COURSE CATALOGUE

UPV SEMESTER 3

emPLANT+ COURSE CATALOGUE

ERASMUS MUNDUS MASTER PROGRAMME IN PLANT BREEDING

Contents

Joint Courses

JOINT COURSES	Description, contents, learning outcomes	Implementation:
Pilot case	The pilot case is a case study to apply the project management tools to a breeding program. First students by group o choose a species to be ameliorated. Then, find a character or several as goal for the breeding strategy. After, they check that there is a potential market for this new variety and verify that farmers will want to cultivate it and consumers too (1-week work) To be accomplished during all the first year. Secondly students are going to define the potential market for their product (seeds), but also the market for the new variety (consumers). Thirdly they need to create a structure who is going to breed the new variety, and define the role of each student on the group in this structure (company, association...)	The introduction to the Pilot Case will take place during the Joint Integration Week where the groups will be formed based on the specialty chosen by the students for Y2. During the first year the students will work in groups with their tutors and via telephone/video conference/email. During S3 the Pilot Case will be finalized with the tutors at the host university and by telephone/video conference/email among the group members. Two juries will be organized. The first jury at the end of S1 will evaluate the content and the form of the work and especially the project management content. At the end of S2 a written report and a second presentation more focused on the breeding schema will be evaluated. At the end of S3 a jury composed of the local tutors, the Coordinators for Y1 and an expert in Project Management will judge the defense of the Pilot Case. The juries of S1 and S3 will be carried out the same day for logistic reasons.
Bio informatics	Biological databases; gene analyses, web-based analytical tools, Unix OS, functional genomics, molecular evolution, RNAseq expression analysis, annotation of new genomes.	This course will be offered via videoconference and tutorials and accompanied by tutors at the host universities. The class will be validated by a computer-based exam.
Big Data	Clustering, Random Forests, K-Nearest Neighbors Method/ Kernel Methods, Sparse Methods for high dimensional data. Databases (Big data) Management Distributed file systems, Hadoop, Parallel, distributed, massive data processing with Map Reduce NoSQL/NewSQL databases	This course will be offered via videoconference and tutorials and accompanied by tutors at the host universities. The class will be validated by a computer-based exam.

Semester 3 UPV

SEMESTER 3 UPV (30 credits)	Objectives	ECTS
Plant Breeding for resistance to stresses	Description: During the lectures breeding methods and special cases related to: i) viruses, ii) fungi, iii) bacteria, iv) pests and v) abiotic stresses (salt, drought, flooding, low-input conditions, low or high temperatures, etc.) are addressed Contents: Models of host-pathogen interaction. Mechanisms of resistance. Resistance genetics. Durability. Specific strategies and methods for improvement. Programs of improvement according to the source of variation (host, pathogen and others). Economic impact of abiotic stress alterations Physiological effects produced by different types of abiotic stresses. Resistance to water stress. Resistance To saline stress. Resistance to low temperatures. Resistance to high temperatures. Development of Parthenocarpic cultivars. Improvement to other types of stress. Learning outcomes: 1. Use knowledge in plant pathogen interactions and genetics in breeding programmes for plant resistance to pest and diseases. 2. Use knowledge in plant physiology and genetics in breeding programmes for plant resistance to abiotic stresses. 3. Locate, analyse, evaluate and synthesise information relevant to plant breeding for resistance to biotic an abiotic stresses. 4. Communicate conclusions, and reasons that support them, to specialized and non-specialized audiences in a clear and unambiguous way 5. Judge which plant breeding methods are appropriate for introducing resistance to plant varieties. 6. Carry out specific phenotyping activities within the resistance breeding (inoculations, stress experiments, stress response measurements…) 7. Use biotechnology advances in breeding for resistance Methods: The course will be delivered by the following means: Lectures (using flip teaching methods), case studies, Practical lab sessions, and home work. The assessment will be continuous.	5
Breeding for crop quality	Description: Factors involved in the quality of edible plant products and their breeding are studied. Bioactive compounds, cereals´ quality, sugars and acids, organoleptic quality, quality for industry traits (oil yield, fatty acids profile) etc. Contents: Concept of Quality. Components of quality. Organoleptic and nutritional quality. Difficulties in quality breeding. Analytical quality assessment. Genetic regulation of quality. Influence of the environment on the parameters of quality. Mathematical methods and techniques of analysis. Specific improvement for different crops. Learning outcomes:	5

