



CIHEAM

International Centre for Advanced
Mediterranean Agronomic Studies
Mediterranean Agronomic Institute of Zaragoza



LEGumes for the Agriculture of TOMorrow

LEGATO project - European Union



EUROLEGUME
2014-2017



EUROLEGUME project - European Union

Advanced Course

ADVANCES IN BREEDING AND AGRONOMY FOR IMPROVING SUSTAINABILITY AND QUALITY OF GRAIN LEGUME CROPS

Zaragoza (Spain), 16-20 October 2017

1. Objective of the course

Legumes are among the most important sources of protein from plant origin, and key food components for achieving a balanced and healthy diet. Despite their beneficial attributes for human health, the consumption of legumes in Europe is very low, partly since many consumers are not aware of their high nutritive value and role in disease prevention.

Besides providing novel food and feed products, legume co-products can offer a further opportunity for increasing added-value. The European Union and other Mediterranean countries are major importers of legumes despite their potential for greatly increased production. N-fixing legumes can replace energy-costly nitrogen fertilizer inputs and decrease pathogen pressure in cropping systems. Thus, incorporating legumes in agroecosystems offers several benefits; for the environment, including reduced greenhouse gas emissions, and for the farmer by increasing the competitiveness of the value chain. The biodiversity of legumes also offers much potential for improving sustainability of agroecosystems and mitigating climate change, although challenges in the areas of yield stability, biotic and abiotic stress tolerance, persist. However, over the past decade several EU projects have addressed many of these issues, resulting in significant progress.

This multidisciplinary course is designed to cover the recent advances in disciplines related to increasing grain legume yield, cultivation and consumption.

By the end of the course, participants will:

- Understand the diversity and current status of legume cultivation including market opportunities.
- Be able to define key criteria for legume grain quality and take into account the use of co-products.
- Comprehend the mechanisms of legume-microbial interactions including biological nitrogen fixation.
- Better manage legumes in conventional and organic cropping systems with an emphasis on environmental sustainability.
- Be familiar with recent advances in application of genomics to breeding.
- Be aware of recent developments in legume breeding for yield, quality, and stress tolerance.
- Understand advanced methodologies for shoot and root phenotyping and their uses for breeding and enhancing plant performance.

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), and the

EU FP7 KBBE research projects LEGATO (LEGumes for the Agriculture of TOMorrow) and EUROLEGUME (Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed). The course will take place at IAMZ and will be given by well-qualified lecturers participating in these projects, coming from research centres and universities throughout Europe.

The course will be held over a period of 1 week, from 16 to 20 October 2017, in morning and afternoon sessions.

3. Admission

The course is designed for 25 participants with a university degree. It is intended for scientists interested in grain legumes with backgrounds in at least one of the following disciplines: agronomy, genetics, breeding, physiology. The course is also open to technical advisors and professionals from companies with these same qualifications.

Given the diverse nationalities of the lecturers, knowledge of English, French or Spanish will be valued in the selection of candidates, since they will be the working languages of the course. IAMZ will provide simultaneous interpretation of the lectures in these three languages.

4. Registration

Application forms may be obtained from:

Instituto Agronómico Mediterráneo de Zaragoza
Avenida de Montañana 1005, 50059 Zaragoza (Spain)
Tel.: +34 976 716000 - Fax: +34 976 716001
e-mail: iamz@iamz.ciheam.org
Web: www.iamz.ciheam.org

Candidates should send the completed application form to the above address, accompanied by a detailed *curriculum vitae*, stating degree, diplomas, experience, professional activities, language knowledge and reasons for applying to the course. Copies of certificates should be enclosed with the application.

The deadline for the submission of applications is 16 June 2017.

Applications from those candidates who cannot present their complete records when applying, or those requiring authorization to attend the course, may be accepted provisionally.

Selected participants will be exempt from payment of registration fees.

5. Scholarships

Candidates from CIHEAM member countries (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey) and candidates participating in LEGATO and

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See updated information at

www.iamz.ciheam.org

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EUROLEGUME projects may apply 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 IAMZ, 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 with a combination of lectures, practical sessions, case studies and discussions.

Participants will work in groups on several exercises that will allow them to put theory into practice, preparing and presenting a case study related to the insertion of legumes in cropping systems, getting acquainted with genome management tools and genome-enabled selection, and characterizing legume shoot and root architecture through image analysis.

Participants are asked to present their own work/research results/activities through a poster presentation, which will facilitate discussions with the lecturers of the course.

