International Conference on

BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS

Online from Latvia

08-10 March 2021

By EUCARPIA Section Organic and Low Input Agriculture jointly with **LIVESEED, BRESOV, ECOBREED, FLPP projects** and **ECO-PB**

E-poster collection

LIVESEED is funded by the European Union's Horizon 2020 under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract No 17.00090.

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Link to Organic Eprints: https://orgprints.org/id/eprint/39763/

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Compiled by: Marta Devīte, Lāsma Rābante, Līga Dzedule, Māra Bleidere, Ilze Skrabule, Leone Ferrari.

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PREFACE

EUCARPIA
European Association for Research on Plant Breeding
Europäische Gesellschaft für Züchtungsforschung
Association Européenne pour l'Amélioration des Plantes

Dear participants of the conference 'Breeding and seed sector innovations for organic food systems' organized by the EUCARPIA Section Organic and Low Input Agriculture. It is a great pleasure for me to welcome you to this online conference jointly organised with the LIVESEED, ECOBREED, BRESOV and FLPP projects. This is the first Section Meeting in 2021 after we had a nearly complete conference lock down in 2020 due to the Covid-19 pandemic. Other Section Meetings are planned for this year which is important. And, there will be the General Congress in August which had to be postponed from last year. As you know, the aim of our organisation is to promote scientific collaboration in plant breeding research, mainly based on Section Meetings as yours. Therefore, I wish you a successful three days conference for exchanging new ideas and initiating new joint projects on the field of organic and low input farming.

Prof. Dr. Dr. h.c. Andreas Börner EUCARPIA President

Dear EUCARPIA Section Organic and Low Input Agriculture members, like-minded and colleagues putting your efforts in other fields besides plant breeding!

This is the 5th conference of the Organic and Low Input Section since its establishment in 2007. Our section addresses the issues that are relevant to plant breeding for organic and low-input agriculture.
In addition, this is also the final conference of Horizon 2020-funded project LIVESEED "Boosting organic seed and plant breeding across Europe" that runs from 2017 to 2021. Relevant sister-projects BRESOV and ECOBREED are involved as well, along with two projects of Latvian national Fundamental and Applied Research program (FLPP). This conference continues and broadens the issues discussed in 2018 in Witzenhausen, Germany on 'Breeding for Diversification' by including a range of research topics, from genetic resources to multi-actor and participatory approaches, socio-economic, market and policy aspects of organic plant breeding and seed production.
We, at the Institute of Agricultural Resources and Economics were planning to meet all of you in person in the small beautiful town of Cēsis in Latvia. Unfortunately the current pandemic has forced us to hold this conference on-line. Nevertheless, I hope that we will have a valuable exchange of research results, discussions and ideas for further cooperation!

Dr. Linda Legzdiņa
Chair of EUCARPIA Section Organic and Low Input Agriculture

LIVESEED – Improving the performance of organic agriculture by boosting organic seed and plant breeding efforts across Europe

Keywords: organic breeding, organic seed, cultivar testing, seed market and regulation, seed health

Organic agriculture is a rapidly growing sector and the European Commission is targeting to reach 25% organically managed farm land by 2030. The availability of high quality seed of a broad portfolio of cultivars and crops adapted to specific climatic, soil, and farming conditions is key for realizing the full potential of organic agriculture in Europe. However, the organic seed market is not meeting the required demand.

LIVESEED (2017-2021, www.liveseed.eu) is a Horizon 2020 project applying interdisciplinary and multi-actor approaches aiming to transform the organic seed and plant breeding sector. It is coordinated by IFOAM Organics Europe with FiBL-CH for scientific coordination and consists of 36 partners and 14 third linked parties from 18 European countries. The main goal is to reach 100% organic seed of cultivars suited for organic agriculture in order to improve competitiveness and integrity of organic production. LIVESEED covers the five main crop categories: legumes, vegetables, fruit trees, cereals and fodder crops, considering diverse cropping systems across Europe including mixed cropping and agroforestry. LIVESEED explored legal, technical, scientific, and socio-economic aspects that impact the use of organic seed from breeding to seed availability.

The goal of LIVESEED is to improve the productivity of the organic sector by boosting organic seed and plant breeding activities across Europe. Specific objectives are to:

- identify production and use of organic seed across Europe
- identify bottlenecks and provide approaches to harmonize the implementation of the rules for organic seed in the EU organic regulation (EC No 834/2007 and EC No 2018/848)
- develop an EU-wide router database tool for seed suppliers,
- develop a toolbox to describe organic heterogeneous material and provide testing protocols to facilitate the registration of organic varieties suitable for organic production (EC No 2018/848)
- develop and improve efficiency of cultivar testing with special focus on on-farm trials
- develop an organic seed health and quality strateg

- train on best practices for organic seed multiplication
- develop novel breeding concepts and deliver new breeding tools, and initiate new breeding activities and more efficient collaborations to close most urgent gaps for legumes, cereals, vegetables, fruit trees and fodder crops
- identify gaps and bottlenecks in the market of organic seeds, analyze business and governance models and develop incentives for the use of organic seeds
- study perception of organic consumers towards new genetic engineering techniques

This is accompanied by constant and targeted exchange with different stakeholder groups (breeders, seed companies, certification bodies, examination offices, national and European authorities, policy makers, farmers organizations, representatives of the organic value chain) and communication and dissemination activities to maximize impact of LIVESEED.

The European project LIVESEED (www.liveseed.eu) will help to establish a level playing field in the organic seed market across Europe, improve the competitiveness of the organic seed and breeding sector, and encourage greater use of organic seeds by farmers. Main results of LIVESEED achieved so far are summarized in a booklet on www.liveseed.eu under tools for practitioners.

LIVESEED received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.

ECOBREED – Increasing the competitiveness of the organic breeding and farming sectors

Keywords: organic breeding, organic seed production, field crops

The organic sector has developed rapidly in the EU in recent years, not only in terms of the areas used for organic farming, but also in terms of the number of holdings and the total number of entities registered in the Union engaged in organic production, processing, and marketing. European H2020 project, ECOBREED is coordinated by the Agricultural Institute of Slovenia and includes 25 partners from 15 countries (AT, CN, CZ, DE, ES, GR, HU, IT, PL, RO, RS, SI, SK, USA, UK) and three continents. The ECOBREED project has been identified by the European Commission (DG AGRI and DG SANTE) as a strategically important project to achieve the objectives set out in Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products. The new regulation seeks, among other things, for better access to organic seed on the market and greater heterogeneity of supply. Currently, the supply of organic seeds in the EU with a high level of genetic and phenotypic diversity is limited. This diversity is an important factor in successful development in organic farming, which contrasts with seed practices in the conventional, where a high degree of seed homogeneity is required.

The focus of ECOBREED is to improve the availability of varieties and seeds suitable for organic and low-input production. Activities focus on four plant species; wheat (*Triticum aestivum* L. and T. *durum* L.), potatoes (*Solanum tuberosum* L.), soybeans (*Glycine max* (L), Merr) and buckwheat (*Fagopyrum esculentum* Moench.). ECOBREED crop species were selected according to their potential contribution to increasing the competitiveness of the organic sector.

Common wheat is the most important crop used for human consumption in Europe and represents the largest organic crop area grown and represents the largest range of organic products available on the market. Potato is the most widely grown organic fresh produce crop in Europe. There is an urgent need to increase EU organic grain legume production to replace imported protein with a local production and growing demand for non-GM soybeans in Europe. Buckwheat is likely to provide key rotational benefits to an organic production system.

The project targets the improvement and availability of organic seed and varieties via extensive phenotyping and breeding activities with the support of an extensive training programme which will facilitate rapid technology transfer from the project (improved genotyping and phenotyping) into commercial practice. An important part of the project is the Participatory plant breeding (PPB) that enables scientists and farmers to improve conventional breeding by offering farmers the opportun to select, develop and create varieties that best suit their needs, agronomic requirements and pedoclimatic conditions. PPB is a suitable alternative to organic production as it uses the expertise of farmers throughout the breeding process, allows selection in contrasting growing conditions and helps to develop local and regionally adapted varieties.

The project will develop (a) methods, strategies, and infrastructure useful for organic breeding, (b) new varieties with improved stress resistance, resource efficiency and quality, and (c) improved methods for producing high quality organic seed.

The specific objectives are to:

- Identify genetic and phenotypic variation in morphological, abiotic/biotic tolerance/ resistance and nutritional quality traits that can be used in organic breeding.
- Evaluate the potential for genetic variation in enhanced nutrient acquisition.
- Evaluate the potential for increased weed competitiveness and control.
- Optimise seed production/multiplication via improved agronomic and seed treatment protocols.
- Provide farmers the opportunity to choose and develop varieties in their own environment that best suit their needs and conditions.
- Produce elite varieties for improved agronomic performance, biotic/abiotic stress resistance/tolerance and nutritional quality.
- Develop training programmes (improved genotyping and phenotyping) to facilitate rapid technology transfer from the project into commercial practice.
- Ensure optimum and rapid utilisation and exploitation of project deliverables and innovations by relevant industry and other users/stakeholder groups via extensive farm-based demonstration and dissemination activities.

The objectives of the project will be put into practice using an integrated and multi-disciplinary approach to increase the competitiveness of the organic/low-input breeding and farming sectors.

The research was funded from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 771367 (ECOBREED).

BRESOV – Breeding for resilient, efficient and sustainable organic vegetable production

The BRESOV project, approved in the frame of the Programme H2020-SFS-07-2017 (GA 774244), deals with increasing the competitiveness of three important vegetable crops (broccoli, green beans and tomatoes) by providing climate-resilient cultivars addressed to organic vegetable farming systems.

Thanks to the wide involvement of stakeholders in genetic improvement, seed production and organic farming, the project aims to create a pipeline for the development of high quality organic seed production for breeders and farmers around the world. By the active involvement of farmers, advisory services, research institutes, breeding companies and food processors the ambition of the project is:

a) improving competitiveness of three important vegetable crops in organic production

b) extending the genetic basis of organic breeding for broccoli, snap bean and tomato

c) enhancing existing and newly developed varieties for organic vegetable production and increasing the plants' tolerance to biotic and abiotic stresses.

During the ongoing activities, 837 genetic materials of Brassica oleracea complex species (broccoli, cauliflower and related wild relatives) 496 of tomatoes and 675 of green beans were genotyped and phenotyped for indentifying traits of interest for organic agriculture such as biomorphological characteristics of the plants, resistance to water, saline and thermal stresses, senescence induced by darkness, nitrogen and water use efficiency, resistance to black rot, downy mildew, Alternaria spp. and other key pathogens of these crops. Particular attention has been paid to detect the content of the antioxidant compounds into the produce matrices, such as glucosinolates, polyphenols, carotenoids, in addition to protein content and the main organoleptic characteristics of the product (eg sweetness, acidity, color).

In relation to high quality organic seed production and to the evaluation of the pre-breeding lines, in organic farms in various European countries characterized by different pedoclimatic conditions, there are various activities in progress that includes evaluating the influence of crop density, of the nutritional compounds allowed in organic farming, and of the methodology for adopting new organic farming tools such as the natural extracts and the bioactive agents for controlling pests and diseases.

The results acquired during the first two years of the BRESOV project already allow the consortium to support the growing demand for organic vegetables, offering the opportunity to combine research results with the requests of growers and consumers of the reduction of chemical contaminants, both into the soil and in food products. The ongoing selection of the elite breeding lines of broccoli, snap beans and tomatoes, more resistant to climate change and to pests and diseases, will render organic production more competitive and attractive for farmers throughout Europe and outside the European Union.

The BRESOV project is supported by 22 partners from 10 European countries, 2 EU associate countries (Switzerland, Tunisia), and 2 Extra-EU countries (China and South Korea), and has adopted multi-actor and interdisciplinary approaches placing particular emphasis on the needs of several European and foreign stakeholders involved in breeding, seed and organic farming activities.

FLPP
FUNDAMENTAL AND
APPLIED RESEARCH
PROJECTS

Genetically diverse populations of self-pollinating cereals for organic farming: agronomic performance, effect of environment, and improvement techniques

Keywords: organic farming, crop breeding, composite cross populations (CCP), genotyping, molecular markers, spring barley, spring and winter wheat

The research aim of the project carried out by Institute of Agricultural Resources and Economy (AREI, Latvia) during 2018-2021 is to investigate agronomic performance, efficient improvement techniques and changes due to environmental effects in genetically diverse populations, which are a potentially significant alternative to traditional varieties for self-pollinating cereals in environmentally friendly agriculture. This work is being continued from another local project, which first started to study genetically diverse populations in Latvia. Agronomic traits important for organic farming as yield and its stability, competitive ability against weeds, nutrient use efficiency, disease resistance/tolerance and grain quality is being assessed for spring barley and wheat composite cross populations (CCPs) in field trials under organic and conventional crop management systems. The effect of repeated multiplication and cultivation in different environments on CCP agronomic and morphological traits and genetic diversity using molecular tools is being evaluated. Development and improvement of breeding techniques includes elaboration of molecular marker, application of negative mass selection for disease resistance/tolerance enhancement, line selection from CCPs for building mixtures, and crossing of CCP to perspective/local genotypes. The material of spring barley CCPs created in Latvia, barley and wheat CCPs from abroad and newly created CCPs are being studied. Testing of selected populations in larger scale on-farm trials is also going one. Results will ensure new knowledge in agriculture and biology as well as information for authorities in order to facilitate registration and marketing system establishment for genetically diverse populations.

This research is funded by the LATVIAN COUNCIL OF SCIENCE, grant number lzp- 2018/1-0404, acronym FLPP-2018-1

FLPP FUNDAMENTAL AND APPLIED RESEARCH PROJECTS

Potato breeding for low input and organic farming systems: nitrogen use efficiency and quality aspects of potato protein

Keywords: NUE, nutrition management, phenotyping, patatin, NIRS

Potato crop requires soil that is rich in nutrients or high doses of fertilizers normally have to be applied to obtain high and qualitative tuber yield.

According to EU legislation, nitrogen (N) applications have to be limited in EU and also in Latvia. Evolving new potato varieties with improved nitrogen use efficiency (NUE) for potato production can help improving nutrition management and reducing N emissions thus minimizing environmental impacts. Varieties with improved NUE, especially under limited N availability, can foster the advancement of low input and organic farming systems. High-quality proteins (incl. patatin) present in potato can be used for feed and food purposes thus increasing added value to potato and processing by-products.

Screening for NUE under field conditions is time-consuming and labor-intensive, therefore more efficient methods for NUE estimation are required.

The aim of the three-year (2020 - 2022) research project is to investigate new techniques for potato breeding for NUE and to estimate NUE effect of the genotype on potato protein quality.

During the project a number of NUE related traits both under *in vitro* and field conditions will be assessed and results obtained in both systems compared to find possible predictive markers for estimation of NUE under *in vitro* conditions. Field trials will be carried out in different locations and farming systems (conventional and organic) for more comprehensive results. Laboratory investigations will be carried out in AREI, Priekuli branch. If a reliable marker will be detected, it will serve as an innovative and more efficient phenotyping method for NUE and will greatly improve the potato breeding process.

Relationships between levels of protein patatin and NUE estimation in potato genotypes will be assessed. As a result, the understanding of the effects of NUE of genotypes on the abundance of patatin in potato tubers will be facilitated. Patatin detection methods will be adopted. New parameters (N, protein) will be calibrated to NIRS for express analysis to accelerate further research on NUE and breeding.

The project is funded by Latvia Council of Science in the frame of Fundamental and applied research projects (FLPP) program.

European Association for Research on Plant Breeding
Europäische Gesellschaft für Züchtungsforschung
Association Européenne pour l'Amélioration des Plantes

EUCARPIA – European Association for Research on Plant Breeding

EUCARPIA aims to promote scientific and technical co-operation in the field of plant breeding in order to foster its further development. To achieve this purpose, the Association arranges and sponsors meetings to discuss general or specific problems from all fields of plant breeding and genetic research. Activities with a predominantly commercial interest are excluded, as EUCARPIA is a non-profit organization.

EUCARPIA organizes section and working group meetings throughout Europe each year. During these meetings devoted to particular crops or cross-cutting topics, specialized up-to-date knowledge and methodology are exchanged among leading scientists and conveyed to practical plant breeders.

Every four years, the General Congress is held together with the general assembly. These congresses are an opportunity for all EUCARPIA members to discuss subjects of a wider interest. They provide a forum for presentation of the problems and challenges which plant breeding faces today and in the future. The next congress takes place 22 till 27 August 2021 in Rotterdam, the Netherlands.

Founded in 1956 and officially seated in Wageningen (The Netherlands), EUCARPIA provides considerable impact on improving international contacts in plant breeding research for nearly 60 years.

EUCARPIA is offering membership for scientists and researchers of all disciplines related to plant breeding.

The work of EUCARPIA is organised in 11 sections and one of them is section Organic and Low-Input Agriculture.

ECO-PB – European consortium for organic plant breeding

Keywords: organic breeding, organic seed, cultivar testing, policy recommendations

The European Consortium for Organic Plant Breeding (ECO-PB) founded 20th April 2001 in Driebergen (NL) in order to

- provide a platform for discussion and exchange of knowledge and experiences among organic breeders, seed producers and researchers
- initiate and support of organic plant breeding programs and strengthen networks among partners
- develop of scientific concepts of an organic plant breeding
- provide independent, competent expertise to develop standard setting with respect to organic plant breeding
- represent the organic plant breeding and organic seed sector on European level

ECO-PB is committed to the principles of organic agriculture as laid down in the IFOAM Basic Standards and EU Regulation (EEC) 2092/91 and is member of IFOAM Organics International, IFOAM Organics Europe, TPOrganic and founder of the international IFOAM Seed Platform. ECO-PB has observer status in the technical meetings of CPVO and is acknowledged organisation of the EU transparency register.

ECO-PB offers full membership to all organisations that are actively and predominantly engaged in the development and promotion of organic plant breeding or organic agriculture and supporting membership to individual persons predominantly engaged in organic agriculture and complying with the objectives of the association. Presently ECO-PB consists of 15 full member associations and 27 associated members spread across Europe (www.eco-pb.org).

Main activities of ECO-PB are to

- carry out and support meetings and workshops on legal, political, technical, socioeconomic aspects related to organic seed and plant breeding
- work out a sound concept based on principles of organic agriculture and systems-based breeding as a basis for organic plant breeding strategies
- promote research topics on organic breeding and set up and participate in research projects and networks on organic plant breeding

- provide discussion paper on plant breeding issues to support the decision making process in European and international level
- find alliance with other organizations and represent our members in political and stakeholder dialogs
- participate in consultations, workshops, stakeholder and policy meetings in order to promote the interests of our members
- provide a platform for young breeders supported by experienced mentors
- collect training material on organic seed and plant breeding from members and partners of LIVESEED, ECOBREED and BRESOV
- support the Preconferences Organic Seed Ambassadors of the Organic World Congress in collaboration with the Organic Seed Alliance from the USA in September 2021 in Rennes https://owc.ifoam.bio/2021/en

Institute of Agricultural Resources and Economics

AREI

The Institute of Agricultural Resources and Economics (AREI), with more than 100 years of history, is the leading field crop breeding institute in Latvia.

The research directions of the institute are related to crop genetics and breeding, crop management and agroecology for sustainable farming, provision of quality requirements of raw materials for processing, as well as development of sustainable rural space, economic analysis for agriculture, food production and fisheries. The institute has two scientific departments – the Department of Crop Research and the Department of Bioeconomics, which carry out research in the fields of agriculture, agrarian economy, and rural development, carrying out more and more interdisciplinary research projects. AREI regularly participates in international research projects, national research programs, research of national importance, as well as perform collaborative research with farmers, merchants and municipalities. Part of research is related to the provision of functions delegated by the government. Crop Research Department carries out significant research in the development and improvement of crop breeding methods, as well as in the study of genes that determine important traits, especially resistance to biotic and abiotic factors. An important task for AREI breeders is the maintenance and evaluation of plant genetic resources.

In the period from 2003 to 2006, Ministry of Agriculture of Republic of Latvia (MoA) funded trials aimed to develop the value for cultivation and use (VCU) testing protocols in Latvia (at present, the Latvia University of Life sciences and Technologies ensures the assessment of the VCU tests of organic plant varieties). During this period, all locally bred cultivars of cereals, potatoes, pea and grasses in the plant variety catalogue (PVC) were tested for their suitability for organic farming. Since then, trials under organic conditions have been possible and well-performing varieties are marked as “Bio” in the national PVC. Since 2003, AREI is testing varieties for their suitability for organic farming. AREI carries out field trials with potatoes, cereals (spring barley, winter rye, winter and spring wheat etc.), field peas and grasses. Six potato varieties, four field pea varieties, five spring barley varieties, two oat and one wheat variety, as well as several varieties for a number of grass species, bred by AREI have been officially recognized as suitable for organic farming.

In 2020, the total agricultural area of AREI was 510 ha, of which 50 ha was organically certified area used for plant breeding, field trials, and seed production. AREI has the organic breeding program. The identification and application of genetic markers of traits important for new varieties is becoming usual for evaluation of breeding material in breeding programs. Currently the breeding for organic farming is carried out for several field crops: spring barley, faba bean, spring pea, winter and spring wheat, and spring oat, and is funded by the MoA. Besides organic breeding and variety testing,AREI is involved in projects aimed to research on growing technologies under organic conditions. These trials include not only common field crops, but also less common species in Latvia such as narrow-leaf lupin, quinoa and soybeans. AREI successfully participated in EC Temporary Experiment on marketing of heterogeneous populations using spring barley composite cross population 'Mirga'. AREI is also organic seed producer for potatoes, red clover, winter and spring wheat, winter rye, field peas, and buckwheat. AREI performs research in agroecology, maintenance of soil fertility, weed management in both integrated and organic farming.

ORGANIC FARMING IN LATVIA

The sector of organic agriculture in Latvia is continuously developing, involving more and more new enterprises. The number of certified organic enterprises in Latvia reached 4450 in 2019, and area under organic farming in Latvia was about 14% from utilised agricultural area or 290 thousand ha. A total of 262.5 thousand ha of land were converted to organic, but 27.5 thousand ha were still undergoing conversion. Compared to 2018, the organically certified area had grown by 6.4 thousand ha that is about by 2.2%.

In 2019, the major part of organically certified fields was under cereal crops covering 58.5 thousand ha, most of which were oats (23.5 thousand ha) and wheat (15.5 thousand ha). Organically certified potatoes were grown on 1486 ha, organic vegetables – 423 ha, most of which were pumpkins (137 ha). The most popular organically grown berries and fruit trees in Latvia were black currants (925 ha), apple trees (712 ha) and sea buckthorn (399 ha). In total, organic fruits and berries were grown on 3053 ha.

Compared to 2018, organic grain production increased by 32% in 2019, reaching 117 thousand tonnes. Quantity of produced vegetables, potato and eggs was also higher. However, the milk production decreased by 6.2 thousand tonnes, less meat, fruit and berries were produced.

Organic farming in Latvia is characterized by multisectoral production. Main sector of animal husbandry in organic farms is milk production. Sheep farming has also become popular.

During last years about 20 organic farms in Latvia produce certified organic seed. Mostly organic cereal seed, especially oat and barley, is produced. Production of certified organic seed material for red clover, timothy, and buckwheat is also significant. The amount of produced organic certified seed covers only 3.2% of organic seed demand in the country. Home-saved organic seed material is still widely used. More than two thousand derogations allowing use of conventional seed or planting material in organic farms are granted every year.

Latvia participates in Temporary experiment (Commission Implementation Decision 2014/150/EU) for marketing of heterogeneous seed material of cereal species. Heterogeneous barley population 'Mirga', which has been developed in AREI, is grown in four organic farms.

THE ASSOCIATION OF LATVIAN ORGANIC AGRICULTURE

The Association of Latvian Organic Agriculture (hereinafter - ALOA) was founded in 1995. It is a legal, professional, non-governmental ings together ~1500 producers, traders and processors of organic products: milk, meat, honey, fruit, vegetable and cereals, processors, traders and supporters of organic food in Latvia. The association unites 11 regional branches and representatives of 11 areas of industries.

ALOA is an important partner and representative of organic farms and companies to the government and the state institutions in charge of planning and supervision of the agricultural sector.

ALOA is actively working with various departments of the Ministry of Agriculture, making proposals for the sector development.

Key areas of cooperation:

- Implementation of the Latvia's Rural Development Programme 2022-2027;
- Implementation of the EU common agricultural policy 2022-2027;
- European Green Deal with its two strategies *Biodiversity Strategy for 2030 and Farm to Fork*;
- Organic farming supervision and control matters.

ALOA cooperates with other public organisations in the areas of agriculture and environment: Farmers Federation, Latvian Fund for Nature, The World Wildlife Fund, Latvian Beekeeping Association and others.

Objectives of the association

To bring together those working in the organic farming industry and supporters of environmentally friendly farming and users of organic products.

To build market policies and find market opportunities for sales of organic food products.

1. To provide learning opportunities for organic farmers.
2. To raise public awareness about the importance of natural products in being healthy.
3. To promote green and sustainable farming methods.
4. To represent members' interests in state and local government institutions as well as non-governmental organisations.
5. Organic farming policy making.

In 2020 ALOA started publishing an informative magazine "BIOLOĢISKI" with the aim to strengthen organic agriculture in Latvia.

CONFERENCE PROGRAM

MONDAY, MARCH 8TH 2021

08:30 Open access

08:50 Technical instruction

09:00 **Welcome addresses**

09:30 **L. LUTTIKHOLT – Transforming food systems, transforming breeding**

SESSION 1 – EXPLORING UNDERUTILIZED GENETIC RESOURCES (moderated by Vladimir Meglič)

10:00 S. GORITSCHNIG – EVA - European evaluation networks harnessing crop genetic diversity present in European genebanks

10:20 E. FLIPON – Mobilising diversity for minor cereals in western France

10:35 D. JANOVSKÁ – Exploring buckwheat genetic resources for organic breeding

10:50 A. KRONBERGA – Domestification potential of Latvian local medicinal and aromatic plants genetic resources

11:05 *Coffee break*

11:20 J. PROHENS – Characterization under low N conditions of advanced backcrosses of eggplant (*S.melongena*) with introgressions from *S.elaeagnifolium*

11:35 C. ARNCKEN – Pre-breeding of white lupin for anthracnose tolerance

11:50 F.BRANCA – Response of different genotypes of *Brassica oleracea* var. *Gongylodes l*. to drought stress

12:05 General discussion

BREAKOUT POSTER SESSIONS

12:30 Topic 1 – **Exploring underutilized genetic resources** (moderated by Ferdinando Branca)

Topic 3 – **Breeding for culinary and nutritional quality** (moderated by Edith Lammerts van Buere

13:15 *Lunch*

SESSION 2 – BREEDING FOR DIVERSITY (moderated by Edwin Nuijten)

14:15 P. MENDES MOREIRA – LIVESEED: Enhancing resilience at systems level through breeding for diverse cropping systems

14:35 D. DESCLAUX – Why is it so difficult to breed for sustainable organic food system? Some examples on cereals

14:50 G. VAN FRANK – Participatory on-farm breeding for diverse and adapted wheat mixtures

15:05 E. FLIPON, V. CHABLE – Comparing two selection strategies of bread wheat diversified populations adapted to organic farming

15:20 I. LOČMELE – Assessment of spring barley variety mixtures and populations in comparison to homogenous varieties

15:35 N. MOUTIER – Breeding for wheat-pea mixtures: are the traits of pea varieties in sole crop predictive of their behaviour in mixture?