	1. Use knowledge in metabolic pathways and genetics in breeding programmes aimed at increase the nutritional/organoleptic/taste quality of the plants 2. Locate, analyze, evaluate and synthesize information relevant to quality plant breeding 3. Communicate conclusions regarding quality breeding, and reasons that support them, to specialized and non-specialized audiences in a clear and unambiguous way 4. Judge which plant breeding methods are appropriate for improving the plant internal quality. 5. Carry out metabolites analysis (sugars, polyphenols, vitamins, etc) 6. Use biotechnological tools in breeding for quality Methods: The course will be delivered by the following means: Lectures (using flip teaching methods), case studies, practical lab sessions, and home work. The assessment will be continuous.	
Fruit (Tree) species breeding	Description: Review of the specific traits, limitations and factors related to tree (fruit) species. Current genomic and genetic tools applied to their breeding. With particular emphasis on the most common ones in Spain: stone fruits a pip fruits, almond and olive trees, loquat, persimmon, and some shrubs. Contents: Methods of improvement in the short, medium and long term. Cloning in the selection and propagation. Design of mating and selection methods. Methods of improvement based on Hybridization and clonal selection. Selection of patterns and grafts. Biotechnology methods in improvement Of tree species. Genetic improvement of forest conservation. Learning outcomes: 1. Describe methods that are used in tree breeding 2. Use jointly conventional breeding methods and new biotechnologies to improve tree species 3. Use of plant genetic resources in breeding programs. 4. Carry out specific breeding activities, such as selection of parental germplasm, observation and recording of phenotypic variation and selection among progeny Methods: The course will be delivered by the following means: Lectures (using flip teaching methods), case studies, practical lab sessions, and home work. The assessment will be continuous.	5
Ornamental Plants Breeding	Description: Breeding procedures and examples of the most relevant ornamental species: roses, carnation, tulips, lily, cactaceae, etc. Contents: Specific breeding objectives. Generation of variation in ornamentals: intra and Interspecific, mutagenesis, somaclonal variation and others. Clonal propagation. Micropropagation. Methods of improvement. Learning outcomes: 1. Describe methods that are used in ornamental breeding 2. Use jointly conventional breeding methods and new biotechnologies to improve ornamental species	5

	3. Use of plant genetic resources in breeding programs. 4. Carry out specific breeding activities, such as selection of parental germplasm, observation and recording of phenotypic variation and selection among progeny. 5. Formulate and justify a plan for the application of plant breeding methods to achieve a specific objective. Methods: The course will be delivered by the following means: Lectures, practical lab sessions, and homework. The assessment will be continuous.	
Transgenic Plants	Description: Using transgenic technology, the agricultural, horticultural or ornamental value of plants can be improved quickly and precisely. This technology represents a strategic bet for the future to promote research and innovation in key productive sectors for economic and social development, such as the agri-food and biotechnology sectors. The objectives of the course will consist of learning the different phases of a genetic transformation program and the techniques used in each of them. The basic requirements for the transformation of plants, the main improvement objectives and the different techniques that allow the analysis and detection of transgenic plants will be analyzed. Other important objectives of the subject are those that refer to the benefits and possible risks of the use, cultivation and experimentation with transgenic plants, as well as with regard to legislation. Contents: - Basic requirements and methods for obtaining transgenic plants - Genetic transformation via a*grobacterium*. Stages of transformation. The plasmid Ti. Vectors derived from the Ti plasmid. Transformation methods with A. tumefaciens. The plasmid Ri. Transformation with A. rhizogenes - Genetic transformation by means of biolistic methods. System Components. Stages. Plants transformed via bombardment. Chloroplast transformation. Other transformation methods - Elimination of marker genes in transgenic plants. Co-transformation. Removal of the marker gene by transposable elements. Systems based on microbial recombinases. Intrachromosomal recombination - Other methods. Agroinfiltration. Transient transformations based on viral vectors - Genetic silencing. Transcriptional gene silencing. Posttranscriptional gene silencing. miRNAs and tasiRNAs - Gene editing. Genome editing with site-specific nucleases (zinc finger and TALENS). The CRISPR / Cas system. Prime editing. Applications of genome editing in plants - Methods for detecting transgenic plants - Applications - Safety and risks assessments and legislation in force. Learning outcomes: - Describe transformation methods used for plant breeding - Formulate and justify a plan for the application of transgenesis in a breeding programme - Use of in vitro culture techniques in plant breeding - Judge the risk of using transgenic plants for human health and the environment - Describe the legal regulations on transgenic plants Methods: The course will be delivered by the following means: Lectures, practical lab sessions, and homework. The assessment will be continuous	4

Advanced Plant Breeding methods	Description: This course is aimed to show and develop the different selection systems applicable to cultivated species, according to their reproductive system and the type of population to be obtained. In addition, during the course the students evaluate the advantages and disadvantages of each selection method, as well as the genetic advance that can be achieved with them. All using the new molecular tools available and statistical methods. Content: Setting goals for breeding. Most important current objectives and breeding methods in extensive and intensive self-pollinated (wheat and tomato) Most important current objectives and breeding methods and alogamous crops (corn and melon). Plant genetic resources and sources of variation. Introduction and management of the necessary genetic variation. Molecular markers and genomic tools Handling and selection of materials during the improvement program. Evaluation and comparative tests. Learning outcomes: - Use the appropriate plant breeding strategy depending on the biology of the plant - Use of conventional and biotechnological selection and breeding techniques. - Analysis of genetic gain and predict results of selection. Methods: The course will be delivered by the following means: Lectures, practical lab sessions, and home work. The assessment will be continuous.	5