

ECPGR Cereals Network
Working Groups on Barley
Project proposal for ECPGR Phase VIII

A PROJECT ACTIVITY APPLICATION ON THE NETWORK LEVEL –
“ACCELERATED PRE-BREEDING FOR CLIMATIC CHANGE”

Background and justification

The challenges of future food production are related to climate change coupled to the maintenance of local agricultural production, ensuring sufficient supplies of energy and water for agricultural use, to the prices of agricultural inputs and to soil fertility. By minimizing the energy use in sustainable cropping systems, through the development of plants adapted to the changing environment with good nutritional value, future food production could be made safe. To achieve these goals, the breeding of plant varieties adapted to different cropping systems and to different climatic environments with increased abiotic and biotic stresses will play a pivotal role. Plant breeding has been critical to past agricultural improvement and increased production but several examples and studies have highlighted the dangers of basing crop improvement on a too narrow genetic base. Thus sustainable future crop productivity will ultimately be achieved through an increased use of plant genetic resources, including wild relatives and exotic materials, to supplement the genetic diversity that conventional plant breeding has at its disposal.

The knowledge of, access to, and use of diversity in cultivated plants and their wild relatives are essential for broadening the genetic base of cultivars to sustain improvement. However, much available germplasm in the primary genepool of crops, and certainly the secondary and tertiary genepools, is not in a form that most breeders can easily use. There is therefore a pressing need to radically improve the relevance and quality of the characterisation and evaluation data available on genetic resources if this material is to have the needed impact of agricultural sustainability. This is now possible through advances in technology

Recent developments in high-throughput genotyping in the crop mean that genetic-fingerprinting of genebank accessions, utilising Illumina GoldenGate SNP assay technology, is now a real possibility in barley. Such genotype data offers considerable potential for the monitoring of collections themselves through, for example, the tracing of duplicates and spurious outcrossing. More fundamentally, it also offers the possibility of a radical change in the ease and means by which collections are characterised and perhaps more importantly utilised by breeders and researchers. These genotyping technologies are already being used in several large-scale European projects that are focussing on the relationship between the marker genotypes and field performance in current elite cultivars. There is thus already an enormous amount of genetic information available in barley and this will continue to grow with ongoing physical mapping and envisaged future sequencing projects. As a crop, barley is very well placed (compared to both wheat and oats) to make the most of this genotyping revolution being an inbreeding diploid species with a large extant easily utilised primary genepool. There is therefore a real opportunity for barley to act as an exemplar in the utilisation in genotyping information in the characterisation of genebank material but in order to fully take advantage of these developments it is imperative that there is some co-ordination of activities at both the national and European level. This project thus accords completely with ECPGR objectives; in particular, (1) capacity building and (2) characterization and evaluation.

Objectives of the project

The objective of the project is to convene a meeting aimed at establishing a pre-breeding cooperation between breeders, genebanks and researchers in the framework of the ECPGR Cereals

Network, with the main focus on barley, but also covering the other major mandate crops of the Network, i.e., oats and wheat. This will establish stronger links between the evaluation of gene-bank material and barley genetics research and bring together participants in the barley working group of the ECPGR Cereals Network and partners of BarleyGenomeNet (<http://pgrc.ipk-gatersleben.de/barleynet/>) to co-ordinate activities that interface between the two groups.

One of the main aims of the meeting will be to define the specific traits that need to be included in national pre-breeding programmes. Some of the increasing biotic stresses due to the climate change are novel and generic (for example *Ramularia collo-cygni*) while some are very host specific with wide research background (for example *Puccinia triticina*). As well abiotic stresses like drought and frost are novel problems in Northern Europe but have been in the focus of the Southern European breeding programmes for a longer period.

Another aim of the meeting will be to assess what evaluation and characterisation data are needed to supplement those currently available on European barley genetic resources. This will include some molecular marker and other data for which fragmentary information exists but which is not publicly available. This will also include discussion on the databasing infrastructure requirements necessary for storing, visualising and analysing the potentially large datasets envisaged (see <http://bioinf.scri.ac.uk/germinate/wordpress/>).

