COURSE OF STUDY Master's degree in 'Innovation Development in Agrifood Systems' (IDEAS) – Class: LM-69 Agriculture

ACADEMIC YEAR 2023-2024

ACADEMIC SUBJECT I.C. Biodiversity mainstreaming in crop production – *Host-pathogen interactions and microorganism diversity*

General information	
Year of the course	2nd year
Academic calendar (starting and ending date)	March 4th, 2024 - June 14th, 2024
Credits (CFU/ETCS):	3
SSD	AGR/12 – Plant Pathology
Language	English
Mode of attendance	Attendance is recommended but not mandatory

Professor/ Lecturer	
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Department and address	Department of Soil, Plant and Food Sciences (DiSSPA) – Plant pathology section - University of Bari – via Amendola 165/A – 70126 BARI -Italy
Virtual room	Microsoft Teams code: ix85cgi
Office Hours (and modalities: e.g., by appointment, on line, etc.)	From Monday to Wednesday, 3.00 pm to 6.30 pm or in the morning following an established appointment requested to the teacher (by phone or e-mail).

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
75	16	14	45
CFU/ETCS			
3	2	1	

Learning Objectives	The course is aimed to provide knowledge and understanding on major molecular mechanisms involved in the host-pathogen interactions focusing on genetic and molecular determinants of pathogenicity/virulence in microorganisms and resistance/susceptibility in plants; on diversity of plant-associated microbial communities, their dynamics and evolution, and impact on ecosystem health, disease management, food system safety and productivity; on recent advances in genomic and molecular techniques applied to study host–pathogen dynamics and microorganism diversity by using multi-omics technologies.
Course prerequisites	Basic knowledge on general biology

Teaching strategie	Lectures supported by Power Point slides, web sites and multimedia. Laboratory classroom, working groups case studies, and transferring of experiences of

	researchers on selected topics. E-learning using the MS Team platform will be also used.
Expected learning outcomes in terms of	
Knowledge and understanding on:	○ Microbial pathogenicity and virulence factors and host resistance mechanisms. ○ Factors affecting host-pathogen interactions. ○ Advanced methods applied to the study of host-pathogen interactions in different model systems. ○ Ecology and evolution of microbial communities (microbiomes) in agri-food systems.
Applying knowledge and understanding on:	○ Understanding on the genetic and molecular basis of disease resistance in plants. ○ Ability to propose microbiome-based solutions as a key for the development of a modern bioeconomy and a sustainable and healthy agrifood systems. ○ Understanding crop–pathogen interactions and how this knowledge can be applied in the prevention of diseases in plants. ○ Understanding on how to preserve microbial diversity in natural and agricultural ecosystems.
Soft skills	• *Making informed judgments and choices* ○ Ability to use recent advances in studies on the molecular and genetic regulatory mechanisms underlying disease resistance for generating crops with durable resistance and reducing environmental impact of agriculture. ○ Ability to maximize efficiency of using plant resistance induction against abiotic and biotic stresses. • *Communicating knowledge and understanding* ○ Ability of evaluating the benefits, risks, and negative side effects of farming practices on microbial communities and their interaction with the host and how this affect ecosystem health, disease management, food system safety and productivity. ○ Ability to promote a sustainable and circular microbiome-based bioeconomy. • *Capacities to continue learning* ○ Capacities of updating the knowledge on new approaches to determine microbial diversity and to explore host-pathogen interaction mechanisms. The results of the expected learning, in term of knowledge and ability, are listed in the Annex A of the Didactic Regulation of the Bachelor Course (expressed by the European descriptors of the study title).
Syllabus	
Content knowledge	• Presentation of the course and educational aims. • Basic concepts on host-pathogen interactions. • Microbial pathogenesis (pathogenicity/virulence factors, *e.g.* effectors, toxins, degradative enzymes, and major genetic and molecular determinants). • Host defense responses: recognition, signalling and regulation, oxidative stress changes, defence genes (*e.g.*, PR-proteins, secondary metabolites). • Microbial diversity and the genetic nature of microbial species.