15:50 M. PETITTI – Evolutionary participatory tomato breeding in Italy for organic agriculture

16:05 General discussion

16:30 *Coffee break*

SESSION 3 – BREEDING FOR CULINARY AND NUTRITIONAL QUALITY (moderated by Edith Lammerts van Bueren)

16:45 J. DAWSON – Scaling up participation in breeding for flavor: engaging farmers, gardeners, culinary professionals and consumers

17:10 E. NUIJTEN – Breeding for quality: lessons learned on three vegetable crops

17:25 J. ZYSTRO – A case study in efficient methods for evaluating and selecting for flavor in organic sweet corn breeding programs

17:40 General discussion

18:00 *Coffee break*

BREAKOUT SESSIONS

18:15

Posters, Topic 2 – **Breeding for Diversity** (moderated by Pedro Mendes Moreira)	**Contribution of genetic resources for breeding for diversity** (moderated by Ferdinando Branca and Vladimir Meglič)	**Discussion on impact of new breeding techniques** (moderated by Monika)

TUESDAY, MARCH 9TH 2021

08:30 Open access

08:50 Technical instruction

SESSION 4 – LIVING SOIL - PLANT INTERACTION (moderated by Pierre Hohmann)

09:00 G. BERG – Sowing the right seeds for sustainable agriculture

09:25 A. WOLFGANG – Bacterial seed communities in sugar beet are influenced by propagation site and genotype

09:40 F. TROGNITZ – Seed endophytes isolated from soybean and their application for biocontrol and plant growth stimulation

09:55 P. KUSSTATSCHER – Pumpkin breeding shapes the seed microbiome

10:10 M. BIGET – Spatio-temporal heterogeneity in the root-microbiota of grape vine: a microbial terroir in vineyards

10:25 T. TAKÁCS – Physiological and growth responses of pea intercropped wheat cultivars

10:40 General discussion

11:00 *Coffee break*

SESSION 5 – ORGANIC PRODUCTION OF HIGH QUALITY & HEALTHY SEED (moderated by Ambrogio Costanzo)

11:15 F. REY – Improving cultivar testing, seed multiplication & health for high quality seeds for the organic sector: overview of LIVESEED outcomes

11:35 M. COLLEY – State of organic seed production in the United States

11:55 S. KLAEDTKE – From seed to plant health – a broader picture

12:10 A. BORGEN – Seed treatments to control common bunt

12:25 S.P.C. GROOT – Carrot seed vigour, field emergence and tolerance to the damping-off pathogen *Alternaria radicina*

12:40 H. CARDOSO – Calorespirometry – a promising phenotyping tool to assess seed viability based on respiratory parameters

12:55 General discussion

13:15 *Lunch*

BREAKOUT POSTER SESSIONS

14:15 Topic 4 – **Living soil - plant interaction** (moderated by Gabriele Berg)

Topic 5 – **Organic production of high quality & healthy seed** (moderated by Federic Rey

SESSION 6 – MULTI-ACTOR & PARTICIPATORY APPROACHES (moderated by Veronique Chable)

15:00 N. ENJALBERT – Simplify collaboration, amplify results: facilitating a diverse seed system with a collaborative digital platform

15:20 F. REY – Frugal, multi-actor and decentralised cultivar evaluation models for organic agriculture: methods, tools and guidelines

15:35 M. COLLEY – The ripple effect of participatory plant breeding: a case study in US organic sweet corn

15:50 *Coffee break*

16:05 A. RODRIGUEZ-BURRUEZO – Participatory breeding in tomato in southern Europe in the frame of organic farming: approaches, plant populations, results and lessons learned

16:20 P. ANNICCHIARICO – Genome-enabled, farmer-participatory selection: making edges meet

16:35 K. ISAACS – A network approach for large-scale participatory variety-by-context testing: results from sorghum variety trials in Mali

16:50 General discussion

17:20 *Coffee break*

BREAKOUT SESSIONS

17:35	Posters, Topic 6 – **Multi-actor & participatory approaches** (moderated by Bernd Horneburg)	**Demonstration of Seedlinked** (moderated by Nicolas Enjalbert)	**Potential of participatory breeding** (moderated by Micaela Colley)
18:35			

WEDNESDAY, MARCH 10TH 2021

08:30 Open access

08:50 Technical instruction

SESSION 7 & 8 – SOCIO-ECONOMIC, MARKET AND CONSUMER ASPECTS OF SEED SYSTEMS (moderated by Raffaele Zanoli)

09:00 S. PADEL – Organic seeds and varieties: can the market deliver?

09:25 E. WINTER – Assessment of policies aiming at boosting organic seed use

09:40 S. ORSINI – Appraisal and usage of organic seed in Europe from organic farmers' perspective

09:55 J. KOTSCHI – Funding organic plant breeding and the potential impact of open source seed systems

10:10 *Coffee break*

10:25 E. CUBERO DUDINSKAYA – European organic consumers' attitudes and acceptance of new plant breeding techniques for crops

10:40 H. WOLTER – Consumer perceptions and evaluations of the Open Source Seeds License

10:55 C. MEIER – Consumer preferences for healthy minor cereals

11:10 General discussion

11:40 *Coffee break*

11:55 **Video excursion to Latvian organic farms Promotion video on organic breeding** Announcements regarding next events

BREAKOUT POSTER SESSION

12:30 Topic 7 & 8 **Socio-economic, market and consumer aspects of seed systems** (moderated by Stefano Orsini)

Topic 10 **Sustainability** (moderated by Giuseppe Timpanaro)**Selection of best posters by partici**

13:00 *Lunch*

SESSION 9 – REGULATORY AND POLICY OPPORTUNITIES (moderated by Bram Moeskops)

14:00 E. GALL, M. SOMMER – New rules on seeds in the new EU Organic Regulation

14:20 K. MEYER – Collecting commitment in 10 EU member states – the organic seed declaration

14:35 M. RAAIJMAKERS – The need for national roadmaps to come to 100% organic seed

14:50 M.H. BERNICOT – Assessing varieties for organic farming: what contribution from evaluation in conventional farming?

15:05 General discussion

15:25 *Coffee break*

SESSION 10 – SUSTAINABILITY (moderated by Monika Messmer)

15:40 A. RIAR – Participatory organic cotton breeding approach to achieve sustainable development goals

16:00 E. NUIJTEN – Implementing the systems-based breeding concept

16:15 A. SCUDERI – Sustainability assessment of broccoli (*Brassica oleracea* var. *Italica*) production with deficit irrigation system in Sicily

16:30 R. LEITÃO – Successional agroforestry systems for Europe: the Portuguese example

16:45 General discussion

17:00 **Winners of the poster contest and quiz**

17:10 **Closing of the conference**

17:40 *Break*

17:45 **EUCARPIA Organic & Low-input section members meeting**

EXPLORING UNDERUTILIZED GENETIC RESOURCES

Intercropping maize and cowpea as a sustainable technique to adapt the production to climate change in Portugal

Paulo PEREIRA[1], Ana Maria BARATA[2], Graça PEREIRA[3], Carlos GASPAR[2], Paulo MARTINHO[1], Micha GROENEWEGEN[1], José COSTA[1], Madalena VAZ[2], João MEXE[3], Manuela MENESES[3]

[1]Living Seeds Sementes Vivas S.A, Idanha-a-Nova, [2]INIAV, Portuguese National Genebank (BPGV), Braga, [3]INIAV- Elvas, Elvas. Corresponding author: paulo.pereira@sementesvivas.bio

Introduction: There are several local populations of cowpea (*Vigna unguiculata* (L.) Walp.) in Portugal which can be intercropped with maize with various potential benefits, however, there is little information on this intercrop in Portugal or in similar contexts.

Goals: Identify the best genotype combinations of cowpea and maize, to optimize the seed rate and the number of the irrigations during the crop cycle.

Material and methods

Field experiments took place over three years (2018 to 2020) in three locations in Portugal: Braga (North), Idanha-a-Nova (Center) and Elvas (Alentejo);

Experimental design: 2018: 11 treatments, 3 replications, plots with 3-4 m^2, ; 2019: 3 treatments, 3 replications, plots with 10 m^2 ; 2020: 2 treatments, 3 replications, plots with 10 m^2.

2018: eleven populations of cowpea were characterized in order to find the three best, crossing the results of the locations;

2019: the three populations of cowpea (Fradel, Cp 5847 and Cp 5849) were intercropped with a Portuguese cultivar of maize, in two different sowing densities;

2020: after choosing the most suitable sowing density of cowpea, two different irrigation levels were tested;

Data collection: germination (%), colour of flowers, number of days until flowering, maturity and harvest, yield (g/plot),LER, 100-seed weight (g) and protein (%)

Results and discussion

Table 1: LER ratio at 2019 trial

Plot	Treatment	Place		
		Braga	Elvas	Idanha-a-Nova
Maize +Fradel	T2	0,95	1,65	1,05
Maize +Fradel	T3	0,81	1,23	0,96
Maize + Cp 5849	T2	0,92	0,73	1,03
Maize + Cp 5849	T3	0,84	0,99	1,07
Maize + Cp 5847	T2	0,97	0,94	1,02
Maize + Cp 5847	T3	0,94	0,84	0,86

In Braga, either in normal sowing density (T2) or in half of it (T3), there was no value equal to or greater than 1. In Elvas, both sowing densities with the Fradel variety showed a value greater than one. Finally, in Idanha-a-Nova, of the 6 options resulting from the 2 treatments and 3 genotypes, the LER was greater than 1 in 4 of them

Figure 1: Maize intercroped with cowpea in Braga

Figure 2: Cp 5849 cowpea

Conclusions: Analyzing the index LER in Elvas and Idanha-a-Nova, some treatments showed values higher than 1, in contrast to what happened in Braga, which may indicate that the intercrop is more favorable in places where temperature are higher and there is low humidity in the soil.

This research was supported by the ConVIGNA project (PDR2020-101-031658)

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GWAS to identify loci conferring resistance to anthracnose in white lupin

Lupin anthracnose caused by the seed- and air-borne fungal pathogen *Colletotrichum lupini* is devastating white lupin (*Lupinus albus*) cultivation worldwide. Its high yield potential and protein quality could make white lupin a sustainable alternative to soybean in temperate zones but resistance against anthracnose needs to be substantially improved. We performed a genome-wide association study (GWAS) on a diverse collection from the white lupin center of origin located around the Mediterranean. Genotyping resulted in 4603 high quality SNPs for 174 genotypes. Significant associations were found for average disease score and relative shoot fresh weight. The identified SNPs were found within candidate genes suggested to be involved in biotic and abiotic stress responses in the family *Fabaceae*.

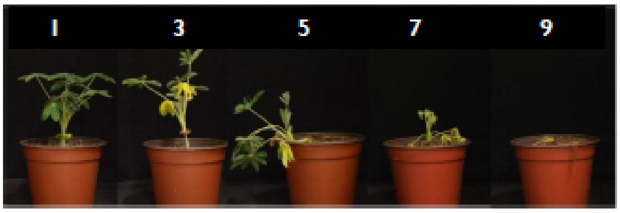

Figure 1. Disease score ranging from 1 (healthy) to 9 (dead). Alkemade, J.A. *et al.* (2021) A high-throughput phenotyping tool to identify field-relevant anthracnose resistance in white lupin. *Plant Dis.* https://doi.org/10.1094/PDIS-07-20-1531-RE.

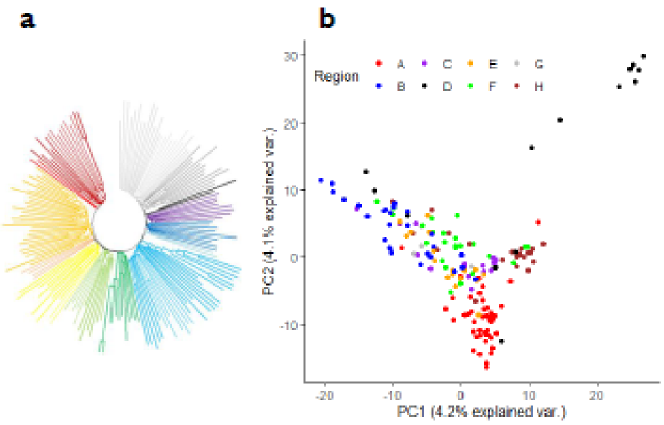

Figure 2: Genetic diversity and population structure (a) Neighbor joining (NJ) tree, color represents different clades. **(b):** Principal component analysis (PCA) showing first two components, colors indicate collection regions.

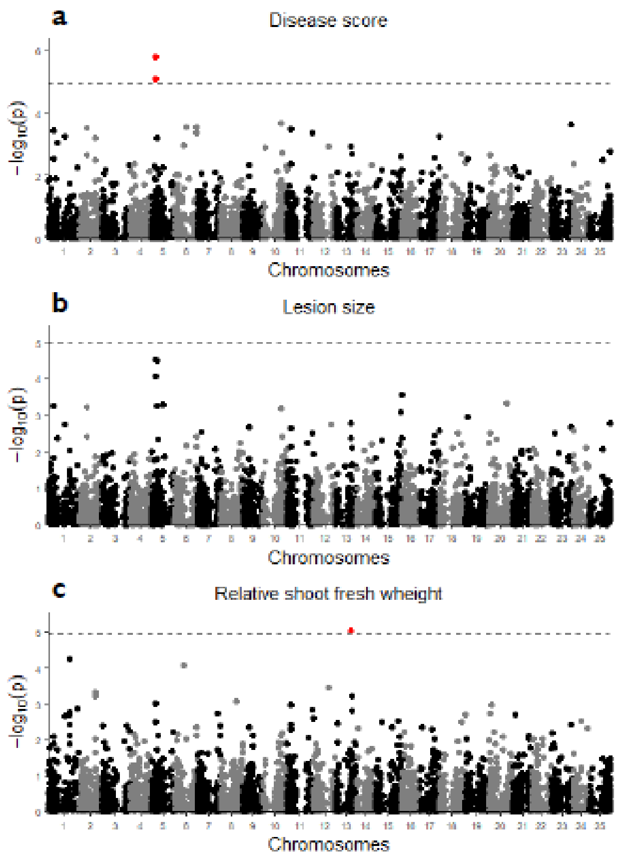

Figure 3: Manhattan plots from GWAS analyses for (a) disease score, **(b)** lesion size and **(c)** relative fresh shoot weight. Dashed line represents Bonferroni threshold of 4.96.

The project was supported by the EU HORIZON 2020 project LIVESEED under the Grant Agreement no 727230 , and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.0009, and the Federal Office for Agriculture (FOAG)

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SELECTION OF ADVANCED LINES FROM ONFARM CONSERVED DURUM WHEAT LANDRACES FOR RAINFED CONDITION OF TURKEY

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Introduction

Durum wheat (*Triticum durum* L.) is a staple food sources of highland farmers in Turkey and used not only for traditional macaroni but also bulgur production which is common energy sources in Turkish cousin. Rain-fed conditions under Turkish highland are characterised severe drought period especially from heading (Z50) to end of dough stage (Z89) so semi-dwarf durum wheat cultivars are not able to tolerate this constraint. Additionally, consumers have been demanding more traditional bulgur and macaroni prepared by durum wheat landraces. Therefore, the aim of this project to select new durum wheat advanced lines suitable for rain-fed condition of Central Anatolian region among Turkish durum wheat landraces cultivated under on-farm conservation system.

Material and Methods

Totally 20 different farm conserved durum wheat population from mountainous areas of Turkish highlands were sampled in the first year of the project and 185 different single spikes were selected based on spike and plant morphologies. Then, each single spike was planted together with semi-dwarf checks under rain-fed conditions of Central Anatolia to test winter hardiness, drought and yellow rust resistance and 33 head rows were selected based on phenotypic selection. In the third year, these lines were tested under augmented design together with two common checks (cvs Kiziltan 91 and C-1252) to examine grain yield and some quality parameters.

Results

There were great variation among selected lines especially for grain quality parameters such as sds sedimentation from 17.0 to 35.0 ml, semolina color from 23.4 to 29.3, wet gluten from 30.6% to 50.7%, and gluten index from 61,5 to 95,0. In addition to grain quality parameters, grain yield of these lines were also very comparable to semi-dwarf checks and they changed from 1,38 t ha^{-1} to 6.03 t ha^{-1}. Among these lines, especially Line 22 with 6,03 t ha^{-1} yield, 27,6 semolina color, 30.6% wet gluten and 90% gluten index was very promising compared to semi dwarf common checks.

Conclusion

The selection study carried out during the last three years showed that the durum wheat landraces still have great potential to select superior genotypes in terms of both grain yield and quality especially for rain-fed conditions of Turkey as indicated by Akar et al 2009 and Newton et al 2010.

Acknowledgement

We kindly acknowledge CEO of TASACO seed company who fully covered all expences of the study.

References

Akar T., Mert Z., Yazar S., Sanal T., Avci M., "Sustainable use of winter Durum wheat landraces under Mediterranean conditions", AFRICAN JOURNAL OF BIOTECHNOLOGY, vol.8, pp.4108-4116, 2009

Newton A.C., Akar T., Baresel J.P., Bebeli P.J., Bettencourt E., Bladenopoulos K.V., et al., "Cereal landraces for sustainable agriculture. A review", AGRONOMY FOR SUSTAINABLE DEVELOPMENT, vol.30, pp.237-269, 2010

UNTWIST

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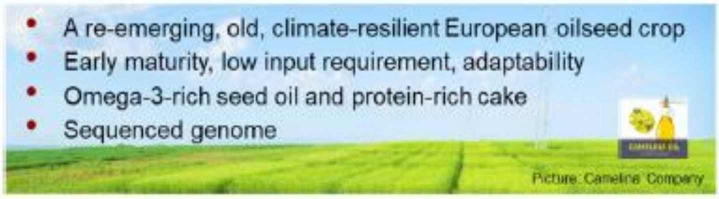
UNCOVER AND PROMOTE TOLERANCE TO TEMPERATURE AND WATER STRESS IN *CAMELINA SATIVA*

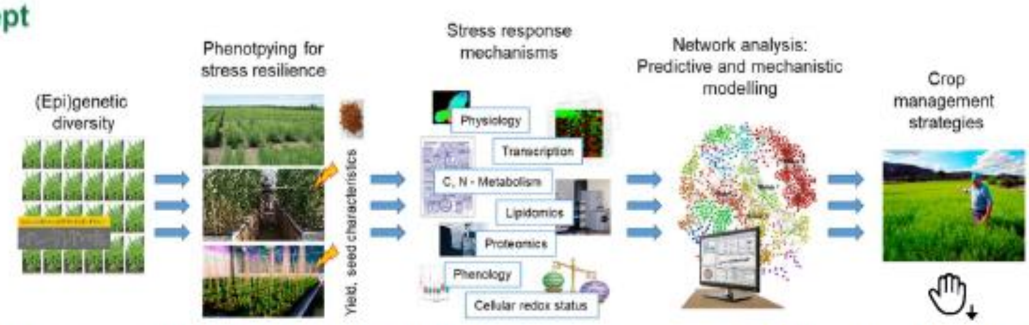
Project coordination: Claudia Jonak,
claudia.jonak@ait.ac.at
AIT - Center of Health & Bioresources

AIT, INRAE, ROTHAMSTED RESEARCH, JÜLICH, Camelina Company | España, Iniciativas Innovadoras, RTDS GROUP



The **UNTWIST** project is based on the **premise that the unravelling of stress adaptation mechanisms in the naturally resilient** and native European oilseed crop **camelina**, which has **not yet undergone intensive breeding, will reveal successful stress adaptation strategies**, which can be **exploited for increasing yield stability in adverse and changing environmental conditions** of camelina and other crops.

Concept



- Understand **mechanisms underlying adaptation of crops** to diverse and extreme local growth conditions;
- **Improve prediction of crop adaptation** in response to environmental stress by more accurate modelling;
- Translate into **crop improvement & optimized management strategies**.

Stakeholder

Researchers, Students & Experts
- Knowledge on Mechanisms of plant abiotic stress tolerance
- Improved cross-disciplinary biological understanding
- Verified yield gap analysis & models for crop plasticity and adaptation to changing environments
- Agronomic management

Breeders, Famers & Farmer associations
- Metabolic & SNP markers
- Optimized and locally adapted crop management practices
- Climate-smart cropping
- Elite camelina germplasm
- Easy-to-use predictive models

EU authorities & Policy makers, International organizations, NGOs, Media
- Benefits of camelina
- Adoption of climate resilience into agronomy
- Stability of vegetable oil supplies to EU industries
- Opportunities for socio-economic development in marginal agricultural areas
- Overcoming uncertainty on EU food security

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EUCARPIA Breeding and Seed Sector Innovations for Organic Food Systems
8 – 10 March, 2021
LIVESEED

COMPARISON OF BIOCHEMICAL PROFILE AND ANTIOXIDANT CAPACITY AMONG TUNISIAN AND ITALIAN CULTIVARS OF CAULIFLOWER

Hajer Ben Ammar[a], Souhir kabtni[a], Dorra Sdouga[a], Maria Concetta Di Bella[b], Simone Treccarichi[b], Ferdinando Branca[b], Sonia Marghali[a].
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b Department of Agriculture, Food and Environment (Di3A), Università degli Studi di Catania, Catania, Italy.

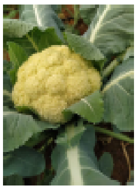
Introduction

The nutraceutical profile of vegetable products is becoming an interesting issue among consumers, being increasingly demanding in terms of functional foods. Among the leafy vegetables, particular consideration has been paid to Brassicacea vegetables for the relevance of their health products (Toscano et al., 2019).The principal vegetable species is *B. oleracea*, which includes vegetable and forage forms, such as kale, cabbage, broccoli, cauliflower and others (Soengas et al.,2011) . The Mediterranean region, especially Sicily, is considered as the main diversification center of the Brassica L genus, where the cytodeme is represented by wild relatives. (Branca et al., 2013). Various researches have been carried out on *Brassica oleracea* plants native of this region focusing on their biochemical variability. Thus this family could be considered as a good source for polyphenols (Sun et al., 2013).The availability of phenolic compound and flavonoids in food has aroused an increasing interest due to their excellent biological effects (Jahangir et al., 2009). Furthermore, the nutritional interest of Brassica crops is relatively linked to their phenolic compound contents, however, the biosynthesis and the concentration of those compounds depends on the genetic environmental factors (Cartea et al.,2010). The high antioxidant potential of several brassica vegetables has been reviewed by Soengas et al(2011).The antioxidative effect is performed through different mechanisms the most general and important of which is direct radical scavenging which depends on the chemical structure of the flavonoids involved (Nijveldt et al., 2001).. The metabolite profiling of *Brassica oleracea* has up until now been carried out using high- or ultra-high-performance liquid chromatography (HPLC,UHPLC).

MATERIAL & METHODS

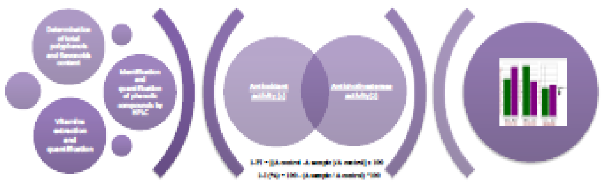
1- Plant materials and Sample extraction

In this study we used 6 Tunisian and Italian Brassica cultivars of cauliflower (*B. oleracea. var.botrytis*) . Plants were grown under field conditions in a botanic garden in the University of Catania Di3A .Leaves were harvested in June2019 ,stored in -80° than lyophilized and ground into a powder to preserve the antioxidants content. Freeze-dried material were stored for further analysis.



The phenolic extraction was performed according to Vallejo et al(2002), slightly modified , 2 g of freeze-dried leaves were diluted in 20 mL of 80 % methanol/ water at room temperature for 15 min under shaking. After one hour, the mixture was incubated at 4°C for 24h and then filtrated with the Whatman paper. The volume of each extract was reduced by a rotary pressure evaporator .The dry residues were weighted and conserved at 4°C for the ultimate analysis.

2- Methodology



RESULTS

Biochemical potential of 3 Tunisian cultivars of *Brassica oleracea botrytis*

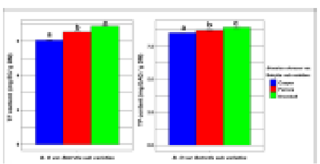


Fig. 1: The variation of the content of TF and TP among Tunisian cultivars.

The TFC were calculated ins mg of quercetin equivalents per gram of leaves extract (mg QE/g). The recorded flavonoids content ranged from 6.87mg to 6.05 mg QE /g D.W as showed in figure 1 respectively for the cultivars the cultivar snowball showed the highest level. The flavonoids contents of all extracts are significantly different from each other. The cultivar ferrara shows a significant difference among the other two cultivars with the highest amount (0. 2167mg/.g.d.w).

The results of the vitamin C amount, measured by acid ascorbic (AA), is shown in Figure 2, the difference between the three Tunisian cultivars of *Brassica oleracea* var *botrytis* were noticeable. The maximum content was observed in the accession snowball with 2.495mg/g.d.w.

The chromatographic profile of the extracts shows a single peak in accordance with standards. We noted that the alpha-tocopherol has been identified and quantified for all cultivars. The compounds are expressed in mg of alpha-tocopherol per g of dry material. *Brassica oleracea* has mean value of alpha-tocopherol content in the order of 0.1136mg/g.d.w.

For the Total cartenoids,the Tunisian cultivar ferrara shows a significant difference among the other two cultivars with the highest amount (0. 2167mg/.g.d.w).

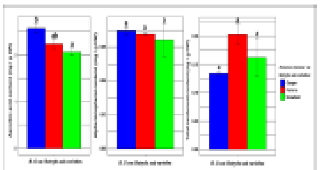


Fig. 2: Vitamins and total carotenoids profile of Tunisian cultivars (expressed in mg/g.d.w)

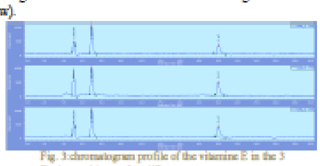


Fig. 3:chromatogram profile of the vitamine E in the 3 Tunisian cultivars of cauliflower

Total and individual phenolic levels varied significantly among cultivars. The difference in quantity is outstanding, epicatechin-3-O-gallate was the predominant compound in the three Tunisian cultivars especially in the extract of the cultivar ferrara, it is also important to underline the abundance of epigallocatchin.

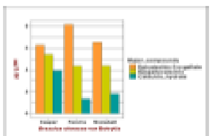


Fig. 4:Profile of the major phenolic compounds of the Tunisian cultivars expressed in µg/g DW.

The DPPH quanching activity of the cultivar ferara was significantly higher compared to the other cultivars. According to our results, there is a significant variability on the capacity level between the studied cultivars.

In this study, we tested the ability of methanolic extract from cauliflower leaves to inhibit the enzyme acetylcholinesterase. According to our results (figure5), it's shown that a low concentration (0.005mg/ml) of the extract of the cultivar casper has the highest capacity of the inhibition compared to the other Tunisian cultivars studied.

In fact, a significant difference (p value=0.0006) in the anti-acetylcholinesterase activity was reported between the different samples by the ANOVA test.

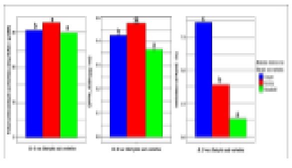


Fig.5: The comparison of TP and TF content between the Tunisian and Italian varities of cauliflower.

2- Comparison between Tunisian and Italian cultivars of *Brassica oleracea botrytis* (Means)

The finding obtained indicate that there is difference between the different cultivars of cauliflower from different origin. As it is illustrated, the Italian cauliflower exhibit the highest content of both flavonoids (7.41mgEAG/g DW), and total phenolic (10.88mgEAG/g DW). These results were confirmed by the ANOVA test revealing a significant difference in the polyphenol contents between the Tunisian and the Italian varieties (p value=0.0000546) (p value= 0.0177) respectively.

The finding obtained indicate that there is difference between the different cultivars of cauliflower from different origin. As it is illustrated, the Italian cauliflower exhibit the highest content of both flavonoids (7.41mgEAG/g DW), and total phenolic (10.88mgEAG/g DW). These results were confirmed by the ANOVA test revealing a significant difference in the polyphenol contents between the Tunisian and the Italian varieties (p value=0.0000546) (p value= 0.0177) respectively.

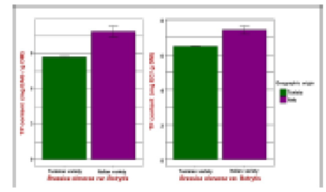


Fig.6: The comparison of TP and TF content between the Tunisian and Italian varities of cauliflower.

Regarding the factor of the geographic origin, it can see that the Tunisian varities has the lowest antioxidant anti antricholinesterase activities comparing to the Italian varities which has the highest mean values for bioactive compounds as it was mentioned previously .

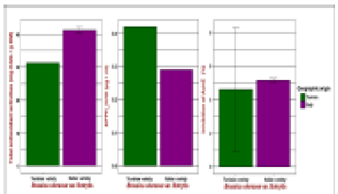


Fig.7: The comparison of antioxidant, IC50 of DPPH. free radical and anticholinesterase activities of methanolic 80% extract of Tunisian and Italian varities of cauliflower .

Discussion et Conclusion

This study aims to valorise cauliflower leaves by exploring their flavonoid and phenolic yield, the antioxidant activity of this part of the plant through the Tunisian cultivars and the correlation between antioxidant activity and the phenolic content. In second step, a comparative study will be done between Tunisian and Italian varieties and its activities. The variability of the vitamin content between the cultivars suggests that the genotype may be involved in this variation. In fact, the variability in total carotenoids, tocopherols and ascorbic acids levels reported in these three cultivars may be related to the allelic variability. , many parameters can influence plant secondary metabolite profile, the abiotic and biotic factors and the post-harvest conditions affect the flavonoid content and composition in plants.

A promote to the entire exploitation of the cauliflower could come from the appreciation of all the parts of this plant. In this case the leaves are considered as generating more economic products of interest. In nature, genotype and ecological parameters influence general phenolic contents (mostly flavonoids and hydroxycinnamic acids) and their antioxidant activity in plant tissue (Zietz et al., 2010). The methanolic extracts from brassica were selected as promising candidates as sources of potent AChE inhibitors as well as antioxidants. Moreover, lots of parameters necessary for data reproduction or comparisons were often neglected or unmentioned, which impedes progress in flavonoid research. Another factor varying between previous studies is the choice of quantification method.

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EXPLOITATION OF B. OLERACEA COMPLEX SPECIES (N=9) FOR INCREASING THE RESISTANCE TO XANTHOMONAS CAMPESTRIS PV. CAMPESTRIS IN THE RELATED CROPS (Brassica oleracea var botrytis x Brassica oleracea var italica)

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BRESOV

UNIVERSITÀ degli STUDI di CATANIA

Università degli Studi di Palermo

INTRODUCTION

Black rot caused by the bacterial pathogen *Xanthomonas campestris* pv. *campestris* (Xcc) is considered one of the most serious diseases of Brassicaceae [1]. This vascular disease affects economically important brassica crops as well as spontaneous ornamentals and weeds. Seven Xcc races have been described and races 1 and 4 are the most widespread in Europe [1,2].

