenweinbergstraße 115, D-71672 Marbach, Germany
Tel.: +49 71 44 84 73 11
E-mail: paul.rubitschek@nunhems.com

Abstract:

- We see different basic types of organic vegetable growers giving different priorities concerning their seed:
  to organic seed (“closed organic cycle’’); to genetic characteristics (best performing variety); to low seed price (conventional seed).
- Due to smaller quantities, due to technical questions, and due to higher risks the costs for producing and processing organic seed are considerably higher than for conventional seed.
- Due to the small share of organic vegetable production, it is impossible to provide simultaneously organic seed of all varieties, which are on the market.
- If the genetic of a variety has absolute priority over the organic production method of the seed, there is no economic incentive for the seed supplier to bring organic seed of his varieties to the market.
- Beneficiaries of the exceptional regulation are those seed suppliers, which are not active in organic seed production.
- The more strict the obligation to use organic seed, the more the availability of organic seed will increase (and will comprise also species with less market relevance).
- Which breeder can invest into new “organic” breeding programs, trusting that in future the use of “organically-bred” varieties will become obligatory, when presently not even a seed production regulation can be forced after such a long transitional period?

Market development

The demand for a “closed organic cycle” in the organic vegetable production by using seed also out of organic multiplication has been an old demand from the organic movements and organic associations. This demand became effective in the Commission Regulation 2092/91. There the use of organic seed as a basis for organic production is stated as obligatory. To give the seed industry sufficient time to develop the organic seed production, exceptions were granted at first for 10 years. This exceptional regulation was extended without big discussion for another 3 years until 2003, to be again prolonged for further 2,5 years, only with some supplementary administrative rules.

Having been active all time ago as seed supplier for organic vegetable growers, the company HILD (German subsidiary of NUNHEMS) started even in 1989 to sell organic seed. With this step we were the first German vegetable breeding company selling organic seed of own registered varieties. In developing the organic vegetable seed market from scratch, HILD tried to fulfill the demands of the organic vegetable growers by providing organic seed of those varieties, which were inquired most by them.

Parallel to this, the demand for organic seed also in the amateur business grew, and this demand could be supplied partly with the same varieties.

By doing this the turnover of organic seed during the first years grew steadily, but then came to a stagnation. Specially larger growers, who were converting (parts of) their growing area into organic production during the last years did only partly use organic seed.

What is the organic vegetable grower asking for?

During developing the organic vegetable seed business we could observe the development of different types of organic vegetable growers with different demands to the seed suppliers (of course with all gradations in between):

- Organic growers, who give first priority to organic seed
  Those growers have priority to the “closed organic cycle” in vegetable production. Therefore they choose expressly such varieties, of which organic seed is available, even if the variety does not meet their specific demands in all aspects.
Here are two types:

- Growers, who are looking for long-term adapted varieties
  They prefer open pollinated varieties when anyhow possible. They require varieties with general “robustness” and general “tolerances”, to balance the varying conditions in their cultivation.

- Growers, who are looking for the most modern (also hybrid-) varieties
  Due to marketing reasons they prefer best possible crop performance, and due to that they use hybrids when those are more suitable. They often are specialized on few crops and adjust to those the whole farm organization. Therefore they are looking for many and specific resistances which they can integrate into their cultivation plan.

- Organic growers, who give first (and absolute) priority to genetic characteristics
  Those growers select at first the varieties, which suit best the specific demands of their cultivation conditions. Only if these “required” varieties are available as organic seed in good quality and in the required seed form (e.g. pills, precision seed), they use organic seed, otherwise they use conventional seed. They (have to) follow the market pressure using the best performing varieties, and (have to) consider the “closed organic cycle” in their vegetable production as less important.

- Organic growers, who give first priority to less expensive (conventional) seed
  Those growers feel the price difference between organic seed and conventional seed as too painful for their business. So they evade the obligation to use organic seed. They choose expressly varieties of which no organic seed is available and therefore they can use the less expensive conventional seed.

What can the supplier do?
He has to take into consideration:

- The market potential (organic acreage) of the variety/species in question
  In the EC only about 3% of the vegetable production acreage is organic, with big variation in the different countries. Therefore the market potential for organic seed is similar small as well. However, due to organizational/technical questions the supplier only can produce organic seed economically, when he can sell a minimum quantity. Additionally the production costs for the small quantities are higher than for larger ones (fixed cost, risk split etc.).

- The special efforts for the organic multiplication and processing
  The organic vegetable grower needs an even better quality concerning seed health and vitality than the conventional one, since chemical aid is not allowed for him. Due to the same reason, also for the seed supplier it is more difficult and entails a much higher risk, to produce organic seed. We see the biggest challenge to develop organic methods in multiplication and processing, to provide also organic seed pathogen free and still have a good vitality.

- The share of organic seed in the organic vegetable production
  The organic seed supplier has to realize, that due to the actual regulations the use of organic seed is not obligatory, when the customer has reasons to use a different variety of which no organic seed is available in the market.

Looking to the economical circumstances it is by far not possible, to supply all varieties simultaneously also as organic seed. And if the use of organic seed is not even secured on all organic surface, the organic seed supplier has to plan his seed production even more restrictive.

Moreover he has no real economic incentive to provide organic seed, if his customers give first priority to genetic characteristics. If he can offer the “required” variety, his organic customers will buy to an important extent also conventional seed, which is for him much easier and less risky to produce. If he can not offer the “required” variety, he can provide organic seed of other varieties with similar genetic characteristics, but only a part of his customers will buy those. So above all those seed suppliers, who are not active in the organic seed production, are the beneficiaries of the current regulation, since they can save all research and development costs in this connection and can sell anyway (conventional) seed of their varieties to organic growers.
What’s the role of the legislator?

If the legislator wants to follow the demands of the organic movements and support not only the organic vegetable production but also the above mentioned “closed organic cycle”, he should do the following:

- He should stimulate the consumption of organic vegetables
  Only if the consumption increases, also the production surface will increase. In many countries a significant increase only is possible via supermarkets, since other marketing channels (farm shops, weekly markets etc.) give only limited quantities.

- He should make the use of organic vegetable seed obligatory
  Only when the use of organic seed is obligatory, the seed suppliers realize the necessity of organic seed production for their varieties. Only then the availability of organic seed will come to the highest possible level, since only then the organic vegetable growers are forced to make sufficient pressure on the seed suppliers to provide a sufficient range of varieties also as organic seed. Only then there also will be pressure to the seed suppliers, to invest also in those species, which are very difficult to produce organically and/or which do not have a big quantitative importance.

The credibility of the legislator has been damaged by the repeated renewal of the temporary regulation. Since there are no clear defined conditions, which have to be fulfilled to enter a species into the (empty) “annex”, the seed suppliers see no reliable scope for their future commitment in organic seed production. Therefore this commitment will be quite restricted.

Organic movements are aiming for varieties developed by organic breeding methods, and they intend to ban other varieties at a future date. Which breeder can invest into new “organic” breeding programs, trusting in such future regulations while seeing the current application of the organic seed regulation?
Production of organic seed of groundnut: strategies and practices

Bhautik Savaliya, Vijaykumar Savaliya, Parshotam Kanani
Department of Extension Education, College of Agriculture,
Gujarat Agricultural University, Junagadh-362001
Gujarat, India
E-mail: bhautiksavaliya@yahoo.com

Abstract
Groundnut is the major oilseed crop of South Saurashtra region of Gujarat state of India. It contributes a greater share in national economy due to its high export value and diversified uses. During the production of groundnut many chemicals like Thiram and Captan for seed treatment; Urea, DAP and Single Super Phosphate as chemical fertilizers; Monocrotrophos, Dimethoate and Endosulfan etc. for pest control; growth regulators and many chemicals for storage of groundnut are widely used. Need for more groundnut production from limited geographical area leads to indiscriminate use of these chemicals. These chemicals are having their harmful and residual effects on soil, plants, animals and human being and they are hazardous to nature. But now people are awakened to reduce these hazards. They have started to adopt an alternative to chemical farming i.e. organic farming. Organic farming is a production system, which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. Adoption of organic farming system focus attention on availability of seed material, which is organically produced. For the production of such kind of seed there should be minimum use of chemicals and mainly organic and traditionally prepared materials should be used in different phases of seed production and storage. To apply major and trace elements to groundnut crop organic manures like, farm yard manure, compost, sewage and sludge, night soil, oil cakes, meat meal, blood meal, fish meal, bio-fertilizers and vermi-composting can be adopted. Crop rotation, mechanical methods, cultural methods and use of bio-pesticides, bio-control agents as well as traditional methods for reducing pest, diseases and weeds should be encouraged. Use of Neem leaves, plant parts and other indigenously prepared material for storage groundnut seed is very essential.

Thus for organic seed production of the groundnut, soil should be free from chemical hazards. Nutrient supply, organic inputs with nature harmony, plant protection, production and storage practices should be adopted. It is very important to concentrate on strategies for creating real demand of organic seed by awareness, among the people about the importance of safe and pure organic seed consumption for animals and human beings. Organic seed producers, traders and consumers should be brought together so that producers can get remunerative prices and consumers can get desired quality. Farmers should be provided effective and sustainable organic farming practices by the research support. For this, more concentrated organic farming research should be carried out and results should be communicated to the farmers by extensive and integrated extension system. Thus, whole process of production of organic seed of groundnut need package of production practices and strategies for creating demand and sufficient supply system. This paper covers many of the practices and strategies for organic seed production right from the seed treatment up to the storage of groundnut seeds.

This may lead to increase in quality of produce, reduction of environmental hazards and pollution. The main benefit of organic groundnut seed production is that the residues of chemicals, which have long and harmful effects on health of consumers, can be reduced.

Key Words: Organic Farming, Groundnut, safe food, sustainable, environment

India is the major oil seed producing country with 21 per cent and 15 per cent world’s area and production respectively. (Shakuntala Gupta, 2000). Groundnut is eulogized as ‘King of Oilseeds’ in India as it contributes 40 per cent of the total area and 30 per cent of total production of oilseed crops. India ranks first in area (5 million hectares) and second in production of groundnut (4.625 million tones) in the world (Singhal, 2003). Groundnut is used mainly for table purpose. Nowadays, there is a trend to use groundnut for different purpose by value addition. More than 50 food items can be prepared from the groundnut kernels. As groundnut is used as direct consumption by human being and animals, its quality directly affects the health of human being and animals.
Need for more targeted production from the limited area forces the farmers to use modern high yielding varieties of groundnut which are more fertilizer responsive and sensitive to pest and diseases. Significant higher yield of groundnut was achieved by use of High Yielding Varieties, high level of fertilizers and plant protection chemicals. Such practices of modern crop production technology has considerably raised the output but has created certain problems like land degradation, residue of pesticides in farm produce, pollution of atmosphere and water. Therefore, it is imperative to find out the economically viable, environmentally suitable, eco-friendly and sustained system of farming. One such an efficient and alternative agriculture system that will help to overcome such problems of soil degradation, declining of soil fertility, over exploitation of natural resources and excessive chemicalization of agriculture is organic farming.

Organic farming is an alternative agricultural production system, which avoids or largely excludes the use of synthetically compound fertilizers, pesticides and growth regulating hormones. It is also considered as a system of cultivation with use of organic manures to maintain soil fertility and tilth to supply all essential plant nutrients in suitable amount and aspects of biological pest control methods to control insects, pests and weeds.

Thus, organic farming focuses attention in two aspects environmental safety and food quality. Organic farming includes the production of crop by applying organic inputs in soil. For the production of organic groundnut, which is very nutritious and free from any hazards, a seed produced by organic farming should be needed. As groundnut is highly self-pollinated crop, no extra care other than isolation distance (3 meter) and roguing is required. The practices which are alternative to the modern seed production technique of groundnut are discussed as under.

**Selection of Varieties**

- The traditional varieties or varieties with higher resistance towards pest and diseases should be selected. However, use of genetically modified seed should be avoided.
- Species and varieties cultivated should, as far as possible, be adapted to the soil and climatic conditions so less care is required for plant protection, growth and development of plants as well as pods.
- In choice of varieties genetic diversity should be taken into consideration.

In Gujarat agro climatic region of India, mainly there are three types of groundnut is cultivated:

- Bunch Varieties: GG-2, GG-5
- Spreading Varieties: GG-10, GG-13
- Semi-spreading Varieties: GG-20

**Land preparation**

Field for sowing of groundnut should be ploughed, harrowed and leveled well to improve sufficient aeration for growth and development of plant and pods. Land should be deep ploughed in summer season so that the hibernated larvae, pupae and eggs of insects are exposed to sun and are eaten by the birds. It also improves the structure and physical properties of the soil.

To control soil borne diseases like stem rot, solution of *Trichoderma hargianum* strain 148 litre (1.38 x 10^7 microbes/ml) is mixed with 30 kg wheat straw and should be applied in furrows. At the time of land preparation Farm Yard Manure@10 t/ha should be added in the soil.

**Seed Treatment**

Groundnut seed is mainly treated for two purposes.

**To facilitate symbiotic N fixation.**

Groundnut is legume crop and possesses symbiotic relationship with N fixing bacteria *Rhizobium*. These bacteria form nodules on groundnut roots and fix atmospheric nitrogen into soil. The crop requires nitrogen at initial stage of growth. Groundnut seeds should be treated with *Rhizobium* biofertilizer @600 g/ha fixes 20-25 kg N/ha and increases yield by 10-25 per cent instead of applying chemical fertilizers.

**To protect the crop from seed and soil borne diseases.**

In groundnut major seed and soil borne diseases are collar rot (*Aspergillus niger*) and stem rot (*Sclerotium rolfsii*). Seeds are treated with Thirum or Carbendazim or Mencozeb @ 3g/kg of seed to control these
diseases. Instead of these chemicals, biocontrol agent *Trichoderma* should be used for controlling these diseases. Seed treatment with *Trichoderma Spp* @ 4 g/kg of seed with soil application of Castor cake @ 500 kg/ha and *Trichoderma Spp* @ 25 kg/ha reduced collar rot incidence by 56.52% (Annon., 2003).

**Nutrient Management**

Nutrients are indispensable for growth and development of any crop. Groundnut requires 12.5 kg N and 25 kg P₂O₅ per hectare. To supply these nutrients farmers prominently use the fertilizers like Urea, Diammonium Phosphate and Single Super Phosphate. In organic farming, to supply major and trace elements to groundnut crop these chemical fertilizers can be replaced by following sources.

**Organic Manures**

Organic manures are of two types: bulky organic manures and concentrated organic manures. Most utilizing organic manure in groundnut is farm yard manure. In a field experiment of three years, among all the treatments including application of chemical fertilizers, FYM@ 10 t/ha gave significantly higher yield (Annon., 2002). Vaghamshi *et al* (1998) reported that there was increase in pod yield of groundnut and pods per plant by addition of Gypsum@ 1 t/ha followed by FYM@ 10 t/ha. Gypsum functions as soil amendment and also improves soil physical condition.

**Bio-fertilizers**

Biofertilizers play an important role in biological N fixation, availability or uptake of nutrients through solubilization or increased absorption, stimulation of plant growth through hormonal action or antibiosis or by decomposition of crop residues.

Treatment of Rhizobium inoculation fixes 20-25 kg N/ha and increases yield by 10-25 per cent in pulses. Asha Mehta *et al* (1995) concluded that application of bacterial culture (*P. strata*) significantly increased the pod and haulm yield of groundnut.

The application of Plant Growth Promoting Rhizobia as seed inoculant positively influenced the groundnut growth and yield and also enhanced the haulm yield, nodule number, pod number, shelling percentage and seed weight. Besides, it also improved the nutrient uptake and significantly increased available N and Phosphorus content in soil (Annon., 2002).

**Vermicompost:**

It is a method of making compost with the use of earthworms, which generally live in soil, eat biomass and excrete it in digested form. In general, vermicompost can be utilized as a substitute of Farm Yard Manure.

Other additives, which can be used as substitute of chemical fertilizers for supplying the nutrients to groundnut, are compost, sewage and sludge, night soil, oil cakes, meat meal, blood meal, fishmeal and green manuring.

**Interculturing and Weed Control**

The competition for nutrients, space and sunlight should be decreased by controlling the weeds. In production of organic seed of groundnut use of herbicides should be avoided and as an alternative to this, hand weeding, interculturing and mulching should be adopted. This will also facilitate healthy environment for crop without any hazards.

**Plant Protection**

**Insect-Pests**

Insects and pests are major threats for production of groundnut seed. Major pest attacking groundnut are Aphid, Jassid, Thrips, Leaf minor, *Spodoptera* and *Heliothis*. To control these pests, farmers are using pesticides like Dimethoate, Monocrotophos, Endosulphan and many more and they have highly residual effects in seeds and soil. So, biological, cultural and mechanical pest control measures should be adopted rather than these chemicals.

Many farmers in India are using traditionally made solutions for the control of these pests since many years. Senguttuvan (1999) revealed that different neem products, Vitex leaf extract and Eucalyptus leaf extract were effective against *Scirotroths dorsalis* in groundnut crop. Sahayaraj and Sekar (1996) shown that *Vitex negundo* leaf extract was effective in controlling Spodoptera in groundnut. Sahayaraj and Paulraj (1998)
concluded that plant extracts of Azadirachta indica, Pongamia glabra and Calotropis gigantia were toxic to the last instar larvae of groundnut leaf minor (Aproaerema modicella). Neem oil at 5 per cent concentration was effective against the Jassid (B. hortensis).

Diseases
Major diseases of groundnut are leaf spots, rust, stem rot and collar rot. To control these diseases, use of bio-control agents and plant products should be used instead of chemicals. Parakhiya et al (1998) observed that the suspension of Trichoderma harzianum was found effective for control of stem rot (Sclerotium rolfsii) disease of groundnut. Trichoderma harzianum mixed with wheat husk (200 ml sq. m.) and added in furrow before sowing consistently reduced the disease i.e. 28.48 per cent as compared to check. Parakhiya et al (1998) reported that Bacillus Spp., Pseudomonas fluorescens and Trichoderma harzianum were found moderately effective against collar rot (Aspergillus niger) as compared to fungicides. Ganapathy and Narayansamy (1990) inferred that Neem oil (1%) and Nerium leaf extract (10%) reduced the incidence of leaf spot and rust and increased pod yield of groundnut over control.

Harvesting and Storing
After harvesting the groundnut crop, it should be dried well in sunlight to control the aflatoxin production and then it is stored in gunny bags in ventilated rooms by covering it with Neem leaves. Traditional practices for storage of groundnut seeds should also be used.

Strategies
It is very important to concentrate on strategies for creating real demand of organic seed by awareness among the people about the importance of safe and pure organic seed consumption for animals and human beings. Organic seed producers, traders and consumers should be brought together so that producers can get remunerative prices and consumers can get desired quality. Farmers are generally not adopting the organic farming practices because they are not giving higher yields during initial years and are not supported by research system. For this, more concentrated organic farming research should be carried out. The organic farming practices are sustainable and economically viable to the farmers on long run. Therefore, effective and sustainable organic farming practices for groundnut seed production should be communicated to the farmers by extensive and integrated extension system. Following is the model for practices and strategies for production and promotion of organic seed of groundnut.
Grower perspective on organic seed production

Dean Gregg
Mission Ranches
100 Broadway
King City, California
93930 USA
Email: dgregg@missionranches.com

Mission Ranches with their joint venture Natural Selection Foods and its grower/partners are growing on 13000 certified organic acres (5200 hectares) with more in transition.

Specialty crops include spring mix (composed of baby lettuce, chards, beet tops, mustard greens and arugula), spinach, romaine and crisphead lettuce, frisee and radicchio for processing. Due to large volume seed needs, Mission Ranches became involved in seed production.

Good seed production requires a suitable climate, experienced growers and seed handling infrastructure. It may be further limited by self imposed districts, crop separation requirements and finally, availability of organic ground and the need for long term rotation to help avoid seed borne diseases. In the Pacific Northwest region, Mission Ranches estimates a current annual need of 200 organic acres (80 hectares) for seed production in a limited geographical area with a minimum 8-year rotation. This in an industry that is growing by 20% annually and is projected to continue at that rate for the next five years.

Seed borne diseases are cause for concern; *Fusarium, Stemphylium and Cladosporium* are all endemic to northwestern Washington state where approximately 50% of the world supply of spinach seed is grown (du Toit). *Verticillium* has been recently introduced to the area from stock sent to the region for seed production. During 2003, on seed purchases from the seed industry, Mission Ranches had crop losses from fusarium in spinach. Fusarium is of particular concern as the ground would not be suitable for growing spinach for some years into the future. Crop losses during 2002 and 2003 from bacterial leaf spot (*Pseudomonas*) in beets and chard have occurred. These were also from northwestern Washington state. In California, lettuce mosaic virus can be transmitted in lettuce seed from plants infected by aphids carrying the virus. Lettuce seed fields must be kept free of aphids to prevent virus transmission. Local lettuce industry regulations require seed indexing for virus at a level of 0/30,000 seeds tested. Development of varieties resistant to the virus help reduce the problem, but not all varieties are currently resistant.

Some in the seed industry feel a date for mandatory organic seed use is required and soon. This is acceptable for some crops like mustard greens that are relatively easy to grow. Those like lettuce, which are required to be lettuce mosaic virus free and have very high seed quality, are of moderate risk. Various producers can do this, but seed quality can be an issue and is still being evaluated. Crops like spinach and chard, which are difficult to produce conventionally, might rarely produce adequate amounts of seed when produced organically. Green chard has been in short supply for the past three years for several reasons; can we expect organic to be any different? What is acceptable quality? This year, Mission Ranches has been offered organic hybrid beet seed which is contaminated with other crop seed which is nothing more than a weed. Are we obligated to buy it? Or if organic lettuce seed is of lower germination percentage than usually acceptable; must we purchase it? Regulations have not yet been written to properly manage the issue of specific seed shortages.

Short-term economic issues can occur for seed dealerships if they are unable to obtain organic seed, thus forcing their customers to switch suppliers. For the grower, it might mean establishing a business relationship that is not preferred. Freedom for the grower to choose between suppliers and varieties are important issues.

Each new regulation has an economic consequence. Use of non-chemically treated seed specifically regarding spinach has resulted in reduced emergence and loss of yield. Some acreage is not suitable for spinach production and has been taken out of rotation. There are also the dollars spent on research looking for solutions.
Current requirement for use of organic pelleting for seed has resulted in pelleting cost increases from 10–25% depending on the supplier. The cost of organic seed will certainly be higher for some species due to higher risks in production.

At the high seeding rates (2.5 million live seed per acre; 6 million/hectare) for baby leaf production; conventionally produced spinach seed average costs per acre US$980 ($2350/hectare), quotes for organically produced spinach seed are $1120/acre ($2700/hectare). Hybrid beet seed costs average US$1280 per acre ($3070/hectare). Organic hybrid beet seed is quoted at US$2200 per acre ($5280/hectare). Organic lettuce seed is quoted at approximately twice the cost of conventional seed. Cost per acre for lettuce seed and pelleting is estimated to jump from US$260 per acre ($620/hectare) conventional to $420 per acre ($1000/hectare) organic. (Please note that organic seed prices vary according to producer and are subject to short term changes.) These added costs cannot be passed along as price increases to the consumer, as the USA has a free market economy.

This is not a call for elimination of the organic seed requirement, but is a call for a gradual approach. It will happen but needs time to evolve. Organic agriculture in the USA succeeded over a 30 year period with out government interference. Successful large scale organic seed production may need new growing locations, new strategies of managing insects and seed borne diseases, new business relationships between growers and seed producers. To expedite this requirement may result in unnecessary costs, paperwork redundancies, seed inventory problems and inequalities among growers. Of the numerous varieties Mission Ranches uses year-round, only five have been produced organically. Two are mustard greens which are relatively easy to produce; the others are the hybrid beet referred to earlier, a chard, and a hybrid spinach which was produced in Europe but there was not sufficient volume to send any to the USA for distribution; certainly none in the volume necessary for large scale farming.

Organic agriculture is important to the world and the challenge is to preserve and encourage its development and avoid regulations that would hinder its growth. Of course, there are environmental costs with the continued use of any pesticide; but there is far greater social good in facilitating large scale organic food production. Demand for high quality, disease free organic seed will naturally follow.

So what is Mission Ranches doing regarding compliance with current regulations? Each year our certifier asks what new steps we have taken toward use of organic seed. In 2003, we were able to purchase 300 kilos of organic mustard green seed. In 2004, we expect to be able to purchase 1000 kilos of organic mustard green seed and 1500 kilos of organic chard seed. Also in 2004, Mission Ranches has contracted organic seed production of 1000 kilos of lettuce, 2500 kilos of spinach and 2000 kilos of mustard greens for availability in 2005. Success or failure of these crops should determine what steps are taken in the future.
Organic seeds and biodiversity in Spain

Maria Ramos García1, Juan José Soriano2, Victor Gonzálvez2.
1COAG (Coordinadora de Organizaciones de Agricultores y Ganaderos). C/ Agustín de Bethancourt 17, 5º, 28003 Madrid (Spain) E-mail: mramos@coag.org; 2Red de Semillas-Plataforma Rural. Dirección postal: c/. San Juan Bosco, 31. 41008 Sevilla (Spain); 3SEAE (Sociedad Española de Agricultura Ecológica). Partida la Peira s/n. Apto.107. 46450 Benifaió. Valencia (Spain).


The organic production in Spain has not stopped growing during these last 20 years. Already 17.000 producers exist and more than 725000 hectares certificated, occupying third place in surface in the European Union, after Italy and Germany, with a turnover of 235.65 million euro. Its greater characteristic lies in the diversity of productions and habitats. We can find from large producers that destine the majority of its turnover to export markets, to small producers that center its efforts in local sale markets development, incorporating an important cultural component and that, in many occasions, do not need an ecological seal for its commercialization.

The ecological agriculture has meant and means a real alternative to maintain the local weave in marginal zones, where the agrarian activity is no longer supported for itself alone to international market prices. The use of the middle resources, the smaller dependence of supplies, the creation of employment and the value added of these products maintains the agrarian activity in these zones (Spain was declared by the EU with 75% of its territory as disadvantaged zone). Likewise, the ecological production is playing an important role in conservation of protected zones all to be the productive and compatible with the environmental conservation of sensitive contamination zones (as was drawn as conclusion in technical Conference of SEAE, in Garrucha) or the specific disappearance of niches of flora and fauna. We must not forget that the 23.5% of the Spanish territory is declared like LIC, (interesting place for conservation under the Network Natura 2000, a total of 118.496 km²). We find ourselves before a productive model key for management of the territory in numerous zones of the Spanish geography and for the mediterranean conservation of ecosystems based on the indigenous association of species as are the Dehesa, the mount and the mediterranean garden, the associated olive grove al vineyard or the systems cattle-cereal.

The problem of biodiversity loss in agriculture.

Unfortunately the majority of Spaniards productive systems have not escaped to the erosion of the cultural and biological biodiversity. It has taken place a change of mentality in farmers and in its working ways along with a change in to a business agriculture in which greater performances, greater productions and greater uniformity is needed. The need to obtain more uniform varieties, of greater unitary performance, producers of grains or fruits of better quality, all along with the necessity of greater quantities of seeds for greater surfaces of cultivation, has caused the increase of supplies and agrarian services, among them those of seeds.

In Europe cities the great mass of consumers have been induced to pay more by exotic, new or out of station products. Due to it, forced production, greenhouses and soilless cultivation, etc, have developed especially in the benign climates in Southern Europe. These systems have also been extrapolated to many organic productions, above all in the mediterranean zone where farmers should resort to a conventional use of seed (easier and accessible, etc.) In horticulture a lot of local varieties have been lost due to lack of use, displaced by new more productive selections, other are maintained cornered and needed of a process of tipificación, selection and improvement so that they return to show their peculiar characteristics, and they be returned to commercial productive process. The organizations of organic consumers (scarce in Spain) in Europe, are not pressuring still the sufficient thing to support initiatives that wager for the biodiversidad in organic farming.

Problems for organic seeds use in organic farming.

Problems for the creation of national production initiatives.

Up to now there has been a clear lack of integration among seed producers, organic farmers and Authorities. The large conventional seeds companies have not wagered for this type of production because the demand is small, but the Spanish legislation of seed marketing is not adapt to the conditions of small businesses with a scarce volume of production. It requires that the farm or the installations where these are produced, be
submitted for a control of a company of certification inorganic farming, recognized by the competent Authorities in Spain. Companies that offer ecological seeds in Spain, produced abroad, should be submitted for a control of an agency of control recognized by the European Union. Until now, it has not been an effort from the public administration by promoting the creation of small businesses of production neither by adapting the obsolete legislation to the conditions that these need.

We have many cases of producers with interest in reproducing certain varieties, but procedures required are not compensated by volume that would be able to produce, so in these moments the majority of the seeds offering comes from the European companies importing that offer varieties adapted only to a part of the demand of the Spaniard organic farming. The fear that is appearing among the producers lies in motion of the annex of the new regulation that, once introduced the species, can oblige to use not convenient varieties for many of them.

On the other hand, we cannot forget the special situation of defenselessness in which our country is found due to genetically modified cultivations. Since 1998 it is cultivated in Spain genetically modified corn in a commercial way for animal diet. Totally absent of GMOs obtaining of seeds will not be able to be carried out if is not protected in a determined way to the organic production. Nevertheless the politics of our Government has walked, up to now, in opposite direction giving, on the order hand, a whole freedom to this type of productions without putting measures of protection to organics. This is what has caused that we have already had same cases of contamination of ecological productions by corn (included seeds) with GMOs in Navarre and Catalonia.

**General seeds regulation and local varieties.**

As already commented, certain local varieties play an important role in the productions of some regions. Others are susceptible to be reintroduced and adapted to the ecological agriculture and already some trials for it have been carried out. Nevertheless, the present legislation forbids that all these varieties can be marketed until figure in the commercial registrations. The Spanish legislation also forbides the exchange of seeds because of considering it as a commercial practice and it only will be able to market them if those varieties are recorded in the commercial registration of varieties (Ministry of Agriculture, 1994). Particularly, not official tests and knowledge acquired thanks to the practical experience during cultivation, reproduction and use and detailed descriptions of the varieties and their corresponding denominations will be taken in consideration, just as they have been notified to the Member State (MS) and, in case that they be sufficient, the exemption of the official exam will be allow. It will have the mention “variety of conservation” in the common Catalogue (Directive 98/95/CE of the Council. 1998).

**The Regulation 1452/2003 contemplates the utilization of the varieties of conservation as one of the exceptions to do not obligue the use of seed in organic. Nevertheless, it is not given a legitimate recognition as one of the criteria to keep in mind to define if a species will be or will not be included on the annex.**

**Current situation about organic seeds access in the Spanish market.**

With Regulation 1452/2003 of the Commission, principles are introduced to establish the organic seeds use obligation at organic farming. This regulation also establishes obligation to each MS set in motion a data base where offering of varieties produced in organic be recorded (see Table1). Companies recorded in this registration (IAC, Palomo Cereals, Agrarian Cooperative San José, OPPOSA) will should market varieties recorded on the commercial registration of varieties and to comply with the general legislation of seeds (supplier licences etc). Besides, the varieties that appear in this registration should be used by organic producers unless they have a justified reason to do not do it. In Spain an organic seeds offering exists already. In 2003 and, subsequently in 2004, we have carried out a poll of the companies that could offer organic seeds in Spain. We have found that there is a great foreign number of seed companies with capacity to market or to operate in Spain, many of them producing also conventional seed being the majority of the seed that sell produced out of Spain and being new varieties or hybrid. We have also found some initiatives of production in Spain and most of them correspond to research agencies or associations, although also there are some producers recorded on the organic production certification bodies. The places where more abound these initiatives are located in Andalusia, Aragón, Castilla La Mancha, Catalonia, Murcia, from Navarre and Valencia. The greater coommercial offering is concentrated on vegetables, existing certain offering in seed of cereals, legumes and potatoes (González 2004). Then, ¿why do there is so few businesses recorded in the official data base? There are several reasons: many of them that have initiatives of production do not comply with the general legislation of commercialization of seeds, others they are not
recorded by control bodies of the organic farming and others reproduce not suitable varieties to the market because of not being recorded at the commercial register. Also there are companies not interesting on recording varieties offered in organic due to they fear that these be displaced of the market by other that still can be bought in conventional. Although there is a perspective on diversity of the offering, is very difficult to establish this in quantitative terms, at the same time this information is not easily accessible. On the other hand, is also complicated to determine the demand, because this is enough complex and for the time being nobody has developed sufficient media to carry out a study on this matter. Besides, some estimations on the prices of the organic seeds offered at present code these in an increment among a 5 and 20% more than the conventional.

Producers, not finding enough offering of varieties (cereals, potato and some local vegetables) and on account of the difference of prices with the conventional one, have not been launched to the organic seed use. In this joint it is difficult to be able to force to Spanish organic farming to a generalized use of organic seeds if we want to maintain the diversity of used now varieties, not only in vegetables, but also in other cultivations.

*A particular case: local biodiversity and organic horticulture.*

The organic horticulture is a faithful image of disparity of situations. We have more than 3800 organic hectares in organic production of vegetables and potatoes and although the main zone situated in the communities of the mediterranean coast (1401 in Andalusia, 847 in Murcia and 261 in Valencian Community), there is organic production of vegetables in all the Spanish provinces under a multitude of different productive systems.

In a evaluation of the regions done by the Red de Semillas in May 2003 we could verify the following: self-production seeds quantity is directly related to the type of variety used that, in these cases, is used to be seed of local varieties and with the market to these varieties are destined, also local. Options to obtain the seeds in these regions are: self-production, exchange and purchase of conventional seed from foreign companies. The consumption of organic seeds is insignificant. In Canary Islands, Madrid and other communities have been given some adaptation problems with foreign varieties. There are communities where new varieties or hybrid are employed in vegetables (Andalusia, Murcia and Valencia), where is used to coinciding that conventional or organic seed is bought imported. There are some regions where old or local use of varieties is maintained. Such is the case of Canary Islands where near a third are local varieties and it begin to be moved local networks of exchange. Balearic Islands cultivates some indigenous varieties in extensive. In La Rioja the 40% of the producers consulted produces its seed with local varieties. In Galicia (northeastern of the Peninsula) 50% of varieties are local and self-produced by farmers (Ramos, 2003). Now, a small company from this region is developing the employment of an indigenous corn (yellow and white corn) kept in the regional seeds Bank for its employment in organic agriculture, after the disappearance of many traditional varieties by the apparition of hybrids for animal consumption. Like this, we can cite numerous examples of trials with local varieties to facilitate its use and conservation in situ by means of the organic production. It has been verified, from descriptors used in the characterization, that evaluated varieties possess sufficient varietal identity and potentially valid presence of characteristics to promote, first, their registration and then place their incorporation at organic market of seeds. This registration would need of a prior work to enlarge the homogeneity and stability of these varieties.

**Table 1. Species recorded at the National Data Base of organic seeds**

<table>
<thead>
<tr>
<th>Species</th>
<th>N° varieties</th>
<th>Species</th>
<th>N° varieties</th>
<th>Species</th>
<th>N° varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hordeum vulgare L.</td>
<td>1</td>
<td>Lactuca sativa L.</td>
<td>2</td>
<td>Borago oficinalis</td>
<td>1</td>
</tr>
<tr>
<td>Triticum aestivum L.</td>
<td>2</td>
<td>Petroselinum crispum</td>
<td>1</td>
<td>Allium cepa L.</td>
<td>5</td>
</tr>
<tr>
<td>Triticum durum Desf.</td>
<td>3</td>
<td>Anthricus cerefolium L.</td>
<td>1</td>
<td>Brassica oleracea L.</td>
<td>2</td>
</tr>
<tr>
<td>Vicia sativa L.</td>
<td>1</td>
<td>Capsicum annuum L.</td>
<td>4</td>
<td>Chicorium endivia L.</td>
<td>3</td>
</tr>
<tr>
<td>Pisum sativum L. Partim</td>
<td>1</td>
<td>Allium porrum L.</td>
<td>1</td>
<td>Espinacea oleracea L.</td>
<td>1</td>
</tr>
<tr>
<td>Solanum melongena L.</td>
<td>1</td>
<td>Brassica oleracea L.</td>
<td>1</td>
<td>Pisum sativum L.</td>
<td>2</td>
</tr>
<tr>
<td>Vicia faba L.</td>
<td>2</td>
<td>Citriullus lanatus (Tumb)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foeniculum vulgare Miller</td>
<td>1</td>
<td>Lycopersicon lycopersicum (L.)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phaseolus vulgaris L.</td>
<td>2</td>
<td>Solanum tuberosum L.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*MAPA. Ministerio de Agricultura, Pesca y Alimentación. May 2004. www.mapya.es*
Some initiatives.
There are diverse initiatives that have developed in favor of the conservation of the biodiversity in our country, most of them from the sector, although some of them are from public institutions.

a) Seeds Banks have passed to play an essential role in conservation of genetic material which use has been left, but conservation in situ is lost, and also the cultural knowledge that it carries associated to her. Continuing the aspects that collects the world Action Plan of FAO for the conservation and the sustainable use of phyto genetic resources, the National Center of Phyto genetic Resources adhering to INIA (National Institute of Agrarian Investigation) compile 61501 entrances of varieties conserved in different Seeds Banks around the country, 27 public centers in total. Most of these entrances are species vegetables and the majority of them are primitive varieties. For instance, the Seed Bank of the Technical University of Valencia conserves 1980 entrances, most of them belonging to primitive varieties collected in nearby regions and they have lost its use on agriculture.

b) In Seville, continuing the guidelines of the works of recovery and conservation of local varieties begun in the decade of the 90 by the Institute of Sociology and Rural Studies (ISEC) of the University of Cordoba and the General Direction of Investigation and Agrarian Formation of the Andalusian Authorities, in contribution with an organic production cooperative and associations of consumers of this type of products in the regions of Villamartín (Cadiz), Estepa (Seville) and Antequera (Malaga), have been developed a project on order to evaluate, use and conserve in situ the local varieties for its use in organic agriculture (Díaz del Cañizo et al, 1998), (González & Soriano & Aguirre, 2002). Execution of trials has been carried out in “La verde” cooperative of Villamartín (Cadiz), where it appeared the need of apt vegetable material for organic growing. This project has been centered in a total of 21 varieties of local vegetables; six of tomato, two of worthless, three of pimientos, two of watermelon and eight of melon. They worked with farmers and consumers (Soriano et al, 1998).

c) In the Basque Region there is a complete survey done by Ekonekazaritza (Basque Confederacy of organic farming) about needs of seed and nursery in this region. It shows that varieties more selfproduced are local. It is clear in case of tomato, corn, pepper and bean when are destined to local market and conventional varieties when they go to great market. Also there is an important number of producers that buy plant. With other vegetables, as the lettuce, conventional varieties are used in greater proportion. The problem comes because the plant should originate from organic seeds, in many cases it is not possible. There are some crops where are used many old varieties as pepper and others where the conventional are used mainly (González, 2003)

Opportunities and new initiatives.
The three organizations that sign this document, that develop activities in different spheres (Red de Semillas in recovery of local varieties and rural development, COAG in agricultural production and SEAE in diffusion of research in organic farming), they carried out an important effort to find spaces of dialogue, almost without official support, to combine efforts and positions before the enlargement of the exception of the conventional use of seeds and the creation of the European base of data. So, different forums were organized as the Conference of Genetic Resources and Seeds in Organic Farming, (Sangonera La Verde, Murcia, May 2003). One of the conclusions shared more noticeable that arrive on this matter refers to that “the ecological agriculture supposes a special niche for the recovery, conservation and improvement of the agricultural local varieties”. Thus, an Organic Seeds Action Plan was edited in which they were proposed, among others, the following measures:
- Trying local varieties status be recognized and facilitating its free utilization and commercialization.
- Developing a survey on the erosion in agrobiodiversity (growing systems and local markets) of it set in motion of the new organic seed moratorium system
- Adaptation of regulation to: obtaining the title of general seed producer to the ecological production of seed in small businesses, adequating technical regulation to the ecological production of seeds to avoiding the use of patents on life in organic agriculture and developing an efficient protection against the genetically modified crops.

Keeping in mind the international framework, determining each time what occurs in the different European regions, we have detected the need to develop strategies or European programs that carry out a joint fight for the use of the diversity in the organic production and they promote the improvement of adapted local varieties Our proposed is directed to the creation of a Platform or a Network destined to it.
Conclusions.
It can be recognized that in some cases, the conjugation of the conservation of agrarian biodiversity and the organic origin seeds use is not always possible, in the short-term and present framework. In spite of the fact that the organic offering of seeds in Spain grows slowly, it is not yet adapted to our realities. Because of it, it is indispensable the development of an adequate framework for the production of seeds adapted to all the productions and that enable a free use of the varieties and the material of reproduction that these farmers need.

This framework should present in an integral way the questions of production, provision and use of seeds. It should contemplate since the management of the indispensable genetic resources for the obtaining of varieties adapted to organic production to networks of provision and marketing that guarantee the sustainability of the productive system.

What three organizations defend is to give local varieties the just deal they deserves, to recognize its use, its importance for the future generations, its right to be marketed and used with all legislative endorsement but with a vision adapted to its use. Recognizing at the same time the role of those that conserve them, without putting join administrative or economic.

References.
Ministry of Agriculture, Fish and Food.(1994). Orden de 10 de octubre de 1994 por la que se modifica la Orden de 23 de mayo de 1986, por la que se aprueba el Reglamento General Técnico de Control y Certificación de Semillas y Plantas de Vivero. Available at: http://www.boe.es


Improving the local varieties of medicinal plants through organic production, 
a case study from Egypt

Dr. Ahmed Shalaby  
Head of Agriculture Department, SEKEM Academy, Egypt  
3 Belbes Desert Road, 11777 Cairo, Egypt, P.O.B. 1535 Alf Maskan.  
Email: ahmed.shalaby@sekem.com

Abstract
Production of Medicinal and Aromatic Plants (MAP) in Egypt is an old tradition. Exports of MAP and their products represent an important part of Egypt’s exports of agricultural commodities, it reached more than 200 million LE in 2003. The last decade witnessed a remarkable increase in the cultivated area with MAP, of which the organically grown area showed the highest rate of increase. Last estimate for the organically grown area with different crops is about fifty thousand acres.

Unfortunately, very little efforts have been directed towards the improvement of yield and quality of these crops. Therefore, SEKEM Co. initiated a breeding program to improve some of these species especially those having large demand for export. The program is going on since 7 years including chamomile, calendula, anise, fennel, hibiscus and basil. The program depends mainly on the local varieties.

Remarkable results have been achieved with all of these crops except with fennel; we are still trying to get a new variety with high anethol but low estragol contents. The improved seeds of the other crops are distributed to all the farmers who grow MAP under organic and/or biodynamic conditions. That helps the farmers to obey to the IFOM requirements regarding the use of organically grown seeds. There is also a big demand for these seeds even from farmers applying the conventional methods, due to the high quality of crops originated from such seeds. That helps in improving the quality of their products to be in harmony with the international standards for these products. The organic seed program is going on in collaboration between SEKEM staff and scientific team from research institutes and universities in Egypt. Some of the achieved results will be presented. We have to say that a lot of work is still needed regarding certification, registration, legislation, and commercialization of the organic seeds in Egypt.

Keywords: Organic seeds, Medicinal plants, SEKEM co.

Introduction
Production of medicinal and aromatic plants (MAP) in Egypt is an old tradition. Exports of MAP represent an important in Egypt’s exports, it came in the third rank of the exported agricultural commodities following cotton and rice. The cultivated area with MAP reached 65 thousand acres in 2003. Exports in the same year reached about 50 million $ of bulk herbs plus 30 million $ of oils and concretes. Available statistics of the last 10 years revealed an increasing rate of 2.7% in the cultivated area, 7.4 % in the production and 12.5 % in exports.

The organic movement in Egypt started in 1979 when SEKEM started the organic production of MAP for the first time in a limited area of about 50 acres. The area of organically grown crops, including field crops, MAP, fruits and vegetables reached about 50 thousands acres in the year 2003. About one third of this area is cultivated with MAP. From the early beginning SEKEM initiated the Egyptian Biodynamic Association (EBDA) as an NGO to support the farmers working in this field. Besides, it initiated the Center for Organic Agriculture in Egypt (COAE) as an inspection and certification body. Now, there are several NGO’s and inspection and certification bodies organizing the organic movement in Egypt.

Status of seed production
Organic production in Egypt as in SEKEM too, is not limited to MAP, but it includes field crops (cotton, wheat and rice), vegetables (tomato, potato, cucumber, pepper squashes, …etc.) and fruits (grapes, citrus, apricots, …etc). Improvement in field crops, vegetables and fruits has been for a long period undertaken by
several research departments belonging to the Ministry of agriculture. Recently, the private sector is playing an increased role in this regard. On the other hand, MAP did not get the same interest and efforts for their improvement. That created some problems;
- Production of MAP for several decades was limited to a small number of crops, i.e. basil, peppermint, chamomile, majoram, geranium, … etc.
- Low quality of some crops, i.e. low active constituents, undesirable constituents, and/or low storage ability.
- Unidentified varieties

**Seed improvement program in SEKEM**

To overcome the above-mentioned problems, SEKEM initiated in 1995 a program improvement and production of the organic seeds. The program depends on collaborative work between scientists from SEKEM, National Research Center and Universities. The program started with those crops of high demand either for export or local market, e.g. chamomile, calendula, basil, anise, hibiscus and fennel. In all cases the selection program depends on the local plant sources. It starts with investigating the range of variation, the behaviour of the different characters, and trying to find out some correlations between the chemical constituents on one hand and the morphological characters on the other hand.

