WINTER WHEAT
SPELT WHEAT

Results of pilot trials

RECOMMENDATION OF VARIETIES FOR ORGANIC AGRICULTURE IN THE REPUBLIC OF MOLDOVA

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FOREWORD

Dear readers,

we are very pleased that, on the basis of findings from trials carried out in Moldova, we have been able to compile the third published edition of Recommendation of varieties for organic agriculture in the Republic of Moldova.

Current development of priorities in agriculture within Europe confirms the appropriateness of our decision to include the recommendation of varieties for organic farming as a component of the project, and that these activities will continue in Moldova, even after the end of the project. We are particularly thinking of the EU Biodiversity Strategy and the "Farm to Fork" Strategy (F2F) which, among other things, require greater diversity in the species and varieties grown, and an expansion in organic acreage (up to 25%), as well as simpler registration and trade in so-called amateur, old, and organic varieties.

With regard to organic farming (OF), the use of organic seed for main crops is a certainty, especially in the developed countries of the EU, such as France, Germany, Denmark, or Austria. However, the vast majority of farmers within the EU use organically grown seed from standard "modern" varieties, which were originally cultivated for conventional farming, where chemical intensification inputs are used.

For organic farming, however, it is necessary to test these varieties once again, to see how they will fare in organic conditions. In our Moldova project, we focus on the most important group of crops in the EU, which is cereals. Important characteristics for cereals include: good seedling emergence, vitality of young plants, and good tillering, plants that have good leaf coverage of the soil, and thus compete well with weeds. Furthermore, the ability, despite limited nourishment, to form reasonable quality grain with a high protein content and a high and stable falling number. Good plant health is important, with resistance to fusarium head blight (danger of mycotoxin = DON), septoria, rust and mildew.

Besides testing classic varieties in organic conditions, the EU is also going in the direction of supporting the development of special organic varieties, which are deep-rooting, have greater ability to take up water and nutrients, as well as having the characteristics mentioned above.

We have also tried these in Moldova (Swiss organic varieties developed by Peter Kunz). The question is, however, the availability of certified seed of these varieties in Moldova.

Support and preference for organic varieties, and so-called organic heterogeneous materials, is included in the new regulation on organic production, which comes into force on 1.1.2022: Regulation (EU) 848/2018 of the European Parliament and of the Council on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007.

Organic heterogeneous materials are not new varieties, they are a mixture of several various populations of the same variety, and should be more amenable and more resistant to extreme weather and infections, which are becoming more prevalent in farming. Research in this field is in the early stages, and is based mainly on the experience of non-government organisations which are allowed to trade these “heterogeneous reproductive materials” as seed, under the new regulation.

In conclusion, we wish to emphasise that, due to the EU legal status of terms such as organic seed, organic variety, or organic heterogeneous material, this issue must be dealt with by the public administration of each member country (including associated countries) and they must have their own organic testing and administration capacity for authorisation and consultancy.

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INTRODUCTION

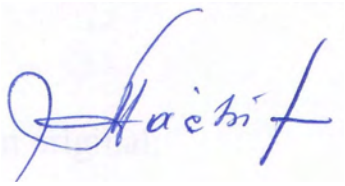
The project “Institutional support within organic agriculture in the Republic of Moldova” was launched on June 8, 2017 and is already successfully implemented over a period of 4 years by the Central Institute for Supervising and Testing in Agriculture from the Czech Republic (UKZUZ). The aim of this international project is to increase the transparency and credibility of state institutions in this important area of the economy on the one hand and to raise awareness and competitiveness of stakeholders in organic farming on both local and foreign markets.

Today, organic farming is becoming even more important than ever for the sector and society as a whole, being an alternative to modern, intensive agriculture, which tends to respect the "laws of nature" and provides the production of agricultural food products with a high content of biologically active substances, in order not to harm human health and the environment.

We all know that food production in organic farming depends on several factors, the basic being the crop rotation, choice of varieties, technology, etc. Thus, the breeders around the world begin to focus on production of varieties in organic conditions for use in organic farming, in order to stabilize their production and quality.

The recommendation of suitable varieties for organic farming has been established in many European countries, which can be found in the Official Register of Varieties and is intended to help organic producers to choose the most suitable variety for their area and to provide them with comprehensive information on the potential of organically grown varieties. In this respect, an important role belongs to the State Commission for Crops Variety Testing, which has as its basic purpose the identification of varieties, which will best achieve their genetic potential for production and quality in different cultivation regions, where specialists analyze the received results from all testing centers and prepare proposals to change the current range of varieties.

The Republic of Moldova, being a country with a huge agricultural potential, where the principles of organic agriculture can be successfully implemented, because it has fertile soils, favorable conditions for crop growth and development, must enter on the international market with competitive agricultural food products of the highest quality, obtained on the basis of modern organic technologies.



Mihail Machidon
State Chancellor, Ministry of Agriculture, Regional Development and Environment

ORGANIC AGRICULTURE

"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved."
(International Federation of Organic Agriculture Movements, 2020).

Organic agriculture in the world

According to the latest available global data on organic agriculture, it is evident that organic production is increasing worldwide. The total area of organic land is more than 70 million hectares, of which 18.6% is arable land, representing 1.5% of total agricultural land. The number of producers has also increased (more than 2.8 million producers) and the global market achieved a value of more than 95 million euros in 2018 (FiBL, 2020).

Organic farming in Europe

Organic agriculture in Europe has an increasing trend. In total, 15.6 million ha are under organic management, which represents 3.5% of agricultural land. Arable land covers 7.5 million ha, permanent pasture 6.2 million ha and permanent cultures 1.7 million ha, respectively. Of the arable land, in 2018 the three main focuses were cereals (2.6 million ha), green fodder (2.2 million ha) and dry pulses (0.5 ha) (FiBL, 2020).

Organic farming in the Republic of Moldova

Organic farming in the Republic of Moldova has increased in the last 5 years and due to the State support by including the subsidy sub-measure 2.5 „Supporting the promotion and development of organic farming".
There were registered 152 operators in the Republic of Moldova in 2019, mainly organic certified farmers and processors., where the largest share belongs to businesses who own 78% certified organic land. The total acreage of organic certified land or in the conversion period was 28 546.6 hectares, of which over 22.1 thousand hectares are certified in organic system, and 6,365 hectares in conversion.
The value chain of organic farming is a promising one in the context of the development of organic products markets and the consumer's interest, and for the opportunity for the rural community's development.

Recommendation of varieties for organic farming

Why to recommend certain varieties?

For efficient and sustainable food production in organic farming, crop rotation, choice of varieties and technology must be carefully considered. Since most of the available varieties have been produced under conventional farming conditions, the potential of organic farming has not been fully exploited. Some characteristics which are important in organic farming, such as resistance to seed-borne diseases, weed suppression or nutrient efficiency (NUE), are not the most important parameters for selection of varieties where these deficiencies are addressed by pesticide protection and mineral fertilizers. Another aspect is the question of the effective root system of the variety, an issue which is completely overlooked in conventional breeding. Therefore, breeders worldwide are starting to focus on producing varieties under organic conditions for use in organic farming, with the aim of stabilizing the production and quality of organic foods.

These varieties must meet the high yield requirements for high-quality production, taking into account the nutritional and technological properties of organic food and the hygienic requirements of production. Organic agriculture differs from conventional agriculture in many respects. One of these, for example, is the use of legumes in crop rotation, the residues of which provide an important source of post-harvest nutrients, especially nitrogen. In contrast, the use of fast-soluble mineral fertilizers in conventional agriculture makes nitrogen easily available to plants. A major problem in organic farming is the lack of regenerative fertilization with mineral fertilizers when winter crops are in great need of nitrogen to restore growth, but this is not readily available. Therefore, a variety grown under organic farming should have the ability to restore growth even under poorer conditions, and should also be tolerant to mechanical weeding processes, which help to accelerate the mineralisation of organic matter in the soil in springtime.

On the agricultural market, most of the available varieties have been developed and promoted under the conditions of conventional agriculture, using artificial pesticides and mineral fertilizers which are prohibited in organic agriculture. Because most varieties are also bred for conventional agriculture, it is not known how these varieties would behave under organic conditions. In several European countries, the recommendation of suitable varieties has been introduced. This is closely linked to the official register of varieties and is intended to help farmers to choose the most suitable variety for their location. The register may contain hundreds of varieties without any information on their suitability for given conditions, and the recommendation list is therefore a means of selecting the best variety. In several European countries, the recommendation of varieties for organic conditions has also been introduced to provide organic farmers and producers with information on how conventionally-bred varieties perform under organic agriculture conditions. Organically-bred varieties are also included.

Choosing the right variety for the local climate, field conditions and the market can minimize loss and increase success in yield and quality of production. It helps to avoid pointless efforts with poorly-adapted or poorly-performing varieties which are unsuitable for the given conditions, and thus reduce costs.

The establishment and implementation of a variety recommendation system helps:

- To minimize loss due to poor variety performance
- To minimize loss due to the occurrence of pests and disease due to poor tolerance/resistance of the variety
- To maximize yield and quality of production
- To improve the most important requirements of the market
- To identify the best variety and the best organic seed source

Establishment of the recommendation of varieties suitable for organic farming in the Republic of Moldova

The recommendation system of varieties suitable for organic agriculture was implemented by the State Commission for Crops Variety Testing according to the project matrix "Institutional support within organic agriculture in the Republic of Moldova".

As a project task, the State Commission has established a process of field trials at two Testing Stations located in different pedological climatic zones, in accordance with the "Methodology on agrotechnical processes in conditions of balanced crop rotation and recommendation of suitable varieties for organic farming".

At the moment, the tests have been extended to a third Testing Station in the northern part of the country. That testing is necessary to obtain objective and independent information on crops varieties with their characteristics and suitability for growing conditions in the Republic of Moldova.

At the same time, during the period of three years, the producers and the inspection and certification bodies were acquainted with the results obtained. There were also presented other lesser known (minority) crops with a market potential in the Republic of Moldova. During the field days, organized and fully financially supported by the project - for which we have a special gratitude and appreciation, where the typical agrotechnical measures for organic farming have been demonstrated, namely crop rotation, the use of green fertilizer and intercropping, organic plant protection and mechanical weed control. At the same time, with great pleasure we note the technical contribution through the project donation of the AEROSTAR 600 finger harrow, without which we could not have had the gained results.

As a result, the premises for the establishment of the recommendation system of crops varieties suitable for organic agriculture were created.

The legal framework that allows us to ensure the implementation of the variety recommendation system is - Government Decision no. 43 of 15.01.2013 approving the Regulation on varieties testing and acceptance in the Catalogue of crops varieties (where all the legal provisions regarding the testing and recommendation of varieties are stipulated, Chapter IV art.11, paragraph 3 - organic testing). The second normative act is the Law no.68 of 05.04.2013 on seeds, where the Chapter III, Article 6 paragraph 1 provides that - testing and registration (recommendation) of crops varieties is carried out by the State Commission for Crops Variety Testing, according to national and international methodologies and standards.

Based on the financial-economic analyzes carried out over a period of three years, we are firmly convinced that the Variety Recommendation System meets all the preconditions for ensuring sustainability, namely - the financial assurance by the State Commission of the required costs for this activity.

In conclusion, we confirm that the experience and knowledge obtained within the project implementation will allow us to continue the activity on testing and recommendation of crops varieties suitable for organic farming.

PROJECT

The situation in Moldova is the same as in other European countries. There is a wide range of varieties on the Moldovan market, but there is no information on the suitability of these varieties for organic agriculture, so testing trials have been started. Organic agriculture has its rules, e.g. the ban on mineral fertilizers and the use of synthetic pesticides, growth regulators, etc. All inputs must be certified as organic, including the field. This means that the entire crop rotation in organic agriculture must also be organic.

There is a huge range of crops in the Republic of Moldova. The most important one, however, is common wheat, its winter form, which is grown both for human consumption and as animal feed. Winter wheat grown for human consumption (for the production of flour, bakery products and pasta), was chosen as a pilot crop because it is the most widely grown crop in Moldovan organic agriculture. Winter wheat is an interesting export product, but under the conditions of organic agriculture, it is quite difficult to achieve optimal parameters for baking (due to the prohibited use of synthetic nitrogen as a fertilizer). This can be partly overcome by using a pre-crop and choosing a suitable variety that can produce the desired proteins of baking quality, even in organic agriculture. The varieties must also be tolerant to harrowing for weed control and must develop well (e.g. good foliage, robust habitus) in order to compete with weeds. Resistance/tolerance to common diseases and procumbence are also important. Therefore, it is necessary to evaluate individual varieties, assess the test results and disseminate the results to the public in order to find out which varieties are most suitable for Moldovan organic agriculture, in terms of human consumption.

The main aims of the project are:

- To obtain objective and independent information on plant varieties with their characteristics and suitability for cultivation in the conditions prevailing in the Republic of Moldova.
- To produce publications that will help producers, processors, and other stakeholders to achieve better orientation in the wide range of plant varieties available on the market.

Project partners

STATE COMMISSION FOR CROPS VARIETY TESTING OF THE REPUBLIC OF MOLDOVA

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State Commission for Crops Variety Testing is an institution of public interest, subordinated to the Ministry of Agriculture, Regional Development and Environment, responsible for examining plant varieties for assessing their compliance with registration, namely distinctiveness, uniformity and stability, and appreciation of cultural value, and usage.

The State Commission keeps the Catalogue of plant varieties permitted for production and marketing in the country, represents the Republic of Moldova in the International Union for the Protection of New Varieties of Plants (UPOV).

Varieties registration is based on the results of official testing, especially field tests. A variety is tested in various pedological-climatic areas of Moldova. Annually, over 1,000 varieties are studied. The State Commission for Crops Variety Testing is the link between research institutes in the field and seed producers, since the multiplication of varieties is allowed only after the variety is tested and registered in the Catalogue of Plant Varieties, edited annually by the State Commission.

The role of the State Commission for Crops Variety Testing is to identify with fairness the varieties that will best realize their production potential and quality in one or another growing area that would valorize the climatic potential of the particular area and locality.

Regional specialists perform the varieties testing according to well-defined methodologies, statistically process the obtained data and present the reports on each crop separately to the Central Commission of the State Commission, where the main specialists analyze the gained results from all testing centers/sectors and prepare proposals for changing of the current assortment of varieties.

PUBLIC INSTITUTION RESEARCH INSTITUTE OF FIELD CROPS "SELECȚIA"

Republic of Moldova MD-3101; Bălţi municipality, 28 Calea leşilor street
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The Research Institute for Field Crops "Selecția" includes the following laboratories:

Laboratory for breeding and cultivation technologies of cereal crops

The main direction of activity is the development of new varieties of winter wheat and winter barley, the production of primary seed for the approved and prospective varieties of winter wheat and barley, spring barley, oats and millet. The terms and sowing rates for the newly breeded varieties are also studied.
Since the beginning, 30 varieties of common winter wheat, 14 varieties of winter barley and 4 varieties of spring barley have been developed and approved, including 15 varieties of common winter wheat and 5 varieties of winter barley in the last 10 years.

Laboratory on production quality analysis

Biochemical analyses are carried out in the laboratory for breeding material of winter wheat, winter and spring barley, soybeans, peas, beans, fodder crops and sunflower. In addition, the typicality of the seeds of the parental lines and the extent of hybridization of the first generation of sunflower are determined by the polyacrylamide gel electrophoresis method. A number of varieties of winter wheat, barley, soybean, bean and alfalfa with high production quality parameters have been developed with the cooperation of the laboratory staff.

Laboratory for breeding and cultivation technologies of leguminous and fodder crops

During the scientific activity in the laboratory, 62 varieties of legumes and fodder crops were developed and approved, including 13 varieties of pea, 20 varieties of soybean, 11 varieties of bean, 13 varieties of winter and spring vetch, 4 varieties of alfalfa, 1 variety of *Galega oficinalis* and 1 variety of millet. Their share in Moldovan agriculture is 80-90% of the area under these crops.
The recently approved pea, soybean, bean and vetch varieties have high biological production potential, combined with high quality, resistance to lodging, drought and disease tolerance.
In parallel with the scientific research, the current team of breeders is actively involved in the implementation of the achievements into production practice.

Laboratory of technologies and agrotechnical systems

The laboratory conducts research in long-term experiments on crop rotations, permanent crops, system of fertilization within crop rotation and irrigation systems lasting more than half a century. Since 1989, multifactorial experiments have been initiated in the laboratory by studing of the action and interaction of crop rotation, tillage and fertilization systems in the absence of chemical means to control diseases, pests and weeds.
The obtained results from the long-term laboratory experiments were the basis for the development of the argued scientific agricultural system in the Republic of Moldova, for the elaboration of a series of monographs on crop rotations, irrigation, tillage and soil fertilization within crop rotation, weed management, etc. Its serve for the permanent training of agricultural producers, regardless of the land ownership form, in the trainings for students and PhD students.
The gathered scientific basis allows arguing the possibility of transition to a system of sustainable agriculture, including to the organic agriculture in the Republic of Moldova.

Laboratory on plant protection

During the activity, complex systems have been developed and implemented, integrated systems for the protection of field crops suitable to the level of technological development of the agriculture of the republic.
In the last 30 years, environmentally friendly integrated systems for the protection of field crops, included as blocks in cultivation technologies, have been developed and implemented; standards regarding these technologies have been approved.
Based on the systemic analysis of agrocenoses, the influence of anthropogenic and weather factors on the development and level of harmfulness of the most harmful pests and phytopathogens was established, options for long-term forecasting of the level of diseases and pests development depending on the types of crop cultivation technologies in the conditions of climate change have been developed.
In the quarantine nursery on natural and artificial environment of annual infection is carried out the assessment of 2.8-3.2 thousand samples of local breeding material and 500-800 samples imported from different countries of the world. The laboratory staff is co-authors of 23 varieties and hybrids with increased level of resistance to the most dangerous pathogens.
Within the weed control field, tests are performed on different options of weed control systems under the conditions of specialized crop rotation. 65-75 products are tested annually and the most effective are recommended for implementation in the crop production of the Republic of Moldova.

Laboratory for the breeding and cultivation technologies of technical crops

The laboratory consists of the *Group on Sunflower Breeding and Cultivation Technologies* and the *Group on Sugar Beet Breeding and Cultivation Technologies*.

