



CIHEAM

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



## Advanced Course

# USE OF MOLECULAR MARKERS IN PLANT BREEDING

Barcelona (Spain), 20 February - 2 March 2012

### 1. Objectives of the course

In forthcoming years plant breeding will face important challenges. Besides the traditional needs for greater yield and quality, one must also consider the greater social awareness of the environment and the need to protect it. This means restricting phytosanitary, herbicidal and hormonal treatments, and reducing chemical fertilization. In order to meet these demands and obtain cultivars which bring together the desired characteristics, several new techniques, particularly the use of molecular markers, appear as indispensable tools to support the classical breeding programmes.

Markers have already been incorporated into many commercial breeding programmes as routine techniques to identify genotypes, determine hybrid purity or select genes linked to known markers. Markers also enable an in-depth analysis of quantitative traits, allowing interesting alleles to be found in wild or cultivated germplasm. As a consequence, breeding methods specifically designed to obtain the maximum benefits from this technology have been developed and are applied to an increasing number of crops.

High levels of conservation among close and distant plant species within the same family have been found by comparative genomics. Polyploidization, either of recent or remote origin, also appears to be the rule in plant genomes. Moreover, the availability of next generation sequencing technologies has dramatically reduced the cost of DNA sequencing, and has moved the focus of "de novo" whole genome sequencing from model plant species to crops providing an enormous amount of useful information that is changing the ways in which markers are discovered and used. These results have permitted the design of new strategies for selection based on genome-wide analyses and for the location, characterization and cloning of useful genes in most crops.

The use of markers in breeding or other areas of plant genetics requires highly qualified professionals, ready to adapt to a rapidly changing environment determined by the rise of new technologies and strategies, and capable of effectively introducing them in

their present and future projects. Therefore, the course will combine complete updated theoretical training on the subject, together with laboratory practices giving the participants a global vision for the incorporation of markers into their work.

The main objectives of the course are the following:

- To provide training and recycling for experts in this specific area, enabling them to promote the application of molecular markers, whether through research and development or as advisors of breeding and nursery companies.
- To acquaint these experts with people and institutions of recognized experience in this subject that can contribute in the future to a greater co-operative effort for the application of markers in genetics and plant breeding.

### 2. Organization

The course is jointly organized by the CIHEAM, through the Mediterranean Agronomic Institute of Zaragoza, and the Institut de Recerca i Tecnologia Agroalimentàries (IRTA) through the Center for Research in Agricultural Genomics (CRAG) CSIC-IRTA-UAB-UB.

The course will take place in the CRAG facilities on the Campus of the Autonomous University of Barcelona and will be given by qualified lecturers from research centres, universities, and private companies in different countries.

The course will be held over a period of 2 weeks, from 20 February to 2 March 2012, in morning and afternoon sessions.

### 3. Admission

The course caters for a maximum of 25 professionals with a university degree who are already directly involved in the subject matter of the course. Previous experience may be from basic and applied research or from work in companies interested in incorporating molecular markers in their production process.

All lectures and material distributed will be in English.

Please display on a notice board if possible



CIHEAM

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[www.iamz.ciheam.org](http://www.iamz.ciheam.org)

INFORMATION  
CONTINUES  
OVERLEAF



## 4. Registration

Application forms may be obtained from:

**Instituto Agronómico Mediterráneo de Zaragoza**  
Avenida de Montañaña 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 **4 November 2011**.

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

Registration fees for the course amount to 800 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) may apply for scholarships covering registration fees, and for scholarships covering the cost of travel and full board accommodation during the course.

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 accident and 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 given in two stages. During the first week participants will have the opportunity to carry out laboratory practices of the techniques used to obtain the most important kinds of marker and in the second week, theoretical lectures will be given, addressing the study of the different types of markers and their main applications.

## 8. Programme

### 1. Markers as tools in genetic studies

- 1.1. Types of marker: isoenzymes, RFLPs, RAPDs, SCARs, SSRs, AFLPs, SNPs. Discovery, genetic interpretation, properties, methodology, comparison of types of markers
- 1.2. Linkage analysis with markers. Genetic mapping. Use of computer programs for mapping
- 1.3. Characterization of genetic variability with molecular markers and applications. Basic concepts and applications on linkage disequilibrium and association mapping

### 2. Marker-assisted selection

- 2.1. Use of markers irrespective of their position in the genome. Seed quality assessment, cultivar identification, pedigree analysis and other applications
- 2.2. Location of markers linked to major genes. Methods of major gene selection with markers. Introgression of genes from other species. Whole genome selection in backcross programmes. Genomic selection.
- 2.3. Dissection, characterization and selection of quantitative traits with molecular markers

### 3. Genome analysis and applications

- 3.1. Comparative mapping and genomics. Colinearity between genomes at the genus, family and plant kingdom levels and applications
- 3.2. Sequenced models and crop plants. Uses of EST collections and microarrays. Candidate gene strategies. Positional cloning. Mutant collections: TILLING
- 3.3. Molecular genetics of disease resistance and fruit quality. Applications for the selection of these characters in a breeding programme

## GUEST LECTURERS

P. ARÚS, IRTA-CRAG, Bellaterra (Spain)  
A. BENDAHMANE, INRA, Evry-Paris (France)  
M. GANAL, TraitGenetics, Gatersleben (Germany)  
C. GEBHARDT, Max-Planck Institut für Züchtungsforschung,  
Köln (Germany)  
J. GIOVANNONI, Cornell University, Ithaca (US)

R. DIRKS, Rijk Zwaan Breeding BV, Fijnaart (The Netherlands)  
Y. VAN DE PEER, VIB-Laboratorium Genetica, University of  
Ghent (Belgium)  
R. WAUGH, The James Hutton Institute-Scotland, Dundee  
(United Kingdom)  
D. ZAMIR, Hebrew University of Jerusalem, Rehovot (Israel)

The week devoted to laboratory practices will be organized by J. GARCIA-MAS and carried out by other IRTA-CRAG members, as A. MONFORT, M.J. ARANZANA, W. HOWAD, M. MARTÍN, M. PUJOL, I. EDUARDO, D. BERGARECHE, W. SANSEVERINO, D. MICHELETTI, A. BLAS, R. TONDA, G. GYETVAI and M. SALADIÉ.



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