International Master in Plant Genetics, Genomics and Breeding

XXIII Edition
(September 2020 – June 2022)
10 Reasons to study this Master

1. The students of today will be the professionals of 2050. The growing demand for food in the twenty-first century highlights the need to train specialists that can apply knowledge of genomics to guarantee a healthier and more sustainable food production.

2. An innovative programme that integrates the most advanced tools of plant genetics, data science for plant breeding, bioinformatics, structural and functional genomics, linkage maps and GWAS, marker enable prediction and selection and phenomics and analysis of omics data.

3. A multidisciplinary programme delivered by more than 70 highly qualified professionals from 7 countries, selected for their expertise.

4. A comprehensive teaching system combining lectures, practicals, individual and group work as well as visits to firms and research centres.

5. Students design a plant breeding programme integrating knowledge acquired during the course to address a topic of their interest in greater depth.
6. The possibility of conducting a second year, of introduction to research at a university, research centre or firm in Spain or abroad.

7. The majority of students graduated from recent editions of this Master are now employed in related topics or are preparing their doctoral thesis.

8. A multicultural environment shared with students and lecturers from over 30 countries.

9. An opportunity to establish a network of contacts and collaboration, a clear differentiating advantage in the professional field.

10. An official degree awarded by CIHEAM recognized by the State of Spain as equivalent to the official Master degree of the Spanish university system.
Who we are

IAMZ-CIHEAM

The Mediterranean Agronomic Institute of Zaragoza (IAMZ) is one of the four Institutes of the International Centre for Advanced Agronomic Mediterranean Studies (CIHEAM), together with Bari in Italy, Montpellier in France and Chania in Greece.

CIHEAM is an intergovernmental organization created more than 50 years ago under the aegis of the Council of Europe and the OECD with the mission to develop cooperation between the countries of the Mediterranean through postgraduate training and promotion of cooperative research in the agro-food, fisheries and natural resources sector.

IAMZ was founded in 1969, offering complementary quality and excellence in international training and cooperation through research project management based on IAMZ’s five fields of study: Environment, Fisheries and Aquaculture, Animal Production, Plant Production and Food Technology and Agro-food Marketing.

IAMZ has become consolidated as a point of reference for specialized international training in the agro-food sector. It is located on the Campus of Aula Dei, one of the largest and most prestigious agricultural science complexes in Spain, strengthening synergies between the scientific community, firms and students.

IAMZ offers two lines of training: Master programmes and advanced courses. IAMZ’s training activities have great international repercussion, and each year more than 450 university graduates attend our programmes delivered by over 250 guest lecturers from approximately 80 countries. This is an enriching multicultural experience and a unique opportunity to build international professional and collaborative networks.
15000 students

170 publications

141 nationalities among lecturers and students

50 years of experience

60 agreements with national and international organizations
10000
guest lecturers

6700
scholarships

40
research projects
and networks

8
MSc programmes

400
courses for
professionals
Organization

The International Master in Plant Genetics, Genomics and Breeding is an official Master of two years’ duration (120 ECTS).

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Ramzi Belkhodja
IAMZ-CIHEAM
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The Master’s Webpage: www.masterplantbreeding.com

Programme

The Master has a duration of two years and is designed to train professionals in the field of Plant genetics, genomics and breeding by integrating the tools of plant genetics, data science for plant breeding, bioinformatics, structural and functional genomics, linkage maps and GWAS, marker enable prediction and selection and phenomics and analysis of omics data. The first year (60 ECTS) is professionally oriented and comprises lectures, field and laboratory practicals, personal and group work and study, and visits to leading companies. Technical experts from Limagrain, Syngenta, Monsanto, Pioneer or Ramiro Arnedo have participated in past editions. Throughout the first year, students have the opportunity to design a breeding programme for a plant species of their choice, applied to specific environmental and socio-economic conditions and following objectives.