**Outputs of the program**

**Chamomile:**
The local source of chamomile was characterized with small to medium size flowering heads having a flower diameter ranging around 2.4cm. They contained about 0.50% of a bluish green colour. After an individual plant selection program for 3 years, the selected variety is characterized with bigger flower diameter (2.8cm) and 0.62% of blue oil. Erect plants were selected to facilitate the flowers collection. It is a continuous selection program to provide the farmers every year with the selected organic seeds.

**Calendula:**
The local source of calendula was characterized with flowers ranging in colour between pale yellow and dark orange, as well as, 1 to 2 rows of petals. The individual selection program led to a homogeneous dark red flower with 10 to 15 rows of petals. Accordingly, the yield of petals per unit area increased by 2 to 3 folds.

**Basil:**
Different types of basil were detected among the local variety. The flower colour ranged between white to violet, and leaves ranged between narrow to broad leaves. As a result of the selection program, two varieties were isolated and classified as narrow leaf type (2.6cm width) and broad leaf type (4.7cm width). The narrow leaf one contains higher level of oil (1.25 %) compared with (0.95 %) in the broad leaf one, but the higher herb yield of the later one may compensate the lower oil content. Both varieties have white flowers.

**Anise:**
Plants of the local variety of anise was characterized with inhomogeneous plant height and long internodes ranging between 13 to 15cm. A short internode type (8 to 10cm) was selected. It showed higher yield of seeds (45.65g/plant) in comparison with the original one (34.47g/plant). The selected variety has higher seed weight (497 seeds/g) compared with (608 seeds/g) for the original one. Both varieties have almost similar oil content of 1.5%. The selected variety showed resistance to lodging.

**Hibiscus:**
Based on the sepals colour, two pure varieties were isolated and classified as pale red and dark red varieties. The first one has higher acidity than the later variety. They are both cultivated now depending on the consumer demand.

**Fennel:**
Good results have been achieved in most cases except in case of fennel. The local sources of fennel are characterized with high contents of estragol but low content of anethol. We aimed to get a variety with low estragol but high anethol contents. A program is going on depending on hybridisation of the local variety
with other imported varieties. Also, some of these varieties are under evaluation and acclimatization under the local environmental conditions. Still there are some problems regarding the productivity and the long season of growth and accordingly, the economic value of these varieties in the local market.

Achievements:
- Availability of the improved organic seeds for organic farming in Egypt to fulfil the requirements of IFOAM regulations regarding the use of organic seeds.
- Availability of these seeds even for conventional production of MAP as improved seeds regarding the yield and quality of these crops to fulfil the export standards.
- Diversification of MAP production in Egypt through introduction and acclimatization of some new MAP, i.e. echinacea, melissa, oenothera, …etc. Organic seeds of these species are now available for farmers.

We have to mention that since three years SEKEM is also producing organic seeds of cotton and wheat, while organic seeds of rice will be available this year for the first time.

Gapes and problems:
- Testing and certification
- Registration and legislation
- Pricing and marketing

At the moment, arrangements are going on with the Ministry of Agriculture to set up the required regulations covering these issues. In the meantime, SEKEM holding group is welling to cooperate with any organizations in production of organic seeds in Egypt.
Organic cereal seed production and quality issues in Germany

Werner Vogt-Kaute
Naturland e.V., Kleinhaderner Weg 1, 82166 Gräfelfing, Germany
Email: w.vogt-kaute@naturland.de

Abstract
At present there is no official data about organic seed production in Germany although it could be easily recorded. Therefore, the data presented here is based on estimations. As many organic farmers in Germany prefer using certified seed because of its high quality in terms of germination, seed production under organic conditions is relatively high. Currently almost all the demand for organic cereal seed in Germany is being met but supply is threatened by extreme weather conditions in some years. Occasional problems of rejection of seed lots are due to internal quality standards of organic associations and traders not being met. These quality standards consist of germination tests under colder conditions (10°C) in soil and control of seed-borne diseases. Cold test in soil shows presence of some diseases causing low germination that cannot be detected in other substrates. Official standards for organic seed in the near future are necessary so organic farmers can be sure to be supplied with organic seeds of high quality.

Keywords: seed, seed quality, cold test

There are no official data about amount of organic seed production in Germany at the moment. The organic seed data base (www.organicxseeds.de) records varieties but not the amount of available seeds. Data about organic seed production could be easily recorded by adding the necessary column on the official papers for admission. The data presented in this paper about the quantity of available seeds are based on estimations.

Although the share of organic arable land in the total is small the share of organic cereal seed propagation in relation to all cereal seed propagation is high. This is due to two factors; the lower seed yield of an organic crop and the high percentage of use of certified seed by organic farmers. Organic farmers prefer using certified seed because of its high germination percentage. There is, however, a limited number of farmers who produce their own seed because of ideological reasons. Of concern is the prevailing economic conditions that could have negative consequences on the use of certified seeds, both in the organic and conventional sectors.

The statistics presented below in Table 1 on cereal varieties show that a higher percentage of available spring cereal varieties are produced for organic farming. It is important to point out that weather conditions at sowing time in the autumn have an influence on the number of varieties produced annually. The proportion of winter barley varieties in organic seed production relative to the total number available was lowest for all winter cereals. Likewise, the number of propagations of winter barley was lowest of all cereals.

Table 1: Number of organic seed propagations, harvest 2003 (Kompetenzzentrum Ökologischer Landbau Rheinland-Pfalz 2003, organicxseeds, 2004)

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of varieties in the German variety list 2003</th>
<th>No. of varieties in organic seed production</th>
<th>No. of organic ‘propagations’ in 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter wheat</td>
<td>105</td>
<td>31</td>
<td>131</td>
</tr>
<tr>
<td>Winter rye</td>
<td>27</td>
<td>16</td>
<td>64</td>
</tr>
<tr>
<td>Winter triticale</td>
<td>22</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Winter barley</td>
<td>81</td>
<td>12</td>
<td>28</td>
</tr>
<tr>
<td>Spelt</td>
<td>7</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Spring wheat</td>
<td>18</td>
<td>11</td>
<td>42</td>
</tr>
<tr>
<td>Spring rye</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Spring triticale</td>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Spring barley</td>
<td>46</td>
<td>16</td>
<td>65</td>
</tr>
<tr>
<td>Spring oats</td>
<td>39</td>
<td>12</td>
<td>45</td>
</tr>
</tbody>
</table>
Farmers who produce organic seeds have to fulfil official criteria such as contamination with weed and other cereal seed and germination standards (Rutz, 1999) in addition to organic criteria set by official organic bodies e.g. Naturland farmers’ trade company. Organic criteria include grain size, germination percentage at 10°C (the so-called cold test in soil) and limits for seed borne diseases. The introduction of ‘official’ criteria for organic seed quality is in discussion and can be expected to be in force in the medium term.

Table 2: Official and Naturland Criteria for certified seeds (Z1) of wheat and barley

<table>
<thead>
<tr>
<th></th>
<th>Official Criteria</th>
<th>Additional Naturland Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain size</td>
<td>-</td>
<td>2.5 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2 mm for barley (6 row)</td>
</tr>
<tr>
<td>Germination</td>
<td>92% at 20 degrees Celsius</td>
<td>80% at 10 degrees Celsius in soil</td>
</tr>
<tr>
<td>Tilletia caries</td>
<td>5 plants in 150 m2 in field</td>
<td>20 spores per seed</td>
</tr>
<tr>
<td>Ustilago nuda</td>
<td>5 plants in 150 m2 in field</td>
<td>0 spores per seed</td>
</tr>
</tbody>
</table>

In general there is an almost 100% supply of organic cereal seeds in Germany with the exception of durum wheat and exotic species. But there is the danger that in years with extreme weather conditions seed supply will be limited due to a higher rate of rejection of seed lots. The table below shows the percentage of seed lot rejection for Naturland.

Table 3: Rejection of Naturland seed lots, harvest 2001 – 2003, in percent

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter wheat</td>
<td>20</td>
<td>41</td>
<td>5</td>
</tr>
<tr>
<td>Winter triticale</td>
<td>18</td>
<td>82</td>
<td>12</td>
</tr>
<tr>
<td>Winter rye</td>
<td>24</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>Winter barley</td>
<td>20</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Spelt</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spring wheat</td>
<td>10</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Spring triticale</td>
<td>60</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>Spring barley</td>
<td>10</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Spring oats</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4: Reasons for the rejection of Naturland cereal seed lots, harvest 2001 – 2003

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Total 38</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Official criteria</strong></td>
<td></td>
</tr>
<tr>
<td>Unacceptable level of weed seed</td>
<td>3</td>
</tr>
<tr>
<td>Unacceptable level of other cereal seed</td>
<td>3</td>
</tr>
<tr>
<td>Official germination</td>
<td>2</td>
</tr>
<tr>
<td><strong>Naturland criteria</strong></td>
<td></td>
</tr>
<tr>
<td>Seed borne diseases</td>
<td>2</td>
</tr>
<tr>
<td>Cold test in soil</td>
<td>28</td>
</tr>
</tbody>
</table>

In the internal Naturland quality standards the cold test in soil represents germination in difficult climatic conditions and is therefore, an important condition to acceptance of a seed lot. Poor germination in cold test in soil is often caused by Fusarium spp, Septoria nodorum, Microdochium nivale or Drechslera graminea. Examinations showed that seed bearing spores can be detected in cold test in soil but not in cold test in other substrates e.g. quartz sand or Ziegelgruß. So these two substrates are not appropriate for showing the number of spores of different pathogens in a differentiated way and giving farmers the necessary information on suitability for sowing.

Table 5: Germination in cold test in different laboratories (Bartl, 2000)

<table>
<thead>
<tr>
<th>Laboratory/Wheat variety</th>
<th>Bussard</th>
<th>Astron</th>
<th>Capo</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBP Freising soil</td>
<td>57</td>
<td>74</td>
<td>63</td>
</tr>
<tr>
<td>LUFA Augustenbg soil</td>
<td>69</td>
<td>62</td>
<td>77</td>
</tr>
<tr>
<td>LUFA Kassel Keimrollen</td>
<td>86</td>
<td>89</td>
<td>94</td>
</tr>
<tr>
<td>LUFA Rostock sand</td>
<td>55</td>
<td>82</td>
<td>84</td>
</tr>
<tr>
<td>NU Flensburg sand</td>
<td>56</td>
<td>83</td>
<td>45</td>
</tr>
</tbody>
</table>
At the moment there are no official regulations for organic seeds in Germany. Cold test in particular is not done uniformly. So there is no comparability of results of different provenances and no real certainty for the organic farmers. As organic farmers like to buy certified organic seed but only those with real good quality, the cold test in soil in our view provides a cheap method that provides fast results. Therefore, it should be the standard for organic seeds.

References
Specific seed health standards for organic cereal seed

L. Girsch & M. Weinhappel
Austrian Agency for Health and Food Safety, PO-BOX 400, A-1226 Vienna
Email: leopold.girsch@ages.at

Introduction
Seed is the basis for complete, vital and healthy crops and the basis for the production of high-quality and healthy feedstuffs and food. The state of health of seed has substantial influence on the value of use of seed, i.e. the value of benefit in practical use. This circumstance is particularly important with untreated seed and seed for the organic agriculture.

Traditionally, the state of health of seed in the Austrian seed standards has a very high ranking. Due to ecological and economical aspects and existing requirements of the organic agriculture, the chemical treatment of certified seed has to be carried out only after appropriate indication and not preventively. The standards for untreated and organic seed used in Austria comply with the minimum requirements of the EC and fulfil specific requirements regarding the state of health and thus the value of use.

The value of use of seed refers to the following:

1. Genetic component (= variety value, variety quality)
In Austria, the genetic potential without specific use of pesticides is already being recorded during the Value for Cultivation and Use (VCU) tests during variety listing. Varieties that are resistant or tolerant to harmful organisms are favoured over susceptible varieties. This basic test approach is independent of whether the varieties are to be used for conventional or organic agriculture. In a research project, specific breeding aims and test criteria for the organic agriculture are evaluated (VCU tests for organic varieties).

2. Technical component (= seed value, seed quality)
The technical components, which cover among other things characteristics like analytical purity, content by number of seeds of other plant species and germination, are defined and regulated by EC minimum standards on the technical seed quality.

Table 1: Minimum requirements to the germination and the state of health of untreated cereal seed in accordance with the Austrian seed standards

<table>
<thead>
<tr>
<th>Minimum germination requirements (in %-number)</th>
<th>Hordeum vulgare</th>
<th>Secale cereale</th>
<th>xTritic-secale</th>
<th>Triticum aestivum</th>
<th>Avena sativa</th>
<th>Triticum durum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum germination 20°C (EC-method) and</td>
<td>85</td>
<td>85</td>
<td>80</td>
<td>85</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Minimum germination 10°C only untreated seed</td>
<td>85/75</td>
<td>85</td>
<td>80/75</td>
<td>85/80</td>
<td>85/75</td>
<td>85/75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum requirements regarding the state of health of untreated seed (%-number, Tilletia spp. and Urocystis occulta Spores/Kernel)</th>
<th>Hordeum vulgare</th>
<th>Secale cereale</th>
<th>xTritic-secale</th>
<th>Triticum aestivum</th>
<th>Avena sativa</th>
<th>Triticum durum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ustilago nuda</td>
<td>0.1/0.5</td>
<td>10</td>
<td>10</td>
<td>0.2/0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilletia spp.</td>
<td></td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urocystis occulta</td>
<td></td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrenophora graminea</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusarium nivale</td>
<td>10/15</td>
<td>10/15</td>
<td>10/15</td>
<td>10/15</td>
<td>20/-N-</td>
<td></td>
</tr>
<tr>
<td>Septoria nodorum</td>
<td></td>
<td></td>
<td></td>
<td>20/-N-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyrenophora avenae</td>
<td></td>
<td></td>
<td></td>
<td>20/-N-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A risk-minimized use of untreated seed under average and usual cultivation conditions is supported considerably by a targeted selection on the basis of suitable criteria for the evaluation of the value of use. For this purpose, additional evaluation criteria for the certification of chemically treated or untreated seed were specified in the official Austrian seed standards:

- Limit value for the state of health by means of a germination test at 10 °C (in the EC seed law as defined in “not explicit”)
- Threshold value for the state of health concerning dangerous seed-borne pathogens (in the EC seed law as defined in “not explicit”)

The EC seed law uses the general formulation: “The presence of pathogens which affect the seed value is limited to a minimum.”

Since, however, the value of use of untreated seed is determined considerably by the state of health. In the Austrian seed standards this general wording has been adapted to specific minimum requirements limiting the presence of the most important pathogens (Table 1).

**Characterisation of the relevant pathogens:**

**Obligate seed-borne pathogens**

Pathogens, which are being transmitted only by the seeds from the previous to the next generation: e.g. loose smut (*Ustilago nuda*), barley leaf stripe (*Pyrenophora graminea*), common bunt (*Tilletia caries/foetida*)

These require no PROTECTIVE FUNCTION, but a pathogen-specific SANITATION FUNCTION at infestation over the threshold value.

**Facultative seed-borne pathogens**

Pathogens, which can be transmitted by seeds respectively by soil or by harvest residuals etc. from one generation to the next: e.g. snow mold (*Microdochium nivale*), all “seedling pathogens” (e.g. *Septoria nodorum*), dwarf bunt (*Tilletia controversa*), rye stem bunt (*Uro-cystis occulta*). In the case of seed infection over the threshold value, facultative seed-borne pathogens require Sanitation function. In case of unfavourable field emergence conditions, late so-wing and persistent snow coverage, the Protective function of seed dis-infection should be applied as well.

**Illustration 1:** “Sanitation” and “Protection” of seed and field emerging young plants
Results and discussion

1. Production of seed with high value of use:
In Austria’s main multiplication areas for grain seed usually optimal conditions prevail for the production of high-quality organic seed. The evaluation criteria for the value of use as specified by law are being achieved in an appropriate manner.

In 2003/04 for example, approximately 95% of winter wheat reached the value of use for untreated seed as specified in the official seed standards. The year before (at the time of evaluation, the season of 2003/04 was not yet completed), the ratio of summer barley with positive value of use only represented approximately 75% of the total organic seed production. Quality defects were, above all, the increased occurrence of the barley leaf stripe, as well as the content by number of wild oat (*Avena fatua*).

The statistic evaluation of the seed health testing results shows that in the course of the official seed certification procedure, obligate seed-borne pathogens only sporadically show a high infection level. However, tests on farmer’s own seed showed a significant increase of the level of infection as well as of the average and maximum infestation heights.

In the last five test years, the fixed limit value for certified seed was exceeded only in 1.5% of the cases. In less than 15%, the threshold value was exceeded, in which cases appropriate seed sanitation, usually a fungicide seed treatment, had to be carried out. As regards wheat (*Triticum aestivum*), legal restraints for fungicide seed treatment are justified due to unidentified “seedling pathogens”. These are determined indirectly, using the germination method at 10 °C. Seed disinfection restraints for seed from organic agriculture are comparable to, but sometimes less strict than those applying to the conventional agriculture. Unlike in conventional agriculture, *Tilletia* spp. and also *Septoria nodorum* occur more frequently.

With barley (*Hordeum vulgare*), the intrusion of inferior farmer’s own seed leads to a significant increase in the occurrence of barley leaf stripe (*Pyrenophora graminea*). On the conventional sector, a contamination by loose smut (*Ustilago nuda*) was rather frequent.

Illustration 2: Investigations on the state of treatment and the state of health of wheat and barley seed
This is evidence of the high quality security of the product “certified seed” and of the efficiency of the quality assurance system “seed certification procedure”. Depending on climatic and plant production conditions (seasonal and other influences throughout the year, growing area, micro-climatic influences, crop rotation etc...), facultative seed-borne pathogens may be found more frequently. In total, however, the level of seed lots that exceed the legally prescribed values and ought to be treated is rather low.

2. Value of use – prognostic value for the practical cultivation

The EC-conformal germination test method at 20°C represents a test under ideal conditions. It neither shows damages caused by “pathogens of seedlings” like *Septoria nodorum*, *Fusarium* spp., etc... nor physiological damages. There are no harmonized EC standards about the contamination by dangerous seed-borne pathogens which exert no or only marginal influence on the germination. The germination test method at 10°C, applied in Austria up to the EEC entry 1993, proves significant, close relationship (correlation) between the occurrence of “pathogens of seedlings”, the field emergence under Austrian cultivation conditions and the germination with this method. This method was kept in the Austrian seed rules and regulations in order to be able to evaluate untreated cereal seed’s state of health. Furthermore, it allows for a rather exact forecast for the actual field emergence.

Illustration 3: Germination (GE)/Field emergence – “Seedling pathogens”

<table>
<thead>
<tr>
<th>at infestation of 0%</th>
<th>untreated</th>
<th>treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE 20°C</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>GE 10°C</td>
<td>98</td>
<td>92</td>
</tr>
<tr>
<td>Fuchsenbigl</td>
<td>84</td>
<td>74</td>
</tr>
<tr>
<td>Schönfeld</td>
<td>78</td>
<td>79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>at infestation of 10%</th>
<th>untreated</th>
<th>treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE 20°C</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>GE 10°C</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>Fuchsenbigl</td>
<td>73</td>
<td>74</td>
</tr>
<tr>
<td>Schönfeld</td>
<td>67</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>at GE-Method 10°C 80% GE infestation</th>
<th>untreated</th>
<th>treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE 20°C</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>Fuchsenbigl</td>
<td>58</td>
<td>74</td>
</tr>
<tr>
<td>Schönfeld</td>
<td>52</td>
<td>77</td>
</tr>
</tbody>
</table>

Illustration 3 shows a germination/field emergence test with winter triticale. The trend lines of the field emergence values - untreated in Fuchsenbigl (moderate location) and Schoenfeld (rough location) are very similar to those of the 10°C-germination method - untreated. The late winter counting of the young plants is decisive for the significance of the tests, since *Septoria nodorum* and *Fusarium nivale* can considerably affect the winter-ring.

If the infection with “pathogens of seedlings” is increased (particulary *Fusarium nivale, Septoria nodorum*), this results in a decrease of the field emergence and of the germination at 10°C. The germination at 20°C is completely unsuitable for the forecast of field emergence. At high infestation values, the treated variants show analogous high germination, high field emergence values and thus appropriate sanitation and protection success.

Healthy and/or only slightly infected seed and treated seed supply statistically comparable results in the 10°C-germination method and the field emergence testing.
Seed treatment of healthy organic or conventional cereal seed supplied no significant improvement of the germination behaviour and wintering under field conditions in Austria.

**Conclusions – summary**
1. In Austria, biologically high-quality cereal seed = cereal seed with high value of use is produced to a considerable degree and marketed in untreated state. The supply security for organic seed of cereal is high.

2. For the determination of the value of use of seed are
   - significant, practice-appropriate, validated and
   - competitive test methods as well as
   - suitable scientifically based evaluation methods (threshold values) available
3. The decrease in pesticide use in an environment-oriented agricultural production is a requirement in organic farms, and in conventional farms even appropriate for business management reasons.
4. The value of use and the application safety of untreated seed is considerably determined by the use of suitable tests and evaluation methods regarding the seed’s state of health
5. according to the Austrian seed standards
   - tested and
   - evaluated

untreated organic or conventional cereal seed - if cultivated in accordance with good agricultural practice disposes of APPLICATION SAFETY comparable to that of (chemically) treated cereal seed.
Healthy cereal seeds for organic agriculture in Switzerland

Irene Bänziger, Gabriele Schachermayr, Silvia Zanetti, Andreas Rüegger, Hans-Rudolf Forrer, & Susanne Vogelsgang

1 Agroscope FAL Reckenholz, Swiss Federal Research Station for Agroecology and Agriculture, 8046 Zurich, Switzerland
2 Indo-Swiss Collaboration in Biotechnology (ISCB), ETHZ, 8093 Zurich, Switzerland
3 swisssem, 1567 Delley, Switzerland

Email: susanne.vogelsgang@fal.admin.ch

Abstract
With a growing surface of organic cereal production in Switzerland, the use of healthy seeds is becoming more important. Therefore, the Swiss Federal Research Station for Agroecology and Agriculture is testing organic cereal seeds to provide information on the incidence of seed-borne diseases including snow mould (Microdochium nivale), damping-off caused by Septoria nodorum as well as common and dwarf bunt (Tilletia caries / T. controversa). If the disease incidence exceeds the given threshold values, the utilisation of such seed lots without a seed treatment is discouraged. Since 1995, an average of 75% of the samples were recommended for seeding without treatment. Samples declared as “not appropriate for use without treatment” showed frequently a greater disease incidence by M. nivale. Infestation by S. nodorum and M. nivale was detected at variable levels during the years. Although the overall incidence by Tilletia species was low, an increase over the last few years was observed. It can be concluded that the production of healthy cereal seeds for the use in organic agriculture is feasible under Swiss conditions. However, given that the severity of fungal infestation has varied strongly throughout the years, a seed health test for these diseases is essential in order to identify healthy seed lots for profitable organic cereal production.

Key words: Microdochium nivale, seed-borne disease, seed health testing, Septoria nodorum, Tilletia caries

Organic cereal seed production in Switzerland
The acreage of organic cereal seed production in Switzerland is becoming increasingly important (presently at approximately 3% of the entire production). The utilisation of healthy seeds is of crucial importance since very few effective seed treatment methods are available for organic agriculture. Furthermore, both the European Parliament (Anonymous, 2003a) and Switzerland (Anonymous, 2003b) recently released new regulations whereupon organic production must use, with few exemptions, organically produced seed and vegetative material.

Impact of seed-borne Microdochium nivale, Septoria nodorum and Tilletia caries / T. controversa
At low temperatures, M. nivale (snow mold) infestation severely reduces the seeds’ germination capacity and causes thinned stands of cereals in early spring. It is globally distributed (Agarwal & Sinclair, 1997) and considered as one of the most serious diseases in cereal seed production in Switzerland (Häni, 1980; Rüegger et al., 1998). Seed-borne S. nodorum (damping-off) affects less the germination capacity but rather the vigour of the seeds. The disease is only important for wheat (Rüegger et al., 1998), however, a heavy colonisation of seeds by this pathogen reduces the growth of the coleoptiles and the roots, which reduces the rate of emergence. Before the implementation of chemical seed dressing, T. caries (common bunt) was deemed the most important wheat disease causing more yield losses than any other wheat pathogen (Fischer & Holton, 1957). Due to their great dispersal ability (Bänziger et al., 2003) and the toxicity of the spores, both T. caries and T. controversa (dwarf bunt) are of particular concern in organic agriculture.

Seed health testing at Agroscope FAL Reckenholz
Since 1995 and because of increased demand from the farming community and seed trade, the Swiss Federal Research Station for Agroecology and Agriculture has been testing organic seeds of wheat (T. aestivum L.), rye (Secale cereale L.), triticale (Triticeaeae Wittm.), spelt (T. spelta L.), emmer (T. dicocoides Schrank.), and einkorn (T. monococcum L.) for the above mentioned seed-borne diseases. Seed health tests for M. nivale, S. nodorum, and Tilletia spp. are performed using a modified ISTA (International Seed Testing Association) germination ability test (ISTA, 1996), a fluorescence test (Kietreiber, 1981), and a washingfiltration test (Kietreiber, 1984), respectively. For the germination test, seeds are placed on moist filter paper
and incubated for 5 days at 10 °C followed by 20 °C for 3 days. The infestation level by *M. nivale* is determined by counting the number of deformed, abnormally growing seedlings as well as the number of non-germinated seeds showing a white-pink coloured mycelium. For the fluorescence test, wheat seeds are incubated during 3 days at 18 °C, 4 hours at −20 °C, and finally for 4 days at 28 °C. Seeds infected by *S. nodorum* are then visualised under near UV light (366 nm), where the toxins formed by the pathogen produce sulphur-yellow fluorescence. To detect *Tilletia* spp. contamination through the washing-filtration test, cereal seeds are drenched in a 0.2% sodium-pyrophosphate solution. The washing solution is subsequently filtered (5 mm), and the number of spores per grain is counted.

**Threshold values: Swiss and international recommendations**

Based on laboratory and field experiments, Winter et al. (1997) established threshold values for these diseases in Switzerland: *M. nivale* 10%, *S. nodorum* 40%, *Tilletia* spp. 10 spores / seed. These threshold values are not compulsory, however, once a seed health test shows a disease incidence exceeding those values, the utilisation of such seeds without a seed treatment is discouraged. Available data on threshold values for *M. nivale* in other countries are similar: Austria recommended 10% (Girsch et al., 2000) and Denmark (Nielsen & Scheel, 1995) as well as Norway (Brodal & Rosok, 1995) suggested 15%. In contrast, Austria (Girsch et al., 2000) and Norway (Brodal & Rosok, 1995) established *S. nodorum* threshold values as low as 20% and 5%, respectively. For *Tilletia* spp., information on inoculum needed for infestation varies strongly between 1 and 5000 spores per seed (Schweyda, 1996). Austria (Girsch et al., 2000) suggested a tolerable level of 10 spores per seed, which is similar to Germany (Fuchs et al., 1995; Spiess, 2003) with 10 to 20 spores per seed.

**Results of the seed health tests at Agroscope FAL Reckenholz**

Between 1995 and 2003, an average of 75% of all samples were recommended for seeding without treatment, i.e. declared “healthy” (data not shown). Throughout the years, the ratio of healthy samples varied between 50% and 86%. A declaration of samples as “not healthy”, i.e. not appropriate for use without treatment, was frequently due to a greater disease incidence by *M. nivale*, as, throughout the years, a mean of 18% of the seed lots were above the threshold (Figure 1). *Septoria nodorum*, which is of importance for wheat only, was detected at variable levels during the years, with a mean of 4% of the seed lots above the threshold, ranging from 0 to 11%. Furthermore, although the overall infestation level by *Tilletia* species was low (mean 2%), an increase over the last few years was observed (Figure 1).

**Figure 1:** Seed health test results between 1995-2003 for cereal seed lots considered „not healthy, i.e. not recommended for use without treatment.

![Graph showing seed health test results](image-url)

Ratio of seed lots with disease incidences exceeding threshold values for *Microdochium nivale* (10%), *Septoria nodorum* (40%), and *Tilletia caries* / *T. controversa* (10 spores / seed). Hatched bars represent seed lots with more than 1 spore per seed. n = number of samples tested.
Alternative treatments of seeds with high disease incidence
If the given threshold values are exceeded, alternative methods to chemical control are recommended for use in organic agriculture. In Switzerland, extensive laboratory and field work has been carried out, including physical methods (warm and hot water treatment, electron treatment) and use of natural substances (skim milk, whey, yellow mustard seeds, plant extracts) (summarised in Schachermayr et al., 2000). Warm water treatments efficiently controlled M. nivale and S. nodorum infection but were less effective against T. caries at higher infection levels. The combination of skim milk powder and a warm water treatment enhanced the efficacy. However, with the present technology, both warm water treatments and skim milk applications are too costly to be used in field scales. Seed dressing with Tillecūra, a product based on yellow mustard seed powder (Andermatt Biocontrol AG, Grossdietwil, Switzerland), was developed and proved to be highly effective against T. caries on wheat. Present studies focus on further screening and formulation of various plant extracts and microorganisms against M. nivale.

Conclusions
Based on our results, the production of healthy cereal seeds for use in organic agriculture seems feasible under Swiss conditions. However, in order to determine the quality of seed lots, it is essential to perform a seed health test for M. nivale, S. nodorum, and T. caries / T. controversa. The severity of fungal infestation, in particular by M. nivale, fluctuated strongly throughout the years. This is possibly due to varying climatic factors. Earlier statements on the importance of M. nivale were confirmed as this pathogen proved to be the most prevalent seed-borne disease in Switzerland. Due to the great dispersal ability of T. caries / T. controversa and the slightly increased disease incidence observed during the last years, these two pathogens need to be closely monitored.

References


Nielsen, B.J. & Scheel, Ch. (1995). Production of quality cereal seed in Denmark. ISTA Pre-Congress Seminar on Seed Pathology, June 6, 1995, Copenhagen, Denmark.


Organic forage seed production: taking small plot research to farm scale development

*Athole H. Marshall and Heather McCalman*
Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth, Ceredigion, UK, SY23 3EB
Email: athole.marshall@bbsrc.ac.uk

Abstract
Forage production is the key to predominantly grassland based organic systems and rotations. Removal of the current derogations to EU organic standards in August 2005 presents significant challenges to organic livestock farmers. Of these, meeting the demand for organically produced forage seed will be one of the most difficult. The National Assembly for Wales Government has set a target of 10% organic production by 2005. Sourcing sufficient quantities of organic seed of appropriate varieties of relevant species may be one of the constraints to successfully achieving this. Conventional herbage seed production in Wales has declined over the last thirty years but has been grown successfully in the past. Following organic farmer discussion group meetings on grass and clover varieties for organic systems and the sourcing and cost of organic seed, a feasibility project to tackle some of the practical challenges of organic forage seed production was set up with local farmers. This project builds on small plot studies at IGER, where organic forage seed crop management techniques are being developed and the technical challenges of organic forage seed production are being addressed. The use of companion legumes and fertility building crops to provide the nitrogen essential for organic grass seed crops, the response of different grass species and integrating results onto commercial farms are important to the success of organic forage seed production. Progress in this project is discussed and the role of the participating farmers in this type of technology transfer highlighted.

Keywords: organic grass seed production, fertility crops, legumes, technology transfer

Introduction
Organic systems of forage production for feeding ruminants are based on a grass plus legume based sward with regular reseeding (Lampkin, 1990), placing a high demand on seed of appropriate varieties. At present a maximum of 50% of the seed of forage species used by UK organic farmers is produced conventionally using inorganic fertiliser, herbicides and fungicides to produce economic seed yields and maintain the seed quality and purity required by the UK Seed Certification Scheme. From August 2005, 100% of seed for use in organic systems must be produced organically. This is being phased in by gradual increases in the percentage. The National Assembly for Wales has an organic target of 10% by 2005 and the production of sufficient quantities of organically produced seed of appropriate varieties of relevant species to meet this target will be challenging (Marshall & Humphreys, 2002).

One of the major problems facing organic grass seed producers is ensuring there is sufficient nitrogen within the system for the developing grass seed crop. Conventional grass seed crops require mineral nitrogen at precise stages of crop development to stimulate flowering, ensure good seed filling and produce high seed yields. In organic systems, nitrogen can be supplied by application of animal manure or by using forage legumes to fix atmospheric nitrogen, either by relying on the residual N in the soil or by using forage legumes as companion crops (Aamld, 1999). Small plot trials have been established at IGER to develop strategies to overcome some of the problems in organic grass seed production, including the potential of white clover as a source of nitrogen during grass seed production.

Discussion group meetings held by organic farmers at the Institute of Grassland and Environmental Research (IGER) and on commercial farms highlighted farmer concerns about the availability of the appropriate grass and clover varieties for organic livestock systems and the difficulty of the sourcing and cost of organic seed. A feasibility project to tackle some of the practical challenges of organic seed production at the farm scale was set up with local farmers to build on the small plot studies at IGER, provide an economic appraisal of organic forage seed production and to assess the potential for organic grass seed enterprises in Wales. This paper reports results of some of the small plot trials and the challenges and progress in the farmer led feasibility project.
Small plot trials
Providing sufficient nitrogen to a developing grass seed crop is a significant challenge for the organic grass seed producer. Research at IGER has investigated the potential of using white clover as a companion crop for seed crops of different grass species, and its capacity to supply the amount of nitrogen necessary to produce reasonable seed yields. An experiment was sown on 23 July 2001 at IGER, Aberystwyth on soil of the Rheidol series. Plots (3 m x 1.4 m) of the perennial ryegrass (Lolium perenne L.) cv. AberDart, hybrid ryegrass (L. x boucheanum Kunth.) cv. AberLinnet and Italian ryegrass (L. multiflorum L.) cv. AberComo were sown at a seed rate of 12 kg/ha, 18 kg/ha and 18 kg/ha respectively in drills 20 cm apart. Plots were sown with white clover (Trifolium repens L.) cv. AberAce (small leaved) or AberHerald (medium leaved) at 3 kg/ha in the same drill as the grass (T1), sown between the grass drills (T2) or between alternate grass drills (T3). Although not sown on certified organic land these plots were treated as though organic and received no fertiliser nitrogen or chemical weed control. Control plots, sown in an adjacent block within the same experimental field, were treated as a conventional seed crop and received fertiliser N and herbicide at a rate comparable with conventional treatments. Plots of AberComo and AberLinnet received a silage cut in May. Two weeks before harvest a 450cm² quadrat was removed from each plot and the number of reproductive tillers, spikelets per tiller and seeds per spikelet counted. All plots were harvested with a Hege small plot combine, seed was dried in linen bags over cold air, threshed and seed weight per plot and mean seed weight was determined.

No differences in heading date or in general crop development were observed between the plots sown with white clover and the controls. However the seed yields were generally lower in the organic plots than the plots receiving a conventional seed crop management and there were significant differences in seed yield components. The number of reproductive tillers of the grasses when grown with white clover was comparable with the control in most treatments (Table 1). Only AberDart in T1 and AberLinnet in T2 and T3 had significantly fewer reproductive tillers than the control plots. In contrast the number of seeds per floret was significantly less than in the control plots in all of the treatments, ranging from 55% to 80% of the controls. This was reflected in the harvested seed yields which were significantly lower in the treatments with white clover than in the control plots. In T1, T2 and T3, AberDart had a significantly higher seed yield than AberLinnet and AberComo with the harvested seed yield in T2 nearly 80% of the control plots. Seed yields were greatest in T2, where white clover was sown between the drills of the grass seed crop. Weed content was relatively low in all of the treatments and there were few significant differences between the treatments or between the treatments and the control. Nitrogen content of the grass foliage in early spring has been used as an indicator of the seed yield potential of perennial ryegrass (Rowarth & Archie, 1995). The nitrogen content of the grass foliage was lower in the plots sown with white clover (1.4% to 1.9%) than in the plots receiving conventional levels of fertiliser N (1.9% to 2.6%). However, the number of reproductive tillers and spikelets per tiller (data not shown) of the grasses sown with white clover and those receiving fertiliser N was comparable. However there were fewer seeds per floret contributing to a lower seed yield suggesting that there was insufficient N for seed filling. This was further emphasised by the lower mean seed weight and lower germination of the grasses when grown with white clover than in the controls (Table 2). These differences in seed weight may be removed by more rigorous seed cleaning however this would significantly increase seed losses during cleaning and reduce the final seed yields even further.

Table 1. Number of reproductive tillers, seeds per floret and harvested seed yield of AberComo, AberDart and AberLinnet sown with white clover in the same drill (T1), between each grass drill (T2) or between alternate grass drills (T3). Data is expressed as a % of the conventional control receiving mineral N.

<table>
<thead>
<tr>
<th>Treatment Variety</th>
<th>Reproductive tillers</th>
<th>Seeds per floret</th>
<th>% of conventional control</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>AberComo</td>
<td>98</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>AberDart</td>
<td>86</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>AberLinnet</td>
<td>101</td>
<td>66</td>
</tr>
<tr>
<td>T2</td>
<td>AberComo</td>
<td>102</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>AberDart 98</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>AberLinnet</td>
<td>85</td>
<td>71</td>
</tr>
<tr>
<td>T3</td>
<td>AberComo</td>
<td>106</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>AberDart 99</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>AberLinnet</td>
<td>92</td>
<td>80</td>
</tr>
</tbody>
</table>
In the UK, conventional grass seed growers defoliate Italian and hybrid ryegrass in the spring prior to the seed harvest (Marshall & Hides, 1999) to remove excessive leaf growth that can impair harvestability. On farms with livestock, the forage removed at defoliation is also used to make high quality silage. In this experiment, a simulated silage cut was taken from these varieties however the low seed yields of AberComo and AberLinnet in comparison with the perennial ryegrass variety AberDart suggests that nitrogen levels within the system were insufficient for regrowth after the silage cut. Further research is needed to quantify seed yields of Italian and hybrid ryegrass without a silage cut, the effect on harvestability and the benefit of the silage cut in terms of forage production. Where a silage cut is desirable then further research may be needed to increase fertility, either by an application of animal manure to supplement the nitrogen removed in the silage or by using a preceding fertility building crop. This will be the focus of further experiments. There was no significant difference between the treatments or clover variety in the weed content of the seed sample suggesting that the weed problem was no worse under this organic system than a conventional system.

Table 2. Thousand seed weight (g) and % germination at 7, 10 and 14 days of seed of AberComo, AberDart and AberLinnet from plots sown with white clover (mean of T1, T2 and T3) and control plots receiving mineral nitrogen.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Variety</th>
<th>Mean 1000 seed weight (g)</th>
<th>% germination after 7days</th>
<th>% germination after 10days</th>
<th>% germination after 14days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sown with clover</td>
<td>AberComo</td>
<td>1.85</td>
<td>66</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>AberDart</td>
<td>1.68</td>
<td>66</td>
<td>75</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>AberLinnet</td>
<td>3.70</td>
<td>54</td>
<td>62</td>
<td>63</td>
</tr>
<tr>
<td>Control</td>
<td>AberComo</td>
<td>2.09</td>
<td>65</td>
<td>77</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>AberDart</td>
<td>1.83</td>
<td>78</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>AberLinnet</td>
<td>4.01</td>
<td>78</td>
<td>86</td>
<td>86</td>
</tr>
</tbody>
</table>

Farm scale demonstration

Integrating the results from small plot trials into organic farming systems has been the focus of a feasibility project conducted on commercial farms throughout Wales. A participatory approach is being used, where the organic farmers in the project, as well as other farmer groups are directly involved in the management of the plots. Four farmers were recruited from within organic discussion groups with a range of farm types and systems. Large scale field plots were designed in discussion with the farmers to address some of the important challenges facing organic forage seed production building on information obtained from small plots. Each farm has focused on different aspects to provide a range of demonstration points and assess the feasibility of different approaches to organic forage seed production. The topics explored include:

- the use of white clover sown between or within the grass drills as a nitrogen source for a hybrid ryegrass seed crop (with one half cut for silage and animal manure applied during the growing season, the other not). From the first harvest year the seed yield of the area without a silage cut was 640 kg/ha with a weed content no greater than a conventional seed crop. It was not possible to harvest the area where silage had been cut due insufficient regrowth, however the results from the small plot trials (see above) showed that seed yields from the area with a silage cut were likely to be > 40% lower than without a silage cut. These farm plots have been kept for a second harvest year in 2004.

- the potential of fertility building legumes (white clover (T. repens L.) / red clover (T. pratense L.)/ vetch (Vicia sativa L.) / lupins (Lupinus alba L.)/ crimson clover (T. incarnatum L.) to provide nutrients to the following grass seed crop. All the legumes, except the vetch, which was frost damaged, grew well. The legumes were ploughed in autumn 2003 and the whole area oversown with hybrid ryegrass. The first seed harvest will be in 2004.

- the response of different grass species (perennial ryegrass (L. perenne L.)/ hybrid ryegrass (L. x boucheanum Kunth>)/ timothy (Phleum pratense L.)) to a white clover companion crop as a nitrogen source. This area was sown in 2003 and will be harvested in 2004.
• the response of different grass species (perennial ryegrass (L.perenne L.), hybrid ryegrass (L. x boucheanum Kunth.) and timothy (Phleum pratense L.)) to a red or white clover fertility building phase. The fertility building crops were sown in 2003 and the grass seed will be sown in 2004.

• integration of herbage seed crops into a whole organic farm system.

To optimise input of interested parties (‘stakeholders’), the participating farmers have held on farm meetings with Organic Seed Certification and National Institute of Agricultural Botany (NIAB) seed certification personnel to explore the issues in organic forage seed production and develop a better understanding of the challenges involved for all. As some of the farmers are new to forage seed production, the farmers visited a recently converted, but experienced, conventional herbage seed producer in England and exchanged information and ideas on organic seed production and approaches to growing and harvesting organic arable and grass crops.

The decision making process for the management of plots has been guided to a large extent by the participating farmers and other group members. Input from other interested parties (ie. NIAB and organic certification bodies) is invaluable so that the problems and challenges are being tackled together and a greater understanding is achieved. The work is on-going and the interest and enthusiasm of the farmers has continued to increase following on farm meetings and discussions (McCalman and Marshall 2003). Additional farmers are being sought to take part in this project with considerable interest arising from the results presented to date at farmer conferences.

Acknowledgements
This work was part funded by the National Assembly for Wales Farming Connect programme.

References


Practical aspects concerning organic seed production of clover and grass in Denmark

Birthe Kjærsgaard and Jørn Lund Kristensen
DLF-TRIFOLIUM A/S, Ny Østergade 9, DK 4000 Roskilde, Denmark
Email: bk@dlf.dk

Abstract

A considerable amount of grass and clover seed has been produced in Denmark for a long period of time. Therefore it made sense to initiate a production of organic seed at the time when demands for organic seed were first presented. The first organic acreages were harvested in Denmark in 1992, and the organic production has since then been increasing until today where it has reached 3.006 ha with a total production of about 2.000 tons ecological grass and clover seed harvest year 2003.

The harvest 2003 comprised seed from Red and White clover (Trifolium repens), Perennial ryegrass (Lolium perenne L), Italian ryegrass and Hybrid ryegrass, Meadow fescue (Festuca pratense), Timothy (Phleum pratense) and Smooth-stalked meadow grass (Poa pratense). Perennial ryegrass accounts for the most significant production with 60% of the total area of organic seed production, white clover accounts for 15% and red clover for 9%. The other species in question are only produced on small acreages and account in total for 16% of the total area of organic seed production.

The situation today is such that organic farmers in Denmark want to produce organic seed on a larger area than required to fulfil demands for organic seed. The yield of the organic seed has improved in the aforesaid period.

Estimated Danish production in 2003 was as follows:

<table>
<thead>
<tr>
<th>Average yield 2003</th>
<th>kg. pr ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per. ryegrass</td>
<td>935</td>
</tr>
<tr>
<td>Ital. ryegrass</td>
<td>865</td>
</tr>
<tr>
<td>Timothy</td>
<td>435</td>
</tr>
<tr>
<td>Meadow fescue</td>
<td>605</td>
</tr>
<tr>
<td>Red fescue</td>
<td>615</td>
</tr>
<tr>
<td>White clover</td>
<td>165</td>
</tr>
<tr>
<td>Red clover</td>
<td>260</td>
</tr>
</tbody>
</table>

Yield for organic seed production compared to conventional in relative figure harvest 2003 is about 75 % in grasses except reed fescue with 50% and for white clover about 30%. However, the difference in terms of yield deriving from individual fields is remarkably bigger within organic seed production compared to conventional production.

Delivery capability of organic seed of clover and grass

In Denmark the production of Perennial ryegrass (Lolium perenne), Timothe (Phleum pratense), Meadow fescue (Festuca pratense), Red fescue (Festuca rubra), Cocksfood (Dactylis glomerata) and Red clover (Trifolium pratense) is larger than the consumption.

More than fifty percent of the total amount of ecological grass and clover seed produced in 2003 will be exported. With a huge majority within EU - Great Britain as the biggest customer.

Production of organic seed is today very reliable in terms of quality. Smooth-stalked meadow grass (Poa pratense) is the only specie where a good quality is difficult to obtain, and supply of this specie can therefore be rather limited.

As to clover production, red clover is produced with relatively stable yields, whereas white clover accounts for the most unstable organic seed produced, and white clover is consequently the most expensive seed to produce.
Production of White clover (Trifolium repens) has until today not fulfilled demands; however we expect that the harvest of white clover in near future will suffice to cover demands in Denmark.

