



Advanced Course

Exploitation of cereal genomic diversity for crop improvement under climate change

Sfax (Tunisia) • 3-7 October 2022



PRIMA
IN THE MEDITERRANEAN AREA



ICARDA
Science for resilient livelihoods in dry areas



Objective

Improving the genetic potential and reducing the yield gap of crops is the most effective way to introduce the innovation needed in agriculture to meet the UN Sustainable Development Goals. Cereals are the main pillar of food security worldwide, and in the Mediterranean region in particular.

Recent developments in genomics and plant biotechnology are delivering novel approaches that are becoming widely applied in plant breeding. Plant scientists and breeders need to be aware of the approaches that will be instrumental to leverage cereal diversity in improving crop yield under climate change.

The course aims to provide an overview of the current genomic tools for addressing basic and applied plant science questions. More specifically, the course will introduce the concepts and methods of structural and functional plant genomics to harness cereal diversity (in particular barley and wheat) for improving tolerance to abiotic stresses (with a focus on heat and drought).

The specific objectives of the course are:

- (i) to raise awareness of the extra challenges imposed by climate change for ensuring food security and improving cereals;
- (ii) to upskill students and young researchers expanding their capabilities for using genomic and biotechnological tools;
- (iii) to provide an integrated overview of the strategies that must be considered to increase breeding effectiveness, combining recent advances on genomics and phenomics. Although the course will focus on barley and wheat, the tools presented are applicable to other crops.

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

- a review of the climate change scenarios and the impact on expected cereal yield;
- an introduction to the bases of genomic prediction;
- insights on challenges caused by climate change for plant breeders;
- knowledge on the use of genomic databases for plant breeding;
- an introduction to the most advanced biotechnological methods, including genome editing.

Organization

The course is jointly organized by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), through the Mediterranean Agronomic Institute of Zaragoza (CIHEAM Zaragoza), the PRIMA GENDIBAR Project (Utilization of local genetic diversity to understand and exploit barley adaptation to harsh environments and for pre-breeding), the International Center for Agricultural Research in the Dry Areas (ICARDA), the University of Sfax through the Institute of Biotechnology, and Tunisia's National Institute of Field Crops (INGC). The course will be given by well-qualified lecturers coming from international and national research centres and universities of different countries.

The course will be held in hybrid modality, combining online with face-to-face lectures, at the University of Sfax headquarters over a period of one week, from 3 to 7 October 2022, in morning and afternoon sessions.

The course will be taught in English through a combination of lectures, and supervised practical work. 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.

Programme

1. Accessing cereal genetic diversity (10 hours)

- 1.1. Types of germplasm
 - 1.1.1. Core collection
 - 1.1.2. Mutant populations, TILLING populations
- 1.2. Genotyping
 - 1.2.1. Genotyping By Sequencing (GBS)
 - 1.2.2. SNPs platforms
 - 1.2.3. Genome databases
 - 1.2.4. Sequencing and genomics resources (pangenomics)
- 1.3. Phenotyping
 - 1.3.1. Precision phenotyping
 - 1.3.2. High-throughput phenotyping
- 1.4. GWAS

2. Breeding cereals under climate change (6 hours)

- 2.1. Breeding crops in a climate change framework
- 2.2. Climate change challenges, the physical environment and climate modelling (drought, heat, biotic stress)
- 2.3. Strategies to cope with climate change (phenology, drought)
- 2.4. Pre-breeding case studies
 - 2.4.1. Low tech approaches for heat tolerance in Morocco
 - 2.4.2. Low tech approaches for drought tolerance in Tunisia

3. Advanced breeding tools (15 hours)

- 3.1. Genomic selection
 - 3.1.1. Concepts
 - 3.1.2. Case studies
- 3.2. Introduction to functional crop modelling for breeding
- 3.3. Functional genomics, from QTL to genes
 - 3.3.1. Fine mapping and candidate gene identification
 - 3.3.2. Functional analysis
- 3.4. Genetic transformation (genome editing, overexpression, silencing RNA, genotype dependence of genetic transformation)
- 3.5. Speed breeding
 - 3.5.1. Definition
 - 3.5.2. Case studies (barley, wheat)
- 3.6. Practicals
 - 3.6.1. Genomic selection
 - 3.6.2. In silico analysis of gene expression data
 - 3.6.3. GWAS analysis

4. Final discussion (1 hour)

Guest lecturers

Battaglia, Raffaella - CREA, Fiorenzuola d'Arda (Italy)
Ben Araar, Aladdin - INGC, Bousalem (Tunisia)
Cattivelli, Luigi - CREA, Fiorenzuola d'Arda (Italy)
Contreras, Bruno - EEAD-CSIC, Zaragoza (Spain)
Elleuch, Amine - Univ. Sfax (Tunisia)
Fricano, Agostino - CREA, Fiorenzuola d'Arda (Italy)
Igartua, Ernesto - EEAD-CSIC, Zaragoza (Spain)
Hanin, Moez - Univ. Sfax (Tunisia)
Hickey, Lee - Univ. Queensland (Australia)
Jarrahi, Tarek - INGC, Bousalem (Tunisia)
Paleari, Livia - Univ. Milan (Italy)
Perego, Alessia - Univ. Milan (Italy)
Sánchez-García, Miguel - ICARDA, Rabat (Morocco)
Visioni, Andrea - ICARDA, Rabat (Morocco)



Admission

The course is designed for 20 students, young researchers and future professionals with a university degree and with a background in plant molecular biology and physiology, plant biotechnology, plant breeding, and related fields to attend the lecturers in face-to-face.

There are 30 places available for participants with the same background who wish to attend online (excluding practical work sessions).

Registration

- Candidates may 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.
- Application are open from 15 May to 8 July 2022.
- Applications from candidates requiring authorization to attend the course may be accepted provisionally.
- Registration fees for the course amount to 500 euro for face-to-face participation and 400 euro for online attendance. This sum covers tuition fees only.

Scholarships

Candidates from CIHEAM member countries (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey) and from ICARDA Middle East and North Africa partners may apply for scholarships covering registration fees, and for scholarships covering the cost of travel and full board accommodation.

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

Insurance

It is compulsory for participants to have medical insurance valid for Tunisia. Proof of insurance cover must be given at the beginning of the course.

Contact:

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More info:



edu.iamz.ciheam.org/CerealGenomic/en/