



Sant'Anna

Scuola Universitaria Superiore Pisa

Ph.D. in Agrobiodiversity
Teaching Activities Cycle 38° - a.y. 2022/2023

Lecturer	Title of the Course	Brief description	Hours	ECTS
P. Bàrberi	Functional plant ecology for sustainable agriculture	The course aims to introduce students to the emerging and fascinating subject of functional plant ecology, and to make a concrete link between old and novel ecological theories and the role that functional plant diversity can play for the development of sustainable cropping, farming and agricultural systems in temperate and tropical environments. Functional plant ecology will be treated through a trait-based approach. Plant traits related to resource acquisition, growth and reproduction, and their relevance for the provision of agroecosystem services will be highlighted. Differences and similarities between the concepts of response and effect traits will be contextualized in natural ecosystems vs agroecosystems. Publicly available (functional) plant trait databases will be presented and discussed. The course will make large use of practical case studies to allow students familiarize with new concepts and metrics	20	2
P. Bàrberi, M. Dell'Acqua, C. Moonen	Principles of Agrobiodiversity - Theory	The course aims to introduce students to the complex and multi-faceted world of agrobiodiversity in an interdisciplinary perspective. The course is divided into six modules: (i) Introduction: definition of concepts and major agrobiodiversity players on the international scene; (ii) Functional agrobiodiversity; (iii) Genetic agrobiodiversity; (iv) Species agrobiodiversity; (v) Habitat agrobiodiversity; (vi) Reappraisal of concepts (group discussion). The course is based on highly interactive sessions with the presentation of numerous case studies from temperate and tropical agroecosystems, focusing on the analysis and interpretation of complex interactions occurring across agrobiodiversity elements and levels and the receiving environment, with the goal of creating a continuum between theoretical foundations and practical applications throughout the course	36	3



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P. Bàrberi, M. Dell'Acqua, C. Moonen	Principles of Agrobiodiversity - Practice	The course aims to put into practice some theoretical aspects presented in the previous, complementary course (Principles of Agrobiodiversity – Theory) through hands-on field work engaging students under the supervision of lecturers. The course is divided into three modules, centred on the three agrobiodiversity levels (genetic, species and habitat). Each module consists of three parts: (i) an introductory session, where the lecturer will propose possible methodological approaches for on-field assessment of agrobiodiversity at the target level and will introduce the field work; (ii) a hands-on field work session, where students will choose and apply one of the methods for actual assessment of agrobiodiversity, gathering data; (iii) a discussion session, where students will analyse and interpret the data they have collected in session (ii), under the lecturer's guidance. Sessions (i) and (iii) will take place in the classroom. Session (ii) will take place at the Agri-Environmental Research Centre of the University of Pisa (CIRAA E. Avanzi, S. Piero a Grado, 8 km SW of Pisa) or in the territory around Pisa. Transportation will be organised by the lecturers. The final evaluation consists in a case study analysis covering all three agrobiodiversity levels, that students will return to the lecturers within an agreed deadline	24	2
TBD	Scientific English	The Course conducted by a native English speaker has the dual purpose of consolidating English language proficiency and developing both oral and written communication skills in science. Ample space is left for conversation and critical review of papers	30	3
M. Dell'Acqua	R for Data Analysis in Agrobiodiversity	This is a course for basic-to-intermediate R users interested in learning the R code practices needed to support data-driven approaches in the life sciences, and particular in agrobiodiversity. The course is organized in seven lectures starting with the basics of computer programming, then on to a thorough explanation of R syntax rule (including tidyverse). We will discuss how to wrangle and transform data and how to visualize data with base plot and ggplot. We will explore most common R packages and formalize scripting routines including automation approaches such as for loops and if statements. Rmarkdown outputs will be discussed and used for the end of course examination. We will then move to multivariate data analysis in R with a focus on agrobiodiversity.	20	2