V-shaped necrotic lesions on leaf margin surrounded by yellow halos and blackening of the vein are the typical symptoms of black rot disease

Xcc dissemination at medium or long distance is provided mainly by seed and infected seedlings) Wind, aerosol, rain, insects, irrigation and other crop operations contribute to the formation of a secondary epiphytic inoculum of the bacterium, which invade the vascular veins through the hydathodes.

The control of black rot is difficult and relies on the use of pathogen-free planting material and the elimination of other potential inoculum sources.

Brassica B-genomic crops including *Brassica nigra B. juncea* and *B. carinata* are resistant to race 1, A-genome crops including *B. rapa* , *B. juncea* and *B. napus* are resistant to race 4, [3,4]. Maior gene resistance is very rare in *B. oleracea* (brassica C genome). A high resistant accession of *B. montana* (UNICT5169) to Xcc race 4 was previously identified [5].

In order to select new source of resistance, the response of 28 Brassica accessions in the Di3A collection to the inoculation of *Xcc* races 1 and 4 was evaluated.

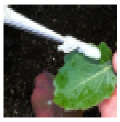
MATERIALS & METHODS

Plant materials

Twenty-eight accessions from ten species obtained at UNICT (DI3A, University of Catania) were inoculated with two *Xcc* strains, DAPP-PG 308 (race 1) and PVCT62.4(race 4).

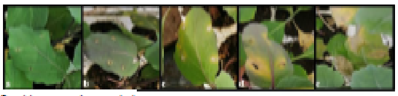
No. accessions	Brassicas accessions	UNICT code
1	*B. bourgeaui*	4786 BBO4
2	*B. hylarionis*	SP41 BHI1; SP42 BHI2
1	*B. drepanensis*	4796 BD 4
2	*B. incana*	3512 BY5/1; 3513 BY6/2
2	*B. macrocarpa*	4481 BM3R; 3370 BM6
1	*B. villosa*	4275 BV7R
4	*B. oleracea* var. *botrytis*	3154 CV553/2; 428 CV26; 3151 CV159R/2/1; 421 CV19
5	*B. oleracea* var. *italica*	71 BR41S2C; 709 BR41S2/2; 710 BR41S2E; 4852 BR325; 4939 BR354
7	*B. oleracea* var. *acephala*	4853 BH 86; 4003 BH; 4005 BH; 4591 BH1R; 4538 BH10; 4601 BH51R; 4448 BH 81
8	*Sinapis alba* ssp. *alba*	3600 SA5; 4257 SA6; 4296 SA8

Inoculation method and disease evaluation



Three youngest leaves of each plants were wounded at the secondary veins by using a mouse tooth forceps wrapped in cotton and immersed in a bacterial suspension (10^8 cfu ml^{-1}).

Plants were scored for disease symptoms 7, 15, 20 and 21 days after inoculation using a 0–4 disease scale.



0 = No symptoms (a)
1 = Small necrosis or chlorosis around the site of infection (b)
2 = Small lesions with black ribs with a diameter of less than 1 cm (
3 = Lesions with black ribs with a diameter greater than 1 cm (d)
4 = Confluent lesions covering at least 50% of the leaf surface (e).

The disease index (DI) and the area under disease progress curve (AUDPC) were calculated using the following formulae:

*DI =[Σ (f x v)] * 100 / N x V*

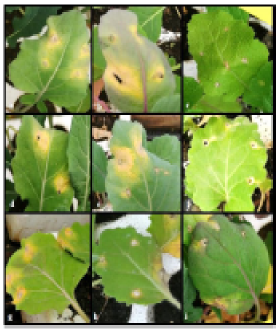
f, value of the rating score,
v, the number of plants in a class
N, the total number of plants observed
, the highest value of the rating score

$$AUDPC = \sum_{i=1}^{n-1}\left[\left(\frac{y_i+y_{i+1}}{2}\right)*(t_{i+1}-t_i)\right]$$

n, the number of evaluations,
y , disease indexl
T, the number of days after Xcc inoculation

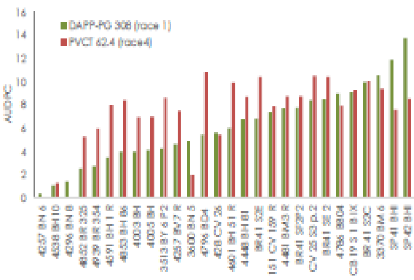
DI and AUDPC values were analyzed using one-way ANOVA and the difference between the mean values were separated by Student Newman Keuls at P= 0.05. Statistical analysis was performed by using Statgraphics PLUS 5.1.

RESULTS & CONCLUSIONS



The symptoms recorded at the first date very often coincided with small chlorotic or necrotic areas around the wound. No symptoms or necrotic area surrounding the inoculation point was recorded as 0 (resistance). Symptoms evolved according to the inoculated species with black vein in areas adjacent to the inoculation point surrounded by chlorotic areas. In later stages the leaves of the most susceptible species wilted.

A significantly different response of the accessions to the inoculation with the two Xcc strains was observed. AUDPC values ranged from 0.38 to13.75 and from 0 to11.50 when the accessions were inoculated with the race 1 or race 4, respectively. Two out three accessions of *Sinapis alba* spp. *alba* (SA 6 e SA 8) revealed the lower AUDPC value and were resistant to both races, while the accession SA5 was more susceptible to PVCT 62.4 (race 4) than to DAPP-PG 308 (race 1).



Accessions of the other *Brassica* species, except *B. oleracea*, were susceptible to both strains, whereas the accessions of *B. oleracea*, as reported in the literature, showed a variable susceptibility with differences related to the varietas and the accession. *B. oleracea var acephala* BH 10 and *B. oleracea* var. *italica* BR 354 showed the significantly lower AUDPC values than the other accessions within the *B. oleracea* varieties.

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EUCARPIA

BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS

8 - 10 MARCH 2021

LIVESEED

NEIKER MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Behavior of a Wheat Landraces collection from Basque Country face to Bunt infection (*Tilletia caries*) in Organic field trials

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In recent years, NEIKER (Basque Institute for Agricultural Research and Development), has been working both on the conservation and on promoting the use of soft wheat local landraces in organic production (Ruiz de Galarreta et al. 2014, Akizu et al. 2007) The interest of Spanish landraces in research is increasing, as their characteristics are considered to be largely unknown (Giraldo et al. 2010)

The organic producers in the Basque Country face the challenge due to the repeated bunt infections of the landraces self-multiplied by themselves. To solve this problem, in 2017 NEIKER began a series of trials with the aim of finding better management methods for cropping landraces. The objective was to find the most appropriate treatment of the seed to avoid bunt infection. Results of the first trial made in 2017 with 15 landraces and 1 check showed a differential behavior of landraces in the presence of bunt in soil (Ruiz de Arcaute et al. 2018).

23 landraces and 2 checks (table 1) were tested in 2018-2019 in a trial in organic certified fields in NEIKER, looking for the best management face to bunt infection (*Tilletia caries*). Wheat landraces were in cultivation till July 2019 in a RCB design with 4 blocks in micro-plots of 12 m². Four treatments were tested (one was control) in every landrace. The plots were collected and 2 random samples of approximately 1000 grains each were checked for the presence of bunt infected grains, counting this number and obtaining the percentage of bunt infection of every plot. The ANOVA made including as variation sources, landraces, treatments pooled (yes: with treatment /no: without treatment) and the interaction landraces*treatments gave the result showed in table 2.

Table 1. ID CRF Code, Common name and Origin of wheats in 2019 trial

CRF Code	Common name	Origin
BGE011944	Mocho de Alava	Alava-Araba
BGE011959	Mocho velloso de Garay	Bizkaia
BGE011960	Mocho velloso de Alava	Alava-Araba
BGE011966	Mocho de Gipuzkoa	Gipuzkoa
BGE012110	Blanco de Abadiano	Bizkaia
BGE012115	Blanco mocho	Alava-Araba
BGE012118	Involcable	Alava-Araba
BGE012191	Mocho rojo	Alava-Araba
BGE012194	Hernani	Gipuzkoa
BGE012201	Martzela	Bizkaia
BGE012203	Vitoria temprano	Alava-Araba
BGE012214	Mocho Rioja	Alava-Araba
BGE012216	Mocho velloso Gipuzkoa	Gipuzkoa
BGE012238	Involcable de Zambrana	Alava-Araba
BGE012292	Garay	Bizkaia
BGE012890	Etxano	Bizkaia
BGE012891	Gipuzkoa2	Gipuzkoa
BGE012892	Gipuzkoa1	Gipuzkoa
BGE013174	Gordejuela	Bizkaia
BGE013801	Rojo de Sabando	Alava-Araba
BGE014283	Gipuzkoa3	Gipuzkoa
BGE018233	Bergara temprano	Gipuzkoa
BGE018356	Amorebieta	Bizkaia
Check	Rex	N/A
Check	Florence-Aurore	N/A

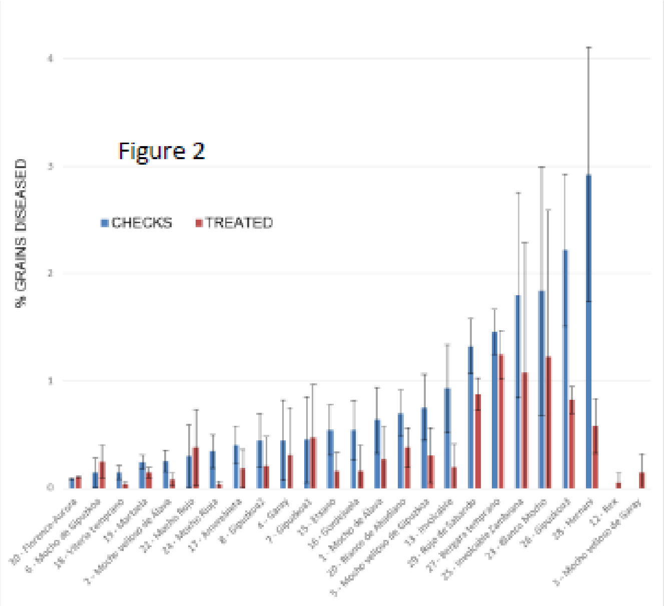
Table 2. ANOVA

Variation sources	df	MS	F
LANDRACES	24	0,7382	***
TREATMS (Y/N)	1	2,8593	***
LANDR*TREATMS	22	0,2123	ns

The ANOVA showed significant differences between landraces in their behavior face to bunt infection, and between pooled treatments, where the application of the treatments supposes a decrease in the level of infection. Analysis did not found interaction landraces and treatments.

The behavior of the landraces is shown graphically in figure 2.

Some genotypes show differential behavior in the presence of bunt, with very low levels of infection even if no treatments were applied. Some genotypes show the same pattern as in the 2017 trial.



It seems that some kind of resistance to bunt infection can be found in some Basque landraces. It can be of great importance in the creation of the new OHM allowed by EU organic regulations.

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EUCARPIA *Breeding and Seed Sector Innovations for Organic Food Systems 8-10 March, 2021* LIVESEED

ON-FARM TESTING OF EMMER AND EINKORN LANDRACES UNDER ORGANIC CONDITIONS IN HUNGARY AND THE SLOVAKIAN UPLAND

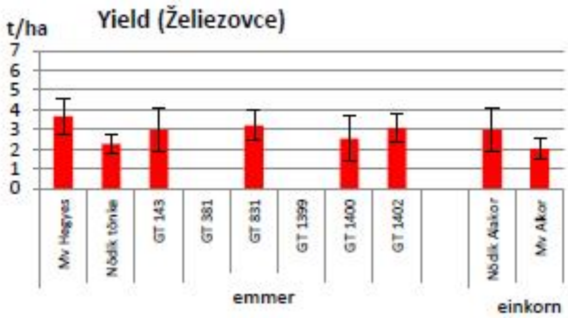
Judit FEHÉR, Szilvia BENCZE, Péter KALLÓ, Mihály FÖLDI, Péter MIKÓ, Dóra DREXLER

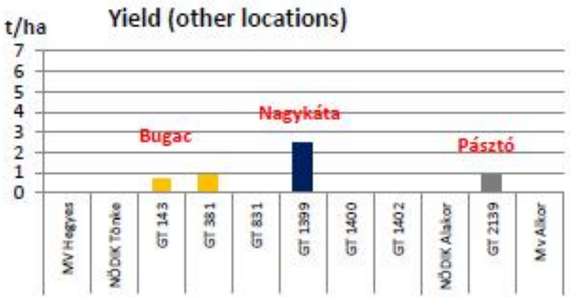
Objectives:

Are ancient cereals suitable alternative crops to diversify organic farms?
Which cultivars are the most successful in a certain area of the country?

Results I.

Under favorable conditions there is a relatively high yield of emmer and einkorn, moreover, landraces can even outperform registered varieties.
Under poor, extensive conditions (e.g. Nagykáta), emmer accession GT 1399 produced similar yield (2,5 t/ha) on-farm, as on-station.
Low performance (< 1 t/ha) of emmer cultivars in Bugac are due to extreme drought and marginal sandy soil conditions.





Methods:

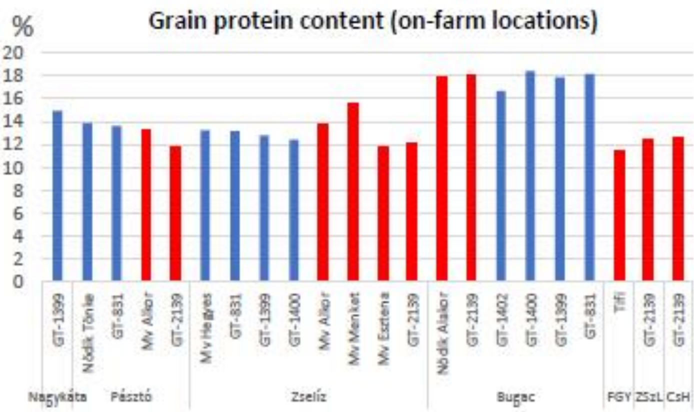
On-farm test (organic) + on-station test (conventional low input) between
On-farm test: 2018/2019 →4 locations, 2019/2020 →3 locations
Želiezovce (rich soil), Nagykáta (poor soil), Bugac (very poor soil)
9 emmer and 2 einkorn landraces + registered varieties (2 emmer and 3 einkorn) were investigated
Not all cultivars were tested in all locations

Results II.

In 2019, Fusarium was a significant problem in the country, however the organic on-farm emmer and einkorn accessions generally were much less affected than common wheat varieties. Nevertheless, on all sites, mycotoxins (DON and ZEA) were either not detectable or their levels were way below the limit set on kernels, even in the case of more severe spike infection, which is another advantage of hulled cereals.

Most emmer varieties were very tolerant to diseases, and especially the einkorn landraces were completely resistant to leaf fungal diseases based on the present and previous results.

While both emmer and einkorn cultivars have a higher protein, flavonoid and lipid level and antioxidant activity compared to common wheat, einkorn accessions show a higher level of bioactive components compared to emmer cultivars.



Next steps:

- Value-chain building based on ancient cereals
- Good quality seed production in suitable quantity for farmers

Conclusions:

Einkorn, considered the most ancient wheat species, has exceptional characteristics, including disease resistance and very high bioactive component content.
We proved that both emmer and einkorn can be grown successfully under low-input organic conditions while keeping their high grain quality. The cultivation of both species could help to achieve a more diverse and sustainable agriculture.

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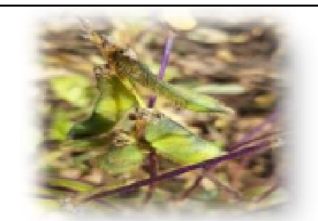

PRODUCTIVITY OF SOYBEAN VARIETIES IN ORGANIC CULTIVATION PRACTICE IN LATVIA

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Soybean adaptation in Baltic / Nordic region is a new opportunity and challenge resulting from climate change. This was evidenced by the increase in soybean sown areas in recent years in Lithuania to 2 100 and in Latvia - 298 ha (2019). There is a demand for GMO-free soy, especially soy that is grown using organic farming practices.

The selection work has resulted in development of especially early varieties (000 or 0000 group), which are suitable for cultivation in regions where the sum of the effective temperature is lower (1500 - 1800°C). **The aim of this study** was to evaluate the productivity potential and suitability of soybean varieties created in Europe for cultivation in Latvian agroclimatic conditions, applying organic cultivation practices.

Materials and Methods. The research was conducted in 2018 and 2019 at the AREI Stende Research Centre (57°11'20"N, 22°33'43"E). The study includes 15 soybean varieties from European countries with environmental conditions similar to those of the Baltic region. The trials plots - 10 m^2 plots in 4 replicates, sowing rate 60 germinating seeds per 1 m^2, no additional fertilizer, pre-crop - barley, weed control - mechanical. The seeds were treated with Rhizobium bacterial product HiStick® before sowing.

The soil characteristics of the test field: clay sand structure, organic matter – 2.1-2.2%, pH 5.6 – 5.8, K_2O – 106 – 197 mg kg-^{1}, P_2O_5 – 128 – 172 mg kg-^{1}.

Meteorological conditions. In 2018 and 2019, the sum of active temperatures during the vegetation period was similar - close to 2000° C, however, in 2018 this amount was reached in 117 days, but in 2019 - in 135 days. In 2018, the productivity of soybeans was adversely affected by the lack of precipitation, in 2019, the development of soybeans was limited by temperatures, significantly lower than the norm.

Results

Table 1. Soybean productivity indicators, average in 2018 and 2019

Year	Pods per plant	Seeds per pod	TSW, g	Plant productiv., g	Plants per m^2	Yield, g m^2
2018	12.5±1.6	1.8±0.08	165.4±2.2	3.8±0.23	42.1±2.9	152.5±12.6
2019	34.5±2.9	1.9±0.08	180.6±2.0	11.9±1.15	13.9±1.4	144.1±24.2

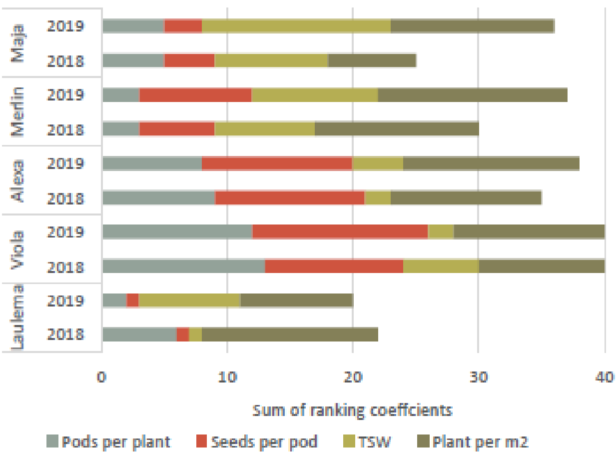

Figure 2. Sum of ranking coefficients of the most productive soybean varieties (in comparison with the variety 'Laulema'), 2018 and 2019.

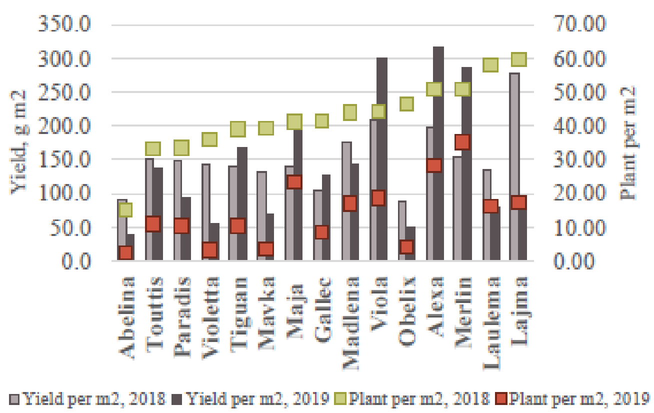

Figure 1. Yield of soya varieties (g m^2) and plant number per m^2

Summary

- Plant density per m^2 is of great importance in assessing soybean field productivity (r_{2018} = 0.626, r_{2019} = 835). The germination of soybeans in the field is significantly affected by meteorological conditions (2018 - lack of moisture, 2019 - persistently low soil temperature).
- Soybean varieties with the highest number of pods had higher plant productivity (r_{2018} = 0.821 and r_{2019} = 0.944).
- Using organic cultivation practices, soybean varieties 'Alexa' and 'Viola' showed the highest productivity in both years, respectively 257 and 254 g m^{-2} in two years.

The research was carried out with the State and EU support measure "Cooperation" 16.1.financial support for EIP working group project No. 18-00-A01612-000015.

NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020
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EVALUATION OF 50 PORTUGUESE LANDRACES, OPEN-POLLINATED POPULATIONS AND COMPOSITES OF MAIZE (*ZEA MAYS* L.) IN LOW INPUT ORGANIC SYSTEM VERSUS CONVENTIONAL IN PORTUGAL.

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Introduction:

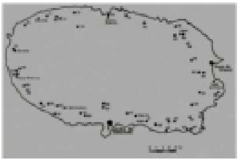
Due to the success of Hybrid-maize (*Zea mays L.*) in Portugal, many open-pollinated landraces have reached the status of underutilized crops. It represents loss of genetic adaptation to a wide range of ecosystems and to human and animal consumption. The objective of this work is to recover underutilized populations of Portuguese maize germplasm with gastronomic potential.

The HUNTERS scale (High, Uniformity, aNgle, Tassel, Ear, Root lodging and Stalk lodging) was developed by Silas Pêgo, in order to perform a summary and expeditious characterization of the biometric parameters of the plant and the ear (Mendes-Moreira et al, 2017). It was used in the characterization of germplasm during the project SOLIBAM and DIVERSIFOOD.

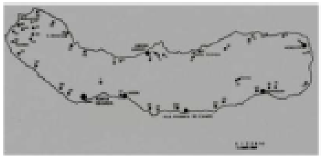
Materials and Methods:

The germplasm used for trials in 2020 included 50 accessions:

- 40 populations were collected in 1979 at Azores (Bettencourt and Gusmão, 1982) and multiplied in 2018 and 2019 at ESAC;
- 7 populations from the Participatory Plant Breeding Program "VASO" in Sousa Valley, Portugal
- 3 Composite Cross Population (CCP).

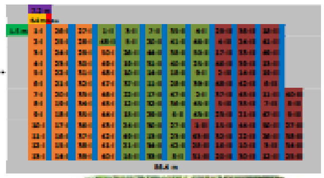


The collection missions took place both at Terceira Islands (left) and S. Miguel (right)



The low input organic agriculture (Caldeirão) and conventional agriculture trials distance 1.3 km

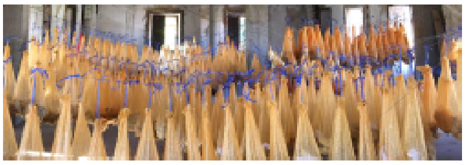
The trials followed the randomized complete block design with three replications



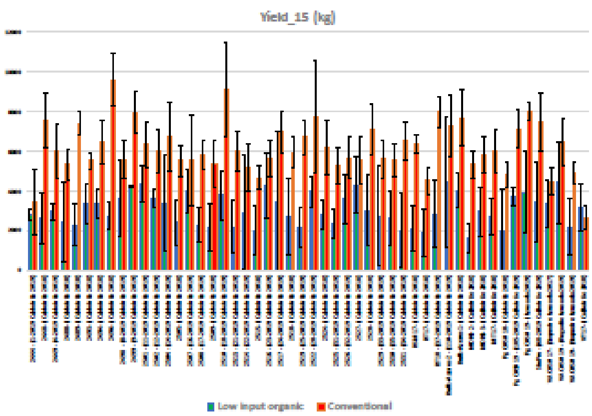
Data collection were based on HUNTERS descriptors, days to anthesis and Yield (Mg/ha, adjusted to 15% grain moisture) at harvest. Metric scale - plant height; Moisture meter - ISOELECTRIC GRAIN CHECK® and digital balance - PLJ 4000-2MKERN® for ears and cobs.

ANOVA - Data treatments

Results:



- The genotypes ranged from 57 to 75 days-to-anthesis.
- The low input organic system showed significant lower values for Plant Height, Uniformity, Leaf angle, Tassel, Ear placement and Yield.
- The yield average was 3049 kg/ha in low-input organic system and 6180 kg/ha in conventional system.
- Root lodging (R) shown values between 4.1% and 81,9% in conventional system and values between 0% and 93,1% in organic system. The Stalk lodging (S) shown values between 1,9% and 58,1% in conventional system and values between 0% and 66,7% in organic system.



Discussion

From the tested genotypes three of them were in the top ten of both systems (Pg COS0 19 - (Lousada 2019), 2499 and BulkAzores1).

The apparent soil deficiencies in the low input organic system did not mean significant differences in yield between the genotypes. However, we identified VA COS0 19 - (Regadio Lousada) (4314 kg / ha), 2501 (4249 kg / ha) and BulkAzores2 (4145 kg / ha) with higher yield and better adaptation to low input organic system.

Root lodging and Stalk lodging values indicate significant differences between genotypes, we identify Sinpre – (Caldeirão 2019) - CCP, with significant lower values in booth traits, revealing resistance to stem and root diseases.

Conclusion:

The present work made it possible to identify accessions adapted for organic farming and for low input sustainable systems. A more detailed study is needed on the viability of this germplasm for human consumption in order to fit into sustainable organic food systems.
Future studies will allow to identify the microbiome impact in plant adaptation and its correlations with agronomic performance.
Some of the populations tested (8) have been subject to Participatory Plant Breeding programs. The identification of new varieties will allow us to use established breeding protocols and develop more tools to fight global climate change.

Escola Superior Agrária LIVESEED

LIVESEED has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.

The authors acknowledge to BPGV for part of the maize collection that allowed the present trials and to ESAC-IPC's staff for their support on field work.

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BREEDING FOR DIVERSITY

Selecting Forage Legumes for Use in Mixture with Grasses

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LIVESEED

Question

Forage legumes are grown in mixture with grasses but often bred in pure stands: Would selection decisions be different if legume species are grown in a spaced plant breeding nursery with or without its future grass companion?

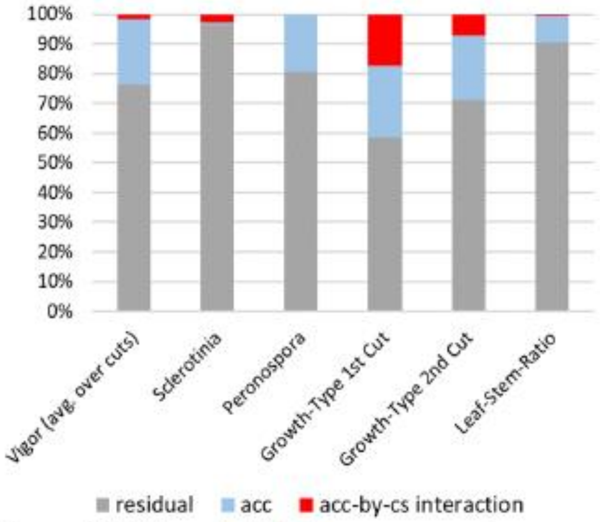

Figure 1. Relative extent of variance components

Method

Growing spaced plants of 50 alfalfa **accessions (acc)** in three different **cultivation systems (cs)**:

- **CON**: on bare soil (herbicide treatment)
- **LAWN**: undersowing with lawn type grasses
- **FORA**: undersowing with forage type grasses

Analysis: **Trait ~ cs + acc + cs:acc + residual**

> If cs-by-acc interaction = large (significant)
> & correlation (r_p) among cs = small
> → need to adopt nursery system with companion grasses

Table 1. Phenotypic correlation coefficients among cultivation sysems based on accession means (n=50)

Trait	r_p between treatments		
	FORA-LAWN	FORA-CON	LAWN-CON
Vigor (avg. over cuts)	0.83	0.77	0.75
Sclerotinia	0.15	-0.07	0.01
Peronospora	0.86	0.82	0.86
Growth Type 1st Cut	0.73	0.57	0.86
Growth Type 2nd Cut	0.77	0.79	0.78
Leaf-Stem-Ratio	0.62	0.71	0.47

Results and Conclusions

- **Vigor:** acc = high, acc-by-cs = low, r_p = high, indicating similar behaviour of alfalfa plants among cultivation systems
- **Sclerotinia:** acc = very low, acc-by-cs = low, r_p = very low, most probably due to inhomogenous disease pressure
- **Peronospora:** acc = high, acc-by-cs = very low, r_p = very high, due to homogenous disease pressure
- **Growth type (errect vs. prostrate):** acc = high, acc-by-cs = very high, r_p(FORA-CON) = moderate, due to strong effect of tall growing grasses in FORA during first cut on growth of alfalfa plants

Accessions grow differently under the tested cs, but no clear indication if FORA leads to different selection decisions compared to CON. A better understanding of acc-by-cs is needed. LAWN can be used as a compromise to allow for an easy selection and better predict performance in forage mixtures.
Next step: grow offspring from experimental selections in pure and mixed swards to test selection efficiency.

Figure 2. Alfalfa plants in spaced plant nursery using the CON, LAWN and FORA cultivation system

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Agroscope good food, healthy environment

Which morphological types are needed for organic mixed cropping of triticale with winter pea?