Another expected outcome of the meeting will be an inventory of what genotyping has already been carried out on European genetic resources in barley. Several projects are already on-going that take advantage of the development of high-throughput genotyping including the ERA-PG projects, ‘Genomics-assisted dissection of barley morphology and development’ (BARCODE) and ‘Genomics-Assisted Analysis and Exploitation of Barley Diversity’ (EXBARDIV) (<http://www.erappg.org/everyone/9587/10868/15326>) and the UK funded ‘Association genetics of UK elite barley’ (AGOUEB) SA LINK project (<http://www.agoueb.org/>). These projects are based upon the genotyping of different sets of germplasm, much of which has been sourced from European gene-banks. There is therefore already considerable activity in this area and some co-ordination within the context of the ECPGR Cereals Network is overdue.

The important final outcome will be agreement on a project plan for future activities as once the scale and overlap of existing activities has been defined and the future needs articulated there will be an urgent need to plan and co-ordinate future applications for external funding. This will need to ensure that there is a comprehensive coverage of the selected germplasm sets (e.g. the barley core collection) and that this addresses the pre-breeding priorities identified. Additionally the use of genetic marker technology will also necessitate the development and multiplication of derived pure genetic stocks (see <http://www.eead.csic.es/barley/index.php?lng=1>).

Any future project will necessitate consultations with experts and stake-holders and will involve a strong element of training. It is expected that the outcomes of such a project will highlight the possibilities that now exist with modern genotyping technologies importance and more fundamentally the centrality of plant genetic resources to future agricultural sustainability.

Workplan

Activities of the project participants

- Kick-off meeting
- Knowledge sharing
- Evaluation of germplasm, extending the present ring tests (or including them in the pre-breeding initiative)
- Inventory of pre-breeding activities in Europe
- Identification characterisation and evaluation data required

- Evaluation of on-going SNP genotyping of germplasm,
- Identification of priorities for additional genotyping
- Starting the development of pure genetic stocks as ‘type specimens’ of gene-bank accessions
- Starting the pre-breeding programmes

Expected outputs and milestones

- Project plan with defined aims
- Funding proposal(s) (could be COST, although somewhat too specific for COST)
- Generation of Evaluation data
- Increased cooperation between gene banks, breeders and researchers
- Increased awareness of PGR
- Increase utilisation of barley PGR by researchers and breeders
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Timetable

- Meeting 2008 November–December (preferably), or early 2009
- External project proposal(s) 2009
- Evaluation of PGR 2009 –
- Molecular evaluation of barley 2009-2010
- Development of databases 2009-2011

Project coordination and administrative structure

Project Coordinators: Marja Jalli, NordGen, Luke Ramsay, SCRI, Morten Rasmussen, NordGen

Project partners (Appendix 1)

People who had shown their interest in a pre-breeding project

Colleagues who expressed their interest to participate in an ECPGR meeting for the preparation of a pre-breeding project proposal are listed below. Participants interested in barley are listed first, ordered by country. Participants interested in wheat or oats only, are given at the end of the table. Information was provided during the ECPGR Cereals Network Meeting (Turkey April 2008) and afterwards.

1. Colleagues interested in Pre-Breeding of barley, including those who are also interested in other cereals

Country	Other cereals	Partner information	Pre-breeding
Azerbaijan	wheat	<u>Sevinj Mammadova</u> <i>Institution:</i> Genetic Recourses Institute <i>Address:</i> 155 Azadlig Avenue, Baku 1106 <i>E-mail:</i> akparov@yahoo.com	<i>Aims of pre-breeding activities:</i> creation of drought resistant varieties of wheat and barley. And cooperation between breeders, researchers, farmers and genebanks by sowing of demonstrative fields. <i>Sources of diversity (landraces, wild species, genetic stocks) to be used:</i> landraces, wild species, and genetic stocks from the genebank are used in creation of new varieties and lines. For example, the new variety 'Barakatly-95' was created by crossing of the land races Qirmyzy bugda and Qaraqilchiq-2 as parental plants. Breeding in these trends is continued. <i>Ongoing activities in pre-breeding:</i> wild relatives are collected from different agro-ecological conditions. Use of landraces and genetic stocks for selection and creation of drought resistant varieties of wheat and barley. For example: definition of canopy temperature depression correlation with yield, evaluation of samples in different drought conditions. Determination of short day genes (PPD), transpiration index. Selection on physiological attributes – potential of photosynthesis, photosynthesis pigments content, intensity of photosynthesis, assimilation area of leaves. Also selection on morphological attributes – plant height, shape of leaves etc.