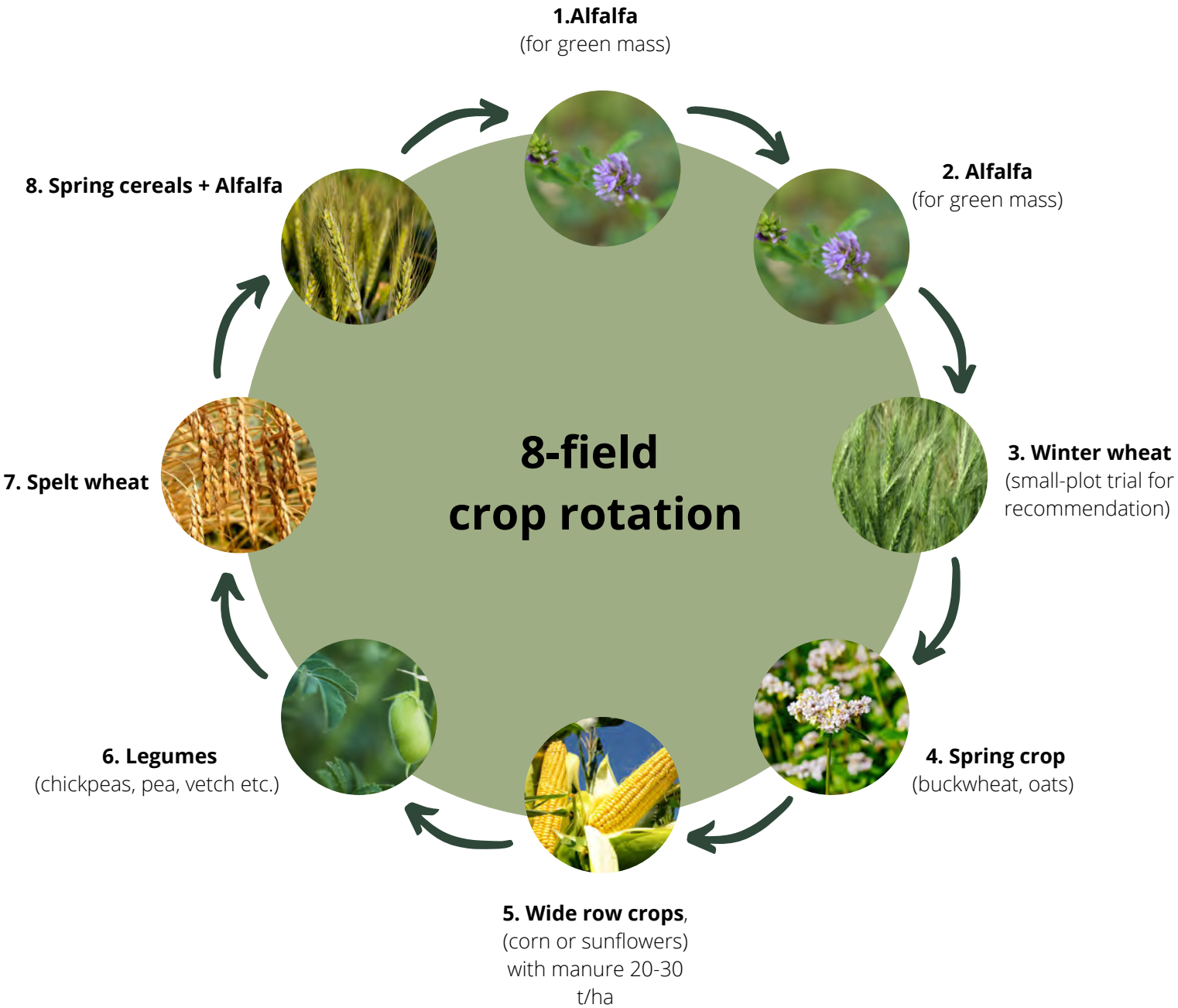
Group on Sunflower Breeding and Cultivation Technologies
Since the beginning of the activity 14 hybrids have been developed and approved. Currently, 12 hybrids are registered in the Republic of Moldova: HS 9506, HS 0428, HS 9729, HS 20032 (developed with Maisadour Semences, France), Luceafărul, HS 9505, MPC 8401, MPC 8506, MPC 8910, Speranta and Ortac.
The method of producing the seed of the parental lines in the primary link has been developed and improved, as well as the technology of cultivating the large-scale parental lines and the seed of the first generation in the hybridization areas.

Group on Sugar Beet Breeding and Cultivation Technologies
In the activity period 28 varieties and hybrids of sugar beet have been developed. Heterozygous hybrids based on androsterility Vilia, Manuela, Scorpion, Vodolei and the varieties Moldavscaia odnosemeanaia 41 and Victoria have been approved. The production potential of the developed genotypes is 60-85 t / ha of rhizocarps, with a sugar content of 18-20%.
Sugar beet cultivation and seed production technologies have been developed by direct and indirect methods.

PROCEDURE FOR TRIAL OF VARIETIES

Small-plot field trials of varieties on experimental sites in Băcioi, Cahul and Bălți are integrated in the following general crop rotation adhering to organic agriculture rules throughout the whole cycle.

On one of the fields in the rotation, a small-plot trial has been established to recommend suitable varieties of winter wheat for Moldovan conditions. The total number of crop blocks in the trial is 8. Each year all crops are sown so that the crops rotate gradually through individual blocks (8-field crop rotation).




CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture
"RECOMANDAREA PRACTICILOR AGROTEHNICE, SPECIILOR ŞI SOIURILOR POTRIVITE PENTRU AGRICULTURA ECOLOGICĂ"
în cadrul proiectului
"SUPORTUL INSTITUȚIONAL ÎN SECTORUL AGRICULTURII ECOLOGICE ÎN REPUBLICA MOLDOVA"
Donator: Agenția Cehă pentru Dezvoltare (CZDA)
Implementator: Institutul Central de Supraveghere și Testare în Agricultură din Republica Cehă (ÚKZÚZ)
Partener: Ministerul Agriculturii, Dezvoltării Regionale şi Mediului
Partener privind activitatea specifică: Comisia de Stat pentru Testarea Soiurilor de Plante
Perioada de implementare: 2017 - 2021


Orz de primăvară
(Hordeum vulgare)


HRIȘCĂ
(Fagopyrum esculentum)
Soiul - KORA


MAZĂRE
(Pisum sativum L.)
Soiul - MENHIR
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising
and Testing in Agriculture


MĂZĂRICHE DE
PRIMĂVARĂ
(Vicia Sativa)
Soiul - LORINA

Basic guidelines for a small-plot trial to recommend varieties of winter wheat

Aim of trial

The aim of this trial is to launch Moldovan testing of various crops and their varieties for organic growing. Conditions of organic agriculture are specific in e.g. not allowing synthetic fertilizers, application of chemical-synthetic pesticides, growth-regulators etc. The whole crop rotation must be organic for the recommendation of varieties – i.e. pre-crops must also be grown organically. This, on the one hand, imposes significant limitation in terms of inputs and, therefore, yield. On the other hand, the agroecosystem develops a long-term sustainable homeostasis. The soil is more enlivened, plants root deeper and are forced to mobilize nutrients actively. Nitrogen input is ensured via green fertilizing with farmyard manure. Weeds are controlled mechanically, disease and pests are avoided or treated preventively, and only non-synthetic and biological preparations are used for plant protection. In such conditions, individual varieties respond differently, compared with plants grown under the common conventional system. Therefore, it is necessary to test individual varieties, evaluate test results and pass on the findings to the farming public.

Winter wheat for human consumption

Winter wheat cultivated for human consumption (e.g. for the production of flour, bakery products and pasta) was chosen as a pilot crop for the proposal of complex guidelines for the recommendation of varieties.
Winter wheat is an interesting export commodity, but in organic conditions it is rather difficult to achieve good parameters for milling and baking (due to the prohibited use of synthetic nitrogen as an auxiliary fertilizer). This can be partly overcome by means of a pre-crop and the choice of a suitable variety, which can form proteins even in organic conditions. The varieties must also be suitable to harrowing for weed control, and must develop well (e.g. good foliage, sturdy habitus) to be able to compete against weeds. Resistance/tolerance to common disease and lodging are also important.
The introductory pilot trial tests 8 common wheat varieties and compares those commonly grown in Moldova with varieties cultivated and/or bred for conditions in organic farming.

Establishing the small-plot trial

The basic area unit sown with a single variety is called a plot. The size of the plot, the spacing of rows and plants within rows, as well as the harvesting area, must be in accordance with the current “Guidelines for utility value testing” by the State Commission for Crop Variety Testing of the Republic of Moldova.

Protective borders for plots (front and back), and distance between crops are used to protect the main cropping areas of plots against damage or other effects.

Size of plots: 15 x 4 m = 60 m²

Size of cropping area: 24 x 60 m² = 1 440 m²
Number of variants (tested varieties): 8
Number of repetitions: 3
Total number of plots: 24
Sowing rate/ha: 238 kg/ha (5.0 million germinative grains per ha)
Recommended sowing period: late Sept., early Oct.
Seed dressing (treatment): untreated or with use of a biological dressing

Evaluated parameters

- competitiveness against weeds (Note: not yet evaluated)
- occurrence of main diseases (rust, powdery mildew, fusarium head blight)
- resistance to harrowing (not yet evaluated!)
- yield
- technological parameters for food quality

Monitoring the trial, keeping records, harvesting, sampling

The procedure for the establishment of the small-plot field trial was based on principles defined in current guidelines, from the State Commission for Crop Variety Testing of the Republic of Moldova, for testing utility value of common wheat varieties. In the procedure an organic variant was adapted, i.e. without the use of industrial fertilizers or pesticides.

Evaluation of plant growth during vegetation focused on the following problem areas:

Resistance to disease - standard evaluation, in natural conditions, of the presence of pathogens by means of an evaluation scale.
Formation of yield-producing elements - basic characteristics of plant productivity were evaluated.
Harvesting and post-harvest treatment by means of common procedures - evaluation of yield and yield stability of individual varieties over the course of 3 years.
Grain sampling and post-harvest analysis (thousand seed weight - TGW)
Determining basic quality indicators for grain - basic milling quality (protein content, Zeleny sedimentation test, gluten index (GI), wet gluten content.

SUMMARY OF TESTED VARIETIES 2018, 2019, 2020

WINTER WHEAT

ANNIE

Breeder/Owner: SELGEN, a.s.
Origin: CZ
Year of registration: 2014
Brief description: Intermediate awned variety with high frost resistance, the highest quality variety in the Czech Republic, high protein content, high Zeleny test value, high loaf volume, high falling number value.

ASZITA

Breeder/Owner: Getreidezüchtung Peter Kunz
Origin: CH
Year of registration: 2005
Brief description: Awned variety with a height of more than 110 cm, suitable for shady and dry conditions, capable of achieving a high protein content even under unsuitable conditions, vigorous growth can suppress weeds, grain is small with high protein content.

BLAGODARCA ODESSCAIA

Breeder/Owner: Селекционно-генетический институт УААН (Institute of Breeding, Odessa, Ukraine)
Origin: UA
Year of registration: 2013
Brief description: Variety with average height and 9-10 cm spike registered for cultivation in the Central and Southern regions of the country. Good resistance to winter conditions, higher resistance to lodging and drought, tolerant to powdery mildew, brown and black rust. TGW 45.5 g and yield approx. 5.5 - 6.5 t/ha. The average gluten content is 30.55%. It has a vegetation period of 238 days.

CAPRIANA

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2006
Brief description: A semi-intensive variety suitable for cultivation on medium or poor soils, with a vegetation period of 240 days. Plant height 87-96 cm with higher resistance to lodging (4.0 points), wintering, drought, and to diseases such as: powdery mildew and brown rust. Higher tillering with 450-700 spikes per m². Average yield 4.82 t/ha. High gluten content of 25.7 - 33%.

CAPRIANA PLUS

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2019
Brief description: A semi-intensive variety suitable for cultivation on medium or poorer soils, with vegetation period of 252 days. Plant height 68-114 cm, with resistance to lodging. Higher tillering with 450-700 spikes per m². Average yield 5.60 t/ha. High gluten content 24.7 - 33.4%.

EPOHA ODESSKAIA

Breeder/Owner: Селекционно-генетический институт УААН (Institute of Breeding, Odessa, Ukraine)
Origin: UA
Year of registration: 2016
Brief description: Early semi-dwarf variety with good resistance to lodging, wintering and drought, tolerant to fungal diseases. Average vegetation period of 238 days. Average TGW 45 g. Average content of protein 13%, gluten 28%. Average production in trials 5.5 t/ha.

FENIX

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2017
Brief description: A universal early variety from the group of steppe varieties, with good resistance to drought and heat. The average height of the plant 86 cm with good resistance to lodging. Average TGW 39 g. Average content of protein in grains 12%, of gluten 27%. Average yield in the steppe conditions of Bălţi 8.0 t/ha.

KUIALNIC

Breeder/Owner: Селекционно-генетический институт УААН (Institute of Breeding, Odessa, Ukraine)
Origin: UA
Year of registration: 2005
Brief description: Variety registered throughout the Republic of Moldova with spike spindle-shaped of average length. Good resistance to winter conditions, higher resistance to lodging and drought. Tolerant to powdery mildew, brown and black rust. Grain of medium size of red colour. TGW between 40 - 42 g. Vegetation period of 240 days. Average yield 5.3-6.5 t/ha. Average gluten content is 30.1-31.2%.

NUMITOR

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2019
Brief description: Variety with plant height 63 - 102 cm and a high resistance to lodging. High tillering ability 434-649 spikes per m². More productive variety in comparison to the control Kuialnik (0.47 t/ha). Grains with high gluten content between 24.8-30.7%.

PÎSANKA

Breeder/Owner: Селекционно-генетический институт УААН (Institute of Breeding, Odessa, Ukraine)
Origin: UA
Year of registration: 2006
Brief description: Semi-late intensive variety of wheat with versatility in growing conditions with a vegetation period of 278-283 days. High resistance to lodging, grain loss, sprouting the grains in the spike. Good resistance to cold and frost. Yield potential 5.4 – 10.8 t/ha and TGW 40 - 44.5 g. Not recommended for early sowing periods. Sowing rate 4.5 - 5.5 million (germinating seeds) per ha.

TALISMAN

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2013
Brief description: Intensive variety of medium plant height 82 cm, with good resistance to lodging, wintering and drought. The average TGW 39 g. Average content of protein in grains 12.5%, of gluten 27%. Yield potential in the steppe conditions of Bălţi 8-9 t/ha.

TENGRI

Breeder/Owner: Getreidezüchtung Peter Kunz
Origin: CH
Year of registration: 2002
Brief description: Swiss higher-class quality variety with significant weed ability, good shading, vigorous growth and plant height 112 cm. The stem with an intense purple colour with good health. High bulk density. Suitable for extensive conditions. Superior baking quality, suitable mainly for products such as rolls, baguettes. Volume of the dough much larger volume after baking with a good processing quality.

VESTITOR

Breeder/Owner: Instituţia Publică Institutul de Cercetări pentru Culturile de Câmp „Selecţia”
Origin: MD
Year of registration: 2015
Brief description: A semi-late variety with an average height 85-105 cm. Higher resistance to lodging and drought. The grain is large and glassy, 1000 grains weight 30 - 38 g. Yield potential 8.5 t/ha. The gluten content (28-30%) exceeds the control with 2-3% in different cultivation conditions. The protein content 12.8%. Good baking quality.

WIVA

Breeder/Owner: Getreidezüchtung Peter Kunz
Origin: CH
Year of registration: 2005
Brief description: Swiss top class high quality variety with high yield and with excellent baking quality. Height over 100 cm, vitreous grain with high protein and gluten content, high resistance to Fusarium head blight, medium resistance to lodging, high resistance to sprouting, suitable for fertile soils.

SPELT WHEAT

ALKOR

Breeder/Owner: Getreidezüchtung Peter Kunz
Origin: CH
Year of registration: 2002
Brief description: Swiss variety bred for organic farming, stable and high yielding. Plant height more than 100 cm. Medium resistance to lodging, very good health; erect spike, strong gluten and good baking quality.

RUBIOTA

Breeder/Owner: Výzkumný ústav rostlinné výroby, v.v.i.
Origin: CZ
Year of registration: 2001
Brief description: Late variety, reddish-brown in colour, height more than 100 cm, sensitive to powdery mildew, good baking properties, suitable for low quality soils. Variety of Czech origin suitable for organic farming.


GRÂU DE TOAMNĂ
Soiul – WIWA
Proveniență - Cehia
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


GRÂU DE TOAMNĂ
Soiul – ASZITA
Proveniență - Elveția
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


GRÂU DE TOAMNĂ
Soiul – TENGRI
Proveniență - Elveția
-
CZECH REPUBLIC


GRÂU DE TOAMNĂ
Soiul – VESTITOR
Proveniență - Republica Moldova
CZECH REPUBLIC


GRÂU DE TOAMNĂ
Soiul – NUMITOR
Proveniență - Republica Moldova
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


GRÂU DE TOAMNĂ
Soiul – KUIALNIK
Proveniență - Ucraina
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


GRÂU DE TOAMNĂ
Soiul – Căpriana
Proveniență - Moldova
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


GRÂU DE TOAMNĂ
Soiul – Pîsanca
Proveniență - Ucraina
CZECH REPUBLIC
DEVELOPMENT COOPERATION
Central Institute for Supervising and Testing in Agriculture


MĂZĂRICHE DE
PRIMĂVARĂ
(Vicia Sativa)
Soiul - LORINA


GRÂU DE TOAMNĂ
Soiul – TALISMAN
Proveniență - Republica Moldova
CZECH REPUBLIC


SPELTA (*Triticum spelta*)
Soiul - RUBIOTA
CZECH REPUBLIC

Wiwa
Băcioi

Aszita
Băcioi

Tengri
Băcioi

Nurmitor
Băcioi

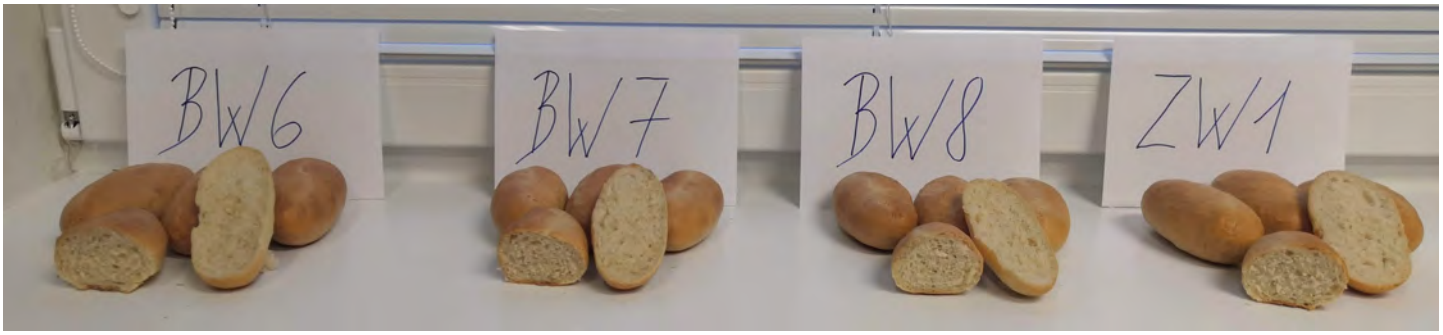
Vestitor
Băcioi

Capriana
Băcioi

Pîsanka
Băcioi

Kuialnic
Băcioi

Fenix
Bălți



SCFCVT Băcioi: *BW 6 - Capriana, BW 7 - Pisanca, BW 8 – Kualnic*
SCFCVT Cahul (Zîrnești): *ZW 1 - Wiwa*

SCFCVT Cahul (Zîrnești)*: ZW 2 - Aszita (Zîrnești), ZW 3 - Tengri (Zîrnești), ZW 4 - Nurmitor (Zîrnești), ZW 5 - Vestitor (Zîrnești), ZW 6 - Capriana (Zîrnești)*

SCFCVT Cahul (Zîrnești): *ZW 7 - Pisanca (Zîrnești), ZW 8 – Kualnic (Zîrnești), SW 1 - Tengri*
Selecția Bălți: *SW 2 - Kualnik*

Selecția Bălți: *SW 3 - Wiwa, SW 4 - Aszita, SW 5 - Pisanca, SW 6 - Capriana*

Selecția Bălți: *SW 7 - Vestitor , SW 8 - Numitor, SW 9 - Fenix, SW 10 - Talisman*

SUMMARY OF OBSERVED PARAMETERS

Evaluated quality parameters of grains

Falling number (s) – standard in the grain and flour milling industries for measuring alpha-amylase activity. Generally, a falling number value of 350 seconds or longer indicates a low enzyme activity and very sound wheat quality. As the amount of enzyme activity increases, the falling number decreases. Values below 220 seconds indicate high levels of enzyme activity. Sprouting can affect food made from wheat in many ways. It can reduce mixing strength, cause sticky dough, and affect loaf volume and crumb.