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Triticale is well known to be able to buffer the loss of peas during winter or disease attacks in spring under organic farming and can help to reduce lodging of peas. Triticale varieties Agostino, Vuka and Securo were combined with different winter peas, differing in height and leaf type over two seasons with three replications of any combination. Grown under certified organic farming with 120 kernels/m^2 triticale and 70 k/m^2 peas at location 53°12'49.3"N, 10°50'29.2"E about 70km south of Hamburg/Germany on a sandy loam. All peas consist as pairs of isogenic (4) breeding lines or similar variety types in length (2) differing in normal vs. semi leafless type for each couple.

Season 2018/19 gave only very low pea yields of 0,9-4,8 dt/ha and season 2019/20 normal 10,3-19,7dt/ha on average per pea line. Analyze of variance (Tab.1) was done for both years and showed only related to total yield calculated between pea lines a different result. Hypothesis of no difference could be discarded for yield of peas depending on pea variety, yield of triticale on yield of pea line and on triticale variety, total yield depending on triticale variety. An interaction between pea line and triticale variety could not be shown. It means that it is regardless which of the three triticale will be used to find the best yielding pea for this kind of mixing.

Variance analyse overview	Discard nullhypothesis		
Seasons 2018/19 + 2019/20	yield pea	yield triticale	total yield
between peas	Yes ***	Yes *	2019:No - 2020:Yes**
between triticale	No	Yes ***	Yes ***
Intereaction pea X triticale	No	No	No
rest	No	No	No
level of significance	*=<0,05	**=<0,01	***=<0,001

Table 1 Results of variance from to seasons of mixed cropping

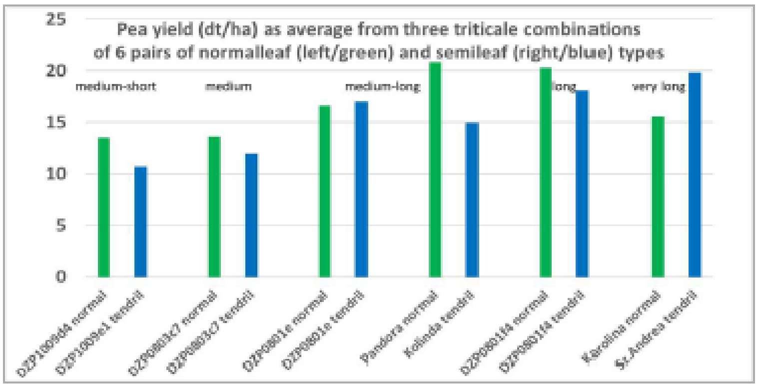

Figure 1 Yield of 12 peas shown as pairs with similar plant length, differing in leaf type. LSD5%= 1,07dt/ha.

Short peas were suppressed, and total yield because of pea yield was best with medium to tall peas (Fig.1). It could not be shown significantly, but there was a tendency that semi leafless type in winter pea might be lower in pea yield and allows more triticale yield than normal leaf type (Fig.2).

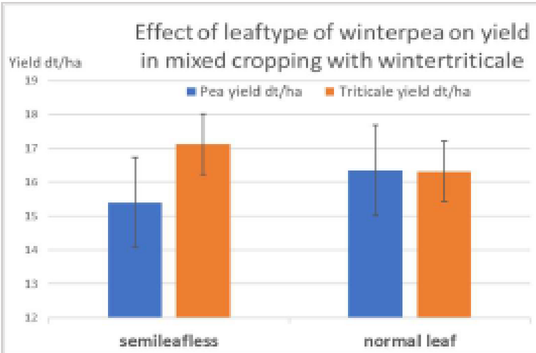

Figure 2 Effect of leaf type in mixed cropping on yield of pea and triticale. Calculated with means of six leaf-types each. Error bars indicate LSD 5%.

Triticale varieties showed differences in suppressing winter pea and in triticale yield in mixture also, but three varieties were too little to find significant effects related to early vigor, broadness of leaves, height, and leaf diseases, which all affects competitiveness of peas.

As result from this trial medium-long to tall normal leaf types of peas should be followed first for mixtures with winter triticale. As triticale yield is important for total yield of mixture there should be laid more emphasis also on suitability of triticale varieties for mixtures.

With impressions from this trial a new trial was set up with about 100 triticale accessions combined only with medium-long semi leafless winter pea Kolinda, where the best triticale for total yield combined with high pea yield could not be found among the early, not the late, not the short, not the tall, not with narrow, neither with broad leaves. It seems to be a medium type of triticale that has to be looked for. This project is still going on.

The author wishes to thank for support under EU-LIVESEED for first steps on the way to a new breeding goal "suitability for cultivation in mixture" for triticale and winter peas under organic farming.

ORGANIC BREEDING FOR DIVERSITY EXPLORING BRASSICA GERMPLASM – PORTUGUESE CASE STUDY

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Background

- Agriculture sustainability and conservation is growing worldwide, proven by the increase in organic farming practices [1].
- With the increased concern with climate changes, genebanks play a vital role by ensuring the safety of crops and supporting research.
- There's a small number of *Brassica rapa* and *B. napus* varieties which have been certified for organic agriculture, according to data from several European countries' organic seed databases [2].
- To highlight the value of organic seed production and germplasm material, we focused on obtaining and proposing new varieties of turnip and rapeseed crops, adapted to a sustainable and organic agriculture.

Need for more environmental friendly practices + **Increased market interest in organic products** + **Lack of Brassica certified organic varieties available** = Proposal of organic turnip and rapeseed varieties

Genebanks' support

Materials and Methods

- 6 Brassica Landraces from the Portuguese Genebank collection (bpgv.Iniav.pt/gringlobal).
- Starting in 2018 [3; 4], in Braga, Portugal.
- A set of morphological criteria (Table 1) was applied in order to obtain a consistent and homogeneous bulk of plants over several generations.

Table 1. Sample of the morphological and reproductive traits assesed during the field evaluations.

		Traits assesed
Morphological	Turnip	% of plants producing turnips
		Position relative to the ground
		Weight, size and shape
	Seed	Amount produced by plant
		Period of harvest
	Plant	Height and diameter
		No. and type of leaves
Reproductive	Stages	Pre flowering state
		Beginning of flowering
		Fully flowering
		Fully mature siliques

Organic farming guidelines
↓
Grown in isolation cages (150-200 plants/SL progenies)
↓
3(SL3) to 4 (SL1, 2 and 6) generations
↓
Mass selection criteria (10% selection intensity)
↓
Reproductive synchrony and morphological homogeneity

Results

According to the continuous mass selection and taking into consideration the morphological and reproductive results (Figure 1 and 2, and Table 2), 3 selection lines (SL) were obtained for ***B. rapa*** (SL1, SL2, and SL3) and 1 for ***B. napus*** (SL6):

- SL1 – Baby leaves, turnip greens and turnip tops - Significant area occupied/plant (competition with weeds) and intermediate precocity;
- SL2 – Early white turnip roots, baby leaves , turnip greens and turnip tops - Semi precocity;
- SL3 – Late purple/bicolour turnip roots and baby leaves, medium size turnips roots - Superficial and cold resistant turnips roots, and late precocity;
- SL6 – Forage and Biodiesel – High foliage density, high area occupied by the plant, significant seed production, and late precocity.

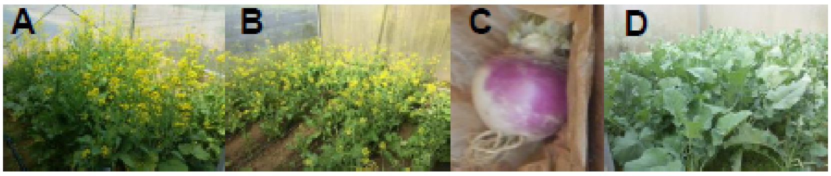

Figure 1. Comparison of selection lines. A – SL1; B – SL2; C – SL3; D – SL6.

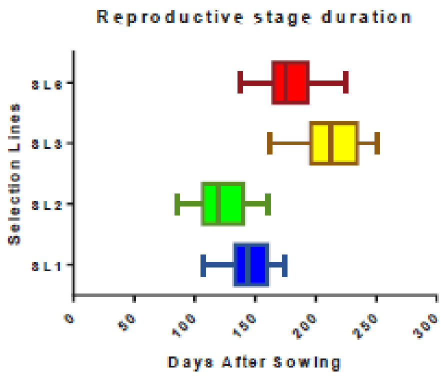

Figure 2. Duration of the plant full reproductive stage for the 4 selection lines (results from the last cycle (2020), from the pre flower stage to the full mature siliqua).

Table 2. Summary of some morphological results from the Selection Lines (SL) in the last generation evaluated (F2 for SL1, SL2 and SL6; and F1 for SL3) in 2020.

	SL1 - F2	SL2 - F2	SL3 - F1	SL6 - F2
Ripeness seed (DAS)	167 to 203	155 to 181	233 to 281	191 to 281
Seeds produced per plant (g)	4	12	6	11
Plants producing turnip (%)	17	21	100	-
Turnip height and diameter (cm)	9 and 5	11 and 5	8 and 10	-
Average turnip weight (g)	103	94	325	-
Foliage density	low	low/medium	medium	high
Average plant height (cm)	120	104	140	190
Average plant diameter (cm)	63	23	65	84

Conclusions and Future Prospects

4 organic, homogeneous and consistent selection lines were obtained, each one with different characteristics and therefore purposes.

Alongside, studies are occurring in order to compare the obtained organic varieties with commercial ones of the same crops.

Genebanks and the conservation of plants' genetic resources are an important asset to our society, as they allow the development and the enrichment of varieties that can aid in the response to the current times.

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NETWORK-BASED GWAS REVEALED SEVERAL CANDIDATES OF GENOMIC REGIONS ASSOCIATED WITH RACE-SPECIFIC RESISTANCES TO COMMON BUNT (*TILLETIA CARIES*) IN WHEAT

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Introduction

Common bunt caused by *Tilleta caries* and *T. foetida*, and dwarf bunt, caused by *T. controversa* are important diseases of wheat grown under organic farming practices. Both diseases are causing significant yield losses as well as losses in quality of grains infected with bunt. So far, the only effective measure in the control of bunt disease in organic farming is growing resistant cultivars.

Material and Methods

In order to develop markers for Bt1, Bt2, Bt5, Bt7, Bt13, BtZ and Quebon-resistance against common bunt (*Tilletia caries*) in wheat, 455 wheat varieties and breeding lines were inoculated with 7 to 11 races of common bunt in field trials in 2018 and 2019, and resistance response was recorded.

Out of 455, 274 lines were selected and genotyped with a 25K SNP micro array chip (TraitGenetics, Germany). Network-based Genome Wide Association Analysis (GWAS) using a nonparanormal approach within Gaussian copula graphical model (semi-parametric) for reconstructing conditional independence networks were applied (Behrouzi and Wit, 2019).

This method adjusts for the effect of all other SNPs and phenotypes while measuring the pairwise associations between them, and therefore accounting for population structure. The resulting genotype-phenotype network is a complex network made up of interactions among genetic markers and among phenotypes, and between genetic markers and phenotypes. Genetic maps of Allen et al. (2017) and Wang et al. (2014) have been used in order to map genomic regions for gene loci affecting the resistance to common bunt.

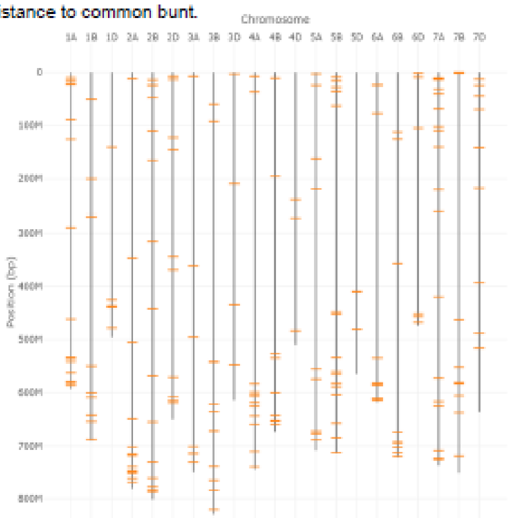

Figure 1. Position of SNPs with significant association with the response of wheat plants to inoculation with *T. caries*, based on RefSeq v1.0 obtained from GWAS analysis.

Results and Discussion

Network GWAS has revealed total 232 SNPs of interest that were distributed over all wheat chromosomes. The position of SNPs is given in Figure1.

Significant association was present in 14 virulence race (Vr) : environment combinations. The largest number of associated SNPs was found for the Vr13 (89), followed by VrG (40) for both environments 2018 and 2019 (Figure 2).

Network also indicates that beside clusters of SNPs that interact with specific race: environment, there are 21 SNPs that interact with different virulence races and different environments.

Additional work directed in further filtering of SNPs of interest as well as their potential use in developing KASP markers that could be applied in marker-associated selection (MAS) in wheat breeding programs is ongoing.

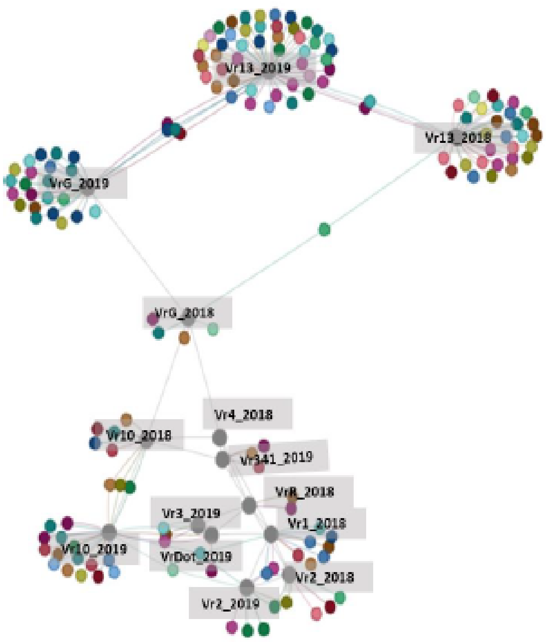

Figure 2. Strain-marker-environment interactions of 274 genotyped lines of wheat. Each edge represent the connection between two nodes, where each node is a SNP marker or a strain-environment. Grey nodes: strain-environment (phenotype), colored nodes: SNP markers, where each color represent a chromosome on which marker is located.

First and second author contributed equally to the work presented in this poster.

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ELKH Eötvös Loránd Research Network
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ReMIX Species mixtures for redesigning European cropping systems

Selection of winter cereals for cereal-pea mixtures to improve biodiversity and LER

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One of the most effective ways to enrich field biodiversity both above and below ground is the use of intercropping, a management system where two or more crops are grown together in the same season either as mixtures or as separated components in space and/or in time. As suitable varieties for mixtures can be seldom found, targeted selection approaches were started at the Centre for Agricultural Research, Hungary within the frame of EU H2020 project ReMIX. Our aims were to find 1) the best ideotype-combination for cereal-pea mixtures and 2) an effective selection method of cereals for mixed cropping systems.

Materials and Methods

- Two-years grain yield trial in organic: 2019-2020
- Sowing density (germs/m^2): 450 (cereal); 120 (pea)
- Mixing ratio (cereal:pea): 50:75
- 6 m^2 plots in three replications with randomized complete block design arrangement (Fig. 1)
- Land Equivalent Ratio (LER) for grain yield (Y) of the cereal (1) and the pea (2) components:

$$LER=(Ymix1/Ypure1)+(Ymix2/Ypure2)$$

Fig. 1: Organic trial of wheat-pea mixtures (2019, Martonvásár, Hungary)

1) 8 winter wheat and 4 winter pea varieties differing in earliness, plant height, protein content and thousand grain weight

2) 10 wheat and 8 triticale lines selected with two different methods: in mixed stand; using stability analyses in mono stand

Results

- Significant response to mixing: only for pea grain yield
- Different LER values for the 4 pea-component groups: 1.2 – 1.8
- Highest LER for mixtures of similar components: early and short wheat and pea varieties (Fig. 2)

- Significant effect of pea (Aviron) on cereal grain yield in mixtures
- Significant difference between selection methods for triticale (Fig. 3)
- Yield stability derived lines performed better than lines selected in mixture
- No significant difference between lines in LER

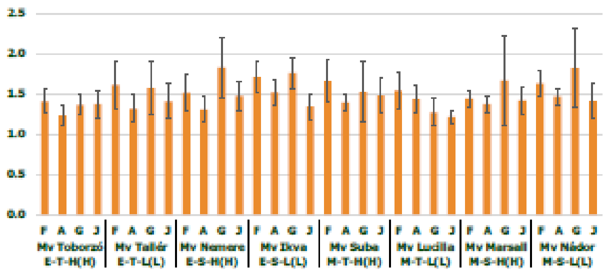

Fig. 2: Land equivalent ratio (LER) and standard error for grain yield of mixtures composed of winter wheat and pea varieties (Furious (F; E-T-(H)), Aviron (A; M-T-(L)), Gangster (G; M-S-(H)) and James (J; E-S-(L))) grown in organic field between 2019-2020 (Martonvásár, Hungary). Variety phenotypes: heading or flowering (pea): E:early, M:mid-early; plant height: S:short, T:tall; protein content of grains (thousand grain weight): L:low, H:high

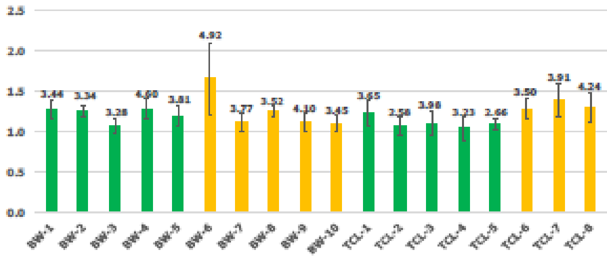

Fig. 3: Land equivalent ratio (LER) and standard error for grain yield of cereal-pea mixtures composed of winter wheat (BW) and triticale (TCL) breeding lines selected in the presence of pea companion plant (green bars) or on the basis of yield stability through different growing environments (orange bars). Mean grain yield of cereals in organic mixed cropping system is also indicated (2019-2020, Martonvásár, Hungary)

Conclusions

- Similarities in earliness and plant height of the cereal and pea components of the mixture are important
- Selection for yield stability (using different sites) could be also effective in cereal mixing partner development
- 2 wheat (BW-4, BW-6) and 2 triticale (TCL-7, TCL-8) lines were selected (highest LER, lowest yield-drop):
  - The shorter wheat lines are recommended to be mixed with a short pea variety (like Gangster)
  - The taller triticale lines are recommended to be mixed with a tall pea variety (like Furious)

PARTNERS IN ReMIX

AGRONOMIC PERFORMANCE OF HETEROGENEOUS SPRING BARLEY POPULATIONS

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BACKGROUND

Composite cross populations (CCPs):

- ✓ mixtures of diallel crosses between around 5-10 parental genotypes;
- ✓ can maintain genetic diversity ensuring adaptability to changing environmental conditions
- ✓ perform relatively better in presence of abiotic stress factors
- ✓ have the ability to evolve and adapt to particular environments while cultivated there for a number of seasons

AIM: to test agronomic performance of spring barley (*Hordeum vulgare* L.) CCPs in order to identify advantages/disadvantages in comparison to homogeneous varieties and mixtures of parents

METHODS and MATERIAL

- ✓ **2019-2020 (+2021), 3 organic and 1 conventional location (=8 environments)**
- ✓ **Main traits of interest:** yield and stability, weed suppression ability, nitrogen use efficiency (NUE), disease severity

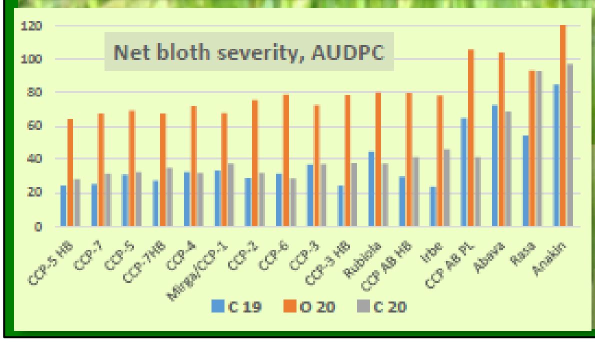
Grain type	Type of material	Origin	n	Number of parents	Generation (2020)
Covered	CCP	Latvia	6	10-32	F4 - F8
		Denmark	1		
	check varieties	Latvia	3		
		Denmark	1		
Hulless (HB)	CCP	Latvia	4	10-32	F5 - F8
		Denmark	1		
	check	Latvia	1		
Mixtures of parents			7		

RESULTS

Ranking according to yield and coefficient of regression (b)

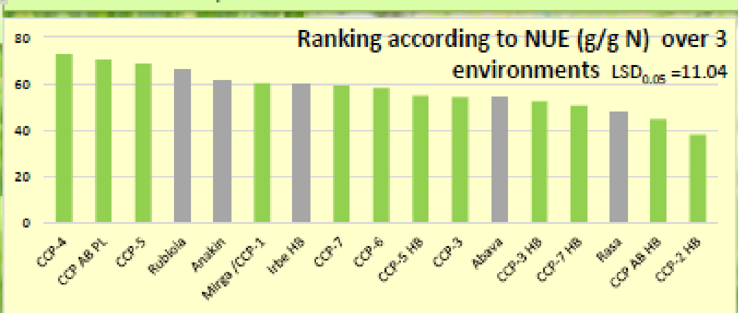
Organic sites (n=6)	yield t/ha	b org	Conventional sites (n=2)	yield t/ha	b (n=8)
MIX CCP-1	2.18*	1.19	Anakin	5.71*	1.32
CCP-4	2.17*	1.06	Rubiola	5.49*	1.17
CCP-7	2.13*	0.90	MIX CCP-6	4.97	1.05
Mirga/CCP-1	2.13*	1.15	MIX CCP-1	5.02	1.06
CCP-5	2.12*	1.09	Mirga/CCP-1	5.01	1.06
MIX CCP-3	2.16*	1.13	MIX CCP-3	4.97	0.94
CCP AB PL	2.02	1.20	CCP-6	4.97	1.05
CCP-6	1.98	1.02	MIX CCP-4	4.97	1.10
Rubiola	1.98	0.96	CCP-4	4.94	1.01
MIX CCP-6	1.97	1.06	Irbe HB	4.84	1.15
MIX CCP-4	1.96	1.19	CCP-5	4.76	0.98
CCP-3	1.94	0.89	Abava	4.69	0.98
Anakin	1.91	1.23	CCP-3	4.65	0.94
MIX CCP-7	1.90	1.23	MIX CCP-7	4.61	1.04
Abava	1.85	0.89	CCP AB PL	4.60	1.00
MIX CCP-5	1.81	0.91	MIX CCP-5	4.53	0.95
Rasa	1.75	1.00	CCP-7	4.51	0.86
Irbe HB	1.56	1.09	Rasa	4.48	0.98
CCP-3 HB	1.49*	0.78	CCP-3 HB	4.29	0.94
CCP-7HB	1.37*	0.73	MIX CCP-2 HB	4.06	0.96
CCP AB HB	1.36*	0.77	CCP-2	3.75*	0.92
CCP-5 HB	1.32*	0.85	CCP AB HB	3.72*	0.82
MIX CCP-2 HB	1.20*	0.78	CCP-5 HB	3.57*	0.81
CCP-2	1.17*	0.91	CCP-7HB	3.48*	0.75
average	1.81		average	4.61	
LSD0.05	0.27		LSD0.05	0.63	

* Significantly different from average over the experiment ($p<0.05$); HB- hulless barley; MIX – mixtures of parents; CCP AB – created by A.Borgens, Denmark



MAIN FINDINGS

- ✓ **YIELD:** CCPs superior under organic farming system; all except one ranked higher
- ✓ most extreme ranking differences for CCP involving the highest number of parents and intensive type variety 'Anakin'
- ✓ most of CCPs tended to outyield the respective mixture under organic; opposite trend under conventional
- ✓ **CCPs stable yielding** over all environments; varieties – most unstable
- ✓ CCPs tended to be **more stable than the respective mixtures over organic environments**; less differences over organic+conventional environments
- ✓ **NUE:** CCPs ranged in the top among investigated entries according to the NUE values showing also the highest values of HI; N uptake efficiency (NUpE) and N utilization efficiency (NUtE) both contributed significantly to the NUE.
- ✓ **WEED SUPPRESSION ABILITY:** in organic environments CCPs weed suppression ability differed as affected by the location and the year. Compared to varieties, covered barley CCPs performed slightly better than the hulless barley CCPs.
- ✓ **DISEASES:** advantages for CCPs over varieties for net blotch severity; powdery mildew severity in between the most resistant and most susceptible varieties; susceptibility to loose and covered smuts can be a problem.



Acknowledgement

This study is financed by Latvian Council of Science project No. lzp-2018/1-0404

IDENTIFYING NITROGEN-EFFICIENT POTATO GENOTYPES FOR ORGANIC FARMING USING CANOPY DEVELOPMENT AND YIELD PARAMETRES

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Potato (*Solanum tuberosum* L.) production in Latvia is a significant branch of agriculture. Potato crop requires abundant nitrogen (N) to obtain high and qualitative tuber yield. The release of nitrogen from soil organic matter and from organic nutrient management sources is slow and highly depended on mineralization processes in the soil. Therefore, N management in organic farming is complicated and should be supported by varieties adapted to low and variable nitrogen availability to ensure yield stability. Area Under Canopy Cover Progress Curve (AUCCPC) has previously been recognized as a good predictor of NUE as well as fresh tuber yield in Northwestern European conditions.

Aim of study: Assess the relationship between potato genotype soil cover by canopy and tuber yield under a relatively short potato growing season conditions.

MATERIALS & METHODS

Trial was carried out at the Institute of Agricultural Resources and Economics, Priekuļi, Latvia in 2020. Twenty potato genotypes were investigated in organic field. The meteorological conditions in trial site are shown in Figure 1. Soil characterisation: loamy sand, pH_{KCl} 5.7, organic matter content 2.3 %, P_2O_5 101 mg kg^{-1}, K_2O 56 mg kg^{-1} and Mg 143 mg kg^{-1}. Potatoes were planted in May 7th and harvested in September 4th. Randomized blocks design in 4 replications was used, plot size - 3.4 m^2. Genotypes were divided into three groups according to their maturity type (early, medium early and medium late/late). During vegetation period, from June 9th to August 14th, soil cover by the canopy was assessed for each plot on average twice a week (18 times per season) using digital photographs (Figure 2). Object-based image analysis was conducted with "Canopeo" application to estimate canopy cover percentage. An adapted Area Under The Diseases Progress Curve (AUDPC) estimation formula used for assessment of Area Under Canopy Cover Progress Curve (AUCCPC) (1). The correlation between canopy cover of potato genotypes (AUCCPC) and tuber yield was evaluated.

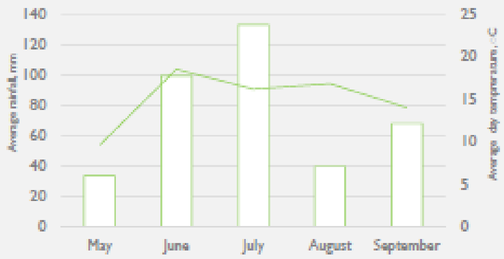

Figure 1 **Average rainfall and temperature at trial site, 2020**

$$\mathrm{AUCCPC} = \sum_{j=1}^{n-1} \left(\frac{y_j - y_{j+1}}{2}\right)(t_{j+1} - t_j) \quad (1)$$

AUCCPC – The Area Under Canopy Cover Progress Curve

y- ground cover by plant canopy at the time of j-observation, %; t – beta termal time at the time of j-observation

Figure 2. **Canopy cover assessment using digital camera.**

RESULTS & DISCUSION

Table 1. **Average tuber yield and AUCCPC of potato genotypes, 2020**

Maturity type	Genotype	Yield t ha^{-1}	AUCCPC	Correlation coeficient	Significance value
Early	Agrie Dzeltenie	27.0	2094	0.40	p>0.05
	Madara	22.9	2206		
	Monta	25.4	2711		
	Rigonda	30.8	2699		
	S 03067-33	30.4	2355		
	Vineta	25.4	2122		
Medium early	Lenora	23.8	2480	0.78	p<0.05
	Prelma	24.4	2268		
	S 01085-21	21.0	2319		
	S 04065-2	19.0	2466		
	S 11161-85	22.7	2381		
	S 13078-1	14.3	1813		
	Verdi	19.7	2368		
Medium late/late	Brasla	21.6	2262	0.87	p<0.05
	Imanta	23.2	2121		
	Jelly	27.3	2202		
	Jogla	31.3	2475		
	Kuras	30.6	2697		
	Magdalena	30.1	2393		
	S 11152-7	14.5	1891		

This season average tuber yield for early (27.0 t ha^{-1}) and medium late/late genotypes (24.8 t ha^{-1}) was significantly higher than for medium early genotypes (20.9 t ha^{-1}) (Table 1). Correlation between estimated AUCCPC values and yield for genotypes maturity groups was positive and significant for medium early genotypes ($r=0.78$, $p<0.05$) and medium late/late genotypes ($r=0.87$, $p<0.05$). The correlation was not significant for early genotypes ($r=0.40$, $p>0.05$).
The percentage of large tubers (>50mm) in yield for medium early genotypes was significantly lower (16.8%) comparing to early genotypes (35.5%) and medium late genotypes (31.9%) having almost equal results of percentage of large tubers in yield.