This project enables students to:

1. Apply the principles and methodology presented during the course.
2. Gain experience in finding technical and scientific information, and in the selective treatment of such information.
3. Make a critical assessment of different breeding alternatives
4. Learn how to define and integrate the different components of a breeding programme.
5. Acquire experience in the preparation and presentation of oral communications and their public defence.
Syllabus

First year

- Purposes, principles and processes in plant breeding
  - 1 ECTS

- Plant genetics
  - 6.5 ECTS

- Introduction to data science for plant breeding
  - 7 ECTS

- Breeding methods and variety development
  - 6.5 ECTS

- Marker enabled prediction and selection
  - 3 ECTS

- Expanding the breeders' toolbox
  - 4 ECTS

- Individual project: design of plant breeding programmes
  - 6 ECTS

Agricultural systems, crop physiology and climate change
  - 3 ECTS

Structural and functional genomics
  - 4 ECTS

Bioinformatics
  - 3 ECTS

Linkage mapping and GWAS
  - 3 ECTS

Phenomics and analysis of omics data
  - 4 ECTS

Applied breeding programmes
  - 9 ECTS

Second year

- Introduction to research

- Final Master Project (Master Thesis)

- Individual project: design of plant breeding programmes
  - 6 ECTS

9 ECTS
Plant breeding programmes designed by students

Najla Ksouri:

Francesc Montardit Tardá:

Chaymaâ Riahi:
“Characterization and fine mapping of QTLs involved in the domestication of melon (Cucumis melo L)”. 2016/2017 edition.

Fatima Zahra Rezzouk:

Miriam Fernández Calleja:

Amri Rihab:

Sergio Francisco Pérez Navarro:

Francisco Carlos Balas Torres:

Lara Pereira García:

Ramón Botet Vaca:
“Breeding olive (Olea europaea) varieties for tolerance to Verticillium dahliae and higher oil stability”. 2012/2013 edition.

Arantxa Monteagudo Galvez:

Erica Fadón Adrián:

Miriam Fernández Calleja:

Amri Rihab:

Sergio Francisco Pérez Navarro:

Francisco Carlos Balas Torres:

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“Breeding olive (Olea europaea) varieties for tolerance to Verticillium dahliae and higher oil stability”. 2012/2013 edition.

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Erica Fadón Adrián:
The second year of the programme (60 ECTS) is oriented towards initiation to research, applying knowledge, skills and competencies acquired during the first year to address real problems related to plant breeding. Second-year Master students carry out the Practicum and Final Master Project (Master Thesis) at universities, research centres or in national and international firms. The lecturers are delivered in English.

Furthermore, for those students that want to have basic knowledge of Spanish language, a preliminary language course is offered to facilitate the adaptation to the IAMZ experience.

The Master prepares students to reach the following objectives:

1. To understand the basics and principles of modern plant breeding, including molecular, genomic and biotechnological techniques.
2. To be acquainted with the different selection and breeding processes and assess the advantages and disadvantages of each according to crop features, breeding objectives and environmental conditions.
3. To acquire the necessary skills to integrate the conventional and most up-to-date techniques, that increase efficacy in the selection processes and improve the development of new varieties in a breeding programme.
4. To design breeding programmes for a specific crop species under particular conditions of a country or region according to certain objectives.
5. To be introduced into research, and apply knowledge, skills and competencies to the critical treatment of plant breeding problems.
Career opportunities

The Master in Plant Breeding opens up a wide range of employment opportunities. The specialization profile of the Master degree prepares alumni to take on technical responsibilities and conduct high level scientific research. They can also pursue professional careers in the following sectors:

- Plant biotechnology firms, seed and plant companies, etc.
- Public bodies in control of seeds and variety certification.
- Research and teaching centres.

During the second year students work towards their Master thesis at universities and national and international research centres. Not only do they improve their language skills but they also become acquainted with different cultures and working environments.

Employability since the 2006 edition

<table>
<thead>
<tr>
<th>Degree</th>
<th>Employed</th>
<th>Master</th>
<th>No answer</th>
</tr>
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<tbody>
<tr>
<td>PhD</td>
<td>13%</td>
<td>1%</td>
<td>6%</td>
</tr>
<tr>
<td>Post - Doc</td>
<td>2%</td>
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“Source: Master monitoring report conducted by IAMZ-CIHEAM study commission”
The IAMZ experience
Testimonials from our students

Samir Kerfal
(Morocco) Academic year 2002/2003
Syngenta, Madrid, Spain

“Doing the Master at IAMZ has enabled me to develop professionally (networking) and personally. This work has allowed me to acquire deeper knowledge of the crop and develop and implement methodologies and new innovative tools to assess varieties. Finally, defending my Final Master Project was yet another opportunity to develop professional skills such as perseverance and orientation towards results.”