Protein content in dry matter (N x 5.7) (%) - The amount of protein in wheat determines how flour performs. It is also used as a trading specification. The wheat protein is quoted at 100% dry matter. A laboratory test uses a near infrared (NIR) spectrometer calibrated against the reference method. In the reference method, a ground sample of wheat is burnt in oxygen at 950°C and the gases produced are analysed for their nitrogen content. The protein is the percentage of that nitrogen gas multiplied by 5.7.

Zeleny Sedimentation test (ml) - the sedimentation value according to Zeleny describes the degree of sedimentation of flour suspended in a lactic acid solution during a standard time interval. This is taken as a measure of the baking quality. Swelling of the gluten fraction of flour in a lactic acid solution affects the rate of sedimentation of a flour suspension. Both a higher gluten content and a better gluten quality give rise to slower sedimentation and higher Zeleny test values. The sedimentation value of flour depends on the wheat protein composition and is mostly correlated to the protein content, the wheat hardness, and the baking volume.

Water absorption (%) – determined by Farinograph. The amount of water that has to be added to a flour to achieve a viscosity of 500 FU. The water absorption of a flour depends on the water-binding capacity and thus determines the yield of the dough and the amount of water to be added in the preparation of the dough. Besides the swelling substances in the wheat (proteins and pentosans), the mechanically damaged starch granules also contribute to the water-binding capacity of a flour.

Loaf volume (ml/100 g flour) – Rapid Mix Test - Baking quality is evaluated by the ability of the flour to produce large, well-shaped rolls. Technological tests such as bread making tests are the most accepted quality control methods for determining wheat flour quality. Basically, a baking test is the best and most comprehensive indication of the real processing (baking) quality.

Hardness - Particle Size Index NIRS (%) - Grain hardness, which is largely genetically determined. The method of measurement is the particle size index (PSI) test. Under controlled test conditions, whole ground wheat is sifted through an 85 micron sieve and the percentage of meal that passes through the sieve is an indication of grain hardness. Soft grained wheat will produce more fine meal than harder grained wheat, thus having a higher PSI.

Gluten Index - GI - The percentage of wet gluten remaining on the sieve after centrifugation is defined as the Gluten Index. If the gluten is very weak, all the gluten may pass through the sieve, and the Gluten Index is 0. When nothing passes through the sieve, the Index is 100.

Wet gluten content (%) - Wet gluten in wheat flour is a plastic-elastic substance consisting of gliadin and glutenin proteins, obtained after washing out the starch from wheat flour dough. Gluten is the functional component of protein and determines many dough and processing characteristics of wheat and wheat flour.

TRIAL SITES 2020

In 2020, we expanded our activities related to promoting organic agriculture and recommending winter wheat and spelt varieties for OA to four different localities. These are located in central, northern and southern Moldova. Our main partner is the State Commission for Crops Variety Testing, as well as Selecția Research Institute for Field Crops from Bălți (where trials take place in small plots) and some private organic farmers (where semi-commercial trials are being carried out and demonstration plots have been established).

Testing Station of the State Commission for Variety Testing, Băcioi village, Chisinau municipality

On an area of 2.20 ha, an organic crop rotation trial was established, comprising of 50% grain, 25% legumes and 25% alfalfa. This trial area incorporates a small-plot trial for recommendation of winter wheat varieties, and a large-plot (semi-commercial) trial of two varieties of spelt in OA conditions.

GȚ "MA-GAȘPER" organic farm, Furceni village, Orhei rayon

In the Orhei district of central Moldova three trials were established, over the course of two seasons, to recommend varieties of winter wheat suitable for OA. The trials are on a large-plot scale (in commercial conditions) using generally available equipment.

"SELECȚIA" - Research Institute of Field Crops,Bălți

On the Bălți site, in northern Moldova, a 3-field crop rotation has been established, including a small-plot trial of winter wheat varieties.

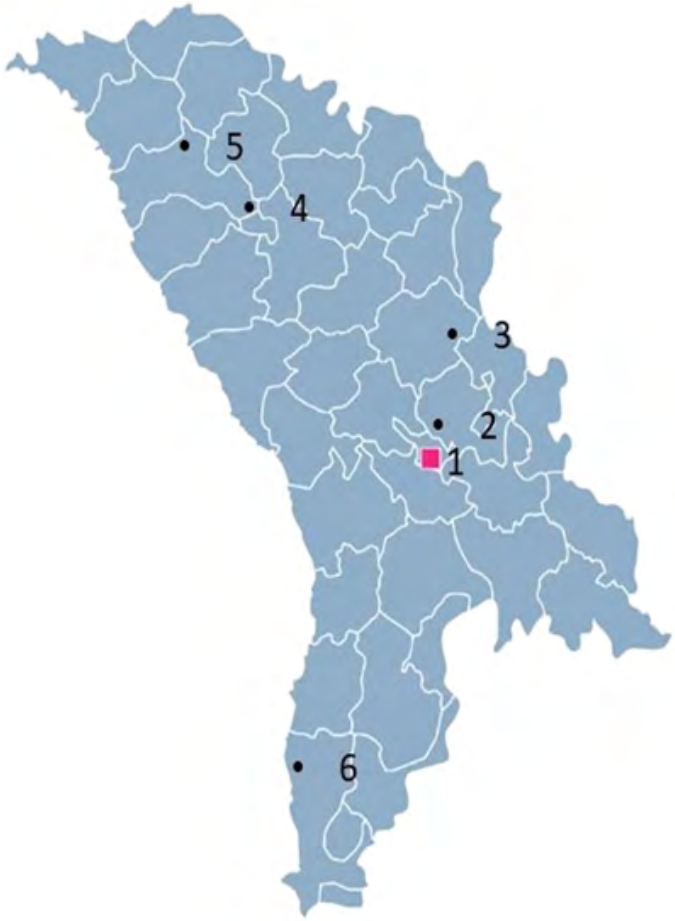
Testing Station of the State Commission for Variety Testing, Zârnești

Zârnești site lies near Cahul in southern Moldova. Here, an 8-field trial was established on an area of 1.53 ha. The trial was set up to be both permanently sustainable and commercially viable in Moldovan conditions. The crop sequence comprises of 50% cereals, 25% legumes and 25% alfalfa. The trial incorporates a small-plot trial for recommendation of winter wheat varieties and a large-plot trial of two varieties of spelt under organic agriculture conditions.

Zabriceni Monastery, Edineț district

A model organic farm of alternative crops, cover crops and medicinal plants suitable for OA is located at Zabriceni Monastery in northern Moldova, at an elevation of 225 m. The monastery is frequently visited by pilgrims from Moldova and surrounding countries, and our aim is to introduce visitors to organic agriculture. The 8-field crop rotation trial features crops suitable for OA, yet uncommon to Moldova, such as common buckwheat, sorghum, marrows, alfalfa, spelt, chickpeas, lacy phacelia and naked oats. On a demonstration plot in front of the church, a 4-field crop rotation grows medicinal plants and catch crops (e.g. crimson clover, *Camelina sativa*, safflower etc.) as demonstration crops suitable for so-called green fertilizing, which also provide a food source for the hives of honey bees kept by the monastery.


ierburi



1. Chisinau, capital city, headquarters of MARDE, ANSA, State Commission for Crops Variety Testing
2. Testing Station of the State Commission for Crops Variety Testing from Băcioi village, Chișinău municipality
3. Organic farm GȚ "MA-GAȘPER"Furceni village, Orhei district
4. "Selecția" – Research Institute of Field Crops, Bălți
5. Religious Community the monastery dedicated „Nașterea Domnului" from. Zăbriceni village, Edineţ district (project demoplots)
6. Testing Station of the State Commission for Crops Variety Testing from Zârnești village, Cahul district

WINTER WHEAT

Results from the Băcioi site

Testing Station of the State Commission for Variety Testing

Băcioi is a village of Chișinău municipality, in central Moldova, at an elevation of 190 m. In September 2017, an 8-field trial was established over an area of 2.2 ha. Set up for Moldovan conditions, the trial had to be sustainable and commercially viable, without the use of mineral fertilizers or synthetic plant protection preparations. The crop rotation comprises of 50% cereals, 25% legumes and 25% alfalfa. The trial also incorporates experimental testing of various varieties of winter wheat and spelt, and recommendation of these for use in OA. The testing of spelt is being carried out as a semi-commercial trial within organic crop rotation. The experimental spelt plots have a total area of 1098 m².

On the basis of soil samples taken before the trial was established, the soil was evaluated as medium chernozem with neutral pH, low phosphorus content, high calcium content and very high content of magnesium. The content of potassium, and the ratio of potassium to magnesium, was evaluated as good. Each year, 12.5% of the area is fertilized with cattle manure, and all crop residues are ploughed into the soil. Catch crops for green fertilizing are only grown if there is sufficient moisture in the soil.

Weeds are controlled within the field trial by means of crop rotation and mechanically by the use of an Aerostar tine harrow. It was obtained for the project and is an essential aspect of organic farming.

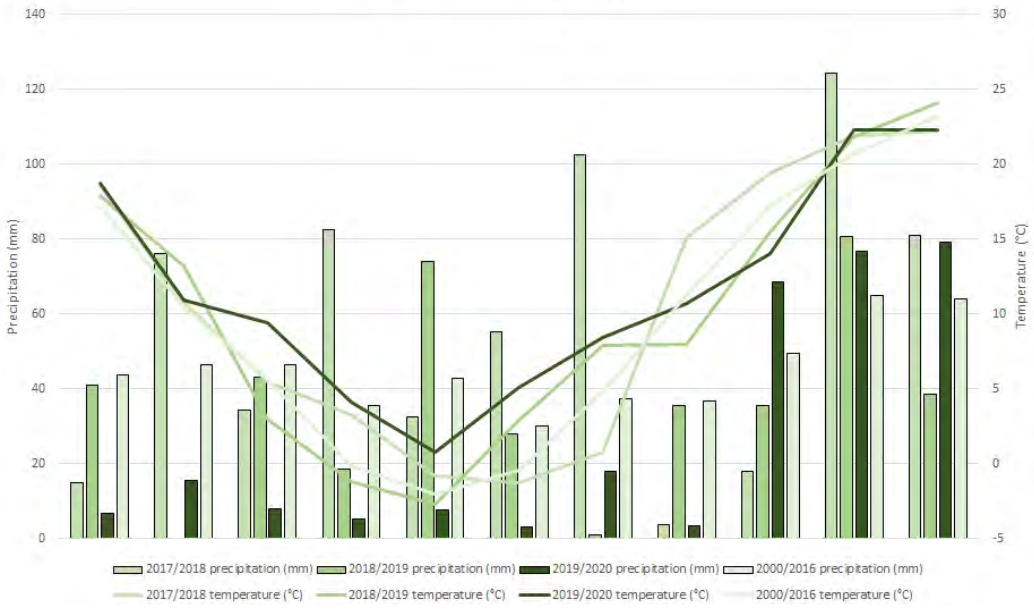
As in the 2018/2019 season, the field trials in Bacioi in the third season comprised of eight varieties of winter wheat (Aszita, Căpriana, Kuialnic, Numitor, Pîsanka, Tengri, Vestitor and Wiwa), with common vetch as a pre-crop. After the pre-crop harvest, the soil was processed twice (on 26th August and 28th September, 2019; MTZ-82 CPS-4). All crops were sown on 2nd October 2019. 10 days later (12th Oct 2019) 75% of the plants had emerged. On 22nd November the plots were weeded mechanically. The crops flowered between 22nd and 28th May 2020. On 29th May and 10th June mechanical weeding was repeated again and on 27th June the crops were harvested.

The occurrence of certain types of disease was evaluated during the vegetation period. *Puccinia striiformis* was most apparent in the Numitor variety and least in the Kuialnic variety. *Gibberella zeae* was found in Vestitor, while in Aszita, Tengri and Kuialnic no occurrence was observed. Ustilago tritici was rather strong in Numitor and Vestitor while *Erysiphe graminus* appeared in Wiwa, Numitor, Vestitor and Kuialnic.

The highest yield was obtained from the Numitor variety (4.35 t/ha), the lowest from the Swiss variety Wiwa (2.70 t/ha). Pîsanka developed the shortest plants (43 cm), Tengri were the highest (65 cm). Numitor had the highest number of spikes per unit area (390 spikes/m²) while Wiwa was the opposite (321 spikes/m² – 69 spikes less). Wiwa also had the second lowest number of grains per spike (28). In this parameter, Căpriana was at the bottom of the scale (27 grains/spike), but it was second best in the number of spikes per unit area (385 spikes/m²). The heaviest thousand grain weight was that of Numitor (40.10 g) while Aszita was the lightest (29.20 g).

Evaluation of quality parameters shows that all varieties met parameters set for bakery use. The Căpriana variety had the highest loaf volume (732 ml/100 g flour) while the lowest loaf volume was found in the Kuialnic variety (576 ml/100 g flour). The highest protein content was that of the Aszita variety (16.96%). This variety also had the highest values – among the studied group – in wet gluten content (41.5 %) and falling number (558 and 435 s). The lowest figures for Aszita were in the Zeleny test (65) and gluten index (40). The Kuialnic variety had the lowest wet gluten (24.2%) and falling number in wholegrain flour (398 s) while its gluten index (98) was the highest of all varieties.

Graph 1: Weather conditions in Băcioi, all seasons



Evaluation of 2018/2019 and 2019/2020 seasons (together)

The same group of 8 varieties was studied in Bacioi in both the 2018/2019 and 2019/2020 seasons. The weather was quite different in terms of precipitation during the two seasons: rainfall in 2018/2019 was 395.6 mm, while in 2019/2020 it was only 291.6 mm, i.e., a difference of 104 mm. This was most significant in a comparison of monthly precipitation in November, January and April of the two seasons when, in the second season, it was very dry. Distribution of precipitation also differed markedly: 50% of rainfall for the whole second season occurred in May and June 2020. Both seasons were different from the long-term average (2000/2016): the first season had 102.2 mm less rainfall and was 0.2°C warmer; the second season had even 206.2 mm less rainfall and 1.7°C higher temperature. The 2-year average values show the influence of the season especially on yield and plant height. The varieties were, on average, richer in yield and taller in the second monitored season (2019/2020) when the values were statistically conclusive.

In terms of individual varieties, there were statistically conclusive differences in yield, thousand grain weight and plant height. Numitor had the highest yield of 4.33±0.04 t/ha (on average for both seasons), while Wiwa was least productive (3.04±0.48). The Kuialnic variety was also successful in yield (4.00±0.06). The highest TGW was that of Numitor (40.30±0.28 g), followed by Pîsanka (39.50±0.42 g), Kuialnic (39.05±0.07 g) and Vestitor (37.10±0.14 g), while TGW of Aszita was the lowest of the whole group (28.60±0.85 g). Tengri was the tallest variety (81.50±23.33 cm), Kuialnic and Pîsanka were shortest (61.00±14.14 cm and 59.00±22.63 cm respectively).

Evaluation of quality proved all varieties in both seasons suitable for use in the food industry. The second season (2019/2020) brought higher values of loaf volume, water absorption and Zeleny test. Higher wet gluten content values were statistically significant in the first season (2018/2019). The quality evaluation of individual varieties showed certain trends. The highest loaf volume was found in Căpriana (678.00±76.37 ml/100 g flour) and Vestitor (676.50±62.93 ml/100 g flour), while the lowest was that of Numitor (541.00±49.50 ml/100 g flour). The Swiss varieties Wiwa and Aszita had the highest protein content (17.15±0.45% and 17.08±0.16% respectively), while the opposite – lowest protein content was that of the Moldovan Numitor (13.74±0.35%) and the Swiss Tengri (14.17±0.57%). The highest wet gluten and water absorption values were found in Aszita (44.43±4.14 % and 65.30±1.41%) and Vestitor (43.06±6.16% and 66.60±1.70%).