Plants emerged from 29 to 35 days after planting depending on genotype.
The total duration of vegetation period for potato genotypes was from 63 to 76 days. The cool air temperature slowed down potato emergence until early June when air temperature increased.

First late blight (*Phytophthora infestans* (Mont.)) damages on leaves were observed by the end of July. At the end of August late blight damages were in range from 10 % to 100 %, stopping plant vegetation for the most damaged ones.

CONCLUSIONS

A significant relationship between tuber yield and AUCCPC parameters were detected for medium early and medium late/late genotypes, however not significant correlation for early genotypes.

ACKNOWLEDGEMENTS

This research work is carried out with the support of the Project on Fundamental and Applied research (FLPP) in the agricultural sector entitled "Potato breeding for low input and organic farming systems: nitrogen use efficiency and quality aspects of potato protein".

EVALUATION OF WHEAT COMPOSITE CROSS POPULATIONS UNDER ORGANIC FARMING SYSTEM

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Introduction

Composite cross populations (CCPs) created by evolutionary breeding method increase resilience against environmental variations and climate change caused by global warming and offer an opportunity to produce populations that show small or no genotype-environment interaction.

Materials and Methods

Field trials with four spring wheat (*Triticum aestivum* L.) CCPs: *Convento C, Convento E* (Germany), *Spring wheat population high gluten index* and Spring wheat population Resistant to common bunt (Tilletia caries) from Denmark, and four winter wheat CCPs: *Popcorn* (Denmark), *Brandex, Liocharls* (Germany) and *MV Elit* (Hungary) were set up at location Stende. Randomized block with 4 replications was applied; plot size was 10 m², seed rate 500 untreated germinable seeds per m². *Tasks of the study* was to investigate agronomic traits, weed suppression ability (S_{var}, weed ground cover difference between a plot sown with the barley genotype and a barley free plot with maximum weed growth, expressed as %), nitrogen use efficiency (NUE) and resistance to the main diseases of spring and winter wheat CCPs in comparison to the locally used check varieties.

Meteorological conditions differed between the years. In 2018 drought stress had a significantly negative impact on plant development. During vegetation periods of 2019 and 2020, the temperature deviations and precipitation were close to the long-term norm. Winter 2019/2020 was very mild and winter hardiness was scored as high (7-9). Meteorological conditions during vegetation periods 2018-2020 were not very suitable for progression of very high level of leaf diseases and significant yield losses were not caused.

Results and discussion

The results showed that the average grain yield (2018-2020) of spring wheat CCPs not exceed the local spring wheat variety 'Uffo'. No significant differences ($p<0.05$) between spring wheat CCPs average yield, TKW and NUE during the three harvest seasons were observed. Significantly higher grain quality (protein and gluten content) was found for *Spring wheat population high gluten index* from Denmark (Table 1).

Table 1 Spring wheat population results, 2018 - 2020

Population/variety	Grain yield, t ha^{-1}	TKW, g	Protein content, mg kg^{-1}	Gluten content, mg kg^{-1}	NUE g g^{-1}N	S_{var}, GS 59-65
UFFO (check)	2.87	35.33	96.05	15.08	47.69	49
Spring wheat population high gluten index	2.30	36.93	124.00	23.35	41.80	37
Spring wheat population Resistant to common bunt (Tilletia caries)	2.12	35.29	107.85	18.60	41.19	35
Convento E	2.39	35.91	108.10	18.73	41.02	42
Convento C	2.47 LSD $_{0.05}$=0.67	34.94	110.45	18.06	43.03	36

Winter hardiness of *winter wheat* in 2018/2019 was satisfactorly, excepted for CCP Liocharls (1 point) but in 2019/2020 over-wintering of all genotypes was good (5-9 points). Significantly higher average yield ($p<0.05$) and the highest TKW were observed for CCP Popkorn (Denmark). The highest grain quality was found for MV Elit (Hungary). Weed suppression ability was different between populations and tightly related to the number of plants (winter hardiness) and tillering capacity (Table 2).

Acknowledgments

Thanks to Anders Borgen (Denmark Agrologica), Carl Vollenweider (Germany Dottenfelderhof) and Péter Mikó (Hungary, Agricultural Institute of the Centre for Agricultural Research) for providing seed material.

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Table 2 Winter wheat population results, 2019 - 2020

Population/ variety	Grain yield, t ha^{-1}	TKW, g	Protein content, mg kg^{-1}	Gluten content, mg kg^{-1}	NUE g g^{-1}N	S_{var} GS 59-65
SKAGEN (check)	3.21	44.02	102.55	16.37	67.00	36
POPKORN	4.75	44.55	115.60	16.89	66.02	21
BRANDEX	3.72	42.28	115.50	21.71	80.18	24
LIOCHARLS	3.17	42.19	119.70	22.78	56.75	28
MV ELIT	3.41 LSD $_{0.05}$=1.36	43.14	122.60	20.70	56.80	22

Conclusion

- Preliminary results indicate that spring wheat CCP P1 (high gluten content) from Denmark can be interesting for organic farmers and grain producers in Latvia.
- Assessment of main agronomical traits of winter wheat CCPs from Denmark, Germany and Hungary will be continued.
- Evalution of wheat CCPs will be continued by adding newly created local CCPs in the following year.

Broadening and exploiting the genetic base of white lupin

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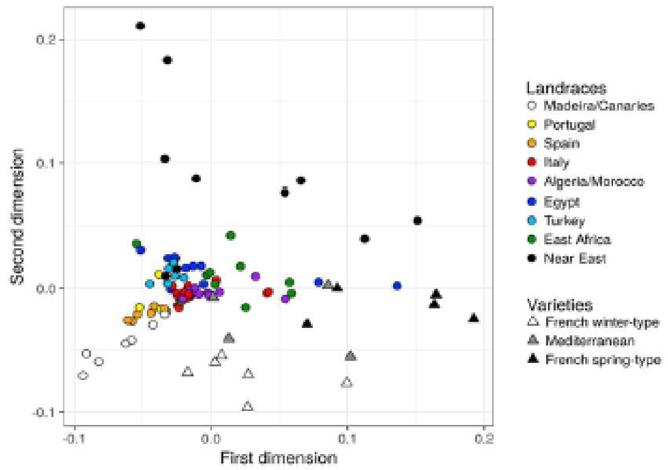
White lupin is a European crop with a long history of domestication and high potential interest for high-protein food or feedstuff. Its development is limited by modest breeding effort and lack of adaptation to calcareous soil, and has to cope with increasing drought stress caused by climate change in several European regions. Here we summarize work aimed to:
(i) exploration of the crop genetic diversity and the extent of this variation exploited by modern breeding;
(ii) identification of elite landraces and sweet-seed germplasm, to broaden the genetic base for European breeding;
(iii) assessment of the genetic variation for tolerance to key abiotic stresses, in germplasm of a novel genetic base;
(iv) genotyping of the novel genetic base, in view of genomic selection and GWAS studies aimed to assist the crop breeding.

Exploration of the crop genetic diversity

In the multi-dimensional scaling of 86 landraces and 15 varieties based on 6198 SNP markers, landrace ordination from the left lower corner to the right upper corner reflected a longitudinal gradient. Modern varieties exploited a modest portion of genetic variation, probably because of extensive use of sweet-seed genetic resources by breeders.

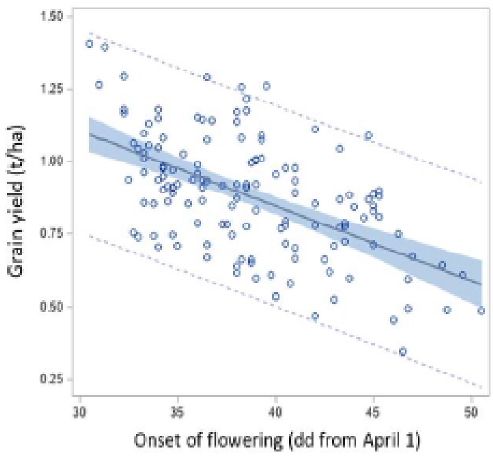


Identification of landrace and sweet-seed parent germplasm

Agronomically outstanding landraces and elite sweet-seed material were identified by evaluating: (i) a world germplasm collection in 3 climatically-contrasting European sites (Annicchiarico et al., 2010, Field Crops Res. 119:114-124); (ii) landrace germplasm for adaptation to calcareous soil (Annicchiarico & Thami Alami, 2012, Plant Soil 350:134-144); landraces and breeding lines for yield under severe drought (Annicchiarico et al., 2018, Plant Breed. 137:782-789).

Yield under severe drought of 138 new inbred lines

Yield responses as a function of onset of flowering expressed stress escape by the regression ($R^2 = 0.31$) and intrinsic stress tolerance by deviations from regression. Intermediate phenology with intrinsic drought tolerance has key value for autumn-sown, cold-prone areas of Southern Europe.

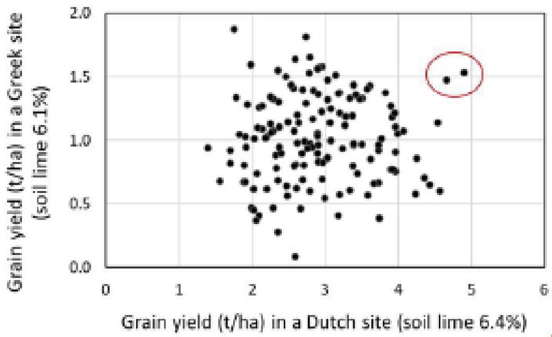


Development of the novel genetic base by CREA

Several hundred sweet-seed inbred lines and an evolutionary population were produced from factorial crosses of 4 elite landraces with 4 elite sweet-seed breeding lines or cultivars. Lines or the population were distributed so far in Italy, the Netherlands, Denmark, Switzerland, Greece, UK and Chile.

Yield of 144 new inbred lines in Dutch and Greek sites featuring moderately calcareous soils

Adaptation to specific climatic conditions or other factors led to inconsistent line response across environments, but two putatively lime-tolerant lines could be identified.



Genotyping

Genotyping-by-sequencing issued over 4,300 SNP markers (for 10% genotype SNP missing data) for lines of the novel genetic base, used for on-going genomic selection and GWAS studies.

LIVESEED LEGATO

Perennial cereals for organic agriculture

W. Vogt-Kaute[1], L. Vogt[1], C. Emmerling[2], P. Titan[3], H. Grausgruber[4]

Background

The cultivation of perennial cereals might represent an economically and ecologically interesting option for extensive cultivation, particularly in marginal land.

Locations

The 3 locations differ in the type of soil and in the amount of precipitation. Due to poor soil quality at all locations, annual wheat can only be grown to a limited extent.

Breeding Lines

5 breeding lines of perennial wheat (*Triticum aestivum* × *Thinopyrum intermedium*) and a mixture of the 5 breeding lines were sown at three sites in Bavaria

2 varieties of annual wheat for comparison: 'Capo', 'Livius'

Breeding lines were selected from a bulk originating from Washington State University

Other plots were additionally sown with white clover and subterranean clover

Results

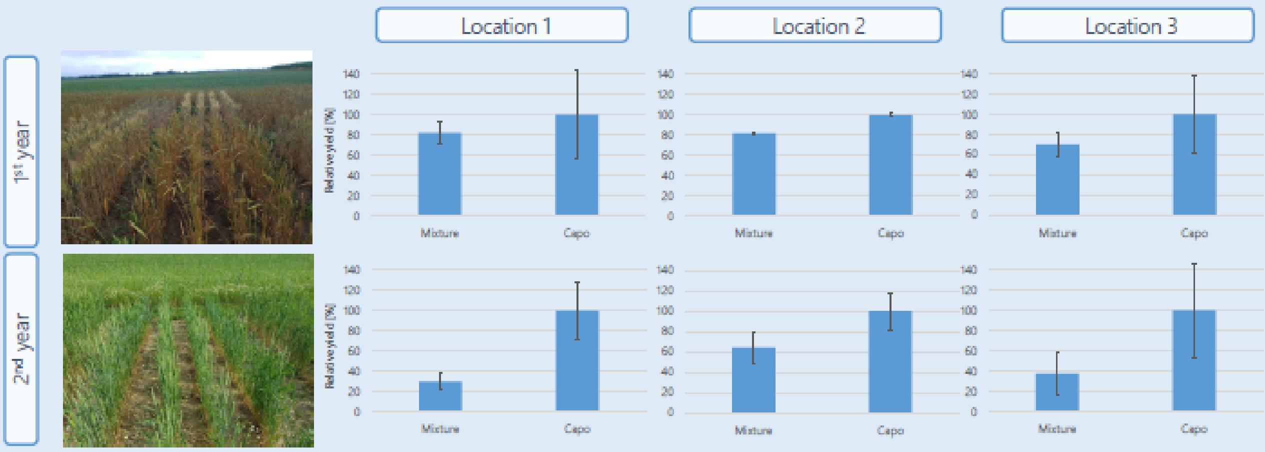
In the 1st year, the grain yield of the perennial breeding lines was 49 to 96% of cv. 'Capo', which reached an average of 17.4 dt/ha

In the 2nd year, the yield was 9 to 38% of 'Capo', which reached an average of 10.8 dt/ha

The re-emergence in autumn was significantly affected by severe drought at all locations in the 1st and 2nd year and showed differences between the lines up to a total failure at one location.

In the 3rd year, the yield of the perennial breeding lines was very low. The yields of the plots with under-sown clover were significantly higher in the third year.

A significant increase of soil organic carbon was observed in the order perennial with clover > perennial > annual in the subsoil of one location. Two of the three locations showed a significant increase of microbial biomass in the same order both in top soil and subsoil. The number of earthworms was up to twice as high in perennial relative to annual wheat.



Conclusion

A third year of cultivation cannot be recommended under these climatic and soil conditions.

A mixture with a low growing clover species is recommended because of better weed suppression.

Perennial cereals are an interesting option for the production in organic agriculture especially on marginal locations in order to reduce erosion and improve soil fertility.

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Funded by European Union
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References:

Vogt-Kaute W, Vogt L (2020) Research on potentials of perennial wheat in Germany, Final Report, in: www.orgprints.org/38421

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Varietal key-traits to optimise agronomic performance of winter wheat-pea mixtures

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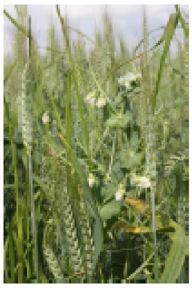
Introduction



Among factors influencing the performance of bi-specific mixtures stands the choice of varieties within each species.
In bread wheat - field pea mixtures, synchronization of maturities (for a simultaneous harvest of both species), resistance to lodging (of the wheat variety), resistance to seed breakage (in the pea variety), and differences in Thousand Seeds Weights between both species (to facilitate sorting) are often considered.
The impact of other varietal trait combinations on mixtures performance have rarely been looked at, so that too few reliable criteria are available to breeders to select for adaptation to mixtures in their breeding programs.

One task of the EU H2020 Remix Project (www.remix-intercrops.eu) therefore aimed at the identification of morphological and/or functional key-traits likely to contribute to high performance of bi-specific mixtures.

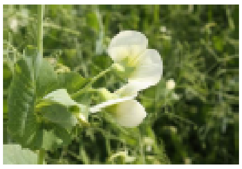
Material and Methods

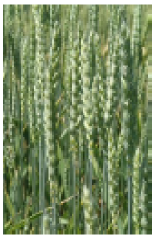
We considered, in the field, the effect of variation in six phenological or morphological traits, suspected to be involved in plant-plant interactions
- 3 varietal wheat traits: earliness at heading stage, canopy height at heading stage and tillering ability
- combined to variation in 3 varietal pea traits: earliness at flowering, canopy height at the end of flowering, and flowering duration

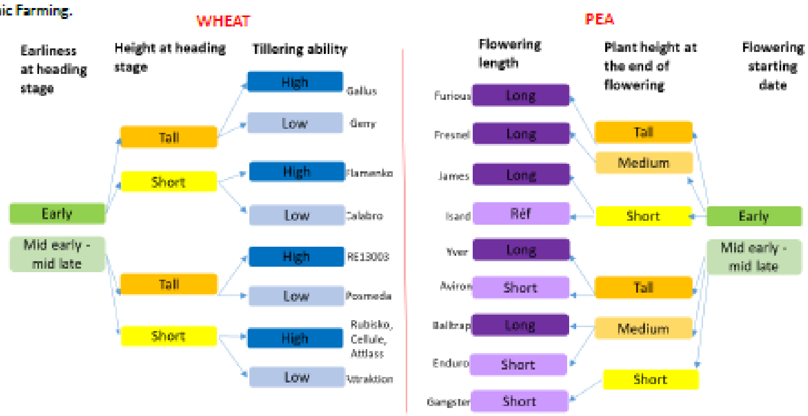
on 4 agronomic performance indicators of the mixture intercrop: wheat yield, pea yield, cumulative (wheat + pea) yield and wheat protein content.

During the 2018/19 season, all possible binary mixtures of 10 bread winter wheat genotypes with 9 winter field pea genotypes were considered.
The mixtures were full mixed on the row, with a unique ratio of the reference sowing densities in SC (wheat 50%-pea 75%). This led to 90 IC and 19 SC modalities in a complete randomized block design, sown in Organic Farming.

	Wheat	Pea
SC (seeds/m²)	300	80
IC (seeds/m²)	150	60
IC/SC ratio (%)	50	75

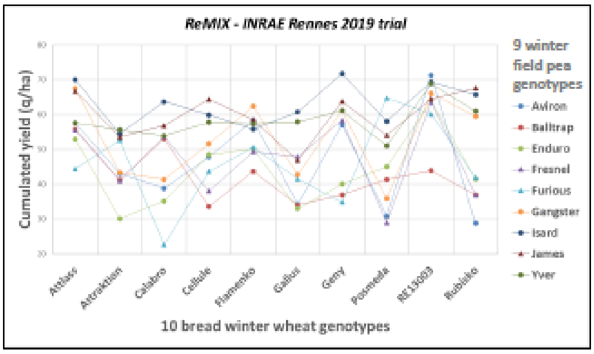






Results

Analysis of the effect of combined varietal traits on the performance indicators showed that:
- there is a high variability in yields depending on varietal combinations and a high complexity of interactions between varieties of both species
- there is a significant impact of the varietal traits of species on performance indicators and the impact of legume cultivar is higher than the impact of cereal cultivar
- wheat cultivar earliness and canopy height at heading stage had a significant impact on wheat protein content, but not on individual or cumulative yields
- wheat tillering ability and pea flowering starting date had a significant impact on all performance indicators except on pea yield
- pea canopy height at the end of flowering and flowering duration had a significant impact on all performance indicators
- values to choose for optimized performance were opposite whether [wheat and cumulative yields] or [pea yield and wheat protein content] were the desired performance.



	Wheat earliness at heading stage	Wheat canopy height at heading stage	Wheat tillering ability	Pea flowering starting date	Pea flowering length	Pea canopy height at the end of flowering
Cumulative yield	NS Mid early-mid late ~ Early	NS Tall ~ Short	** High > Low	** Early > Mid early-mid late	*** Ref > Long ~ Short	*** Short > Tall > Medium
Pea yield	NS Mid early-mid late ~ Early	NS Short ~ Tall	NS Low ~ High	NS Mid early-mid late ~ Early	* Short ~ Long > Ref	*** Tall > Medium ~ Short
Wheat yield	NS Mid early-mid late ~ Early	- Tall ~ Short	*** High > Low	*** Early > Mid early-mid late	*** Ref > Long > Short	*** Short > Tall ~ Medium
Wheat Protein Content	** Early > Mid early-mid late	*** Tall > Short	*** Low > High	*** Mid early-mid late > Early	*** Short > Long > Ref	*** Medium ~ Tall > Short

Conclusions and perspectives

We confirm that the agronomic performance of a mixture depends on the combined traits of the chosen cultivars.
Four traits (wheat tillering ability, pea flowering starting date, pea flowering duration and pea canopy height at the end of flowering) are good candidates to be introduced as selection criteria in breeding schemes specific to wheat-pea mixtures.
BUT these results need to be confirmed across sites and years (because of genotype x genotype x environment effects on the stability of cereal-legume intercrops productivity) -> complementary trials have been sown in 3 other European locations (Parisian Basin in France, near Budapest in Hungary and near Thessaloniki in Greece) and a replicate of this trial has been sown at INRAE Rennes in 2020/21.
Mixed model have to be developed to analyse genotype x genotype (GxG) and genotype x genotype x environment (GxGxE) effects.

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BREEDING FOR CULINARY AND NUTRITIONAL QUALITY

EFFECT OF THE RIPENING STAGE AND THE GROWING SYSTEM ON THE CONTENT OF MAIN FLAVONOIDS IN PEPPERS

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INTRODUCTION

Capsicum peppers have both economic and nutritional relevance, for example, for their content in phenolic compounds like flavonoids. Spain has a large group of pepper traditional varieties. These varieties with high genetic diversity can be useful in breeding programs for specific growing conditions like organic farming, which is an alternative system with an increasing demand (FAOSTAT, 2020).

MATERIAL AND METHODS

Content in flavonoids **quercetin** and **luteolin**
→ **HPLC** (Bae, 2012)

Genotype

Bierzo Bola Piquillo Serrano Valenciano

Growing system
Organic
Conventional

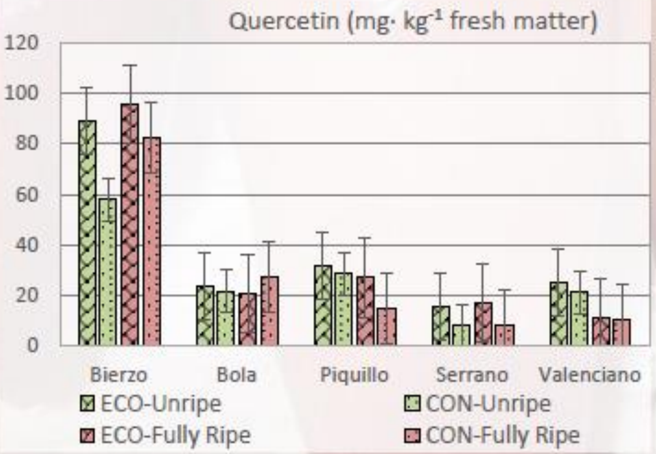
Ripening stage
Unripe
Fully ripe

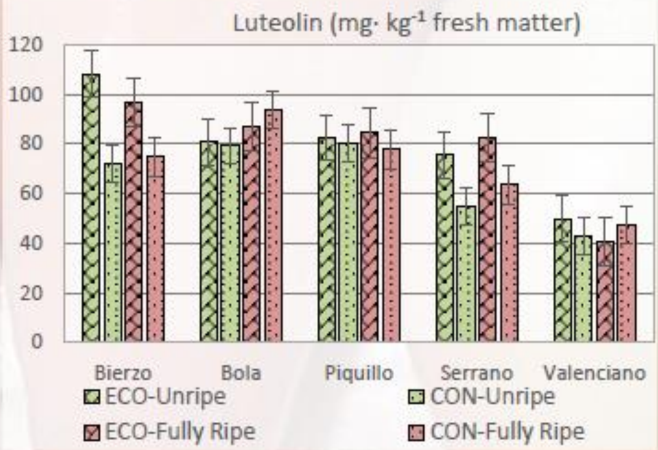
OBJECTIVE

The present work shows a preliminary study on the content of main flavonoids in a selection of *Capsicum* peppers, under organic and conventional growing systems

RESULTS

- ✓The genotype, ripening stage, growing system, as well as their interactions contributed considerably to the variation in phenolics, as previously described (Bae, 2012; Materska, 2005).
- ✓The content of flavonoids in general was higher in the organic growing system.
- ✓In general, the content of luteolin was similar or increased during the ripening process.
- ✓Quercetin increased and decreased similarly.





CONCLUSIONS

The interaction between the genotype and the growing system found, suggests the opportunity for selecting pepper accessions for organic farming with high content in phenolic compounds at both commercial ripening stages.

AKNOWLEDGEMENTS

A.M. Ribes-Moya expresses her gratitude to the Universitat Politècnica de València (UPV) for her PhD scholarship FPI-UPV-2017 (PAID-01-17). This work has been partially funded by INIA project RTA2014-00041-C02-02 and European Regional Development Fund (ERDF).

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UNIVERSITÀ degli STUDI di CATANIA

Nutraceutical traits and sensory proprierties of "ciurietto" (*Brassica oleracea* var. *botrytis* x *Brassica oleracea* var. *italica*)

BRESOV

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Introduction & Aim of the work

The richness of phytochemicals of the *B. oleracea* complex species (n=9) has been evidenced since some decades by several research teams which have individuated the related crops for obtaining several superfoods to use for reducing chronical-degenerative diseases.

The increasing request of consumers and food industries for tasty organic vegetable products supported us to evaluated some traditional Sicilian landrace of "**Ciurietti**" for bio-morphometric, organoleptic and phytochemical traits ,in the frame of the **BRESOV (Breeding for Resilient, Efficient and Sustainable Organic Vegetable Production, H2020 European project)**.

The '**Ciurietto**' is considered a "Culton" of the violet cauliflower group; seems to be originated by the crossing of broccoli (*Brassica oleracea* var. *italica*) and cauliflower (*Brassica oleracea* var. *botrytis*).

It is a **typical Sicilian landrace, widespread** in South-East of Sicily for its interesting culinary traits. It is usually collected and cooked during winter-autumn season utilizing them as traditional dishes.

Considering the high nutraceutical value of this product, the **aim of the trial** was to individuate the variation of the sweetness and of the bioactive compounds in the different farmer selection compared among them.

Materials & Methods

The trial was carried out in an organic farm, during the autumn - winter seasons in a greenhouse located near Ragusa. The plants were transplanted on October 2019. The crop density of four plants m-². The Five accessions of 'Ciurietto', called with local denomination indicating different harvesting times of the year (Iannarino, Friarolo, Mazzarolo, Maiolino and Natalino) were used.The curd are characterized by the violet color**.** At the harvesting time, the following parameters were determined: bio-morphometric, nutraceutical and organoleptic traits ,as such as ,total phenolic content (**TPC**) and , total soluble solids (**TSS**).

Results & Conclusions

The **Harvest Time** of the curds confirmed the local name of the cultivar studied and varied in relation to the cold request of the plants for the reproductive induction; it ranged between the **23** [rd] Julian day and 356 [th] Julian day (**Table 1**). The **Fresh Weight** of the curds varied between 315,8 g and 666,6 g for **BZ (Natalino)** and **BW (Maiolino)** respectively. The **Dry Matter** percentage of the curds ranged from 12,2 % to 18.9 % for **BZ (Natalino)** and **BW (Maiolino)**

Table 1. *Bio-morphometric traits*

N°	Accessions Code	Working Code	Local Name	Code	Harvest time (JD)	Fresh weight (g)	Hight (cm)	Maximum diameter (mm)	Minimum diameter (mm)	Dry matter (%)
1	UNICT 5082	BR 363	Iannarino	BS	23±6,0	595,5±27,1	20,0±2,8	225,1±21,2	38,7±13,1	16,4
2	UNICT 5083	BR 362	Friarolo	BT	52±18,5	630,5±18,7	16,7±0,8	192,3,±68,4	34,4±10,1	17,4
3	UNICT 5080	BR 359	Mazzarolo	BU	96±14,1	576,0±26,4	16,9±2,1	195,2±63,6	36,0±9,1	17,2
4	UNICT 5088	BR 365	Maiolino	BW	143±25,0	315,8±34,4	12,0±4,0	171,1±36,4	32,0±14,2	18,9
5	UNIICT 5085	BR 363	Natalino	BZ	356±12,5	666,6±18,7	18,6±2,3	203,5±39,6	42,5±11,2	12,2

The **Total Soluble Solid** of the curds showed an interesting variation among the genotypes studied from 5,7 °Brix to 11,6 °Brix from **BZ (Natalino)** to **BS (iannarino) (Figure 1).**The **Total Penolic Content** varied from 2,2 mg G/GAE d. w. to 3,6 mg G/GAE d. w.) for **BW (Maiolino)** to **BU (Mazzarolo) (Figure 2)**.

Figure 1. *Total soluble solids (TSS)*

Figure 4. *Traditional Sicilian Street food «PASTIZZU RI CIURIETTI»*

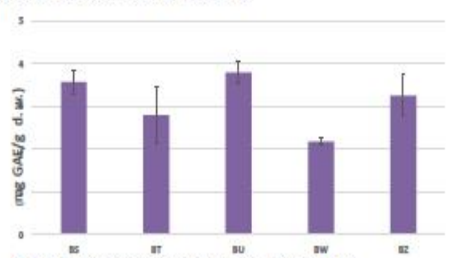

Figure 2. *Total amount of phenolic content (TPC)*

This study found that **BW (Maiolino)** is the genotype that presented more deformity inside the bio-morphometric traits and had low value for nutraceutical traits **TSS** and **TPC**, while in genotype **BZ** (**Natalino**) showed to be the best one for the bio-morphometric traits but not for the nutraceutical traits, **TSS** and **TPC** not had high values. **BS** (**Iannarino**) is the is the best one for all the traits bio-morphometric and organoleptic traits ,so have a low variability coefficient. For this reason this cultivar can be included as biological heterogeneous materials (**OHM**), for its distinct uniform stable (**DUS**) and for it a value for cultivation and use (**VUS**).