José Manuel Estévez
Granada la Palma, Spain

“From a professional and educational standpoint, the different editions of the Master have helped me update my knowledge on genetics and new gene technologies. The programme has also been very useful for my work, helping me to learn and understand how horticultural variety breeding companies work. I have been able to contact lecturers and researchers from other centres, share opinions and ideas that have helped me refocus some aspects of my work and even establish other approaches to the lines of development and innovation pursued in the cooperative I work for. The usefulness and advantages of attending this Master are many, from research grants, training for researchers, development of breeding programmes to the pride in learning and being continuously updated on everything related to plant breeding”.

Rosa Angélica Sánchez Díaz
(Peru) Academic year 2008/2010
Director General for Genetic Resources and Biotechnology
National Institute for Agricultural Innovation-INIA, Peru

“The Master has meant a large step forward in my professional career as well as in my personal life. At a professional level, it has enabled me to consolidate my knowledge and embark upon a scientific career that I thoroughly enjoy; it has been a very good Master as it offered us the possibility of learning together with a great group of staff and lecturers at IAMZ. On a personal level it has allowed me to establish links of friendship with colleagues from different countries and during my time in Zaragoza, IAMZ became home for international students, for which I am very grateful”.

Najla Ksouri
(Tunisia) Academic year 2014/2015
PhD student CSIC-EEAD, Zaragoza, Spain

“Attending this Plant Breeding Master programme is one of the best decisions I have ever made for my professional training and personal development. It was a very fulfilling experience which afforded me great knowledge and opened many doors for me. The scientific contents of the Master’s and the combination of lectures with team work and workshops were very useful to help me acquire new knowledge and provided me with many connections, work offers and references. The opportunity I had to conduct research during the second year was very useful to guide my first steps in my scientific career”.

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Guest lecturers
More than 60 international experts sharing knowledge

Fred van Eeuwijk
(Wageningen UR, the Netherlands)

The phenomenon of genotype by environment interaction (GxE) occurs when genotypes react differently to changes in their growing environment. Modelling of GxE is important for understanding adaptedness, adaptability and stability of genotypes. Simultaneously, understanding GxE allows breeders to design efficient breeding programmes. In the course, students will learn about various classes of statistical models to tackle problems related to GxE.

Chris Carolin Schön
(Technische Universität München, Freising, Germany)

Prediction of complex traits from DNA profiles has revolutionized plant breeding. Getting to know the underlying data and statistical methods is exciting and at the end of the course quantitative genetics and genomics will be your friends.

David Marshall
(The James Hutton Institute, Dundee, UK)

With rapid advances in the generation of genome sequence for most crop plants and high throughput technologies for genotyping and phenotyping bioinformatics has grown to play a central role in many public and private sector breeding programmes. Bioinformatics bridges the gap between molecular technologies for data generation and the application of the resulting information in the decision making processes which underpin modern plant breeding.

Ignacio Romagosa
(Agrotecnio, UdL, Lleida, Spain)

Experimental Design and Analysis is a fundamental tool for all scientific disciplines, but it is particularly relevant in Plant Breeding as it is a powerful instrument for studying quantitative traits.
Patrick Hayes  (Oregon State University, Corvallis, USA)

Barley is the world’s oldest crop, an ideal genetic model system, and a crop of increasing economic importance in this time of climate change. Barley breeding and genetics are fascinating, engaging, and relevant: it is an honor to present them in the context of the IAMZ-CIHEAM Master in Plant Breeding course.

Pere Arús  (CRAG, IRTA-CSIC-UAB-UB, Barcelona, Spain)

One of the most decisive elements of the new breeding techniques is the incorporation of molecular markers as a selection tool. Markers enable the integration of a new dimension, linkage, to the breeding methodology and to the study of trait inheritance, whether it be simple or complex. To become acquainted with the fundamentals of linkage, how to measure it and how to use it when building genetic maps and how to apply such maps, which is the part of the course that I deliver, is essential for training modern breeders.

Paul Christou  (Agrotecnio, ICREA-UdL, Lleida, Spain)

The set of lectures on Applied Plant Biotechnology provides comprehensive insight on the current state of the art in the field. The lectures include the latest developments on the topic and cover biotic and abiotic stresses in crop plants, the mechanistic basis of transgene integration in cereal crops, the production of recombinant pharmaceuticals, synthetic biology in plants, and aspects of intellectual property, regulation and public perception of plant biotechnology. The course has been updated to include coverage of the latest developments of genome editing in plants.