Evaluation of 2017/2018, 2018/2019 and 2019/2020 seasons (together)

Five winter wheat varieties (Aszita, Numitor, Kuialnic, Tengri, and Vestitor) were studied during three subsequent seasons within field trials in Bacioi. The individual seasons differed in weather, especially in terms of precipitation. 2017/2018 was the wettest of the three seasons with 126.7 mm more rainfall than the long-term average, 228.9 mm more in comparison with 2018/2019, and even 332.9 mm more in comparison with 2019/2020. Of this amount of rainfall, 33% occurred in June and July 2018. The season 2019/2020 was also quite different from the long-term average: this latest season had only 58.5% of the long-term average rainfall, of which 76.8% occurred in May, June and July 2020. There were also differences in average temperature as all three seasons were warmer than the long-term average (2000/2016): 2017/2018 by 0.7°C, 2018/2019 by 0.2°C, and 2019/2020 by 1.7°C. The weather pattern affected the evaluated parameters.

A statistically significant influence of the season was found in the number of grains per spike, plant height and yield. In 2017/2018 the yield was the lowest (2.36±0.47 t/ha) of all three seasons, due to weather conditions and irregular rainfall. In the same season, the number of grains per spike was also the lowest (19.40±3.91). On the other hand, seasons 2017/2018, and 2018/2019 were better for plant height (58.00±6.52 cm on average) than the last season. Evaluation of variety influence on agronomic parameters (average of all 3 seasons) showed statistically significant differences in TGW, plant height and yield. The highest TGW was found in Numitor (39.60±1.23 g), Kuialnic (39.13±0.15 g), and Vestitor (38.50±2.43 g). Tengri was the tallest variety (81.67±16.50 cm) and the Ukrainian Kuialnic was the shortest. (61.67±10.07 cm). The highest yield was obtained, in all three seasons, from the Numitor variety (3.84±0.84 t/ha), while the lowest yielding varieties were the Swiss Aszita (2.71±0.67 t/ha) and Tengri (2.93±0.83 t/ha). The influence of season on quality was statistically significant in all monitored quality parameters except gluten index.

Generally we can state that the lowest values were those in the 2017/2018 season when, in comparison with the other seasons, the trials were strongly influenced by the weather conditions during the vegetation period and a less suitable pre-crop (winter oilseed rape, instead of common vetch in 2018/2019 and alfalfa in 2019/2020). Only in terms of water absorption by flour was a difference evident, which separated the resulting values into three individual groups according to individual seasons. In statistical evaluation of the quality of the studied varieties, statistically significant differences were found in the content of protein, wet gluten content, water absorption, falling number, hardness and gluten index. The highest protein content within the average of all three seasons was that of the Swiss Aszita variety (15.28±3.12 %). The lowest average values were found in the Moldovan Numitor (13.10±2.71%) and Ukrainian Kuialnic (12.48±2.19%). The Aszita variety had the highest values of wet gluten content (40.68±7.12 %), water absorption (62.03±5.75%), and falling number (485.00±88.90 s). On the other hand, the Kuialnic variety had the lowest values of wet gluten content (23.43±3.77%) and water absorption (58.00±4.06%). The group of varieties with higher wet gluten content and water absorption also included the Swiss Tengri variety (38.01±9.76% and 62.90±6.52% respectively) which also had the softest grain of all evaluated varieties (12.67±1.53%).

The 3-year evaluation brought the following conclusions: with the exception of the specific 2017/2018 season with its weather-affected quality and yield across all the evaluated crops, all five varieties can be considered food-grade quality crops. The Swiss varieties had a higher protein content, but lower yield, while Vestitor, Kuialnic and Numitor had a higher TGW and yield, but less protein. The 3-year evaluation confirmed the trend of the first two seasons.

Table 1: Comparison of yield in monitored years, Bacioi site

	2018	2019	2020	average	2018	2019	2020	average
	yield (t/ha)				yield (%)			
pre-crop	winter rape	common vetch	alfalfa		winter rape	common vetch	alfalfa	
Aszita	2,01	3,35	2,77	2,71	85,17	87,51	77,29	83,2
Numitor	2,87	4,3	4,35	3,84	121,61	112,33	121,37	117,89
Kuialnic	2,02	3,96	4,04	3,34	85,59	103,45	112,72	102,54
Tengri	2,03	3,67	3,09	2,93	86,02	95,87	86,22	89,95
Vestitor	2,87	3,86	3,67	3,47	121,61	100,84	102,4	106,43
average of all varieties	**2,36**	**3,83**	**3,58**	**3,26**				
variance coefficient (%)	**17,6**	**8,2**	**16,3**	**14,06**				
standard deviation	**0,42**	**0,31**	**0,58**	**0,44**				
variance (0.05)	**0,22**	**0,12**	**0,43**	**0,26**	3,90%	0,8	3,3	1,9

Table 2: Weather conditions in Bacioi

		IX	X	XI	XII	I	II	III	IV	V	VI	VII
2017/2018	precipitation (mm)	14.9	76.1	34.2	82.4	32.4	55.1	102.6	3.7	18.0	124.2	80.9
	temperature (°C)	18.6	10.8	5.5	3.3	-0.8	-1.3	0.8	15.1	19.4	21.9	22.2
2018/2019	precipitation (mm)	40.9	0	43	18.6	74.0	28.0	1.0	35.4	35.6	80.6	38.5
	temperature (°C)	17.9	13.2	3.0	-1.2	-2.7	2.9	7.9	8.0	15.5	21.8	24.1
2019/2020	precipitation (mm)	6.8	15.4	8.0	5.2	7.8	3.0	18.0	3.3	68.4	76.6	79.1
	temperature (°C)	18.7	10.9	9.4	4.1	0.8	5.1	8.4	10.7	14.0	22.3	22.3
2000/2016	precipitation (mm)	43.7	46.5	46.4	35.6	42.9	30.2	37.2	36.8	49.6	64.9	64.0
	temperature (°C)	17.2	10.5	5.6	-0.1	-2.0	-0.4	4.8	11.2	17.2	20.7	23.2

Table 3: Selected quality parameters 2019/2020, Bacioi site

	Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Aszita	635	**16.96**	**41.5**	66.3	**558**	**435**	*65*	14	*40*
Căpriana	**732**	15.81	32.2	63.7	521	409	69	16	84
Kuialnic	*576*	*13.99*	*24.2*	62.2	500	*398*	68	13	**98**
Nurmitor	670	14.81	29.1	65.3	488	415	69	14	85
Pîsanka	580	14.57	26.1	62.0	496	412	70	16	**98**
Tengri	721	16.34	38.7	**67.8**	482	413	68	*11*	57
Vestitor	691	15.87	32.3	63.6	483	414	**71**	**17**	83
Wiwa	709	16.83	36.2	*59.5*	*453*	416	**71**	16	89

Table 4: Selected agronomic indicators throughout the monitored seasons

2017/2018					2018/2019					2019/2020					Average				
	TGW (g)	spikes/ m²	grains/ spike	plant height (cm)		TGW (g)	spikes/ m²	grains/ spike	plant height (cm)		TGW (g)	spikes/ m²	grains/ spike	plant height (cm)		TGW (g)	spikes/ m²	grains/ spike	plant height (cm)
Aszita	31.10	365	17	92	Aszita	28.00	391	30	80	Aszita	29.20	342	30	64	Aszita	29.43	366.00	25.67	78.67
Căpriana Plus	36.90	301	25	71	Căpriana	38.00	367	29	78	Căpriana	38.50	385	27	60	Căpriana*	38.25	376.00	28.00	69.00
Numitor	38.20	302	24	63	Numitor	40.50	375	28	78	Numitor	40.10	390	30	52	Numitor	39.60	355.67	27.33	64.33
Kuialnic	39.30	273	18	63	Kuialnic	39.00	351	28	71	Kuialnic	39.10	348	32	51	Kuialnic	39.13	324.00	26.00	61.67
Tengri	35.10	373	15	82	Tengri	32.50	384	29	98	Tengri	32.20	334	31	65	Tengri	33.27	363.67	25.00	81.67
Vestitor	41.30	292	23	73	Vestitor	37.00	380	27	75	Vestitor	37.20	368	29	58	Vestitor	38.50	346.67	26.33	68.67
Annie	41.40	345	14	66	Pîsanka	39.20	356	27	75	Pîsanka	39.80	364	30	43	Pîsanka*	39.50	360.00	28.50	59.00
Blagodarca Odesscaia	40.90	285	24	65	Wiwa	39.00	296	29	83	Wiwa	32.10	321	28	58	Wiwa*	35.55	308.50	28.50	70.50
average	38.03	317	20	71.88	average	36.65	362.5	28.38	79.75	average	36.03	356.50	29.63	56.38	average**	35.99	351.20	26.07	71.00
variance coefficient (%)	8.81	11.31	20.92	13.46	variance coefficient (%)	10.84	7.77	3.50	9.63	variance coefficient (%)	10.95	6.41	5.05	12.19	variance coefficient (%)	11.09	4.33	2.96	11.08
standard deviation	3.35	35.86	4.18	9.68	standard deviation	3.97	28.18	0.99	7.68	standard deviation	3.94	22.84	1.49	6.87	standard deviation	3.99	15.20	0.77	7.87

* Average for only 2 seasons – 2018/2019 and 2019/2020
** Values of 5 varieties for all 3 evaluated seasons

Table 5: Statistical evaluation of monitored agronomic parameters in 2 monitored seasons, Bacioi site

		Yield t/ha	TGW (g)	Spikes/m²	Grains/spike	Plant height (cm)
Year	2019	**3.82 ± 0.34b**	36.65 ± 4.25	362.50 ± 30.13	28.38 ± 1.06	**79.75 ± 8.21b**
	2020	*3.55 ± 0.62a*	36.03 ± 4.22	356.50 ± 24.41	29.63 ± 1.60	*56.38 ± 7.35a*
Variety	Aszita	3.06 ± 0.41ab	*28.60 ± 0.85a*	366.50 ± 34.65	30.00 ± 0.00	72.00 ± 11.31ab
	Căpriana	3.92 ± 0.29abc	38.25 ± 0.35bc	376.00 ± 12.73	28.00 ± 1.41	69.00 ± 12.73ab
	Numitor	**4.33 ± 0.04c**	**40.30 ± 0.28c**	382.50 ± 10.61	29.00 ± 1.41	65.00 ± 18.38ab
	Kuialnic	4.00 ± 0.06bc	39.05 ± 0.07bc	349.50 ± 2.12	30.00 ± 2.83	*61.00 ± 14.14a*
	Tengri	3.99 ± 0.06abc	32.35 ± 0.21ab	359.00 ± 35.36	30.00 ± 1.41	**81.50 ± 23.33b**
	Vestitor	3.38 ± 0.41abc	37.10 ± 0.14bc	374.00 ± 8.49	28.00 ± 1.41	66.50 ± 12.02ab
	Pîsanka	3.77 ± 0.13abc	39.50 ± 0.42bc	360.00 ± 5.66	28.50 ± 2.12	*59.00 ± 22.63a*
	Wiwa	*3.04 ± 0.48a*	35.55 ± 4.88abc	308.50 ± 17.68	28.50 ± 0.71	70.50 ± 17.68ab

Table 6: Statistical evaluation of quality parameters in 2 monitored seasons, Bacioi site

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Year	2019	*581.25±49.72a*	15.33±1.62	**36.65±8.58b**	*60.24±3.12a*	485.88±16.63	**433.50±11.59b**	*53.25±5.55a*	**16.88±1.64b**	78.88±22.33
	2020	**664.25±61.30b**	15.65±1.09	*32.54±6.03a*	**63.80±2.64b**	497.63±31.03	*414.00±10.23a*	**68.88±1.96b**	*14.63±2.00a*	79.25±20.37
Variety	Aszita	588.50±65.76abc	**17.08±0.16c**	**44.43±4.14c**	**65.30±1.41c**	534.50±33.23	444.50±13.44	59.00±8.49	14.50±0.71ab	*39.50±0.71a*
	Căpriana	**678.00±76.37c**	15.12±0.98abc	32.09±0.16ab	61.25±3.56ab	503.50±24.75	421.50±17.68	59.00±14.14	17.00±1.41bc	**88.00±5.66b**
	Numitor	*541.00±49.50a*	*13.74±0.35a*	*25.48±1.81a*	59.95±3.18ab	491.50±12.02	419.00±29.70	60.00±11.31	15.00±2.83abc	**99.00±1.41b**
	Kuialnic	654.00±22.63bc	14.67±0.21ab	32.10±4.24ab	63.35±2.76bc	471.00±24.04	423.50±12.02	57.50±16.26	15.50±2.12abc	**83.50±2.12b**
	Tengri	559.00±29.70ab	*14.17±0.57a*	*27.00±1.27a*	60.05±2.76ab	487.00±12.73	424.50±17.68	62.00±11.31	17.00±1.41bc	**98.50±0.71b**
	Vestitor	**676.50±62.93c**	16.66±0.45bc	**43.06±6.16c**	**66.60±1.70c**	486.00±5.66	413.00±0.00	61.50±9.19	*12.50±2.12a*	*55.00±2.83a*
	Pîsanka	646.50±62.93bc	15.33±0.77abc	32.14±0.23ab	61.25±3.32ab	491.50±12.02	422.00±11.31	61.50±13.44	**18.00±1.41c**	**87.50±6.36b**
	Wiwa	638.50±99.70abc	**17.15±0.45c**	40.45±6.01bc	*58.40±1.56a*	469.00±22.63	422.00±8.49	68.00±4.24	16.50±0.71bc	**81.50±10.61b**

Table 7: Statistical evaluation of agronomic parameters in 2 monitored seasons, Bacioi site

		TGW (g)	Spikes/m²	Grains/spike	Plant height (cm)	Yield t/ha
Year	2018	37.00±3.99	321.00±45.13	19.40±3.91a	74.60±12.54b	2.36±0.47a
	2019	35.40±5.12	376.20±15.25	28.40±1.14b	80.40±10.41b	3.83±0.35b
	2020	35.56±4.68	356.40±22.60	30.40±1.14b	58.00±6.52a	4.57±0.81c
Variety	Aszita	*29.43±1.56a*	366.00±24.52	25.67±7.51	78.67±14.05ab	*2.71±0.67a*
	Numitor	**39.60±1.23b**	355.67±47.08	27.33±3.06	64.33±13.05ab	**3.84±0.84b**
	Kuialnic	**39.13±0.15b**	324.00±44.19	26.00±7.21	*61.67±10.07a*	3.34±1.14ab
	Tengri	*33.27±1.59a*	363.67±26.27	25.00±8.72	**81.67±16.50b**	*2.93±0.83a*
	Vestitor	**38.50±2.43b**	346.67±47.72	26.33±3.06	68.67±9.29ab	3.47±0.53ab

Table 8: Statistical evaluation of quality parameters in 3 monitored seasons, Bacioi site

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Year	**2018**	483.60±81.36a	10.53±0.96a	24.17±6.13a	54.66±1.73a	295.00±64.57a	229.40±70.11a	26.00±4.69a	15.40±1.82b	89.60±7.77
	2019	584. 00±57.86b	15.39±1.62b	37.72±9.31b	61.54±3.33b	487.60±21.55b	433.80±14.97b	51.60±3.36b	16.40±1.95b	73.20±26.11
	2020	658.60±55.80b	15.59±1.19b	33.16±7.03b	65.04±2.20c	502.20±32.00b	415.00±13.17b	68.20±2.17c	13.80±2.17a	72.60±23.52
Variety	**Aszita**	589.67±46.54	**15.28±3.12c**	**40.68±7.12b**	**62.03±5.75b**	**485.00±88.90b**	404.67±69.64	49.00±18.33	14.67±0.58b	*52.00±21.66a*
	Kuialnic	497.33±83.34	*12.48±2.19a*	*23.43±3.77a*	*58.00±4.06a*	425.67±114.34ab	352.33±117.36	49.00±20.66	15.33±2.08b	**98.33±1.53c**
	Numitor	581.33±126.88	*13.10±2.71a*	*28.18±7.42a*	61.00±4.51ab	*394.67±133.30a*	337.33±149.49	46.33±22.50	15.33±1.53b	86.33±5.13bc
	Tengri	634. 00±86.02	14.92±3.02bc	**38.01±9.76b**	**62.90±6.52b**	432.67±92.46ab	366.67±80.25	51.33±18.77	*12.67±1.53a*	66.00±19.16ab
	Vestitor	574.67±132.14	13.41±3.36ab	*28.11±6.98a*	*58.13±5.89a*	403.33±152.95ab	336.00±149.17	47.33±26.31	**18.00±1.00c**	89.67±5.86bc

Results from Zârnești site (SCFCVT CAHUL – State Commission for Crops Variety Testing Cahul, Zârnești Testing Center)

Zârnești testing site lies near the town of Cahul in southern Moldova, at an elevation of 10 m, where an 8-field trial was established in September 2018 on a 1.53 ha plot. The trial has been set up for Moldovan conditions as a sustainable and commercially viable project, without the use of mineral fertilizers or synthetic plant protection preparations. The crop rotation comprises of 50% cereals, 25% legumes and 25% alfalfa. The trial also incorporates experimental testing of various varieties of winter wheat and spelt, and recommendation of these for use in OA.

The soil was evaluated as heavy alluvial fluvisol with alkalic pH. The content of phosphorus was evaluated as satisfactory, while magnesium, potassium and calcium content was very high. The ratio of potassium to magnesium was evaluated as good. Each year, 12.5% of the area is fertilized with cattle manure, and all crop residues are ploughed into the soil. Catch crops for green fertilizing are only grown if weather conditions are suitable.

The trial includes eight common wheat varieties - Numitor, Vestitor, Tengri, Kuialnic, Căpriana, Pîsanka, Aszita and Wiwa. The trial design was unified to 50 m² for each variety in three repetitions. A pre-crop of pea was grown on the plot. The wheat was sown on 3rd October 2018. Due to low precipitation after sowing, the seedlings emerged erratically until the beginning of February. The first substantial rain only came in May and June. Individual varieties began to flower within the span of 3 days, Tengri and Wiwa first, and Pîsanka and Kuialnic as the last. The variety Numitor suffered the worst from rust infection, while Kuialnic was the healthiest. Fusarium head blight was also found in Numitor, Vestitor and Căpriana.