8. Programme

1. **Overview (5 hours)**
 - 1.1. Origin, biodiversity and genetic relationships of cultivated grain legumes
 - 1.2. Genetic resources of grain legumes: origin, collection, traditions, genetic clusters
 - 1.3. Diversity of growing regions and agricultural practices in Europe and the Mediterranean region
 - 1.4. Determining factors and limitations for legume grain yields and yield stability
 - 1.5. Food vs feed uses
 - 1.6. Market importance and trends
 - 1.7. Poster session and discussion
2. **Quality of grain legumes and technological innovation in legume products and byproducts (2 hours)**
 - 2.1. Nutritional quality of grain legumes
 - 2.1.1. Compounds affecting nutritional quality, health-beneficial properties, and organoleptic and processing qualities
 - 2.1.2. Evaluation and quantification of grain quality traits for human and animal consumption
 - 2.2. Innovative food products
 - 2.3. Added value of coproducts and residues from legumes
3. **Advances in plant-microbial communities' interactions (2 hours)**
 - 3.1. Rhizospheric partners and variety of interactions
 - 3.2. Feedback loop regulation: benefits for the plant nutrition
 - 3.2.1. Symbiont diversity and efficiency, and potential for inoculation
 - 3.2.2. Molecular characterization and selection of the best partners
 - 3.3. Innovative aspects of rhizobial inoculation *in situ*
4. **Advances in agronomy (6 hours)**
 - 4.1. Influence of management practices on legume crop yield and sustainability
 - 4.2. Agronomical systems involving grain legumes: benefits and challenges
 - 4.2.1. Crop rotations
 - 4.2.2. Intercropping and crop and variety mixtures
 - 4.3. Contribution of legumes to the environmental sustainability of agricultural systems
 - 4.3.1. Cover crops
 - 4.3.2. Legumes in organic cropping systems
 - 4.3.3. Legumes and climate change mitigation
 - 4.4. Group work on the insertion of legumes in cropping systems, assessing the benefit and advantages for the ecosystem (option 1)
5. **Advances in breeding and genomics (5 hours)**
 - 5.1. Advances in genomics and molecular tools
 - 5.1.1. Available genetic and genomic resources for pea and faba bean
 - 5.1.2. Pea gene expression atlas and pea genomic sequence exploitation
 - 5.1.3. Comparison of currently used genotyping methods and their applications in plant breeding
 - 5.1.4. Genomic selection
 - 5.1.5. Practical work on genome management tools and genome-enabled selection (option 2)
 - 5.2. Advances in breeding strategies for crop yield improvement
 - 5.2.1. Target regions and GxE interactions
 - 5.2.2. Global genetic resources: variation and exploitation
 - 5.2.3. Crop ideotypes
 - 5.2.4. Genomic selection: accuracy and incorporation in breeding schemes
 - 5.2.5. Other innovative breeding schemes (evolutionary, farmer-participatory, etc.)
 - 5.2.6. Breeding for specific utilizations: fodder, organic systems, intercropping
 - 5.2.7. Optimizing selection procedures (managed environments, trial designs, etc.)
 - 5.3. Advances in breeding for food and feed quality
 - 5.3.1. Importance of GxE interactions on grain legume quality
 - 5.3.2. Selection for quality traits in breeding programmes
6. **New phenotyping methodologies, with emphasis on roots (5 hours)**
 - 6.1. Image acquisition and treatment
 - 6.2. Associated tools
 - 6.3. Various platforms and their access
 - 6.4. Novel modelling approaches in phenotyping
 - 6.5. European and international initiatives and opportunities to join
 - 6.6. Practical group work on the characterization of legume shoot and root architecture through image analysis
7. **Advances in plant adaptation to abiotic and biotic stresses (4 hours)**
 - 7.1. Abiotic stresses
 - 7.1.1. Effect of the cropping system on managing environmental stresses
 - 7.1.2. Assessment of plant's response to abiotic stress including non-destructive imaging techniques
 - 7.1.3. Effect of abiotic stresses on the legume-rhizobia symbiosis
 - 7.1.4. Prediction of ideotypes adapted to withstand drought
 - 7.1.5. Identification of candidate genes and bacterial strains involved in the symbiotic plants' adaptation to abiotic stress
 - 7.2. Biotic stresses
 - 7.2.1. Effect of the cropping system on managing biotic stresses
 - 7.2.2. Novel and additional sources of resistance
 - 7.2.3. Identification and mapping of candidate genes for resistance
8. **Final feedback from participants on the application of the course content to their own work (2 hours)**

GUEST LECTURERS

P. ANNICCHIARICO, CREA-FLC, Lodi (Italy)
A. BARROS, UTAD, Vila Real (Portugal)
E.S. JENSEN, Swedish Univ. of Agricultural Sciences, Alnarp (Sweden)
J. KREPLAK, INRA, Centre de Dijon (France)
F. MUEL, Terres Inovia-Centre de Grignon, Thiverval-Grignon (France)
N. NAZZICARI, CREA-FLC, Lodi (Italy)
M. PRUDENT, INRA, Centre de Dijon (France)

B. REWALD, Institute of Forest Ecology, Vienna (Austria)
E. ROSA, CITAB-UTAD, Vila Real (Portugal)
D. RUBIALES, CSIC-IAS, Córdoba (Spain)
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R. THOMPSON, INRA, Centre de Dijon (France)
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