**Production systems of organic farms**

Grass seed is mainly produced on dairy farms due to the fact that grass seed production fits well into their crop rotation. They have access to nutrients (animal manure) and they can utilise secondary products such as straw and Autumn regrowth for feed. A typical organic grass seed crop rotation looks as follows:

- spring cereal, cover crop
- grass seed
- field pea
- winter or spring wheat
- pulses (lupin or field bean)

Organic clover is typically produced on all-arable farms. Their interest in organic forage seed production is often driven by the need to grow crops with a low export of nutrients or crops which in fact import nutrients, such as legumes and clovers. A typical crop rotation on organic clover seed farms is as follows:

- spring cereal, cover crop
- clover seed
- winter or spring wheat
- spring cereal
- field pea

Two examples of production strategies for grass seed and clover, respectively, are shown below.

**Production of Perennial ryegrass (Lolium perenne)**

Perennial ryegrass seed can be produced in all regions in Denmark, since this type of seed has no specific requirements as to the quality of the soil. On light soil, however, irrigation is required.

*Establishment*

Per. ryegrass is mostly undersown in Spring barley. Undersowing in Spring in a not too dense Winter wheat field is also an option, however, more uncertain. Undersowing in Spring barley to be harvested as a whole crop silage is also a good possibility. An extra cut in the Autumn will have a positive impact on the control of weeds.

6 to 12 kg basic seed per ha is used depending on the variety, seed weight and seedbed. The aim is to have 100 – 125 plants per m².

*When undersowing in Spring crop, the grass seed can be sown together with the grain crop in the same row, or be sown subsequent to one or several blind harrowings. The grain crop and grass seeds can, if needed, be mixed and sown together. In this way, the small Per. ryegrass plants will be protected by the grain crop plants if weeds need to be removed at a later stage using a spring tine.*

In case grain crop and seeds are sown separately, blind harrowing with a spring tine can be undertaken before sowing of the seeds. The disadvantage of this method is, nevertheless, that the upper layers of earth are easily desiccated making it hard for the Per. ryegrass seeds to germinate.

Undersowing in Spring in already established Winter wheat is practiced with varying results. Sowing is made after spring tining.

Topping of vigorously growing leys in the Autumn may also reduce waste grain plants and weeds. 2nd year production is possible. However, the field needs to be clean from weeds and the stand not too dense. It will be possible to have a cut in Autumn – in the beginning of October by the latest.

**Fertilizers/slurry:**

Weak undersowing can be given 20 – 30 kg N per ha after harvest over the cover-crop.

Fertilizing in Spring : 110 – 150 kg N per ha, however, late varieties to be fertilized most. Before cutting and 2nd year production fertilizing is to be done in Autumn (70 kg N per ha) in terms of slurry right after harvest. After grazing or cutting another 25 kg N per ha is given.
Weeds
You should only sow Per. ryegrass in clean fields. Especially couch grass(*Elytrigia repens*) and other grass
weeds are prohibited; however also weeds like thistle(*Cirsium*), dock(*Rumex*), (*Artemisia vulgaris*) and
camomile(*Matricaria*) should not be present in large amounts.

After harvest of the cover crop, the field can be grazed or cuttings can be made to reduce the weeds stand.
In Spring, weeds that are higher than the crop can be cut, if necessary, by special equipment before harvest.

Diseases
Attacks from mildew and rust may occur. The greatest risk of production loss is in connection with attacks
from black rust. Attacks from insects seldom cause a heavy production loss.

Harvest
Per. ryegrass can be threshed direct when the crop is evenly mature and logged, or can be laid in swaths. The
crop has to lay on swaths for 7 to 14 days before being combined.

Production of White clover (*Trifolium repens*)
The climatic conditions play a decisive role in connection with White clover production. Traditionally the
production has been concentrated on the Eastern islands of Denmark and only in nearshore areas – preferably
on southernmost areas. A yearly rainfall of 650 mm, however with no rainfall in July, and with sunshine and
relatively high temperatures in June are necessary. White clover grows well on clayey soil.

Establishment
White clover is undersown in Spring barley, partly so that the plants achieve a sufficient growth the
following year, and partly to reduce the presence of weeds.
The straw is to be removed very quickly right after harvest of the cover crop. The highest yield is obtained
in fields offering an open stand, however, in organic areas the power of resistance of the crop against weeds
is normally emphasized more than the yield.

To that effect, a uniform and dense stand is preferred. 2 to 4 kg basic seed per ha is used, and the sowing
depth is approx. 1 cm (not mixed with the sowing of the cover crop).

Weed Control
Organic White clover can only be produced on areas offering a moderate presence of weeds.
Delayed undersowing is practiced, however, the covercrop is sown first, and blind spring tining is done
before the sowing of the clover seed.

In order that this procedure succeed, a rainfall on a regular basis is required, otherwise the seedbed of the
clover will dessicate.
The covercrop is to be established relatively thinly so that sufficient light may reach the undersowing. This
method is unsecure, and in years with drought periods only few crops will succeed.

Alternatively, the cover crop and the seed crop can be established on every second row. I.e. the grain crop
is sown on 24 cm, and the grass seed is placed between the grain crop rows also on a 24 cm row distance.
In this way, the most vigorous and well-established undersowing is obtained. Otherwise, the undersowing
can be sown together with the grain crop (but not at the same depth) in the same row having a 24 cm row
distance. In this manner the crop is well protected if any mechanical weed control is required.

Hoeing can be done in Autumn right after harvest of the nurse seed and/or in the following Spring.
Alternatively the fields can be grazed by sheep or mechanical toppings be undertaken several times to
reduce the weeds stand. Also, manual hoeing must be expected.

The most loss-making weeds in organic White clover are:
- dock(*Rumex*), white campion(*Melandrium album*), chickweed(*Stellaria media*), cut leaved cranesbill
  (*Geranium dissectum Just.*), field pansey(*Viola arvensis*), forget-me-not(*Myosotis arvensis*),
dandelium(*Taraxacum*), camomile(*Matricaria*), thistle(*Cirsium arvense*)

Insects
The low yields in organic White clover compared to conventional White clover production is caused by
insects. The loss may in certain cases reach up to 100%.
Bean weevil (Sitona spp.)
In connection with the establishing of the crop, heavy attacks from Bean weevil may ruin the small plants. Good growing conditions for the clover plants and a not too dense/vigorous cover crop will reduce the problem.

Clover leaf weevil ((Phytonomus nigirostris)
The adult Clover leaf weevil overwinter, and reappear early in the Spring, and soon after it will lay eggs - approx. 100 per adult beetle within a period of approx. 30 days.
The grub of the Clover leaf weevil can be found in the flowering and maturing season of the White clover, where it will eat from the total foliage and the leaf stalks without damaging the crop seriously, however it will also eat from the flower stalks as well as the flower heads causing much damage and a severe decrease of yield.

Clover seed weevil (Apion apricans)
The adult clover seed weevil will invade the fields in Spring time laying approx. 100 eggs in the flowerheads. In average, each grub will consume approx. five seeds.
To reduce attacks on the White clover crop, the White clover can be topped and plant material removed, however at a relatively late stage whereby also early flower heads will be removed.
Subsequent to topping, the area can be burnt off by means of a gas burner; whereby the beetles as well as their eggs/grubs will be destroyed.
This method can only be employed under vigorous growth conditions, otherwise the crop will not be able to produce a sufficient amount of well-developed flower heads afterwards.

Pollination and Harvest
The White clover will be pollinated by means of honey bees set in the fields in question.
The weather in the harvest period is crucial in terms of yield.
At the time of maturity the crop is laid on swaths and will lay on swaths for 5 to 10 days, and subsequently combined. A constant rain in this period will ruin the crop completely.
Challenges in organic carrot & white clover seed production

James Smith - Dip FmAg
Midlands Seed Limited
393-405 West Street, Ashburton 8300
New Zealand
Email: jgsmith@jhug.co.nz

The challenges we face to ensure there are sustainable management systems for the production of organically produced white clover and carrot seed.

Preamble
I represent Midlands Seed Ltd, a specialist seed production company based in the South Island of New Zealand. Midlands produce a range of seed crops including vegetable seed, cereals, pulses and of course white clover just to name a few. Conventional seed production in New Zealand is still our primary focus as it is in most other parts of the world. In recent times there has been a growing demand for organically produced food products.

Legislation will demand that growers who are producing organically produced products are required to sow organically produced seed.

My role at Midlands is purely focused on research mainly for conventionally produced crops to maximise yield and quality but with the demand clearly shifting toward organically produced seed. My efforts are to ensure that we can in the future produce a reliable and sustainable organic system to maximise the quality and quantity of organically produced seed.

Midlands have two very close relationships with European seed companies:

a) Tri-lateral agreement to breed superior white clover cultivars for the European market with our partners Barenbrug Holdings BV of the Netherlands and Grasslands AgResearch of New Zealand who are well known in the breeding of white clover. This programme is titled the ABM Programme. Barenbrug is the Marketing Partner, AgResearch is the Breeder and Midlands is the Seed Production Partner. The partnership has been very successful in producing a number of improved cultivars.

b) Bejo Zaden who are a specialised vegetable seed company who Midlands in turn remultiplies their seed requirements.

Organic White Clover Production Principals
The history of white clover production in New Zealand started with one variety called Huia so large areas were planted of this one variety for seed production and pastoral grazing. Huia has largely been replaced with superior varieties which need to be produced for seed. Clover has the ability to produce a hard seed in some seasons which stops water imbibing the seed so it can stay in the soil for a long length of time before striking. When sowing a new variety of clover in a paddock for seed production, sow in twelve-inch rows. It is deemed that every clover plant that strikes between the rows is a volunteer clover and must be removed by interrow spraying between the rows or cultivation between the rows for the first season of seed production. Once the paddock has been deemed by inspection authorities and the volunteer clover levels are at a satisfactory level the paddock is passed and deemed to be a change of cultivar paddock to the variety that was sown and he paddock can now be sown in that particular variety from now onwards.

Selection of the paddock is very important. It must not have produced clover for the last five harvests and have low levels of volunteer clover. A summer fallow to control weeds is very important, aiming for 3-4 months. Drilling should take place in early February in twelve-inch rows with grass to help with weed control. Aim for 3-5 kg/ha of clover and 2-3kg/ha of grass. The grass also helps with being able to identify where the clover is for cultivation for spraying purposes. After planting but before crop emergence the use of Interceptor, which is a fatty acid, should be band sprayed over where the clover has been drilled. This helps with the control of weeds emerging in the row. Once grass rows become visible Interceptor should be applied between the rows to control weeds struck between the clover rows, this may need to be applied again if weeds continue to strike. The main pests that can be present in the establishments are grass grub. If present apply a product called Invade. This product is a disease that occurs naturally in the grass grub population and helps stop the grub in feeding once applied. Slugs can feed on the surface of the plant, heavy rolling at night and can lower the slug population.
Heavy rolling of the crop should take place at least twice over the growing season usually in the autumn and in the spring period. This ensures that the contour of the ground is flat and makes harvest loss minimal. Grazing of the crop takes place in the spring period. Sheep are introduced for short periods and you are aiming to graze until mid October to help keep the grass under control. A final application of Interceptor is applied after the last grazing or shutting up of the crop. The grass plant starts to slow in its production in the months November and December and is more interested in going reproductive. The clover plant is then taken over with stollons competing for row closure with every internode produced on a clover stollon a floret is produced which in turn is pollinated and produces seed. As the flowering of the crop takes place aphid numbers can build up in the florets of the plants, neem oil should be applied on a preventative basis to keep these pests at a minimum.

Irrigation management of the crop should be carefully managed with the soil water holding capacity kept at 80% while stollons are running the use of moisture probes over this period helps keep track of irrigation inputs. Once flowering takes place moisture stress of the plants tricks the plant in producing more flowers so the irrigation trigger point drops to around 40% water holding capacity of the soil with light irrigations of around 20-25mm at any one time the aim is to have 2-3 even flowerings of the crop which is controlled by lowering the water holding capacity to 40% moisture stressing then irrigating the crop. Harvesting of the crop is either done with blanket spraying the crop with Interceptor or windrowing the crop. With either of the two techniques 4-5 days is required before harvesting takes place. Once harvesting is completed scalping or precleaning of the crop may need to take place and dried to a safe moisture of 8%.

**Organic Carrot Seed Production Principals**

Carrot seed is a project Midlands has been involved with conventionally for the last 12 years. We have a vast knowledge of what is required to produce quality and yield. For the last two seasons we have been producing carrot seed organically and this season planted our first red beet crop. It was a large learning curve for our seed producer and myself. We started off growing carrots on beds and then lifting and transplanting in the spring. This enabled us more time to fallow the seedbed for weeds and introduce a bigger plant which increased on which options were available for weeding. This seemed to work extremely well with some of the parent lines but we noticed that some of the parent lines lost a large amount of vigour after transplanting. Transplanting took around 60 hours/ha and was done all by hand. After transplanting the carrots were ridged or covered and these ridges were pulled back with tine weeding and re-ridged afterwards. This enabled weeds to be controlled in the rows without hand weeding between. The rows were cultivated with hoes and basket weeders which keep the weeds under control easily. Cultivation for weeds stopped when the crop started to bolt. We found that with the last cultivation at this stage the quick growth of the canopy shaded out any competing weeds effectively. Enzymes were applied to the crop on a weekly basis to protect against disease, and when aphids started to be detected neem oil was added to help keep levels at a minimum. Flowering took place on par with conventional parent lines but the vigour of one of the Amsterdam parent lines was very low through the transplanting process, crop height and umbel numbers were low. Harvest of the crop was very similar in timing again to conventional parent lines with the crop being windrowed and harvested 5-6 days after cutting. Crops were then dried to moisture of 8% and dressed. Yields achieved were 120kg/ha of seed of the Amsterdam line, which lost a lot of vigour, and 400kg/ha seed of the other hybrid, so overall the project was a success with germinations over 90%.

This season a discussion was made to direct seed all 40ha of organic crop with enough transplants were sown if needed to replant the crop in the spring, if direct seeding was a failure the paddocks were fallowed from September and sown at the start of February. Controlling of the weeds was done by the use of hoes between the rows and hand weeding was done over the row. Weeds were controlled very well but grass grub attacked the young plants so a decision was made to use a product called invade which is a natural occurring disease of the pest. That’s where the program is up to this season.

The carrot and white clover projects are two that Midlands are very proud to be involved in with a combination of enthusiasm and lateral thinking has ensured that even crops as specialised as these can be produced on a reliable basis.
Growing organic seed potatoes in the Netherlands

Jae Vergroesen
Bioselect Atrico
Postbus 70,
NL-8300 AB Emmeloord, The Netherlands
Email: vergroesen@AGRICO.NL

The organic seed potato production in the Netherlands started somewhere in the late eighties.

At that time, the area organic farming was still very small in the Netherlands. Initial organic seed potato producers were farmers that changed their farm to Bio Dynamic or Ecologic farming and continued producing seed potatoes. They sold the seed potatoes directly to organic farmers and received the normal seed price, plus a bonus. The surplus seed potatoes were sold in the conventional marked by the seed potato company they were connected with.

The organic seed potatoes were grown under the same regime of field checks and laboratory test by the Dutch N.A.K. and had to comply with the same minimal quality demands.

Due to the limited availability of nitrogen potato plants in organic fields were shorter, had an earlier tuberisation and were earlier maturing. Because fertilization was mainly supplied as manure, irregular fields were more the rule then the exception. The field inspectors were trained to declassify irregular fields. Also single plants or small groups of plants, yellowing in generally green crops were considered as being infected by Erwinia bacteria and the fields were therefore declassified or even completely rejected.

Virus diseases, transmitted by aphids, were expected to be the mayor problem for organic growers. The farmers learned that aphids did not occur more often in organic seed fields due to the physiological older crop and the higher number of antagonists. Therefore, declassification on virus in the field or after post harvest Elisa control did not occur more then with conventional seed potato fields.

After the initial problems with the field inspectors, bacterial diseases caused by Erwinia are generally not a problem in organic seed potato production.

Rhizoctonia however proved to be an increasing problem. Intensive tests with all kind of organic antagonists, subsidizing and stimulating the use of pre-sprouting techniques and for some farmers a clear adaptation of the soil helped to manage the problems. Still, most companies have stronger demands on organic seed potatoes regarding Rhizoctonia. While in The Netherlands the demands for seed potatoes are maximum 25% light, for organic seed potatoes, 15% light is the maximum tolerance and farmers are financially stimulated to produce better then 10% light.

Lately the occurrence of silver scurf becomes more and more a problem because clients are demanding seed potatoes with none or very little silver scurf.

Late blight proved to be the main reason for defoliation. The farmers are used to the fact that the late blight and not the N.A.K. is mostly setting the dates for defoliating. The influence on the yield is high and planning production is therefore not easy in organic seed potatoes. In storage, late blight was never considered a mayor problem.

In 1989 Agrico and Bioselect started organizing the organic farmers. They became a separate part of the company with their own logistic, technical and commercial department. Variety trials, resistance trials, trials with crop killing and trials with antagonists gave more insight in the specific problems and possibilities for the organic growers. Knowing the problems and having some solutions, the internal en visual quality was brought to a higher level and net yields of 65% of conventionally grown seed potatoes are now normal. With the better organization and the development of export, the acreage of organic seed potatoes has grown over the years to approximately 300 hectares in the Netherlands, produced by some 60 organic farmers. This is still less than 1% of the seed potato area in The Netherlands. The seed is sold all over the European Community, to Israel, Egypt and some South Asian countries.
Putting into practice of a diagram of organic seed potato production

Trehorel Fabrice(1), Marhic Jeannot(2), Jouan Bernard(3)

(1) Aval-Douar Beo (Association des producteurs de plants et de pommes de terre biologiques de consommation de Bretagne), la Maison de Pays, 22530 Mir de Bretagne, France, Email: aval-douar.beo@wanadoo.fr
(2) Bretagne-Plants, Roudouhir, 29460 Hanvec, France
(3) INRA, UMR BIO3P, 35650 Le Rheu, France

Abstract
The statutes of organic agriculture require that organic farmers use organic seeds if they are available for the cultivar chose. In the case of potato, these statutes require that the chemical seed potatoes are cultivated one year, at least, in the conditions of organic agriculture for selling them with the trademark ‘AB’. However, at more or less long time they will have to be issue of a scheme entirely organic, in order to propose organic seed potatoes adapted to the needs of organic producers, preserve a wide variability of cultivars, to be coherent, and to be independent of the in-vitro micropropagation used in seed potato production. A program of studies was therefore engaged in Brittany (France) by the I.N.R.A. (Research institute), Bretagne-Plants (Certification organization of seed potato) and the G.E.P.A.-B. in 2000 for elaborating a diagram of organic seed potato production.

It’s brought out the expediency to put into place a diagram of Simplified Linear Seed production, to cultivate the three first generations under film ‘Insect proof” as to privilege the area of the Brittany centre for the next second generations. For the initial material, it must be constituted a collection of tubers which are reproduced according to the rules of organic agriculture and exempt from Rhizoctonia solani.

First results show the feasibility of organic seed potato production, but also stress some key points, such as the resistance of cultivars.

Keywords: Solanum tuberosum, organic seed, diagram of production, site location, Rhizoctonia solani

Introduction
In the case of vegetative multiplication plant as potato, the seed production depends on the control of phytopathological problems. So, it’s bound by rules very strict and a whole organization of the production, which stretches on 6 or 9 years (under the responsibility of National Federation of seed potato producers or Bretagne-Plants in Brittany). The organic seed potato production is also bound by these rules, on more that it must respect its own rules. In particular, the statutes of organic agriculture require that organic farmers use organic seeds if they are available for the cultivar chose. For the potato, these statutes require that the chemical seed potatoes are cultivated one year, at least, in the conditions of organic agriculture for selling them with the trademark ‘AB’. However, at more or less long time they will have to be issue of a scheme entirely organic, in order to propose organic seed potatoes adapted to the needs of organic producers, preserve a wide variability of cultivars, to be coherent, and to be independent of the in vitro micro propagation used in seed potato production. A program of studies was therefore engaged in Brittany (France) by the I.N.R.A. (Research institute), Bretagne-Plants (Certification organization of seed potato) and the G.E.P.A.-B. in 2000 for elaborating a diagram of organic seed potato production. This program has consisted in a survey of producers practices and needs, an environmental evaluation of different sites of organic pre-basic seed production and in an elaboration and assessment of a diagram specifically adapted to the organic seed potato production.

Material and methods
Survey of producers practices and needs
The first stage of this program has consisted in 2000 to analyse methods, problems and aims of producers of organic seed potatoes in Brittany through a questionnaire and analysis of tender and soil samples. The questionnaire concerned the farm (surfaces, surfaces by plant species, animal productions, type of marketing, …), the cultivation of potato of the year (surfacer, cultivars, characteristics of the soil, historic of the field, fertilisation, cultural techniques, current problems, …) and the opinion of the farmer about various subjects (rules of organic agriculture about seed potato, the opportunity or not of the in-vitro micro propagation, the opportunity or not to select new cultivars, …).
Concerning analysis of tubers and soils, we have taken samples of 100 tubers of each cultivar cultivated in 2000 at each producer, and we have evaluated disease levels of black scurf, black dot, silver scurf and common scab. In the same time we have taken samples of soil in each parcel. 50 samples of 1 kilo of soil per hectare were collected. Samples of the same parcel were mixed and distributed in pots. Tubers of the cultivars Bintje, Charlotte and Sirtema (issued of in-vitro micropropagation, then exempt from pathogenic agents) were planted in these pots. From the week 8, the contamination by Rhizoctonia solani was observed on 1 pot each week.

**Environmental evaluation of different sites of organic pre basic seed production**

The production of pre-basic seed potato is submitted to rules very strict. In particular, it supposes that we have less than 0,1 % of virus at the end of the crop. Therefore, in organic agriculture, it’s necessary to choose natural conditions which were unfavourable to the multiplication of greenflies which are the principal vectors of potato viruses. Then we have distributed yellow traps in 4 sites all over the Brittany in order to capture greenflies. Each week, we have collected insects trapped, identified greenfly species and counted the number of greenflies by specie during all the crop.

**Elaboration and assessment of a diagram specifically dedicated to the organic seed potato production**

The objective of the second stage, engaged in 2001, was to elaborate a diagram of organic seed potato production which respects the statutes of organic agriculture and the rules of the Services of control of Department of agriculture. In the same time, this diagram had to be realist in the technical and economical sphere and not use the in-vitro micropropagation. Then, we have realized a technical and an economical assessment of different diagrams: the old diagram used in France until 1979 (figure I), the same system of genealogical selection of tubers but simplified and a scheme using, for the departure, propagation by cuttings (stem cuttings growing in organic soil).

**Figure I** : Scheme of genealogical selection of tubers knew in France as “Family scheme”

![Diagram](image)

F0,F1,F2,F3 : pre-basic; MS : material of selection ; SE, E, A, B : marketable class : knocked out family.

**Results and discussion**

**Survey of producers practices and needs**

We have noted a large diversity of systems (surfaces, plant species, ...) and a good rotation of crops with the exception of 3 parcels on the 35. The fertilisation is essentially based on manure of bovine (37 t/ha) or compost (10 t/ha).

For these producers in oceanic atmosphere, the main problems in organic seed potato production are the late blight (due to Phytophthora infestans) and, at the second position, the black scurf (due to Rhizoctonia solani). Against the late blight, they use the Bouillic Bordelaise (copper) which they consider quite efficient but for the black scurf they have not control methods.

A large part of them want to have in the future cultivars more adapted to the conditions of organic agriculture. And a majority want a scheme of seed potato production entirely organic and don’t accept the in-vitro micropropagation.
The analyses of tubers show that only 8% of the samples are exempt from black scurf. For the orders, 51% of the tubers are contaminated. On more, we have frequently observed the presence of silver scurf due to Helminthosporium solani (62% of the samples), common scab due to Streptomyces spp (86.5% of the samples with 26.5% of the tubers contaminated) and black dot due to Colletotrichum coccodes (89% of the samples with 30% of the tubers contaminated).

For the soil samples, we have isolated Rhizoctonia solani AG3 in 15 of the 21 parcels concerned. All these parcels have received potato for the last time 3 to 5 years ago.

The data stress the importance of black scurf in organic potato production because of the contamination levels of seeds, because of the absence of efficient control methods usable in organic cropping and because of the use of manure for the fertilisation which favours the maintenance of Rhizoctonia in the soil. In a general manner, these results stress the necessity for the organic farmers to have seeds adapted to their means and their specificities.

Environmental evaluation of different sites of organic pre basic seed production

The results (Figure II) show that the dynamic of the greenfly populations is very various on a lapse of time very short. We note also that these variations are quite similar between the 4 sites. But, we can see important differences about the number of greenflies. We observe that it’s in the area of Paule (in Brittany centre) we have captured the less greenflies during the crop. These data ratify the observations that we can do on the crops and harvests about virus damages. Then, we can say that the centre seems to be the most interesting area for growing pre-basic or basic seed potato in organic agriculture in Brittany.

**Figure II** : Dynamic of greenfly populations in 4 sites distributed in the south (Pontivy), the centre (Paule), the northwest (Pleyber Christ) and the west of Brittany

\[\text{Elaboration and assessment of a diagram specifically dedicated to the organic seed potato production}\]

The study of the “Family scheme” (figure I) shows that the production of 55 000 tubers (classic density per hectare) of generation F4 would suppose an investment of 7 670 euros. Before to sell the first generation of seed potatoes completely organic, it will be necessary to produce each year, at the beginning at least, the generations of replacement. So, when we will harvest the generation F4, 5 generations F0, 4 generations F1, 3 generations F2, and 2 generations F3 will have been grew. Without the generations of replacement it would cost 5 750 euros, for instance, 10 cents per tuber. One of the reasons of this cost is the maintenance, in this scheme, of each family during 4 years. On more, producers want to keep a large diversity of cultivars, which increases the complexity of such production. Concerning the method of propagation by cuttings (Figure III), the main limiting factor is the transplanting of stem cuttings. This type of material is frailty, therefore it supposes optimal conditions of growth (irrigation, ...) and a difficult control of diseases (late blight, ...).

Consequently, of these two years of work, it’s brought out the opportunity to put into place a diagram of Simplified Linear Seed Production. This scheme is more simple than the traditional ‘Family scheme’, so less expensive and less complex to manage. All the tubers of departure are cultivated together. There is no individualization of the tubers during the 4 first years. Tubers are more rustic than stem cuttings, therefore the culture is easier and less sophisticated, which permits us to choose the parcels with the better ecological conditions for the production of organic seed potatoes. For example, in relation to greenflies, Rhizoctonia, isolation of the orders potato crops.
The strength of tubers offers a better resistance to the pathogenic agents and a weeding easier. We have proposed to cultivate the three first generations under insect proof film in order to protect plants against greenflies (vectors of potato viruses) as to privilege the area of the centre of Brittany for the next second generations. For the material of departure we have proposed to constitute a collection of cultivars which would be planted each year in open field and cultivated according to the rules of organic agriculture, for acclimating the material to these conditions of cultivation. After presentation, the Department of Agriculture has accepted that we experiment this diagram for the organic agriculture.

Therefore, in 2002, we have created an association (Aval-douar Beo) in order to putting into practice this diagram with the collaboration of Bretagne-plants. We have chosen to test all cultivars of the organisations which were interesting, in Brittany for the beginning, by this work. Two organisations were agreed to introduce their cultivars in this diagram (Payzons ferme and Coopagri Bretagne). The cultivars were : Bintje, Désirée, Spunta, Belle de Fontenay, Monalisa, Rubis, Emeraude, Eden, Kéméré, Ostara, Nicola, etc.. We have tested 60 tubers of each cultivar in relation to virus, bacteria and fungal, and we have planted them in a field where there was never had potato farming. Ten of these tubers have been used for constituting the collection. This collection will permit to replace basic material.

After two weeks, we have weed crops and put the insect proof film. During the vegetation’s period we have realized only 3 treatments with 3 kilograms of Bouilie Bordelaise against Phytophthora infestans. At the end of the cycle, and in accordance of precocity of the different cultivars we have pulled the haulms in order to avoid infections by virus and to limit a possible contamination by Rhizoctonia solani. For the same reason, the harvest was executed 3 weeks after haulm destruction. All tubers were controlled and tested in relation to virus, bacteria and fungal.

In 2003, the harvest which satisfied to our requirements was replanted. In the same time, a new generation was planted in order to permit replacement and 8 others cultivars were introduced in this program at professional request.

**Conclusion**

The first results are very interesting, considering the system used, the yield of each variety and the quality of tubers in relation to virus, to black scurf and the others pathogenic agents.

Now, we expect replanted the first “family” 5 years again for proposing to producers seed potatoes which are not too expensive and adapted to the conditions and control methods of organic farming. And for hitting this target, we go on, in the same time, improving this diagram and the control of potato pests and diseases. Overall, this work takes part in the identification of the limiting factors of the organic seed potato production and, if it’s necessary, will permit to engage a specific breeding program in order to obtain cultivars more adapted to the organic system.
Organic potato seed: questions to the future of it!

Eric Bonnel
Germicopa SAS, 1 Allée Loiez Herrieu, 29334 Quimper Cedex, France
Supported by François Le LAGADEC, Biomass (MAS SA), Bel Air, 29670 Tailé, France
Email: eric.bonnel@germicopa.fr

Statistics on production of organic potato seeds throughout the EU are rather difficult to obtain from the official seed certification bodies. In Austria, one of the countries, which strongly supported organic production during the last two decades, an estimate is 8% for the market share for certified seed. In Germany, this rate is a little lower with 5%.

In France, the constant rate of 0.6% (table 1) is quiet disappointing for professional seed growers! A total of about 1,200T is certified as organic potato seeds, to be compared to the 270,000 T for the total certified potato seeds used in France. Germicopa (Table 2) produces about one third (400T) thanks to contracts with organic growers, out of which 200T are for the home market (100T for the gardeners, 100T for professionals) and 200T are exported to Germany. This is to be compared to the 80,000T of conventional certified potato seed produced by the company, therefore no more than 0.5% as well!

Table 1: French organic potato seed production

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ha</td>
<td>70</td>
<td>61</td>
<td>91</td>
<td>93</td>
</tr>
<tr>
<td>% Total</td>
<td>0,5%</td>
<td>0,4%</td>
<td>0,7%</td>
<td>0,6%</td>
</tr>
<tr>
<td>Retailers</td>
<td>11</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varieties</td>
<td>47</td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Germicopa’s organic seed production

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ha</td>
<td>34,65</td>
<td>27,25</td>
<td>30,5</td>
<td>28,75</td>
</tr>
<tr>
<td>% Bio France</td>
<td>49,5%</td>
<td>44,7%</td>
<td>33,5%</td>
<td>30,9%</td>
</tr>
<tr>
<td>Producers</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Ha/producer</td>
<td>4,95</td>
<td>4,54</td>
<td>5,08</td>
<td>3,59</td>
</tr>
</tbody>
</table>

When visiting the specialised European websites to check the availability of organic seed, (organicxseeds.com, semences-biologiques.org, biodatabase.nl), one can find as many as 141 different potato varieties which are offered for sale by about 25 retailers in France, Germany, Switzerland and United Kingdom. Although only a fraction (15%) of the 880 varieties currently registered on the EU list has been proposed, a large choice still exists.

Potato specialists will recognize among the list of the most frequently available varieties (table 3) a range of public and private varieties for table and French fry products, very much known by the conventional growers, processors and consumers. Therefore, despite the strong demand from the organic associations or lobbying bodies, the organic producers are currently focusing on leading varieties, not on specific varieties. Resistances to major pests (nematodes, wire worm) and diseases (late blight, rhizoctonia, viruses) are welcomed, but they are not decisive yet.
Table 3: Number of retailers on EU web sites for the most frequently varieties available for organic production.

<table>
<thead>
<tr>
<th></th>
<th>CH</th>
<th>D</th>
<th>F</th>
<th>NL</th>
<th>UK</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicola</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Charlotte</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td></td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Sante</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td></td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Désirée</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Cosmos</td>
<td>1</td>
<td></td>
<td>8</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valor</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Romano</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maris Bard</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remarke</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accent</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agria</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kestrel</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maris peer</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentland Dell</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premiere</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At Germicopa, thanks to the high degree of skill and motivation of the organic growers involved, and also thanks to a suitable environment, the production of organic potato seeds is technically affordable in compliance with the standards of the French seed certification regulation (Table 4).

Table 4: Yields of Conventional & Organic Certified Seed Production at Germicopa. (T/Ha, 40mm).

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>13,38</td>
<td>12,90</td>
<td>18,72</td>
<td>15,45</td>
<td>15,11</td>
</tr>
<tr>
<td>Organic</td>
<td>11,74</td>
<td>15,55</td>
<td>15,53</td>
<td>15,92</td>
<td>14,69</td>
</tr>
<tr>
<td>(% Conv)</td>
<td>88%</td>
<td>121%</td>
<td>83%</td>
<td>103%</td>
<td>97%</td>
</tr>
</tbody>
</table>

The “Obligation of Means” imposed by organic certification bodies are compatible with “Obligation of Results” imposed by the states seed certification bodies.

The economy is most likely to limit the organic potato seed production. To develop this activity, Germicopa has had to pay double price of the regular certified seed to compensate:

- the average 40% reduction in marketable yield because of the limited size (40mm instead of 45mm) of the seed sold on the organic market when compared to the conventional market (Table 5);
- higher risk of rejection in national seed certification because of rhizoctonia, wire worms and dry rot infections;
- higher value of the organic ware production

Table 5: Yields of Conventional Certified Seed Production at Germicopa. (T/Ha, 45mm).

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>22,38</td>
<td>22,12</td>
<td>28,4</td>
<td>26,1</td>
<td>24,75</td>
</tr>
</tbody>
</table>
Difficulties occur after the harvest! Storage, packaging and transport are very sensitive to accidental pollutions by various agrochemicals from different sources, which are not compatible with organic standards.

In the fall 2003, Germicopa experienced a fortuitous pollution by Thiabendazol that was found on organic seeds of the variety Charlotte at a very low rate, near the limit of detection by accredited analytical laboratories. This resulted in one-month delay in sales to give time to experts and the certification body to trace back the origin of the pollution to dust in a duly accredited grading station. After this delay, the authorisation for the sale of organic seed has been given, but it was too late for Germicopa, which therefore lost half of its sales to the benefit of conventional seed or foreign organic seed.

A specific distribution chain, from the seed storage to the customers (growers and gardeners) might be added to the specific production chain to ensure the total absence of chemical residues, but the costs of such investments are still disproportionate in regard with the very small market.

For organic seed growers and for the retailers, the market is very small, so are the customers. Maximum size for the seed delivery units is 1T. A few bags of 25 kg are common figure of this market!

Up to now, a significant proportion of the organic growers have had preferably used conventional certified seeds rather than organic seeds, whatever was the variety choice, just to ensure a good crop with low cost of seeds!

In France, the demands for derogation to the use of organic seed because of “variety unavailability” were numerous in 2003-2004. This resulted in unacceptable levels of unsold organic certified seeds on the market and questioned the motivations of these growers!

Given the small size of the market, the high level of risks for unsold seed and for declassification all along the production and distribution chain, the added value that one can get for the organic seeds is far too low. Investments in breeding for specific new varieties and in organizing a full distribution chain completely separated from the conventional certified seed chains are questionable.

Despite those facts, considering the new regulation on organic seeds tending to allow only organic certified seeds to be used for organic production, Germicopa and its organic trade partner are studying the ways to go on producing and dispatching their varieties in the full respect of both the organic and seed regulations and to be guaranteed on economic outlooks.

Questions on the true perspectives are raised. We hope this first world congress will contribute to answer them.
Feasibility and obstacles in New York state (USA) to produce double certified
certified seed and certified organic) seed potatoes

Michael Glus
Northeast Organic Farming Association of New York and The Public Seed Initiative
9398 W. Creek Rd., Berkshire, NY 13736, USA
Email: michaelglos@nofany.org

Abstract
With the recent adoption of national organic standards in the United States of America all certified organic
growers are required to used certified organic seed and planting stock, including potatoes. With no New
York State (NY) certified organic seed potatoes being produced, NY organic growers have had to abandon
their local but non-organic seed suppliers and purchase seed potatoes from out of state sources. New York
Growers now pay up to and sometimes over 6 times more than non-organic seed and instead of picking up
their seed locally have it shipped from up to 2500 miles away. This has led to investigating potential local (in
state) production of double certified (certified organic and certified by the state seed program) seed potatoes.
Some of the obstacles include: organic growers not having large acreage, little knowledge on how to
produce organic seed potatoes, keeping organic potatoes disease-free under organic management, and
storage. This is an on-going effort and recent successes and challenges will be presented.

Keywords: certified organic seed potato production

Background
New York State (NY) is home to over 276 certified organic Farms and processors (NOFA-NY Certified
Organic, LLC, 2004). Potatoes make up an important part of this with many vegetable farms growing them
for wholesale and direct marketing. Since October of 2001 under the United States Department of Agriculture
(USDA) National Organic Program (NOP) farmers who wish to sell their products as organic must be
certified by a USDA accredited certifier and follow the regulations as described under the NOP Final Rule
(United States Department of Agriculture, 2000). Part of the new requirements are that producers “must use
organically grown seeds, annual seedlings, and planting stock” which includes potatoes. Prior to the NOP
many NY organic growers purchased their seed potatoes from in-state growers that were not organic but
produced seed certified by the New York State Seed Improvement Project (NYSIP). Through NYSIP
certification growers fields and crops are inspected for variety purity and diseases. With the new requirement
to purchase certified organic seed potatoes growers must purchase seed from outside the state because
currently no commercial NY certified organic seed production exists. While growers previously purchased
seed potatoes for $18.00 per hundred weight (45.46 kg) and were able to pick the potatoes up themselves,
current certified organic seed potatoes cost $85-$118 plus shipping of an additional $7-43.50 per hundred
weight (lead, pers. comm. 2004). Fingerling varieties can cost upwards of $225 a hundred weight compared
to non-organic sources of $30.00 a hundred weight. This means that growers are paying 4.7- 6.5 times as
much for seed potatoes plus the additional cost of shipping. Shipping is one of the main things that affect
the total price that a grower pays. It is not uncommon for the potatoes to be grown in one region of the
country like the state of Virginia, Colorado or Idaho, shipped to a seed dealer in another state like Maine, and
then finally shipped to the farmer. (Henderson, pers comm, 2004). This additional shipping and middle man
drives up prices. It is invariably more expensive to produce organic seed potatoes compared to those
produced non-organically. Wherever the potatoes are produced they will cost more that non-organically
produced ones.

A New Direction
As part of the Public Seed Initiative (PSI) an effort is being undertaken to help make local double certified
(certified organic and blue tag certified) seed potatoes available to NY organic farmers. There are several
reasons to do this including: reducing costs to farmers, produced locally adapted varieties, and supporting
our local farmers. By producing potatoes in-state it is thought we can eliminate much of the transportation
costs that are currently involved in buying out of state seed potatoes. One New York grower who is just
starting to produce double certified seed potatoes in 2004 believes he will be able to wholesale seed
potatoes to growers for around $50.00 a hundred weights picked up at his farm. Although still 2.8 times the
conventional price this is much more reasonable that upwards of 6 times the price. With many growers
getting around $1.00 a pound for certified organic potato table stock the price of locally produced seed potatoes can be absorbed. In addition to price it is important to have available varieties that do well in the climate of New York State. Through NYSIP and Cornell University efforts are made to breed new varieties and adapt older ones for New York State growing conditions. And thirdly this effort will help support our local farmers.

**Challenges**

With any effort come new challenges. We have approached several growers to help encourage them to begin double certified seed potato production. There are many good organic potato growers but they know very little about what it would take to grow seed stock instead of potato stock. Many grow small acreages of potatoes (less than 1 acre), have limited winter storage, and are uncertain about starting a new production and marketing enterprise. There are also many good local conventional seed potato producers which although they are great seed potato producers know very little about organic growing practices. Most don’t have land that can be currently certified organic.

To overcome some of this obstacles one organic grower has teamed up with his neighbor who is retiring and discontinuing seed potato production. They are working together to use the one’s knowledge of how to produce seed potatoes with the others knowledge of how to grow organic potatoes. Additionally NYSIP is working to provide the growers with foundation seed stock of varieties that are requested by local growers. For some varieties this will require growing them out from tissue culture because they are not readily available. Growers are eagerly awaiting the results of this years growing season.

**Other Efforts**

To assist growers and provide valuable information to new seed potato producers several efforts are being undertaken. As part of PSI potato variety trials are being done on 9 farms throughout the entire state. A dozen local varieties and 30 from across the country are being trialed. These include unreleased varieties from the Cornell University potato breeding program, newly released varieties that are not available as organic seed, and several heirloom varieties that show promise for organic systems. All are being compared to standard varieties that organic farmers grow. The results will be shared with growers and those producing organic potato seed. Another trial is at the University of Wisconsin where Professor Doug Rouse is trialing over 450 potato varieties for many traits including the ability (or difficulty) to produce each one as seed stock using organic methods. This will be important information to know so that organic seed growers can try to grow varieties that are more adapted to organic seed production.

**Conclusion**

It is hopeful that through the initial efforts with one grower and new working relationships of conventional seed producers, universities, growers, and seed certification agencies that NY double certified organic seed potatoes will become a reality. NY farmers need a reliable and affordable source of high quality certified organic seed potatoes and we are getting closer to this becoming a reality.

**References:**

Henderson, Elizabeth (2004). Personal communication 22/03/04.

Leed, Andrew (2004). Personal communication 20/5/04.


Organic seed & coating technology: a challenge and opportunity

Ir. R.J. Legro
Incotec Holding B.V., Westeinde 107, 1601BL Enkhuizen, The Netherlands
Email: bob.legro@incotec.nl

Abstract
Seed enhancement and seed coating technology methods are considered indispensable for successful organic crop production. Existing methods however, are often based on the use of synthetic substances. The legislation on organic food production in the world and more specific in both US and Europe, is not yet harmonised and not adapted to deal with seed technology. The degrees of freedom for use of substances in seed technology processes are uncertain. Adapting the existing processes with the present limitation in substances will be extremely time-consuming and in many cases may not be fully effective. Based on the special position in the food production chain, a plea is made to have a separate section for seed enhancement en seed coating processes and to obtain more clear and harmonised guidelines. With respect for the organic principles, a responsible tolerance for the use of substances that do not affect the natural behaviour of the plant is desirable. This approach in combination with active search for acceptable substances and innovative seed technology processes, will support the further expansion of organic farming and give new opportunities for those involved in organic food production.

Keywords: Enhancement, Priming, Upgrading, Disinfection, Coating, Pelleting, Encrusting, Filmcoating

Commercial seed & coating technology
Over the past 50 years seed enhancement and seed coating technology, gradually has taken a prominent place in the life cycle of modern crop production all around the world. Based on intensive long term research programs the seed technology service company Incotec has developed and optimized many seed enhancement and seed coating protocols to fit a broad variety of species, markets and environmental conditions. Of to-day and worldwide Incotec has commercialized about 50 seed enhancement recipes, over 30 seed pelleting recipes and over 50 filmcoating formulations, which in combinations have lead to over 500 different product forms.

The success of these seed and coating technology protocols largely depends on an accurate selection and well-balanced, often-complex, combination of substances. Frequently, these substances are of a synthetic nature.

Seed enhancement
Seed enhancement includes special grading techniques, disinfection methods and variety of priming treatments to overcome light- or temperature dormancy, increase of germination energy, uniformity and final germination. As an example of priming (see Figure 1.), the most traditional method used around the world, is based on osmoconditioning the seeds in solutions of PEG (PolyEthyleneGlycol) with additional plant growth regulators (PGR) at optimal temperature for a determined period of time. Typically the large PEG molecules will not penetrate into the seed but simply facilitate a limited and controlled level of imbibition.

Figure 1. Effect of priming on the upper temperature limit for germination of lettuce seeds.
Figure 2. Result of fluid density grading on the germination of tomato seed fractions.
In upgrading of vegetable seeds an innovative method is the fluid density grading in which a mixture of synthetic liquids with specific densities, enables separation of dry seeds based on their density. Seed density is often related to seed quality characteristics (see Figure 2.).

With regard to seed disinfection a widely used type of treatments is based on immersing seed for a certain time period in solutions of antibiotics (e.g. streptomycin), fungicides (e.g. Thiram) or inorganics (e.g. TriSodiumorthophosphate).

**Seed coating**

Seed coating includes a broad spectrum of seed modifications ranging from a thin-layer filmcoating to a full size pelleting process. Primary functions are the improvement of seed plantability to enable a fast and accurate machine planting and/or the application of active substances for improved germination, emergence and final stand. In all these standard traditional seed crop production processes, a variety of both natural and synthetic substances are commonly used.

For encrusting and pelleting of seeds there is a large pool of natural minerals or volcanic rock substances which are commonly used, including for example diatomaceous earth, perlite, limestone, quartz flour, kaoline, bentonite, attapulgite, sepiolite, talcum (Halmer, 1988). In general most of these substances are mined and only processed through physical treatments such as heating, grinding, and screening. Yet, some of these materials can be chemically treated to change the physical properties. Furthermore, synthetic materials are often used to optimize the water uptake and oxygen balance in the pellets. Very common is the use of synthetic binders such as cellulose- and polyvinyl-polymer. As a natural binder, clay-minerals such as bentonite and attapulgite can be used. These substances however are relatively heavy and thus less suitable for seed coatings used for vacuum planters. Besides, such clays are often highly hydrophilic and it demands special well-balanced formulations to realize a sufficient oxygen supply to the seeds and thus create an optimal condition for germination.