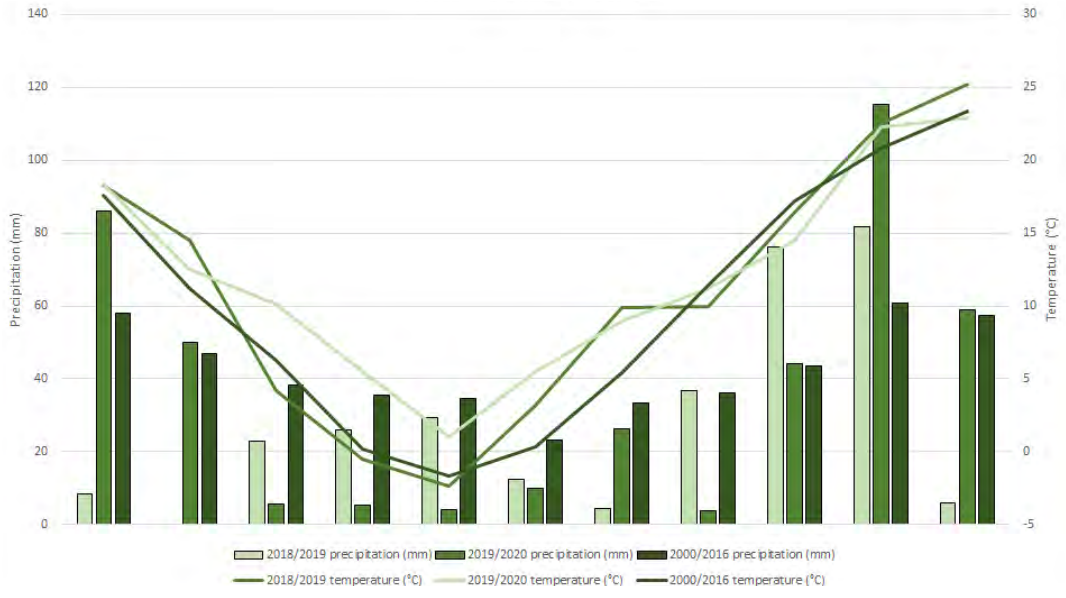
Evaluation of the 2019/2020 season

In the second year at Zîrnești site, field trials were conducted with 8 varieties of winter wheat (Aszita, Căpriana, Kuialnic, Numitor, Pîsanka, Tengri, Vestitor, and Wiwa) with a pre-crop of common vetch, after which the plot was processed twice (MTZ-82. PD-2.2) and also harrowed twice (MTZ-82 CPS-4). The wheat was sown on 3rd October 2019. 75% of the plants emerged by 14th October. The plot was mechanically weeded three times during the vegetation period, on 22nd March, 29th May and 10th June 2020. The crops flowered from 20th to 28th May 2020 and were harvested on 2nd July 2020.

Of the diseases monitored, no *Erysiphe graminus* was observed. A minimal occurrence, evaluated as the lowest degree of occurrence (1) of *Ustilago tritici* was found in Căpriana, Kuialnic, Numitor, Pîsanka, and Vestitor. Puccinia striiformis was strongest in Căpriana and Vestitor of all the varieties, while *Gibberella zeae* was worst in Vestitor. Wiwa was the least disease-affected variety on the site.

The Numitor variety had the highest yield (4.69 t/ha), Wiwa had the lowest (2.66 t/ha). Tengri and Azita were the tallest varieties (74 cm) while Kuialnic was the shortest, (45 cm) but had the highest number of spikes per unit area of all the evaluated varieties (514 spikes/m²) and the second highest yield (4.23 t/ha). The lowest number of spikes per unit area (352) was that of the Wiwa variety, which also had the lowest yield (2.66 t/ha) and least grains per spike (21). The most grains per spike (27) were equally found in Numitor and Pîsanka. The highest TGW – thousand grain weight – was found in Wiwa (38.9 g) and the lowest in Tengri (29.5 g). Within quality evaluation, all varieties were categorised in the group of varieties suitable for bakery use. The highest loaf volume was found in Numitor (744 ml/100 g flour) and the lowest in Kuialnic (545 ml/100 g flour) which also had the lowest protein content in dry matter (14.22%) and wet gluten content (25.3%). The highest protein content was that of the Aszita variety (17.05% in dry matter). The falling number was high in all varieties; the lowest levels were found in Wiwa (490 s) and the highest in Aszita (551 s).

Graph 2: Weather conditions in Zîrnești, all seasons



Evaluation of 2018/2019 and 2019/2020 seasons (together)

A comparison of both seasons clearly shows a difference in the weather conditions. Rainfall volume in the first season was 105.1 mm lower than the second season (2019/2020). There was also a difference in the distribution of precipitation within the monitored period. In the first season 63.9% of rainfall occurred between April and June 2019. Both seasons had less precipitation than the long-term average (2000/2016); the difference was -163.3 mm and -58.2 mm respectively. The distribution of precipitation within the vegetation period also differed: it was more evenly balanced in the first season, while in the second season the most rainfall (115.4 mm) occurred in June 2020, which is nearly twice the long-term average (60.8 mm, average for 2000/2016) and 28% of total 2019/2020 precipitation. Both seasons were warmer than the average, +0.8 °C and +1.9°C respectively.

In the evaluation of selected parameters, the influence of season was statistically significant in terms of plant height, spike length, number of grains per spike and yield. In the first season (2018/2019) the plants were generally taller, had more grains per spike and provided higher yield. Longer spikes were found in the second season (2019/2020). Only two of the evaluated parameters were statistically significant, i.e. plant height and spike length: Aszita and Tengri were the tallest varieties (82.50±12.02 cm and 84.50±14.85 cm respectively) while Kuialnic was the shortest variety (62.00±24.04 cm). The difference between the longest spike of the Wiwa variety (8.50±0.71 cm) and the Vestitor variety (6.50±0.71 cm) was 2 cm.

In terms of selected quality parameters, a statistically significant difference determined by the season was found in nearly all the characteristics, except protein content in the grain and gluten index. The second season (2019/2020) was generally better in terms of loaf volume, as well as water absorption, falling number and Zeleny test. Evaluation of varieties according to the two-season average resulted in the following: in terms of loaf volume the group of lower values included Kuialnic (the lowest average, 496.00±69.30 ml/100 g flour) and Pîsanka (545.00±98.99 ml/100 g flour). A medium loaf volume group included Aszita (642.00±86.27 ml/100 g flour), Căpriana (630.50±101.12 ml/100 g flour), Vestitor (643.00±100.41 ml/100 g flour), and Wiva (629.00±24.04 ml/100 g flour). The highest average loaf volume was found in Numitor (721.50±31.82 ml/100 g flour) and Tengri (687.50±50.20 ml/100 g flour). The highest protein content in the grain was found in Aszita (17.28±0.32%), Tengri (16.80±0.28%), and Wiwa (16.93±1.46%) cultivation of which specifically focused on this parameter in Switzerland. The lowest protein content was that of the Kuialnic variety (14.00±0.31%). Wet gluten content proved highest also in Aszita (46.18±6.89%) and Tengri (43.42±1.58%) while the lowest content of wet gluten was found in Kiualnic (26.37±1.51%) and Pîsanka (29.75±1.91%).

Table 9: Weather conditions in Zîrnești

		IX	X	XI	XII	I	II	III	IV	V	VI	VII
2018/2019	precipitation (mm)	8,5	0	23	26	29,4	12,4	4,5	36,7	76,1	81,6	6
	temperature (°C)	18,3	14,5	4,2	-0,5	-2,4	3,2	9,9	10	16,4	22,5	25,2
2019/2020	precipitation (mm)	86	50	5,6	5,3	4	10	26,3	3,7	44	115,4	59
	temperature (°C)	18,4	12,5	10,1	5,5	1	5,5	9	11,2	14,5	22,3	22,9
2000/2016	precipitation (mm)	57,9	46,9	38,2	35,6	34,6	23,2	33,2	36,1	43,5	60,8	57,5
	temperature (°C)	17,6	11,2	6,3	0,2	-1,7	0,3	5,4	11,4	17,2	20,8	23,4

Table 10: Comparison of yield in monitored years, Zîrnești site

	2018/2019	2019/2020	average	2018/2019	2019/2020	average
	yield (t/ha)			yield (%)		
Aszita	5,2	2,78	3,99	94,55	78,53	86,54
Capriana	4,7	3,4	4,05	85,45	96,05	90,75
Kuialnic	5,7	4,23	4,97	103,64	119,49	111,56
Numitor	6,3	**4,69**	**5,5**	114,55	**132,49**	**123,52**
Pîsanka	5,3	3,99	4,65	96,36	112,71	104,54
Tengri	**7,2**	2,9	5,05	**130,91**	81,92	106,41
Vestitor	5	3,67	4,34	90,91	103,67	97,29
Wiva	*4,6*	*2,66*	*3,63*	*83,64*	*75,14*	*79,39*
average of all varieties	5,5	3,54	4,52			
variance coefficient (%)	14,94	19,47	17,2			
standard deviation	0,82	0,69	0,76			
variance (0.05)	**0,77**	**0,54**	**0,4**			

Table 11: Selected quality parameters 2019/2020, Zîrnești site

	Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Aszita	703	**17.05**	41.3	63.5	**551**	407	70	15	55
Căpriana	702	16.04	33.5	63.1	528	400	69	15	82
Kuialnic	*545*	*14.22*	*25.3*	62.2	542	*393*	69	13	**99**
Nurmitor	**744**	15.82	32.8	64.3	535	415	70	*12*	78
Pîsanka	615	15.25	28.4	62.5	514	440	70	15	98
Tengri	723	17.00	**42.3**	**67.6**	514	**457**	*67*	13	*47*
Vestitor	714	15.61	32.0	64.2	507	429	70	15	77
Wiwa	646	15.89	31.4	*61.1*	*490*	417	**71**	**16**	95

Table 12: Selected agronomic indicators throughout the monitored seasons, Zîrnești site

	2018/2019				2019/2020				AVERAGE			
	TGW (g)	spikes/ m²	grains/ spike	plant height (cm)	TGW (g)	spikes/ m²	grains/ spike	plant height (cm)	TGW (g)	spikes/ m²	grains/ spike	plant height (cm)
Aszita	36.7	483	29	91	37.8	361	22	**74**	37.25	422	25.5	82.5
Căpriana	40.2	434	27	90	33.8	434	25	59	37.00	434	26.0	74.5
Kuialnic	38.6	514	29	79	37.0	**514**	24	*45*	37.80	514	26.5	62.0
Numitor	41.4	514	30	78	38.7	484	**27**	59	40.05	499	28.5	68.5
Pîsanka	37.5	505	28	81	31.6	505	**27**	54	34.55	505	27.5	67.5
Tengri	37.2	661	30	95	*29.5*	461	23	**74**	33.35	561	26.5	84.5
Vestitor	40.2	418	30	81	36.5	418	26	61	38.35	418	28.0	71.0
Wiva	35.4	459	28	88	**38.9**	*352*	*21*	61	37.15	405.5	24.5	74.5
Average of all varieties	38.40	498.50	28.88	85.38	35.48	441.13	24.38	60.88	36.94	469.81	26.63	73.13
Variance coefficient (%)	5.01	14.07	3.65	7.00	9.16	13.07	8.69	14.82	5.34	11.35	4.67	9.70
Standard deviation	1.93	70.15	1.05	5.98	3.25	57.63	2.12	9.02	1.97	53.32	1.24	7.09

Table 13: Statistical evaluation of monitored agronomic parameters in both monitored seasons, Zîrnești site

		Plant height (cm)	Spike length (cm)	Spikes/m²	Grains/spike	TSW (g)	Yield (t/ha)
Year	**2019**	**85.38±6.39b**	*7.00±0.76a*	498.50±75.00	**28.88±1.13b**	38.40±2.06	**5.50±0.88b**
	2020	*60.88±9.34a*	**7.88±0.64b**	441.13±61.61	*24.38±2.26a*	35.48±3.47	*3.54±0.74a*
Variety	**Aszita**	**82.50±12.02b**	8.00±0.00ab	422.00±86.27	25.50±4.95	37.25±0.78	3.99±1.71
	Căpriana	74.50±21.92ab	7.50±0.71ab	434.00±0.00	26.00±1.41	37.00±4.53	4.05±0.92
	Kuialnic	*62.00±24.04a*	7.00±0.00ab	514.00±0.00	26.50±3.54	37.80±1.13	4.97±1.04
	Numitor	68.50±13.44ab	7.00±1.41ab	499.00±21.21	28.50±2.12	40.05±1.91	5.50±1.14
	Pîsanka	67.50±19.09ab	7.50±0.71ab	505.00±0.00	27.50±0.71	34.55±4.17	4.65±0.93
	Tengri	**84.50±14.85b**	7.50±0.71ab	561.00±141.42	26.50±4.95	33.35±5.44	5.05±3.04
	Vestitor	71.00±14.14ab	*6.50±0.71a*	418.00±0.00	28.00±2.83	38.35±2.62	4.34±0.94
	Wiva	74.50±19.09ab	**8.50±0.71b**	405.50±75.66	24.50±4.95	37.15±2.47	3.63±1.37

Table 14: Statistical evaluation of quality parameters in both monitored seasons, Zîrnești site

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Year	**2019**	*574.63±83.97a*	15.78±1.43	**38.82±7.90b**	*61.13±2.71a*	*490.13±30.45a*	**456.00±27.98b**	*56.75±5.95a*	**15.63±0.92b**	79.25±17.21
	2020	**674.00±67.01b**	15.86±0.92	*33.38±5.48a*	**63.56±1.95b**	**522.63±20.07b**	*419.75±21.32a*	**69.50±1.20b**	*14.25±1.39a*	78.88±19.39
Variety	**Aszita**	642.00±86.27bc	**17.28±0.32b**	**46.18±6.89b**	64.10±0.85ab	548.50±3.54	461.50±77.07	65.00±7.07	14.50±0.71	50.00±7.07a
	Căpriana	630.50±101.12bc	15.58±0.66ab	35.47±2.78ab	*61.50±2.26a*	516.00±16.97	424.50±34.65	61.50±10.61	15.50±0.71	81.50±0.71abc
	Kuialnic	*496.00±69.30a*	*14.00±0.31a*	*26.37±1.51a*	*60.55±2.33a*	516.50±36.06	423.00±42.43	59.00±14.14	14.00±1.41	99.00±0.00c
	Numitor	**721.50±31.82c**	15.45±0.53ab	34.52±2.43ab	63.15±1.63ab	488.50±65.76	420.50±7.78	61.50±12.02	14.00±2.83	79.50±2.12abc
	Pîsanka	545.00±98.99ab	15.03±0.31ab	*29.75±1.91a*	*60.90±2.26a*	492.50±30.41	436.50±4.95	62.00±11.31	15.50±0.71	98.50±0.71bc
	Tengri	**687.50±50.20c**	**16.80±0.28b**	**43.42±1.58b**	**66.55±1.48b**	492.50±30.41	450.00±9.90	64.00±4.24	14.00±1.41	59.50±17.68ab
	Vestitor	643.00±100.41bc	15.51±0.14ab	34.36±3.34ab	62.35±2.62ab	502.00±7.07	443.00±19.80	62.50±10.61	16.00±1.40	80.50±4.95abc
	Wiwa	629.00±24.04bc	**16.93±1.46b**	38.74±10.38ab	**59.65±2.05b**	494.50±6.36	444.00±38.18	69.50±2.12	16.00±0.00	84.00±15.56abc


2
Aszita

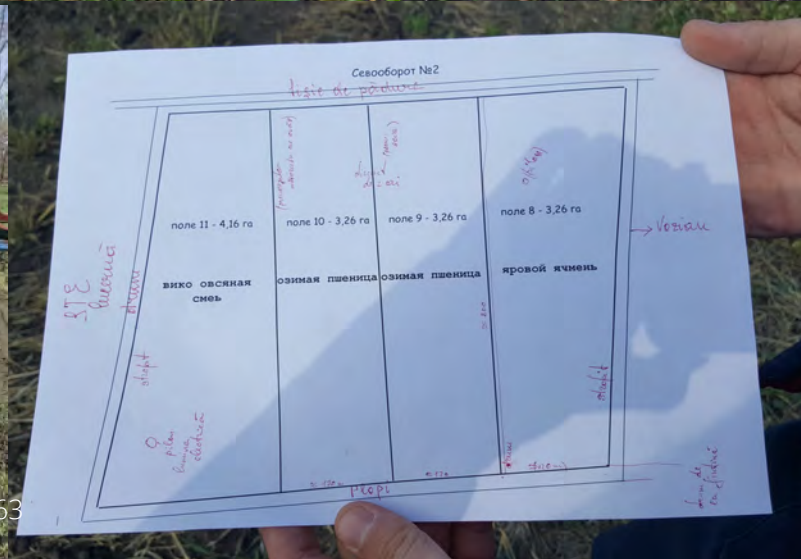

wiwa


1
wiwa

Results from Bălți site (Research Institute of Field Crops Selecția")

Field trials in Bălți were established in autumn 2018 (2.0 ha). The Bălți site is typical steppe landscape, situated in the north of Moldova at an elevation of 146 m. The soil is medium chernozem. Soil analysis showed neutral pH, a low phosphorus content, and a remarkably high content of calcium and magnesium. The content of potassium and the potassium : magnesium ratio were evaluated as good.

The trial was established in 2018 but weeding the plot had begun in autumn 2017. A high infestation of persistent weeds, especially the creeping thistle (*Cirsium arvense*) was a problem here. A decision was made to attempt to reduce the weeds, without using herbicides, purely by means of the competitiveness of some crops and the allelopathic effect of alfalfa on creeping thistle. In autumn 2017 the weed-covered plot was ploughed, and a legume-cereal mix (vetch and oats) was sown in spring 2018 and ploughed into the soil on 27th June 2018 as green fertilizer. Afterwards the plot was regularly cultivated by subsoiling to weaken the weeds' growth and prevent them from seeding. A three-field crop rotation was chosen as an appropriate way to rid the area of weeds (a mix for green fertilizing, winter wheat – trials, and alfalfa).