Country	Other cereals	Partner information	Pre-breeding
Czech Republic	<p>Jarmila Milotová, Katerina Vaculová (+1+2 technicians) <i>Institution:</i> Agricultural Research Institute Kromeriz, Ltd. <i>Address:</i> Havlickova 2787, 76701 Kromeriz <i>E-mail:</i> vaculova@vukrom.cz</p>	<p><i>Aims of pre-breeding activities:</i></p> <ol style="list-style-type: none"> 1) to establish a cooperation between genebanks, research (researchers) and breeding (breeders) 2) to develop new barley materials for different cropping systems (especially for organic agriculture) and for different environments with various biotic stresses (especially diseases) 3) to develop new genetic resources with better quality, resistance (mainly to leaf diseases – <i>Pyrenophora teres</i>, <i>Puccinia hordei</i>, etc.) and simultaneously good agronomic characters (cooperation with laboratory for MAS, genetic markers, etc. will be acknowledged), <p><i>Sources of diversity (landraces, wild species, genetic stocks) to be used:</i></p> <p>Pre-breeding for alternative quality: we will use mainly own new hybrids, made on the base of barley materials (genetic resources, mutants, landraces and cultivars) with requirement quality parameters (low phytate content, different content of amylose and amylopectin, high N-content, higher content of beta-glucans, essential amino-acids, etc.).</p> <p>Pre-breeding for different cropping systems (especially for organic agriculture) and for different environments with various biotic stresses will be associated in one programme and we will use particularly landraces with defined genes of resistance.</p> <p><i>Ongoing activities in pre-breeding:</i></p> <ol style="list-style-type: none"> 1) Evaluation of germplasm on the base of planned pre-breeding activities and existing collection of the crops in the cooperating institutions (on the base of discussion at the autumn meeting and taking into consideration existing knowledge about required characteristics of the crops) 2) Starting of the pre-breeding programmes on the base of sharing of the duties (determined on the agreement, made during the first meeting in the autumn 2008) 3) Certification of the required characters and parameters using molecular markers and screening tests 4) Confirmation of the resistance to the biotic stresses in the special environmental conditions (ring tests only in the case of the best new genetic resources – not all hybrids with certificated resistance) <p>Chemical analyses of the quality parameters (the best hybrid materials done in the pre-breeding project)</p>	

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Denmark	wheat	<u>Ahmed Jahoor</u> <i>Institution:</i> University of Copenhagen, Faculty of Life Sciences, Dept. of Agricultural Sciences <i>Address:</i> Thorvaldsensvej 40, DK-4000 Roskilde <i>E-mail:</i> aja@life.ku.dk	<i>Aims of pre-breeding activities:</i> To combat biotic and abiotic stresses <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> landraces, synthetics, wild relatives <i>Ongoing activities in pre-breeding:</i> Ramularia (barley), Fusarium (wheat)
Estonia	oats, wheat	<u>Külli Annamaa</u> <i>Institution:</i> Jõgeva Plant Breeding Institute <i>Address:</i> Aamisepa 1, 48309 Jõgeva, Estonia <i>E-mail:</i> kylli.annamaa@jpbi.ee	<i>Aims of pre-breeding activities:</i> disease resistance and quality for wheat; winter resistance of winter wheat; suitability of all crops for organic use (fast development, wide-leaf oats); dwarf types of oats <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> genetic stocks – collections from Vavilov Institute, CIMMYT, obsolete Estonian varieties <i>Ongoing activities in pre-breeding:</i> 1) at the Jõgeva PBI: evaluation of above-mentioned collections; 2) at the Tallinn Technical University: <i>Triticum timopheevii</i> , <i>T. militinae</i> , <i>T. dicoccum</i> , <i>Aegilops speltoides</i> are used as donors of disease resistance in wide crosses; monosomic aneuploid analysis and molecular-genetics techniques are used for localization and identification of the powdery mildew genes in the introgressive wheat lines.
Finland	wheat, oats	<u>Marja Jalli</u> <i>Institution:</i> MTT Agrifood Research Finland <i>Address:</i> Plant Protection, 31600 Jokioinen, Finland <i>E-mail:</i> Marja.jalli@mtt.fi	<i>Aims of pre-breeding activities:</i> biotic and abiotic stresses <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> landraces, wild relatives <i>Ongoing activities in pre-breeding:</i> Net blotch, scald, mildew resistance (barley)
Germany	wheat	<u>Christiane Balko</u> <i>Institution:</i> Julius Kuehn Institute Federal Research Centre for Cultivated Plants Institute for Resistance Research and Stress Tolerance <i>Address:</i> Rudolf-Schick-Platz 3, 18190 Sanitz <i>E-mail:</i> christiane.balko@jki.bund.de	<i>Aims of pre-breeding activities:</i> Improvement of drought tolerance in barley and (wheat) <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> Gene bank accessions (Gatersleben, VIR St. Petersburg), cultivars with expected differences in drought tolerance <i>Ongoing activities in pre-breeding:</i> Evaluation of drought tolerance of spring wheat genotypes