In filmcoating formulations the majority of the used substances are synthetic, including polymer binders, color pigments and effect pigments (surface treated micas). Besides, filmcoatings are typically used to apply chemical pesticides and other more or less chemical substances such as micro-nutrients to the seed. It must be emphasized that seed coatings are an extremely efficient, accurate and safe way of adding protective or simulative substances to the seed in comparison to the environmentally burdening soil- and foliar applications.

The last decade the interest in organic crop production and thus the need for organic seed has gradually increased. The organic market is becoming more and more important for the consumer and is expected to further increase fairly rapidly. Like in traditional seed markets, also in the organic seed market the same needs for seed enhancements and seed coatings are valid. With the organic regulations further implemented in both Europe and the USA and the call for organic seed enhancement and seed coating processes a fact, challenges and opportunities for both legislators and seed technology companies lay ahead.

**Challenges and opportunities with regard to organic seed legislation**

As a globally operating seed technology provider, one of the first challenges for Incotec was to understand the organic principle, the various relevant regulations with its exceptions, the differences in legislation between the US and Europe and the interpretations by the certifying agencies. In the US the rules for organic farming are laid down in the National Organic Program (NOP) under the direction of the United States Department of Agriculture (USDA). In Europe the rules are described in the EEC directive no. 2092/91, which is adopted by all the member states and the national certifying agencies.

A major hurdle was to understand which section of the regulations would apply best to seed technology. It was obvious that none of the sections in both the directives in the US and Europe, had ever taken into account seed enhancement and seed coating for improving seed quality before planting. As a result in both the US and Europe Incotec has experienced a change in opinion as under which section seed technology would belong and, as a consequence, which substances were cleared for use and which synthetics were allowed.
Thanks to major efforts of the California Crop Improvement Association (CCIA) in corresponding with the USDA officials, in September 2003 a provisional formal statement for the position of seed technology was obtained. This enables the industry to work with all approved natural substances (section 205.602 of Subpart G), listed approved synthetics (section 205.601) and minor non-organic substances as allowed in organic food processing (section 205.605).

In Europe at this moment the situation for seed technology is not yet as favorable as in the US. After initial classification by the Dutch certifying agent SKAL under Annex VI section B of the EEC directive no. 2092/91 (Processing aids and other products etc.), the present formal opinion in the Netherlands is that seeds are considered as “unprocessed agricultural crop products”. Thus substances used in seed technology are limited to those allowed according to Annex II (e.g. Fertilizers and soil conditioners, Pesticides).

A second complicating factor in interpreting the regulations is the description of the allowed substances, which seems rather coincidental and sometimes technically incorrect and thus confusing. As an example, in the EEC directive Annex II “Clay (perlite, vermiculite, etc.)” is mentioned as an allowed substance. Yet, in the scientific classification of minerals, perlite does not exist since it is not a mineral but a complex of volcanic origin. The “Clay” group in itself belongs to the subclass of the “Phyllosilicates” and covers minerals such as kaolin, talc, vermiculite and bentonite which are commonly used in seed coatings. Next to minerals in the “Clay” group the Annex II allows the use of limestone (CalciumCarbonate – Class of Carbonates) and gypsum (Calciumsulphate – Class of Sulfates), but for no specific reason thus excludes all the other natural minerals from these or other classes.

Finally, the classification of seed technology in a certain section or annex automatically excludes the use of allowed synthetic substances that can be used in other sections or annexes. With interpretation it may happen that a synthetic substance is cleared for direct use on the consumed vegetable but could not be used on the initial seed from which the vegetable was grown.

Next to that one can state that for flowering (e.g. broccoli) or fruiting vegetables (e.g. tomato) the organic nature of the consumed product has no relation with any seed technology treatment, specially when no substance from this treatment has been absorbed into the seed or seedling.

In general it holds true that any seed treatment technology can be considered a minor use application in comparison to traditional soil and foliar treatments. Within the non-organic crop protection for instance there are various examples where substitution of an insecticide foliar treatment by a seed treatment can save up to 99% of the chemical. With seed enhancement and seed coating being so efficient in the use of substances to improve seed quality, it seems justifiable to support a separate and more tolerant approach with regard to the allowance of both natural and synthetic substances.

Challenges and opportunities with regard to organic seed and coating technology
To understand the true challenges it is obvious that clear and unambiguous rules in both the US and Europe for the use of both natural and synthetic substances in seed enhancement and seed coating processes are needed.

As today the challenges in seed priming are to develop processes in which the priming of the seed is done without osmotic agents and with the use of allowed natural PGR’s or synthetic substances. Alternative methods to obtain a controlled imbibition, are known as “solid matrix priming” (Austin, 2000) and “drum priming” (Rowse, 1992). Yet, the options would be much broader when it would be allowed to prime seeds with the use of macro-molecular osmotic agents, which basically can be considered chemically inert to the seed. Synthetic PGR’s may be replaced by natural substitutes produced by micro-organisms or derived from plant extracts. It should be realized that these may not be as pure and stable in quality and activity as the synthetic counterparts. Small deviations in quality can have significant effect on final priming effect. Within the present limitations Incotec recently has developed a priming process (see Figure 3.) which is certified in the US as well as in the Netherlands.
With regard to fluid density separation it can be questioned to what extend the use of synthetic substances would be in conflict with the organic principles. The substances are not absorbed by the dry seeds and merely create a specific density situation in which the seeds can be graded. If fully recycled for future use, this seems a very responsible method.

New grading methods based on image analysis technology are being developed, which are expected to be allowed for use on organic seeds. One example is the sorting on the seed quality-parameter seed maturity through analysis of the chlorophyll fluorescence of excited seeds. Incotec is currently developing an X-ray sorting system that will allow grading of individual seeds based on their X-ray image. It is a highly innovative system that only will be economical for the most expensive seeds at the present level of imaging technology. Besides, for optimal results the priming of the seeds is a necessity.

With regard to organic disinfection methods, questions can be raised if all present options within the group of the existing physical seed treatments are allowed. Hot water or air treatments (e.g. hot steam, dry air) should have no problem. Yet, will it be acceptable to use radiation treatments (e.g. microwave, gamma radiation, UV-light) or even gaseous treatments such as with ozone?

In organic seed encrusting and pelleting, a major challenge is to obtain good pellet properties with sufficient pellet integrity without the use of synthetic substances such as the synthetic polymer binders. If today all synthetic substances would have to be removed from the pellet formulations, most seed pellets will have little or no integrity and perform poorly under moist soil conditions and /or extreme temperature regimes. (see Figure 4.). It could be stated that a pellet is a temporarily present inert seed packing, which only facilitates the planting of the seeds. How different is this from the synthetic bags and boxes, which are used to pack the final organic food product?! Thus a physiologically inert seed coating could also be exempted from the directives on allowed substances.

Figure 4. Effect of synthetic substances used in standard seed coatings on germination
Finally, with regards to growth stimulating or crop protecting additives the limitation is not so much the absence of natural substitutes in the first place. There is a large pool of natural and biological substances with proven bactericidal, fungicidal or insecticidal and/or growth promoting properties. Examples are the group of plant extracts (e.g. azadirachtin from the neem tree), essential oils (e.g. thyme oil) and biocontrol agents (e.g. Bacillus ssp.). Yet, the major barrier is the obligation to obtain a registration in the standard local directives for use of pesticides and growth promoters. Typically the registration process is extremely time consuming, very costly and thus often not feasible for minor use substances. For the time being the options are limited to those substances that are either allowed or exempted from allowance by both the organic and pesticide directives. In this respect the essential oils seem to be realistic options. (Groot et al., 2004, Van der Wolf, 2004).

**Conclusions**

“Good quality seed is half the battle”, is an often used expression to emphasize the relevance of seed quality in modern horticulture and agriculture. For organic crop production this seems to be even more important since the additional use of fertilizers and crop protectants is extremely limited and substitutes are often less effective.

There is challenge for the organic lawmakers to create clear, unambiguous and worldwide-harmonized regulations for seed enhancement and seed coating technology. There are various arguments given why the use of substances in seed enhancement and seed coating processes should be regarded in a tolerant but responsible way. A separate section on organic seed technology would do justice to the special position it takes in the organic food production.

Even with the maximum degrees of freedom there are many challenges for seed technologists to find substitutes for unacceptable substances and to develop optimal enhancement and coating processes for organic seed.

At the end the combined efforts will lead to a further and faster expansion of the organic crop and food production with many opportunities for those involved.

**References**


Critical Control Points in Organic Seed Production

Kees Langerak¹, Carin van Tongeren¹, Ronald Driessen² & Ruud van den Bulk¹
¹ Plant Research International, P.O. Box 16, 6700 AA Wageningen, The Netherlands
² Rijk Zwaan Zaadteelt & Zaadhandel B.V.
P.O. Box 40 2678 ZG De Lier, The Netherlands
Email: ruud.vandenbulk@wur.nl

Abstract
Organic seed production may encounter various problems dealing with seed-borne pathogens. Reduction of such problems by application of chemical crop protection agents during plant developmental stages with increased risks of seed contamination is not possible. Controlling the problem of seed transmission of pathogens is particularly complex in perennial crops, which need two growing seasons for the complete production cycle from basic seed to sowing seed.

In our research the host-pathogen combination carrot-Alternaria, with Alternaria radicina Neerg. as the target fungus, has been chosen as a model for developing strategies for disease management. The main approach in this research is to get a better understanding of the epidemiology of A. radicina throughout the entire production chain. This approach started with an evaluation of available detection methods for A. radicina and improving them for use in different stages of plant development and during storage of carrots. Furthermore, experiments have been performed to study the transmission of the pathogen from seeds to plants to the second generation seeds. As a result of this research, critical control points during carrot seed production have been determined. These control points can be the basis for disease monitoring activities and treatments with preparations acceptable to the organic sector as tools in a disease management strategy.

Keywords: Organic seed production, carrot, Alternaria, disease management

Introduction
Organic seed production encounters various problems, of which weeds and the transmission of seed-borne pathogens are the most serious ones. Contrary to conventional seed production, control of these problems by input of chemicals in certain stages of plant development is not possible.

In the organic seed production of glasshouse crops like sweet pepper, cucumber and tomato, knowledge from organic and integrated production methods can be used rather easily, because seed production is almost the same as crop production. However in biennial crops like carrot, cauliflower and leek almost no information or experience is available for use in developing organic seed productions. The management of controlling the transmission of pathogens is most complex in biennial crops, because two growing seasons are required to produce sowing seed from basic seed. Weeds are also in biennial seed crops difficult to control, demanding a large input of labour which makes seed production expensive. Other common problems are the availability of nitrogen at the moment of regrowth after vernalisation in winter, specific pests during bolting, flowering and seed maturation and infestation by fungi.

Our research focuses on the host-pathogen combination Daucus carota - Alternaria radicina as a model to determine the critical control points in the seed production chain of this biennial crop by getting more insight in the epidemiology of the fungus, and the effects of culture and climatological conditions. These control points should be the basis for disease monitoring activities and, when appropriate, treatments with preparations acceptable to the organic sector, as tools in a disease management strategy.

Detection methods
To be able to study disease transmission in all stages of the reproduction chain, from seed to seed, appropriate detection methods are needed. Such methods should be used to determine the presence of the pathogen in basic seed and other kinds of plant material produced from that, viz. seedlings, leaves, roots, flower stems, flowers and the second generation seed. Usually, the so-called blotter test recommended by ISTA (ISTA, 2003) is used for detection of A. radicina. However, we preferred to use the ARSA method (Prior et al., 1994), because that method is more sensitive and enables also the detection of slight infections. Examination of plant material for fungal growth took place after 7-14 days on the semi-selective ARSA medium. A PCR-based assay for detection of A. radicina has been developed (Konstantinova et al., 2002). Specific primers for detection and identification of the Alternaria species on carrot seeds and roots were designed and shown to be sensitive and able to differentiate between the Alternaria species occurring on carrot, i.e. A.
radicina, A. alternata and A. dauci. A. radicina could be detected in DNA isolated from infected carrot material, but comparison with the results of the blotter method and plating on ARSA medium showed that results of the PCR-assay were not always reliable. This method was therefore not further used.

**Disease transmission**

In order to optimise organic carrot seed production, we focused on gathering knowledge of “thresholds”, describing the link between measured seed contamination levels of a pathogen and the potential disease risk in practice. Several field experiments were carried out under organic conditions, using basic seeds of six different cultivars with various levels of *A. radicina*. Seed infections found with the blotter method were mainly related to a bad field emergence and occurrence of symptoms during the seedling stage. Slight seed infections could only be detected with the ARSA method, and seemed in later stages to result in non-visible, latent infections in the crown part of the carrot root. These infections may become visible as a black rot either at a high temperature (>20 °C) during maturation of the carrots or during long-time cool storage of the carrots followed by a period of a higher temperature, e.g. as experienced during washing of the carrots or during transport. A positive correlation between the seed infection percentage and percentage of storage rot developed during storage (5 months at 0.5 °C) was found (Figure 1).

When young carrot plants or mature roots are vernalised in order to induce flowering, latent infections mostly remain unnoticed. Such infections can finally result in infected flowers (Figure 2). We assume that the latent infections in earlier stages are present in or around the meristems, and thus can easily be transmitted to the developing flowers. Infected flowers and diseased seeds may form a source of inoculum for secondary infection of seeds developing on healthy plants. Wind, rain and insects were important factors contributing to the spread of the disease.

**Critical control points and control measures**

With the results obtained, we were able to design a simple scheme for the carrot seed production chain with a number of critical control points (Figure 3). These control points comprise stages in the production chain where monitoring and, when appropriate, treatments will contribute to the production of a better quality seed. In particular it is recommended to monitor for the presence of *Alternaria* in the basic seed, the plants or stocklings undergoing vernalisation, and the flowering plants. The information obtained with respect to the infection percentages will be helpful in deciding whether or not to give a treatment, which material, e.g. basic seed lots or stockling batches, to select, and to predict which productions will be good and which will not be worth harvesting. Indications were obtained that harvest time, which is related to the developmental stage of the flowers and the maturity of the seeds, also influences the contamination levels for *A. radicina* in the seeds harvested. Thus, harvest time likely can also be used as a control measure to reduce seed infection with *A. radicina*. An earlier harvest date is also suggested to improve the health of barley and wheat with regard to infestation by Bipolaris sorokiniana (Olvång, 2004).

Control measures that can be applied may include treatment of the basic seed with hot water (45-50 °C) or with natural compounds such as essential oils. A hot water treatment is effective in reducing the contamination level of infected seed, but also reduces the number of diseased flowering plants later in the production chain (Figure 4). Nonetheless, this treatment is not 100% effective, because the temperatures needed to achieve a full eradication of *A. radicina* will have a drastic negative effect on germination. Applications with compounds of natural origin, such as plant-derived essential oils, may contribute to control of seedborne *Alternaria* as well (see Groot et al., Perspectives of organic seed treatments, these proceedings). Biocontrol agents based on antagonistic micro-organisms may be useful, but experimental results of applications in the field with the antagonist *Ulocladium* showed that the developmental stage of the flowers at the time of application is essential (Köhl et al., 2004).

**Conclusion**

Organic carrot seed production requires a high degree of sanitation, e.g. disease freedom of the basic seed, selecting and/or roguing in any stage of plant development when possible and a stringent isolation of production fields from other umbelliferae. Monitoring defined control points in the production chain will contribute to the process of decision making. Seed treatments, such as hot water treatments, are available, but do not lead to 100% control of *A. radicina*. Other control measures need to be developed as well. The ‘buffering capacity’ of the soil and its micro-flora needs further studies, but also the possibilities of sorting out infected seeds based on maturity or other seed characteristics may have perspectives for the future. Treatments with natural compounds or microorganisms may contribute to control of *Alternaria* as well, but
it still is a discussion point whether these types of treatments are acceptable for the organic sector on the long term.

Fig. 1. Occurrence of black rot in roots grown from *A. radicina* contaminated basic seed after 5 months storage at 0.5 °C.

Fig. 2. A healthy (upper flower) and an Alternaria-diseased (lower flower) umbel of carrot.

**Relation slight seed infections and storage rot for six cultivars**

<table>
<thead>
<tr>
<th>Storage Rot (%)</th>
<th>Seed Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Fig. 3. The critical control points in the carrot seed production chain: the basic seed, the seedling, the young plant, the stockling, the flowering plant, and the second-generation seeds.

**Acknowledgements**

This work was financially supported by the Dutch Ministry of Agriculture, Nature and Food Quality (DWK programme 388) and the European Commission, programme Quality of Life and Management of Living Resources (QLK1-1999-0986).

**References**


Possible methods for organic seed treatment

Anna Ertsey \(^1\) – László Radics \(^2\)
BUEPA, Faculty of Horticultural Science,
Department of Ecological and Sustainable Production Systems
Villányi út 29-43, H-1118, Budapest, Hungary
Email: ertsey@mail.keh.hu

Abstract
The importance of ecological farming in Hungary is increasing. The utilisation of organic seed is regulated by national law (82/2002. (IX. 4.) FVM-KvVM Regulation) According to this regulation the use of organic seed is obligatory in organic plant production from 01.01.2004. This regulation makes it important to find alternative methods for seed treatment instead of chemical treatment which is not allowed in organic farming. The goal of our research is to find methods, which keep good quality of organic seeds, assure healthy seed and safety field emergence. Experiment has two parts. In the first part the effect of the chosen materials were measured on the germination ability of green pea (Pisum sativum L.) seeds. In the second part the effect of the chosen materials were observed on the seed-borne fungi Ascochyta sp. The chosen materials are warm water, Biokál (permitted in ecological farming as plant conditioning substantial), Alginit and Vetozán (permitted in ecological farming as fertiliser) and oil of thyme. Effects on germination ability were observed in the laboratory and in the field as well. Phytopathological tests were made in vitro after international rules (International Rules for Seed Testing 2003). According to our present results Biokál enhanced germination and oil of thyme gave the best pathological effect.

Keywords: green pea, oil of thyme, Biokal, Ascochyta sp. germination

Introduction
The role of organic farming is more and more important not only in the agricultural practice but also in regional level in the European Union. Organic farming is increasing in Hungary as well. In the last twelve years the size of organically cultivated area in our country has reached the 110000 ha.

This kind of agricultural cultivation is also regulated in Hungary. The use of organic seed is obligatory in organic plant production from 01.01.2004 according to the 82/2002. (IX. 4.) FVM-KvVM Regulation (82/2002. (IX. 4.) FVM-KvVM együttes rendelet). Therefore it is important to find alternative methods for seed treatment instead of chemical treatment which is not allowed in organic farming (Plakolm & Söllinger 2000), (Rügger, A.& Winter, W.& Banzinger, I. 1998).

The situation is difficult because of the low amount of non-chemical seed treatment methods and additionally most of them are not effective enough. Certainly there are some proposed methods like heat-treatments: hot air drying (Kristensen, L.& Forsberg, G. 2000) and soaking in hot water (Schachermayr et al., 2000). Selection of seeds to size, morphological shape or damage could make a higher and more homogeneous quality of organic seeds with better germination ability and with higher vigour (Guberac et al., 1998). There are many researches to find any material, which could replace chemical seed treatments and that are permitted in ecological farming.

The goal of our research is to find acceptable methods, which keep the good quality of organic seeds and assure a safety field emergence.

The first part of this project studies the relations between the different treatments and seed germination and field emergence.

In the second part the effect of the chosen materials were observed on the seed-borne fungi Ascochyta sp on poisoned agar plate.

The experiment was carried out in the germination laboratories and in the post control station of the National Institute for Agricultural Quality Control (OMMI) in the years 2002-2003.
Material and Methods
Non-treated pea seed (Pisum sativum L.) was used in our experiment. The variety was Marcado, the percentage of germination ability was 91%, which fulfills the requirements of EU and Hungarian Standard for Seed. The sample was fractionalised in two fractions after size in a separator with a Æ7 riddle. (Æ7 > fraction I, Æ7<fraction II)

The effect of two treatments warm water and Biokál were tested on seed germination with different solutions. The Biokál is permitted in ecological farming as plant conditioning substantial. Biokál contains 57% medicinal herb extracts, 38% bio-humus extract, 5% volatile oil and metal and trace elements.

Different methods of soaking were applied:
1. In the laboratory:
   - control means germination test with untreated seeds .
   - seeds were soaked for 40 minutes in the 30°C warm water then dripped down
   - the seeds were soaked for 2 hours in the 30% Biokál solutions.
   - the seeds were soaked for 4 hours in the 30% Biokál solutions
   - the seeds were soaked for 6 hours in the 30% Biokál solutions

Germination test was carried out according to the ISTA (International Seed Testing Association) International Rules 2003 between paper (BP Roll) in 20 °C under 8 hours lighting in germination chamber. The samples were evaluated as normal seedling and measured the length of shoot (hypocotyl) and root (mm/plant) on the third day.

Treatments were carried out with both fractions in four replications each with 100 seeds.
2. In the field:
   - control means untreated seeds.
   - seeds were soaked for 40 minutes in the 30°C warm water then dripped down before sowing
   - the seeds were soaked for 4 hours in the 30% Biokál solutions then dried for 24 hours in air temperature and then sowed

The experiment under field conditions were carried out in Monor in the post control station of the OMMI. The date of sowing was the 26. of March 2003.

The field emergence was followed from the first appeared plant till 7th days. Final the plants were collected and measured the dry weight of shoot and root. (g/100 plants).

Treatments were carried out with both fractions in three replications each with 100 seeds.
3. Phytopathological test
Poisoned agar plate method was used.

The warm agar dextrose substrate was mixed with the materials.
- 10g Alginit / 1l agar dextrose
- 10 g Vetosan / 1l agar dextrose
- 30 ml Biokal / 1l agar dextrose
- 10 ml oil of thyme / 1l agar dextrose

The fungi Ascochyta sp. was placed in the centre of the cold plate. The growing of fungi was measured. All data were analysed with one-way analysis of variance, with Tukey test at 5% significance level.

Results

In laboratory
By the measuring the length of shoots the best results (in average 20,34 mm/plant) showed the four hour soaking in Biokal in both fractions.

The second best results were in six hour Biokal treatment but only by the fraction I.

The next effective treatment by both fractions was the warm water soaking for 40 minutes.

By the results of root the six hour treatment with Biokal were the best (129,72mm/plant) in the fraction I., but in the fraction II. best results gave the four hour soaking in Biokal.

The second best results were by the treatments with four hour soaking in Biokal by both fractions.
By the phytopathological test the oil of thyme showed full inhibition. The other treatments had no significant effect.

In the field
After the results of the laboratory only two treatments were carried out. The four hour soaking in Biokal because difference at 5% significance level can be found between this and the control in all tested parameters. The second treatment was with warm water because by the values of the length of shoot gave also better results and is recommend in organic farming too.
15 days after sowing appeared the first seedling. The dynamic of field emergence was objected during 7 days.
The figure shows that the most came up plants were after the treatments with soaking in Biokal for four hours by both fractions.
The treatment with warm water showed also better results than the control.

By the dry weight of shoots both treatments gave better value than the control. The four hour Biokal were better (7.63g/100 plants by fraction I., 6.66g/100 plants by fraction II.), it follows the warm water treatment by both fractions.
In the results of dry weight of roots in the fractions II. the treatment of Biokal gave better result then the control (32.7g/100 plants). By the fraction I. the treatment with warm water was better than the control.
Conclusion
Our results in the laboratory show positive effects of using 30% solution of Biokál for seed treatment. It gave better results with all soaking methods in all tests than the control regarding the length of shoots. 4 hours soaking of seed in 30% solution of Biokál was the most successful treatment. The results in the field showed also the positive effect of four hour soaking of Biokal. The effect of the different size did not give significance differences. The well developed shoot and root system can mean a great benefit at the field emergence and organic farming should take advantage of this profit.
By the phytopathological test the oil of thyme showed full inhibition. The other treatments had no significant effect.
The experiment will be continued. Experiment is supported by OTKA T43072

References
Control of seed-borne pathogens on vegetables by microbial and other alternative seed treatments

Annegret Schmitt1, Tahsein Amein2, Federico Tinivella1, Jan van der Wolf4, Steve Roberts5, Steven Groot3, Maria Lodovica Gallino3, Sandra Wright2 and Eckhard Koch1
1Biological Research Centre for Agriculture and Forestry, Institute for Biological Control, Heinrichstrasse 243, D-64287 Darmstadt, Germany; Email: a.schmitt@bba.de
2Goeteberg University, Sweden; 3University of Turin, Centre of Competence for the Innovation in the Agro-Environmental Sector (Agrinnova), Italy; 4Plant Research International (PRI), Wageningen, The Netherlands; 5Henry Doubleday Research Association (HDRA), Coventry, Great Britain

Abstract
In the EU-project “Seed Treatments for Organic Vegetable Production” (STOVE) physical and biological methods aimed at the control of seed-borne vegetable pathogens are being investigated. These include formulated, commercialised microbial preparations, resistance inducers, non-commercialised antagonistic micro-organisms and plant extracts / compounds of natural origin. Trials are being carried out against seed-borne pathogens, e.g Alternaria dauci, Septoria petroselini, Xanthomonas campestris, Phoma valerianellae, Fusarium spp., Colletotrichum sp. in different hosts, such as carrot, parsley, brassicas, lamb’s lettuce, basil and bean.

Treatments of brassica seeds with MSMX (based on Streptomyces sp.) and BA2552 (based on Pseudomonas chlororaphis) reduced the infection with Alternaria spp. in emerged plants from 25 % (control) to below 6 %, the same level achieved after chemical treatment.

From bean seeds infected with Colletotrichum sp. 10 % of the emerged plants showed disease symptoms, while treatments of seeds with the resistance inducers salicylic acid, ChitoPlant, Bion and Milsana resulted in 100 % healthy plants. Effects on germinability were differing among the treatments.

Two non-commercialised micro-organisms gave good protection against Phoma valerianellae on lambs lettuce and Alternaria dauci and A. radicina on carrot seeds.

In an in vitro assay with plant extracts, the Minimum Inhibitory Concentration (MIC)-values for Xanthomonas campestris pv. campestris and Clavibacter michiganensis subsp. michiganensis were lowest for oregano- and thyme-oil and C2000 (Citrex). For Alternaria dauci and Botrytis aclada MIC-values were lowest for oregano-oil, clove-oil, thyme-oil, cinnamon-oil and for C2000.

Field trials with those seed treatments that gave highest efficacy are currently under way.

Keywords: Biological control, organic seed production, plant extracts, induced resistance, microbial antagonists

Outline of the EU-project “STOVE”
Due to the difficulty in organic farming of producing pathogen free seeds, and the lack of simple, effective non-chemical methods for seed sanitation, a substantial part of the seed used by European organic vegetable growers has been derived from conventional production. This is now strongly restricted (EU Council regulation 2092/91).

In March 2003, an EU-project “Seed Treatments for Organic Vegetable Production” (QLK5-2002-02239; STOVE) was initiated, which is aimed at improving currently available, non-chemical methods for control of seed-borne vegetable pathogens and to develop new methods, which are acceptable to organic farming.

Besides three physical methods (hot water, hot air and electron treatment) (see article in these proceedings entitled “Control of seed-borne pathogens on vegetables by physical seed treatment methods”, Jahn et al.), micro-organisms and other agents of natural origin acceptable to organic farming are included in the project.

In a first step, the potential alternative seed treatments (micro-organisms, plant extracts and inducers of resistance) were screened against the different seed-borne pathogens (e.g. Alternaria dauci, Septoria petroselini, Xanthomonas campestris, Phoma valerianellae, Fusarium spp., Colletotrichum sp.) in different hosts, such as carrot, parsley, brassicas, lamb’s lettuce, basil and bean. The efficacy of the methods will then be compared in glasshouse and field trials. Further studies will specify suitable combinations of the most efficient different alternative and physical methods. In the final step selected combinations are evaluated in glasshouse and field trials.
Participants in the project are: Federal Biological Research Centre for Agriculture and Forestry (BBA), Germany, Plant Research International (PRI), Wageningen, Netherlands, University of Gothenburg, Sweden, Findus R&D AB, Bjuv, Sweden, Nuhnems Zaden BV, Haelen, Netherlands, Nuhnems Zaden (Hild), Marbach, Germany, University of Turin, (Agrinnova) Italy, Henry Doubleday Research Association (HDRA), Coventry, Great Britain

For further information see: www.stove-project.net

**Selection of commercial microbial preparations**

Seven formulated microorganism preparations (either commercially available or test preparations) were used for coating of seeds of all host/pathogen systems under investigation. Three preparations were based on *Bacillus subtilis* (FZB 24, Serenade and MBI 600), two on *Pseudomonas chlororaphis* (Cedomon, BA2552), one on an aposathogenic Fusarium oxysporum and one on Streptomyces sp. (Streptomyces sp. (MSMX)).

Germination tests on filter paper (200 seeds in total) with infested brassica seeds (*Brassica oleracea L. convar capitata*) revealed a germination level of 70.7 % (healthy seedlings) for untreated (control) seeds. BA 2552 and Serenade significantly increased the germination, but only when the seeds were coated with the test formulation BA2552 germination was increased to more than 90 %. Treatment with *F. oxysporum* showed the tendency of a slight decrease in germinability.

Trials in soil (600 seeds, 3 experiments each 4 replications) showed an increase in emergence over the control for all preparations tested. Levels were raised from 72 % (control) up to 80.3 % (BA 2552). The number of plants infected with Alternaria sp. was 23.8 % in the control. All preparations tested reduced the infection levels significantly. Treatments of seeds with MSMX, Cedomon and BA2552 gave the greatest reduction in the percentage of infected plants with final infection levels below 6 %; this was comparable to that after chemical treatment with Thiram. MSMX and BA 2552 are currently being tested in trials with brassica in the field.

**Selection of resistance inducers**

Seven resistance inducing agents (two organic acids and five commercialized plant strengtheners) were selected for testing in the different host/pathogen systems. In a first step, suitable concentrations were selected for each test system. For bean (Phaseolus vulgaris var. nanus) the following concentrations were used: jasmonic acid (1 mg/l), salicylic acid (10 mg/l), acibenzolar-S-methyl (Bion) (1 mg/l), ComCat (0.5 mg/l), ChitoPlant (0.5 mg/l), Kendal (0.3 %) and Milsana (1 %). Bean seed infested with Colletotrichum sp. were soaked for 1 hour in the given solutions. Trials were carried out in soil with 50 seeds per trial with a total of 3 independent replicates. It appeared that treatments with the resistance inducers affected germination/emergence of bean seeds while this was not observed in the other host/pathogen systems. Mean of 3 trials; treatments with different letters differ significantly for P=0.05 (Duncans multiple range test)

Figure 1: Effect of treatment of bean seeds infected with *Colletotrichum* sp. with resistance inducers on emergence and development of healthy seedlings.
For all treatments a significant reduction in the number of infested plants was recorded (figure 1). From water-treated seeds, 10 % of the emerged plants showed disease symptoms on the leaves, while treatments with salicylic acid, ChitoPlant, Bion and Milsana resulted in 100 % healthy plants, the same level to which a chemical treatment, Thiram, reduced infection. Emergence of seedlings was significantly reduced after treatment with ChitoPlant, jasmonic acid, ComCat, Bion and Kendall compared to the water treated control or Thiram treatment. No significant differences in emergence compared to the water control, however, were found after treatment of seeds with Milsana and salicylic acid. Based on these results, Milsana, which is a commercialised plant strenghtener in Germany, suitable for use in organic agriculture, will be included in field trials with bean this year.

Selection of non-commercialised antagonistic micro-organisms

In order to identify new biological control agents with good protection properties against seed-borne pathogens, a screening with 87 micro-organisms (bacteria, fungi, streptomycetes and yeasts) was carried out. The most efficient micro-organisms were selected, cultivated either in liquid culture or on Petri-dishes and were tested as seed treatments in the different host-pathogen systems.

First results after coating of lamb’s lettuce seeds (Valerianella locusta) infected with P. valerianellae with eight different antagonistic micro-organisms indicated that seven of these increased the percentage of emerged healthy seedlings in soil up to 86 %. Emergence of healthy seedlings from water treated seeds reached a level of 69 %. However, four of the effective bacteria retarded emergence of seedlings, pointing to the possible production of phytotoxic metabolites.

For carrot seeds (Daucus carota) heavily infested with A. dauci and A. radicina, first results showed that two of the bacteria that enhanced emergence in lamb’s lettuce also increased the percentage of healthy emerged seedling in this system. From water treated seeds only 9 % emergence was recorded while these two antagonistic bacteria increased emergence to 54 %. In carrot however, no retardation of emergence was observed, indicating that lamb’s lettuce seeds are more sensitive to the metabolites.

Further repetitions of trials for selection of the most suitable candidates for field trials are under way.

Selection of plant extracts and natural compounds

The activity of plant extracts and natural compounds was tested against seed-borne bacteria and fungi and their effects on seed vigour were evaluated. For screening of the antimicrobial properties of the plant extracts, two seed-borne fungi, Botrytis aclada and A. dauci, and two seed-borne bacteria, X. campestris pv. campestris (Xcc, Gram-negative) and Clavibacter michiganensis subsp. michiganensis (Cmm, Gram-positive) were selected. Choice of pathogens was made for a maximum diversity in test strains in order to allow extrapolation of results to a wide variety of pathogens.

In vitro assays were carried out in 96-well plates for bacteria, based on an indicator (resazurin), which was converted by actively growing bacteria from blue to pink. Incidentally, test results were verified by plating of bacteria on a non-selective medium (TSA). For fungi, 24-well plates were used, in which the radial growth of mycelium was measured. Seven essential oils (oregano, peppermint, basil, clove, thyme, manuka and cinnamon) were tested. These oils were selected on the basis of their reported antimicrobial properties against a number of human pathogens. Essential oils are especially of interest as they can be used in many countries as a crop protection agent for seed treatment without the need of (costly) registration procedures. They are also listed in Annex 2B of EU directive 2092/91, which lists the natural agents allowed in organic agriculture in the EU. Additionally, three crude plant extracts C2000 (synonymous for Citrex) and ethanol extracts of stinging nettle and golden rod as well as a plant extract based plant strenghtener (Tillecur) were included in the tests. Finally, fungicidal activity of five organic acids were evaluated: lactic-, acetic-, citric, propionic- and ascorbic acid. Organic acids are used as surface disinfectants, and as preservatives in organic cattle feed. Each compound was tested in three replicates.

The Minimum Inhibitory Concentration (MIC)-values for Xcc and Cmm were lowest for oregano- and thyme-oil and C2000 (Table 1). The MIC values for A. dauci and B. aclada were lowest for oregano-oil, clove-oil, thyme-oil, cinnamon-oil and for C2000. Tillecur and the extracts of stinging nettle and golden rod did not inhibit growth of either of the pathogens, supporting earlier findings of their indirect mode of action (induced resistance) (Meineck & Schmitt, 1998; Winter et al., 2001).

Based on these results, treatments of infected seeds with selected agents are currently under way.
Table 1: Minimum Inhibitory Concentration (MIC)-values [% on volume basis] of plant extracts for seed-borne bacteria *Xanthomonas campestris* pv. *campestris* (Xcc) and *Clavibacter michiganensis* subsp. *michiganensis* (Cmm) and seed-borne fungi *Alternaria dauci* and *Botrytis aclada* in an *in vitro* assay

<table>
<thead>
<tr>
<th>Compound/Pathogen</th>
<th>Xcc</th>
<th>Cmm</th>
<th>A. dauci</th>
<th>B. aclada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregano</td>
<td>0.15</td>
<td>0.15</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Peppermint</td>
<td>1.25</td>
<td>2.5</td>
<td>2.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Basil</td>
<td>5</td>
<td>2.5</td>
<td>5</td>
<td>0.6</td>
</tr>
<tr>
<td>Clove</td>
<td>2.5</td>
<td>2.5</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Thyme</td>
<td>0.3</td>
<td>0.3</td>
<td>0.07</td>
<td>0.3</td>
</tr>
<tr>
<td>Manuka</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>C2000</td>
<td>0.15</td>
<td>0.07</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Tillecur</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>0.6</td>
<td>1.25</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Stinging nettle</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Golden Rod</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Lactic Acid</td>
<td>ND</td>
<td>ND</td>
<td>5</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>ND</td>
<td>ND</td>
<td>5</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>ND</td>
<td>ND</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>Propionic acid</td>
<td>ND</td>
<td>ND</td>
<td>0.3</td>
<td>1.25</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>ND</td>
<td>ND</td>
<td>&gt;10</td>
<td>&gt;10</td>
</tr>
<tr>
<td>ND = not done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References


Acknowledgements
Thanks are given to Yvonne Birnbaum, Incoronata Luongo, Particia van der Zouwen and Petra Zink for the technical assistance. The project (QLK5-2002-02239) is funded by the European Commission.
Control of common bunt of wheat (Tilletia caries) by alternative seed treatment

Werner Vogt-Kaute & Ralf Tilcher
Naturland e.V., Kleinhadernerweg 1, 82166 Gräfelfing, Germany
Email: w.vogt-kaute@naturland.de
KWS SAAT AG, Grimsehlstraße 31, 37574 Einbeck, Germany
Email: r.tilcher@kws.de

Abstract:
Tilletia caries is one of the most important seed borne diseases in wheat. While conventional farming systems control T. caries successfully with the help of chemical fungicides organic farming is looking for alternative treatments. The KWS group and Naturland have been co-operating for some years evaluating and attempting to improve alternative seed treatment methods to control T. caries. Two field experiment were performed under organic conditions, the third experiment was sown in autumn 2003. Emergence, stand, infestation of seeds, infected ears and yield were determined. Tillecur and variants based on electron treatment showed lowest infestation rates and highest yields. This corresponds to former trials which also showed that T. caries was successfully controlled by alternative treatments. The registration of electron treatment in organic standards is not clear and has to be discussed.

Keywords: Tilletia caries, common bunt, seed treatment, winter wheat, seed-borne disease

High standards of seed quality are only guaranteed by seeds without pathogen infestation and are the basis of reliable cooperation between seed industry and conventional as well as organic growers. Common bunt of wheat represents one of the most important seed borne diseases and causes yield losses of up to 50%. Wheat infected with T. caries spores can be toxic so there is a limit set also for feed (Spieß, 2003). Spores can survive in soil for some years (Borgen, 2000). While conventional farming systems control T. caries successfully by the help of chemical fungicides organic farming is investigating means of disease control for years. Breeding towards resistance to Common bunt is under development, but could not solve the problem up to now.

The KWS group and Naturland have collaborated for some years in evaluating and improving alternative seed treatment methods to control T. caries. Two field experiments were performed under organic conditions. Seeds, naturally infested with T. caries were treated with organic and inorganic compounds, microbial antagonists and hot water, respectively. These treatments were applied to untreated seeds and to some electron-treated seeds in parallel. The approach is that electron treatment cause disinfection effects and creates the base for substances with plant growth promoting effects.

Seeds were sown in a plot trial with four replicates. Emergence, stand, infestation of seeds and yield was determined.

The trial in 2001/02 based on a naturally high infested seed lot (variety LUDWIG) was treated by Tillecur, Chitosan, FZB 24 (Bacillus subtilis), electronic treatment and a combination of electron treatment with the others. The results showed Tillecur® and electron treated variants to have the highest yield results. While electron treatment decreased spore germination completely Tillecur did not affect the germination of spores, but reduced the share of infested ears (Figure 1-3).

Figure 1: field trial 2001/2002: plant stand in autumn (plant/5m)

Figure 2: field trial 2001/2002: ears with bunt spores (infested ears, %), end of July
The trial in 2002/2003 was based on a naturally low infected seed lot (variety CAPO). It was treated with Tillecur, Chitosan, FZB 24, FZB 42 (Bacillus subtilis), NL1, hot water, electron treatment and a combination of electron treatment with the others except hot water. Electron treated variants combined with different organic and inorganic compounds caused lowest infestation rates and highest yield (Table 4-6).

Table 4: field trial 2002/2003: plant stand in early spring (plant/m²)
Table 5: field trial 2002/2003: ears with bunt spores (infested ears, %), mid of July

<table>
<thead>
<tr>
<th>treatment 1</th>
<th>treatment 2</th>
<th>plants / m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-treatment</td>
<td>NL1</td>
<td>126.2</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 42</td>
<td>113.7</td>
</tr>
<tr>
<td>hot water</td>
<td>NL1</td>
<td>121.9</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>116.5</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 42</td>
<td>104.7</td>
</tr>
<tr>
<td>hot water</td>
<td>Tillecur</td>
<td>102.4</td>
</tr>
<tr>
<td>treatment 1</td>
<td>NL1</td>
<td>109.1</td>
</tr>
<tr>
<td>treatment 1</td>
<td>FZB 24</td>
<td>104.2</td>
</tr>
<tr>
<td>treatment 1</td>
<td>FZB 42</td>
<td>102.4</td>
</tr>
<tr>
<td>treatment 1</td>
<td>Chitosan</td>
<td>112.1</td>
</tr>
<tr>
<td>treatment 1</td>
<td>Chitosan</td>
<td>102.4</td>
</tr>
<tr>
<td>treatment 1</td>
<td>Chitosan</td>
<td>104.7</td>
</tr>
<tr>
<td>treatment 1</td>
<td>Chitosan</td>
<td>101.4</td>
</tr>
<tr>
<td>treatment 1</td>
<td>FZB 24</td>
<td>100.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>treatment 1</th>
<th>treatment 2</th>
<th>ears with bunt spores (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>0.0 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>NL1</td>
<td>0.5 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>NL1</td>
<td>0.6 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>0.8 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 42</td>
<td>0.9 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 24</td>
<td>1.6 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>1.8 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>2.2 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>2.3 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>2.6 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>3.3 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>4.0 a</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>4.3 b</td>
</tr>
</tbody>
</table>

Table 6: field trial 2001/2002: corn yield (dt/ha), mid of July

<table>
<thead>
<tr>
<th>treatment 1</th>
<th>treatment 2</th>
<th>dt/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>55.1</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 42</td>
<td>53.2</td>
</tr>
<tr>
<td>e-treatment</td>
<td>NL1</td>
<td>51.5</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 42</td>
<td>51.1</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>50.9</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>49.2</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Chitosan</td>
<td>48.9</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>47.6</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Tillecur</td>
<td>47.0</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Hot water 2</td>
<td>45.9</td>
</tr>
<tr>
<td>e-treatment</td>
<td>Hot water 4</td>
<td>44.8</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 24</td>
<td>43.9</td>
</tr>
<tr>
<td>e-treatment</td>
<td>FZB 24</td>
<td>42.5</td>
</tr>
</tbody>
</table>

The trial in 2003/2004 works with nearly the same treatments as the year before. It is based on artificially infected seed for the first time (variety CERTO). In harvest 2004 not only infected ears, but also spores on corn will be counted. Literature talks about an increase factor of infection between 100 and 1000 a year (Borgen, pers.). This factor has not been tested under German weather conditions. It is only to be expected
that tests will show different results depending on the year, sowing time and temperature. One former trial showed illogical results from minus 100 to plus 1000 on the same field (Pommer, 2003). This factor would be important for estimation of a necessarily minimum effect for seed treatment. Based on chemical treatments the effectivity is often stated with 99%. Our trial did not show this high effect for low infected seed. Other trials (Spieß, 2003) did show high effects on high infected seed often based on different Tillecur-treatments.

Table 7: Effect of Tillecur, average of 3 years (Spieß, 2003)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination %</th>
<th>Infected ears %</th>
<th>Effect %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non treated, 4000 – 7000 spores/corn</td>
<td>74,8</td>
<td>49,5</td>
<td></td>
</tr>
<tr>
<td>Tillecur 20:80 H2O, 6l/100 kg</td>
<td>74,0</td>
<td>1,6</td>
<td>97,1</td>
</tr>
<tr>
<td>Tillecur 15:85 vinegar (2%acid), 4l/100 kg</td>
<td>74,9</td>
<td>0,7</td>
<td>99,1</td>
</tr>
</tbody>
</table>

Our results demonstrate that control of Tilleteia caries is achieved by application of non-chemical seed treatment substances, because spores on the surface of the corn can quite easily be damaged. Additionally electron treatment represents a physical method, which causes maximal results. The registration of this method in organic standards is not clear at the moment and has to be discussed. Electron treatment is a method which is also available for larger quantities of seeds. Other methods provided good results but often bear problems in appropriate applicability especially for larger quantities. A new project which has started in beginning of 2004 deals with this problem.

References
Inoculum thresholds for the oats loose smut pathogen Ustilago avenae based on transmission rates from seed to the crop

Guro Brodal
Norwegian Food Safety Authority, National Center for Plants and Vegetarian Food
Moernv 12, N-1430 Aas, Norway
Email: guro.brodal@mattilsynet.no

Healthy seed is an important seed quality character and essential for successful plant production. To avoid the use of seed carrying disease-causing organisms, health testing of every seed lot is necessary, and such tests should be a compulsory part of the certification programme for organic seed. This requires standardised (accredited) testing methods and thresholds (tolerances) for the amount of seed borne inoculum that can be accepted without the risk of disease development that cause significant damage to quantity and quality of the crop. Oats is an important crop in Norway and loose smut, caused by the pathogen *Ustilago avenae*, is an important seed borne disease on oats (Brodal et al., 1997). The aim of the work presented in this paper was to get information about the extent of transmission of *U. avenae* from seed to the crop, and based on this relationship define inoculum thresholds for organic seed.

Seed samples from 105 oats seed lots showing smutted plants when grown in the field control plots during the years 1992-2003 were analysed in laboratory. The spore load of *U. avenae* on seed was determined by a modified ‘washing/sporecounting’ method (Kietreiber, 1984). Spores on the seed surface and between the caryopsis and the glumes in a sample of 50 g were extracted by shaking in water with a detergent for 10 minutes. The decanted suspension was centrifuged (1800 g) for 10 minutes. The sediment was suspended in glycerol/ethanol solution and examined for spores of *U. avenae* in a counting chamber (haemocytometer) with a microscope. The spore load was calculated as number of spores/g seed and compared with the corresponding percentage of smutted plants recorded in the growing plot, which consisted of approximately 6000–9000 plants, divided on two replicates.