C. Moonen	Analysis of Multivariate Data using CANOCO	This course is an introduction to the theory and use of multivariate data analysis methods. The objective is to provide participants with a good insight in the characteristics of multivariate analysis techniques in order to allow them to evaluate if and how these techniques can be useful for the analysis of their own data. Various analysis techniques will be presented and compared such as: constrained and partial analyses, forward selection of explanatory variables, Monte Carlo permutation test, inclusion of randomized blocks, variation partitioning and approaches to analyse repeated measurements. Specific requests of students can also be taken into account such as interest for advanced regression methods in CANOCO, cluster analysis or classification methods. About 4 hours will be dedicate to work on own data or on a given dataset. The final exam will consist in a mix of MC and open questions	14	1
S. Bartolini	Floral and Fruiting Phenology of Fruit Trees Species under Current and Changing Climate Conditions	The aim of this course is to analyze the floral and fruiting phenology of the main perennial fruit species such as olive, grape, pome and stone fruits. Under pressure from climate change, with growers set to face difficult choices in the years ahead, the biological cycles of these species need to be studied and characterized. In particular, the impact of climate change on the life cycle of fruit trees, on their biology and physiology and on the quality traits of fruits will be examined. The impacts on geographic distribution of the considered species will be also proposed in a future scenario	20	2
S. Carlesi	Methods to study and analyze biodiversity in Agroecosystems at species level	The course focus on main theories and tools to study and analyze the spontaneous diversity present in the agroecosystem, with a particular focus on weed composition: 1) the concept of spontaneous diversity in agroecosystems; 2) the methods to plan sampling and quantify the spontaneous diversity at species level; 3) example of some mathematical concepts connected to the quantitative measurement of diversity 4) statistical methods to study species composition; 5) the functional approach to diversity and methodology to study. The course will use the program R to apply the methodology studied to some real cases and scenarios	20	2



A. Mensuali	Advanced Plant Tissue Culture for Biodiversity Conservation	The course aims to introduce students to in vitro technologies for crop species. They will be enabled to orient themselves in the choice of in vitro culture to use, according to their work and / or research objectives in the field of plant breeding or biodiversity conservation. Basic information on plant in vitro culture and novel approaches for in vitro establishment of germoplasm bank and for ex situ conservation will be provided. The course will be structured as follows: classroom lectures, lab experience, bibliographic research, seminars	20	2
L. Ercoli	Principles and Methodology in Crop Physiology	The course investigates the productivity of agroecosystems, and the underlying processes for the production of food, feed and high-quality vegetable raw materials. Structure and function of managed plant communities and access to resources that support their growth are analyzed as key drivers of productivity in order to provide knowledge to allow manipulation and modification of processes in term of direction, rate and intensity. Addressed topics include light interception, photosynthesis, respiration, plant and root architecture, growth and yield components, source-sink relationship, water use efficiency, and crop yield relative to water stress	10	1
C. Fadda	Challenges of using plant genetic resources: a historical and political perspective	The course aims at providing an historical and political perspective to the regulation of transfer of genetic resources and of their use in plant breeding. The several challenges of genetic resources transferring from public seed banks to both public and private stakeholders will be addressed, such as farmers' rights and the utilization of the revenues related to farmers' rights. The new challenge posed by the availability of extensive genomic sequences produced from the accessions present in the seed banks will also be discussed and the different interpretations and options will be analyzed	20	2
A. Mantino	Agroforestry systems	This course focuses on concepts and principles of agroforestry systems, describing examples from throughout the world, and exploring agroecological process and socio-economic aspects that underpin agroforestry systems. Course presents the components of agroforestry systems and their integration, and the strength and weakness of the development of agroforestry.	14	1
A. Mensuali	Complements of Genetics	Students work to address key agroforestry hypotheses during this course. The course will include on-field activities in experimental and real farms.	20	2