Country	Other cereals	Partner information	Pre-breeding
Germany	wheat	<p><u>Karl-Josef Müller</u> <i>Institution:</i> Cereal Breeding Research Darzau (Getreidezüchtungsforschung Darzau) <i>Address:</i> 29490 Neu Darchau, Darzau Hof 1 <i>E-mail:</i> k-j.mueller@darzau.de</p>	<p><i>Crops (details):</i> wheat, einkorn (small spelt) <i>Aims of pre-breeding activities:</i> Developing prototypes of barley, wheat, einkorn for organic farming systems with combined characters for multiplication and use. <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> genetic stocks combined with cultivars <i>Ongoing activities in pre-breeding:</i> Barley: Resistance to seed borne diseases under natural infection (loose and covered smut, barley leaf stripe, net blotch). Different starch characters (amylose-amylopectin-ratio, viscosity, low/high beta-glucan), hullless threshing ability, formative forces, drought resistance. Cooperation interests: Evaluation/Scoring for scald, mildew, net blotch. Testing for amino acid composition. Wheat: Resistance to seed borne diseases under natural infection (loose smut, common bunt). High baking quality under low input conditions. Einkorn: Enhancing baking quality</p>
Germany	wheat, <i>Aegilops</i>	<p><u>Andreas Graner, Benjamin Kilian</u> <i>Institution:</i> Genebank Department, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) <i>Address:</i> Corrensstr. 3, D-06466 Gatersleben, Germany <i>E-mail:</i> graner@ipk-gatersleben.de, kilian@ipk-gatersleben.de</p>	<p><i>Crops (details):</i> wheat (all diploid and tetraploid wild and domesticated species; <i>T. spelta</i>), <i>Aegilops</i> (<i>Sitopsis</i> group, especially <i>Ae. speltoides</i>) <i>Aims of pre-breeding activities:</i></p> <ul style="list-style-type: none"> • to study genetic diversity, evolution and domestication of barley and wheat • to associate phenotypic and genotypic traits • marker development • high throughput targeted re-sequencing <p><i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> Access to IPK genebank collection and MPIZ collections. But especially:</p> <ul style="list-style-type: none"> • About 220 spring barley cultivars (phenotyped and genotyped) • About 1000 genotyped spring barley landraces • About 900 barley lines (<i>H. spontaneum</i>, <i>H. agriocrithon</i>, <i>H. vulgare</i>) phenotyped, genotyped and re-sequenced in order to study domestication and evolution • Comprehensive diploid and tetraploid wheat collection (genotyped and phenotyped) <p><i>Ongoing activities in pre-breeding:</i></p> <ul style="list-style-type: none"> • to study genetic diversity, evolution and domestication of barley and wheat • marker development • high throughput targeted re-sequencing • Association studies