A summary of the results when dividing the samples into ‘spore load classes’: Seed lots with 10-200 spores/g seed produced 0-0.15% smutted plants, 201-1000 spores/g produced 0.01-0.7% smutted plants, 1001-2000 spores/g produced 0.1-0.9% smutted plants, 2001-5000 spores/g produced 0.1-3.3% smutted plants, 5001-10 000 spores/g produced 0.1-3.7% smutted plants, 10 001-30 000 spores/g produced 0.7-11% smutted plants. A correlation was found between the spore load on seed and disease occurrence in the field. However, the percentage of smutted plants produced by a given spore load showed a wide variation, which is likely to be caused both by differences in variety resistance as well as the environmental conditions during plant emergence and growth. In addition, the fact that *U. avenae* may exist as mycelium within the outer part of the seed (Punithalingam & Waterston, 1970) with only few spores on the surface, will disturb the relationship. This can also explain why in a few cases some smutted plants were developed in the field plots grown from seed with only few or no detected spores.

A seed test showing the *U. avenae* spore load is considered indispensable for organic oats seed, and for untreated conventional seed with unknown smut status, in spite of that fact that mycelium is not detected. The detection limit for the method is 10 spores/gram. Based on this information about the transmission from seed to crop, and the high risk for multiplication of loose smut, the following thresholds have been suggested in Norway for *U. avenae* in organic seed:

- Seed for further multiplication: 200 spores/g seed
- Seed for no further multiplication: 1000 spores/g seed

Higher inoculum levels may be tolerated on cultivars known to have a good resistance to the pathogen.

References
Comparison of health status of winter wheat and spring barley grain cultivated in organic, integrated and conventional systems and monoculture

Anna Baturo1, Aleksander Lukanowski1, Jan Kus2
1 University of Technology and Agriculture, Faculty of Agriculture, Department of Phytopathology, Kordeckiego 20, 85-225 Bydgoszcz, Poland
E-mail: baturo-a@atr.bydgoszcz.pl
2 Institute of Soil Science and Plant Cultivation, Czartoryskich 8, 24-100 Pulawy, Poland

Abstract

The research materials were harvested grain, roots and stem bases of spring barley and winter wheat cultivated in organic, integrated and conventional systems and monoculture. The lowest plant health status of both cereals was observed in organic one. The most important threat for spring barley was Bipolaris sorokiniana and Fusarium spp. Fungi from Fusarium genus were the main pathogens for winter wheat. In the case of spring barley C. sorokiniana occurred in significantly higher intensity in organic system and Fusarium spp. in integrated and conventional ones. It can be stated that organic conditions are favourable for B. sorokiniana. Because of higher occurrence of this pathogen on harvested grain in this system it can be dangerous in the case of using them as a sowing material. The efforts taken to verify efficacy of biological methods show that treatment of sowing material with chitosan and antagonistic strain of Trichoderma viride results in pathogens limitation and better plant health. Lower occurrence of Fusarium spp. in organic system is advantageous from the nourishment point of view because of these fungus abilities to producing mycotoxins.

Key words: barley, wheat, organic system, biopreparations, health status

Introduction

Consumers are becoming interested in the origin and methods used in the production and processing of their food and this has lead many farmers to adopt integrated or organic farming methods. They are especially interested in cereals and vegetables. Thus, the research materials of Department of Phytopathology are barley, wheat, potatoes and vegetables e.g. carrot, onion, red beet, and parsley farmed for food and for sowing material and the possibility of seed coating with biopreparates. Research reported in this paper aimed to evaluate the impact of different farming systems on the health of spring barley and winter wheat and to compare the occurrence of the main crop pathogens. Additionally, the efforts were taken to find biological method to improve plant health and yield quality.

Materials and methods

The studies over 1998-2003 were carried out on experimental fields at Osiny in south-eastern Poland. Both cereals were farmed in organic, integrated and conventional and winter wheat additionally in monoculture. The fungi composition on harvested grain was studied. In all systems the research variety was spring barley, cv. Rudzik and winter wheat c.v. Roma. Also, fungi composition on harvested grain of 4 cultivars of barley: Rudzik, Rodos, Start, Maresi and 2 cultivars of wheat: Roma, Kobra farmed in organic system was compared.

Material was also taken, over 1997-2001, on production fields in conventional farm and in organic one near Tuchola, north-western Poland, approved by Association of Ecological Food Producers EKOLAND. The research material was harvested grain of spring barley cv. Damazy and winter wheat cv. Roma. Sowing material originated from organic farm was used there every year. Additionally, on production fields, the macroscopic estimation of plant health status and mycological analyses were carried out at emergence stage.

Crops in the conventional farm, in integrated and conventional systems and monoculture were chemically treated, and chemical fertilisers and pesticides in recommended levels were applied during the vegetation season.

Additionally in the case of spring barley the sowing material used in organic and conventional farm was tested. The research material was cv. Rudzik. The germination capacity and the main pathogens as B. sorokiniana and Fusarium spp. on non-germinated grain were determined.
Also effect of organic originated grain treatment with KMnO4, lime with basalt powder and CuSO4 with comparison of non-treated grain, on mentioned two pathogen development was tested. The experiment was conducted twice in 4 replications of 100 grain.

In 2002-2003 the effect of grain treatment with Biochikol 020 PC based on chitosan, Biosept 33 SL based on grapefruit seed extract, conidia of antagonistic strain of *T. viride* and thermotherapy, on seedlings health, was tested in plot experiment in organic farm. Before sowing the mycological analysis of grain was carried out. More carefully the impact of Biochikol 020 PC on *B. sorokiniana* was tested. The research materials were colonies of *B. sorokiniana* originated from organic farm inoculated into PDA medium with Biochikol 020 PC added % in four concentrations: 1.0%, 2.0%, 2.5% as an concentration recommended by producer, and 3.0%. The control trial were Petri dishes with the same medium but without Biochikol 020 PC. The experiment was conducted twice, in five replications.

In all cases to evaluate root and stem base infestation caused by fungus complex the 0-5 scale were used: 0 means healthy roots or stem bases and 5 - roots destroyed very much and rotted on the surface larger than 70%, or stem bases rotted completely. The level of infestation was transformed to disease index, DI, according to Townsend’s and Heuberger’s formula. The obtained data were analysed statistically.

For health evaluation and fungus isolation 200 plants were sampled randomly from each field: 50 in four replications. Plants with disease symptoms on roots and stem bases were separated. Their 0.5 cm fragments, according to previous assumption in number of maximum 30 in each system, were taken to mycological analyse.

In the case of grain 4 x 100- grain samples were taken from all trial to mycological analyses. Fungi were isolated on PDA medium, pH 5.5. Fragments of roots and stem bases and non-treated grain, before putting them onto the PDA medium were washed 40 minutes under tap running water and then three times with sterile water. Treated and disinfected with warm water grain was put directly on medium. After the proper time of incubation in thermostat in 23°C and after transferring on proper mediums fungi were determined according to mycological keys.

To determine the germination capacity and pathogens on non-germinated grain, they were put on wet blotting paper on plates, Ø 140 mm and kept in thermostat in 23°C for 7 days.

**Results**

The mycological analyses of spring barley and winter wheat harvested grain revealed the clear dependence between the main pathogens and farming system in the case of spring barley. Grain from organic system was many times more infected by *B. sorokiniana* than grain from the remaining two systems. Quite different results were obtained for *Fusarium* sp. In organic system these fungi were isolated in the lowest intensity. The tendency of the lowest grain infection by *Fusarium* sp. in organic system was clear in the case of experimental fields in the case of both cereals. On production fields *Fusarium* sp. were stated in a bit higher intensity on grain from organic farm. Taking in to consideration two main pathogens of barley, comparison of four cultivars resulted that cv. Start and Maresi show a little advantageous reaction to organic conditions. The reaction of two cultivars of wheat to that farming system was similar. The grain analyses revealed also in all cases the high occurrence of *Alternaria alternata* and *Epichoccum nigrum* and others fungi in lower intensity (Table 1, 2).

**Table 1**

Fungi mostly isolated from harvested grain of spring barley [% of infected grain]

<table>
<thead>
<tr>
<th>Fungus [Sacc. in Sorok] Shoem.</th>
<th>Experimental fields</th>
<th>Production fields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rudzik</td>
<td>Rodos</td>
</tr>
<tr>
<td><em>Bipolaris sorokiniana</em></td>
<td>62.8</td>
<td>67.1</td>
</tr>
<tr>
<td><em>Fusarium</em> spp.</td>
<td>29.5</td>
<td>29.7</td>
</tr>
<tr>
<td><em>Alternaria alternata</em> (Fr.) Keissler</td>
<td>48.1</td>
<td>39.6</td>
</tr>
<tr>
<td><em>Epichoccum nigrum</em> Link</td>
<td>16.2</td>
<td>18.7</td>
</tr>
</tbody>
</table>

Abbreviations: O – organic, I – integrated, C – conventional, M – monoculture
Table 2
Fungi mostly isolated from harvested grain of winter wheat [% of infected grain]

<table>
<thead>
<tr>
<th>Fungus</th>
<th>Experimental fields</th>
<th></th>
<th>Production fields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Roma</td>
<td>Kobra</td>
<td>Roma</td>
<td>Roma</td>
</tr>
<tr>
<td><em>Fusarium spp.</em></td>
<td>19.3</td>
<td>20.5</td>
<td>40.7</td>
</tr>
<tr>
<td><em>Alternaria alternata</em></td>
<td>80.3</td>
<td>75.5</td>
<td>56.5</td>
</tr>
<tr>
<td><em>Epicoccum nigrum</em></td>
<td>24.8</td>
<td>27.6</td>
<td>32.1</td>
</tr>
</tbody>
</table>

Abbreviations: O – organic, I – integrated, C– conventional, M – monoculture

Mean level of DI on roots and stem bases at emergence was higher in organic farm compared to conventional one, especially in the case of spring barley (Table 3). Mycological analysis of diseased plants showed that the main cause of barley infection were *B. sorokiniana* and *Fusarium* spp. *Bipolaris sorokiniana* was isolated in very high intensity in organic farm. It was stated on 52.2% of diseased roots and on 54.3% stem bases and in conventional farm respectively: 17.1% and 36.4%. Fungi from genus *Fusarium* were isolated more numerously in conventional farm. They infected 34.2% of roots and 36.4% of stem bases and in organic one respectively 16.4% and 5.2%. Wheat was infected by *Fusarium* spp. that were isolated in a little higher intensity in organic farm.

Table 3
Health status of spring barley and winter wheat at the emergence stage on production fields [DI in %]

<table>
<thead>
<tr>
<th>Feature</th>
<th>spring barley</th>
<th>winter wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>organic farm</td>
<td>conventional farm</td>
</tr>
<tr>
<td>roots</td>
<td>9.4 a</td>
<td>2.6 b</td>
</tr>
<tr>
<td>stem bases</td>
<td>9.1 a</td>
<td>0.5 b</td>
</tr>
</tbody>
</table>

* values in the same line followed by different letters are significantly different

Additional studies carried out only on spring barley showed that grain sowed and originated from organic farm characterised in lower germination capacity, than non-treated grain sowed in conventional farm. The percent of germinated grain was respectively 84% and 90%. On non-germinated “organic” grain *B. sorokiniana* was the main pathogen. It was stated on 78% of grain, while on “conventional” grain *Fusarium* spp. were prevalent and infested 75% of non-germinated grain.

Taking into consideration the potential efficacy of lime with basalt powder, KMnO4, CuSO4 to limit of pathogens transferred with grain, it was stated that lime with basalt powder did not have advantageous effect, but KMnO4 can limit *B. sorokiniana* and *Fusarium* spp. (Table 4).

Table 4
Effect of spring barley grain treatment on *B. sorokiniana* and *Fusarium* spp. [% of infected grain]

<table>
<thead>
<tr>
<th>Fungus</th>
<th>non-treated grain</th>
<th>lime with basalt powder</th>
<th>KMnO4</th>
<th>CuSO4</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>B. sorokiniana</em></td>
<td>32.0</td>
<td>28.5</td>
<td>18.0</td>
<td>10.0</td>
</tr>
<tr>
<td><em>Fusarium spp.</em></td>
<td>25.0</td>
<td>40.0</td>
<td>16.5</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Based on the mycological analysis of grain treated and disinfected with warm water, aimed to plot experiment, it was stated that Bioscept 33 SL and *T. viride* can limit *B. sorokiniana* development on grain. Fungi from *Fusarium* genus were limited by *T. viride* too but also by Biochikol 02 PC and thermotherapy. Estimation of plant health revealed that the best effect was in the case grain treatment with Biochikol 020 PC and *T. viride* (Table 5).

Table 5
Effect of spring barley grain treatment and thermotherapy on health of spring barley [DI in %]

<table>
<thead>
<tr>
<th>Feature</th>
<th>non-treated grain</th>
<th>thermotherapy</th>
<th>Bioscept</th>
<th>Biochikol</th>
<th><em>T. viride</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>roots</td>
<td><em>5.2 a</em></td>
<td>5.0 a</td>
<td>2.6 a</td>
<td>3.8 a</td>
<td>2.2 a</td>
</tr>
<tr>
<td>stem bases</td>
<td>12.3 a</td>
<td>13.4 a</td>
<td>12.6 a</td>
<td>11.6 a</td>
<td>8.6 a</td>
</tr>
</tbody>
</table>

* values in the same line followed by different letters are significantly different
Additionally the inhibited effect of Biochikol 020 PC at *B. sorokiniana* development in comparison with control trial was stated in Petri dish experiments. Every concentration of Biochikol 020 PC resulted in growth inhibition of *B. sorokiniana*, but the strongest one was observed at concentration of 2% (Table 6)

Table 6
*B. sorokiniana* colony growth inhibition [GI] by Biochikol 020 PC in comparison with control in Petri dish experiment [%]

<table>
<thead>
<tr>
<th>Feature</th>
<th>mean value from I and II experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>1.0*</td>
</tr>
<tr>
<td></td>
<td>34.0</td>
</tr>
</tbody>
</table>

* concentration of Biochikol 020 PC [%]

**Discussion**

Based on the obtained data it seems that plant health status was dependent on farming system that also had an effect on grain quality. Spring barley and winter wheat were significantly more intensively infected in organic system. According to Sadowski et al. (2002) potatoes also show negative reaction to organic system. *Bipolaris sorokiniana* and fungi from the *Fusarium* genus clearly influenced cereal health. The results of spring barley showed that *B. sorokiniana* occurred in significantly higher intensity in organic system and *Fusarium* spp. in integrated and conventional ones. It seems that organic conditions could be favourable to *B. sorokiniana* development. This confirms observations of heads made in organic and conventional farms and at experimental fields (Baturo-Czajkowska et al., 1998; Baturo, 2002). This pathogen is considered as the main disease factor of barley, transferred with grain (Christensen, 1963). For that organically obtained sowing material can be dangerous.

In the integrated and conventional systems higher levels of *Fusarium* spp. were isolated from grain of barley and wheat confirming observations made in winter wheat by Lukanowski et al. (2001) who found higher incidence of *Fusarium* spp. in mentioned two systems than in organic one. Fungi from *Fusarium* genus can be dangerous for human and animal health too due to their abilities to produce mycotoxins (Chelkowski, 1994). Trewavas (2001) claims that the organic product pollution by mycotoxigenic fungi and mycotoxins can be higher in organic products than in conventional ones. The results presented here don’t confirm that notice in the case of *Fusarium* spp.

Efforts taken in order to improve health of grain sowed in organic system by treatment with different substances showed that KMnO4, CuSO4, could limit the source of infection by *Fusarium* spp. and *B. sorokiniana* transferred with grain. Treatment with conidia of *T. viride* and chitosan resulted in beeter plant health. Adequate results were obtained by Pieta et al. (2000) where treatment with chitosan satisfactorily protected germinated seeds of bean and next roots and stem bases from soil-borne pathogens. In similar to results reported in this paper, Petri dishes studies made by Pastucha (2001) liquid solution of chitosan added to medium was stated as an efficient in growth inhibition of pathogenic fungus colonies. Results obtained here confirm these effects and showed, that *B. sorokiniana* development can be inhibited with chitosan added to medium. Favourable effect of chitosan was observed in the case wheat. It limited growth of fungi from *Fusarium* genus (Lukanowski, 2003). Also *T. viride* showed good effect on health of pea (Lacicowa & Pieta, 1996) and vegetables in organic farm (own results of Phytopathology Dep.)

**Conclusion**

This study has shown that cereal health status is dependent on farming system. The effect of organic system can be disadvantageous for plant health and quality of harvested grain, especially in the case of spring barley.

Taking to consideration *Fusarium* spp. it can be stated the advantageous effect of organic system in nourishment aspect. These fungi, that produce one of the most dangerous mycotoxins, were not numerous isolated in this system.

There is potential possibility to protect plants with biological substances, as chitosan or *T. viride*, in organic system.
Acknowledgements
We thank Voivodship Fund of Environment Protection and Water Management in Torun, Poland, for financial assistance.

References
Seed treatments against fusarium in organic spring wheat

Aart Osman1, Steven Groo1, Jürgen Köhl1, Laurens Kamp2 and Esther Bremer1
1Louis Bolk Instituut, Hoofdstraat 24, 3972 LA Driebergen, The Netherlands
Email: a.osman@louisbolk.nl
2Plant Research International, Postbus16, 6700 AA Wageningen, The Netherlands
3Experimental Farm Rusthoeve, Postbus 46, 4460 BA Goes, The Netherlands

Abstract
The results of 2003 and preliminary results of 2004 of a research on non-chemical seed treatments against fusarium in organic spring wheat are presented. Treatments in 2003 were hot water treatment, electron beam treatment and grading. In 2004 seeds were treated with hot water and aerated steam. Trials were sown at different dates (2003) and different sowing densities (2004). We looked at the effect of the treatments on seed infection, seed emergence in the field and grain yield. Also the development of the disease from the infected seeds to higher plant parts was studied. In 2003 the hot water treatment was highly effective for the early sowing date. A feasibility study also showed its practical and economical potential. In 2003 hot water treatment was executed at laboratory scale. Seeds treated at “industrial” scale in 2004 did not confirm these positive results. This might be due to technical problems with the application of this method at larger scale (and if so, could be overcome with more experience). In 2004 the aerated steam treatment gave good results, but as this treatment was applied at laboratory scale, future trials at “industrial” scale are needed to confirm these results.

Keywords: Fusarium spp, Microdochium nivale, Spring Wheat, Seed treatment, Organic Farming

Introduction
In the Netherlands the organic spring wheat seed harvest contains moderate to high levels of fusarium disease in one out of two years (Agrifirm, major Dutch organic cereal seed producer, pers. comm.). To be able to supply all farmers with sufficient seeds, batches of sub-optimal quality are put on the market. Dutch seed regulations allow a contamination with fusarium of up to 25% in certified seed, but between 10 and 25% the seed label should state that seed treatment is required. However, organic cereal seeds are not treated, because of lack of available methods.

Fusarium disease of wheat may be caused by a number of fungi. In the Netherlands Fusarium graminearum is the dominating species, followed by F. culmorum and Microdochium nivale (Waalwijk et al., 2003). When seeds are infected these may show no or poor germination with weakened seedlings. Such seedlings may overcome the disease when weather conditions after sowing are good, but in rainy and cold springs a considerable number of seedlings of infested seeds are lost. In such years, seed lots with a contamination of 20-25% result in poor crop establishments. The current practice of organic farmers is to increase seed density (e.g. sow 20% more if seed lot contains 20% fusarium) and to postpone seeding until the end of March, when temperatures are higher.

These practices increase costs (more seeds) and reduce yield (shorter cropping period). Despite these measures, farmers too often are confronted with disappointing crop stands. Therefore a group of farmers asked the authors to study seed treatments, which are appropriate to organic farming and economically viable. Seed treatments are compared at different sowing dates (in 2003) and seeding rates (in 2004). We also studied the possible effect of seed contamination with Fusarium spp. on the amount of fusarium in the harvested grain. This information is important to determine whether a low amount of seed infection may be tolerated or not.

Seed treatments against fusarium
In literature thermal treatments show the most promising results. Before the sixties of the last century, when the use of synthetic fungicides became wide spread, cereal seeds were treated with hot water. In the Netherlands knowledge on the practical application of this method disappeared with the people who applied it. In a recent research in Switzerland Winter et al. (1998) applied this method at farm scale level. They submerged 25 kg sacks of seeds in a container, regularly used for cheese making, with water of 45°C for two hours and afterwards dried the seeds back with forced air of 35°C with equipment available at any commercial farm. This method proved to be effective against fusarium. However, when this method would be applied at
a larger scale (seed company level) drying back large quantities of seeds in a short period may be a drawback. Forsberg (2001) proposed the aerated steam method. In this method seeds are exposed to moist air with a high temperature (>60°C) for a few minutes. Because seeds are not immersed in water, drying is not a problem. The high temperature also may damage the seeds and hence the exact temperature and exposure time should be determined in a pre-test for each separate seed lot. A prototype treatment system with a capacity of 1.3 tons/hour is operative in Sweden.

Besides these treatments the German company E-ventus has commercially developed the electron beam treatment (e-dressing) (www.e-ventus.de). This method is based on treating the seeds with low-energy electrons and was developed during the 1980’s for control of seed-borne fungal pathogens (Burth et al 1991). In recent years the method was developed for large scale treatments of cereal seeds (Röder and Schröder 1998).

According to Dutch organic farmers grading might be a solution. This is supported by Hare et al. (1999) who showed that in fractions with bigger seeds less seeds were contaminated with *F. culmorum*. Grading also implies higher losses during seed cleaning and therefore an increase in seed price. Other options would be applications of beneficial micro-organism by seed treatment (Harman 1991).

**Research in 2003**

The project started in 2003 and continued in 2004. The research consisted of a field trial and a study on the practical and economic feasibility of the best treatment of 2003. The field trial was located at an experimental field station, that was recently converted to organic (conversion started in 2001). The first year the field trial was sown in a complete block design with three replicates, the second year the trial was sown in four replicates. All seeds were of the spring wheat variety *Lavett*, which is grown by most organic farmers in the Netherlands. Normal sowing rate for organic spring wheat is 180 kg/ha or 475 plants/m².

**Treatments in 2003**

In 2003 we compared hot water treatment, seed application of a commercially available antagonist (*Bacillus subtilis*), grading seeds (fraction >2.5 mm and >2.8 mm, normal fraction >2.4 mm) with untreated seeds of the same seed lot (23% fusarium), sowing the same seed lot at greater density (23% more seeds) a “healthy” seed lot (8% fusarium) and Farmers’ seed (farmer multiplication for his own use). The trial was sown at two different sowing dates (18 March, 11 April). Also the seed supplier offered us a separate lot of seeds which were treated with electron beams. This lot together with its untreated control (32% fusarium) was added to the first sowing date. Hot water treatment was carried out at laboratory scale. Seeds were immersed in water of 35°C for two hours (starting at the moment after immersion when water temperature reached 35°C again) and dried back for two hours with air of 40°C. *Bacillus subtilis* was applied by mixing 1 gram of the commercial product Terranal with 1 kg of seeds. Grading was done by hand using split sieves. For e-dressing seeds were sent to the German company E-ventus.

**Analyses and field measurements**

Infection rate of the sowing seeds and harvested grains were analysed in the laboratory both using a blotter test (de Tempe, 1958) and incubating seeds on Potato Dextrose Agar (PDA) Medium. The amount of *Fusarium avenaceum*, *F. graminearum*, *F. culmorum*, *F. poae* and *M. nivale* was quantified in seeds, in various plant parts before harvest and the harvested grain. For quantification of these fungi, real-time PCR using species-specific TaqMan primers and probes was applied (Waalwijk et al., in press).

In the field we observed seed emergence (number of plants/m² and a visual score/plot) and grain yield.

<table>
<thead>
<tr>
<th>Seed lot</th>
<th>Infestation with Fusarium (% of seeds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated control 1</td>
<td>24</td>
</tr>
<tr>
<td><strong>Treatments</strong></td>
<td></td>
</tr>
<tr>
<td>hot water</td>
<td>0</td>
</tr>
<tr>
<td><em>Bacillus subtilis</em></td>
<td>29</td>
</tr>
<tr>
<td>Grading Fraction&gt;2.5mm</td>
<td>28</td>
</tr>
<tr>
<td>Grading Fraction&gt;2.8mm</td>
<td>33</td>
</tr>
<tr>
<td>Untreated control 2</td>
<td>32</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td></td>
</tr>
<tr>
<td>E-dressing</td>
<td>21</td>
</tr>
</tbody>
</table>
**Economic and practical feasibility study**

Farmers, companies involved in seed treatment and manufacturers of the necessary equipment were interviewed.

**Results in 2003**

**Seed treatments**

According to the blotter test (Table 1) the treatment with hot water reduced the original fusarium infection of 24% to 0. In the PDA test we found that still a small amount (1.5%) of the seeds of the warm water treatment was infected with fusarium. The effect of e-dressing was too small to be of practical use. The other treatments had no effect on the fusarium infection. Results of the TaqMan analysis show that *Fusarium graminearum* and *Microdochium nivale* were present in the seeds (Table 2). In the early sowing the laboratory results were confirmed: number of plants/m² after hot water treatment was more than 40% higher than the untreated control (Figure 1), while the other treatments had no effect. In the late sowing date the hot water treatment still gave the best results, but differences were not statistically significant. This was because the germination of the other treatments had improved, while the hot water treatment remained as high as in the first sowing. This confirms that with better weather conditions during germination infected wheat seedlings are able to overcome the disease.

Although the hot water treatment improved crop stand, we did not find differences in yield between seed treatments at harvest time. Between sowing dates we did find a considerable difference: the average yield of 8500 kg/ha in the early sowing was 1600 kg/ha higher than in the late sowing date. The climate in 2003 was exceptionally favourable for (organic) wheat production, resulting in high yields all over the country. This probably enabled the crop to recover from the poor stand in the beginning of the season.

**Economic and practical feasibility of hot water treatment**

Although in 2003 the hot water treatment did not result in higher yields, it did show other benefits. First of all a better stand in the early stage, which for organic farmers is very important because this helps to suppress weeds. Secondly it allows farmers to sow earlier, which indirectly may increase yield. Thirdly seeding rates could be reduced. Currently Dutch organic farmers sow at least 12.5% denser than the recommended seeding rate. With an effective hot water treatment this amount can be saved on expenditure on seeds and so if the hot water treatment would not increase seed costs with more than 12.5%, it would be economically beneficial.

Winter et al. (1998) suggest to submerge 25 kg sacks of seeds in containers used for small scale cheese making and ordinary hot air blowers for drying back the seeds. In the Netherlands this equipment is available for affordable prices on the second hand market and could be an option for farmers who do not want the economic value of the labour they invest. If labour costs are included, seed price would increase considerably more than the 12.5% we calculated above.

Another option in the Netherlands is using equipment which is used for hot water treatment of bulbs and onion sets. Commercial companies (in the Netherlands known as “bulb boilers”) treat complete wooden crates of 1m³ in a container with hot water and use forced air to dry the bulbs back. A preliminary price estimate is about 12.5% of the current organic seed price. As these companies have no experience with wheat yet an exact price only can be established after practical experience.

**Relationship Fusarium in seeds and in the field**

For the detection and identification of fusarium species we only analysed the samples of the hot water treatment, the untreated control and the “healthy” seed lot, with respectively 0%, 23% and 8% fusarium (*Fusarium graminearum, Microdochium nivale*) in the seeds.

---

**Table 2: Fusarium species present in hot water-treated and untreated seed according to TaqMan analysis**

<table>
<thead>
<tr>
<th>Fusarium species</th>
<th>Amount of fungus (picogram DNA/mg dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Untreated control</td>
</tr>
<tr>
<td><em>Fusarium avenaceum</em></td>
<td>1</td>
</tr>
<tr>
<td><em>Fusarium culmorum</em></td>
<td>0</td>
</tr>
<tr>
<td><em>Fusarium graminearum</em></td>
<td>119</td>
</tr>
<tr>
<td><em>Fusarium poae</em></td>
<td>0</td>
</tr>
<tr>
<td><em>Microdochium nivale</em></td>
<td>58</td>
</tr>
</tbody>
</table>

---

**Figure 1: Emergence (plants/m²) of different treatments after early sowing in 2004**

- Healthy seed
- Farmers seed
- Warm water
- Dense sowing
- Basile sods
- Grading
- Grading check 1
- Grading check 2
- Untreated check 1
- Untreated check 2
Using TaqMan, no *Fusarium* spp. were found in the ear or in the harvested grains. This can be explained by the dry weather during anthesis, not favourable for infections by *Fusarium* spp. In samples collected one month before harvest, *M. nivale* was present in the stembase, stem and in necrotic and green leaves. *F. graminearum*, found on seeds before, was not present on such plant parts. *F. culmorum* and *F. avenaceum* occurred in the stembase and in dead leaves. No clear treatment effects could be detected.

**Research in 2004**

The second year we only continued with the hot water treatment and added the Thermoseed™ (aerated steam) method to the trial. The hot water treatment is able to eliminate fusarium, but its adoption depends on its costs. One way to diminish the costs is by reducing the seeding rate. Therefore we added two different seeding rates to our research (normal = 475 and reduced = 350 plants/m²). These treatments were applied to a seed lot with 16% fusarium and compared with the untreated control, this control sown 16% denser and a “healthy” seed lot.

The other important difference with 2003 was the execution of the hot water treatment. Based on our results of 2003 the organic seed trader decided to send two tons of seeds to a commercial “bulb boiler” for treatment. So we used these seeds, instead of the seeds treated at laboratory scale. Thermoseed™ was applied at laboratory scale by Acanova in Sweden. Laboratory and field measurements are identical to 2003

**Preliminary results of 2004**

At the moment of this publication only the field results are available. The Thermoseed™ treatment showed a better stand than the hot water treatment and the untreated control at both seed densities. This difference was statistically significant (Anova followed by LSD, p<0.01). The hot water treatment showed no effect compared to the untreated control.

The stand of the Thermoseed™ treatment sown at 350 plants/m² was equal to the stand of the untreated seeds sown at 475 plants/m². So, after application of this treatment one could reduce sowing density with 25%.

**Discussion and Conclusions**

In 2003 we found good results with the hot water treatment at the early sowing date. The trial of 2004 did not confirm these results. The better plant emergence in 2003 only was statistically significant at the early sowing date, when weather conditions were more unfavourable for germination. This confirms the knowledge that fusarium disease only causes problems under unfavourable germination conditions.

In 2004 the Thermoseed™ treatment had a positive effect on seed emergence, while the hot water treatment showed no effect. This contradictory result might be explained by a different way of executing the hot water treatment. In 2003 the seeds were treated at laboratory scale, while in 2004 the treatment was done at “industrial” scale. As this was done without prior experience a proper working protocol still had to be developed. The major difficulty that was encountered was drying back the seeds within an acceptable period. This might have caused damage to the seeds. If so, with more practical experience these difficulties probably will be overcome. The difference in results between the treatment at laboratory scale and practical scale underlines the importance of doing this type of research also at practical scale. As the Thermoseed™ treatment in 2004 also was executed at laboratory scale, it is still too early to draw conclusions from these results.

We also quantified populations of different *Fusarium* spp., for a part brought into the field with the seeds. Due to the unfavourable weather conditions in 2003 for these fungi, infection rates in the field were low and no fusarium was found in the ears. However, we found *M. nivale* at lower plant parts including green leaves and dead leaves. Leaves from plots sown with hot water-treated seeds tended to be less infected with this fungus. On the other hand we found more *F. culmorum* and *F. avenaceum* on the halmbase and leaves of such plants. However, such differences were statistically not significant, possibly due to the relatively low quantities of *Fusarium* spp. found and the variation between plots, estimated only for three replicates.
Acknowledgement
The European Regional Development Fund and the Dutch Ministry of Agriculture, Nature and Food Quality have made this research possible

References
The effect of seed treatment for the control of bird damage in corn and Ascochyta blight of pea

Ralf Tilcher1 & Werner Vogt-Kaute2
1KWS SAAT AG, Grimsehlstraße 31, 37574 Einbeck, Germany, r.tilcher@kws.de; 2 Naturland e.V., Kleinhädernerweg 1, 82166 Gräfelfing, Germany, w.vogt-kaute@naturland.de

Abstract
Corn seed was treated with different substances to prevent damage by birds (crow, pigeon, pheasant). Over two years string trials at three locations in north-west and south Germany were performed. Final stand of plants was used as a measure of the efficacy of the different treatments. As the presence of birds at different locations was irregular, the results were not consistent between different locations and years. Nevertheless the trials showed the potential of different substances (blue pigment, cow gall, copper) used to prevent damage by birds.

Field emergence and infection with Ascochyta pisi could be influenced by seed treatments (warm water, acetic acid, electrons). Significant improvements compared to an untreated check were not observed. Electron treatment bears the potential of increasing field emergence of infested seed, warm water treatment reduces occurence of fungal structures.

Background
Seed treatment provides seed protection, ensures high seed germination percentage, uniform plant establishment and high crop yield for the farmer. Attack by fungal pathogens and by bird might be effectively avoided by treating seeds with active components. Corn and pea belong to those fodder crops, which are essential for organic production systems. While conventional farming uses synthetic pesticides to prevent bird attack (e.g. Methiocarb, Anthrachinon) organic growers are not allowed to apply these substances. This might cause problems with seed quality and plant stand in different ways.

Corn and pea: control of damage by birds

Introduction
Seeds and seedlings of corn are a preferential target for birds such as crows, pigeons, pheasants whose natural habitat is close to agricultural areas. This becomes a major problem for farmers in corn growing areas as well as for seed production by the seed industry. Experiences from industry, agricultural practice and universities show that growing and field testing based on untreated corn often fail simply because birds did not leave any seed uneaten. In general, significant trials related to this topic are difficult to perform because of the unpredictability of bird damage. Likewise, pea is also affected by damage caused by birds.

Material and methods
String trials at three locations in northwest and south Germany were performed in 2002 and 2003. Corn was treated with different pigments, cow gall, copper and Tillecur® respectively. Two varieties were used, representing typical varieties for northern Germany (TASSILO S 200) and southern Germany (ROMARIO S 240).

Results
Laboratory germination tests (figure 1) show that Tillecur® (extract of mustard) might cause decreasing germination of treated seed and increasing number of seedlings with abnormal growth. Pigments and cow gall show no negative effects.

Figure 1: Germination (%) and abnormal seedlings (%) of variants applied with different substances for control / prevention of birds. Laboratory cold test. Effect of different varieties.
Table 1: Field trial 2002 - emergence of corn seedlings (plants per 10m). Results from different locations in Germany: Nordhorn/northwest Germany (variety TASSILO), Goppertshofen and Scheyern/Bavaria (variety ROMARIO)

<table>
<thead>
<tr>
<th></th>
<th>variant</th>
<th>plant / 10 m</th>
<th></th>
<th>variant</th>
<th>plant / 10 m</th>
<th></th>
<th>variant</th>
<th>plant / 10 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cow gall</td>
<td>54.8 a</td>
<td></td>
<td>blue</td>
<td>79.2 a</td>
<td></td>
<td>blue</td>
<td>71.2 a</td>
</tr>
<tr>
<td></td>
<td>orange</td>
<td>44.5 a</td>
<td></td>
<td>orange</td>
<td>78.9 a</td>
<td></td>
<td>orange</td>
<td>61.8 ab</td>
</tr>
<tr>
<td></td>
<td>blue</td>
<td>38.8 ab</td>
<td></td>
<td>Tillecur®</td>
<td>75.2 a</td>
<td></td>
<td>copper</td>
<td>61.7 b</td>
</tr>
<tr>
<td></td>
<td>Tillecur®</td>
<td>24.8 b</td>
<td></td>
<td>cow gall</td>
<td>75.6 a</td>
<td></td>
<td>cow gall</td>
<td>60.3 b</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tillecur®</td>
<td>56.8 b</td>
<td></td>
<td>Tillecur®</td>
<td>54.4 b</td>
</tr>
</tbody>
</table>

In 2002 (table 1) location Nordhorn was influenced by attacks of birds. Highest emergence rates was observed when seeds were treated with cow gall as repellent substance. In Goppertshofen no bird damage occurred while in Scheyern some attacks were registered. Blue stained seeds seem to be most effective. Combined treatment of blue pigments and Tillecur® had no synergistic effect.

Figure 2: Field trial 2003 - emergence of corn seedlings (%). Results from different locations in Germany: Nordhorn/northwest Germany (variety TASSILO), Goppertshofen and Scheyern/Bavaria (variety ROMARIO)
In 2003 (figure 2) only one location in Nordhorn was heavily attacked by birds. None of the applied substances had a positive effect. At the two Bavarian locations only a few birds were observed. Effects of seeds applied with cow gall and copper respectively were contradictory. In Goppertshofen copper caused significant higher plant stand compared to seeds applied with cow gall. In Scheyern the results were opposite.

In parallelism to corn pea is affected by damage caused by birds as well. Our trial consists of seed treated with different pigments, copper and cow gall respectively. Final stand of plants and yield was increased by all applications compared to an untreated check.

Conclusion
Our trials showed the potential of different substances (blue pigment, cow gall, copper) to prevent damage by birds. The results of field string trials are inconsistent over the two years period. In order to produce significant reproducible results it seems to be necessary to perform semi-field trials under controlled conditions with a defined extent of bird attack. Bird control by seed treatment represents only one factor and has to be integrated in a system with other means of control (“Bird management” including deep sowing of seed, frightening devices like cannon, balloons, kites)

Pea: control of Ascochyta blight

Introduction
Ascochyta blight caused by Ascochyta pisi represents one of the most important seed-borne pathogens in pea and often leads to deprivation of seed lots. Survival and transmission of the pathogenic fungus takes place mainly via seeds. Structures of the fungus infest the seed surface as well as the inner parts. This creates a special challenge for seed treatment because application must induce systemical effects.

Material and methods
A seed lot (variety GRANA, leaf-type, which is well-known to be susceptible) naturally infested with Ascochyta pisi, was incrusted with Tillecur® and treated with warm water, acetic acid and electrons respectively. Infestation with Ascochyta pisi was detected in vitro (ISTA-rule 7-005). In 2003 a field trial (block trial, 4 replications) was performed in Wiebrechtshausen/Germany (KWS farm for organic agriculture).

Results
In a field trial no significant differences between different variants concerning emergence and yield of harvested pea seed were observed (table 2). There was the tendency that electron-treatment, application of Tillecur® and acetic acid, respectively increased field emergence. In vitro tests showed that nearly all harvested seeds were infested (table 2). The extent of white Ascochyta-mycelium covering the seed and seedling was generally low. This parameter indicated warm water treatment to be most effective.

Table 2: Effect of different seed treatments of Ascochyta-infested pea on field emergence (%), yield (dt/ha) and infection of harvested seed (infected seed, %), (extent of growing mycelium in vitro, 1 = no infection, 8 = seed completely infested)

<table>
<thead>
<tr>
<th>variant</th>
<th>field emergence (%)</th>
<th>yield / plot (dt / ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>electron-treatment</td>
<td>58.0</td>
<td>a</td>
</tr>
<tr>
<td>Tillecur®</td>
<td>56.1</td>
<td>a</td>
</tr>
<tr>
<td>acetic acid</td>
<td>56.0</td>
<td>a</td>
</tr>
<tr>
<td>warm water</td>
<td>51.4</td>
<td>a</td>
</tr>
<tr>
<td>check</td>
<td>48.9</td>
<td>a</td>
</tr>
<tr>
<td>acetic acid</td>
<td>39.8</td>
<td>a</td>
</tr>
<tr>
<td>check</td>
<td>39.2</td>
<td>a</td>
</tr>
<tr>
<td>warm water</td>
<td>38.9</td>
<td>a</td>
</tr>
<tr>
<td>electron-treatment</td>
<td>38.0</td>
<td>a</td>
</tr>
<tr>
<td>Tillecur®</td>
<td>37.8</td>
<td>a</td>
</tr>
<tr>
<td>infection with Ascochyta (%) infected seed</td>
<td>variant</td>
<td>infection with Ascochyta (extend of growing mycelium)</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>electron-treatment</td>
<td>warm water</td>
<td>2.12</td>
</tr>
<tr>
<td>Tillecur®</td>
<td>check</td>
<td>2.47</td>
</tr>
<tr>
<td>acetic acid</td>
<td>acetic acid</td>
<td>2.52</td>
</tr>
<tr>
<td>check</td>
<td>Tillecur®</td>
<td>2.62</td>
</tr>
<tr>
<td>warm water</td>
<td>electron-treatment</td>
<td>2.79</td>
</tr>
</tbody>
</table>

Conclusion

Field emergence and infection with Ascochyta pisi could be influenced by seed treatment. Significant improvements compared to an untreated check were not observed. Surprisingly our in vitro tests detected very high percentages of infected seeds over all variants while the extent of mycelium growth was generally low. In 2003 extraordinary dry conditions affected the trial, therefore experiments on effective seed dressings are continued in 2004. Beside seed treatment, control of Ascochyta blight in organic farming should involve use of resistant varieties, use of disease-free seed and elimination of the pathogen by crop rotation.

References

ISTA-rule 7-005: Detection of Ascochyta pisi on Pisum sativum (Pea), ISTA, 2002
Achieved quality in organic seed production of clover and grass in Denmark

Jøn Lund Kristensen and Birthe Kjersgaard
DLF-TRIFOLIUM A/S, Ny Østergade 9, DK-4000 Roskilde; Denmark
Email: jlk@dlf.dk and bk@dlf.dk

Abstract
Organic seed production is based on a selection of quality varieties necessary to obtain high quality grass seed mixtures as required by customers.

The minimum quality of organic seed is defined by the EU norms for certified seed. In practice, the organic seed quality has proved to be better than the EU minimum quality standards required. Especially the perennial ryegrass (Lolium perenne L.) quality is very similar to that of conventional seed.

Production of organic perennial ryegrass is most successful compared to other species, and offers the highest yields as well as a very high quality. Crop 2003 was characterized by an average purity of 99.0 %, germination 94.9 % and approx. 60 % of the production was free from couch grass (Elymus repens L.). However, also the yield and quality in other species like Italian ryegrass (Lolium multiflorum), timothy (Phleum pratense), meadow fescue (Festuca pratensis), red fescue (Festuca rubra) has proved satisfactory.

The quality of the organic white clover (Trifolium repens) is particular affected unfavourably by low yields. Curled dock (Rumex crispus L.), common chickweed (Stellaria media L.), and cut-leaved cranesbill (Geranium dissectum Just.) are accounting for problem weeds in the white clover production. Manual hoeing is a must in order to reduce the weed problem in organic seed production. Likewise, topping and grazing by sheep will reduce the presence of weeds.

The following average qualities were achieved in crop 2003 within organic white clover production: purity 98.7 %, content of other species 0.45 % and germination 89.0 %.

Key words: Organic seed production, grass seed, clover seed, organic farming

Introduction
The basis for organic seed production is the regulation stipulating that organic seed is to be used in organic farming. Most of the seed for sowing in organic farming is sold in grass seed mixtures for grass fields and grass-clover leys. The best grass field quality depends on the right composition of varieties in these mixtures. In addition to producing the right varieties, the yield and especially the quality of the seed has to be satisfactory. In this respect, the organic seed production is facing demands with regard to certification regulations. However the market also demands that all requirements are met as to the technical purity, the content of other species, and of course germination.

Weeds and other species
An element of success in terms of a high seed yield and good quality is a well-established seed plant. Few, however big and well-established undersown plants of grass and clover offer the biggest yield potential and are more competitive in relation to weeds. Nitrogen supply to the grass seed crop is a must.

Weeds in clover and grass seed will affect the crop in two different manners. Primarily, some weeds will have a detrimental effect on the yield when competing against the crop to get light, water and nutrition. Secondly, the weeds will cause a deterioration of the quality of the seed.

Couch grass (Elymus repens L.), camomile (Matricaria spp.), creeping thistle (Cirsium arvense L. Scop.), dock (Rumex spp.) and cruciferous weeds are all examples of weeds that compete heavily against the grass seed and that will affect the yield negatively. Organic farmers must seek to reduce such weeds to a minimum by soil cultivation and by crop rotation in order to prevent multiplication.

Weeds and other cultivated crops that develop seeds of the same size as the grass seed crop are difficult/impossible to remove by cleaning, and must therefore be reduced in the field. A significant existence of couch grass and other species having the same seed size as perennial ryegrass can be topped right before flowering of the weed grass. Topping of couch grass ear can be done mechanically, in cases where the
perennial ryegrass field has logged and the couch grass ear is above the crop. The couch grass ear can be cut by a special mower, swath forming mower or by combine harvester.

Topping of flower heads of the problem weeds can also be practiced in white clover at the time when the weeds are above the clover crop. This method is especially applicable to camomile and cruciferous weeds and to a minor extent to dock (Rumex spp.). A reduction of seed bearing weeds in white clover can also be obtained by grazing of sheep and/or topping of the clover field before its flowering period.

In addition to dock (Rumex spp.), chickweed (Stellaria media) and cut-leaved cranesbill (Geranium dissectum Jusl.) are also a problem when cleaning the white clover. There is no difference in heights between chickweed and cranesbill and white clover in the field. Weed control is often undertaken by means of a mechanical weed control (spring tining) in April, however, the best and safest method is a manual hoeing.

Grass seed fields that are heavily contaminated by weeds should not be harvested, however, it is recommend that they be condemned. All grass seed fields are hoed manually, to a small or large extent, in order to remove weeds and cultivated plants that are difficult to remove when cleaning the seed.