José Esquinas  (UPM, Madrid, Spain)

Genetic resources are a treasure inherited from our ancestors and it is our duty to transmit them to future generations. They are essential to guarantee food security and face the challenges of climate change because without diversity there is no possible selection. The course analyses the importance of genetic resources, their growing erosion and the interdependence of genetic resources between countries. Furthermore, the socio-economic, political and ethical implications related to their conservation and sustainable use are analysed as well as the development of legal instruments negotiated and approved by all countries.
The subjects taught on the Masters and the advanced courses for professionals are delivered by guest lecturers from 10 countries, all leading specialists in their field of expertise. IAMZ hires specialists in each subject to provide students with the most rigorous training and novel content. The quality of the lecturers is a guarantee of the high level of teaching and updating of subjects.

In turn, the diversity of provenance, both in geographical and institutional terms, contributes to the dynamics of the courses and prepares students to face different theories, methods and results.

**International Networking**

More than 30 years building an international network of plant breeding professionals

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**Lecturers participating in the 2018/2019 edition**

**FRANCE**  
J.M. AUDERGON, INRA, Montfavet  
J. BETRÁN, Syngenta, Toulouse  
M. MENZ, Syngenta, Toulouse  
L. MOREAU, INRA/Univ Paris XI/CNRS/INA PG, Gif-sur-Yvette

**GERMANY**  
C.C. SCHÖN, Univ.Munich  
W. LINK, Univ. Göttingen

**ITALY**  
P. ANNICHIAVICO, CREA-FLC, Lod  
S. SALVI, Univ. Bologna  
M. STANCA, CREA-FLC, Fianaraola d’Ardi  
R. TUBEROSA, Univ. Bologna

**SPAIN**  
C. ALONSO-BLANCO, CNB-CSIC, Madrid  
J.L. ARAUS, Univ. Barcelona  
A. ARBELOA, CSIC-EEAD, Zaragoza  
M. ARNEDO, Ramiro Arnedo S.A., Almería  
P. ARÚS, CRAG, IRTA-CSIC-UAB-UB, Barcelona  
J. BARRIUSO, CITA-GA, Zaragoza  
R. BELKHODJA, CIHEAM-IAMZ, Zaragoza  
R. BLANCO, Agrotecnio, Udl, Lleida  
T. CAPELL, Agrotecnio, Udl, Lleida  
A. CASTILLO, CSIC-EEAD, Zaragoza  
A. CASAS, CSIC-EEAD, Zaragoza  
P. CHRISTOU, Agrotecnio, KREA-Udl, Lleida  
M.A. COSTAR, CSIC-EEAD, Zaragoza  
J.I. CUBERO, Univ. Càdora
Students and lecturers in the 2006/2019 period

- Number of students per country
- Number of lecturers per country

X. DOMINGO, EURECAT, Lleida
J. ELENA, Consultant-CPVO, Madrid
F. ESCRIU, CITA-GA, Zaragoza
J.T. ESQUINAS, Univ. Politècnica Madrid
G. FARRÉ, Agrotecnio, UdL, Lleida
A. GARCÉS, CITA-GA, Zaragoza
J. GARCÍA, CRAG, IRTA-CSIC-UAB-UB, Barcelona
G. FARRÉ, Agrotecnio, UdL, Lleida
A. GARCÉS, CITA-GA, Zaragoza
J. GARCÍA, CRAG, IRTA-CSIC-UAB-UB, Barcelona
Y. GOGORCENA, CSIC-EEAD, Zaragoza
P. GRACIA, CSIC-EEAD, Zaragoza
E. IGARTUA, CSIC-EEAD, Zaragoza
N. JOUVE, Univ. Alcalá
S. C. KEFAUVER, Univ. Barcelona
J.J. LÓPEZ-MOYA, CRAG, IRTA-CSIC-UAB-UB, Barcelona
J. MARÍN, CSIC-EEAD, Zaragoza
J.M. MARTÍNEZ ZAPATER, ICVV, Logroño