Country	Other cereals	Partner information	Pre-breeding
Latvia	wheat, oat	<u>Vija Strazdiņa</u> (wheat), <u>Mara Bleidere</u> (barley) <u>Sanita Zute</u> (oat) <i>Institution:</i> State Stende Cereal Breeding Institute <i>E-mail:</i> stende.selekcija@apollo.lv, vijastrazdina@inbox.lv, maara.bleidere@stendeselekcija.lv	<i>Aims of pre-breeding activities:</i> resistance for diseases, quality traits <i>Sources of diversity:</i> genetic stocks <i>Ongoing activities:</i> we have no activities in this programme at present.
Lithuania	wheat	<u>Alge Leistrumaite</u> , <u>Vytautas Ruzgas</u> , <u>Zilvinas Liatukas</u> <i>Institution:</i> Lithuanian Institute of Agriculture <i>Address:</i> Instituto av. 1, LT-58344 Akademija, Kedainiai distr. <i>E-mail:</i> alge@lzi.lt, ruzgas@lzi.lt, liatukas@lzi.lt	<i>Aims of pre-breeding activities:</i> to create initial material for spring barley and winter wheat breeding programmes adapted to different cropping systems and to different climatic environments with various abiotic and biotic stresses <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> landraces, genetic stocks, wild species, related species, breeding lines <i>Ongoing activities in pre-breeding:</i> to draw a plan for purposive crossings to create initial material adapted to various abiotic and biotic stresses
NordGen		<i>Institution:</i> <u>NordGen</u> <i>Country:</i> <i>Address:</i> <i>E-mail:</i>	<i>Aims of pre-breeding activities:</i> <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> <i>Ongoing activities in pre-breeding:</i>
Russia		<u>Olga Kovaleva</u> <i>Institution:</i> Vavilov Institute of Plant Industry <i>Address:</i> 44, Bolshaya Morskaya str., 190000, St-Petersburg <i>E-mail:</i> o.kovaleva@vir.nw.ru	<i>Aims of pre-breeding activities:</i> select plant material for agronomic characters (earliness, semi-dwarfness, lodging resistance, etc.), resistance to important diseases (powdery mildew, leaf blotch, Fusarium head blotch (FHB), etc.), biochemical components, etc. There are about 18000 barley accessions in the VIR collection. The collection includes wild species, landraces, advanced cultivars, genetic stocks. We annually evaluate 3000 accessions in different regions of Russia for complex characters and distribute selected material to Russian breeding centres.
Spain		<u>José Luis Molina Cano</u> <i>Institution:</i> IRTA <i>Address:</i> Alcalde Rovira Roure 191; 25198 Lleida <i>E-mail:</i> JoseLuis.Molina@irta.es	<i>Aims of pre-breeding activities:</i> using the Spanish Barley Core Collection in barley breeding <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> Spanish Barley Core Collection <i>Ongoing activities in pre-breeding:</i> Starting the work above mentioned

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UK		<p><u>Luke Ramsay</u> <i>Institution:</i> Genetics Programme, Scottish Crop Research Institute <i>Address:</i> Invergowrie, Dundee, Scotland, DD2 5DA, UK <i>E-mail:</i> Luke.Ramsay@scri.ac.uk</p>	<p><i>Aims of pre-breeding activities:</i> Utilisation of SNP genotyping to facilitate breeding including introgression from landrace and <i>H. spontaneum</i>. SCRI have developed the SNP genotyping platform in collaboration with Prof T. Close (University of California, Riverside) and already have considerable data using this technology mainly on current cultivars. Resistance to <i>Rhynchosporium</i> and <i>Ramularia</i> are a priority as well as genes associated with Mineral use efficiency. SCRI also has interests in amongst other traits the control of lignin and beta glucan levels. <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> I have an interest in old varieties and landraces from the UK and particularly Scotland including bere barleys. <i>Ongoing activities in pre-breeding:</i></p>
UK		<p><u>Andy Flavell</u> <i>Institution:</i> University of Dundee at SCRI <i>Address:</i> Invergowrie, DUNDEE, DD2 5DA, Scotland, UK <i>E-mail:</i> a.j.flavell@dundee.ac.uk</p>	<p><i>Aims of pre-breeding activities:</i> genetic diversity characterisation using high throughput molecular markers and next generation sequencing <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> EXBARDIV collection of barley cultivars, landraces and wild barleys <i>Ongoing activities in pre-breeding:</i></p> <ul style="list-style-type: none"> • Analysis of genetic diversity, phylogeography and evolution of barley • High throughput SNP marker development • high throughput gene-based next generation sequencing of diverse germplasm • Association genetic studies