Except from red clover (Trifolium pratense), only a minority of the organic production areas offer the possibility to use an inter-row cultivator. Instead organic farmers are aiming at getting good, well-established seed plants being at the same time able to outcompete the weeds. The mechanical weed control therefore mainly consists of blind harrowing and harrowing (spring tining) of the cover crop. In the grass seed crop a mechanical weed control is rarely practiced, however, a reduction of the ears of the weeds is made in order to avoid having other species in the final grass seed product.

Quality requirements
The certification regulations are the same for organic and conventional seeds for sowing. The certification is exercised in connection with a field inspection done by the staff from the seed companies and The Plant Directorate, where the variety purity is controlled as well as the distance isolation to avoid any cross pollination. The certification regulations laid down also specify the requirements as to the analysis of the cleaned material in terms of purity, germination and content of other species.

Organic seed can, of course, only be produced by authorized organic farmers. This authorisation is approved and controlled by the Danish Plant Directorate. The Plant Directorate carries out minimum one inspection/control visit per year at the organic farmer as well as at the processing site. In connection with the control visit to the organic farmer, a control report is worked out. This control report is to accompany the crop, also a grass seed crop, in connection with a sale of the crop, before the production can be approved as being organic. The grass seed crop is likewise accompanied by a declaration from the organic farmer stating that the grass seed crop in question has been produced according to organic regulations.

Germination
The germination of clover and grass seed is primarily ensured by the fact that all grass seed farmers are in possession of a drying plant at their farms. Most of the grass seed fields of ryegrass and fescues are harvested direct on root. Direct harvest is undertaken when the water content is approx. 20 %. As a consequence, it is of utmost importance that the harvested material be aired and dried to reach a water content that is below 13 %. Combining subsequent to swathing is practiced in white clover and smooth-stalked meadow grass, among others, as well as in grass seed fields that have not logged evenly. A crop that has been laid on swaths should also be aired right after harvest.

Cleaning of seed
All seed is cleaned by the grass seed company before analyzing the cleaned material in an authorized laboratory. The settlement of the farmer account is based on the analysis in question. The main objective of the cleaning is to secure a satisfactory purity result. When cleaning the seed, straw parts, dust and empty seed capsules are removed. In order to remove other species during cleaning, a distinct difference is required as to seed size, weight or length in relation to the seed. The cleaning consists of air conditioning, sieve cleaning as well as cleaning on indented cylinders. Cleaning by means of a gravity separator is also performed. By cleaning on a gravity separator, the seed lot is fractioned according to its weight. Many resources are used in connection with cleaning of organic white clover on a gravity separator. Employees
having practical experience and know-how within cleaning are of utmost importance in order to ensure a high quality in organic seed production.

In table 1 are shown the average qualities for organic seed compared to the conventional seed quality and the qualities defined by the EU minimum certification requirements.

Table 1: Quality of organic seed compared to conventional seed and the EU minimum norms for certified seed – Harvest 2003 – DLF-TRIFOLIUM A/S

<table>
<thead>
<tr>
<th></th>
<th>Purity %</th>
<th>Germination %</th>
<th>Other species %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red clover</td>
<td>97</td>
<td>99.4</td>
<td>98.9</td>
</tr>
<tr>
<td>White clover</td>
<td>97</td>
<td>98.7</td>
<td>99.0</td>
</tr>
<tr>
<td>Perennial ryegrass</td>
<td>96</td>
<td>99.0</td>
<td>98.9</td>
</tr>
<tr>
<td>Meadow fescue</td>
<td>95</td>
<td>98.5</td>
<td>98.8</td>
</tr>
<tr>
<td>Red fescue</td>
<td>90</td>
<td>96.6</td>
<td>96.3</td>
</tr>
</tbody>
</table>

Conclusion
The organic seed production in Denmark is able to offer a satisfactory quality of organic seed.

Purity and germination of organic seed is better than the minimum requirements laid down in the EU certification regulations. There is no pronounced difference in quality with regard to purity and germination when comparing organic and conventional clover and grass seed production. The content of other species is higher in organic seed than in conventional seed. Some species have a more deteriorating effect than others; this goes for couch grass in perennial ryegrass and dock (Rumex spp.) in white clover. Speaking of couch grass in organic perennial ryegrass, more than 60 % of the seed lots were free from couch grass in the 2003 analyses. More than 70 % of the analyses showed that organic perennial ryegrass was free from couch grass in harvest 2002.

It is very difficult to produce seed from organic white clover, however in harvest 2003 about 99 % of the production was certified, whereas only 85 % of the organic seed production was certified in harvest 2002.
Organic forage seed production in Finland

Markku Niskanen
MTT Agrifood Research Finland, South Ostrobothnia Research Station, Alapääntie 104, FIN-61400 Ylistaro, Finland.
Email: Markku.niskanen@mtt.fi

Abstract
Interest in organic farming began to increase in Finland when it joined the European Union in 1995. The total organically farmed area increased rapidly after that and in 2002 it was 156, 692 ha, 7 % of the total arable land. Timothy (Phleum pratense) and meadow fescue (Festuca pratensis) are the most cultivated grass species both in conventional and organic farming. During recent years interest has developed among organic farmers in cultivating tall fescue (Festuca arundinacea) Red clover (Trifolium pratense) and white clover (Trifolium repens) are the most important forage legumes in Finland. The supply of organic seed has been limited and for many varieties there is no organically produced seed available. New varieties are needed as soon possible for the organic sector as well as for the conventional sector. Because of lower yields organic seed is more expensive than conventionally produced seed. The high seed price and limited seed supply has dampened interest among organic farmers to use organic grass seed. There is therefore an urgent requirement to increase the effectiveness of organic herbage seed production in order to be able to provide seed at competitive prices. The main challenges in certified organic herbage seed production in Finland are the control of weed infestation to meet purity standards, timely application of sufficient nitrogen fertilizer for grasses, harvesting forage legumes without using desiccants and improved seed cleaning technology.

Keywords
organic forage seed production; timothy; meadow fescue; red clover

Introduction
Interest in organic farming began to increase in 1995 when Finland joined to European Union. Finland’s agricultural income support system in 1995-2002 was based on payments made in accordance with the common agricultural policy (CAP). Agri-environmental support co- financed by the EU and Finland, has a major influence on expansion of organic farming.

The total cultivated area in Finland was 2.2 million ha in 2003 (Anon 2003a). This is increased by little each year after membership. In 1994 the total organically farmed area was approximately 26, 000 ha, 1.2 % of the total arable land (Anon 1998). The total organically farmed area has increased substantially and by 2002 it was 156, 692 ha representing 7.0 % of the total arable land (Fig 1).

Fig 1. Total arable land and organic farming area in Finland 1994-2003 (Anon 2003a,1998)
The number of farms covered by the organic farming inspection system in 2002 was 5071 (Anon 2003). Average organic farm size was 30.9 ha in 2002, rising from 17.2 ha in 1994. The total number of farms in Finland has decreased rapidly during EU membership: there were 114, 510 and 75, 474 farms in 1994 and 2002 respectively. Simultaneously average farm size increased from 17.3 ha to 30.0 ha (Anon 2003a, 1998)

Volume of organic forage seed production in Finland

Grasslands play a key role in crop rotation in organic farming. The entire crop rotation system is based on grasses and particularly on forage legumes. The forage plants significantly affect soil structure, weed flora and soil nutrient level. Finnish organic farmers cultivate the grasses and legumes for forage and/or green manure. A little over 50 % of the total arable land in organic farming is cultivated grass or green fallow.

Current legislation dictates that swards in organic production have to be established using organically produced seed. During the transition period it was legal to use conventionally produced seed if organically produced seeds were not available. Organically produced seed was to be made available after 31.12.2003. That requirement has been a big challenge to the entire seed industry, including the organic seed producers. For forage production it is of utmost importance that organically produced seed of main species and varieties grown in Finland is available.

Timothy (*Phleum pratense*) and meadow fescue (*Festuca pratensis*) are well adapted to northern European conditions. Both species are very winter hardy and are consequently the most cultivated grass species in Finland. Timothy is suitable for mixtures with red clover and meadow fescue and therefore it is very suitable for organic farming. Interest in cultivating tall fescue (*Festuca arundinacea*) has increased among organic farmers because it produce abundant dry matter yield. Tall fescue variety Retu was specifically bred for Finish growing conditions.

Seventeen varieties of timothy and nine varieties of meadow fescue are included on the Finnish official variety list. Most timothy varieties on the list were bred in Finland. Three varieties came from Sweden and two varieties from Norway. Meadow fescue has also been bred in Finland (4 varieties), in Sweden (2 varieties) and in Norway (2 varieties). One variety originates from Holland (Anon 2004)

Perennial ryegrass (*Lolium perenne*) and cocksfoot (*Dactylis glomerata*) are little grown in Finland. Neither species have particularly weak winter hardy and therefore only suit southern Finland. Three varieties of ryegrass and three varieties of cocksfoot were included on the official variety list of Finland (Anon 2004)

Red clover (*Trifolium pratense*) and white clover (*Trifolium repens*) are the most important forage legumes in Finland. In organic farming white clover is particularly cultivated in pasture. Other clovers (*Trifolium hybridum, Trifolium resipatum, Trifolium subteraneum*) are cultivated a little in organic farming for green manure.

The official variety list of Finland includes nine red clover varieties. Four varieties of red clover originate from Finland and three come from Sweden. Two varieties of red clover were bred in Estonia at Jõgeva plant breeding institute. One variety of white clover and one variety of alsike clover are included on the Finnish variety list (Anon 2004)

The total seed production area of timothy in 2001 and 2002 was 7189 ha and 7681 ha of which 270 ha and 270 ha hectares were under organic farming. In 2003 organic timothy seed was produced on 322 ha. In 2002 the seed production area for meadow fescue was 1668 ha for conventional farming and 21 ha for organic farming. In 2003 organic meadow fescue seed was produced on approximately 40 ha. Seed production area for tall fescue in 2003 was a little under 60 ha for conventional farming and only 10 ha for organic farming (Vallivaara-Pasto 2002,2003)

Organic red clover seed was produced on 302 ha and 170 ha respectively in 2002 and 2003. Organic and conventional white clover and alsike clover seed were each produced on about 10 ha.
The supply of organic seed has been limited in Finland and for many varieties no organically produced seed is available. According to the Control Centre for Crop Production (KTTK), in February 2003 organic seed was supplied for only two varieties of meadow fescue by five seed packers, five varieties of red clover by sixteen packers and five varieties of timothy by fifteen packers. Forage breeders have developed new varieties with high yield and good feed quality, that need to be made available to the organic sector as soon as possible.

Organic seed is more expensive than conventionally produced seed due to the lower yields. In addition, there is an increased labour requirement to control weeds and a higher cleaning cost. High seed price and limited seed supply have decreased interest of organic farmers in using organic grass seed. There is great need to increase the effectiveness of organic herbage seed production in order to be able to provide seed at competitive prices. The lack of organic herbage seed will cause severe difficulties for organic milk and beef production, which depend on grasses and legumes.

Challenges for herbage seed production

The main challenges in certified organic herbage seed production in Finland are:

1) Control of weed infestation to meet purity standards
2) Timely application of sufficient nitrogen fertilizer for grasses, particularly if organic manure is not easily available
3) Harvesting forage legume without crop desiccants
4) Cleaning technology to rid forage seed of weed seeds. Combined seed production of timothy and clovers sets high cleaning demands.

Minimizing weed infestation in organic seed production fields is vitally important to ensure high seed yields and adequate seed quality. In Finland the most harmful weeds in grass seeds stands are scentless mayweed (Tripleurospermum inodoa) and couch grass (Elymus repens). Scentless mayweed is a noxious weed in timothy seed stands, especially during the first year. Couch grass should be controlled in organic farming before the establishment of a seed stand, but harvest timing and a developed the cleaning process might also be useful to minimize the problem, particularly for meadow fescue and tall fescue seed production.

In Finland the use of organic soils after peat lifting has ceased, but remains under discussion. The total area of peat production in Finland is approximately 60,000 ha. It has been estimated that by 2010 around 15,000 ha will be released from peat lifting (Anon 2003b). One option for the use of these areas might be grass seed production, particularly organic seed production because low weed seed content.

The main challenge in organic timothy seed production is to get an adequate amount of nitrogen to the plants in spring. Many organic farmers in Finland are located in areas where the supply of animal manure is very limited. Therefore, timing and rate of animal manure application are very important. One solution to the nitrogen problem might be mixed cultivation of timothy and clover species (Aamlid 1999). In sequential cultivation systems timothy seed would be harvested from second and third year stands, while clover seed would be harvested during the first production year. In the simultaneous system, timothy and clover seed are produced together in mixed stands. In this system separating timothy and clover seed might represent a problem and it sets high demands on the cleaning process.

Use of leaf desiccation agents, common in conventional seed production of red clover, is forbidden in organic seed production. A need is therefore created to secure red clover seed harvest using alternative means. One solution might be swath drying and two-step combine harvesting.

During recent years forage seed production research has been very limited in Finland and research projects concerning organic herbage seed have not been initiated. Research on organic forage seed production has been done in Scandinavia (Aamlid 1997,1999,2002,Boelt 1997) but it will be essential to establish a research program that addresses problems in organic forage seed production in Finland.
References


What are the limiting factors to seed quality in organic production of
green and clover seed and how to improve yield?

Birte Boelt & René Gislen
Danish Institute of Agricultural Sciences
Department of Plant Biology
Research Centre Flakkebjerg
DK-4200 Slagelse
E.mail: Birte.Boelt@agsci

Abstract
In conventional seed production of grasses and clover it is recognised that a low plant density in the seed
crop stimulates the reproductive development and hence increase seed yield. Most temperate forage species
of grasses and white clover establish slowly and have a relatively poor ground cover, which limits the
competition against weeds. In order to optimise quality and yield in organic grass and clover seed production
alternative establishment methods have been identified. These methods enhance crop competitiveness
against weeds and allow for mechanical weed control.

Establishing the under sown seed crop right between the cereal cover couple row provides a higher ground
cover, and the establishment rate of the seed crop is enhanced. This method of establishment is recommended
when weed density is low or where the prevailing weeds produce seeds that can be separated from the
harvested grass or clover seed. Establishing the under sown seed crop in the cereal row allows for different
strategies of mechanical weed control and our results show that perennial ryegrass tolerates a range of
strategies of mechanical weed control including up to three harrowings. However, grass and clover species
with a low seed weight and/or a slow establishment rate might not establish successfully when sown in the
individual row.

Identifying the optimal establishment technique must take the occurrence of weed species and the weed
density into account.

Keywords
Establishment, crop competitiveness, mechanical weed control, defoliation.

Introduction
Danish seed producers hold a considerable proportion of the total EU grass and white clover seed production
due to favourable climatic conditions, long tradition and expertise in this specialised production. On average
more than 40% of the total EU production of grasses are grown in Denmark and 80% of the total white clover
(Trifolium repens L.) production. It is a great challenge to the Danish seed growers to supply an equivalent
proportion of the required organic seed, and Danish seed companies have been establishing an organic
forage seed production.

Organic forage production for ruminants in Northern European farming systems is based on mixtures of
various grass and clover species with the main constituents being perennial ryegrass (Lolium perenne L.)
and white clover. In addition timothy (Phleum pratense L.), meadow fescue (Festuca pratensis Huds.),
cocksfoot (Dactylis glomerata L.) and smooth stalked meadow grass (Poa pratensis L.), are also constituents
of forage mixtures since they possess specific properties.

In Denmark a production of one of the main constituents of forage mixtures, perennial ryegrass is established
and seed is available for export, however, another main constituent, white clover is still in request (Boelt,
2003).

Temperate grass and clover species for seed production establish very slowly compared to a cereal crop and
for most species a satisfactory seed yield is not obtained until their second growing season. Therefore more
than 90% of the grass and clover species for seed production are established in a cover crop. The slow
establishment results in weak competitiveness against weeds. 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. Organic seed has to meet EU quality standards of germination
and purity as a minimum, but often higher demands are requested. Due to the above-mentioned factors
(slow establishment rate and low plant densities) weed control in seed crops is one of the most essential management aspects in organic seed production.

**Methods**
An organic crop rotation was established in 1996/97 at The Danish Institute of Agricultural Sciences, Research Centre Flakkebjerg. Organic seed production trials were established in this rotation in 1998 and additionally registrations and plant samples are collected in organic seed grower fields.

In this paper the results of three experiments are reported:

**Establishment**
In a field experiment different establishment methods of perennial ryegrass cv. Borvi were tested in three consecutive years from 1996-1998. The trial was performed in a conventional crop rotation. In all treatments perennial ryegrass was under sown in spring barley, and the grass seed and the barley were sown at the same time – in one field operation. Spring barley and perennial ryegrass was sown at 24 cm row spacing. Treatments included placing of the perennial ryegrass seed in the cereal row, 2 cm, 6 cm and 12 cm besides the cereal rows. The establishment rate of the under sown perennial ryegrass and first year seed yield were recorded in 1997-1999.

Additionally four grass species differing in seed weight and growth rate were established in spring barley in the organic crop rotation in order to evaluate crop competitiveness against weeds when established either in the cereal row or right between the cereal rows. These grass species were red fescue (*Festuca rubra* L.), perennial ryegrass, a hybrid between Italian ryegrass (*Festulolium*) and meadow fescue and timothy.

**Strategies of mechanical weed control**
In 1999 and 2000 a field experiment was established in order to investigate the tolerance of perennial ryegrass seedlings under sown in spring barley to different strategies of mechanical weed control. The spring barley was established at 24 cm row spacing except for treatment 3 where row spacing was 12 cm. Perennial ryegrass cv. Borvi were sown in the cereal row except for treatment 3 where it was sown at 12 cm row spacing placed right between the cereal rows. Different strategies of mechanical weed control were conducted in the establishment year and these included harrowing and hoeing. The establishment rate of the under sown perennial ryegrass and first year seed yield were recorded in 2000 - 2001.

**Defoliation in white clover**
In the organic crop rotation white clover cv. Sonja was established in spring barley in 2001-2003, and the effect on seed yield of different strategies of defoliation are recorded. Seeding rate of white clover was 1.5 kg ha⁻¹. The treatments include defoliation at three different developmental stages.

**Results and discussion**

**Establishment**
The experiments have shown, that the under sown perennial ryegrass has a better establishment (higher biomass production, more tillers) when sown between barley rows compared to sowing in the same row, however, in the consecutive seed production year, no difference in seed yield was recorded between the two establishment techniques. When sown between the cover crop rows ground cover by crops was higher and therefore competition against weeds is enhanced. Management guidelines are summarised in table 1. Grass species with a low seed weight such as red fescue and smooth stalked meadow grass may not establish successfully when sown in the cover crop row.

**Table 1. Management guidelines for establishment of organic grass seed crops.**

<table>
<thead>
<tr>
<th>Field situation</th>
<th>Optimal establishment technique</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low weed number</strong></td>
<td></td>
</tr>
<tr>
<td><strong>And</strong> Weed species with seeds, that can easily be separated from the harvested grass- or clover seed</td>
<td>The grass seed crop should be established between cover crop rows to obtain maximal ground cover by the two crops / no mechanical weed control</td>
</tr>
<tr>
<td><strong>High weed number</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Or</strong> Weed species with seeds, that can are difficult to separate from the harvested grass or clover seed</td>
<td>The grass seed crop should be established in the row of the cover crop to allow for mechanical weed control between rows</td>
</tr>
</tbody>
</table>
Ongoing research in conventional seed fields of perennial ryegrass and red fescue show that establishment at wider row distances (up to 24 - 36 cm) does not affect seed yield compared to establishment at 12 cm row distance. These findings are very interesting since wider row spacing will allow for mechanical weed control between the rows in the seed production year. Inter-row competition against weeds are increased due to a constant seeding rate which means that by increasing the row distance from 12 to 24 cm twice as many seeds are sown at 24 cm. These experiments have not yet been conducted in organic seed fields, however they might be very promising.

One of the most essential problems in organic grass seed production on arable farms in Eastern Denmark is inadequate nutrient supply - especially nitrogen. Besides the nitrogen amount, seed crops are also very sensitive to the timing of nitrogen application. Correct timing will stimulate reproductive development whereas excessive and poorly timed nitrogen application will be in favour of vegetative growth Gislum et al. (2003). If a nitrogen-fixating pre-crop provides nutrients, the grass seed crop will take up nitrogen as soon as it is mineralised which will most likely lead to excessive vegetative growth. Mixed cropping of a grass seed and a green manure crop provides an option on timing the nitrogen release and besides it also increase the crop competitiveness against broadleaved weeds.

**Strategies of mechanical weed control**

As a consequence of the investigations showing that in perennial ryegrass establishment in the cereal row does not decrease seed yield although establishment rate was decreased, experiments which combine establishment methods and strategies of mechanical weed control were conducted. It is assumed, that when the seed crop is sown in the cereal row, cereal plants protect the grass seedlings during mechanical weed control (Melander & Boelt, 2003).

**Table 2.** The effect of mechanical weed control in a spring barley cover crop on yield in an under sown perennial ryegrass seed crop. Average of 2000 and 2001. a. Barley 3-4 leaves, b. Barley 3-4 leaves and at tillering.

<table>
<thead>
<tr>
<th></th>
<th>Average 2000 and 2001 (Kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a.</td>
</tr>
<tr>
<td>1. Blind harrowing</td>
<td>1619</td>
</tr>
<tr>
<td>2. Untreated</td>
<td>1772</td>
</tr>
<tr>
<td>3. Untreated (sown between cereal rows)</td>
<td>1635</td>
</tr>
<tr>
<td>4. 1 harrowing</td>
<td>1606</td>
</tr>
<tr>
<td>5. 2 harrowings</td>
<td>1668</td>
</tr>
<tr>
<td>6. 3 harrowings</td>
<td>1642</td>
</tr>
<tr>
<td>7. 1 hoeing</td>
<td>1671</td>
</tr>
<tr>
<td>8. 2 hoeings</td>
<td>1717</td>
</tr>
<tr>
<td>LSDₜ=0.05</td>
<td>149</td>
</tr>
</tbody>
</table>

There were no significant difference between the different treatment strategies and in general seed yield was not reduced compared to untreated (sown between cereal rows). Except for treatment 3 all plots were established with the grass seed crop established in the cereal row at 24 cm row spacing. The trial shows that perennial ryegrass seedlings tolerate a range of strategies of mechanical weed control without imposing a decrease in yield in the subsequent seed production year. These findings are in contrast with Borm (1995), however, this might be due to the establishment of the grass seedlings in the cereal row.

**Defoliation in white clover**

It is a common practice to defoliate the white clover seed crop, in order to remove excessive vegetative growth, synchronise flowering and besides it also has some effect in controlling weeds. The defoliation takes place when the first flower buds appear in the leaf axils. Ongoing research show that a late defoliation in white clover i.e. four weeks after the first flower bud appeared in the leaf axils, removes a high number of
flower heads and hence results in a decrease in seed yield (Boelt, unpublished data), which is in agreement with earlier findings by Nordestgaard (1986). However, defoliation is in particular relevant to organic growers since it decreases the competition from some broadleaved species. Seed yields in organic clover have been very disappointing (averaging 100 – 200 kg ha⁻¹). Registered yields in 2001 - 2002 show an 80 per cent decrease when white clover was grown organically compared to conventional production (Boelt, 2003). It is believed that Apion damage is one of the main explanations for these low yields. Investigations in a number of organic clover seed fields in 1999 have shown that Apion damage may account for approximately 30 per cent of yield loss varying from 5 – 65 per cent (Rohde et al., 2000). However, the investigations also showed that weed control among other management techniques failed in order to obtain optimum yields. For the moment it is investigated if a late defoliation decrease Apion damage in white clover seed fields.

Identifying the optimal establishment technique for seed crops must take the occurrence of weed species and the weed density into account. Although these new management techniques will facilitate mechanical weed control, it is important to establish the seed crop in a field free of weeds that are either present in large numbers and/or which have seeds that are difficult to clean out from the harvested grass or clover seed. Therefore organic seed production of grasses and clover requires that weed control is carried out in the crop rotation in the years between seed crops.

**Conclusion**

Highest competition against weeds is obtained when the cultivated crops cover as high a proportion of the ground as possible. However, most temperate forage species of grasses and white clover establish slowly and have a relatively poor ground cover. Under sowing grasses and clover right between the rows of the cereal cover crop will increase establishment and enhance crop competitiveness especially against broadleaved weeds. This establishment method does not allow for mechanical weed control.

Grass species with a high seed weight and a relatively fast growth rate such as Italian and perennial ryegrass establish successfully when sown in the cereal row. This establishment method allows for mechanical weed control and perennial ryegrass tolerates a range of strategies of mechanical weed control including up to three harrowings.

In organic white clover production some reduction of broadleaved weeds may be obtained by defoliation the crop, however, late defoliations decrease seed yield due to a removal of a large number of flower heads.

**References**


Some approaches in research targeted to varieties and seed production in potato organic farming

Daniel Ellissèche¹ *, Yves Le Hingrat², Roland Pellé³, Mathieu Conseil⁴, Fabrice Tréhorelt⁵, Bernard Lejeune⁶, Didier Andrivon⁷, Laurence Fontaine⁸
¹ INRA, UMR INRA-Agrocampus APBV, Kerabier, F-29260 Ploudaniel, France
² FNPPPT Roudouhir F-29460 Hanvec, Inter Bio Bretagne 33 avenue Winston Churchill, BP 71612, F-35016 Rennes Cédex
³ Aval-douar Beo -Maison de pays F-22530 Mûr-de-Bretagne
⁴ Lycée Agricole, Suscinio, F-29600 Morlaix, France
⁵ UMR INRA-Agrocampus BiO3P, BP 35327, F-35653 Le Rheu Cedex, France
⁶ ITAB 149, rue de Bercy F-75595 Paris
*Corresponding author E-mail: ellissec@rennes.inra.fr

Abstract
A research program is being developed in France since 2000 by INRA, organic farming organizations and seed potato organizations to define the optimal conditions for building up a scheme of organic seed potato production. This program consists in comparing the effects of the genotype, the environment and their interaction on different sites, genotypes and seed origins (organic versus conventional, in vitro plantlets and stem cuttings). In order to identify the relevant traits enabling a potato genotype to perform satisfactorily under organic cropping, a number of cultivars and genotypes under selection were studied during the 2 first years. They were chosen to cover a wide range of variability, at least when evaluated under conventional farming, for characteristics such as earliness of maturity, resistance to late blight, storage ability. All these characteristics were assessed as well as total and marketable yield.

First results are presented. They show the feasibility of organic seed potatoes and they indicate some key points as the cultivar and isolation. According to the location and the year, resistance to late blight and maturity type appear as two important varietal traits.

Opportunities for seed production and breeding especially devoted to organic potato crop and areas for research are discussed.

Keywords: seed potato, genotype x environment, certification, genetic resources, ideotype

Introduction
Organic farming develops successfully at the moment, as consumers and tradespeople take more and more interest in its products. The potato crop is specially concerned and one may wonder whether the expectation of 5% organic potato crop for the next years in France is not underestimated. Generally speaking, the ethics and the philosophy of organic farmers demand a restricted range of fertilizers and chemicals (pesticides, sprouting inhibitors…) to be used – and sometimes none – compared to that authorised in conventional farming. These regulations, which apply to organic farming also, encompass the building up of a specific seed production scheme to be put into practise from 2004. Such requirements may induce some difficulties in efficiently protecting crops against diseases and pests (Ghesquière, 1999), in reaching economical yield levels or in storing tubers without losses, at least when current cultivars are grown. The use of in vitro propagation is also questioned.

A programme is developed with the collaboration of INRA (Institut National de la Recherche Agronomique), organic farming institutions (ITAB) and organizations (Inter Bio Bretagne, Aval-douar Beo) and the seed potato growers federation (FNPPPT). It aims at assessing the feasibility and the critical points of an organic potato seed production scheme by defining the relevant environmental conditions and varietal traits and by studying the effects of seed origins.

Material and methods
In order to identify the relevant traits which may enable a potato genotype to perform satisfactorily under organic farming husbandry, about 65 cultivars and genotypes under selection were studied during 2 years (35 per year plus a common set of standards) in an experimental farm were a typical oceanic weather prevailed. They were chosen to cover a wide range of variability, at least on the basis of data already
recorded under conventional farming, in such characteristics as maturity, resistance to late blight, storage ability, and tuber aspects. In a 3 replicate randomised block experiment, maturity was estimated by measuring plant height at flowering stage and percentage of foliage destruction by late blight was recorded 4 times during the growing season. At harvest, total yield and marketable yield (tubers of >35 mm size) were weighed. Storage ability was assessed on 3 samples of 20 tubers each per genotype, which were kept in a shed at outside temperature; initial and final sample weights were recorded as well as sprout weigh.

The effects of genotypes, environment and their interactions were studied on 6 cultivars: Charlotte, Désirée, Eden, Emeraude, Kerpondy, Sirtema, which the previous experiments showed different to each other in terms of maturity, resistance to late blight and to viruses, and keeping ability, in Brittany and in the Centre of France, two locations which differ by their climatic conditions. In the trials (randomised blocks, 3 replicates) two origins of seeds were compared, i.e. conventional and organic. The conventional seeds were the second generation of tubers from in vitro cuttings, while the organic seeds were the first generation of tubers harvested from an organic crop. The organic seeds were presprouted before planting. Weed control and haulm killing were done mechanically. Mineral oils were sprayed on the Centre of France trial to prevent aphid transmission of Potato Virus Y (PVY). Data were recorded during the growth cycle; PVY contaminations (during the growth cycle and in samples of tubers after harvest) and yields were assessed.

In every situation, Bordeaux mixture was sprayed to protect the plants against late blight.

To tackle the question of getting rid of in vitro cuttings in the first stages of a seed production scheme, a production of stem cuttings was tried (6-7 successive cycles of production over a year. Finally the cuttings were planted in the field to produce tubers. No rooting hormones were used. One single experiment was carried out on the 6 aforementioned cultivars.

Results
The assessment of the 65 cultivars and genotypes under selection proved that a wide variability is detectable under organic cropping. The maturities of the genotypes ranked in the same way as in conventional farming, although the plants looked less vigorous in these conditions. The commercial yields ranked from 3.5kg to 12.5kg per plot of 14 plants first year and from 1.7kg to 11.7kg the second year, that is to say from very low to fairly high yields. The hierarchy between the standard cultivars was the same in the 2 years, and different from that observed in conventional cropping. The genotypes also varied in their degree of susceptibility to late blight, exactly as in their official assessment, which could be foreseen (assessment under natural contamination, without any fungicide spraying). Weight losses during storage varied from 5% to more than 20%. For one given cultivar, the results differed from one year to the other. The results obtained the first year showed negative correlations between degree of susceptibility to late blight expressed by AUDPCs (Fry, 1987) and yield (Fig. 1), and between plant vigour and AUDPC whereas positive correlations existed between plant vigour and yields and between AUDPCs and weigh losses during storage. The “r” values were higher the first year than the second year: only correlations yield and AUDPC and between plant vigour and AUDPC were significant.

In the 2 trials devoted to the Genotype x Environment study, emergence was faster in the plots planted with organic seeds then in the plots planted with conventional seeds. In both places almost no symptom of late blight was observed. In the Centre, yields were significantly higher in the plots planted with organic seeds (Fig. 2). Sirtema the earliest cultivar among the 6 was the most productive when organic seeds were used. In Brittany, the same difference as in the Centre was observed between the 2 origins of seeds. The cultivars were placed differently and Eden, a medium to late one, was the best yielding whether conventional or organic seeds were planted. In the Centre, the yields per plant ranked from 0.300kg to 0.700kg in the organic origins and from 0.250kg to 0.450kg in the conventional origins. In Brittany the figures were respectively 0.350kg – 0.880kg and 0.280kg-0.310kg. PVY contaminations varied from 0 to 12% according to the cultivar and the seed origin. They were lower in the Centre than in Brittany and lower in the organic origins than in the conventional ones.

In the preliminary study devoted to stem cuttings production and field transplantation, stem cuttings yielded 2-3 tubers per plant.
Figure 1:
Relation between levels of blight resistance and yield in potato varieties grown in organic farming conditions

![Graph showing the relationship between AUDPC and commercial yield with regression lines for Year 2000 and Year 2001.]

Year 2000: $y = -27.481x + 9.3901$ ($R^2 = 0.7146$)
Year 2001: $y = -9.5377x + 9.3069$ ($R^2 = 0.1665$)

Figure 2:
Comparison of the influence of 2 origins of seeds on the yields of 6 potato cultivars in 2 regions of France

![Bar chart comparing yield per plant in different regions and for different cultivars.]

Discussion
To protect potato crops against pests and diseases is probably one of the main difficulties to overcome in organic farming, as a very restricted range of pesticides is authorised. The difficulty increases when speaking of a seed production scheme, which must meet the requirements of both organic farming and seed certification regulations, based on very strict standards. More generally, one may wonder where and of which cultivar it will be possible to produce organic potato seeds. The assessment of several genotypes in one oceanic location proved that a low degree of susceptibility to late blight is an important trait of adaptation of potato
genotypes to organic farming. It was especially true in 2000 where the epidemics of late blight started early. This was not confirmed in the 2 Genotype x Environment studies because almost no blight occurred there. However Eden, which is one of the most resistant to late blight among the current cultivars, was the highest yielding cultivar in the Brittany location. The worldwide importance of late blight and the restricted use of copper sprays compel to take into account the resistance of genotypes. The maturity type also appeared as an important trait of adaptation, and medium to late genotypes proved to be better adapted either because of a longer cycle, or because of a better survival to defoliation by blight or because they develop deeper their rooting system than early cultivars (Ellissèche et al., 2000). This was obvious in 2000, with that early attack of late blight and less pronounced in 2001. The performance of the early cultivar Sirtema in the Centre location, where the climate is more continental than in Brittany, plays in favour of an earliness strategy where cultivars, thanks to their early and short growth cycle, could escape part of biotic and abiotic stress. Other authors (Möller, 2002) underline the importance of other limiting factors than late blight in continental locations. The observed advantages of organic seeds on conventional seeds in terms of yield and in terms of PVY contaminations probably proceeds from the fact that the organic seeds were presprouted, which the conventional seeds were not. Daughter plants from presprouted seeds emerged faster, which helped them developing faster, maturing faster, yielding more, and being less receptive to virus diseases. Anyhow the low percentages of contamination by PVY observed after one year of multiplication of 6 cultivars showed than an organic seed production is possible. These results need to be confirmed after several years of multiplication, the number of which is still to be defined. It must be précised that the trials were located in 2 regions of France were the potato seeds are historically produced on a large scale. One field (Brittany) was specially chosen for its exposure to winds and rain very unfavourable to aphid pullulation. It underlines the importance of the environment. In the other field, the conditions were less optimal but mineral oil sprayings were done, which seems up to now accepted in organic farming practise.

Possibilities of replacing in vitro cuttings by stem cuttings in an organic seed production scheme were dealt with in preliminary studies only. The technology per se seems suitable but both systems need to be compared, technically and economically.

**Conclusion**

Although our experiments were carried out in 3 locations only their results were very diverse in terms of varietal behaviour and possibilities of seed production. It would be worthwhile to continue over several years and in more locations, representative of various environments. This would very helpful, as organic farming is not only practiced in European countries. An international collaboration frame would make it possible.

It may be wondered whether breeding targeted varieties would be useful to solve some specific problems and to add recognition to that organic production.

**References**


Rhizoctonia in organic seed potato production

Monique Hoppers, M.Sc1; Dr. Jooke Postma2; Dr. Leontine Color2
1Louis Bolk Instituut, Hoofdstraat 24, 3972 LA Driebergen, The Netherlands, Email: m.hoppers@louisbolk.nl
2Plant Research International, PO Box 16, 6700 AA Wageningen, The Netherlands

Abstract
In organic seed potato production Rhizoctonia solani is one of the main problems. Farmers’ experiences indicate that farm specific seed, propagated for several years on the same farm, is less infected by Rhizoctonia, while seed from a different origin is infected more severely. When the latter is propagated on the own farm for several years, the damage decreases again. Several farmers report a decrease of Rhizoctonia-related damage several years after conversion to organic agriculture. Possible causes for this phenomenon are the use of farm specific seed, changes in soil life after conversion, or weather circumstances.

In scientific literature the phenomenon of ‘Rhizoctonia-decline’ is described for several crops (wheat, sugar beet, cauliflower, radish, potato). The mechanism of disease suppression is of biological nature, because it disappears after sterilisation of the soil. The mechanism for disease suppression when farm-specific seed potatoes are used may be a combination of micro-organisms in the soil which are compatible to the Rhizoctonia population on the skin of the seed potato, and/or vice versa.

Against the background of the fact that most Dutch organic potato growers consider Rhizoctonia a major problem, it is remarkable that there is a group of growers who seem to have overcome the problem. If insight can be gained in how they have reached this result, this may give a good perspective for organic seed potato production!

Keywords
Rhizoctonia solani, decline, organic potato production, farm specific seed

Introduction
In organic potato production Rhizoctonia solani is one of the main problems. Some people consider Rhizoctonia even more threatening than late blight (Phytophthora infestans). Several messages from the organic field, however, indicate that when farm specific seed, propagated for several years on the same farm, is used, the damage by Rhizoctonia decreases (‘decline’), while seed from a different origin (another farm) is infected more severely. In a survey with seven organic seed potato producing farms this phenomenon of ‘Rhizoctonia-decline when farm specific seed is used’, including the accompanying circumstances, was documented.

In addition, a literature review on the phenomenon ‘Rhizoctonia decline’ in potatoes and other crops was carried out. The results open up interesting perspectives for solutions to the Rhizoctonia-problem.

Farmers’ experiences
Six out of of seven farmers, who were all selected as ‘good’ seed potato growers, had experiences that in the course of time the problems caused by Rhizoctonia decreased. Two farmers even report that after one rotation Rhizoctonia was in fact not a problem any more. Others report a gradual decrease that is not related to the crop rotation.

Five farmers recognize the fact that own seed suffers less from Rhizoctonia than ‘foreign’ seed, whereas the damage often decreases again after propagation of the seed on the own farm for several years. Moreover, there was one example, where seed suffered more damage when it was grown on another farm than when it was grown on the ‘own’ farm. On the other farm, the damage decreased again in the second year.

Most farmers have the opinion that soil factors contribute a lot to the control of Rhizoctonia. A good and balanced soil life (antagonism) is considered a main factor. On plots with a bad structure they often experience more problems. In addition, the use of own, farm specific seed is considered important. Some farmers only import potato seed from another farm into their system when they start growing a new variety. In other situations they refuse to import ‘foreign’ seed. But Rhizoctonia is always capricious. Even farmers who are in control of the disease sometimes have bad results, which they do not understand.

Summarised, in a context in which Rhizoctonia solani is, next to late blight, the main disease in organic potato production, a group of farmers is identified who have experienced a decrease of the problem in the course of time after their conversion to organic agriculture.
Possible causes for this decrease are
1. the use of own, farm-specific, seed as mentioned above.
2. changes in soil life after conversion to organic agriculture.
3. weather circumstances in the years after conversion, which have been unfavourable for Rhizoctonia.

The accompanying circumstances on the farms (crop rotation, soil fertility management, chitting, defoliation, harvest, etcetera) do not give an immediate answer to the question how the farmers reached this result, but it is clear that insight in the underlying mechanism will be an important tool in Rhizoctonia-management.

**Literature review**

**Disease suppression**

As stated before, Rhizoctonia is often unpredictable. In the literature several agronomic factors that influence Rhizoctonia are described. We concentrated on those factors that give insight in the possible underlying mechanism of disease suppression.

Application of compost and crop residues can improve disease suppression (including Rhizoctonia) in soils (Postma et al., 2001, 2003a), but the underlying processes are complex, and therefore difficult to predict. Large amounts of compost (up to 20 %) are required (Postma et al., 2003a; Blok et al., 2002), meaning that this is not practical in field situations, but only in the raising of planting material.

For cellulose similar effects are described. Effects are correlated with a high C/N-quotient and higher populations of antagonists (Kundu & Nandi, 1985; Croteau & Zibilske, 1998). Possibly the large amounts of C result in a high CO₂-production which suppresses Rhizoctonia (Croteau & Zibilske, 1998). In other experiments the effects were temporal, and showed at first a stimulation of Rhizoctonia, and later a suppressing effect (Postma et al., 2001; Westerdijk et al., 2000, 2002). It is possible that cellulose stimulates Rhizoctonia, and that on the larger population of Rhizoctonia the population of antagonists can increase resulting in a suppression on Rhizoctonia.

In an experiment with different rotations (50 years permanent grassland, of 20 years arable rotation) the microbial diversity was higher on plots with a history of permanent grass (Garbeva et al., 2003; 2004a; 2004b). On these plots Rhizoctonia was suppressed better than on the plots with a longstanding arable history.

**Rhizoctonia-decline**

In scientific literature the phenomenon of ‘Rhizoctonia-decline’ is described for several crops. In wheat, sugar beet, cauliflower and radish it is proven that when the crop is grown on a field continuously, the damage by Rhizoctonia increases in the first years, and afterwards decreases again. In field circumstances after 3 - 5 years disease suppressing effects start to show up (Lucas et al., 1993; Mazzola & Gu, 2002, Hyakimachi et al., 1990; Postma et al., 2003b; Westerdijk et al., 2002). In greenhouses, with more crops per year, this time period is shorter. For potato it is also observed that when it is grown in narrow rotations (especially 1:1, but sometimes also in wider rotations) the later cultures suffer less damage by Rhizoctonia (Jager et al., 1979; Velvis et al., 1989; Jager & Velvis, 1995).

The mechanism of disease suppression is of biological nature, because it disappears after sterilisation of the soil (Wiseman et al., 1996). Is has been possible to transfer the disease suppressing activity to sterilised soils, by adding 10 % disease suppressing soil (Postma et al., 2003b; Westerdijk et al., 2002). It is not sure which organisms are responsible for the effect, research results are largely speculative. The effects are correlated with the amounts of actinomycetes and/or bacteria in the soil, or with the population of a specific antagonist, such as Verticillium biguttatum, Trichoderma or Pseudomonas-species.

**Strategies**

For the control of Rhizoctonia solani in organic potato production systems several tools are available:

- Agronomic management can influence the disease suppressing capacity of the soil.
- There are (limited) differences in Rhizoctonia-susceptibility between potato varieties.
- Several antagonists for Rhizoctonia have been identified (viruses, bacteria, fungi).
It is important to realise that the decline as a result of the use of farm-specific potato seed is not a result of a continuous potato crop on the same field. In this case the mechanism for disease suppression may be a combination of a population of micro-organisms in the soil which is compatible to the Rhizoctonia population on the skin of the seed potato, and/or vice versa (see figure 1).

Against the background of the fact that most Dutch organic potato growers consider Rhizoctonia a main problem, it is remarkable that there is a group of growers who seem to have overcome the problem. If insight can be gained in how they have reached this result, this may give a good perspective for organic seed potato production!

**References**


Introduction

Potato is considered one of the most valuable food for humankind. Its economical importance for developing countries is tremendous, being the most important crop after wheat, maize and rice (Christiansen, 1967; Monares, 1981; Horton, 1987) An essential crop for the household food security, it contains high quality protein and substantial amounts of essential vitamins, mineral and trace elements. Furthermore, the energy supplied by the potato when cooked is significant, although still not equivalent to cereals and beans (Antunez de Mayolo, 1987).

Highlands in South east Peru and the Peruvian Bolivian “altiplano” are the richest areas on potato native varieties worldwide (Cahuana, 1993). These are the centers of origin of the crop were it was domesticated and is still widely consumed. Eight different potato species are found in the South America highlands (Hawkes, 1978), and even now there are more than 1,000 native varieties cultivated by the small farmers under highland conditions, using mostly traditional technologies generated through of experiences in its cultivation (Huaman, 1985).

The total potato production area in Puno, the peruvian southern highland, is between 28,000 to 35,000 has. Around 40 % of this area is cultivated under traditional systems and with about 300 different varieties. As an strategy to offer alternatives to producers of the local high plateau (3900 m), an organic farmers’ association, the Asociación Nacional de Productores Ecológicos (ANPE), and Slow Food have recently organized in Ayaviri, Puno, an association to produce organic seed of potato, quinoa (Chenopodium quinoa) and kañiwa (Chenopodium pallidicaule). This presentation introduces the initiative of this farmers’ group, in order to understand better how organic production could be of growing importance for the sustainable management of native potato varieties in the centers of origin of the crop.

Farming potato production systems in the Andes

Potato is the main crop of all land crop rotation systems in the high altitude Andean mountains (over 3600 m). The rotation is the following: after the potato is harvested, other tubers (oca, olluco, mashua) are cultivated the following year, and then a cereal such as barley is grown before a pasture are established or land is left to fallow for 4 to 7 years. This system is not applied in areas below 3000 m, where potato is used as a rotation crop after maize and commercial varieties are utilized. Native potato varieties on this high mountain environments are produced in similar conditions to organic productions, using organic manure as fertilizer and natural inputs for management of pests and diseases. Land is ploughed either with the use of oxen or with a foot plow called “chaqutaclla”.

Native potato varieties in the Andes

The cultivated diversity of potatos is still impressive, see for example table 1 for some of the potato cultivars grown in Puno. Most of the native varieties are seeded on mixture arrays to reduce climatic and pest attack risks. More than 20 different native varieties can be grown in a single plot, and each farmer grows from10 to more than 100 varieties in their private plots or communal lands (Tapia, 1998).