Figure 3. *The five genotypes:* **BS,BT,BU,BW,BZ**

In **conclusion**, Among the cultivars evaluated **BZ (Natalino) and BS (Iannarino)** could be appreciated as new (**OHM**) to use for organic farming increase. The data acquired permitted to individuate among the traditional landraces of **CIURIETTO** the more interesting ones for culinary purposes for its sweetness and **TPC** traits as an important sensory property to exploit to it to obtain a high-quality foods.

EUCARPIA

BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS

8 - 10 MARCH 2021

LIVESEED

NUTRITIONAL AND CULINARY VALUE OF SOME IMPROVED PEPPER GENOTYPES (*CAPSICUM ANNUUM*) CULTIVATED IN ECOLOGICAL SYSTEM

Creola BREZEANU[1], Petre Marian BREZEANU *[1], Gabriel Ciprian Teliban[2], Florin Murariu[2*], Otilia Cristina MURARIU[2*], Branca Ferdinando*[3]

Objective: The current research started from the premise that organic production involves the achievement of adequate nutritional and culinary quality of pepper fruits. Several fruit quality traits, like total soluble solids, Vitamin C, colour (carotene, lycopene, xantophylls and chlorophyll content), dry matter pH and titratable acidity, all responsible for culinary quality will be explored in this study.

RESULTS

Table 1. The influence of the crop place and genotypes on the antioxidants compounds

Variant	Caroten mg · 100g^{-1} f.w.	Lycopene mg · 100g^{-1} f.w.	Vitamin C mg · 100g^{-1} f.w.	Chlorophyll A mg · 100g^{-1} f.w.	Chlorophyll B mg · 100g^{-1} f.w.	Xantophylls mg · 100g^{-1} f.w.
Crop place						
Iași	0.7 ± 0.07	0.5 ± 0.05	168.4 ± 8.23	2.8 ± 0.22	3.5 ± 0.35	5.6 ± 0.78
Bacău	4.8 ± 0.49	2.2 ± 0.27	185.3 ± 10.97	0.8 ± 0.06	1.5 ± 0.09	0.6 ± 0.03
	*	*	ns	*	*	*
Genotype						
Genotype 1	1.5 ± 0.02 ns	0.6 ± 0.02 ns	167.9 ± 6.69 b	0.9 ± 0.04 ns	1.1 ± 0.03 b	0.9 ± 0.17 ns
Genotype 2	2.7 ± 1.03 ns	1.7 ± 0.50 ns	121.6 ± 5.76 c	1.8 ± 0.62 ns	3.3 ± 0.72 ab	1.8 ± 0.61 ns
Genotype 3	1.6 ± 0.50 ns	1.1 ± 0.04 ns	152.0 ± 6.42 bc	2.6 ± 0.87 ns	2.0 ± 0.43 ab	1.53 ± 0.34 ns
Genotype 4	2.2 ± 0.56 ns	0.9 ± 0.33 ns	134.2 ± 4.46 bc	1.9 ± 0.31 ns	2.9 ± 0.32 ab	6.3 ± 2.64 ns
Genotype 5	2.8 ± 1.16 ns	2.0 ± 0.80 ns	115.5 ± 7.41 c	1.5 ± 0.16 ns	2.1 ± 0.03 ab	6.2 ± 2.52 ns
Genotype 6	1.7 ± 0.43 ns	0.7 ± 0.05 ns	214.5 ± 7.33 a	1.6 ± 0.28 ns	2.1 ± 0.1 ab	1.3 ± 0.26 ns
Genotype 7	3.0 ± 1.15 ns	1.3 ± 0.43 ns	235.11 ± 13.79 a	2.7 ± 0.92 ns	4.5 ± 1.44 a	1.9 ± 0.67 ns
Genotype 8	5.4 ± 2.11 ns	2.8 ± 1.01 ns	210.7 ± 15.02 a	1.5 ± 0.45 ns	2.3 ± 0.54 ab	4.2 ± 1.65 ns
Genotype 9	4.0 ± 1.35 ns	1.1 ± 0.27 ns	239.8 ± 4.07 a	2.0 ± 0.38 ns	2.5 ± 0.53 ab	3.5 ± 1.31 ns

Values with the same lower-case letters are not statistically different at $p< 0.05$ according to Tukey test

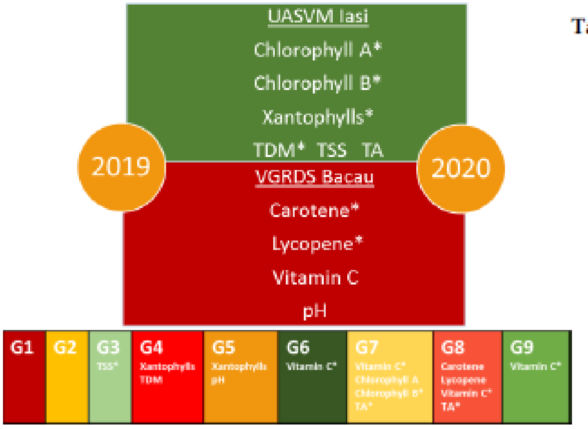

Table 2. The influence of the crop place and genotypes on the quality indices

Variant	TDM g · 100 g^{-1} f.w.	TSS °Brix	pH	TA g citric acid · 100L^{-1} f.w
Crop place				
Iași	13.0 ± 0.44	6.1 ± 0.10	5.1 ± 0.07	0.3 ± 0.02
Bacău	7.6 ± 0.47	5.7 ± 0.13	5.2 ± 0.02	0.3 ± 0.02
	*	ns	ns	ns
Genotype				
Genotype 1	11.2 ± 0.29 ns	5.9 ± 0.06 bc	5.0 ± 0.25 ns	0.2 ± 0.03 b
Genotype 2	10.9 ± 0.32 ns	6.7 ± 0.08 ab	5.2 ± 0.03 ns	0.2 ± 0.01 b
Genotype 3	10.0± 1.31 ns	6.8 ± 0.04 a	5.0 ± 0.08 ns	0.3 ± 0.01 ab
Genotype 4	13.3 ± 2.03 ns	5.3 ± 0.03 c	5.2 ± 0.01 ns	0.2 ± 0.02 ab
Genotype 5	10.2 ± 1.98 ns	5.7 ± 0.14 c	5.4 ± 0.13 ns	0.2 ± 0.01 ab
Genotype 6	8.4 ± 1.15 ns	5.9 ± 0.06 bc	5.2 ± 0.05 ns	0.3 ± 0.04 ab
Genotype 7	8.9 ± 1.82 ns	5.8 ± 0.42 bc	5.2 ± 0.04 ns	0.3 ± 0.01 a
Genotype 8	10.2 ± 1.72 ns	5.5 ± 0.28 c	5.1 ± 0.09 ns	0.3 ± 0.04 a
Genotype 9	9.5 ± 1.29 ns	5.6 ± 0.04 c	5.2 ± 0.06 ns	0.3 ± 0.06 ab

Values with the same lower-case letters are not statistically different at $p< 0.05$ according to Tukey test

In summary, among the chemical compounds present in organic sweet pepper, the amount of β-carotene and lycopene appears as a parameter to improve the culinary value of sweet pepper production, especially on genotypes 7, 8, 9 based on the nutritional benefits obtained from their consumption.

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EUCARPIA *Breeding and Seed Sector Innovations for Organic Food Systems* *8 – 10 March, 2021* LIVESEED

Escola Superior Agrária
Politécnico de Coimbra

LIVESEED

EXPLORING PORTUGUESE MAIZE LANDRACES AS FRESH MAIZE

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INTRODUCTION

The concept of culinary breeding aims to identify, discover and make accessible new populations of cultivars in which consumers and chefs aren't already accustomed to purchasing or cooking. The aim of this work was to make a sensory analysis with five maize landraces grown in organic agriculture. Color, texture, and flavor were some of the attributes observed and studied to know what the purchase intention would be among those who tried the maize landraces.

MATERIALS AND METHODS

CB-81 MILHO VERMELHO(Nº69)
POPULATION: REGIONAL
DESTINATION: FOOD AND FEED
SIZE: MEDIUM
GRAIN COLOR: RED
GRAIN TYPE: ROUND
CYCLE: EARLY

2495 (Nº441)
POPULATION : REGIONAL AZOREAN
DESTINATION: FOOD AND FEED
SIZE: TALL
GRAIN COLOR: WHITE
GRAIN TYPE: TOOTHED
CYCLE: LATE

AMC 397 (Nº797)
POPULATION : SOUSA VALLEY REGION
DESTINATION: FOOD AND FEED
SIZE: MEDIUM
GRAIN COLOR: YELLOW
GRAIN TYPE: ROUND
CYCLE: EARLY

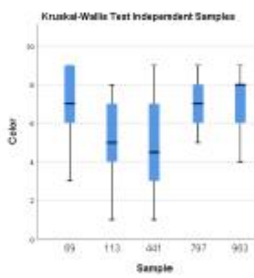
PIGARRO SN 2019 (Nº113)
POPULATION : SOUSA VALLEY REGION
DESTINATION: FOOD AND FEED
SIZE: TALL
GRAIN COLOR: WHITE
GRAIN TYPE: ROUND
CYCLE: LATE

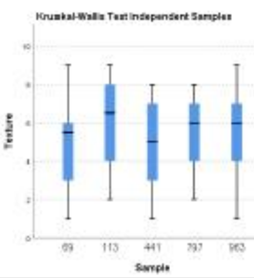
CANICEIRA AMARELO(Nº963)
POPULATION : REGIONAL OF ZONA CENTRO
DESTINATION: FOOD AND FEED
SIZE: SMALL
GRAIN COLOR: YELLOW
GRAIN TYPE: ROUND
CYCLE: EARLY

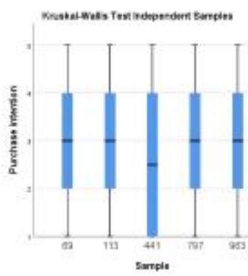
-The maize landraces were harvested on August 20th, 2020, at milky stage (R3)
-30 participants contributed to identify the characteristics of the maize that most attracted their attention
-Each sample was presented sequentially and separately to the participants
-Each participant had tasted between three and five populations
-The evaluated attributes were: color, flavor, texture, global impression. The scale used was hedonic with nine points, varying between 9 as I liked it very much and 1 as I disliked it a lot
-The purchase intention test was also carried out where a five-point scale was used, ranging from certainly not buying to certainly buying
-Data were submitted to ANOVA and PostHoc methods, Kruskal-Wallis test using the IBM SPSS 26

RESULTS AND DISCUSSION

-Attributes such as color and texture, showed great acceptance among participants
-It´s possible to observe that these attributes attract more consumers attention
-The average and respective standard deviation were for Color 6.1±2.17, taste 5.4±2.11, texture 5.3±2.10 and global appreciation 5.6±1.97. The buying intention was 2.9±1.24

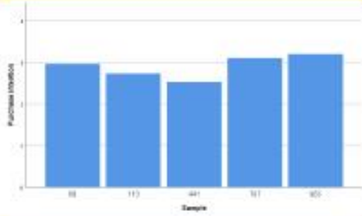






CONCLUSIONS

Maize Landrace's with a colour, such as red, had a better acceptance by consumers. The willing to pay was lower for whitish varieties even that they have soft textures. The present landraces do not exist in the market, hence it was possible to observe that they have a market with great potential, with the organic added interest. That can be explored in short supply chains.



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LIVING SOIL – PLANT INTERACTIONS

EUCARPIA *Breeding and Seed Sector Innovations for Organic Food Systems, 8 – 10 March, 2021* LIVESEED

Drivers of endospheric root microbiome assembly of on-farm selected tomato in agroforestry

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Context

Understanding **plants/microbiome interactions** is a growing issue to locally adapt plants to the diversity of organic systems, while combining scientific approaches and farmers' knowledge. **On-farm plant breeding is a holistic process** in which plants are biological systems shaped by **genetic and microbiological processes.** Understanding how on-farm breeding enhances these interactions could inspire organic plant breeding aiming resilient cropping systems (Duhamel & Vandenkoornhuyse, 2013).

Methods

We considered two agroforestry farms in southern France both growing ***Rose de Berne*** (RDB) tomato variety, and ***Coeur de Boeuf*** (CDB) only in Roumassouze farm. This farm has 3 plots with agroforestry modalities testing the effect of **pruning intensity**, and a non-agroforestry control. The Boulidou farm has a single agroforestry modality and a control plot. **Plants have been grown and selected for 3 generations.** Fine roots are sampled to undergo **microbial and bioinformatic analysis** (Lê Van et al., 2017 ; Escudié et al., 2018). To asses plants adaptation, a **chemotype** (Gautier et al., 2008), and a **genetic analysing** targeting 8 SSR markers have been performed on plants grown at the Roumassouze farm.

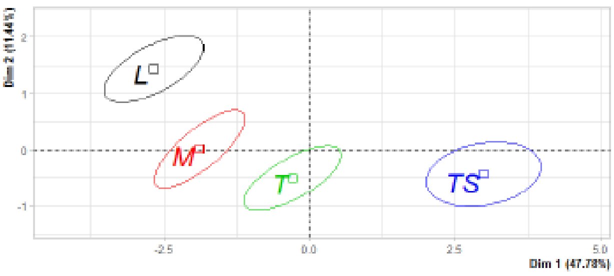


Fig.1 PCA ordination of agroforestry modalities with tomato chemotypes. Light pruning (L), medium pruning (M), pollard (T), non agroforestry control (TS). Dimension 1 is linked to vitamin C and phenolic compound, dimension 2 to acids and carotenoids.

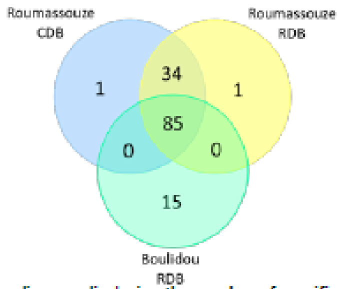


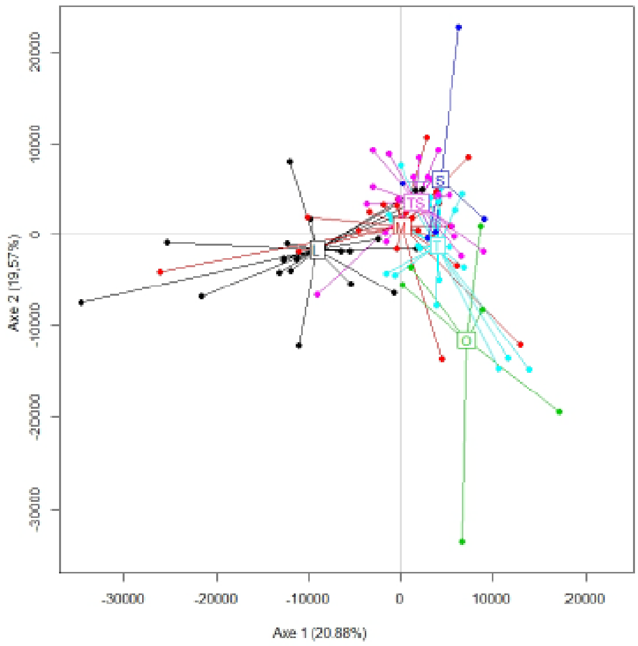
Fig.2: Venn diagram displaying the number of specific sequence clusters among the total community (136 sequence clusters) for the 3 site/variety combinations

Results

The AMOVA performed on SSR markers has shown that **on-farm selection has maintained the same genetic structure of the varieties** through the control and agroforestry modalities. Fig.1 shows that **agroforestry has impacted flavour and nutritional quality** following the pruning gradient. As microbial communities have a strong impact on organic compounds synthesis, their assembly may impact nutritional quality (Castañeda et al., 2020).

In both sites, microbial communities have shared most of their sequence clusters while varieties have shown a weak specificity (Fig. 2) (p-value>0,05).

But **agroforestry practices have impacted significantly community assembly** (p-value<0,05). Fig.3 shows that communities segregate according to pruning intensity, and that agroforestry modalities have been more similar between them rather than with their respective control.



►Fig.3: PLS-DA regression of fungal communities for light pruning (L), medium pruning (M), pollard (T), non agroforestry control (TS) at Roumassouze farm, and agroforestry modality (O) and control (S) at Boulidou farm, tested on the total community (136 sequence clusters)

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PRELIMINARY STUDIES ON GENE EXPRESSION IN *CAPSICUM* PEPPERS ROOTS IN RESPONSE TO PHOSPHORUS DEFICIENCY

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Peppers (*Capsicum annuum* L.) are one of the most important cultivated species of vegetables. Many varietal types are adapted to a great range of different conditions (*DeWitt and Bosland, 2009*). Within this genetic diversity, we could identify genotypes with low input tolerance and genes involved in such differential response.

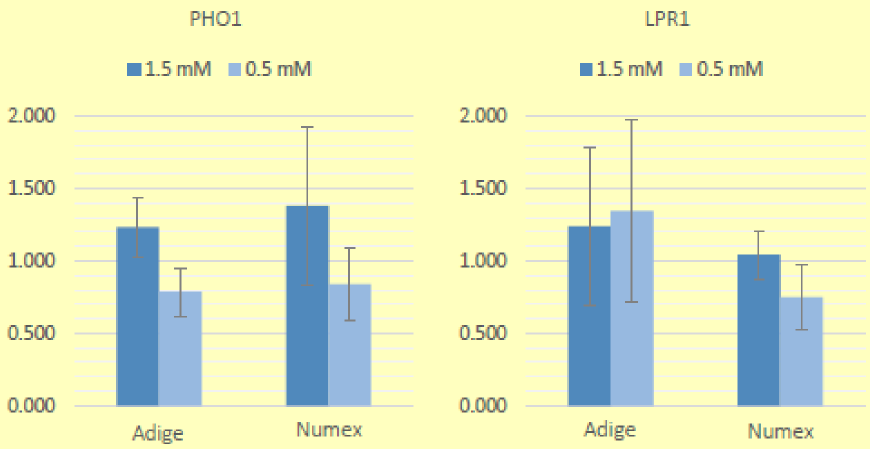
This work is an approach on the search of root over-expressed candidate genes in response to essential macronutrient Phosphorus (P) deficiency in peppers as a potential tool in breeding programs for tolerant and sustainable lines, avoiding excessive fertilization and its inherent environmental problems (*Fita et al., 2015*).

Materials and Methods

- 4-leave stage plants of cv. Adige and cv. Numex (*Pereira-Dias et al., 2020*)
- Control (1.5 mM) and Low (0.5 mM) phosphorus for 3 weeks
- 35 P-responsive candidate gene orthologs identified *in silico*
- Gene expression quantified by quantitative polymerase chain reaction (qPCR)

Results and Discussion

- No differences were detected in the growing patterns among treatments
- No significant over-expression of 5 of the validated genes in relation to β-TUB
- PHO1 and LPR1 genes shows little over-expression in Numex and Adige genotypes respectively, which suggest their potential interest as candidate genes for this tolerance



Next experimental designs should be modified to null P available and sampling in a shorter period of time to detect significant changes in gene expression

Fig. 1. Expression levels of PHO1 and LPR1 genes in genotypes Adige (left) and Numex (right) in control (1.5 mM) and low (0.5 mM) phosphorus conditions

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ORGANIC PRODUCTION OF HIGH QUALITY & HEALTHY SEED

BOOSTING COMMON BUNT MANAGEMENT IN EUROPE

Stephanie KLAEDTKE, Anders BORGEN, Angela THURINGER, Judit FEHÉR, Victor PETCU, Jean-Pierre BOUCHET, Frédéric REY

Introduction

Common bunt, caused by the fungi *Tilletia caries* and *T. foetida*, is a disease in wheat and related cereals. Starting from just a few spores on the seed, the disease can develop in the crop and considerably reduce grain yield and especially quality. The disease is mainly seed-borne, although it can also persist in soils. Techniques that allow the management of common bunt in organic farming - including sound crop management, observation, seed analyses and seed treatments – are well identified [1]. However, when these are not put into practice, occurrences of common bunt still regularly devastate organic wheat crops. This work followed two objectives: Firstly, collecting techniques already available for bunt management and developing appropriate formats to disseminate them. Secondly, exploring new approaches to bunt management, ranging from novel seed treatments to more holistic approaches to plant health.

Results

An overview of techniques available for bunt management in organic systems was compiled and communicated, in particular via dedicated websites in French and English [3], and a document in Hungarian.
A comparison of bunt requirements for certified seeds in EU Member States has identified a potential for exchanging on experiences with different bunt norms, as well as a need for transparency when wheat seed is shipped across Member States.
Vinegar seed treatments were officially experimented for the 1st time in Austria, as well as Hungary and Romania.
Brush cleaning has been experimented in France and disseminated in France, for farmers' cultivars at risk of being lost because of bunt, in particular.
Methodology for participatory workshops on bunt management were shared between Denmark, Italy and France.

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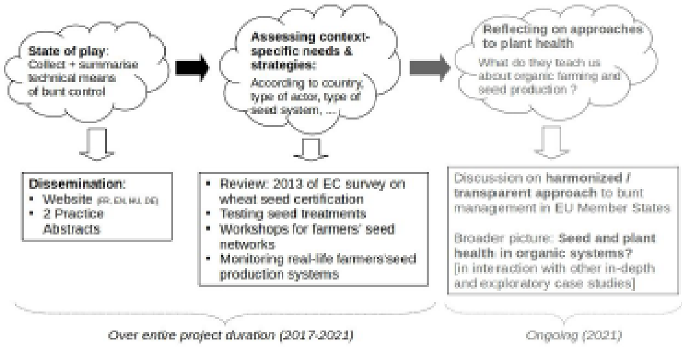
Materials & Methods



As a first step, techniques and strategies used for bunt management in organic systems were collected across Europe. The bunt requirements implemented for certified seeds in different EU Member States were compared, based on a previous inquiry [2].
Transdisciplinary exchange of knowledge and know-how was favored both among LIVESEED project partners and with practitioners beyond the consortium through workshops and seminars in Denmark, France and Italy (8 events, each with 8-50 participants).
Field trials were conducted in Austria, Denmark, France, Denmark and Romania to test and fine-tune a range of seed treatments and sanitation methods, including compound-based (vinegar), biologicals (CERALL ®) and physical treatments (seed washing, brushing).

Discussion

The experimentation and dissemination of techniques for bunt management in organic systems have been facilitated by this exchange between European researchers. Knowledge on bunt and its management has been made widely available, not in the objective of uniformising management approaches, but to enable practitioners to find the best combination of techniques according to their situation and context.
Topics have been identified for future research & development:

- Exchanging experiences with different bunt requirements in EU Member States as a first step toward more transparency on the topic
- Evaluating the effect of seed treatments on seed vigour
- A (long-term) monitoring of bunt on farmers' seeds has been initiated in France.

Conclusions :

LIVESEED has facilitated the **transdisciplinary exchange of knowledge and experience at European level** at several scales (ranging from local to European) and thereby enabled:

- The sharing of concrete tools, both for bunt management and for bunt research
- Getting inspired from other approaches, such as bunt requirements of various countries
- Identifying future topics for research & development.

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NARDI Agrologica AGES ÖMKi Ubios itab LIVESEED

Suitability of potatoes varieties and breeding clones for organic farming in North Courland region of Latvia.

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Institute of Agricultural Resources and Economics,
Centre Crop research department

Rationale.
In Latvia, the potato market has a very wide range of varieties from abroad, and with aim to introduce and offer created in Latvia potato varieties to farmers, a research trial was set up according project founded by the Latvian Ministry of Agriculture: "Support for the Evaluation of Breeding Material to Implement Integrated and Organic Agriculture Crop managment"

Key words: potato variety, tuber yield, yield structure.

Objective. To assess the suitability of potato varieties and clones of breeding material to an organic farming system.

To achieve the goal, a field trial was set up with 9 potato varieties: Monta, Rigonda, Lenora, Prelma, Brasla, Imanta, Magdalena, Jogla, Gundega and 10 breeding clones: S 07169-35, 2001-33.17, 07131 -15, S 10063 -178, S 10063 -48, S 09035-22, 19694.5, S 07156-22, 19922.29, 2008 - 6.5.

Methods.
The study was caried out over several years (2015-2020). Evaluated traits: potato tuber yield, yield structure, phenological phase, resistance of varieties and clones to diseases during the growing season and post-harvest tuber infection.

Results. The analysis of the data shows that the potato tuber yield, using all agrotechnical measures, achieved very good results in average of three (2018 -2020) years. Yields varied significantly between varieties (Ffact> F crit). Obtained results proved significant difference between yield of varieties, tuber yield ranged from 15.9 to 29.22 t ha-1. Highest productivity showed variety 'Jogla' (27.69 t ha-1) and breeding clones S 09035-22 (29.22 t ha-1); S10063-128 (27.79 t ha-1); 19922.29 (26.50 t ha-1). When assessing the yield structure, varieties and breeding clones with highest commercial yield and larger tubers of food fraction (>50 mm) were noted (Imanta (51.39%); 2001-33.17 (50.90%); 19922.29 (56.1%), S 07156-22 (60%); S10063-128 (64.99%)).

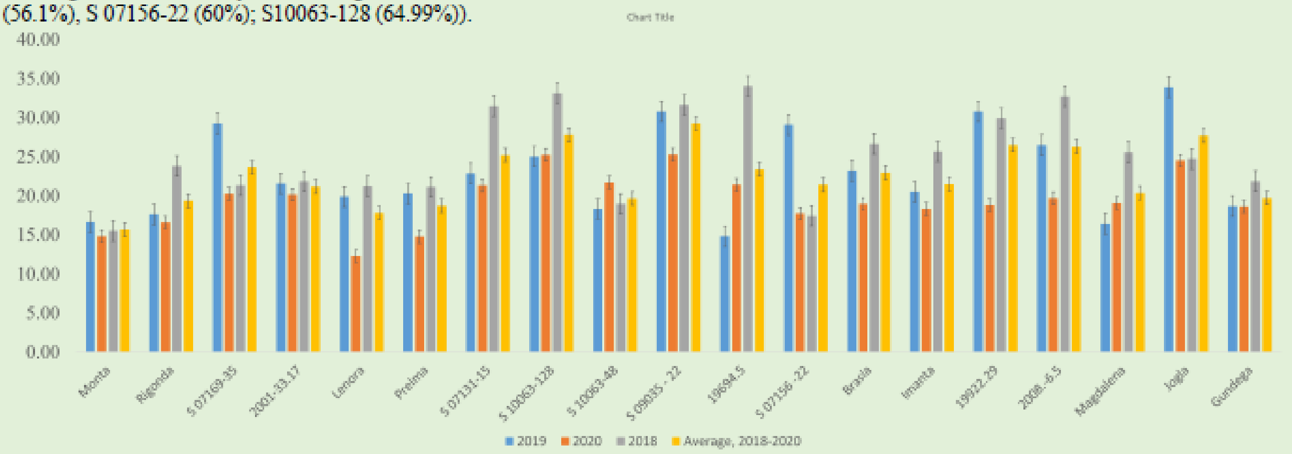


Figure 1. Yield of tuber in organic growing systems in Stende RC, 2018-2020.

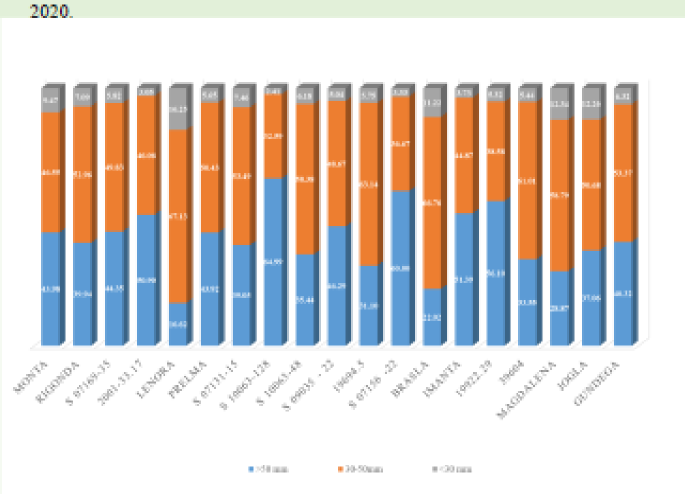


Figure 2. Potato variety and clones yield structure %, on average in 2018-2020.

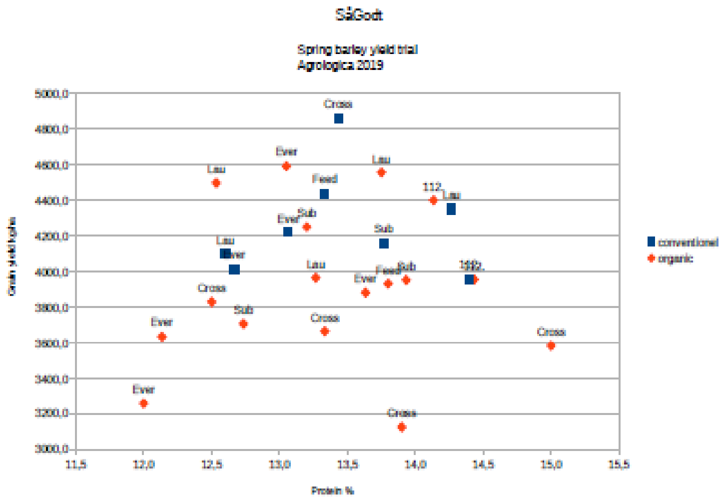
Conclusion

Breeding clones and varieties will be selected from the evaluated material, the traits of which are best suited to the organic management system in Latvia.