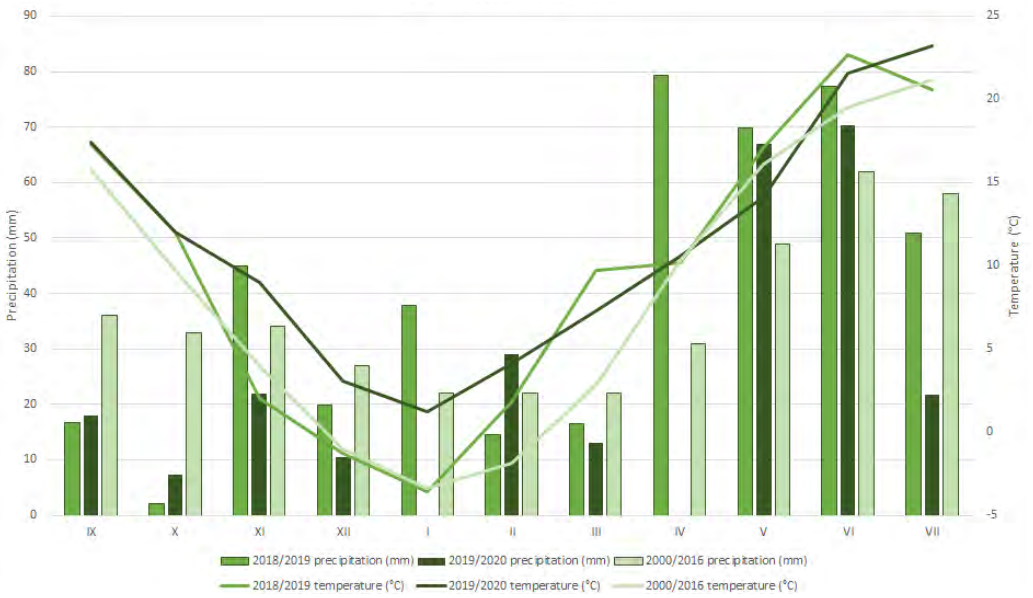


The trials were established according to unified methodology – the harvesting area of individual plots was 10 m² in three repetitions. 10 varieties were chosen for the trial, the Swiss trio Tengri, Wiwa, Aszita, Ukrainian Pîsanka and Kuialnik and the Moldovan Căpriana, Vestitor, Numitor, Fenix and Talisman. The trials were established on 15th October 2018 and were seriously affected by a lack of precipitation after sowing. The plants emerged slowly for months, until mid-February. The area suffered heavy storms on 11th and 24th March, which damaged the crops and thinned them considerably. On the other hand, the occurrence of disease was lower as a result of this. The crops were harvested on 11th July 2019. Aszita was the tallest variety of the whole group (101.42 cm) followed by the other Swiss varieties Tengri (92.2 cm) and Wiwa (89.8 cm), while the Moldovan varieties Talisman (66.16 cm), Numitor (66.9 cm) and Fenix (68.64 cm) were shortest. The highest number of spikes per m² was found in the Tengri variety (338) and the lowest in Talisman (187). The most grains per spike were in the varieties Vestitor (41), Tengri (40) and Talisman (39). The highest TGW was that of the Swiss variety Wiwa (37.50 g) and the lowest was Aszita (26.20 g). The highest yield came from Fenix (3.49 t/ha) – one of the shorter varieties (68.64 cm). The Talisman variety had the lowest yield (2.63 t/ha), as well as the least spikes per m² and was also the shortest (66.16 cm).

In autumn 2019 Selectia company in Bălți started the second season of the field trials with 10 varieties of winter wheat. 8 varieties were identical to those on the other two sites (Aszita, Căpriana, Kuialnic, Numitor, Pîsanka, Tengri, Vestitor, and Wiwa). As in the 2018/2019 season, Fenix and Talisman were added only in Bălți. The pre-crop of alfalfa was worked into the soil on 28th July 2019. The plot was ploughed on 27th August 2019 and processed on 14th September 2019 (MTZ-82, BDT-3). On 15th October 2019 the soil was harrowed (MTZ-82 CPS-4) and prepared for sowing, which was done on 17th October 2019. The land was mechanically weeded only once within the vegetation period, on 27th March 2020. The crops were harvested on 17th July 2020. Pest and disease incidence was part of the evaluation. Both parameters were quite low during the season, Wiwa and Numitor being the worst affected by pests of the studied varieties. The lowest incidence of disease was observed in Kuialnic, Vestitor, Fenix, and Talisman. The highest yield was obtained from the Talisman variety (2.33 t/ha) and the lowest from Wiwa (1.70 t/ha). Numitor had the highest number of spikes per unit area (386) while Aszita was the opposite, with only 190 spikes/m², and also provided low yield (1.85 t/ha). The highest number of grains per spike was that of Kuialnic (29) and Aszita (29), the lowest – 25 grains/spike – were found in Numitor, Tengri, and Vestitor. Tengri was the tallest variety (81.40 cm); Numitor was the shortest (57.46 cm). The highest thousand grain weight was that of Pîsanka (40.30 g) and the lowest was found in Wiwa (27.83 g).

Evaluation of quality parameters shows that all varieties met parameters set for bakery use. The Tengri variety had the highest loaf volume (779 ml/100 g flour) while the lowest loaf volume was found in the Kuialnic variety (576 ml/100 g flour). The highest protein content was found in the Wiwa variety (17.81%) and the lowest, again, in Kuialnic (14.42%) which also had the lowest content of wet gluten (27.9%). The highest content of wet gluten was measured in the Tengri variety (45.6%). The falling number ranged in the group of varieties between 324 and 405 s. the highest value was found in Numitor and the lowest in Căpriana.

Graph 3: Weather condition in Bălți



Evaluation of 2018/2019 and 2019/2020 seasons (together)

Evaluation of weather conditions in both seasons shows that the second season (2019/2020) was below average in precipitation and above average in temperature. In comparison to the first season, there was 170.7 mm less rainfall which was also 137.1 mm less than the long-term average (2000/2016). In terms of temperature, the second season was 1.4 °C warmer than the first, and even 2.8°C warmer than the long-term average. In January and April 2020 no precipitation was recorded at all. These conditions affected yield which, on average for all varieties, was 0.96 t/ha lower in the second season than in the first. A statistically significant influence of season was also found in plant height, spike length, number of spikes per unit area and the afore-mentioned yield. Shorter plants (by 11.9 cm on average) and spikes (by 2.7 cm on average) were found in the second season. On the other hand, the second season was richer in the number of spikes per unit area. The influence of variety showed a statistically conclusive difference only in the plant height. The average plant height for both seasons divided the varieties into two groups which was statistically significant. The group of the shortest varieties (whose height did not differ significantly in each season) comprised of Fenix (63.31±7.54 cm), Kuialnic (66.97±6.52 cm), Numitor (62.18±6.68 cm), Talisman (64.70±2.06 cm), and Vestitor (67.32±9.11 cm). The tallest variety was Aszita (90.45±15.51 cm).

Quality parameters were also affected by the weather conditions, especially loaf volume, water absorption, falling number, Zeleny test, and gluten index. Higher values of loaf volume, water absorption and Zeleny test were found in the second evaluated season (2019/2020). In statistical evaluation of quality within both seasons, the Tengri variety showed the highest values of all varieties in terms of loaf volume (716.50±88.39 ml/100 g flour), protein content (17.60±0.12%), wet gluten content (47.00±1.98%), and water absorption (67.95±3.18%). The lowest value was that of grain hardness (14.00±0.00%). A high protein content was also detected in the Wiwa variety (17.42±0.56%), while the lowest protein content was found in Fenix (14.60±0.13%) and Kuialnic (14.47±0.07%). The Fenix variety also had the lowest content of wet gluten (28.75±0.21%).

Table 15: Weather conditions in Bălți

		IX	X	XI	XII	I	II	III	IV	V	VI	VII
2018/2019	precipitation (mm)	16,8	2	45	19,8	37,8	14,5	16,5	79,3	69,8	77,3	50,8
	temperature (°C)	17,3	12	2	-1,3	-3,6	1,8	9,7	10,2	17,1	22,7	20,6
2019/2020	precipitation (mm)	18	7,3	22	10,5	0	29	13	0	67	70,3	21,8
	temperature (°C)	17,4	12	9	3,1	1,2	4,1	7,3	10,6	14,1	21,6	23,2
2000/2016	precipitation (mm)	36	33	34	27	22	22	22	31	49	62	58
	temperature (°C)	15,8	9,7	4	-1	-3,4	-1,9	2,8	10,3	16,1	19,5	21,2

Table 16: Comparison of yield in monitored seasons, Bălți site

	2018/2019	2019/2020	average	2018/2019	2019/2020	average
	yield (t/ha)			yield (%)		
Aszita	2.78	1.85	2.32	92.48	90.20	91.34
Căpriana	3.17	2.23	2.70	105.46	108.73	107.09
Fenix	3.49	2.06	2.78	116.10	100.44	108.27
Kuialnic	2.79	2.15	2.47	92.81	104.83	98.82
Numitor	3.10	2.05	2.58	103.13	99.95	101.54
Pîsanka	2.92	2.17	2.55	97.14	105.80	101.47
Talisman	2.63	2.33	2.48	87.49	113.60	100.55
Tengri	3.15	1.76	2.46	104.79	85.81	95.30
Vestitor	3.35	2.21	2.78	111.44	107.75	109.60
Wiwa	2.68	1.70	2.19	89.16	82.89	86.02
Average of all varieties	3.01	2.05	2.53			
Variance coefficient (%)	9.18	9.84	7.15			
Standard deviation	0.28	0.20	0.18			
Variance (0.05)	0.08	0.05	0.04			

Table 17: Selected quality parameters 2019/2020, Bălți site

	Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Aszita	580	17.60	42.1	67.1	**482**	375	65	*14*	*30*
Căpriana	752	16.51	36.8	61.6	440	*324*	**70**	17	54
Fenix	650	14.69	28.9	60.9	422	381	67	16	95
Kuialnic	*576*	*14.42*	*27.9*	61.4	442	371	68	16	**98**
Numitor	720	15.43	35.3	62.1	449	**405**	63	16	45
Pîsanka	627	15.59	30.7	63.5	427	378	**70**	17	94
Talisman	688	15.63	34.4	*60.4*	*394*	371	*61*	**20**	54
Tengri	**779**	17.68	**45.6**	**70.2**	440	363	**70**	*14*	47
Vestitor	641	15.38	32.5	61.7	395	*324*	63	18	65
Wiwa	678	**17.81**	41.9	60.7	437	399	68	16	55

Table 18: Selected agronomic indicators throughout the monitored seasons, Bălți site

	2018/2019				2019/2020				AVERAGE			
	TGW (g)	spikes/ m^2	grains/ spike	plant height (cm)	TGW (g)	spikes/ m^2	grains/ spike	plant height (cm)	TGW (g)	spikes/ m^2	grains/ spike	plant height (cm)
Aszita	*26.20*	323	38	**101.42**	39.19	*190.00*	**29.00**	79.48	32.70	256.50	**33.50**	**90.45**
Căpriana	35.20	257	26	78.50	37.84	306.00	27.00	67.16	36.52	281.50	26.50	72.83
Fenix	32.00	270	*22*	68.64	32.93	385.00	26.00	57.98	32.47	**327.50**	*24.00*	63.31
Kuialnic	29.70	295	27	71.58	37.63	245.00	**29.00**	62.36	33.67	270.00	28.00	66.97
Numitor	34.30	247	29	66.90	34.79	**386.00**	*25.00*	*57.46*	34.55	316.50	27.00	*62.18*
Pîsanka	31.80	220	33	77.56	**40.30**	215.00	28.00	61.26	36.05	*217.50*	30.50	69.41
Talisman	30.50	*187*	39	*66.16*	35.93	274.00	27.00	63.24	33.22	230.50	33.00	64.70
Tengri	26.70	**338**	40	92.20	37.10	241.00	*25.00*	**81.40**	*31.90*	289.50	32.50	86.80
Vestitor	35.30	230	**41**	73.76	39.59	344.00	*25.00*	60.88	**37.45**	287.00	33.00	67.32
Wiwa	**37.50**	297	30	89.80	*27.83*	307.00	27.00	76.28	32.67	302.00	28.50	83.04

Table 19: Statistical evaluation of monitored agronomic parameters in both monitored seasons, Bălți site

		Plant height (cm)	Spike length (cm)	Spikes/m^2	Grains/spike	TSW (g)	Yield (t/ha)
Year	**2018/2019**	**78.65±12.00b**	**8.83±0.98b**	*266.40±47.54a*	32.50±6.69	31.92±3.74	**3.01±0.29b**
	2019/2020	*66.75±8.99a*	*6.11±0.47a*	**289.30±68.32b**	26.80±1.55	36.31±3.73	*2.05±0.21a*
Variety	**Aszita**	**90.45±15.51d**	8.19±1.88	256.50±94.05	33.50±6.36	32.70±9.19	2.32±0.66
	Căpriana	72.83±8.02abc	8.71±3.52	281.50±34.65	26.50±0.71	36.52±1.87	2.70±0.66
	Fenix	*63.31±7.54a*	6.86±2.23	327.50±81.32	24.00±2.83	32.47±0.66	2.78±1.01
	Kuialnic	*66.97±6.52a*	7.83±1.65	270.00±35.36	28.00±1.41	33.67±5.61	2.47±0.45
	Numitor	*62.18±6.68a*	6.72±1.56	316.50±98.29	27.00±2.83	34.55±0.35	2.58±0.74
	Pîsanka	69.41±11.53ab	7.40±1.67	217.50±3.54	30.50±3.54	36.05±6.01	2.55±0.53
	Talisman	*64.70±2.06a*	7.57±1.91	230.50±61.52	33.00±8.49	33.22±3.84	2.48±0.21
	Tengri	86.80±7.64cd	7.31±2.05	289.50±68.59	32.50±10.61	31.90±7.35	2.46±0.98
	Vestitor	*67.32±9.11a*	6.88±1.44	287.00±80.61	33.00±11.31	37.45±3.03	2.78±0.81
	Wiwa	83.04±9.56bcd	7.25±1.34	302.00±7.07	28.50±2.12	32.67±6.84	2.19±0.69

Table 20: Statistical evaluation of quality parameters in both monitored seasons, Bălți site

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Year	**2018/2019**	608.20±44.60a	15.77±1.08	35.70±6.60	59.88±2.67a	454.10±19.88b	394.70±26.96b	62.60±5.42a	16.60±1.84	75.40±20.07b
	2019/2020	669.10±67.91b	16.07±1.25	35.61±5.99	62.96±3.20b	432.80±25.76a	369.10±26.98a	66.50±3.31b	16.40±1.78	63.70±23.81a
Variety	**Aszita**	587.00±9.90ab	17.14±0.65cd	42.15±0.07d	**65.30±2.55b**	469.00±18.38	377.00±2.83	62.50±3.54	*14.00±0.00a*	*38.50±12.02a*
	Căpriana	704.00±67.88bc	16.22±0.42bcd	37.05±0.35c	*60.35±1.77a*	443.00±4.24	345.00±29.70	68.50±2.12	16.50±0.71b	62.00±11.31abc
	Fenix	620.00±42.43abc	*14.60±0.13a*	*28.75±0.21a*	*60.30±0.85a*	442.00±28.28	398.50±24.75	63.00±5.66	16.00±0.00ab	95.00±0.00cd
	Kuialnic	*567.00±12.73a*	*14.47±0.07a*	27.55±0.49a	*59.85±2.19a*	465.50±33.23	396.50±36.06	66.00±2.83	16.50±0.71b	**98.00±0.00d**
	Numitor	677.50±60.10abc	15.11±0.46ab	34.85±0.64bc	*60.30±2.55a*	447.50±2.12	419.50±20.51	56.50±9.19	17.00±1.41b	51.50±9.19ab
	Pîsanka	579.00±67.88ab	15.23±0.52ab	30.75±0.07ab	*61.00±3.54a*	453.50±37.48	390.50±17.68	67.00±4.24	17.00±0.00b	95.00±1.41cd
	Talisman	677.50±14.85abc	15.84±0.29abc	33.45±1.34bc	*59.55±1.20a*	427.00±46.67	395.00±33.94	61.00±0.00	**20.00±0.00c**	73.00±26.87bcd
	Tengri	**716.50±88.39c**	**17.60±0.12d**	**47.00±1.98e**	**67.95±3.18b**	441.00±1.41	369.50±9.19	68.50±2.12	*14.00±0.00a*	48.50±2.12ab
	Vestitor	624.00±24.04abc	15.63±0.35ab	33.65±1.63bc	*60.80±1.27a*	408.50±19.09	348.00±33.94	64.50±2.12	18.00±0.00bc	75.00±14.14bcd
	Wiwa	634.00±62.23abc	**17.42±0.56d**	41.35±0.78d	*58.80±2.69a*	437.50±0.71	379.50±27.58	68. 00±0.00	16.00±0.00ab	59.00±5.66ab


GRÂU DE TOAMNĂ
Soiul – FENIX
Proveniență - Republica Moldova
CZECH REPUBLIC
DEVELOPMENT COOPERATION

Results from Furceni site (GȚ "MA-GAȘPER")

In the Orhei district of central Moldova, three field trials were established at an elevation of 140 m, over two seasons (2 trials in 2017/2018 and one trial in 2018//2019), to recommend varieties of winter wheat suitable for OA. The trials were established under commercial conditions on the GȚ" MA-GAȘPER" farm, part of which is managed according to organic rules and the farmers are familiar with various organic-suitable practices and own the appropriate equipment (tine harrow etc.)

In the first season, a trial was established on a plot where the soil was evaluated as medium-heavy chernozem with slightly acidic pH, low phosphorus, high calcium and good potassium content. The ratio of potassium to magnesium was evaluated as good. The following varieties were included in the trial: Tengri, Annie, Aszita, Epoha Odesskaia, Pîsanka, Capriana Plus, Numitor and Vestitor. The trials were sown on the 3rd and 5th October 2017, on 2 ha after 2 pre-crops – pea (1ha) and alfalfa (1ha), to the same design. The aim was to determine the influence of different pre-crops on yield and quality parameters in the 8 varieties of winter wheat. There was 50 mm of rainfall after sowing. Significant weather phenomena occurred during vegetation period: very low temperature at the end of February and beginning of March, down to -25°C. At the end of March there was 40 cm of snow and the temperature dropped to -14°C, while in mid-April it rose up to 27°C. No rainfall was recorded throughout April. Precipitation in mid-May amounted to 26 mm, including hail. A further 77 mm of rain at the end of June delayed the harvest until 7th July 2018.

In general, we can state that the yield from all varieties was higher after a pre-crop of pea. This was confirmed statistically. The highest yield was from the Pîsanka variety (3.71 t/ha), which also had the highest yield after alfalfa. The lowest yield was that of the Aszita variety, after both pea and alfalfa pre-crops (2.63 and 2.38 t/ha respectively). In terms of the number of spikes per m² and number of grains per spike, varieties grown after pea showed higher figures on average. The Annie variety had the highest number of spikes per m² (452.2) while the lowest was that of Aszita. These two varieties proved their respective highest and lowest values in both pre-crops. As for quality parameters, differences were found in relation to the type of pre-crop, although they were not statistically significant, except for water binding capacity, falling number of wholegrain flour and hardness. Apart from hardness, higher values were measured in wheat crops grown after alfalfa. Of wheat grown after pea, the highest protein content was that of Tengri (12.32%) and Aszita (12.27%). The lowest values were found in the varieties Pîsanka (9.47%) and Epoha Odesskaia (9.77%). In wheat grown after alfalfa, the highest and lowest values were found in the same varieties. The only significant difference was a high protein content (12.13%) in the Vestitor variety which, grown after pea, showed average figures. When evaluating the varieties regardless of pre-crop, we can state in general that the varieties Tengri and Aszita, bred specifically for organic agriculture, attained the best quality parameters. Of the remaining varieties, only the Zeleny test results were comparable or even better in Annie and Vestitor.