2. Colleagues interested in Pre-Breeding of other cereal crops

Country	Crops	Partner information	Pre-breeding
Israel	wheat	<p><u>Eitan Millet</u> <i>Institution:</i> Weizmann institute <i>E-mail:</i> eitan.millet@weizmann.ac.il</p>	<p><i>Aims of pre-breeding activities:</i> disease resistance, drought tolerance <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> wild species (secondary gene pool) <i>Ongoing activities in pre-breeding:</i> disease resistance gene transfer from <i>Aegilops</i> to wheat</p>
Norway	bread wheat	<p><u>Jon Arne Dieseth</u> <i>Institution:</i> Graminor AS <i>Address:</i> Hommelstadvegen 60, 2344 IIseng, Norway <i>E-mail:</i> jon.arne.dieseth@graminor.no</p>	<p><i>Aims of pre-breeding activities:</i> Disease resistance <i>Sources of diversity</i> (landraces, wild species, genetic stocks) <i>to be used:</i> What ever <i>Ongoing activities in pre-breeding:</i> <i>Fusarium</i> resistance, horizontal resistance to powdery mildew</p>

Country	Crops	Partner information	Pre-breeding
Norway	oat	<p><u>Trond Buraas</u> <i>Institution:</i> Graminor AS <i>Address</i> Hommelstadvegen 60, 2344 Ilseng, Norway <i>E-mail:</i> trond.buraas@graminor.no</p>	<p><i>Aims of pre-breeding activities:</i> Increase the genetic variation in oat. It is also important to incorporate new genes for disease resistance and quality aspects both for human consumption and for feed.</p> <p><i>Sources of diversity (landraces, wild species, genetic stocks) to be used:</i> In the breeding programmes there have mostly been used commercial varieties and breeding lines in crosses. The oat varieties in Northern Europe have therefore a very narrow base. It is therefore important to incorporate other material to increase the genetic variation in oat.</p> <p><i>Ongoing activities in pre-breeding:</i> <i>Fusarium graminearum</i> has been a big problem in oat in Norway the last year and we have started to incorporate resistant genes from other oat varieties to <i>Avena sativa</i>. We hope that in the future we can use genetic markers in the screening of the material. This work will mostly be done at the Agricultural University of Norway (UMB) at Ås.</p>
Romania	wheat	<p><u>Manuela Ibanescu</u> <i>Institution:</i> Suceava Gene Bank <i>Address:</i> B-dul 1 Mai, Nr. 17, Suceava, 720224 <i>E-mail:</i> manuelaibanesco@yahoo.com</p>	<p><i>Aims of pre-breeding activities:</i> To find valuable germplasm with the following characteristics: resistance to drought; resistance to diseases and pests; high protein content.</p> <p><i>Sources of diversity (landraces, wild species, genetic stocks) to be used:</i> Landraces</p> <p><i>Ongoing activities in pre-breeding:</i></p> <ul style="list-style-type: none"> - Collecting activity; - Morphological characterization; - Biochemical characterization.
Russia	oat	<p><u>Igor Loskutov</u> <i>Institution:</i> Vavilov Institute of Plant Industry <i>Address:</i> 44, Bolshaya Morskaya str., 190000, St-Petersburg <i>E-mail:</i> i.loskutov@vir.nw.ru</p>	<p><i>Aims of pre-breeding activities:</i> select plant material for agronomic characters (earliness, semi-dwarfness, lodging resistance, etc.), resistance to important diseases (crown and stem rust, leaf blotch, Fusarium head blotch (FHB), etc.), biochemical components, etc. There are about 12000 accessions of cultivated oat species and about 2000 accessions of wild <i>Avena</i> species in VIR collection. Cultivated species include landraces, advanced cultivars, genetic stocks. We annually evaluate 2000 accessions in different regions of Russia for complex characters and distribute selected material to Russian breeding centres.</p>
Russia	wheat	<p><u>Olga Mitrofanova</u> <i>Institution:</i> Vavilov Institute of Plant Industry Russia <i>Address:</i> 44, Bolshaya Morskaya str., 190000, St-Petersburg <i>E-mail:</i> o.mitrofanova@vir.nw.ru</p>	<p><i>Aims of pre-breeding activities:</i> select plant material for agronomic characters (earliness, plant height, lodging resistance, etc.), resistance to important diseases (powdery mildew, leaf blotch, etc., biochemical components, etc.). There are more than 35000 accessions of cultivated and wild wheat species in the VIR collection. It includes wild species, landraces, advanced cultivars, genetic stocks. We annually evaluate many wheat accessions in different regions of Russia for complex characters and distribute selected material to Russian breeding centres.</p>