F. MORALES, CSIC-EEAD, Zaragoza
M.A. MORENO, CSIC-EEAD, Zaragoza
C. MUÑOZ, Univ. Córdoba
R. NAVARRO, CITA-GA, Zaragoza
S. NOGUÉS, Univ. Barcelona
B. ORDAÍS, CSIC-MBG, Pontevedra
M. PÉREZ DE LA VEGA, Univ. León
F. PIÉGO, Univ. Málaga
G. RODRIGO, LabFerrer, Cervera
J. ROMAGOSA, Agrotecnio, UdL, Lleida
E. SÁNCHEZ-MONGE, Limagrain Ibérica S. A., Elorz
R. SAVIN, Agrotecnio, UdL, Lleida
J. SUSIC, Bayer, Almería
J.M. VILLAU, Pioneer Hi-Bred Spain, S.L., Sevilla
J. VOLTA, Agrotecnio, UdL, Lleida

THE NETHERLANDS
D. BUSTOS, Wageningen UR
N. DAVILA, BASF Nunhem
R. NIKS, Wageningen UR
F. VAN EEUWIJK, Wageningen UR

TUNISIA
M. HARRABI, NAT, Tunis

UNITED KINGDOM
J. BRADSHAW, The James Hutton Institute, Dundee
I. MACKAY, NIAB, Cambridge
D. MARSHALL, The James Hutton Institute, Dundee

US
P. HAYES, Univ. Oregon State
In the second year students work on their Final Master Project (Master Thesis) at accredited institutions (universities, research centres or firms) generally in Spain or in the student’s country of origin, under the supervision of a distinguished scientist. Collaboration agreements established with numerous prestigious institutions in different fields of specialization for working towards the thesis is a key factor of the programme’s success. Students are trained in an environment of team research that provides excellent resources and hands-on advice. The experience acquired during this period is not limited to knowledge and practical skills, but also offers a complete introduction to the professional environment.
Access, admission and scholarships

Dates and duration
The first part of the Master will be held from 21 September 2020 to 11 June 2021.
The second part will begin in September 2019 with a duration of 10 months.

Selection
The IAMZ selection committee will consider application based on CV and supporting documents.

Admission and deadlines
Complete the application form: https://www.admission.iamz.ciheam.org/en/
The deadline for the presentation of applications is May 29, 2020.

Registration and scholarships
For candidates from any nationality, registration fees are 2950 eruo per academic year.
Candidates from CIHEAM member countries may apply for scholarship covering registration and full-board accommodation.
Candidates from other countries who require financial support should apply directly to other national or international institutions.
Spain: Leading country in the agro-food sector

Spain is the 5th largest economy in the European Union and the 13th in the world in nominal terms. Spain is the 3rd most popular tourist destination in the world.

Spain is the 8th largest exporter of agro-food products in the world.

Spain is the largest surface area of vineyards in the world.

Spain is the largest producer of olive oil.

Spain is the 2nd largest pork producer in the EU and 4th largest in the world.

60% of the irrigated surface area of Europe is in Spain.

Spain has the largest organic farming area in the EU.

Spain is leader in aquaculture production in the EU.

Spain is one of the top commercial fresh fruit and vegetable operators.

The largest area of protected crops in Europe is in Almeria.
Zaragoza, 2000 years of history in a Mediterranean country: Spain
Zaragoza has the fourth largest population in Spain after Madrid, Barcelona and Valencia with 700,000 inhabitants. It is strategically located between Madrid, Barcelona and Bilbao and is a 2-3 hour drive from the Pyrenees, bordering with neighbouring France. Zaragoza’s two-thousand years of history offer visitors unique sightseeing opportunities and a wide gastronomic and cultural offer.

Spanish is the second most spoken language in the world after Mandarin Chinese, with 416 million native Spanish speakers, and the second in international communication after English.

The international airport offers regular flights to Paris, London, Brussels and Milan. The high-speed train (AVE) connects Zaragoza with major cities in Spain and the French TGV network.

Zaragoza has a wide cultural and gastronomic offer, including the famous tapas bars in El Tubo.

Besides the sports facilities, parks and recreation areas, Zaragoza has a network of cycle paths as well as a bike hire service.

The Basilica del Pilar, La Seo Cathedral and the Mozarabic Palace of La Aljafería are just some of the emblematic monuments not to be missed.

The Aragonese people are renowned for their warm hospitality.

Spain has the most days of sunshine in Europe.