YIELD POTENTIAL IN ORGANIC AND CONVENTIONAL CEREAL SEED

Authers: Anders BORGEN, Agrologica, DK,
Pernille SARUP and Hans HALDRUP, Nordic Seed a/s DK

Yield potential of a seed lot may be affected by environmetal factors during growing season of seed propatation.



Material and method:

8 variety trials were grown over three years under organic and conventional conditions. In each trial, seed of each variety came from both organic and conventional certified seed lots.

Conclusion:

Effect of variety was significant in all trials, but in most trials, now difference were seen between conventional and organic grown seed.

However, in a few trials grown under extreme low input organic conditions, there was a significant lower yield from organic propagated seed (ANOVA, p= 0.02). This may indicate that seed quality is significant only under low input conditions, but insignificant normal organic or conventinal conditions.

VINEGAR SEED TREATMENT TO CONTROL COMMON BUNT IN WHEAT

Anders BORGEN,Agrologica, DK,
Stephanie KLAEDTKE and Frédéric REY, ITAB, F
Judit FEHÉR, ÖMKi, HU; Angela THÜRINGER AGES, AU; Victor PETCU NARDI, RO; Laurane BOFFIN Ubios, F

Many microorganisms are sensitive to acetic environments, and vinegar (acetic acid) can therefore be used as a seed treatment to contol common bunt and other seed borne pathogens.
Vinegar is listed as a natural substance legal to use in organic farming.

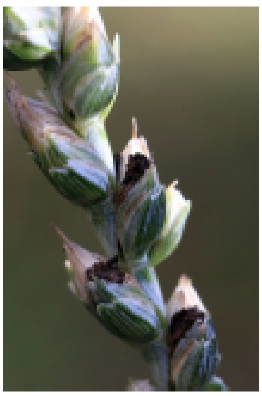
Common bunt can be controlled >95% without significant effect on germination at correct application and dose.

- A minimal dose of 17ml/kg is needed to get full effect. Even distribution on the seed surface is crucial at this dose.
- Doses higher than 17-20ml/kg for more than 60 seconds may harm germination.
- Doses higher than 17ml/kg is easier to apply evenly, and can be applied in combination with drying after 60 seconds.

Vinegar seed treatment is recommended for small scale production and low investment conditions as little equipment is needed.

Correct dose (17ml/kg) for hand hold conditions is when all vinegar is absorbed by the seed without surrounding equipment getting wet.

If your hand gets wet from touching the seed, drying is needed or more seed should be applied.



Vinegar can be implemented also in large scale production. However, equipment applying precise dose and maybe integrated re-drying is needed at large scale conditions.

Work was funded by LIVESEED H2020 and SåGodt (GUDP/DK)

EFFECTS OF MICROORGANISMS AND AMINO ACIDS ON ORGANIC SEEDS PRODUCTION OF TOMATO (*Solanum lycopersicum*) IN MEDITERRANEAN CLIMATIC CONDITIONS

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INTRODUCTION & AIM

Organic seed production of tomato is an important goal for companies interested in covering the gap to provide a good amount of high-quality vegetable propagation materials, statisfying the request of the European growers. The availability of new tools for organic farming, such as **microorganism** and **amino acids** mixtures, will speed up the transition phase toward more resilient, efficient and sustainable vegetable growing systems. In the present work we evaluated eight **tomato** cultivars provided by ISI sementi, Semillas Fitò, Semo. The reported experimental activity represent one step of the H2020 BRESOV project and it deals with the improvement of organic vegetable production by means of new organic cultivars, which react well to the soil microbiome. The general aim of this work is provide to the growers the basic protocols facing the transition to the organic farming.

MATERIAL AND METHODS

The growing cycle was carried out in an organic farm located in Gerbini Sferro (Catania, Italy, **Sicily** - 37°31'06.5"N 14°47'27.5"E) transplanting the plantlets on May 27° 2020.

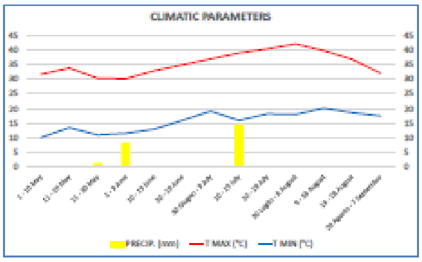
The experimental design adopted was split-plot with the first experimental factor represented by plant nutrition protocol (**IP – Itaka Protocol**), based on Ammino Complex Extra (amino acids mixture) and 3KO (*Trichoderma harzianum, T. asperellum, T. atroviride*) by different doses (IP0= 0 g L^{-1}; IP1= 1.5 g L^{-1}; IP2= 3.0 g L^{-1}), and the second experimental factor by genotypes (G); each thesis was represented by three replicates of fourteen plants (**Tab. 1**). The plantlets were placed at the crop density of 4 plants m^{-2}, along single rows 1 m spaced each other. All the plots were fertilized by 8,5 Kg in total of microorganisms and amino acids mixture distributed by five treatments, one each three weeks, and by 325 m^{-3} of water for the entire growing cycle of 114 days.

The experiments were performed using a completely randomized blocks design with 3 replicates. The significance of differences were evaluated by two-way analysis of variance (ANOVA). All statistical analyses were performed using CoStat release 6.311 (CoHort Software, Monterey, USA).

RESULTS & CONCLUSIONS

The temperature level reached during the flowering time (15 July – 26 August) affected negatively the fruit set, such as the soil composition rich in salts too (**Tab. 2; Fig. 1**). The results provide additional evidences about the significance level in genotype (G), Itaka protocol (IP) and their interaction (**Tab. 3**). The number of trusses per plant were affected significantly by (IP). The number of fruits and the fruits weight showed a significant interaction by genotype (G) and the highest value was registered for Moradeta and Bangalore Red. The fruits yield, although affected negatively fruit set due to the high temperature, showed a significant between the two experimental factors studied (**Fig. 2**). About seeds yield there are not significant interactions. Some, among the genotypes used, have given remarkable results, especially in fruits yield. In particular two cultivars, Moradeta and Bangalore Red were the most significant, while UC82 and Pavlina were the least significant among all genotypes (**Fig. 3**). For this reason they will be used in the future to investigate their use in organic farming.

Fig. 1: Climatic parameters



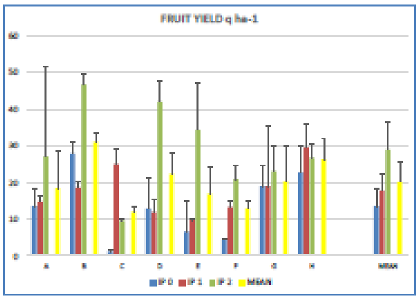
Tab. 1: list of utilized Genotype

Genotype	Species	Accession Code	Denomination
A	Solanum Lycopersicum	318	Moradeta
B	Solanum Lycopersicum	322	Money Maker
C	Solanum Lycopersicum	323	UC 82
D	Solanum Lycopersicum	324	Minired
E	Solanum Lycopersicum	325	Orbit
F	Solanum Lycopersicum	326	Pavlina
G	Solanum Lycopersicum	328	Sejik
H	Solanum Lycopersicum	330	Bangalore Red

Tab. 2: Soil Analisys

TASK 4.1 UNICT	IP0			IP1			IP2			OPTIMAL RANGE
	BEFORE	AFTER	MEAN	BEFORE	AFTER	MEAN	BEFORE	AFTER	MEAN	
SKELETON (g/kg)	57	210	133,5	56	89	72,5	45	100	72,5	
FINE SOIL (g/kg)	943	790	866,5	944	911	927,5	955	900	927,5	
SAND (g/kg)	235	266	250,5	928	190	559	185	268	226,5	[500 - 750]
LOAM (g/kg)	270	250	260	29	327	178	295	300	297,5	[150 - 400]
CLAY (g/kg)	495	484	489,5	43	483	263	520	432	476	[50 - 250]
E.C. (dS/m)	3,58	4,88	4,23	4,8	3,28	4,04	6,78	4,57	5,675	[0,2 - 1,9]
CEC meq/100g	36,2	32,9	34,55	28,2	30,2	29,2	43,6	25,9	34,75	
C/N RATIO	5,1	6,9	6	4,6	7	5,8	3,9	6,4	5,15	
pH	7,9	8,1	8	7,9	7,3	7,6	7,8	8	7,9	[5,5 - 7,5]
N	0,8	0,8	0,8	1,1	0,8	0,98	0,9	0,8	0,85	

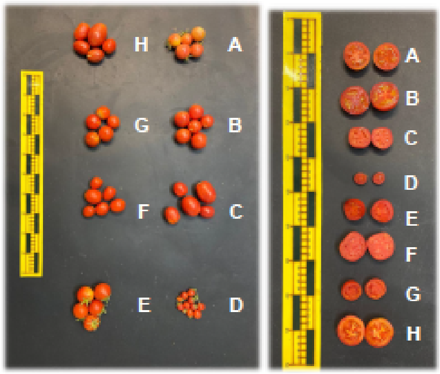
Fig. 2: Fruit Yield



Tab. 3: statistical analisys (ANOVA)

ITAKA PROTOCOL (IP)	GENOTYPE (G)	TRUSSES (n)	FRUITS PLANT^{-1} (n)	FRUIT WHEIGHT (g)	FRUITS YIELD	SEEDS YIELD
IP0		6.99 ± 0.03 b	2.56 ± 1.51 a	16.22 a	28.89 ± 4.75 a	0.032 ± 1.35 a
IP1		9.66 ± 0.02 a	2.65 ± 2.39 a	17.95 a	17.78 ± 6.90 b	0.020 ± 1.40 a
IP2		10.99 ± 0.02 a	2.84 ± 2.71 a	18.32 a	13.61 ± 7.52 b	0.025 ± 4.86 a
	Moradeta	7.62 ± 0.06 a	2.91 ± 2.88 b	15.15 ± 5.06 b	18.53 ± 10.18 bc	0.05 ± 2.99 a
	Money Maker	8.96 ± 0.04 a	1.35 ± 0.98 b	22.31 ± 3.69 ab	31.12 ± 2.54 a	0.04 ± 2.52 a
	UC 82	8.74 ± 0.03 a	0.80 ± 1.08 b	22.51 ± 8.55 ab	12.01 ± 1.52 c	0.02 ± 1.52 a
	Minired	11.11 ± 0.01 a	12 ±9.01 a	1.68 ± 0.29 c	22.33 ± 5.87 abc	0.01 ± 3.50 a
	Orbit	9.40 ± 0.004 a	0.72 ± 0.68 b	15.07 ± 6.80 b	16.94 ± 7.17 bc	0.005 ± 2.55 a
	Pavlina	8.31 ± 0.005 a	0.21 ± 0.18 b	28.09 ± 10.69 a	12.99 ± 1.84 c	0.007 ± 1.35 a
	Sejik	8.70 ± 0.01 a	0.87 ± 0.88 b	15.21 ± 10.28 b	20.41 ± 9.57 abc	0.01 ± 2.44 a
	Bangalore Red	10.74 ± 0.04 a	2.62 ± 2.07 b	19.97 ± 12.15 ab	26.42 ± 12.42 ab	0.03 ± 3.41 a
SIGNIFICANCE						
IP		***	ns	ns	***	ns
G		ns	***	***	***	ns
IP x G		ns	ns	ns	**	ns

Fig. 3: all genotypes during the fruit surveys



The cell fusion-free vegetable list helps organic farmers to find suitable cultivars

BUNDESVERBAND NATURKOST NATURWAREN (BNN) e.V.

Holger Scharpenberg (scharpenberg@n-bnn.de)

Fig.1: Newly developed and already approved, cell fusion-free broccoli „Rasmus". Photo: Kultursaat e.V.

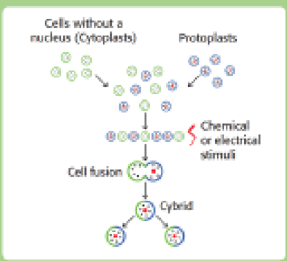


Fig.2: Fusion of a nucleus with an external cytoplasm, in which the nucleus was previously destroyed. Source: FiBL.

What is cell fusion and the cell fusion breeding technology?

During cell fusion, two cells fuse into one. It is used as a method to transfer the so-called ›cytoplasmic male sterility‹ (CMS), e.g. in cabbage species. CMS occurs naturally in many plants but is now often introduced into the breeding lines in the laboratory using methods similar to genetic engineering. In addition to cost and time savings, CMS technology is used to ensure a safer and higher degree of hybridization during propagation, rather than to achieve certain properties.

What is the problem?

The market for Brassicas, for example, is dominated by cell fusion derived CMS-hybrids. Although varieties produced with the help of cell fusions are permitted according to the EU organic regulation, this technique is rejected by many cultivation associations for ethical reasons, as it does not comply with the principles of organic farming. In addition, there is currently no statutory labeling requirement. The cultivation associations Bioland, Naturland, Bio Austria, Bio Swiss and Demeter prescribe the use of cell fusion-free varieties, but so far there has been no reliable list of varieties that farmers could use for orientation.

Objectives:

In order to create clarity and reliability for the producers of the named associations, all information was collected and a binding positive list of cell fusion-free varieties has been drawn up - in collaboration with Bioland, Demeter, Naturland, Bio Austria, Bio Suisse, BNN and coordinated by FiBL. It is also important to further sensitize the public to this issue.

Methods:

As a first step, breeders and seed companies are asked to provide detailed information on all available cell fusion-free varieties in their product range. The listed varieties must have at least one of the following assurances for freedom from cell fusion: flower morphological observation by a breeding expert, written assurance from the breeder, quantitative PCR analysis of seeds from a sealed original seed package or a confirmation as an open-pollinated, seed-solid variety (e.g. according to the EU list of varieties).

Results:

With the publication of this positive list, an instrument is available for the first time that clearly names all known varieties of cabbage and chicory that are not based on CMS transmitted by cell fusion. This enables producers to select cell fusion-free varieties fast without time-consuming research work and with the greatest possible certainty.

In the query procedure described, a total of ~700 cell fusion-free varieties for Brassicas and a further ~100 for chicory could be identified for the present positive list.


Positive list

Cell fusion free varieties in vegetable production

Fig.3: The positive list of cell fusion-free varieties in vegetable production. Available in 5 languages. See QR-Code.

Outlook:

The list is continuously expanded to include other varieties and new cultivated groups if cell fusion is used in these recently. It is updated annually. In the future, the list is also being expanded step by step by including Mediterranean countries.

This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230.

This project is supported by the Coop Sustainability Fund.

MULTI ACTORS & PARTICIPATORY APPROCHES

Postgraduate course on participatory plant breeding and resilient seed systems

Edith T LAMMERTS VAN BUEREN[1], Conny JM ALMEKINDERS[2], Eva WELTZIEN-RATTUNDE[3], Veronique CHABLE[4], Riccardo BOCCI[5], Monika MESSMER[6], Fred RATTUNDE[3], Claudius ADM VAN DE VIJVER[7]

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Objective

There is a worldwide need for critical thinking about and training in participatory breeding and seed system concepts, issues and approaches in order to support professionals and graduate students who seek to contribute to resilient seed system development.

We identified key aspects of the course design and explored the experiences, insights and participants' feedback gained during the first postgraduate course in 2020.

Results

This train-the-trainer type of course held in 2020 was fully online due to the COVID19 restrictions, facilitated by the WUR-PE&RC graduate school, 39 participants joined this course.

Among the participants were practical breeders, MSc students, PhD candidates, postdocs and other professionals. Participants originated from Europe (21), Africa (9), Asia (4), Latin Amerika (2), USA (3).

Course material: The course guide and presentations are shared on Organic Eprints (Lammerts van Bueren et al. 2020): https://orgprints.org/38731/.

The course included five key topics:

- Decentralised and participatory approaches to plant breeding and seed system development;
- Governance and policy issues regarding seed control, (co-)ownership and benefit sharing;
- Specific needs and challenges for different crop types and socio-economic contexts;
- Approaches for multi-actor collaborative learning;
- Interactions and trade-offs between technical solutions and social choices.

Main conclusions for future course work

- ✓ It is a multidisciplinary topic!
- ✓ Not only PPB, also the seed system as a whole needs to be on the course agenda!
- ✓ Next to lecturers with ample time for discussions, also include small-group project-work and lecturer's engagement with these groups, for active participation!
- ✓ Provide a balance between concepts vs. practical experiences and tools!
- ✓ Publically available course design should stimulate more courses in other countries!

Acknowledgements: The course in 2020 was hosted by the Graduate School Production Ecology & Resource Conservation (PE&RC) at Wageningen University and Research, and was supported by Global Alliance for the Future of Food, EU Horizon 2020 projects LIVESEED (grant agreement No 727230) and DYNAVERSITY (grant agreement No 773814), and the CROP ROOT TUBER AND BANANAS and NWO-WOTRO.

Participatory potato breeding in The Netherlands: the BIOIMPULS project

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[2]Wageningen University and Research (WUR), Department of Plant Sciences/Wageningen UR Plant Breeding, Wageningen, The Netherlands.

Objective of research

To facilitate and further stimulate organic potato production in the Netherlands new varieties resistant to late blight are bred in cooperation between researchers from WUR and LBI together with farmer breeders and professional breeding companies. Breeding capacity amongst organic potato farmers is to be increased by setting up a dedicated training course.

Materials & methods

Together with farmer breeders and professional breeding stations resistance genes originating from wild *Solanum* species are incorporated in selection material which is selected in a participative way.

A crossing program is carried out by WUR in which 11 major resistance genes conferring resistance to *Phytophthora infestans* are used. Pre-breeding to introgress the major resistance genes into near commercial potato clones is carried out entirely by WUR, while seeds from crosses that reach the commercial level are mainly distributed over farmer breeders and breeding companies to select resistant clones showing commercial potential.

All selections from farmer breeders, breeding stations and WUR are subsequently together evaluated for resistance, yield potential and general agricultural performance both under organic and non-organic management. When applicable, presence of resistance genes is confirmed with molecular markers.

Selected clones from commercial crosses are both reused by the project as input for further breeding cycles, and after further commercial evaluation brought to the market by one of the breeding companies.

To increase breeding capacity amongst organic potato farmers a dedicated potato breeding training course is developed addressing topics like basic potato genetics, designing and conducting crosses, raising seedlings, designing selection trials, selection procedures and regulatory issues.

Results & discussion

In Bioimpuls-I (2009-2014) and Bioimpuls-II (2015-2019) 7 breeding companies and 14 farmer breeders were engaged at some stage.

Since the start in 2009, 521,810 botanical seeds were distributed, of which 499,838 at the commercial level and 21,972 at the pre-breeding level. In total 399 new selections by farmer breeders and breeding stations were evaluated centrally for Phytophthora resistance and agronomic potential. The first selection derived from Bioimpuls crosses is submitted for official variety registration and National listing in 2019, expected to be registered early 2022.

The practical training course for small scale potato breeding has trained 208 people with backgrounds in organic farming, professional breeding, education, and seed certification. Bioimpuls has received funding for the next 10 years and will run until 2029, at which stage all resistance genes processed will be incorporated in commercial selection pipelines, from which new *Phytophthora* resistant varieties will become available for organic and low input potato production in the Netherlands and beyond.

Photo 1: Phytopthora field trial 2020 of Bioimpuls selection material at Wageningen UR.

Acknowledgements

The Bioimpuls project is funded by the Dutch Ministry of Agriculture, Nature and Food Quality under the program Groene Veredeling (Green Breeding).

www.louisbolk.nl

Louis Bolk Instituut

Gefinancierd door de provincie Gelderland in het kader van POP3, Innovatieve landbouw

LIVESEED

PARTICIPATORY RESEARCH INTO THE QUALITY OF VEGETABLES IN ORGANIC FARMING

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Keywords: participatory research, quality, organic farming

Project Aim

To secure and possibly increase the quality of the product produced using organic farming methods.

Product quality

The quality of a product is defined by several traits. Yield, yield stability, shelf-life, disease resistance, appearance and flavour are all important aspects of what make a crop desirable from the growers perspective. To a greengrocer's shelf-life, appearance and flavour are key traits, a chef will aim for a flavoursome product. For consumers appearance, flavour and price are important.

Trials and analyses

During these trials five varieties of beetroot and pumpkin were produced at three locations in Gelderland, the Netherlands (2018 and 2019). The entire value chain was involved; from the growers, to restaurant owners, retailers, and consumers. Analyses were performed to determine the yield, product uniformity and shelf-life and component analyses was performed to determine the dry matter content, sugar and mineral content and taste.

Results

Appearance

In beetroot one cultivar was lower in both the total yield and in the number of beetroots per m². In pumpkin the yield also differed among the cultivars. In these cases the difference was caused by a higher weight per pumpkin.

Figure 1. Beetroot varieties 'Robuschka' and 'Jannis'.

Component analyses and taste

Component analyses beetroot, trial locations

Year	Parameter	Location 1	Location 2	Location 3	P (year)	P (location)
2018 2019	Dry matter content (%)	19,3 12,2 (a)	17,2 14,5 (a)	22,2 13,7 (b)	<0,001	0,005
2018 2019	Brix	18,0 10,2 (a)	16,9 12,8 (ab)	20,6 11,7 (b)	<0,001	0,028

Table 1. Dry matter content and Brix for beetroot grown at 3 locations in 2018 and 2019. In yellow, and indicated by lettering a-b, significant differences.

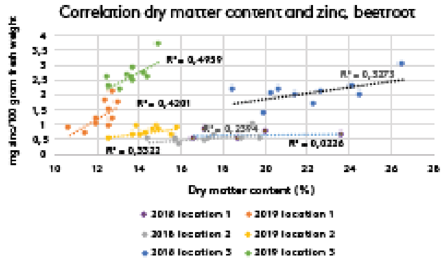

Figure 2. Correlation between dry matter and zinc content in beetroot.

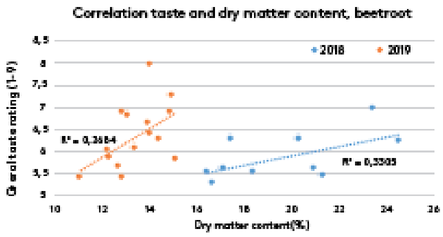

Figure 3. Correlation between dry matter content and the overall taste of beetroot.

Conclusion

The main differences were found between location and year. Certain minerals in the fruits can be up to 2 or 3 times higher depending on location. The minerals commonly found in beetroot based on the NEVO table of the National Institute for Public Health and Environment in combination with the recommended dietary allowance (RDA) in relation to the mineral content of the beetroot in this project (Table 2).

The higher the dry mater content the more positive the taste is perceived and the higher the mineral content. For a tasty and healthy product dry matter content seems to be an important parameter.

Beetroot						
Year	Mineral	Location 1 (mg)	Location 2 (mg)	Location 3 (mg)	NEVO-table (mg)	RDH (mg/day)
2018	Coper	0,10	0,06	0,20	0,02	0,90
2019		0,09	0,10	0,15		
2018	Iron	0,62	0,63	0,64	0,40	11
2019		0,58	0,64	0,55		
2018	Magnesium	24,50	17,50	28,20	14	325
2019		30,60	19,90	22,70		
2018	Zinc	0,66	0,55	2,08	0,40	8
2019		1,30	0,75	2,65		

Table 2. Average nutritional content of the tested beetroot, the NEVO data and RDA. Units in mg/100g fresh weight except the RDA (mg/day).

Recommendation

To growers it is recommended to keep a close eye on the soil mineral content and the occasionally analyse their fruits on mineral content.

Rete Semi Rurali

Beyond the yield driven strategy - breeding for specific adaptation in organic rice in Italy

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Introduction

Italy is the largest producer of rice in Europe. The production is based mainly on monocultures and intensive exploitation of land, together with a widespread use of chemical inputs and water. The implementation of a new rice breeding strategy, specifically targeted to the organic rice farming systems (**ORFS**), represents a necessary and urgent contribution to this transition.

Figure 1. Contrasting management practices in two of the four farms

Materials and Methods

In 2019 four organic and biodynamic rice farms hosted on-farm trials for the evaluation of 22 local rice varieties (released before 1960) set up in an incomplete randomized block design. Each farm adopted different field management (FM) practices. The following traits were assessed: panicle length, plant height, stem posture, tillering and susceptibility to *Fusarium spp* and *Pyricularia oryzae*. Evaluation involved more than 120 participants who scored each plot from 1 (worst) to 5 (best). The same methodology was repeated in 2020. Data were submitted to spatial analysis, ANOVA and GGE Biplot with GenStat v 21 and R software.

Figure 2. Participatory evaluation in one of the four farms close to maturity

Results

Preliminary results indicate that most phenotypic traits show a significant "farms x varieties x field management interaction. The biplot in figure 3 shows the example of grain yield with a different set of top yielding varieties in two distinct groups of farms.

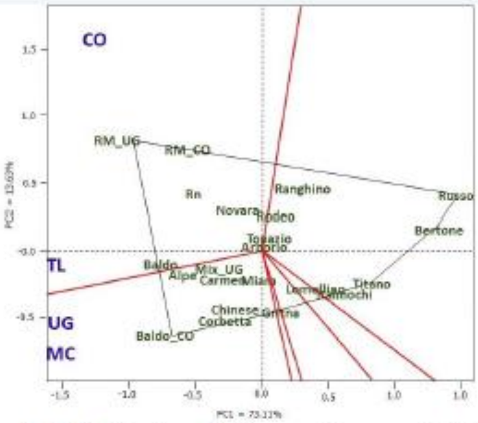

Figure 3. Biplot of grain yield (means of two years) of the 22 rice varieties in four farms (CO, TL, UG and MC).

A similar pattern was observed in the case of resistance to diseases (Fig. 4) with the most resistant varieties differing from farm to farm.

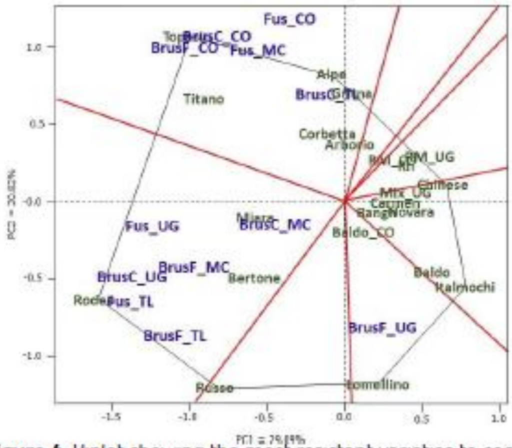

Figure 4. Biplot showing the most resistant varieties to each of three diseases in the four farms (Brus = *P. oryzae*; Fus = *Fusarium spp*); CO, TL, UG and MC are the four farms

Conclusions The results support the hypothesis that organic and biodynamic farms are an heterogeneous population of target environments, than can only be effectively served by a decentralized-participatory breeding program developing specifically adapted varieties

Acknowledgements The authors acknowledge the farmers U.Stocchi, M. Stocchi, M. Mussa. A. Parravicini, R. CaimoDuc, M.Cuneo, P. Aina. Credits are also due to Dr F.Orlando, V. Vaglia, and Prof S. Bocchi, for their valuable advice and technical support and to the Fondazione Cariplo – donor, for supporting the programme.

AMBASSADORS OF BIODIVERSITY

A PARTICIPATORY PROJECT TO VALORIZE TRADITIONAL SEEDS

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EUCARPIA Breeding and Seed Sector Innovations for Organic Food Systems
8 – 10 March, 2021

"Ambassadors of Biodiversity" is a project of citizen science, which involves growers and educational communities, who have a key role in this research, growing traditional seeds and collecting accurate data.

Local non-professional growers

The amateur farmers grew in their orchards the seeds in the original area where they were collected for the *ex-situ* conservation in the seed bank:

- To transmit their traditional knowledge
- To study the varieties in their traditional growing area
- To recover *in-situ* valuable local vegetable seeds

43 local growers "Ambassadors of seeds" have studied 104 landraces of 12 crops from the Vegetable Germplasm Bank of CITA – Aragón.

Networks of "Ambassadors of Seeds"

Educational community

Teachers and students grew the traditional seeds in their scholar orchards, of two leguminous crops from the *ex-situ* collection of the seed bank: Broad beans (*Vicia faba* L.) and Pea type *"bisaltos"* (*Pisum sativum* L.)