In the second season, a trial was established, with chickpeas as a pre-crop, on a 0.83 ha plot where the soil type is medium, of the chernozem group, with alkalic pH. The content of phosphorus in the soil was evaluated as low, while the content of potassium and magnesium was good, as was their ratio. The content of calcium was evaluated as very high. Varieties Aszita, Căpriana, Kualnic, Numitor, Pîsanka, Tengri, Vestitor and Wiwa were chosen for the trial. The field was sown on 1st October after a crop of chickpeas. There was no precipitation from the time of sowing until mid-November when snow appeared. Consequently, only 50% of the sown seed emerged (at the beginning of winter) while the rest began to emerge in early February when the snow melted, and the temperature rose above 5°C. The first significant rain only arrived in April. A very strong rust infection was recorded during the vegetation period, with the Swiss varieties – Wiva, Tengri and Aszita – being the worst affected. The crops were harvested on 12th July 2019.

The highest yield was from the Vestitor variety (4.25 t/ha), while the lowest yield was from the Wiwa variety (1.01 t/ha). The highest number of spikes per m² before harvest was counted in Vestitor (580) and the lowest in Aszita (368). The highest number of grains per spike was found in Pîsanka (49), the lowest in Căpriana (30). Tengri was the tallest crop (average height of plants 113 cm) while Pîsanka was the shortest. As for quality parameters, the highest values of loaf volume, protein content, wet gluten, water binding capacity, and falling number were measured in the Swiss varieties of Aszita, Tengri and Wiwa. Of these, Tengri achieved the highest values. Despite showing lower values, the other two Swiss varieties met the parameters required for flour of baking quality.

A comparison of the results of the two seasons, and all three trials, draws the following conclusions: in the second season the trials were heavily affected by gradual emergence and a serious rust infection in the Swiss varieties. However, it can be stated that, even though the differences in yield were not statistically significant, on average the yield was highest from the Vestitor variety (3.61 t/ha) and lowest from Aszita (2.34 t/ha). Aszita was also the tallest variety (91.17 cm), while Pîsanka was shortest (73 cm). In quality parameters, there was a statistically significant difference between the two seasons – higher figures in some of the parameters were measured in the 2018/2019 season. The number of grains per spike was also average to double compared to the 2017/2018 season. The Swiss varieties Aszita and Tengri were of the best baking quality, in terms of protein content and required wet gluten values, as well as their water binding capacity, falling number and loaf volume, although these varieties were among the lowest yielding.

Note: Thousand grain weight (TGW) was not measured in the 2018/19 season.

Table 21: Evaluation of yield, averages, GT "MA-GAȘPER"

	2017/2018		2018/2019		2017/2018		2018/2019	
Locality Pre-crop	Furceni Pea	Furceni Alfalfa	Furceni Chickpeas	Average	Furceni Pea	Furceni Alfalfa	Furceni Chickpeas	Average
	yield (t/ha)				yield (%)			
Aszita	2.63	2.38	2.02	2.34	84.1	81.7	72.7	79.5
Numitor	2.96	2.75	3.74	3.15	94.6	94.4	134.6	107.9
Pîsanka	3.71	3.43	1.92	3.02	118.6	117.7	69.1	101.8
Tengri	2.83	2.6	1.72	2.38	90.5	89.2	61.9	80.5
Vestitor	3.38	3.22	4.24	3.61	108	110.5	152.6	123.7
All varieties on average	**3.10**	**2.88**	**2.73**	**2.90**				
Variance coefficient (%)	**13**	**14**	**38**	**17**				
Standard deviation	**0.39**	**0.39**	**1.05**	**0.48**				

Table 22: Weather pattern 2017/2018 and 2018/2019, Furceni village, Orhei district

Nr.	Date	Precipitation (mm)	Records of extreme temperatures	Comments	Nr.	Date	Precipitation (mm)	Records of extreme temperatures
1	08.10.17	50 mm			1	05.09.18	23 mm	
2	14.10.17	5 mm			2	07.09.18	5 mm	
3	22.10.17	8 mm			3	10.09.18	26 mm	
4	24.10.17	15 mm			4	11.09.18	6 mm	
5	10.11.17	4 mm			5	24.09.18	12 mm	
6	records are missing				6	25.09.18 – 16.11.18	0 mm	
7	24.02.18	Snow			7	17.11.18	Snow 3 cm	
8	25.02.18		-21°C		8	19.11.18	Snow 15 cm	
9	01 - 05.03.18		-16°C		9	24.11.18	Snow 10 cm	
10	08.03.18	Rain, 16 mm			10	25.11.18	Snow 5 cm	
11	18-22.03.18	Snow, 20 cm			11	27.11.18		-5°C
12	23.03.18	Snow, 20 cm			12	10.12.18	Snow 10 cm	
13	24.03.18		-13°C to -14°C	Low temperature	13	21.01.19	Snow 10 cm	
14	15.04.18		+ 27 °C		14	22.01.19	Snow 40 cm	
15	April	0 mm		High temperature	15	25.01.19	Snow 30 cm	
16	09.05.18	5 mm			16	27.01.19	Snow 15 cm	
17	13.05.18	26 mm		Rain with small hail,	17	30.01.19		+8°C
18	20.05.18	4 mm			18	16.03.19	5 mm	
19	05.06.18	7 mm			19	04.04.19	5 mm	
20	17.06.18	20 mm			20	06.04.19	3 mm	
21	22.06.18	45 mm			21	07.04.19	2 mm	
22	29.06.18	77 mm			22	08.04.19	3 mm	
23	01.07.18	3 mm			23	09.04.19	4 mm	
					24	11.04.19	2 mm	
					25	13.04.19	36 mm	
					26	19.04.19	5 mm	
					27	19.05.19	16 mm	
					28	25.05.19	12 mm	
					29	02.06.19	30 mm	
					30	04.06.19	7 mm	
					31	14.06.19	17 mm	
					32	18.06.19	2 mm	
					33	03.07.19	7 mm	

Table 23: Selected evaluated agronomic characteristics, average values, GȚ "MA-GAȘPER" 2017/2018

		Pea			Alfalfa			Average		
	TGW (g)	Number of spikes/m²	Number of grains/spike	Plant height (cm)	Number of spikes/m²	Number of grains/spike	Plant height (cm)	Number of spikes/m²	Number of grains/spike	Plant height (cm)
Tengri	38	438	17	77.5	427	16	72.5	432.5	16.5	75.0
Annie	38	449	17	67.5	456	17	60.0	452.5	17.0	63.8
Aszita	35	396	19	95.0	378	18	72.5	387.0	18.5	83.8
Epoha Odesskaia	42	397	19	72.5	388	18	67.5	392.5	18.5	70.0
Pîsanka	42	402	22	72.5	389	21	62.5	395.5	21.5	67.5
Capriana Plus	36	394	23	72.5	391	22	60.0	392.5	22.5	66.3
Numitor	34	395	22	72.5	385	21	62.5	390.0	21.5	67.5
Vestitor	34	414	24	77.5	412	23	72.5	413.0	23.5	75.0
Average	**37.4**	**410.6**	**20.4**	**75.9**	**403**	**19.5**	**66.3**	**406.9**	**19.9**	**75.9**
Variance coefficient (%)	**8**	**5**	**12**	**10**	**6**	**12**	**8**	**5**	**12**	**8**
Standard deviation	**3.04**	**20.09**	**2.55**	**7.80**	**24.95**	**2.40**	**5.30**	**22.36**	**2.47**	**6.07**

Table 24: Quality parameters, average values, GȚ "MA-GAȘPER" 2017/2018

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Peas	Tengri	595	12.32	29.78	58.50	391	353	38	11	92
	Annie	519	11.06	23.56	58.70	362	332	32	13	96
	Aszita	634	12.27	34.04	57.00	421	375	31	13	71
	Epoha Odesskaia	375	9.77	19.42	52.60	366	311	27	16	98
	Pîsanka	376	9.47	17.63	52.20	330	292	24	15	96
	Capriana Plus	461	10.43	21.98	52.30	368	311	28	17	95
	Numinor	415	10.41	21.90	55.30	368	304	27	14	93
	Vestitor	438	10.28	22.22	51.90	363	302	27	16	97
	Average	476.6	10.75	23.82	54.81	371.1	322.5	29.3	14.4	92.3
Alfalfa	Tengri	559	12.40	30.47	59.40	390	354	39	10	93
	Annie	525	11.02	22.76	59.70	394	354	31	12	94
	Aszita	587	12.24	33.24	58.60	422	375	31	12	78
	Epoha Odesskaia	408	10.32	20.33	55.20	370	347	31	14	98
	Pîsanka	412	10.15	19.80	54.90	350	301	29	15	97
	Capriana Plus	394	10.79	23.22	54.40	372	334	31	17	96
	Numinor	446	11.05	24.46	58.40	362	322	30	14	94
	Vestitor	546	12.13	27.12	55.80	377	348	41	14	97
	Average	484.6	11.26	25.18	57.05	379.6	341.9	32.9	13.5	93.4

Table 25: Selected evaluated characteristics, average values, GȚ "MA-GAȘPER" 2018/2019

	Plant height (cm)	Number of spikes/m^2	Number of grains/spike	Yield (t/ha)
Tengri	113	420	38	1.72
Pîsanka	84	512	49	1.92
Aszita	106	368	45	2.02
Kuialnic	87	416	40	3.14
Wiwa	96.5	464	31	1.01
Numitor	90	488	40	3.74
Căpriana Plus	108	480	30	3.04
Vestitor	105	580	40	4.25
Average	98.7	511	39.13	2.61
Variance coefficient (%)	10	27	15	40
Standard deviation	10.11	138.52	5.97	1.04

Table 26: Quality parameters, average values, GȚ "MA-GAȘPER", 2018/2019

	Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	Gi
Aszita	568.0	13.5	61.0	34.5	478.0	408.0	32.0	16.0	58.0
Căpriana	444.0	12.1	55.9	26.7	438.0	398.0	32.0	16.0	83.0
Kualnic	409.0	11.4	56.4	21.8	470.0	416.0	29.0	17.0	98.0
Numitor	425.0	12.1	58.2	27.0	412.0	425.0	34.0	17.0	85.0
Pîsanka	439.0	12.6	58.4	24.9	457.0	394.0	39.0	17.0	96.0
Tengri	641.0	15.3	62.8	41.4	439.0	384.0	46.0	15.0	68.0
Vestitor	455.0	11.6	55.2	24.8	442.0	412.0	32.0	18.0	95.0
Wiwa	569.0	14.3	56.5	33.9	461.0	391.0	49.0	17.0	86.0
Average	**493.8**	**12.8**	**58.1**	**29.4**	**449.6**	**403.5**	**36.6**	**16.6**	**83.6**

Table 27: Evaluation of quality parameters of varieties and pre-crops, GȚ "MA-GAȘPER"

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	Gi
2017/2018	Alfalfa	510.00	11.59	27.02	57.42	380.20	340.00	34.00	13.00	91.80
	Chickpeas	505.60	13.01	59.12	30.52	445.60	404.60	36.60	16.60	80.40
2018/2019	Pea	491.60	10.95	25.11	54.98	374.60	325.20	29.40	13.80	89.80
	Aszita	596.33	12.67	42.76	50.05	440.33	386.00	31.33	13.67	69.00
	Numitor	428.67	11.19	34.85	46.89	380.67	350.33	30.33	15.00	90.67
variety	Pîsanka	409.00	10.74	31.94	44.00	379.00	329.00	30.67	15.67	96.33
	Tengri	598.33	13.32	41.02	53.11	406.67	363.67	41.00	12.00	84.33
	Vestitor	479.67	11.32	34.85	44.15	394.00	354.00	33.33	16.00	96.33

Table 28: Evaluation of selected agronomic parameters of varieties and pre-crops, GȚ "MA-GAȘPER"

		Number of spikes/m²	Number of grains/spike	Plant height (cm)	Yield (t/ha)
2017/2018	Alfalfa	398.20	19.80	68.50	2.88
	Chickpeas	473.60	42.40	99.60	2.73
2018/2019	Pea	409.00	20.80	79.00	3.10
variety	Aszita	380.67	27.33	91.17	2.34
	Numitor	422.67	27.67	75.00	3.15
	Pîsanka	434.33	30.67	73.00	3.02
	Tengri	428.33	23.67	87.67	2.38
	Vestitor	468.67	29.00	85.00	3.62

SUMMARY OF RESULTS 2018/2019 AND 2019/2020 SEASONS AND OVERALL EVALUATION OF ALL WHEAT TRIALS FROM ALL SITES TOGETHER

Data from 8 varieties grown on three sites in two subsequent seasons were chosen for overall statistical evaluation. Site influence was confirmed in yield, as each site formed a separate group. The highest average yield was obtained in Zîrnești (4.52±1.28 t/ha), the lowest in Bălți (2.50±0.55 t/ha). This corresponded to the number of spikes per unit area: the lowest numbers were found in Bălți (277.56±54.87) and highest in Zîrnești (469.81±72.62, i.e. an average of 192.25 more spikes/m² than in Bălți). The number of grains per spike showed opposite results. The highest numbers were those from Bălți (29.94±5.28) and the lowest in Zîrnești (26.63±2.90). The influence of season was confirmed in number of grains per spike, plant height and yield. In the 2019/2020 season the average number of grains per spike was lower (26.96±2.84). The first evaluated season (2018/2019) had taller plants on average (82.20±9.01 cm) which was due to higher precipitation on all three sites during the evaluated vegetation period. This also determined yield (4.11±1.19 t/ha). In statistical evaluation of the varieties, the Swiss variety Tengri was the tallest (84.27±13.66 cm) and the shortest were Kuialnic (63.32±13.13 cm), Numitor (65.23±10.98 cm), and Pîsanka (65.30±15.05 cm). The highest yield was found in Numitor (4.13±1.45 t/ha) and the lowest in the Swiss variety Wiwa (2.95±0.97 t/ha).

Site locality influence was found in all evaluated parameters except water absorption. A higher loaf volume was found in crops from Bălți and Zîrnești. Bălți crops also had a higher protein content (16.10±1.18%). This was due to a lower TGW value in Bălți, even though this indicator was not statistically conclusive. Smaller grain usually has a higher percentual protein content because the starch component partially decreases. Higher falling numbers and gluten index were found in Bacioi and Zîrnești. The influence of season showed in loaf volume, wet gluten content, falling number in wholegrain flour, Zeleny test and hardness. Higher values were measured in the 2018/2019 season in wet gluten content, falling number and hardness.

Statistical evaluation of quality parameters showed the influence of variety on all evaluated parameters, with the exception of wholegrain flour falling number. The highest loaf volume was found in Căpriana (670.83±72.42 ml/100 g flour), Numitor (684.33±44.35 ml/100 g flour), and Tengri (693.50±56.57 ml/100 g flour); the lowest was that of Kuialnic (534.67±50.15 ml/100 g flour). The highest protein content and wet gluten content were found in the Swiss varieties Aszita, Tengri, and Wiwa which are cultivated for these characteristics. Tengri also had the highest water absorption (67.03±1.88%), the lowest hardness (13.50±1.38%) and, together with the Aszita variety (42.67±8.45), also the lowest gluten index (54.33±9.46). The lowest protein content (14.07±0.39%) and wet gluten content (26.47±1.42%) were found in the Kuialnic variety. The results from three sites and two seasons show that all varieties met the food-grade quality requirements. As in the evaluation of three subsequent seasons in Bacioi, the varieties were divided into several groups, of which two are more significant – shorter plants, higher yield, higher TGW, and lower protein content (Kuialnic, Numitor), and taller plants, lower yield, lower TGW and higher protein and wet gluten content (Aszita, Tengri). The other varieties are in the range between these two groups.