	• Microbes in agriculture and biotechnology. • Structure and dynamics of microbial communities. • Effects of plant microbiota on soil, plant, and agro-ecosystem health. • Impact of farming practices on plant-associated microbiome. • Determination of microbial diversity in plants and environmental samples • Multi-omics approaches applied to pathogens, mycotoxigenic fungi and studies of interactions among pathogen, host plant, microbial antagonists, and plant-associated microorganisms. • Bioinformatics tools in molecular plant pathology.
Texts and readings	• A. Singh, I.K. Singh (2018) Molecular Aspects of Plant-Pathogen Interaction. Springer Nature Singapore Pte Ltd., pp. 351. DOI: 10.1007/978-981-10-7371-7 • N.P. Money (2014) Microbiology: A Very Short Introduction. Oxford University Press, pp. 144. DOI: 10.1093/actrade/9780199681686.001.0001 • K.R. Hakeem, M.S. Akhtar, S.N.A. Abdullah (2016) Plant, Soil and Microbes. Vol. 1 (pp. 366; DOI: 10.1007/978-3-319-27455-3) and Vol. 2. (pp. 438; DOI: 10.1007/978-3-319-29573-2). Springer, Cham • https://doi.org/10.1016/B978-0-12-812060-6.00011-8 • https://doi.org/10.3389/fsufs.2021.624203 • https://doi.org/10.1111/1751-7915.12592 • https://doi.org/10.1093/femsec/fix050 • https://doi.org/10.1016/j.cell.2006.02.008 • https://doi.org/10.3389/fpls.2017.01806 • https://doi.org/10.1128/IAI.68.12.6511-6518.2000
Notes, additional materials	Personal notes of the lectures and didactic materials distributed during the course. Examples of websites: • https://fems-microbiology.org/ • https://microbiomedb.org/mbio/app • https://www.nature.com/collections/jcbagaigaa/ • http://www.fao.org/home/en/ • http://www.apsnet.org/ • https://apsjournals.apsnet.org/journal/pbiomes Further materials as research articles and websites will be provided on request.
Repository	All didactic materials will be shared in MS Teams.

Assessment	
Assessment methods	The students enrolled in the academic year during which this discipline is offered can have an intermediary exam during the teaching period of the discipline. The result of this intermediary exam remains valid for the whole academic year and concurs to the final evaluation of the student. The intermediary exam will be given on the subjects treated during the lessons and the practical activities up to the suspension of the teaching activity. The evaluation of the intermediary exam is expressed in thirtieths. At the end of the module teaching period, the students who passed positively the intermediary exam, can give the final exam concerning on the subjects

	treated during the lessons and the practical activities since the intermediary exam. Students who did not pass or give the intermediary exam will be examined on the whole subjects treated during the lessons and the practical activities as reported in the Didactic Regulation of the Master course (art. 9) and syllabus (annex A) and which is correlated to the actual teaching period. The intermediary and the final exams consist of an oral test in English concerning the topics developed during the theoretical and practice lessons. The examinations are public.

Assessment criteria	• *Knowledge and understanding*
	  ○ Ability to describe mechanisms of microbial pathogenesis and virulence and host defence responses.
	  ○ Ability to describe composition, evolution and interaction of microbial communities associated with plants in various agro-ecosystems.
	  ○ Ability to describe advanced methods for determine microbial diversity and to explore host-pathogen interaction mechanisms.
	• *Applying knowledge and understanding*
	  ○ Ability to define and propose new approaches for generating new genotypes of plants with durable resistance to pathogens and microbiome-based solutions for sustainable and healthy agri-food systems.
	  ○ Ability to identify and propose tools and methods for evaluating microbial diversity and exploring interactions among microorganisms and between beneficial or pathogenetic microorganisms and their hosts.
	• *Autonomy of judgment*
	  ○ Ability to analyse and critically evaluate various factors affecting soil and plant microbiome and host-pathogen interactions.
	• *Communicating knowledge and understanding*
	  ○ Ability to explain the genetic basis of pathogenicity and host resistance and to motivate choices in the field of plant breeding and selection for disease resistance, usage of plant resistance inducers, and microbiome-based solutions for sustainable agriculture.
	• *Communication skills*
	  ○ Ability to explain in exhaustive way, with appropriate words, the needs of appropriate choices in production process management based on natural mechanisms of interactions among organisms, preserving microbial diversity for plant health and sustainable agri-food systems.
	  ○ Ability to explain and motivate the potentialities offered by development of new innovative technologies to study complex mechanisms of interactions among soil, plants, pathogenetic and non-pathogenic microorganisms.
	• *Capacities to continue learning*
	  ○ Ability to apply acquired knowledge and skills for problem solving in various operative situations in agri-food systems.

Final exam and grading criteria	The evaluation is expressed in thirtieths. The final exam is passed with a vote of at least 18/30. For students who were undergone the partial check, the final evaluation is expressed by the average of the votes obtained in the two oral tests. A *cum laude* may be added to the highest vote (30/30), as a special distinction. The evaluation of the student's attainment agrees with pre-established criteria, as detailed in Annex A of the Academic Regulations for the Agricultural Technologies and Science Degree Course.

Further information	