- To learn about the crops throughout the production cycle (from sowing to harvest)
- To collect the accurate data following a Teaching Guide and processing the information for the project

31 school centers "Ambassadors of seeds" have studied 59 seed samples of 30 accessions from the Vegetable Germplasm Bank of CITA – Aragón: 14 broad beans and 16 *"bisaltos"*

FECYT

Acknowledgements: financial support of the Spanish Foundation for Science and Technology (FECYT); the technical support of Esciencia (S Portero, G Orduña); the volunteers (growers, teachers, and students), and the BGHZ-CITA team (A Vela, I Peral, J Pallarés)

The promise of commons for the organic breeding sector: Conceptualizing Seed Commons

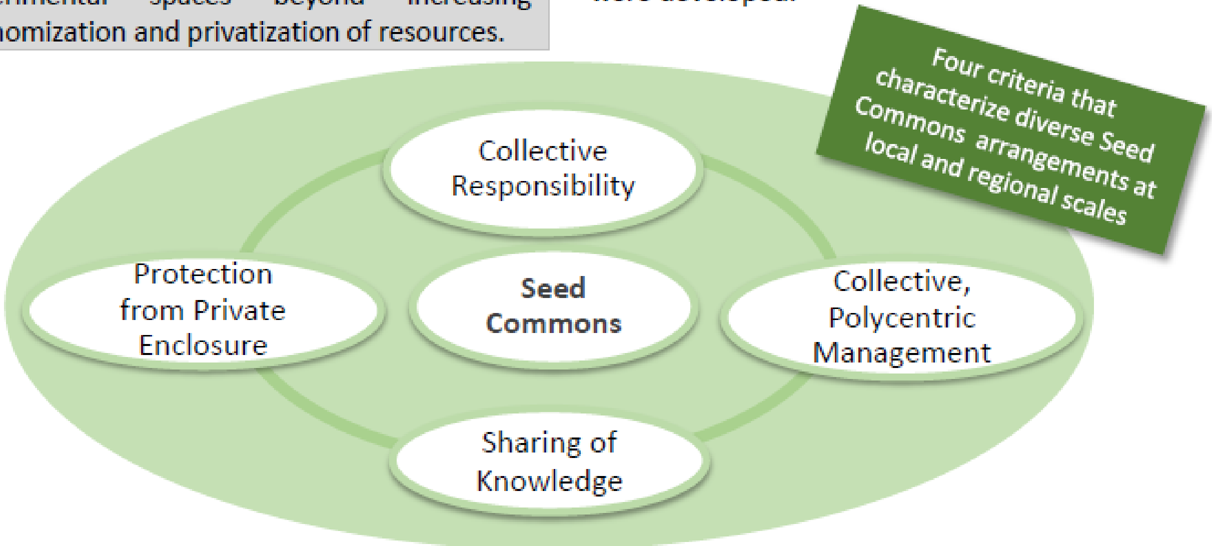
Stefanie Sievers-Glotzbach, Hendrik Wolter, Julia Tschersich, Nina Gmeiner, Lea Kliem, Anoush Ficiciyan

Background

'Commons', defined as institutions that enable the collective development, management, and sharing of goods and resources, are an alternative principle of resource management. It carries the potential for a more sustainable use of natural resources, a democratization of resource governance, and for opening up experimental spaces beyond increasing economization and privatization of resources.

Goal and approach

The two research projects RightSeeds and EGON analyzed in which way commons-based fruit and vegetable breeding can contribute to achieving sustainability in agricultural systems. In a transdisciplinary research process, using qualitative methods like interviews, workshops and focus groups, four Seed Commons criteria were developed.



Case study examples

apfel:gut is an organization of farmers and breeders, focused on organic fruit breeding with non-profit goals.


Photo by Inde Sattler (Apfel:gut e.V.)


Photo Bingenheimer Saatgut AG

Kultursaat e.V. is an association of organic vegetable breeders who self-govern their breeding efforts.

Sustainability potentials

- enhance food sovereignty
- support social-ecological resilience of agricultural systems

→ It credibly realizes the principles of organic agriculture, including issues of intellectual property rights, process transparency, and participatory breeding approaches

Contact:
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Carl-von-Ossietzky University Oldenburg, Department of Business Administration, Economics and Law, Germany

For the detailed results, please see:
Sievers-Glotzbach S., Tschersich J, Gmeiner N, Kliem L. and Ficiciyan, A. (2020): Diverse Seeds – Shared Practices: Conceptualizing Seed Commons. International Journal of the Commons [online] 14(1), p.418–438. Available at: https://www.thecommonsjournal.org/articles/10.5334/ijc.1043/
Wolter, H. and Sievers-Glotzbach, S. (2019): Bridging traditional and new commons: The case of fruit breeding. International Journal of the Commons [online] 13(1). Available at: https://www.thecommonsjournal.org/articles/10.18352/ijc.869/

Carl von Ossietzky Universität Oldenburg | iöw Institut für ökologische Wirtschaftsforschung | Niedersächsisches Ministerium für Wissenschaft und Kultur | Federal Ministry of Education and Research | FONA Social-Ecological Research

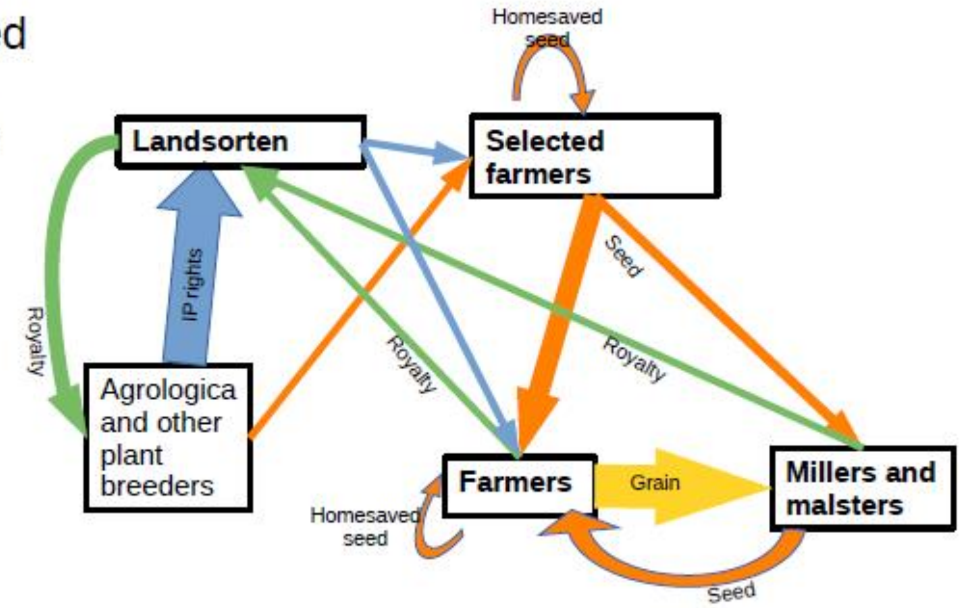
www.uol.de/rightseeds
www.rightseeds.de

Landsorten

an organic seed system without seed company

A decentralised seed system of varieties and heterogeneous material from organic plant breeders.

Membership organisation for farmers and grain processors.



Legal frame:

Seed is only sold from farm to farm in small amounts for trial production which is legal (EU seed legislation Article 3). Farmers hereafter reproduce home saved seed.

Selected varieties:

- Spring wheat
- Winter wheat
- Spelt
- Purple wheat
- Naked barley
- Winter oat
- Macha wheat
- Durum wheat
- Millet

Started in Denmark 2020
http://landsorten.dk
email: landsorten@kulturplanter.dk

DESIGNING VARIETAL EVALUATION SYSTEMS FOR ORGANIC FARMING: A MULTI-ACTOR APPROACH

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Context = Significant development of **organic farming** (OF)
→ increases demand for **varieties adapted to OF**
→ Need for **varietal evaluation systems** adapted to OF
To breed and register varieties & provide reliable references to users

Which involvement of the stakeholders ?

Sources : research programme ECoVAB[1] and CTPS committee CISAB[2]

There are several levers to involve stakeholders (farmers, advisors, researchers, breeders, processors, consumers):

Previous consultation: Which varieties are expected?

- ✓ Expected abilities and traits — Ex. weed competitivness
- ✓ Growing conditions
- ✓ Quality / use

Explore ranges of varieties for various environments? Looking for ideotypes adapted to many situations?

=> Design varietal evaluation systems

To retain: all traits don't have to be assessed in the conditions of use

Ex. Diseases resistances (in case of major genes) evaluated in conventional farming (CF)
Ex. Phenological traits such as flowering dates for intercropped pea assessed in sole crop[3]

Although some results can be provided by data obtained in CF, ECoVAB survey cites the importance of setting up varietal platforms in OF

Main sources of information cited by OF farmers to chose their varieties:
Trials in OF (57%) > other farmers (51%) >> advisors (31%) >> publications on varieties (17%)

Varietal platforms in OF = Privileged discussion forum

= Places to visually appreciate the varieties & to share experience

Different organisations to imagine:

- ✓ Researchers / farmers involvement — Participatory approaches
- ✓ Trial location — Cropping systems, soil, climate. On farm, on station
- ✓ Trial design — Small plots / large band. Protocol / observations.

Targeted communication

- ✓ Description of varieties is not sufficient, communication aimed at OF is also expected: varieties adapted to OF, traits of significant interest, targeted actors

What's next? Recommandations:

Farmers are key actors

- ✓ Identify needs at regular intervals of time + compare them to varietal supply
- ✓ Support or create multi-actor consultation groups, including farmers
- ✓ Question the involvement of farmers at each stage of the creation and evaluation of varieties (from consultation to collaboration)

[1] ECoVAB project « How to describe and evaluate a variety adapted to OF in case of arable crops » (2015-2018) was funded by CASDAR (French Ministry of Agriculture).
[2] CISAB is the CTPS internal Transverasl Commission for OF. CTPS is the national authority managing registration for the Ministry of Agriculture. CISAB was created in 2015 to promote registration of varieties for OF. https://www.geves.fr/about-us/the-ctps/
See also: Bernicot *et al*, « Assessing varieties for OF: what contribution from evaluation in CF? » Session Regulatory & policy opportunities
[3] Moutier *et al*, « Breeding for wheat-pea mixtures: are the traits of pea varieties in sole crop predictive of their behavior in mixture? » Session Breeding for diversity

EUCARPIA – Breeding and seed sector innovations for organic food systems
March 8-10, 2021 - Session Multi-actor & participatory approaches

Agricultural Institute
Centre for Agricultural Research
Martonvásár, PO Box 19, H-2462
ELKH | Eötvös Loránd Research Network
ÖMKi
✉:miko.peter@atk.hu

On-farm comparison of trials based on different plot sizes to help farmers' wheat cultivar choice

@LIVESEEDeu
www.liveseed.eu
LIVESEED

Péter Mikó✉, Mihály Földi*, Mária Megyeri, Gyula Vida, Szilvia Bencze*, Judit Fehér*, Dóra Drexler* (*ÖMKi, Hungary)

All farmers are searching for the best performing plant cultivars to improve their profitability, but there is still a lack of knowledge on how to choose these cultivars for organic production in Hungary. Organic cultivation is more affected by environmental factors compared to conventional due to the ban on artificial pesticides, herbicides and fertilizers. Additionally, without an official organic small plot variety testing system, there is a strong limitation regarding the annual number of cultivars that could be tested under on-farm growing conditions. Therefore, our aim is to develop an effective system for testing large number of wheat cultivars on the targeted organic farm.

Materials and Methods

- Testing on an organic farm near Nagydorog (Central Hungary) between 2019-2020 (Fig. 1)
- 11 winter wheat cultivars: 8 in 2019; 7 in 2020 (4 in both years)
- Farmer plot (1000 m² each) versus small plots (6m² each)
- 3 sampling (1 m²/sample) per farmer plot versus 3 replications of small plots (randomized complete block design)
- Traits: grain yield, protein and gluten contents, Zeleny sedimentation value (quality measurement with NIR technology)
- Regression analyses between the 2 types of performance trials

Fig. 1: Winter wheat trial on an organic farm near Nagydorog (2019, Hungary)

Results

- Significant moderate correlation for all quality traits ($0.45<R^2<0.56$; $p<0.001$)
- Higher grain yield in small plots, but with good correlation ($R^2=0.6$; $p<0.001$) to farmer plots (Fig. 2)
- Based on the 4 common cultivars: stronger correlation ($R^2=0.7$) for protein and gluten contents
- Best (protein, gluten) and worst (yield) performing group of cultivars are the same
- Rapid NIR measurement of Zeleny sedimentation is not reliable, but good rank correlation with protein and gluten contents ($R^2>0.83$)

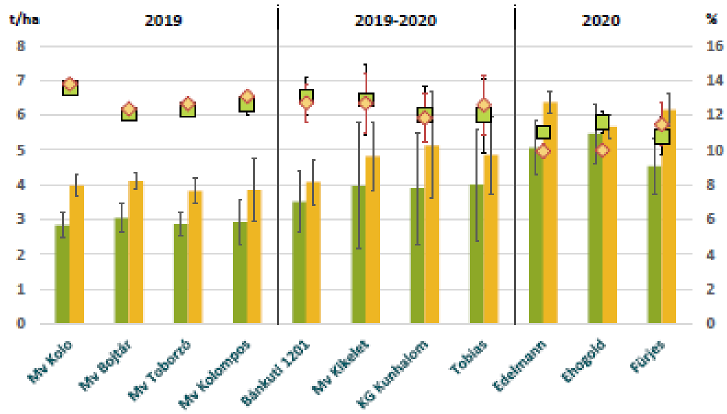

Fig. 2: Mean grain yield (bars), protein content (dots) and standard deviations of winter wheat cultivars examined for 2 years (2019-2020) on an organic farm near Nagydorog, Hungary using two types of trial setup (farmer plots: green; small plots: orange). Four cultivars were examined in both years (middle of the diagram)

Conclusion

Combination of trials is recommended on the target farm:

2 years of small plot trial
(high number of cultivars, NIR quality)

⇩

Positive selection of the best quality cultivars, while negative selection of the worst yielding cultivars

⇩

Testing of preselected cultivars under farming conditions (1 year)

⇩

Selection of best cultivars for the own organic farming system

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.


Variability of EPO spikes

INTRODUCTION OF PARTICIPATORY BREEDING PRACTICES IN HUNGARY –A CASE STUDY

Szilvia BENCZE[1], Péter MIKÓ[2], Judit FEHÉR[1], Jacques DAVID[3], Pasquale De VITA[4], Pierre ROUMET[3], Aline ROCHER[3], Mihály FÖLDI[1], Dóra Drexler[1]

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[2]Agricultural Institute, Centre for Agricultural Research, Hungary
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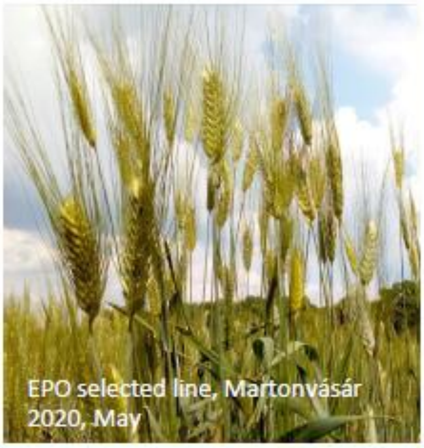
Traditional practice of plant breeding is very different from modern breeding. Under our changing climate, however, organic heterogeneous materials (OHM) might better adapt to their growth site than genetically uniform varieties. After adaptation, they might also produce more stably, while providing farmers an opportunity to select their own varieties according to their needs. Our aim was to introduce participatory breeding, using the EPO durum (evolutionary evolving population), received from INRAE in 2017, in the frame of EU H2020 project SolACE.


EPO selected line, Martonvásár 2020, May

After propagation for two consecutive years in Martonvásár, Hungary, the segregating EPO population was ready for on-farm testing, starting from 2019. The organic trials took place in Nyíregyháza, Bugac, Füzesgyarmat and Želiezovce (Slovakia), while those in conventional were in Kiszombor and Vlčany (Slovakia). The rising interest of farmers and a new research project (MNVH) made possible in 2020 that more than a dozen additional Hungarian farmers joined the initiative from all over Hungary, with the intention of learning participatory breeding methods.

Evolutionary processes - driving forces of natural selection

Adaptation to various soil and climatic conditions can sometimes lead to powerful evolutionary processes driven by natural selection. Such examples were observed under the sandy and weedy conditions of Nyíregyháza, and in Bugac, where the drift-sand combined with extreme drought caused a dramatic loss of plants (picture shown below). The country-wide epidemy of *Fusarium* of 2019 led to an immense loss of susceptible plant individuals, the grains of which were not present in the next generation.

Spike selection – the participatory breeding approach

In Martonvásár, Želiezovce, Füzesgyarmat and Bugac, a *positive selection* on the best, healthy spikes was carried out to create new local population lines. *Mass counter selection* of hyper-tall plants (via cutting off their spikes) was performed in Füzesgyarmat.

Plans – and the future

Seeds of local EPO populations collected from all sites were sown in one site, Szár, last autumn, allowing comparisons between population variants regarding phenology, morphology and yield characteristics. It also provides an opportunity for genetic analyses aiming at disease or abiotic stress resistance but also at assessing the adaptation potential of EPO population or the degree of genetic change in case it had taken place.

The introduction of interested farmers to participatory breeding methods will be continued via a practical workshop (planned for June 2021) and by publishing a booklet on participatory breeding methods and good practices of sowing-seed saving.


Variability at maturation, Želiezovce, 2020 June

Acknowledgements
This work received financial support from the EU H2020 project SolACE No 633571 and the MNVH project, Hungary.


Bugac, severe drought on sand, May 2020


EPO population
Füzesgyarmat May 2020


Farmers' choice – the participatory breeding

MAIZE PARTICIPATORY BREEDING IN PORTUGAL- GERMPLASM EVALUATION

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[2] CERNAS, Polythecnic Institute of Coimbra, 3045-601 Coimbra

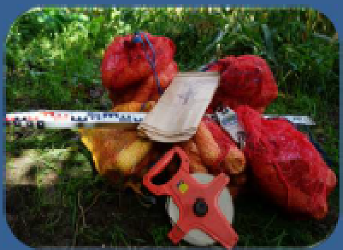
Escola Superior Agrária
Politécnico de Coimbra

INTRODUCTION

✓The Participatory Plant Breeding Program "VASO" (Sousa Valley in Portugal) started in the 80s with the purpose of valorizing the maize landraces for farmers needs that included the use of maize for maize bread.

HUNTERS

✓The HUNTERS scale (High, Uniformity, aNgle, Tassel, Ear, Root lodging and Stalk lodging) was developed by Silas Pêgo, in order to perform a summary and expeditious characterization of the biometric parameters of the plant and the ear (Mendes-Moreira et al, 2017).



DEMONSTRATION FIELD

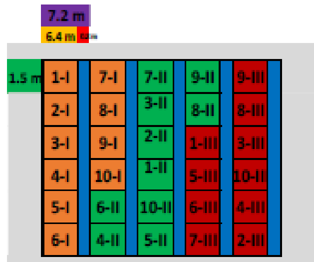
Farmers and stakeholders participated in the demonstration field at Macieira da Lixa and indicated from the 10 populations, their preferred germplasm for gastronomic use and for animal feed;

- FN-2014 for feed
- Pg C0S019 (Lousada) for maize bread purposes.

MATERIALS AND METHODS:

Phenotypic and yield evaluations using HUNTERS descriptor were conducted using 10 maize landraces:

- 8 populations
- 1 composite cross population (CCP) derived from PPB "VASO",
- 1 CCP derived from 40 maize populations from Azores, Portugal that were obtained in a collected mission in 1979) (Bettencourt and Gusmão, 1982; Mendes-Moreira et al, 2017).



The trials followed the randomized complete block design with three replications

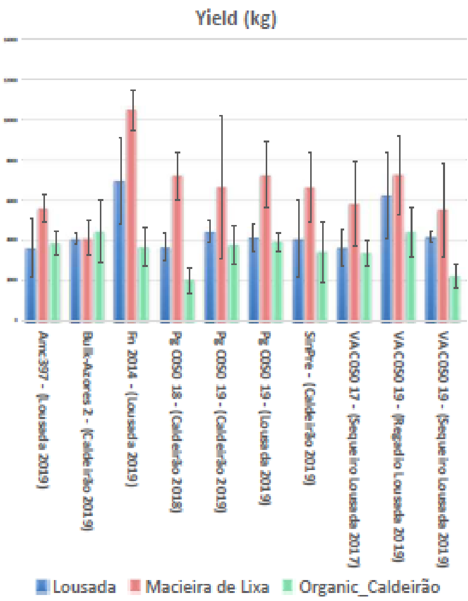
2 locations distance 15 km in Sousa Valley region: Macieira de Lixa and Lousada – agroecological sites

Area certified for organic production at Escola Superior Agrária de Coimbra (ESAC-IPC)- Low input organic system

Evaluation of the agronomic behavior and adaptation of the landraces and composites in farmers conditions (2 locations) versus low input organic system. Data treatments followed ANOVA.

RESULTS:

- The tested populations didn't show significant phenotypic differences between the environments, although there were significant phenotypic differences among genotypes for Plant Height, Ear placement and Stalk lodging.
- The yield ranged from 2015 kg/ha to 10505 kg/ha, with significant higher values in Macieira de Lixa.
- From the tested genotypes only VA C0S0 19 - (Regadio Lousada 2019) ranked in top 3 in all environments, being the highest yield in low input organic system (4314 kg/ha).
- BulkAzores2 (CCP) obtain its higher yield in the low input organic system (4145 kg/ha).
- AmC397 attain higher yield values in the low input organic system compare to conventional farming system in Lousada.



DISCUSSION:

The population VA C0S0 19 - (Regadio Lousada 2019) showed organic potential and promising yield results across environments, despite not being chosen for gastronomic use or animal feed by farmers and stakeholders.

The CCP- BulkAzores2 shown yield stability, higher in low input organic system. Greater genetic heterogeneity can provide adaptation to wide range of ecosystems.

FN-2014 proved to be a population with regional interest due to its productive and phenotypic traits. However, its poor agronomic behavior in the low input organic system, reinforces the need to introduce this population in organic plant breeding systems.

CONCLUSION:

The trials and the demonstration field aim to continue the commitment with participatory plant breeding tradition in the region and reinforce the organic network. The diversity and uniqueness of germplasm used, makes it possible to fit in sustainable organic agricultural systems and adapt under multi-actor approach.

Future studies will allow to identify the microbiome impact in plant adaptation and its correlations with agronomic performance.

ACKNOWLEDGMENTS

LIVESEED has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 17.00090. The information contained in this communication only reflects the author's view. Neither the Research Executive Agency nor SERI is responsible for any use that may be made of the information provided.

The authors acknowledge to farmers, COPAGRI and ADERSOUSA, so as the ESAC-IPC's staff for their support on field work.

SOCIO-ECONOMIC, MARKET AND CONSUMER ASPECTS OF SEED SYSTEMS

ANALYSIS OF VEGETABLES SEED SYSTEMS IN GHANA

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Introduction

- Seeds are important inputs for agricultural productivity.
- They are vehicles for the dissemination of knowledge and technologies in the agricultural sector.
- Ensuring food and nutritional security depends on access to good quality seeds of improved varieties.
- Understanding seed systems farmers use for various crop production is crucial to design tailored interventions to improve their access to good quality seeds.
- This study set out to map the seed systems of three major vegetables, onion, tomato and pepper in Ghana.

Methodology

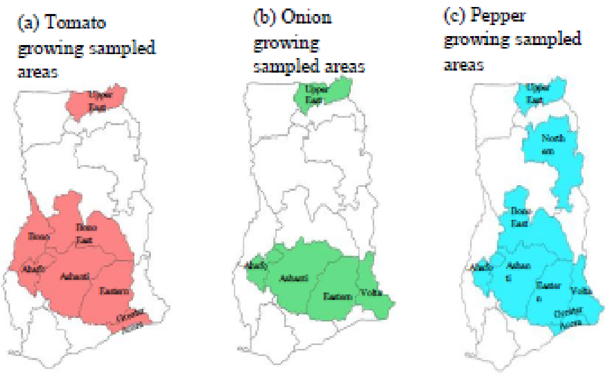

Fig 1. Map of Ghana showing areas of high production of tomato (a), onion (b) and pepper (c)

- Multi-stage sampling to identify the survey locations (Fig 1)
- Sample size: 180 (tomato), 150 (onion) and 130 (pepper)
- Seed system regulatory framework was collected through Key Informant
- Interview with seed regulatory officers
- Chi square to test relationship between seed sources and crop

Results

Seed sources were crop-dependent (Table 1)

Crops	Seed purchase	Combined seed saving and purchasing	Seed saving	Probability of Chi square test
Tomato	117	4	58	
Pepper	45	11	65	P<0.0001
Onion	111	17	16	

Fig 2: Seed purchasing sources per crop

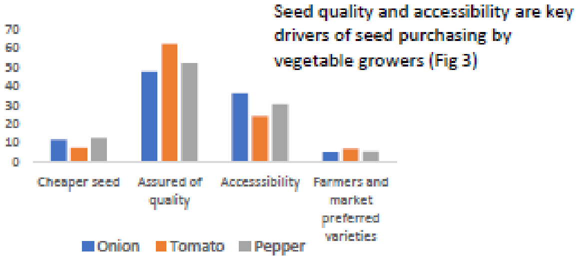

Fig 3. Drivers of seed purchasing

- Poor seed availability, affordability and access are the major constraints faced by vegetable growers
- There is no local vegetable seed production company
- The improved vegetable varieties marketed in the country were imported

Conclusion

- Interventions to promote access to high-quality seed should take into account crop specificities,
- Seed sourcing from fellow farmers is still an important channel to get seeds,
- There is a need to strengthen local vegetable breeding and seed production.

Acknowledgement

We acknowledge funding from SNV and AATF

SUSTAINABILITY

BRESOV EUCARPIA European Association for Research on Plant Breeding Europäische Gesellschaft für Züchtungsforschung Association Européenne pour l'Amélioration des Plantes LIVESEED UNIVERSITÀ degli STUDI di CATANIA

ASSESSMENT OF BROCCOLI (Brassica oleracea var. Italica) SEED PRODUCTION FOR THE ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT

Di3A-University of Catania (Italy)

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Background

The European Commission through the Green Deal has established practices to preserve biodiversity, ensure resource use for future generations and reduce dependence on pesticides and fertilizers, with the dual aim of achieving more sustainable production and providing consumers with sufficient food and high nutrient content. The Brassica oleracea crops has allowed, within the **BRESOV H2020** European project to set the optimal growing conditions necessary for pursuing good yield and a high quality organic seed by the use of low inputs.

Methods

Two cultivars, named E (BR357, "Sparaceddu") and G (BR358, "Riccio di Messina") belonging to Brassica oleracea crops, have been used to carry out the trial. These have been placed in the field following an experimental split plot scheme, characterized by three replications with seven plants. Each plot was treated by different doses of nutrients. The first was not fertilized (IP0), the second replication provided for a half dosage (IP1) while the third was characterized by a dose of nutrition able to meet the real needs of the crop (IP2), with the aim of studying the response and the growth rate of the different cultivars. In order to assess the production of quality organic seeds, a germination test and calculation of seed yield were carried out.

Results

The experimental tests showed that the plots not treated with fertilisers (IP0) obtained a higher seed yield and germinability in both cultivars than the plots fertilised at 50% and 100% of the actual crop needs analysed. As shown in Figure 1, the seed yield of the untreated plots (IP0), although low, is appreciable in both genotypes in contrast to the IP1 and IP2 plots where only seeds of genotype E reached a quantifiable yield. In the case of germination percentage (Figure 2), the untreated plots also showed better results. The seeds obtained from the two genotypes had a germinability close to 100% in both cases, unlike the IP1 and IP2 plots where only genotype G gave appreciable results.

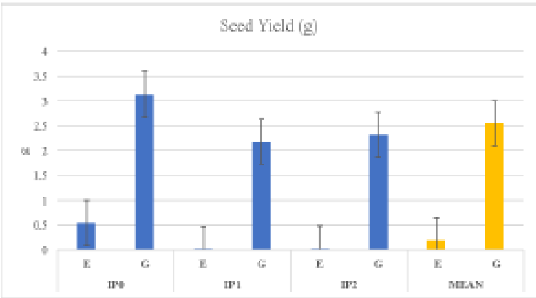

Figure 1 Seed yield per genotype and nutrition dose

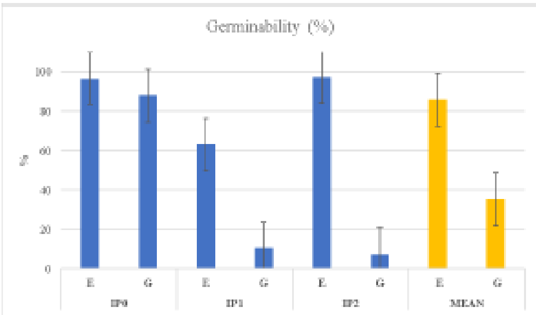

Figure 2 Germinability (%) per genotype and nutrition dose.

Conclusions

The results show that agricultural production can also ensure good seed quality through more rational use of materials to reduce pollutants, climate change and negative impacts on human health. There is a strong need to affirm the concept of 'minimum dose' to achieve a satisfactory result. As far as the Green Deal of the Farm to Fork strategy is concerned, the aim of the work is to raise farmers' awareness of the implementation of more sustainable practices, in through a reduced use of inputs in terms of fertilizers it is possible to obtain economically sustainable yields, making the production process environmentally friendly.

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