Table 29: Statistical evaluation of agronomic parameters from 3 sites and 2 seasons (2018/2019 and 2019/2020)

		Spikes/m²	Grains/spike	TGW (g)	Plant height (cm)	Yield (t/ha)
Site	Bacioi	359.50±26.67b	29.00±1.46ab	36.34±4.10	*68.06±14.22a*	3.68±0.50b
	Balti	*277.56±54.87a*	**29.94±5.28b**	34.44±4.65	**74.88±12.36b**	*2.50±0.55a*
	Zirnesti	**469.81±72.62c**	*26.63±2.90a*	36.94±3.14	**73.13±14.92b**	**4.52±1.28c**
Year	2018/2019	378.96±106.43	**30.08±4.00b**	35.71±4.42	**82.20±9.01b**	**4.11±1.19b**
	2019/2020	358.96±85.32	*26.96±2.84a*	36.09±3.78	*61.85±9.84a*	*3.03±0.91a*
Variety	Aszita	348.33±95.78	29.67±5.09	32.85±5.67	81.65±13.08cd	3.12±1.13ab
	Căpriana	363.83±70.80	26.83±1.33	37.26±2.34	72.11±12.15abc	3.56±0.85ab
	Kuialnic	377.83±112.43	28.17±2.64	36.84±3.59	*63.32±13.13a*	3.81±1.23ab
	Numitor	399.33±94.21	28.17±1.94	38.30±3.04	*65.23±10.98a*	**4.13±1.45b**
	Pîsanka	360.83±128.61	28.83±2.32	36.70±3.99	*65.30±15.05a*	3.73±1.07ab
	Tengri	403.17±145.27	29.67±5.92	32.53±4.15	**84.27±13.05d**	3.63±1.86ab
	Vestitor	359.67±69.78	29.67±5.85	37.63±1.88	68.27±9.49ab	3.63±0.90ab
	Wiwa	338.67±62.50	27.17±3.19	35.12±4.41	76.01±13.66bcd	*2.95±0.97a*

Table 30: Statistical evaluation of quality parameters from 3 sites and 2 seasons (2018/2019 and 2019/2020)

		Loaf volume (ml/100 g flour)	Protein content (% in d.m.)	Wet gluten content (%)	Water absorption (%)	Falling number flour (s)	Falling number wholegrain flour (s)	Zeleny test (ml)	Hardness (%)	GI
Site	Bacioi	*622.75±68.88a*	*15.49±1.34a*	*34.59±7.47a*	62.02±3.34	**491.75±24.80b**	**423.75±14.59b**	*61.06±9.01a*	15.75±2.11ab	**79.06±20.64b**
	Balti	**636.13±69.34b**	**16.10±1.18b**	**36.79±6.25b**	61.79±3.56	*445.69±23.37a*	*378.19±29.99a*	**65.19±4.97b**	**16.13±1.45b**	*65.94±21.85a*
	Zirnesti	**624.31±89.55b**	15.82±1.16ab	36.10±7.28ab	62.34±2.60	**506.38±30.04b**	**437.88±30.46b**	63.13±7.78ab	*14.94±1.34a*	**79.06±17.71b**
Year	2019	586.33±60.48a	15.67±1.37	37.49±7.50b	60.47±2.85a	476.13±28.51	426.17±36.27b	57.75±6.98a	16.25±1.45b	76.33±19.47
	2020	669.13±65.58b	15.94±1.09	34.17±6.03a	63.63±2.59b	486.42±43.28	400.38±31.96a	68.50±2.34b	14.96±1.73a	73.04±22.11
Variety	Aszita	605.83±56.20bc	**17.16±0.34c**	**44.25±4.02d**	64.90±1.49d	**517.33±41.62b**	427.67±53.14	62.17±5.85ab	14.33±0.52ab	*42.67±8.45a*
	Căpriana	**670.83±72.42d**	15.64±0.74b	34.87±2.59c	61.03±2.08bc	487.50±37.46ab	397.00±45.86	63.00±9.10ab	16.33±1.03cd	77.17±13.36b
	Kuialnic	*534.67±50.15a*	*14.07±0.39a*	*26.47±1.42a*	60.12±2.05ab	491.17±32.10ab	412.83±30.98	61.67±8.87ab	15.17±1.83abc	**98.67±0.82c**
	Numitor	**684.33±44.35d**	15.07±0.48b	33.82±2.58bc	62.27±2.38c	*469.00±36.33a*	421.17±11.34	*58.50±10.21a*	15.50±2.17bcd	71.50±16.18b
	Pîsanka	561.00±57.37ab	14.81±0.63ab	29.17±2.02ab	60.65±2.29abc	477.67±29.23ab	417.17±24.19	63.67±7.84ab	16.50±1.05cd	**97.33±1.97c**
	Tengri	**693.50±56.57d**	**17.02±0.51c**	**44.49±3.56d**	**67.03±1.88e**	*473.17±28.65a*	410.83±36.54	64.67±5.91ab	*13.50±1.38a*	*54.33±9.46a*
	Vestitor	637.83±55.15cd	15.49±0.41b	33.38±1.95bc	61.47±2.10bc	*467.33±47.02a*	404.33±48.24	62.83±7.83ab	**17.33±1.37d**	81.00±9.19b
	Wiwa	633.83±53.82cd	**17.16±0.76c**	**40.18±5.50d**	*58.95±1.76a*	*467.00±27.62a*	415.17±36.31	**68.50±2.26b**	16.17±0.41bcd	74.83±15.13b

SPELT WHEAT

Results from the Băcioi site

Evaluation of 2019/2020 season

As in seasons 2017/2018 and 2018/2019, winter spelt varieties Alkor and Rubiota were sown in Bacioi, on a plot where a pre-crop of peas had been processed into the soil on 20th July 2019 (MTZ-82, PD-2.2). On 2nd October, the plot was prepared for sowing and both varieties were sown on that day. Emergence of 75% of seed in both varieties was evaluated on 14th Oct 2019. The plot was mechanically weeded three times during the vegetation period; on 28th February 2020, 28th May 2020 and 13th June 2020. Earlier flowering was observed in Rubiota, on 21st May 2020, while Alkor flowered on 27th May 2020. The incidence of disease and pests was also evaluated throughout the vegetation period. No pests were detected at all and, in terms of disease, only *Puccinia striiformis* occurred in Alkor to a minimum extent. On 27th June 2020 both trial crops were harvested. Rubiota variety produced a higher yield (3.80 t/ha) than Alkor (3.00 t/ha). In the evaluation of selected characteristics, most higher values were found in Rubiota – thousand grain weight - TGW (37.3 g), number of spikes per unit area (328 spikes/m²), number of grains per spike (19) and stem height (87 cm). A similar trend was also apparent in an evaluation of quality. Alkor only showed higher values in terms of falling number (388 s). All other values were measured higher in the Rubiota variety.

Evaluation of 3-year trials (2017/2018, 2018/2019 and 2019/2020)

Evaluation of a 3-year average in both winter spelt varieties showed no statistically significant difference between the two varieties in terms of selected parameters. As for individual years, the first evaluated season 2017/2018 had the highest number of spikes per unit area (476.50±54.45). Quality indicators differed. The Rubiota variety had higher levels of protein content (15.55±3.65%) than Alkor (14.14±3.47%). Wet gluten content was also higher in Rubiota (38.60±12.72%) in all three evaluated seasons. Other parameters were not statistically conclusive, although the falling number and Zeleny test were higher in Rubiota. Gluten index was higher in Alkor. The influence of individual seasons was also found in the protein content and wet gluten content. Weather conditions especially differed in the amount and distribution of rainfall. The highest level of precipitation was recorded in the first season 2017/2018 when, during the vegetation period, there was 228.9 mm more precipitation than in the second season (2018/2019) and even 332.9 mm more than in the third season (2019/2020) which was drier, even if compared to the long-term average. This last season was also 1.7°C warmer than the long-term average.

Protein content values were highest in the second monitored season 2018/2019 (18.03±0.91%) which benefitted from the best conditions during the vegetation period. The lowest protein content was found in the first season 2017/2018 (11.01±0.74%). Similar results also appeared for wet gluten content, as the highest values were measured in the second season (49.05±5.85%) while the lowest were those of the first season (25.50±6.10%). The content of both protein and wet gluten was also affected by the type of pre-crop: winter rape in the first monitored season and peas in the two following seasons.

Table 31: Statistical evaluation of yield of spelt, two monitored seasons, Bacioi site

	2018/2019	2019/2020	average	2018/2019	2019/2020	average
	yield (t/ha)			yield (%)		
Alkor	4.90	3.00	3.95	98.00	88.24	93.12
Rubiota	5.10	3.80	4.45	102.00	111.76	106.88
Average of all varieties	5.00	3.40	4.20			
Variance coefficient (%)	2.00	11.76	6.88			
Standard deviation	0.10	0.40	0.25			
Variance (0.05)	**0.02**	**0.32**	**0.13**			

Table 32: Selected evaluated agronomic characteristics of spelt, three monitored seasons, Bacioi site

	2017/2018				2018/2019				2019/2020				AVERAGE			
	TGW (g)	spikes/ m²	grains/s pike	plant height (cm)	TGW (g)	spikes/ m²	grains/ spike	plant height (cm)	TGW (g)	spikes/ m²	grains /spike	plant height (cm)	TGW (g)	spikes/m²	grains/s pike	plant height (cm)
Aszita	38.3	515	11	98	33	223	22	100	35.90	306.00	16.00	76.00	35.73	348.00	16.33	91.33
Rubiota	35.5	438	15	118	34.8	236	18	130	37.30	328.00	19.00	87.00	35.87	334.00	17.33	111.67
Average	36.90	476.50	13.00	108.00	33.90	229.50	20.00	115.00	36.60	317.00	17.50	81.50	35.40	353.00	16.50	111.50
Variance coefficient (%)	3.79	8.08	15.38	9.26	2.65	2.83	10.00	13.04	1.91	3.47	8.57	6.75	0.19	1.98	3.03	9.12
Standard deviation	1.40	38.50	2.00	10.00	0.90	6.50	2.00	15.00	0.70	11.00	1.50	5.50	0.07	7.00	0.50	10.17

Table 33: Quality parameters of spelt, Bacioi site

	protein content (% in d.m.)	wet gluten content (%)	falling number wholegrain flour (s)	Zeleny test (ml)	GI
Alkor	14.55	28.6	388	21	20
Rubiota	16.45	32.8	385	32	30

Table 34: Selected agronomic and quality parameters, three monitored seasons, Bacioi site

		plant height (cm)	spikes/m²	grains/spike	WTS (g)	protein content (% in d.m.)	wet gluten content (%)	falling number wholegrain flour (s)	Zeleny test (ml)	GI
variety	**Alkor**	91.33±13.32	348.00±150.46	16.33±5.51	35.73±2.65	*14.14±3.47a*	*31.57±12.14a*	360.00±30.81	18.33±9.29	36.33±20.26
	Rubiota	111.67±22.19	334.00±101.13	17.33±2.08	35.87±1.29	**15.55±3.65b**	**38.60±12.72b**	380.67±12.10	24.33±10.79	33.67±3.51
year	**2018**	108.00±476.50	**476.50±54.45b**	13.00±2.83	36.90±1.98	*11.01±0.74a*	*25.50±6.10a*	347.00±28.28	10.00±2.83	48.00±15.56
	2019	115.00±21.21	*229.50±9.19a*	20.00±2.83	33.90±1.27	**18.03±0.91c**	**49.05±5.85b**	377.50±17.68	27.50±2.12	32.00±2.83
	2020	81.50±7.78	317.00±15.56ab	17.50±2.21	36.60±0.99	15.50±1.34b	*30.70±2.97a*	386.50±2.12	26.50±7.78	25.00±7.07

Results from the Zârnești site

Evaluation of 2019/2020 season

Season 2019/2020 was the second year of winter spelt trials in Zîrnești. The varieties used were the same as in Bacioi – the Swiss Alkor and Czech Rubiota. The trials were sown after a pre-crop of peas which had been disc-harrowed twice on 23rd August 2019 (MTZ-82, PD-2.2). The plot was prepared for sowing (MTZ-82 CPS-4) on 3rd October 2019 and spelt was sown on the same day (T-25, SN-16). On 20th October 2019 75 % of the crop emerged. The plot was weeded mechanically three times during the vegetation period – on 20th February 2020, 18th May 2020 and 10th June 2020. During the vegetation period practically no pests or diseases occurred and all vegetation was evaluated as healthy and un-infested. The crops were harvested on 2nd July 2020. Rubiota produced a higher yield (4.10 t/ha), as well as a higher TGW (39.20 g) and number of spikes per unit area (340 spikes/m²). Alkor plants were 1 cm taller and had 3 more grains per spike than Rubiota. Quality parameters were higher in Rubiota, with the exception of gluten index which was higher in Alkor (19).

Evaluation of 2-year trials(2018/2019 and 2019/2020)

The evaluation of a 2-year average in 2-year trials which were both sown after a pre-crop of peas, shows a difference between the two years in terms of grain protein content and gluten index. Higher protein content was found in the first season 2018/2019 (18.75±1.36%) which was 3.34% more than in the second season. Gluten index in the first season was 40.50 ±6.36, i.e., more than double if compared with the second season (16.00±4.24). Although the other parameters were not statistically significant, in the first season (2018/2019) the plants grew taller, had more grains per spike and produced a higher yield, while their TGW and number of spikes per unit area were higher in the second season (2019/2020). The monitored parameters might have been affected by uneven precipitation and higher temperature during the second season of the trial. The influence of variety only appeared in terms of protein content which was, on average, 1.95% higher in Rubiota. Some other parameters were also higher in this variety (yield, plant height, number of grains per spike, wet gluten content, and Zeleny sedimentation test values) but these were not statistically significant.

Table 35: Statistical evaluation of yield of spelt, two monitored seasons, Zîrnești site

	2018/2019	2019/2020	average	2018/2019	2019/2020	average
	yield (t/ha)			yield (%)		
Alkor	5.20	3.40	4.30	101.96	101.96	90.67
Rubiota	5.00	4.10	4.55	98.04	98.04	109.33
Average of all varieties	5.10	3.75	4.43			
Variance coefficient (%)	1.96	9.33	5.65			
Standard deviation	0.10	0.35	0.23			
Variance (0.05)	0.02	0.25	0.03			

Table 36: Selected evaluated agronomic characteristics of spelt, two monitored seasons, Zîrnești site

	2018/2019				2019/2020				AVERAGE			
	TGW (g)	spikes/ m^2	grains/ spike	plant height (cm)	TGW (g)	spikes/ m^2	grains /spike	plant height (cm)	TGW (g)	spikes/m^2	grains/spike	plant height (cm)
Alkor	32.1	266	18	105	36.90	318.00	16.00	81.00	34.50	292.00	17.00	93.00
Rubiota	39.2	242	22	120	39.20	340.00	13.00	80.00	39.20	291.00	17.50	100.00
Average	35.65	254.00	20.00	112.50	38.05	329.00	14.50	80.50	36.85	291.50	17.25	96.50
Variance coefficient (%)	9.96	4.72	10.00	6.67	3.02	3.34	10.34	0.62	6.38	0.17	1.45	3.63
Standard deviation	3.55	12.00	2.00	7.50	1.15	11.00	1.50	0.50	2.35	0.50	0.25	3.50

Table 37: Quality parameters of spelt, Zîrnești site

	protein content (% in d.m.)	wet gluten content (%)	falling number wholegrain flour (s)	Zeleny test (ml)	GI
Alkor	14.42	27.2	376	26	19
Rubiota	16.4	31.6	414	32	13

Table 38: Selected agronomic and quality parameters, three monitored seasons, Zîrnești site

		Protein content (% in d.m.)	Wet gluten content (%)	Falling number wholegrain flour (s)	Zeleny test (ml)	GI	TGW	Spikes/m^2	Grains/spike	Plant height (cm)	Yield (t/ha)
Variety	Alkor	*16.11±2.38a*	37.95±15.20	378.50±3.54	27.50±2.12	32.00±18.38	34.50±3.39	292.00±36.77	17.00±1.41	93.00±16.97	4.30±1.27
	Rubiota	**18.06±2.34b**	45.39±19.50	406.00±11.31	32.50±0.71	24.50±16.26	39.20±0.00	291.00±69.30	17.50±6.36	100.00±28.28	4.55±0.64
Year	2019	**18.75±1.36b**	53.94±7.42	389.50±12.02	31.00±2.83	**40.50±6.36b**	35.65±5.02	254.00±16.97	20.00±2.83	112.50±10.61	5.10±0.14
	2020	*15.41±1.40a*	29.40±3.11	395.00±26.87	29.00±4.24	*16.00±4.24a*	38.05±1.63	329.00±15.56	14.50±2.12	80.50±0.71	3.75±0.49

Evaluation of 2-year trials on two sites, Bacioi and Zîrnești (2018/2019 and 2019/2020)

Data selected for statistical evaluation was taken from complete data sets from two sites and two seasons. The first season (2017/2018) in Bacioi was not used as the data was incomplete and thus could not be compared with another site. Therefore, the Bacioi data was evaluated independently for all three seasons (3-year evaluation). The results from both sites show that there was no statistically significant influence, in terms of site, on any of the evaluated parameters. The influence of variety was significant only in the protein content of the grain and wet gluten content – the Rubiota variety had higher levels of protein (17.81±1.65%) and wet gluten (44.19±14.07%). The most significant difference in average values was that of plant height, again, Rubiota was taller on average (104.25±24.17 cm). However, this parameter was significantly affected by weather conditions during the monitored seasons, to a level of statistical significance. In the first season the plants of both varieties were 32.75 cm (on average) taller than in the second season. Yield was also higher (5.05±0.13 t/ha), as well as protein content (18.39±1.03%) and wet gluten (51.49±6.14%). In the second season (2019/2020) the plants developed more spikes per unit area (323.00±14.47 spikes/m²). The differences in the two seasons were affected by precipitation which was markedly greater in comparison with the second season.

Table 39: Statistical evaluation of selected characteristics, two monitored seasons, two locations

		Plant height (cm)	Spikes/m²	Grains/spike	TGW (g)	Yield (t/ha)	Protein content (% in d.m.)	Wet gluten content (%)	Falling number wholegrain flour (s)	Zeleny test (ml)	GI
Variety	Alkor	90.50±14.15	278.25±43.02	18.00±2.83	34.48±2.29	4.13±1.09	*16.04±1.80a*	*37.35±11.04a*	377.50±9.68	25.50±3.32a	28.50±12.07
	Rubiota	104.25±24.17	286.50±55.12	18.00±3.74	37.63±2.09	4.50±0.65	**17.81±1.65b**	**44.19±14.07b**	396.75±12.69	31.50±1.73b	28.25±10.47
Site	Zîrnești	96.50±19.47	291.50±45.30	17.25±3.77	36.85±3.35	4.43±0.83	17.08±2.23	41.67±14.91	392.25±17.29	30.00±3.16	28.25±14.82
	Bacioi	98.25±23.33	273.25±51.58	18.75±2.50	35.25±1.82	4.20±0.98	16.76±1.73	39.88±11.25	382.00±11.52	27.00±4.69	28.50±5.97
Year	2019	**113.75±13.77b**	*241.75±18.01a*	20.00±2.31	34.78±3.16	**5.05±0.13b**	**18.39±1.03b**	**51.49±6.14b**	383.50±14.15	29.25±2.87	36.25±6.34
	2020	*81.00±4.55a*	**323.00±14.47b**	16.00±2.45	37.33±1.38	*3.58±0.48a*	*15.46±1.12a*	*30.05±2.59a*	390.75±16.32	27.75±5.32	20.50±7.05

CONCLUSION

Several years of testing varieties should result in a list of recommended varieties, which will be authorised and published by an independent state institute. Apart from the results of the long-term trial, the recommendation will also take the site into consideration, and a final recommendation will be made on the basis of the results from all test sites. For this purpose, it will be necessary to establish a committee for the recommendation of varieties, which will determine basic characteristics of individual varieties as value for cultivation and use (VCU), and their parameters that must be fulfilled in order for the variety to be recommended. On conclusion of the project (after evaluation of the vegetation year 2020/2021), this independent list will be published, wherein varieties will be categorized (recommended, preliminarily recommended, and possibly other varieties). Characteristics, and their parameters, will be set in a similar way for Moldova as they are in other European countries – i.e. yield, grain quality (bakery values), and the plants' state of health during vegetation.
The list of recommended varieties will then be updated and published annually.

A specific problem for the internal market in Moldova is that grain purchasing price does not take quality fully into consideration (bakery values). Thus, organic varieties are at a disadvantage, as organically grown crops tend to produce lower yield, but are of higher quality and better state of health. On the other hand, raw materials for export, such as wheat, are purchased only if they fulfil bakery parameters. Otherwise, grain is purchased at a lower price as feedstuffs. A further publication will be a List of recommended varieties of winter wheat and spelt wheat for organic growing in Moldova.

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