Table 1: Some important native potato varieties in Puno
Perú grows around 240,000 has with potatoes growth every year, yield range from 6 to 40 T depending on the agroecological zone, seed quality, plant disease and pest control, as well as level of modern agronomic technology used.

In the Andean agricultural system we must differentiate the private productions units, ranging from small plots to rather large farms, so the technology used varies. Commercial potato varieties are grown mostly for market oriented production, and the native varieties are used for household self-consumption (over 70%) with an organic oriented system of production. This includes self seed production, organic fertilization, use of traditional tools as well as post harvest management.

The sweet varieties are used for direct consumption and the so called bitter potatoes more frost resistant, must be transformed in chuño or moraya (white chuño) with a dehydrated and washed process (Franco, et. al. 1983; Rhoades, et. al. 1988).

**Traditional technology knowledge**

Agricultural local knowledge in the andean high altitude mountains is linked to the understanding of the clime changes and the experience accumulated by generations of farmers. Periods of intense rainfall or drought are frequent in the altiplano agroecological areas, so the flat lands and the slopes areas have to be ploughed each year according to those conditions (Tapia, 1999). Peasants in the area use different natural indicators, as presence of stars, birds or plants to predict with some approximation when, how and where to seed. Therefore, land preparation is closely related to the predicted conditions, and varies from year to year. Also hails and nightly frosts can affect the crop growth, so burning of some shrubs to produce protection smoke is used to reduce its damage effects on the plants.

Manure is widely used in the area also, although the levels required for the potato are rather low (4 to 5 t.). It is also quite common the use of biocide plant extracts to control some of the pest and diseases with variable results (Pratec, 1991).

Potato storage in the Andes is a tradition that goes back 3 thousand years. The storage strategy has been crucial in helping satisfy consumption needs of communities living over 3800 m. as well as linking production cycles through the maintenance of seed stock. Archaeological research has shown the existence of a large and well-organized network of state storages from the pre Inca times (Ravines 1978; Rhoades, 1988).

Nowadays, seed tuber storage in the highlands is mainly done in in-house stores, which may be rooms or small corners in the rooms, depending on the type of producer. In order to protect the seed tubers from insects, small producers often use aromatic plants such as “muña”, Minthostachys spp., or Eucaliptus leaves. Insect damage is the most evident problem to peasant production systems.

**Potato seed quality**

Consumers preferences for types and qualities of potatoes vary greatly among locations, consumers may prefer different potatoes for different food preparations. The use and the demand from consumers depend on the tuber size, shape, skin and flesh color and cooking quality depends of the potatoes varieties (Horton, 1987).

In selecting a variety, peasants consider cooking characteristics and quality, and market preference in addition to yield and storability capacity. Consumers generally prefer local varieties that are already well known, and are ready to pay premium prices for them (Canahua et. al, 2002).

**Results on organic seed potato production**

Potato has fewer pest problems in high altitude areas than in the lowland. Late blight is usually the most serious disease problem and bacterial wilt is an important production constraint. The attack of the insect *gorgojo de los Andes, Premnotryptes latithorax*, is also a problem especially during the dry years. Producers in the area have been forced sometimes to apply pesticides but some ecological practices to manage the pest had already been introduced before the project started (Yabar, 1994).

A small group of farmers in Ayaviri, Puno, working under the ANPE National Association, have decided since 2003 to concentrate their effort on the production of potato organic seed using the following strategies:
• Select the most pest, frost resistant local potato varieties (locka, Solanum juzepzukii, and Occucuri white and purple, Solanum curtilotobum) produced by the National Agriculture Research Institute, INIA.
• Used land that had not been cultivated for the last 10 years.
• Use manure as well as “guano de las islas” (manure from the coastal birds) as a fertilization source.
• Two hectares of this varieties were seeded as an experimental plots at over 3,900 m. to evaluated the agronomic adaptation of the native varieties and the economical analysis.
• Seed will be used to expand the organic production in the area, oriented to get certificate organic food as starch.

Table 2: Organic potato seed yields under altiplano conditions (3,900 m.)

<table>
<thead>
<tr>
<th>Variety</th>
<th>Main characteristics</th>
<th>Yields (range of variation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locka ó ccapo</td>
<td>early variety</td>
<td>7-13 t.</td>
</tr>
<tr>
<td>Occucuri white</td>
<td>middle variety</td>
<td>8-12 t.</td>
</tr>
<tr>
<td>Occucuri blue</td>
<td>middle variety</td>
<td>9-12 t.</td>
</tr>
</tbody>
</table>

The results of the first trials show that seed yields are reasonably good, seed had quite good sanitary conditions and total yields could be economically satisfactory, since the seed material got better prices than commercial seeds. The agronomic and economical analysis shows that organic potato seed production could be a major alternative to benefit the producers in Puno’s high altitude conditions, especially if industrial transformation of the final product is developed.

References
Fanco Efrain, P. Vilca, V. Niño.1983 Producción, distribución y uso de semilla de papa. CIP, INIPA,COTESU,PNP.Lima, Perú.
Seed quality in organic carrot seed production
Does tunnel production in Denmark provide sufficient seed quality?

Birte Boelt¹, Anne Mette Dahl Jensen¹ & Gitte Kjeldsen Bjorn²

¹Danish Institute of Agricultural Sciences, Department of Plant Biology, Research Centre, Flakkebjerg, DK-4200 Slagelse, E.mail: Birte.Boelt@agrsci
²Danish Institute of Agricultural Sciences, Department of Horticulture, Research Centre, Aarslev, Kirstinebjergvej 10, DK-5792 Aarslev

Introduction
In vegetable species the supply of organic seed is very limited and the supply of seed from varieties that has been identified as suitable for growing in Denmark or for specific products are limited. The report ‘The consequences of gene-modified-organisms (GMO) on organic farming’ identifies the lack of organic seed as a potential source for GM-dispersal to organic farming (Kjellsson & Boelt, 2002) if/when GM-varieties are approved for cultivation. Development of an organic vegetable seed production is the focus of the DARCOF-project ‘Vegetable and Forage Seed – development of an organic, GMO-free seed production’. A number of vegetable species such as carrot use to be seed multiplied in Denmark in relatively large quantities. However, the production has been moved to France and Italy, in order to obtain a higher seed quality, since the seed ripen earlier and the prevalence of quality-deteriorating fungi thereby diminished.

Seed production in tunnels is an important tool to maintain genetically purity. This production method is already used today by the Danish seed industry in the production of spinach hybrids. Screening of an organic vegetable seed production in tunnels was initiated in 2000 at the Danish Institute of Agricultural Sciences, Research Centre Flakkebjerg. A part of the project is to investigate seed quality and health status of carrot seed produced in open field and in tunnels.

Methods
In 2000 – 2003 carrots have been planted in spring in a tunnel (50 m x 250 m). In 2000-2001 roots of an open-pollinated variety was planted, and in 2002-2003 vernalised seedlings of a hybrid was planted. From the soil surface up to 1 m height the tunnel is covered by insect-net and the top cover is plastic. The crop was fertilised with degassed slurry or poultry manure equivalent to 100 kg N ha⁻¹. In 2002-2003 the plant densities of 0,25 x 0,35 m and 0,25 x 0,70m were tested. The seed yield has been recorded at three different harvest times, and harvest has been performed on primary, secondary umbels separately.

Seed quality was assessed recording germination percentage and health status of the harvested seeds. Carrots were also planted in open field in order to compare the infection percentage of Alternaria dauci and Alternaria radicina in carrot plants and seed grown in ‘open land’ and in tunnels. In 2003 image analysis was evaluated as a possible technique to identify pathogen infection on carrot seed.

In order to evaluate germination and performance of the produced seed in the field situation, the harvested seed were sown in the organic crop rotation at Research Centre Aarslev, and performance and product quality of the harvested carrots were evaluated using UPOV guidelines.

Results and discussion
Relatively high seed yields have been obtained – in the range of 1 – 2 t ha⁻¹. The germination percentage has been evaluated and it is found that in open field production germination varies from 39–58%, whereas the same variety had a germination percentage of 78-91% in tunnel production. Seed on the primary umbel had a germination percentage of 95%. During 2003 activities have focussed on a screening of image analysis in order to evaluate the possibility to identify pathogen infection of carrot seed by this new technique. Carrot seed with different pathogen infection percentage has been tested, and the results are very encouraging.

The organically produced carrot seed were tested against conventionally, untreated seeds – both sown directly in the organic rotation using the same size grading. Seed, organic produced germinated not as well as the conventional produced seed. The germination rate was 59 and 85 percent respectively. However, no difference in the amount of harvested carrots or on product quality has been recorded.

The investigation is continued.

References
Tomato seeds and biodiversity : who holds the stakes ?

N. Perrot2 & S. Bellon1

1 INRA SAD, Unité Ecodéveloppement, Domaine Saint Paul, Site Agroparc, F-84914 Avignon Cedex 9;
2 CESSA, 11 bd National, F-13001 Marseille

Conservation of genetic resources and management of biodiversity are at stake for many years. International and national public policies (Daunay, 2001; Trometter, 2002) take part in such dynamics. Who are the actors implied in such policies? Are there other actors holding these stakes and who are they? In order to contribute to answer this issue, we focussed our exploratory study on vegetables. We selected Tomato in France as a case study, due to the crop extension and the diversity of actors (farmers, gardeners, distinct seed producers). Based on web consultations, a set of interviews and participation in special events, various networks and actors were identified.

As preliminary results, three main categories of actors were identified.
* The network “Seed propagated Solanaceae genetic resources”, which is a product of the French public conservation policy. It includes public research institutes and industrial seed companies. Two associated partners having information and training activities (horticultural association, public historical garden) also contribute to this network.

* Other collective organisations (associations and networks), which emerged independently from public policies and from each other. Three forms can be characterised :
  (i) networks of gardeners producing and conserving seeds (associations or internet exchange networks);
  (ii) associations including gardeners and other actors (restaurant owners, consumers), managing “potagers conservatoires” and organising events to promote biodiversity;
  (iii) networks created by farmers, moving away from conventional agriculture (organic, biodynamic, “peasant”..): community supported agriculture gathering farmers and consumers; peasant seeds network presently gathering farmers, ancient-seed producers and associations (for biodiversity conservation, for rural development).

* Individuals (private-owned historical gardens, farmlands) acting as private enterprises, although sometimes connected with the previous category.

These categories reflect the present state of relations as well as corresponding conceptions and practices for conservation. The official network prioritises ex-situ conservation (including genebanks) and focuses on the conservation of ancient French varieties. For the second category, conservation consists in cultivating and developing ancient varieties in gardens and farms (economic insertion of these varieties). In the third one, conservation is implemented in conservation plots (historical gardens) and in the fields; both sites acting as support for public information.

A discrepancy appears between public conservation policy, which focus on ex-situ methods and steady-state material, and stakeholders operating in-situ, who advocate dynamics in genetic resources. Our framework can contribute to interpret possible links or breakpoints between these categories. It can also be completed with the study of other conservation initiatives and of the practices implemented in biodiversity management.

References
An example of web site in Europe for organic seed suppliers and farmers:  
www.semenes-biologiques.org

Jean Wohrer  
GNIS (Groupement National Interprofessionnel des semences), 44 Rue du Louvre, 75001 Paris  
Tel : + 33 1 43 63 97 79, Fax : + 33 1 40 28 40 16, Email : jean.wohrer@gnis.fr

Abstract: European Commission regulation nº1452/2003 lays down procedural rules and criteria relating  
the maintenance of derogations for use of seed or vegetative propagating material not obtained by the  
organic production method. In consequence, french database is open since the first of January 2004 on the  
website: www.semenes-biologiques.org. It works not only for registration of the suppliers and their varieties,  
but also for authorisation applications and granting.

GNIS (Groupement National Interprofessionnel des Semences), manager of the French computerised database,  
presents the results of his work for the suppliers and for the users of seeds: 63 suppliers and more than 700  
varieties of 90 species are registered; they are available through the Internet to the users of seed or seed  
potatoes and to the public; 8 000 authorisation demands have been asked for and transmitted to the  
certification bodies.

Keywords: seeds, organic, database

Since 1995, Council Regulation (EEC) nº 2092/91 provides for a derogation by which European Member  
States may authorise the use, in organic production, of seed and vegetative material not produced by the  
organic method, as it was clear that for certain species there is no adequate amounts of organically produced  
seed and vegetative propagating material available. European Commission regulation nº1452/2003 of august  
2003 lays down procedural rules and criteria relating the maintenance of derogations.

Three aims for a useful web-site

French Ministry of agriculture entrusted Gniss with the task of creating the web-site with several functions.  
The site would first enable, as stated in EEC Regulation, the seed suppliers to register their contact details  
and the species and varieties for which seed or seed potatoes produced by the organic production method  
are available in a precise area for the delivery. That information constitutes the official database, available  
through the Web, free of charge, to the users of seed or seed potatoes and to the public. Through the  
website, each supplier can update in real time his information with his reserved access. All his amendments  
are recorded.

Authorisations to use seed or potatoes seedlings not obtained by the organic production method may only  
be granted if the variety which the user wants to obtain is not registered in the database and the authorisation  
therefore is significant for his production, or if no supplier is able to deliver before sowing or planting.  
Two other important functions have been built for helping use of this site: Farmers and vegetable growers  
can ask directly by Internet for an authorisation. They can print the application forms and they must keep  
them for control. On the other part, the authorisations are directly transmitted to the inspection bodies in  
charge of granting them, so that they can do their work “on line”.

Present results

Setting up the database has surely contribute to give a better information on seed offer: 63 suppliers and  
more than 700 varieties of 90 species have been registered and updated for availability; (200 varieties for  
aricultural crops and 500 for vegetables), 8 000 authorisation applications have been asked for (mostly on  
cauliflower, tomato, corn and alfalfa) and transmitted to the certification bodies.

Expert groups meet under supervision of Ministry of agriculture to propose evolutions on the web-site. For  
example, discussions about “general authorisations” have first ended by a list of species or sub-species  
with no availability in organic seed. That list is now on line and updated each time there is one variety  
available in a species.

In the next future

The annual report of the granted authorisation will give a better image of the varieties and quantity of  
organically produced seed demand. This is very important for the seed sector and has been asked many  
years ago, to improve the supply of organic seed for the farmers...
European agriculture is confronted with a growing demand of consumers for organic vegetables. However, undesirable components such as mycotoxins pose a challenge to the safety of organic vegetable products. An EU-project was started in 2000 with the objective to develop strategies to ensure a safe organic food supply by developing detection methods, anticipating mycotoxin risks, tracing the sources of contaminants in the food production chain, and eliminating the risk factors. The research is done with the model carrot – Alternaria. Alternaria spp. are seedborne and this group of fungi contains known producers of harmful mycotoxins.

Establishing methods for detection of Alternaria and analysis of Alternaria mycotoxins

Suitable methods for detection of the mycotoxin-producing A. alternata and A. radicina on various types of carrot plant material were established. The methods are based on plating on blotters or selective agarmedia. HPLC-based analytical methods for simultaneous determination of the principal Alternaria mycotoxins were developed. To monitor mycotoxin accumulation in carrots, it was necessary to clean up the extracts on a polymeric based column or a C18 column for determination of tenuazonic acid, radicinin, altetroxin I, and alternarerioli methyl ether by HPLC and UV diode array detection.

Establishing the basic understanding of Alternaria mycotoxin production

Various strains of A. radicina and A. alternata from diverse sources were isolated and tested for their virulence and toxin production. In particular for A. radicina, isolates with differences in virulence were detected. With regard to toxin production, A. radicina isolates could produce high amounts (> 1000 μg/g) of radicin when cultured on carrot slices. A new compound was isolated from infected carrot tissue and identified as epi-radicinol. A. alternata isolates produced high amounts of the key mycotoxin tenuazonic acid when grown on rice. Fortunately, tenuazonic acid was hardly produced in carrot, and only lesser amounts of alternariol and alternariol methyl ether were produced. The incubation temperature affected the mycotoxin production, with much lower amounts produced at temperatures close to 1°C, the common storage condition of carrots in practice.

Monitoring mycotoxin accumulation in the production chain

Organic carrots were produced from the same seed batches contaminated with Alternaria on 3 locations in Europe. Production in The Netherlands resulted in two subsequent seasons in high contamination levels of A. radicina on the roots produced, and production in France resulted in high levels of A. alternata. A correlation between the initial seed contamination and edible root contamination was established, suggesting that disease-free starting material is important. With regard to contamination with toxins, so far only one out of 213 samples from carrot production fields was contaminated with epi-ROH. Occasionally, carrot samples showing black rot symptoms caused by A. radicina were found contaminated with epi-radicinol and, less frequently, radicin and radicinol. These 3 compounds have been tested and seem to be of a more phyto-toxic nature than harmful to humans and animals. Also in storage experiments at various temperatures, the mycotoxins which are considered to be the most risky for human health, i.e. tenuazonic acid, altetroxin-I, alternariol, and alternariol methyl ether, were not
detected in artificially inoculated carrots. This suggests that storage of carrots at low temperatures, e.g. in cooled warehouses, diminishes the risk of *Alternaria* mycotoxin production.

**Control measures**
Control measures to prevent the introduction of *Alternaria* in the carrot production chain were studied. Bioassays to test carrot accessions for differences in resistance towards *A. radicina* were developed, and will be used for selection purposes in breeding programmes. Furthermore, antagonistic microorganisms have been isolated from carrot habitats and were tested for their control efficacy. Coating or priming seed with selected *Clonostachys* isolates effectively controlled seed borne *Alternaria* spp. and improved field establishment. A plant-based compound, which inhibited the growth of *Alternaria in vitro*, improved seedling emergence in green-house tests. In seed production experiments the epidemiology of the disease was studied, and the results obtained should lead to measures enabling an *Alternaria*-free organic carrot seed production.

**Acknowledgement:** This research is financially supported by the European Commission, Quality of Life and Management of Living Resources Programme (QoL), Key Action 1 on Food, Nutrition and Health.

---

**Application of light and natural compositions in new technology of seed enhancement**

*Vladimir Vasilenko, Ph.D., Senior Scientist, CERES Environmental Solution Industries Inc., 208 Joseph Carrier, Vaudreuil, Quebec, J7V 5V5 CANADA, Tel: 450-510-5151; Fax: 450-510-5544; E-mail: v.vasilenko@perfectlynatural.ca*

High rates of germination and vigorous seedlings are priority goals for the horticulture and plant agriculture. Every non-germinated seed or poor quality seedling wastes valuable space and resources. Seed technologies continue to offer new solutions for solving the problems of establishing healthy fast growing plants. However, in most of the cases technologies for increasing seed germination rates are limited to chemical treatments only – they are not suitable for growing plants organically. Our technology uses a unique combination of seed irradiation with light and treatment with a proprietary natural composition.

A light-emitting device was specifically designed to illuminate seeds with light comprising specific wavelengths. The temperature of the seeds does not change more than 1 or 2 degree C during irradiation. Seed performance in our trials was improved by the combined treatments of seeds with light and the proprietary natural composition. These trials included, nine vegetables (Beans, Carrot, Cucumber, Lettuce, Onion, Peas, Pepper, Radish and Tomatoes), five field (Barley, Maize, Soybean, Tobacco and Wheat) and several ornamental crops (Begonia, Impatience, Petunia, Portulaca and others). The treatment increased the percent of germination of low and medium quality Cucumber, Lettuce, barley, Maize, soya and wheat seeds from 5% to 25%. Stimulation of germination (20%) and 1.5-fold increase in dry weight accumulation were observed with tobacco treated with the light. Also, the treated carrots, peppers, radish, tomatoes as well as maize, barley wheat and ornamental crops had much faster germination times and produced greater numbers of healthy plants than the untreated control. The treatments produced statistically significant improvement in germination of seeds for all these crops. For example, tomatoes, including Heinz Seed tomato hybrids had 7-14% more healthy plants than untreated (control) and greater biomass accumulation.

In 2000-2001 about 200,000 HEINZ tomato seeds (variety H9478) were treated with our lighting system and taken into space by Canadian astronaut Marc Garneau. They were then tested for germination in 3000 classrooms across Canada in the National Education Event —"**Tomatosphere: Food for Sustaining life in Space**". The treated seeds had a higher percent of germination. The reaction of researched crops to the seed treatments included:

a.) acceleration of germination and increased germination percentage;
b.) better quality of seedling;
c.) increased biomass (fresh and dry weight) of plants
d.) in some cases increased tolerance of young plants to cold and heat stresses.
Application of the proprietary composition in combination with appropriate light irradiation facilitates substantially the procedure of seed treatment. Our company designed the seed treatment units that can be easily used by seed growers. The growers, especially organic growers, can save substantial funds priming the seeds themselves instead. CERES Environmental Industries Inc. believes that this research has a potential commercial ability for organic agricultural market. Our company is looking for new opportunities to run series of trials in order to demonstrate the effectiveness of our technology on seeds of different organically grown crops. The interest of organic farmers, seed companies and research institutions will be welcomed.

**Cedomon® and Cerall® – biological seed treatments for cereals**

Per Widén & Peter Annas  
BioAgri AB, Box 914, SE 751 09 UPPSALA, Sweden.  
Phone: +46 (0)18 674 900, Fax: +46 (0)18 674 901  
E-mail: info@bioagri.se, www.bioagri.se

Since the introduction in 1997 the biological seed treatment product Cedomonâ has been used on certified seeds for sowing of approximately 1,2 million hectares. In Scandinavia Cedomonâ is mainly used on seed for conventional farming but is also allowed for organic seed. Cedomonâ has documented effects on several seed borne diseases in barley and oats such as *Pyrenophora spp*, *Fusarium spp* and *Bipolaris sorokiniana*. More than 100 field trials in spring barley under Scandinavian conditions during 1997 to 2003 showed a mean increase in yield of 3-5%. Field trials have been performed in most EU countries.

In a near future a new product, Cerallâ, suitable for wheat, rye and triticale will be launched by BioAgri. In field trials and in-door tests Cerallâ has proved to have good effect against seed borne *Tilletia caries*, *Microdochium nivale* and *Septoria nodorum*. During 2004 more than 1000 tonnes of certified wheat seed will be Cerallâ treated and sown in Scandinavia.

**The first EU approved biological seed treatment product**

The active ingredient in Cedomonâ and Cerallâ is a soil living bacterium *Pseudomonas chlororaphis* strain MA342 that occurs naturally and is free from genetic and other modifications. The bacterium’s impact on environment and health has been scientifically investigated and documented. In their extensive and independent evaluation, the EU Scientific Committee on Plants concluded that no risk to workers or consumers is expected through the use of *Pseudomonas chlororaphis*. This statement has led to the approval of *Pseudomonas chlororaphis* by the EU Commission for Annex I inclusion under the Directive 91/414/EEC concerning the placing of plant protection products on the market.

In the 1980’s strain MA342 of *Pseudomonas chlororaphis*, was first isolated in Sweden. The antagonistic properties against seed borne diseases were thoroughly investigated for several years in field trials and indoor studies by a team of researchers at the Swedish University of Agriculture, led by Professor Berndt Gerhardson. The results of these studies have been published (Hökeberg, M. 1998). Since the first isolation, the bacterium has been found in various soils in Sweden as well as other countries.  

After the seed treatment the bacteria stay in dormancy until the seeds are sown and start to germinate. The environment on the germinating seed stimulates the bacterium to multiply. The bacterium has a dual action; it controls the pathogen on the germinating seed and promotes the development of roots and shoots. When the plant has reached the 3 to 4 leaf stage, the population of the bacteria declines to normal back ground levels for soil.

Cedomonâ and Cerallâ, both liquid formulations, improve the working environment for the staff at the seed treatment plants as well as for the farmer. No volatile organic solvents are emitted and the level of air borne dust is reduced. Furthermore, all of the ingredients are easily biodegradable or approved as food additives. In most large-scale seed treatment plants, the flow of seeds is enhanced by Cedomonâ and the production
capacity is increased. Cedemonâ and Cerallâ are used in seed treatment facilities with a production capacity of up to 30 tonnes of seed per hour but could also be used in small-scale seed treaters. Cedemonâ and Cerallâ are manufactured and marketed by BioAgri AB a Swedish biotechnology company within the Lantmânnen Group. Lantmânnen is a farmers cooperative with 11 000 employees and 74 000 members. The strain MA342 of Pseudomonas chlororaphis, and the use of it, is patented in most countries of the world.

Reference

Control of seed borne diseases in organic seed propagation

Anders Borgen
Agrologica, Houvej 51, DK-9550 Mariager, Denmark, borgen@agrologica.dk, www.agrologica.dk

Keywords: Seed treatment, seed health, vegetable seed, cereals.

The key control measure of plant diseases in organic agriculture is crop rotation, mixed cropping and moderate fertilization. A wide range of plant diseases can be controlled or minimized in this way. However, at least one group of plant diseases, the seed borne diseases, cannot. The seed borne diseases are not transmitted through the soil, and crop rotation is therefore an insufficient tool. Mixed cropping is impractical in seed propagation, where seed purity according to the seed legislation is imperative. The fertilization level primarily has an impact on facultative saprophytes, and not on the specialized seed pathogens.

Seed borne diseases were the first plant pathogens to be controlled by pesticides. Heavy metals has been used as seed treatments for more than 200 years, and for almost 100 years, the seed borne diseases has been controlled exclusively and very effectively by chemical seed treatments. On this background, research in control of seed borne diseases has had practically no priority in research programs during the last century. Compared with other agricultural topics, the control of seed borne diseases in organic agricultural therefore suffers from the largest lack of knowledge, as we are 100 years behind in research.

International seed legislation does with a few exceptions not define minimum quality standards for seed infections with pathogens, as seed sold on the international market normally are treated with fungicides. Surveys show that for some crops, the nationally recommended thresholds for seed pathogens are regularly exceeded in organic seed-lots, and some years the majority of organic seed lots are discarded due to seed borne diseases in propagation systems, where seed health is assessed on a routine basis. To ensure the availability of organic seed for the organic farmers, control measures for seed borne diseases are imperative, and an international system to ensure seed health in organic seed lots should be implemented.

Methods to control seed borne diseases in organic agriculture exist. Resistant varieties exist in many cases, and could be used to a wider extent. Different heat treatment can control most seed borne diseases, and new technologies can make this opportunity practical to implement. Technology to separate seed exists, and could be used as a tool to promote the propagation of seed in mixed cropping systems to decrease plant pathogens, including seed pathogens in propagation. Heavy and large seed are generally less infected than small and light seed. The separation and removal of the latter can therefore reduce the infection level in a seed lot. Some seed amendments of natural origin can be used in organic agriculture to replace synthetic pesticides.

Ongoing projects
Agrologica is currently involved in several projects on control of seed pathogens. This includes:
1. heat treatments of cereals by drum-dryer, (Pyrenophora teres, Tilletia tritici, Ascochyta pisi, Fusarium ssp)
2. heat treatments of vegetables seed with steam and ultrasound, (Altanaria radicina, A. petroelini, Cladosporium sp, Septoria Petro, Stemphylium ssp, Phoma lingam, Botrytis ssp, Xanthomonas compestris)
3. seed dressings, including plant extracts, smoke, natural chemicals and biological control, physical cleaning of seeds to remove pathogens and infected seeds from seed lots (Ustilago nuda, Pyrenophora graminea, P. teres, T. tritici, Fusarium ssp).
4. integrated control of common bunt (T. tritici) in spelta-wheat (Triticum spelta),
5. preventive cropping methods to reduce build-up of pathogenic fungi during propagation (mixed cropping, early harvest),
6. determining threshold values for organic cereals related to the susceptibility of the individual varieties (P. graminea, P. teres, T. tritici, Ascochyta ssp, Fusarium ssp).

Conclusions and recommendations
Research during the last two decades has shown that progress can be achieved and that solutions exist. Based on this, it can be concluded that seed borne diseases can be controlled in organic agriculture. However, extension and research to refine methods are urgently needed to do so.

---

Non-chemical seed treatment in sugar beets for the control of soil borne fungi and improvement of field emergence

Ralf Tilcher
KWS SAAT AG, Grimsehlstraße 31, 37574 Einbeck, Germany
Email: r.tilcher@kws.de

Abstract
Next to occurrence of weed soil borne fungi, which occur during germination and emergence of sugar beet seed are the most important problem for organic sugar beet. To control fungal pathogens (damping-off-complex) experiments under conventional and organic conditions were performed by treating seed with microbial antagonists and organic compounds. Application of these substances might lead to higher emergence levels, improvement of plant development and higher sugar yield compared with a non-treated control.

Keywords: sugar beet, soil borne fungi, microbial antagonists, field emergence

Introduction
In conventional farming systems phytopathological problems, which might occur during germination and emergence of sugar beet seed, are controlled by seed treatments with fungicides (mainly Thiram, Hymexazol) and insecticides (mainly Imidacloprid, Tefluthrin). In the last years experiments were performed both by KWS and in the framework of external projects (e.g. IMPROBIOSEED promoted by the EU) in order to investigate the abilities of microbial antagonists and organic compounds to control damping-off diseases (mainly Pythium ultimum, Aphanomyces cochlloides, Rhizoctonia solani, Phoma betae) and to improve early and final emergence. This is the base for an acceptable stand and yield in organic sugar beet growing.

Material and methods
Strains of Bacillus subtilis, Pseudomonas fluorescens and antagonist fungi provided by different commercial and scientific partners represented the main beneficial microorganisms used in the experiments. Antagonistic organisms were mixed into the seed pellet or into a layer surrounding the pill. Pelleting material was examined for the impact on adhesion and survival of antagonistic bacteria. Additionally pills applied with antagonists were investigated for effects on physical (e.g. hardness, roundness) and biological (e.g. germinability, vigour) characteristics of the pill.

Results
Physical properties of the sugar beet pill were not negatively influenced by integration of antagonists. Field results of different years and locations demonstrated that antagonists bear the potential to accelerate early emergence in the field. Final emergence was increased by application of antagonistic microorganisms, but was generally lower compared with seeds applied with standard synthetic pesticides. A field trial under organic farming conditions (table 1) indicated that seeds applied with antagonists and organic compounds caused higher emergence rates and yield results compared with an untreated check.
Table 1: Field trial 2003 – emergence (ff = final field emergence) and yield of sugar beet seed, pelleted with different microbial antagonists and an organic additive (Chitoplant) respectively.

<table>
<thead>
<tr>
<th>variant</th>
<th>ff emergence (%)</th>
<th>% of check</th>
</tr>
</thead>
<tbody>
<tr>
<td>F54</td>
<td>72,6</td>
<td>a</td>
</tr>
<tr>
<td>PV</td>
<td>72,3</td>
<td>a</td>
</tr>
<tr>
<td>Chitoplant</td>
<td>70,3</td>
<td>ab</td>
</tr>
<tr>
<td>EB4</td>
<td>70,2</td>
<td>ab</td>
</tr>
<tr>
<td>RK13</td>
<td>68,8</td>
<td>ab</td>
</tr>
<tr>
<td>FZB24</td>
<td>68,5</td>
<td>ab</td>
</tr>
<tr>
<td>TUSAL®</td>
<td>67,3</td>
<td>ab</td>
</tr>
<tr>
<td>F30B</td>
<td>65,1</td>
<td>ab</td>
</tr>
<tr>
<td>-</td>
<td>61,0</td>
<td>b</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>variant</th>
<th>sugar yield (dt/ha)</th>
<th>% of check</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUSAL®</td>
<td>109,3</td>
<td>a</td>
</tr>
<tr>
<td>F30B</td>
<td>108,1</td>
<td>a</td>
</tr>
<tr>
<td>FZB24</td>
<td>106,7</td>
<td>a</td>
</tr>
<tr>
<td>Chitoplant</td>
<td>106,7</td>
<td>a</td>
</tr>
<tr>
<td>PV</td>
<td>106,4</td>
<td>a</td>
</tr>
<tr>
<td>RK13</td>
<td>106,0</td>
<td>a</td>
</tr>
<tr>
<td>F54</td>
<td>104,5</td>
<td>a</td>
</tr>
<tr>
<td>-</td>
<td>100,8</td>
<td>a</td>
</tr>
<tr>
<td>EB4</td>
<td>100,0</td>
<td>a</td>
</tr>
</tbody>
</table>

Conclusion

Application of antagonists without fungicidal supplementation results in non maximal final emergence values compared with conventionally pesticide treated seeds. Nevertheless, in terms of ecological farming application of microbial antagonists has the potential to be a reliable component of plant protection and growth promotion, which might lead to higher sugar yield. Results from several years indicate, that efficacy persistence might cause problems.

Organic seed production and development at Rijk Zwaan

Ronald Driessen
Rijk Zwaan Zaadteelt & Zaadhandel B.V. Department of Seed Technology
P.O. Box 40 2678 ZG De Lier, The Netherlands
Email: r.driessen@rijkzwaan.nl

Rijk Zwaan Seed Company was one of the first Dutch seed companies, which recognised the demand for organic seeds for the organic vegetable production on a professional basis. Regular varieties have been tested under organic circumstances and the best were selected for this market. Hereafter organic seed production was focussed on these varieties.

Organic seed production encounters various problems of which weeds and the transmission of seed-borne pathogens are the most serious ones. Contrary to conventional seed production, reduction of these problems by input of chemicals in certain stages of plant development is not possible.

In the organic seed production of glasshouse crops like sweet pepper, cucumber and tomato, knowledge from organic and integrated production methods can be used rather easily, because seed production is almost the same as crop production. In annual seed crops like lettuce and endive, we obtained already good results after a few years of experiences.

However in biennial crops like carrot, cauliflower and leek almost no information or experience was available, which could be used to develop the organic seed productions.

The management of controlling the transmission of pathogens is most complex in biennial crops, because two growing seasons are required to produce sowing seed from basic seed. Weeds are in biennial seed crops difficult to control and control demands a lot of labour, which makes seed production expensive. Other problems are the availability of nitrogen at the moment of regrowth after vernalisation in winter, specific pests during bolting, flowering and seed maturation and infestation by fungi.

Besides commercial seed productions, Rijk Zwaan started also experimental seed productions in biennial crops, to get more knowledge and experience with organic seed production. In experiments, which were carried out in co-operation with other companies, institutes and universities, we got more knowledge about suppression of weeds, the effect of Plant Growth Promoting Agents, transmission of diseases and effects of harvest time, to improve the seed quality of organic seed productions. Some of them will be presented.
Research programs from the Dutch Ministry of Agriculture and The European Union granted a lot of this work. Rijk Zwaan participated in the European Commission sponsored project “Save Organic Vegetables” (QLK 1999-00986), which focussed on the Alternaria complex in carrots. Part of this work deals with improvement of the production of seeds under organic culture conditions. Other parts of research activities were carried out under the DWK 388 program of the Ministry of Agriculture in the Netherlands.

Besides our interest in the organic market and organic seed production, we also gather a lot of knowledge from these projects, which can be applied in conventional seed production and leads to further reductions in the use and dependency on fertilisers and pesticides.

Rijk Zwaan will continue to improve and develop the organic seed productions of vegetable crops in order to supply the organic market with high quality seeds for optimal harvests.

---

**The first steps in variety testing for organic agriculture in Latvia: oats and potatoes**

Zinta Gaile, Mara Bleidere, Ilze Skrabule, Janis Vigovskis
RSF “Vecauce” of LUA, Akademijas street 11.a, Auce, Latvia, LV-3708
Email: zinta@apollo.lv

Since 1989 organic agriculture was known in Latvia as if de novo. During last two years (2001, 2002) number of farms certified as organic has grown comparatively at a dash. 352 farms were certified at the end of 2002 as organic at different level (1st transitional year, 2nd transitional year, organic), and they occupied 0.7 % from the agricultural land in Latvia. Further increase could be predictable (Programme for development..., 2003). Up to now organic farmers have used home saved seed or conventional untreated seed of field crops. Not always this seed was grown under the ‘Seed Law’ of Latvia, and quality of the seed was different. But everybody knows that the good seed is the base of good yield (Borgen, 2002, Semaskiene, 2002). From January 1, 2006, Latvian organic farmers will have to use organically produced seed. Getting ready for this, working group for the developing the organic seed growing system was established in 2002. Some first activities of this working group were the field crop variety testing organization under organic condition. These are not Official State trials for the present, but field crop varieties testing trials in four scientific institutions in the fields certified as the 2nd year transitional to organic conditions. Oat’s varieties testing was organised in Research and Study farm “Vecauce” of Latvia University of Agriculture, in the State Stende Plant Breeding Station and in Research Centre Skriveri of Latvia University of Agriculture, but potatoes varieties testing in RSF “Vecauce”, in the State Priekuli Plant Breeding Station and in the Research Centre Skriveri in 2003.

**Oat testing**

Four locally bred oat varieties were selected for testing: ‘Laima’ (standard), ‘Mara’, ‘Arta’, ‘Liva’. All of them are included in the Catalogue of Plant Varieties of Latvia, but no one was evaluated in organic conditions before. It was predicted by breeders that oat varieties mentioned before could be suitable for organic conditions. In organic research fields comparatively high yield was obtained in 2003. In average the best yielding in organic conditions was standard variety ‘Laima’ – 4.64 t ha⁻¹ (4.04 – 5.25 t ha⁻¹), but although varieties ‘Mara’ and ‘Liva’ were less little yielding if compared with ‘Laima’ differences were not proven statistically. Variety ‘Arta’ was the less yielding variety, but with the least husk content. Yield was affected substantially by used variety (<0.01) and by the trial site (<0.01), but effect of interaction variety x site was not substantial (p>0.05). Some other qualitative and quantitative traits of varieties were evaluated, too. Significant disease damage was not observed. Conclusion was done after the first testing year, that oat is very suitable crop for organic agriculture. For getting high grain yield more suitable were ‘Laima’ and ‘Mara’, for green crop – ‘Liva’, but if one need variety for food processing – ‘Arta’ although is less yielding, but with the least husk content and the highest crude protein and crude fat content.

**Potatoes testing**

Six potatoes varieties from two maturity groups were selected for testing. Five of them are bred in Latvia - ‘Lenora’ (medium early- ME), ‘Brasla’ (medium late – ML – standard for the group), ‘Zile’ (ML), ‘Bete’ (ML), ‘Magdalena (ML), and well known variety ‘Sante’ (ME, standard for the group) from the Netherlands. The
average yield of ML varieties (27.09 t ha⁻¹) was higher if compared with the average yield of ME varieties (24.02 t ha⁻¹). But ML varieties are more endangered by potato late blight. Late blight resistance is very important for varieties grown organically, but unfortunately it was not possible to evaluate this trait completely in all the trial sites due to meteorological conditions in 2003. Potatoes yield in 2003 was affected substantially by used variety (p<0.01), trial site (p<0.01) and interaction variety x site (p<0.01). Some other qualitative and quantitative traits of varieties were evaluated, too. Conclusion was done that potatoes could be suitable for organic growing. Problems could arise due to used field – great damage by worms of *Elaterea* ssp. if pre – crop is perennial grass, and due to diseases (potatoes late blight, virus diseases etc.), particularly if grown for seed.

**References**


---

**Perspectives of organic seed production in Azerbaijan**

Professor Amin Hajibaba oglu Babayev  
Post-graduate student Vugar Vahid oglu Bashirov  
E-mail: g_gaba@azeurotel.com

Seed-growing enterprises (entrepreneurs engaged in seed production and trade) like every sphere of industry and agriculture, has also been building their new development since the Azerbaijan Republic is managed by the laws of market economy. Because of Azerbaijan is mainly an agrarian country the main profit source of national economy is agriculture. And the basic condition for increasing this profit is undoubtedly creation of seed fund of agricultural crops.

There are enough opportunities for producing organic seeds within the seed systems in Azerbaijan. Thus, lately the demand for organic seeds also increases because the number of farmers engaged in organic farming increases day by day. For example, Ganja Agribusiness Association (GABA) - the propagandist of organic farming in Azerbaijan - had 80 organic farmer members out of 300 three years ago, but at present the number of organic farmer members has already been 200. Besides, the natural soil-climate condition and economical situation in Azerbaijan creates condition for organic farming once more. I.e. 60% of the areas of Azerbaijan are mountainous and we can say that not all agricultural works were intensified there and those farms are prone to engaging in organic agriculture. Furthermore, their economic resources are limited for applying agrochemicals and chemicals are also deficit. That’s why, under the compulsion they organize their farms using the natural methods although sometimes blindly. Organic seed production also is more profitable compared to conventional seed-growing. I.e. money isn’t spent for chemicals, organic methods are cheaper but the price of organic seeds is more expensive.

There are enough phytoresources in our country for protecting crops from diseases and pests. Farmers already treat their crops using the extracts from different plants (absinth, mustard, garlic, tobacco, camomile, celandine, yarrow, rue) and apply prophylactic measures using organic and agrotechnical methods.

It’s known that organic seed must be of high quality – thus, because of not applying other artificial means in organic seed production the seeds must be clearer, more vigorous and with better tolerance to unfavourable conditions of nature. For this purpose in the frame of the project jointly implemented by International Wheat and Maize Improvement Center (CIMMYT) and Ganja Agribusiness Association (GABA) for increasing grain yield through growing wheat varieties tolerant to salinity and drought, introducing the cereal crops with better salinity tolerance (such as barley, triticale, durum wheat), using quality seed material and advanced agriculture experience the seed-growing demonstration fields in 2 districts were created in irrigated saline soils of Azerbaijan. In 2 hectares of land plot in each demonstration field the super-elite seeds (5 soft wheat,
2 durum wheat, 2 triticale, 1 barley and 2 maize varieties) were sown. Besides, alfalfa was sown in 2 hectares. Rotation of cereals with alfalfa manures soil by natural method, reduces weeds, diseases and pests. In the same demonstration fields after testing of 12 cereal varieties the seed fund of saline and drought-tolerant, efficient varieties will be created in each district. Ganja Agribusiness Association using those demonstration fields shares its experience in seed-growing and especially in organic seed production among the farmers. Certification is the most important problem from the factors preventing the development of organic seed production in Azerbaijan. It’s explained by that there is a problem in differentiation of conventional and organic products during the realization of seed product in domestic or foreign market. This problem has a little influence to the farmers who are GABA's members. Thus, GABA’s organic farmer members who engaged in seed production (wheat, maize, potato, onion, cabbage, etc.) during realization their seed products in domestic market try to prove that these seeds are organic by presenting GABA's (the only Azerbaijani member of IFOAM) recommendation. GABA also periodically controls that they really use organic methods in their farms. But in general level, certification of products has a great importance for achieving access to international market and as well as strengthening of organic products in domestic market.

Based on all above-mentioned we can say that organic seed production is prospective and profitable sphere to satisfy the seed requirements of organic farms raising and having more perspectives gradually.

---

**Effects of plant extracts on seed-borne pathogens**

*Katharina Kuhn*, Karin Förster** and Wulf Diepenbrock**

*BioService GmbH Halle, Weinbergweg 22, 06120 Halle (S), Germany

kuhn@landw.uni-halle.de

**Institute of Agronomy and Crop Science, Martin-Luther-University Halle-Wittenberg, L.-Wucherer-
Str. 2, D-06108 Halle (S), Germany

Introduction

In Germany, there are no registered crop protectants for organic seed treatment available yet. An effective plant strengthening agent exists against common bunt of wheat (Jahn 2002). Due to rising importance of organic farming and the concomitant increase of acreage, novel seed protection strategies have to be developed. Plant extracts with antifungal properties are a constructive complementation to physical methods of seed-treatment in organic farming.

The main goal of this study is the screening of plant extracts and their antifungal impact on *Fusarium culmorum* (W.G Smith) Sacc. and *Microdochium nivale* (Fries). Therefore the in vitro activity of these fungi in the presence or absence of plant extracts was investigated.

Materials and Methods

Plant extracts were generated from different species and plant organs by various procedures.

Antifungal activity of plant extracts was tested using the potato dextrose agar (PDA) plate test. Plant extracts were diluted with de-ionized water to 100, 50 and 10% of the initial concentration before mixing with PDA. Plates were inoculated with 10:1 macroconidia suspension. Diameter of formed mycelium was measured in a 24-hours-rhythm up to eight days after incubation at 20±0 °C in the dark (control: PDA). Tests were carried out with three replications.

Results and Discussion

The antifungal activity of 44 plant extracts from different species was investigated. Both fungi revealed very similar responses on plant extract treatments. The reactions enclosed complete and partial growth inhibition as well as growth retardation.

Eight plant extracts induced complete growth inhibition and three others showed potential growth control of investigated fungi.

Further tests to evaluate potential antifungal extracts against other seed-borne fungi and their feasibility of seed treatment will be done.


---

Challenges and Opportunities for Organic Agriculture and the Seed Industry
Commercial organic pelleting and priming treatments for sugar beet seed

Halmer, Peter1, Groot, Steven P.C2, Birnbaum, Yvonne2, Groeneveld, Roel2 and van Swaay, Noud3
1Germain’s Technology Group, Hansa Road, King’s Lynn, PE30 4LG, UK. phalmer@germains.com
2Plant Research International, Wageningen University and Research Centre,
PO Box 16 NL-6700 AA Wageningen, Netherlands
3Instituut voor Rationele Suikerproductie, P.O. Box 32, 4600 AA Bergen op Zoom, Netherlands.

We report the development of two certified organic sugar beet seed treatments: (a) a sugar beet pellet (Beta vulgaris, pelleted with ProBio®) and (b) an organic version of the Advantage® primed seed treatment that is currently used by about 70% of sugar beet growers in the UK, and many growers in the USA (Anon., 2004). Priming was evaluated in combination with the pellet, in separate studies in the UK and the Netherlands.