M. Pè	Elements of Molecular Biology	The course will mainly focus on the structure, the chemical properties and the functions of DNA and RNA. The course will start by describing how DNA has been identified as the genetic material and how the flow of the genetic information from the genome to the trait(s) can be crucial to attain a basic understanding of molecular biology. Along this line, DNA replication, DNA transcription, RNA synthesis and its role in protein synthesis will be studied. It will be described how the deep knowledge of the mechanisms and enzymology of DNA replication and function have been crucial for the development of the fundamental methods that are used in modern molecular biology and genomics	20	2
M. Pè, M Dell'Acqua	Genetics of Complex Traits	The course is divided in two parts. The first part will provide theoretical and methodological knowledge on the genetics of complex traits, starting from classical quantitative genetics to modern, genetic marker-based quantitative genetics. GWAS and QTL mapping procedures will be described to map complex phenotypes. Multiparental populations design and properties will be described. In the second part, experimental data already obtained from the phenotypic and molecular characterization of diversity panels or segregating genetic populations will be analysed and the advantages and limitation of different approaches will be discussed	20	2
E. Pellegrino	Bioinformatics applied to the study of soil diversity	The aim of the course is to provide bioinformatics tools to assess and analyse soil biodiversity. In particular, the course will discuss the aspect indicated below. Sequences databases and similarity searching: exploration of the main web-based similarity search programs; Introduction to Multiple Sequence Alignment: the theory underlying multiple sequence alignment, how Progressive Sequence Alignment (PSA) works and how the most widely used MSA packages are and how they differ, when and how to modify an alignment; Phylogenetic Analysis I – Introduction to Phylogenetic Trees; Phylogenetic Analysis I – Introduction to Distance Matrix Methods; Phylogenetic Analysis II – Tree Searching Methods; Molecular Phylogeny II – Bayesian Inference.	20	2



P. Perata	Experimental Plant Physiology	The course is aimed to provide a forum of discussion about experiments performed by PhD students within the framework of their PhD projects. Contributions from experimental activities of post-docs and Ms students are also planned. The Course is active during the whole year, with one-two hour class every week. The presentations are discussed and placed in the context of the future publication of results thanks to the contribution of all the participants to the class. The main topics discussed are the research themes described in the PlantLab website: www.plantlab.santannapisa.it	40	4
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L. Sebastiani	Introduction to R	The course provides basic knowledge on the characteristics and use of R statistical package. R is an open-source program used for statistical analysis and graphic restitution of experimental data. More specifically, this course is meant to be an introduction to the use of the R. The course arguments will be: 1) R and R-Studio installation procedure; 2) basic commands and explanation to make "scripts" of commands; 3) objects in R (vectors, dataframes) and basic operations; 4) data from external files (txt, xls, csv); 5) functions for the creation of graphics	10	1



P. Tonutti	Principles of Perishable Fruit Production and Storage	The course will provide students with the basic knowledge of the techniques and protocols for the production of the main perishable temperate fruit crops (apples, pears, grapes, olives, peaches). The botanical features and the ecological and environmental requirements for a successful cultivation will be illustrated. The reproductive biology of each species will be described as well as the factor affecting fruit growth and development, including ripening. The quality parameters at harvest will be defined and the pre-harvest and post-harvest factors affecting external appearance and internal composition will be analyzed. The last part of the course will be devoted to the description of the main protocols applied to store perishable fruits and the effects of applying refrigeration and other tools (ethylene inhibitors, low oxygen) on the evolution of ripening and the subsequent shelf- and commercial-life	20	2
Francesca Di Donato – Denise Amram - Caterina Sganga	Open Science and Research Data Management	The course covers all modern aspects of Open Science and provides the tools and standards required to embed Open Science in research workflows. After a brief overview of the foundations of key IP rights, data protection principles and non-personal data regimes, it focuses on the concept and application of Open Science in Horizon Europe, the ongoing reform of the research assessment system in the EU, meaning and practice of open access publishing and data FAIRification. Specific attention will be devoted to research data management, Data Management Plans, the use of existing Research Infrastructure (RI) to disseminate research data and other outputs, and the definition and implementation of the European Open Science Cloud (EOSC).	12	1
	Seminars and other activities			
Invited speakers	Disciplinary seminars		10	
Invited speakers	Inter- Trans-disciplinary seminars		10	
Invited speakers	Workshop		8	
ABD PhD students	Journal Clubs		10	