

Advanced Course

BREEDING SMALL GRAIN CEREAL CROPS IN A CLIMATE CHANGE SCENARIO

Zaragoza (Spain), 19-23 February 2018

1. Objective of the course

Small grain cereals (mainly barley and bread and durum wheat) are the most important staple crops in Europe and in the Mediterranean region. Over the past century, breeding has been able to provide the highest yield increase ever seen, although now in many regions a yield plateau is evident.

Climate change may be the single unifying, and chronic issue that will affect everyone and every aspect of the economy. Changes in weather patterns and variability, as well as differential combinations of effects in different parts of Europe and the Mediterranean region are expected. The North will see warmer and wetter weather, whereas the South will experience more frequent and severe droughts and heat waves, and in both cases there will be a shifting pattern of incidence of pests and diseases.

The Intergovernmental Panel on Climate Change (IPCC) models predict that average yields of cereals will fall due to drought, insect predation and diseases, whilst the demand for food will rise significantly due to population growth. The identification of new varieties adapted to the expected climatic conditions requires the accurate prediction of the new scenarios and the efficient use of genetic resources and advanced genomic tools. The recent progress in plant genomics and phenotyping offers the opportunity for a next generation breeding era to overcome the limitations of traditional breeding.

The course will present, using a multidisciplinary approach, the most recent research for an advanced knowledge-based breeding to cope with climate uncertainty. The aims of the course are: (i) to raise awareness of the extra challenges imposed by climate change to food security and cereal breeding; (ii) to give guidance on the impact and uses of recent advances on genomics, phenomics and modelling for cereal breeding; and (iii) to provide an integrated overview of the strategies that must be considered to increase breeding effectiveness.

At the end of the course the participants will have gained:

- A holistic view of the impact of climate change on small grain cereal production.
- A clear understanding of the challenges of breeding for climate instability.

- Insights on the latest developments of genomics for small grain cereal crops.
- Strategies to find useful genetic diversity.
- Better knowledge on how to discover traits to cope with a variety of stresses.
- Insights on the physiological bases of stress responses and their translation into cereal breeding.
- Updated knowledge on current advances in plant phenotyping methods and platforms with emphasis on affordable tools.
- Information on the contribution of crop modelling to breeding.

2. Organization

The course is jointly organized by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), through the Mediterranean Agronomic Institute of Zaragoza (IAMZ), the ClimBar project of the EU Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI ERA-NET Plus on Climate Smart Agriculture) and the International Center for Agricultural Research in the Dry Areas (ICARDA). The course will take place at IAMZ and will be given by well-qualified lecturers coming from international and national research centres and universities of different countries.

The course will be held over a period of 1 week, from 19 to 23 February 2018, in morning and afternoon sessions.

3. Admission

The course is designed for 25 professionals with a university degree and with a background in cereal (preferably small grain) breeding, molecular genetics or physiology who want an integrated perspective of the tools and methodologies to identify and manage traits, genome regions, genes and alleles needed to breed resilient varieties adapted to climate change conditions.

English will be the working language of the course.

4. Registration

Candidates must apply online at the following address:
<http://www.admission.iamz.ciheam.org/en/>



Applications must include the *curriculum vitae* and copy of the supporting documents most related to the subject of the course.

The deadline for the submission of applications is 1 December 2017.

Applications from those candidates requiring authorization to attend the course, may be accepted provisionally.

Registration fees for the course amount to 500 euro. This sum covers tuition fees only.

5. Scholarships

Candidates from CIHEAM member countries (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey) and from ICARDA MENA partners may apply for scholarships covering registration fees, and for scholarships covering the cost of travel and full board accommodation in the Hall of Residence on the Aula Dei Campus.

Candidates from other countries who require financial support should apply directly to other national or international institutions.

6. Insurance

It is compulsory for participants to have medical insurance valid for Spain. Proof of insurance cover must be given at the beginning of the course. Those who so wish may participate in a collective insurance policy taken out by the Organization, upon payment of the stipulated sum.

7. Teaching organization

The course requires personal work and interaction among participants and with lecturers. The international characteristics of the course favour the exchange of experiences and points of view.

The course will be taught through a combination of lectures, supervised practical work and discussions. Participants will gain practical experience in the use of simple phenotyping methods, and will work in groups to identify phenotypes for different climate scenarios and specific crops.

Participants will be invited to provide a brief written report about research and breeding initiatives in their countries/regions, as well as any personal goals/activities, to cope with climate change challenges. These reports will be distributed to all participants and lecturers.

8. Programme

1. Climate change expectations for cereal production in Europe and the Mediterranean region (5 hours)

- 1.1. Climate change scenarios
- 1.2. Impact of climate change on abiotic stresses: drought and heat
- 1.3. Impact of climate change on biotic stresses: pests and diseases

2. Genetic diversity to cope with climate change (4 hours)

- 2.1. Diversity relevant to resilience, sustainability and quality in new and old varieties, landraces and wild relatives
- 2.2. Genetic diversity and genome structure insights from sequencing projects
- 2.3. Relevant genomic databases and resources
- 2.4. Trait mining approaches and ecogeographic analysis of genetic diversity

3. Germplasm trialling and trait discovery (12 hours)

- 3.1. Phenotyping with varying degrees of environmental control
- 3.2. Precision phenotyping
 - 3.2.1. Drought response strategies
 - 3.2.2. Heat tolerance
 - 3.2.3. Adaptation to increased CO₂
 - 3.2.4. Pests
 - 3.2.5. Diseases
- 3.3. Low-cost high-throughput phenotyping: phenotyping apps, drones and others
- 3.4. Practical work: use of phenotyping apps and data interpretation
- 3.5. Field experiments to assess climate change adaptation: from hotspots to managed environments for particular stresses

4. Breeding for adaptation to climate change (13 hours)

- 4.1. Linking genotype, phenotype and climate
 - 4.1.1. Genomics-assisted breeding tools
 - 4.1.2. Crop modelling as a tool to predict adaptation
- 4.2. Selection strategies for climate change resilience
 - 4.2.1. Design of ideotypes: architecture, development and phenology
 - 4.2.2. Breeding for climate instability (Genotype x Year interaction)
 - 4.2.3. Breeding for quality under climate change
 - 4.2.4. Practical group work on identifying phenotypes for different climate change scenarios for specific crops
- 4.3. International research and breeding efforts to cope with climate change challenges
 - 4.3.1. ClimBar and other international research projects
 - 4.3.2. ICARDA breeding programmes
 - 4.3.3. International phenotyping platforms and initiatives

5. General discussion and concluding remarks (1 hour)

GUEST LECTURERS

F. BADEK, CREA, Fiorenzuola d'Arda (Italy)

A. BENTLEY, NIAB, Cambridge (UK)

A. CASAS, CSIC, Zaragoza (Spain)

M. EL BOUHSSINI, ICARDA, Rabat (Morocco)

M. GHANEM, ICARDA, Rabat (Morocco)

E. IGARTUA, CSIC, Zaragoza (Spain)

M. MOSHELION, Hebrew University of Jerusalem (Israel)

S. RASMUSSEN, University of Copenhagen (Denmark)

R. RÖTTER, Georg-August-Universität Göttingen (Germany)

M. SANCHEZ-GARCIA, ICARDA, Rabat (Morocco)

P. SCHWEIZER, IPK, Stadt Seeland (Germany)

A.H. SCHULMAN, Luke & University of Helsinki (Finland)

A. TONDELLI, CREA, Fiorenzuola d'Arda (Italy)

A. VISIONI, ICARDA, Rabat (Morocco)

R. WAUGH, James Hutton Institute, Dundee (UK)