The proprietary commercial priming treatment used water steeping to remove germination inhibitors and contaminants, followed by incubation at controlled moisture content, temperature and oxygenation for two to three days (Thomas et al., 1993). It is now well established, through extensive trials conducted in many European countries over more than a decade, that priming gives faster and more even emergence in the non-organic sugar beet crop. The speeding response is greatest in the poorer growing conditions found in sowings earlier in the spring. Priming has also leads to mean yield improvements of about 1% to 2% in replicated trials at normal drilling dates; however, yield responses are often greater than this in grower strip-trials. It is considered that priming might be of additional value under organic farming conditions. For example, priming may increase the competitive ability of the crop with weed seedlings, and allow an earlier start to mechanical weed control. Also, because the mineralisation of organic fertilisers is relatively slow, especially at low soil temperatures, the earlier growing rooting system may enable the seedling to retrieve nutrients sooner.

UK study
This study, sponsored by the British Beet Research Organisation, comprised nine experiments over three years (2000-2002), using two varieties sown in mid-April to early-May at two seed spacings on a range of soil types. Priming increased mean plant establishment by 2.6% and sugar yield by 2.9% (and the overall mean white sugar yield was 7.7 t ha⁻¹). The establishment and yield responses were each significant at one site, but not significantly overall across all nine sites taken together. It was also concluded that seed spacing for organic sugar beet need be no closer than in conventional crops, except on soils prone to slug activity. (Cormack et al., 2004)

Netherlands study
In this study of two varieties, in both cases the primed pelleted treatments germinated faster in laboratory germination tests (tₐ2, reduced by about 2 and 3 days at 20°C), and emerged about 2 days faster in a field trial. The responses to the priming treatment also included: earlier ground cover, greater light interception by the crop, and a 3% mean increase in yield (the overall mean white sugar yield was 10 t ha⁻¹). In one of the varieties, where 7% of the untreated seed was contaminated with Phoma betae, this pathogen was not detectable on seed after priming and pelleting.

Though not significant at individual sites, these yield improvements in response to priming are comparable to those seen in conventionally-grown sugar beet crops.

Keywords: Sugar beet, Priming, Pelleting, Yield increase, Phoma betae

References

ProBio® and Advantage® are registered trademarks of the Germain’s Technology Group.
Control of seed-borne pathogens on vegetables by physical seed treatment methods

*Marga Jahn, Carola Kromphardt, Gustav Forsberg, Sigrid Werner,
Mariann Wikström, Steven P. C. Groot, and Nicholas K. Rop
Federal Biological Research Centre for Agriculture and Forestry, Institute for Integrated Plant Protection, Stahnsdorfer Damm 81, D-14532 Kleinmachnow, Germany
Email: M.Jahn@bba.de

In March 2003, the EU-project “Seed Treatments for Organic Vegetable Production” (QLK5-2002-02239; STOVE) was initiated. The aim of the project is to evaluate and optimise existing, as well as to develop new, non-chemical methods for control of seed-borne pathogens in organic vegetable crops (see also article in these proceedings entitled “Control of seed-borne pathogens on vegetables by microbial and other alternative seed treatments”, Schmitt et al.).

Three physical methods – hot water, hot air and electron treatment – are investigated to be performed in the project.

The method of hot water seed treatment has been known for more than 100 years. However, in the second half of the 20th century it has only been applied on a very limited scale. Growers willing to use this method are faced with the fact that commercial equipment is not available and that up-to-date operation procedures for safe and effective use are not published or not known. A hot air seed treatment method has been established for the treatment of cereal seeds. However, although preliminary results indicate that this method can also be used on seeds other than cereals, it has not been adapted to vegetables. The situation is similar with electron seed treatment that uses low energy electrons to eradicate pathogens from seeds. Electron seed treatment has been used on cereals and on a limited number of vegetables, but more development work is needed to establish its use in vegetables.

A problem with all physical seed treatment methods is their inherent potential to damage the seed if they are applied at high dose. It is known that differences in sensitivity exist not only among species but also among different seed lots. Knowledge on the physiological factors determining these differences in sensitivity is lacking. It is obvious that the use of the physical methods would be safer and more acceptable if determinants for seed sensitivity were known.

The project will address all these points. The expected achievements are knowledge about the safe and effective use of hot water, hot air and electron seed treatment in a number of vegetable pathosystems (e.g. carrot/Alternaria radicina, A. dauci, parsley/Septoria petroselini, brassicas/Phoma lingam, Xanthomonas campestris, lamb’s lettuce/Phoma valerianellae, basil/Fusarium spp., bean/Colletotrichum lindemuthianum) as well as knowledge about the physiological factors determining the sensitivity of vegetable seeds to the physical seed treatment methods.

In a first step of investigations, optimisation and/or adaptation of treatment parameters have been done. Trials carried out with healthy seed confirmed the usability of all the methods. The hypothesis that seed maturity is one of the factors influencing the sensitivity of the seeds was confirmed so far for brassicas and carrot. With increased duration of the treatment, germinability of the seeds declined, and less mature seeds were more sensitive.

Generally, positive results concerning phytosanitary effects were proven on infested crops. On highly infested carrot seed (A. dauci about 70 %, and A. radicina 30 % - 40 %), on bean (about 25 % C. lindemuthianum) and on parsley (about 30 % S. petroselini) a significant reduction of pathogens with all three treatment methods was obtained. As already observed on cereals, the phytosanitary effect of the treatments differed depending on the host-pathogen-system. For all three methods on all host-pathogen-systems the process of further optimisation of treatment parameters is in advance. Furthermore, field trials are currently starting selected optimised treatment parameters.
Genotype and environment interaction on seed health and seed germination of organically grown winter wheat - Triticum aestivum L. genotypes

Ichinkhorloo Dashbaljir1, P. Liebhard1, W. Hartl, F. Löschengerber, H.-P. Kaul1

1 DAPP, University of Natural Resources and Applied Life Sciences, Gregor Mendel Street-33, 1180 Vienna
2 Ludwig Boltzman Institute, Rinnbäckstrasse 15, A-1110 Wien, Austria
3 Seed Breeding Donau, Saatzuchtstrasse-11, A-2301 Probstdorf, Austria

Introduction
In organic agriculture seed quality is relatively more important than in conventional agriculture. It is an ambiguous term, covering a wide range of different aspects of seeds. Germination rate and seed health are main aspects of seed quality. We investigated the effects of genotype and environment on seed quality of eight winter wheat (Triticum aestivum L.) genotypes under organic conditions.

Material and methods
The genotypes were grown over two vegetation periods (2001/02, hereafter termed 2002; and 2002/03, hereafter termed 2003) on two different sites which differ significantly with regard to climatic conditions (Table 1).

Table 1: The study sites’ environmental conditions

<table>
<thead>
<tr>
<th>Study sites</th>
<th>Elevation, m</th>
<th>Location</th>
<th>Soil type</th>
<th>Annual mean rainfall, mm</th>
<th>Annual mean temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innviertel</td>
<td>350</td>
<td>Upper Austria</td>
<td>Eutric cambisol</td>
<td>831</td>
<td>8.5</td>
</tr>
<tr>
<td>Marchfeld</td>
<td>150</td>
<td>Lower Austria</td>
<td>Chernozem</td>
<td>500</td>
<td>9.2</td>
</tr>
</tbody>
</table>

The germination tests were done according to ISTA standard procedure (1999) by filter paper method. Microdochium nivale was studied by Agar method (AGES 1999), Septoria nodorum by fluorescence method (ISTA 1999).

Results

Table 2: Seed germination and seed health mean values for four environments

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Germination at 10°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>97</td>
<td>85</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Germination at 20°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>96</td>
<td>88</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Septoria nodorum</td>
<td>10</td>
<td>1</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Fusarium nivale</td>
<td>32</td>
<td>1</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

The highest germination values were determined at the site Marchfeld in year 2002, the lowest germination values were observed at the site Innviertel in both study years (Table 2). The Septoria nodorum and Fusarium nivale infection rates were highest at the site Innviertel in both study years. Germination at 10°C was significantly correlated with germination at 20°C (r=0.46***), with Septoria nodorum (r=0.53***) and Fusarium nivale (r=-0.92***) infection. The germination results at 20°C were not significantly correlated with both disease rates. The ANOVA showed that there was a significant effect of year on germination values, also genotype-by-year, site-by-year and genotype-by-site-year interactions were significant (Table 3). An effect of study site was proven for germination at 10°C only.

Table 3: ANOVA results for the laboratory germination tests and seed health test

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Germination test at 10°C</th>
<th>Germination test at 20°C</th>
<th>Septoria nodorum</th>
<th>Fusarium nivale</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEN</td>
<td>7</td>
<td>0.095</td>
<td>0.6391</td>
<td>&lt;0.0001***</td>
<td>0.9973</td>
</tr>
<tr>
<td>YEAR</td>
<td>1</td>
<td>&lt;0.0001***</td>
<td>0.0161*</td>
<td>0.0018***</td>
<td>&lt;0.0001***</td>
</tr>
<tr>
<td>SITE</td>
<td>1</td>
<td>&lt;0.0001***</td>
<td>0.0549</td>
<td>&lt;0.0001***</td>
<td>&lt;0.0001***</td>
</tr>
<tr>
<td>GEN*YEAR</td>
<td>7</td>
<td>&lt;0.0001***</td>
<td>0.0015*</td>
<td>0.0308*</td>
<td>0.0012*</td>
</tr>
<tr>
<td>GEN*SITE</td>
<td>7</td>
<td>0.1295</td>
<td>0.1455</td>
<td>&lt;0.0001***</td>
<td>0.0029*</td>
</tr>
<tr>
<td>SITE*YEAR</td>
<td>1</td>
<td>&lt;0.0001***</td>
<td>&lt;0.0001***</td>
<td>0.022*</td>
<td>&lt;0.0001***</td>
</tr>
<tr>
<td>GEN<em>SITE</em>YEAR</td>
<td>7</td>
<td>&lt;0.0001***</td>
<td>&lt;0.0001***</td>
<td>0.0238*</td>
<td>&lt;0.0001***</td>
</tr>
</tbody>
</table>

Genotype had a significant effect only on Septoria nodorum infection, but the year and site effects as well as all interactions affected both seed borne diseases.

Conclusions (1) environmental effects in Innviertel were unstable with regard to germination, especially at 10°C, while in Marchfeld grown genotypes revealed high germination capacity in both years; (2) only the cold test at 10°C allows for a clear differentiation in seed quality; (3) the seed harvested in Marchfeld was latively healthy compared to that from Innviertel; (4) for obtaining healthy seed a production site with favourable climate conditions should be chosen.
The impact of different ways of nutrition on the grass seed yield in organic agriculture

Radek Macháè, Bohumír Cagaš
OSEVA PRO Ltd., Grassland Research Station at Zubri, Hamerská 698, CZ-756 54 Zubri, Czech Republic
Email: machac@quick.cz

Abstract
The yields of seed of perennial ryegrass and timothy grown together with companion legumes were compared in a 3-years field trial. The trial consisted of one of the two grass species (factor 1); one of the leguminous companion crops diploid red clover, white clover or black medic (factor 2); N-nutrition (factor 3) was supplied either by bacterial nodules of the legumes, or the organic matter from harvested legumes, or by organic manuring with slurry. The seed yields from all combinations of the factors were compared with that from conventional grass seed growing.

The seed yield in perennial ryegrass (in three harvest years) ranged from 82 to 718 kg.ha⁻¹; the combination with black medic gave the best results. The seed yield in timothy (in 2nd and 3rd harvest year) ranged from 157.8 to 863.3 kg.ha⁻¹; the combination with black medic gave 676.3 kg.ha⁻¹. The field trial demonstrated that some grasses grown together with certain companion legumes (black medic and red clover) and with organic manuring are able to give adequate seed yield, comparable to the conventional production system.

Keywords
perennial ryegrass, timothy, organic seed production

Introduction
The acreage of organic grass swards in the Czech Republic has increased in the last few years. The demand to establish such grasslands by using only seed grown under organic conditions led to Project No. QD0004 „Grass seed production in ecological agriculture“. One of the crucial problems of that project is the supply with nitrogen, which is important for the formation of fertile tillers of grasses.

Materials and methods
Seed yields of perennial ryegrass ( Lolium perenne L.) and timothy ( Phleum pratense L.) grown together with companion legumes were compared in a 3-years field trial. A polyfactorial trial was established in April (timothy) and August (ryegrass) 2000 at the Grassland Research Station at Zubri. Timothy was undersown into spring wheat as cover crop, but perennial ryegrass was sown by pure sowing. The trial consisted of one of the two grass species (factor 1); one of the leguminous companion crops diploid red clover (Trifolium pratense L.), white clover (T. repens L.) and black medic (Medicago lupulina L.) (factor 2); N-nutrition (factor 3) was supplied by either bacterial nodules of the legumes, or the organic matter from harvested legumes or by organic manuring with slurry. The seed yield from all combinations of the factors was compared with that from conventional grass seed growing.

Results
The seed yield in perennial ryegrass (in three harvest years) ranged from 82 to 718 kg.ha⁻¹. The combination of perennial ryegrass with black medic gave the best results, 544.1 kg.ha⁻¹ (average of all types of treatment) in the first harvest year, 456 kg.ha⁻¹ in the second harvest year and 238.7 kg.ha⁻¹ in the third harvest year. Compared with the “classical type” of seed production the yield in the 1st year was 8 % higher, in the 2nd year 32 % lower, and in the 3rd year it was 40 % lower. The seed yield in timothy (in the 2nd and 3rd harvest year) ranged from 157.8 to 863.3 kg.ha⁻¹. Timothy with black medic gave 676.3 kg.ha⁻¹ (15 % lower than in conventional growing) in the second harvest year (seed of legumes was harvested in the first year) and 255.1 kg.ha⁻¹ (29 % higher than in conventional growing) in the third year. However, the highest seed yield (299.3 kg.ha⁻¹) in the third harvest year was achieved by the combination of timothy and red clover. – In all combinations of grass/legume, supply of N by organic manuring had the best impact on seed production, followed by bacterial nodules, while the effect of mulching was very poor.

Conclusion
The 3-years field trial showed that some grasses grown for seed together with certain companion legumes (black medic and red clover) and in combination with organic manuring are able to give an adequate seed yield, comparable to the conventional production system.

Acknowledgements
Supported by the Ministry of Agriculture of the Czech Republic, Project No. QD 0004.
Organic clover seed production: Does intercropping with plant species with at strong scent distract the clover seed weevil and increase seed yield?

Lars Monrad Hansen1 & Birte Boelt2
1Danish Institute of Agricultural Sciences, Department of Plant Protection, Research Centre Flakkebjerg, DK-4200 Slagelse
E.mail: Lars.M.Hansen@agrsci.dk
2Danish Institute of Agricultural Sciences, Department of Plant Biology Research Centre Flakkebjerg, DK-4200 Slagelse
E.mail: Birte.Boelt@agrsci

Abstract
A field experiment was conducted in 1999-2001 in order to test if intercropping with other plant species with at strong scent would be able to distract clover seed weevils away from the clover seed field. Intercropping with chives, caraway, oregano or thyme did not have any effect on the number of clover seed weevils registered and white clover seed yield was not affected by any of the treatments. It is concluded, that a well-established white clover seed crop is very competitive against other plant species.

Keywords: Seed yield, clover seed weevils, intercropping.

Introduction
In conventional clover seed production pest control is included in the standard management practice. Since chemical insecticides became available, investigations of the biology and the presence of pests in Danish clover seed fields have been limited. When organic clover seed production was initiated, yields of only 25% of the average yield in conventional fields were registered, and weevils of the genera Apion and Hypera have been identified as a major yield-reducing factor in organic white clover seed fields (Langer, pers. comm.). Apion damage may account for approximately 30 per cent of yield loss varying from 5 – 65 per cent (Rohde et al., 2000).

The weevils over winter in field boundaries, edges of the wood and other uncropped areas, and when spring temperature is approximately 20°C they disperse over large distances in order to find clover plants where eggs are laid in the flower buds. It’s is believed that the weevils navigate visually and olfactory, therefore, an experiment was initiated to test if intercropping with other plant species with at strong scent would be able to distract the weevils away from the clover seed field.

Methods
Field experiments were established in the organic crop rotation at Research Centre Flakkebjerg, the Danish Institute of Agricultural Sciences in 1999, 2000 and 2001 in white clover (Trifolium repens L.) cv. Sonja and in 1999 in red clover (Trifolium pratense L.) cv. Rajah. The white clover was established at 24 cm row spacing, under sown in a spring barley cover crop. Seed of chives, caraway, oregano or thyme where sown separately in between rows of white clover. The red clover was also established at 24 cm row spacing, under sown in a spring barley cover crop, however, other plant species were established in the seed production year i.e. the year after establishment.

In the seed production year red clover was defoliated medio May and other species were established in between the clover rows. White clover was defoliated when the first flower buds appeared (late May or early June).

The presence of clover seed weevils and seed yield was recorded.

Results and discussion
The white clover seed field was established successfully in all three years; however, the clover was very aggressive against the chives, caraway, oregano or thyme, which is illustrated by a low and varying plant density in these species. Establishment of other plant species in red clover in spring in the seed production year was not successful due to excessive regrowth in the red clover, and the experiment was cancelled after the second year of establishment.

In 2001 the number of clover seed weevils in white clover was in average 10 weevils flowerhead⁻¹. Seed yield was 156 kg ha⁻¹ in average of the three seed harvest years 2000-2002, however, seed yield was significantly higher in 2000. There was no effect on the number of clover seed weevils and on white clover seed yield of intercropping with chives, caraway, oregano or thyme.

References
Organic agriculture in East Europe, Caucasus, and Central Asia (EECCA)

Dr. Nune Darbinyan
ECOGLOBE- Organic Control and Certification Body
Heratsi 18/3, 375025 Yerevan, Republic of Armenia
Email: nuneemil@yahoo.com

Abstract
The organic agriculture is a new movement in East Europe, Caucasus, and Central Asia (EECCA) countries. It has different trends from country to country. But the similarity is that the in new socio-economic conditions, on the way of finding new market and new demand, the organic agriculture movements started to become active. Armenia is one of the countries, which can be seen as a model country.

Key words: Organic agriculture-organic certification-Ecoglobe- production-environmental movement

Armenia has a long tradition of agriculture, with records dating back to eight or ninth centuries BC. It is characterized by a rich diversity of crops, which is conditioned by the climate and terrain. Armenia is furthermore considered as the primary gene centre for a number of cultivated crops, including grape and apricots. Cattle breeding also goes back a long way. Agricultural land covers 46.8 per cent of the total area of the country. Armenia’s agriculture is traditionally highly specialized. Today the focus is on wheat and barley, cattle and sheep breeding, wine grapes, apricots, peaches, other fruits and walnuts. Potatoes and tobacco are also important. Conditions in Armenia are also favorable for the production of technical plants rich in ether oils (geranium, rose, and peppermint, and speciality teas). Armenia’s fruits are considered of superior quality, and its vineyards are famous for their vine, cognac and other liqueurs. The privatization of land started in 1991 and had been privatized to the rural population by late 1993. About 320 000 individual farms were created, producing 95 per cent of agricultural output. The farms hold an average of 1.2 ha.

During the last 5 years in Armenia was done significant progress towards establishment of organic sector. Both the production and the organic certification and control systems were developed. More stakeholders became involved and formed organic forums and groups, which was resulted in the establishment of Armenian Organic Agriculture Foundation. The certification activities are undertaken by the ECOGLOBE Organic Control and Certification Body in Armenia, which is the First Organic Certification Body in Armenia established in December 2002. It offers the organic Control and Certification services to its Clients, based on international requirements and standards. ECOBLOVE has developed its ‘Standard for organic agricultural production, ecological management and certification 39067138. 001-2003’, Quality, Control and Certification Systems, Procedures and Documents. The Standard complies with the requirements of Codex Alimentarius, IFQAM, EU/CEE Regulation 2092/91. ECOGLOBE Clients are producers of apricots, other fruits, herbs, honey, and vegetables. ECOGLOBE has qualified professional personnel, which attended a series of trainings conducted by GTZ, EPER, NATO with trainers from GTZ, BioLatina, Bioherb (Germany). Specialists of ECOGLOBE have studied the success of other countries and organizations in organic farming and certification, such as Belgium, Netherlands, Germany, and Turkey. ECOGLOBE cooperates with stakeholders in Armenia and abroad: national and international authorities, producers and processors, NGOs and other organization. Its partners are USA, USAID, BioLatina, other organizations. ECOGLOBE is active in formation of National Organic movement in Armenia and in EECCA region. ECOGLOBE participated at Biofach Nuernberg in 2004.

In the new circumstances and organic production demand the absence of organic seeds on seed market in EECCA countries may cause further difficulties for the access of western markets. Another problem is the uncontrolled trading of GMO seeds in EECCA, which has even bigger danger. This issue should be discussed in all organic forums and conferences and aim to facilitate the access of newly involved countries to organic seed production and trade.

References
The IFOAM Basic Standards for Organic Production and Processing.
UNECE ‘Environmental Performance Reviews-Armenia’(2000), Capter 11. Environmental concerns in agriculture, 139-158.
Resistance to Fusarium head blight and DON accumulation in spring wheat cultivars

Olga E. Scholten & Dick H. Masteboek. Plant Research International, P.O. Box 16, 6700 AA Wageningen, The Netherlands. Tel. +31-317-477022. Fax: +31-317-418094. Email: olga.scholten@wur.nl.

Keywords
Fusarium head blight - spring wheat - resistance - deoxynivalenol

Introduction
Fusarium fungi are the causal agents of Fusarium head blight (FHB) in cereals, such as wheat. In wheat, Fusarium infection not only affects yield, but also the quality of the harvested product due to the accumulation of mycotoxins, particularly deoxynivalenol (DON). Consumption of DON-contaminated food or feed can cause serious illnesses and immuno-suppression in humans and animals. Breeding for Fusarium resistance is considered to be crucial to eliminate the threat of mycotoxins, as resistance to Fusarium fungi results in lower accumulation of mycotoxins. In this research project spring wheat cultivars grown in organic agriculture were investigated for their levels of resistance to Fusarium culmorum, as well as to the accumulation of DON.

Materials and Methods
Spring wheat cultivars and breeding lines were obtained from experimental cultivar trials under organic farming conditions. Fusarium field experiments were performed in two years at organic farms in the Netherlands (NL). Since wheat is most susceptible at flowering time, artificial inoculations were made at this stage. Spores were applied with a spraying machine. FHB ratings were determined as the product of the percentage of infected heads and the proportion of infected spikelets per infected head. Kernels were harvested for mycotoxin analysis by the TRL in Rotterdam, NL (qualified ‘Sterlab-accreditation’).

Results and Discussion
All artificial inoculation treatments resulted in successful infection. Average disease ratings 4 weeks after inoculation and DON-concentrations are presented in Table 1. Significant differences were found between cultivars. In 2003, average infection levels were higher than in 2002. The higher infection also resulted in higher DON concentrations in 2003 than in 2002. Thasos, Lavett, Minaret and Pasteur are the cultivars with the highest levels of resistance and the lowest DON concentrations in two years. Some cultivars did not or hardly responded to increased disease pressure. In Baldus and Monsun, FHB ratings were much higher in 2003 compared to 2002. In Tybalt and Sunnan, two highly infected cultivars, DON concentrations were the highest.

Table 1. Levels of FHB infection and DON concentrations in artificially infected spring wheat cultivars.

Conclusions
Significant differences in levels of resistance between spring wheat cultivars give farmers the opportunity to choose for cultivars with highest levels of resistance to FHB. This study also shows that in years with severe Fusarium infections, in all cultivars DON concentrations can become higher than accepted.

Acknowledgements
Aart Osman, LBI, Driebergen, The Netherlands & Lubbert van den Brink, PPO-WUR, Lelystad, The Netherlands are acknowledged for providing plant materials and collaboration.
Effect of fruit load array on melon (Cucumis melo L.) seed production in greenhouse under organic cultivation: Yield and seed quality

Hernán Paillán, Gilda Carrasco and Hernán Villalobos
Departamento de Horticultura, Universidad de Talca, 2 Norte 685, Talca, Chile.
Email: hpaillan@utalca.cl

Introduction
Organic cultivation requires that plants must proceed from seeds produced under the same system. Therefore it is expected an increase in the organic seed request. To better understand the source-sink relations (competitive abilities to attract assimilates) this study was focused on the influence of fruit load array in the fruit and seed production; germination and content of seed sugars.

Material and methods
Melon (Cucumis melo L.) Honey Dew was cultivated at the Universidad de Talca Experimental Station, Talca, Chile (35°26′13″ S; 71°40′42″ W) in a polyethylene greenhouse under organic system. The experiment was organized in a completely randomized design with 4 m2 plots. Plant population was 28690 ha-1 with an spacing of 0.35 m over the row and 0.55 m between rows. The treatments consisted into pollinate the first flower at a tertiary vine separating flowers pollinated by 2, 3 or 4 leaves on the plant axis until 3 flowers were completed.

Results
It was detected a difference among treatments on the fruit number; which could be explained by a larger abortion and practice difficulties in some of them. The mesocarp soluble solids averaged 8.8° Brix (table 1).

<table>
<thead>
<tr>
<th>Fruit load array</th>
<th>Fruit per plant</th>
<th>Fruit weight</th>
<th>Soluble solids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>(g)</td>
<td>(g)</td>
</tr>
<tr>
<td>2 leaves</td>
<td>1.6 a</td>
<td>2229 a</td>
<td>1359</td>
</tr>
<tr>
<td>3 leaves</td>
<td>1.6 a</td>
<td>1790 ab</td>
<td>1133</td>
</tr>
<tr>
<td>4 leaves</td>
<td>1.0 b</td>
<td>1370 b</td>
<td>1370</td>
</tr>
</tbody>
</table>

Seed yield showed a similar pattern observed in the fruit number and averaged 18.1 g per plant. The seed production was 634 kg ha-1 in the treatment with flowers pollinated every 2 leaves. This is superior to the one obtained in open field hybridizations were have been reported yields up to 250 kg ha-1, but lower than those reported in greenhouse production with mineral fertilization. The vain seed varied between 6 and 8% of the total, percentage similar to those observed under greenhouse conditions. There was no variation in the number of seeds per fruit and the seed weight (table 2).

<table>
<thead>
<tr>
<th>Fruit load array</th>
<th>Seed yield</th>
<th>Seeds per fruit</th>
<th>Seed weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plant</td>
<td>1Hectare</td>
<td>(mg)</td>
</tr>
<tr>
<td></td>
<td>(g)</td>
<td>(kg)</td>
<td></td>
</tr>
<tr>
<td>2 leaves</td>
<td>22.1 a</td>
<td>634 a</td>
<td>490</td>
</tr>
<tr>
<td>3 leaves</td>
<td>18.6 ab</td>
<td>534 ab</td>
<td>461</td>
</tr>
<tr>
<td>4 leaves</td>
<td>14.0 b</td>
<td>402 b</td>
<td>519</td>
</tr>
</tbody>
</table>

Conclusions
(1) it occurred a better yield on arrays with larger fruit load concentration, because practice simplicity and phyllotaxy absence in the source-sink relation; (2) it were maintained unaltered quality factors, germination and content of seed sugars; (3) under organic cultivation was obtained high quality seed equivalent to the standard of conventional cultivation.

References
Thresholds for Net Blyotch infestation in organic barley seed production

Hans O. Pinschmidt ¹, Bent J. Nielsen ¹ and Henrik J. Hansen ²,
Danish Institute for Agricultural Sciences, Plant Protection Division, Flakkebjerg Research Center,
DK-4200 Slagelse, hans.pinschmidt@agrsci.dk and ²Danish Plant Directorate, Microbiological
Laboratory, Skovbrynet 20, DK-2800 Kgs. Lyngby

Abstract
Seed born net blotch is a threat to the organic barley seed production in Denmark because it often exceeds
the legal 15% infestation threshold in organically produced barley seed lots. Relationships among initial
seed infestation levels, disease development during the growing season, yield parameters and net blotch
infestation of the harvested grains were examined. Highly significant positive correlations among initial
seed infestation, primary infection of seedlings and disease severity during the growing season as well as
among disease severity at flowering and infestation of the harvested grains were found. The seed infestation
level was much less than proportionally related to the primary infection of seedlings and to the disease
severity later in the season. All these variables were negatively correlated with single grain weight, fraction
of large grains and total yield. Varietal resistance appeared to be a key determinant for disease severity and
seed infestation. The results will be used to help develop more flexible net blotch infestation thresholds for
organically produced barley seeds.

Keywords: Seed born net blotch, Pyrenophora teres, seed infestation thresholds, organic seed production,
barley.

Background and objectives
Infestation levels of barley seed lots with net blotch (Pyrenophora teres) can easily exceed the legal 15%
threshold in Denmark, especially in organically produced seeds. This threatens the supply of the Danish
organic barley growers with organically produced healthy barley seeds (Nielsen & Kristensen, 2001). The
ORGSEED project aims at quantifying the links between initial seed infestation, primary seedling infection,
disease severity during the growing season, yield parameters and new infestation of the harvested seeds to
improve decision support for handling net blotch infestations in organically produced barley seeds.

Materials & methods
Inoculated field trials employing a susceptible variety and seed lots with various known levels of net blotch
infestation were conducted as well as non-inoculated field surveys subject to natural infection using
several spring barley varieties planted in 3 locations and 2 years. Net blotch development during the
-growing season was assessed and yield parameters and net blotch infestation of the harvested grains were
determined.

Results
The net blotch seed infestation level was highly positively correlated with the frequency of primary seedling
infection and disease severity at flowering and explained ca. 90 and 50% of the variation of these variables,
respectively, although the relationships were very “flat”, i.e. much lower than proportional. The disease
severity at flowering was highly positively correlated with the level of net blotch infestation of the harvested
grains and explained about 60% of its variation. All of the a.m. variables were negatively correlated with
single grain weight, fraction of large grains and total yield. Disease severity and seed infestation were much
higher in susceptible than in resistant varieties.

Conclusions and outlook
Our results underline the importance of varietal resistance for seed health and give reason to assume that
the present legal infestation threshold of 15% for seed born barley net blotch could be set higher for
varieties having a reasonable level of net blotch resistance. Supplemental results are expected from ongoing
field trials and more detailed analyses will follow to improve our understanding of quantitative relationships
among key variables to develop decision support tools for handling net blotch infestations in organic
barley seed production.

References
økologisk jordbrug (Breeding of cereals and pulses including seed production in ecological land use). FØJO
report nr. 14, Research Center for Ecological Land Use (FØJO), Denmark, 168 p.
A new variety of Lucerne for Italian organic farming

Mario Falcinelli and Renzo Torricelli
Dipartimento di Biologia Vegetale e Biotecnologie Agroambientali. Borgo XX Giugno, 74 - 06126 Perugia, Italy
Email: torricel@unipg.it

Introduction
Organic agriculture is increasingly expanding. Although organic farmers profit from the improvements of conventional breeding, this does not imply that those varieties are the most suitable for organic farming systems (Lammerts van Bueren, 2003). Therefore, the selection of new varieties suitable for organic farming is assuming increasing importance (Falcinelli, 1998). This is also true for forage crops, particularly for those species that have not been exploited for breeding purposes.

Material and methods
The experiment was carried out at Spello (Perugia) on an organic farm. The breeding program used an ecotype (“Cuore Verde”) of Medicago sativa L. grown on this farm for about 15 years.

Experiment 1. Evaluation trial. In 1999-2000 a dense stand, planned with the aim of confirming the high level of forage yield of “Cuore Verde”, was sown together with four varieties (Equipe, Gea, Sitel and Pomposa), according to a randomized block design with 4 replications, using 10 m² plots and a seeding rate of 40 kg ha⁻¹ of viable seed. The crop was cut at full bloom twice in 1999, and three times in 2000.

Experiment 2. Phenotypic selection. 1600 plants of “Cuore Verde” were space transplanted in a nursery in May 1999. The plants were phenotypically evaluated during the 1999-2000 growing seasons for DMY (g plant⁻¹), growth score (1=min; 9=max), flowering (days from the first of May). In the second half of June 2000, 480 plants were selected for uniformity and all the non-selected plants were eliminated. In September 2000 all the seeds produced by intercrossing within the selected plants were harvested. An equal amount of seeds for each of the 480 selected plants was mixed and used to produce the first lot of seeds of the variety called “Cuore Verde”.

Results and discussion
Experiment 1. Data relative to total DMY(1999/2000) are reported in Table 1. Anova did not show significant differences from “Cuore Verde” and the best varieties (Gea in 1999 and Pomposa in 2000). This indicates that “Cuore Verde” is a very interesting ecotype when grown in its own area of adaptation.

Experiment 2. Of the initial 1600 plants, 194 did not survive during the first winter, 22 were eliminated because of disease problems, 270 were eliminated as a consequence of flower color ranging from variegated to yellow, and 634 were also eliminated because they differed too much from the ideotype. The results as to the phenotypic selection are reported in Table 2. The differences in DMY, flowering and growth score between the selected plants and the initial population do not seem to be relevant enough to produce significant changes in the behaviour of the broad-based new variety with respect to the ecotype.

Table 1. Dry Matter Yield (DMY, t ha⁻¹, total 1999 and 2000).

<table>
<thead>
<tr>
<th>Materials</th>
<th>1999</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cuore Verde</td>
<td>2.04</td>
<td>5.27</td>
</tr>
<tr>
<td>Sitel</td>
<td>1.79</td>
<td>5.90</td>
</tr>
<tr>
<td>Equipe</td>
<td>1.38</td>
<td>3.66</td>
</tr>
<tr>
<td>Gea</td>
<td>2.37</td>
<td>5.46</td>
</tr>
<tr>
<td>Pomposa</td>
<td>2.18</td>
<td>6.15</td>
</tr>
<tr>
<td>LSD(0,05)</td>
<td>0.58</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Table 2. Dry Matter Yield (g plant⁻¹), flowering and growth score of selected plants (Mean) in relation to initial population (Mean) and selection differentials (S = Mean' – Mean).

<table>
<thead>
<tr>
<th>Traits</th>
<th>Mean ± se</th>
<th>C.V.</th>
<th>Mean' ± se</th>
<th>C.V.</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMY</td>
<td>27.88 ± 0.41</td>
<td>0.49</td>
<td>27.90 ± 0.59</td>
<td>0.47</td>
<td>0.02</td>
</tr>
<tr>
<td>Fl</td>
<td>20.10 ± 0.12</td>
<td>0.19</td>
<td>19.58 ± 0.17</td>
<td>0.20</td>
<td>-0.52</td>
</tr>
<tr>
<td>SG</td>
<td>4.66 ± 0.32</td>
<td>0.32</td>
<td>5.08 ± 0.06</td>
<td>0.26</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Conclusions
This paper aims to illustrate one of the first examples of organic plant breeding in Italy. We emphasize that in our country this field of research needs new strategies and more public and private resources, because...
many varieties used for conventional agriculture often lack some specific characteristics, like competitiveness against weeds, or resistance to disease and insects. In other words, it is necessary to define the best ideotype for each crop. The new variety of lucerne called “Cuore Verde” is being registered in the Italian List of Varieties. This variety is characterized as being broad-based and can be used in organic agriculture in Central Italy.

References

Cereal varieties for the organic farming in Latvia

Vija Strazdina, Mara Bleidere
State Stende Plant Breeding Station, LV-3258, p. Dizstende, Latvia
Email: stende.selectcija@apollo.lv

Abstract
At the National List of Latvia there are many cereal varieties but not each one suits for the organic farming. The field experiments that focus on crop rotation for cereal production and varieties testing concerning organic farming were started at State Stende Plant Breeding station in 2000. According to results suitability for growing in organic conditions show middle intensive local winter wheat varieties ‘Krista’, ‘Sakta’. The rye varieties ‘Duonai’, ‘Amilo’, ‘Voshod’, ‘Kaupo’ have more stable grain yield level. All spring barley varieties bred in Latvia are suitable for growing in organic farming conditions. Varieties ‘Klinta’, ‘Ruja’ and ‘Gate’ gave highest yield (3.87-3.96 t ha⁻¹), but varieties ‘Linga’, ‘Abava’ and ‘Rasa’ made the highest protein content (above 14.0 %).

Keywords organic farming, cereal varieties, investigation, Latvia

Introduction
Interest of organic farming is growing rapidly in Europe also in Latvia. Now certified organic land area are occupied 0.7 % of the total agricultural land, the certified farm number 0.4% from all land in Latvia. The field experiments that focus on crop rotation for cereal production and varieties testing concerning organic farming were started at State Stende Plant Breeding station in 2000. The main task was to test the mainly grown cereal varieties in Latvia.

Materials and Methods
The total area of field experiments was 3.4 ha. All acreage was certified. The part of crop rotation was divided in 8 separate fields, 0.2 ha each. For cereal varieties testing was assigned 4 fields, but another 4 were under green manure. As a green manure were used buckwheat, red clover, mustard and oil rape.

There were estimated for 8 winter wheat varieties and lines, 6 rye varieties and 10 spring barley varieties phenological phases and morphological traits (plant height, length of spike, number of spikelets per spike), grain yield components - 1000 kernel weight, volume weight, coefficient of productive tillering, number of grain per spike and quality (protein content, falling number, e.t.c.). Resistance to most dangerous diseases and lodging, also winter hardiness for winter crops was evaluated too. Each variety was tested in 4 replications; the recorded plot was 20 m².

Results
During (2002-2003) 8 winter wheat varieties: ‘Krista’, ‘Sakta’, ‘Banga’ (Latvia), ‘Pamjati Fedina’ (Russia), ‘Ibis’ (Germany), ‘Cobra’ (Poland), ‘Belina’, ‘Garmonija’ (Belorusia) were tested. In 2002 the grain yield varied from 4.74 t ha⁻¹ (variety ‘Pamjati Fedina’) until 6.24 t ha⁻¹ (variety ‘Banga’). The protein content was not on high level, the grain quality conformance for food reached only a few varieties – ‘Sakta’ (12.5 %) and ‘Garmonija’ (11.5%). In 2003 winter wheat grain yield was lower, it varied from 2.99 t ha⁻¹ (variety ‘Cobra’) and 3.99 t ha⁻¹ (variety ‘Krista’) but protein content was higher, it varied from 11.59 % (variety ‘Pamjati Fedina’) and 13.38 % (variety ‘Krista’). Analyzing the results of two years it can be concluded that the middle intensive local varieties as ‘Krista’, ‘Sakta’ characterized with good winter hardiness, grain yield and quality stability, suitability for growing in organic conditions.
Rye varieties ‘Kaupo’ (Latvia), ‘Amilo’ (Poland), ‘Valdai’, ‘Voshod’ (Russia), ‘Duonai’ (Lithuania), ‘Jorge’ (Germany) had not a big grain yield variance between two years - the grain yield were from 2.36 t ha⁻¹ until 4.21 t ha⁻¹. The varieties ‘Duonai’, ‘Amilo’, ‘Voshod’, ‘Kaupo’ had more stable grain yield level (3.10-3.51 t ha⁻¹). One of the very important traits for the rye is winter hardiness. Varieties ‘Kaupo’ and ‘Voshod’ showed good results (winter hardiness was 7-9 points). The falling number varied very much each year, more stable it was for 2 varieties ‘Amilo’ and ‘Kaupo’ (307-314 s).

Barley is the main feed crop in Latvia. There were 10 varieties tested in the organic farming conditions: ‘Abava’, ‘Sencis’, ‘Rasa’, ‘Druvis’, ‘Lingga’, ‘Malva’, ‘Klinta’, ‘Ruja’, ‘Gate’, ‘Idumeja’. All varieties are bred in Latvia. The average yield during three years was 3.33 t ha⁻¹ until 4.24 t ha⁻¹. It can be concluded, all varieties are suitable for growing in organic farming conditions, but the highest level of protein content was achieved for varieties ‘Lingga’ (14.5 %), ‘Abava’ (14.5 %) and ‘Rasa’ (14.2 %). The best resistance against most dangerous diseases had varieties ‘Gate’, ‘Druvis’ and ‘Rasa’.

---

**Strategies for the regulation of common bunt (Tilletia caries) of wheat with regard to threshold values and non-chemical protection measures**

*Franziska Waldow and Marga Jahn*

**Federal Biological Research Centre for Agriculture and Forestry, Institute for Integrated Plant Protection, Stahnsdorfer Damm 81, D-14532 Kleinmachnow, Germany, M.Jahn@bba.de**

According to the Council Regulation (EEC) No 2092/91 all plant material used for organic farming should have been produced under organic farming conditions. A deadline for deviations was set at 1st January 2004. Seeds can be contaminated with seed-borne pathogens. Seed-borne diseases tend to accumulate and develop into a problem after several multiplication cycles without adequate disease control. Contamination of wheat seeds with spores of *Tilletia caries* has become a serious problem in recent years for seed quality and yield. Suitable measures for disease control are the use of resistant cultivars, determination of seed contamination and non-chemical seed treatment methods.

The objectives of this research are the determination of threshold values depending on cultivar resistance and the optimisation of seed treatment methods. A complete protection against bunt should be achieved by the combination of the measures.

Seeds of four winter wheat cultivars with different susceptibility to bunt (‘Batis’, ‘Bussard’: highly susceptible, ‘Aron’: medium susceptible, ‘Ökostar’: new cultivar with unknown susceptibility) were inoculated with spores of *T. caries* in six levels (20 - 5000 spores/seed). Inoculated seeds were treated with various alternative methods and the effect on germination of spores and seeds was examined in laboratory and greenhouse tests. The following methods were used: hot water treatment (52 °C, 10 min), treatments with plant strengthening products Tillecur® (yellow mustard powder), FZB 24 TB (*Bacillus subtilis*), PRORADIX (*Pseudomonas fluorescens*), whey powder, and acetic acid. Spore germination on agar plates was almost completely inhibited after treatment with Tillecur and was clearly reduced in the hot water and acetic acid treatments. Slightly negative effects on seed germination were observed only after acetic acid treatment. In greenhouse experiments infestation with bunt was determined on the basis of early symptoms (necrotic flecking) on the leaves at BBCH 14. The effects of treatments on early symptoms differed between cultivars. Trends indicated good effects of Tillecur and hot water and no effects in treatments with microorganisms. The other treatments were not evaluated due to the variability of symptom expression.

At five locations field trials were performed with three cultivars (‘Ökostar’, ‘Aron’, ‘Batis’), three inoculum levels (20, 100, 1000 spores / seed) and two treatments (hot water, Tillecur). Infestation was different at the locations and depended on sowing date and weather. Differences between inoculum levels and cultivars were clearly visible. Highly susceptible cultivars had bunted ears already after inoculation with 20 spores/seed, in the medium susceptible cultivar bunted ears were developed after inoculation with 1000 spores/seed. In these trials, the new cultivar ‘Ökostar’ was proved to be highly susceptible. At all locations and all inoculum levels nearly no infested ears were counted in Tillecur-treated plots. After hot water treatment distinct effects were recorded only at higher inoculum levels. Apparently, a low percentage of spores survives that treatment.
From the results preliminary threshold values can be derived. The field trials and calculations of the theoretical spore load revealed the risk potential of a low infestation. To avoid disease accumulation, susceptible cultivars should be treated from 5-10 spores/seed up, in case of less susceptible cultivars the threshold value is much higher (preliminary value 1000 spores/seed). To confirm these results field trials were repeated and they will be completed in summer 2004.

Organic seed programme in Lithuania

Algirdas Sliesaravičius, Vida Rutkovičienė
Studento 11, Akademija, Kauno r., LT 53067 Lithuania
E-mail: Algis@nora.lizu.lt

Keywords: organic seeds, programme, grain, varieties.

Increase of organic farms number in Lithuania is because of expanding request of organic production. In the year 2003 the number of organic farms increased two times and area of the land—tree times. There are about 700 registered farms, which occupy about 24000 ha of agricultural land. Many of these farms are using seeds grown in conventional farms. But according to the European Union directives from the year 2006 organic farms will have to use organic seeds and planting material. We have to care that decision would not overtake without preparation, because in other case production of farms could not be certified as organic.

First step of organic plant production must be growing of organic seeds. For this reason the organic seed programme is almost finished.

1. Scheme of organic seed growing is prepared, whereby organic seed growing is joined to the general seed growing system. It is cared that organic seed growers could buy high category seeds, because during growing seeds in organic farms seed category will be one step lower. Special requirements for organic seeds and planting material are under preparation.

2. Organic farms, which have necessary equipment for the seed growing (for different plant varieties of organic seeds and seedling growing), are selected and certified. In 2003 some of these farms started organic grain seed production, because it is new business kind. Organic seeds are grown for Lithuanian farms and for the export.

3. Support for organic seed growers is discussed, because grain yield in organic farms as usually is lower. If growers will be interested in organic seed production this process will be faster.

4. Internet database of organic seeds and seedling was established. This database can help operatively get information about organic seed growers and organic seeds.

5. Training programme and courses for organic seed growers are established.

6. Demand of organic seeds for the year 2005 – 2006 is calculated and lack of different kinds of organic seeds for the nearest year is revised. Implements for procurement of organic seeds are foreseen.

7. Selection of best varieties for organic farming was started, because different plant varieties are genotypic different and unequally reacts to the changed growing conditions, especially management with nitrogen. It is important to choose varieties which genetic potential could be expressed in the best way in the organic farming conditions.

Research carried out at the University showed, that productivity of Lithuanian varieties of summer barley “Luokė” and “Alsa” were three times bigger than most of other researched kinds. Summer barley was considerably more sensitive to the organic farming conditions and lack of nitrogen. Though, plant productivity was low, but varieties differentiate and intensity was from 9.2 percents to 62 percents. Especially well grew peas and lathyrus. They themselves stocked up biological nitrogen and were not touched by diseases. Peas and lathyrus fit to the organic farming conditions and is good preplant for other plants. Thus, in case of proper varieties, productivity of organic grain can be considerably bigger and plants less damaged by diseases.

References