Syllabus

Course Description

Course Title	Biochemistry and Physiology of Agricultural Plants
Course Code	40193
Course Title Additional	
Scientific-Disciplinary Sector	AGR/13
Language	English
Degree Course	Bachelor in Agricultural, Food and Mountain Environmental Sciences
Other Degree Courses (Loaned)	
Lecturers	Prof. Stefano Cesco, stefano.cesco@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/30263
Teaching Assistant	
Semester	Second semester
Course Year/s	2
CP	6
Teaching Hours	40
Lab Hours	20
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	The course belongs to the area of learning that characterize the Study Course (corsi caratterizzanti) and specifically in the context of the disciplines of Plant Production. The aim of the course is to provide students with an adequate mastership of general scientific principles and methods as well as some specific professional knowledge. The aim of the course is to acquire the basic knowledge that is necessary to understand the chemical changes that matter undergoes in living organisms by relating qualitative and quantitative aspects of agriculture. In particular, it is expected that

	the student acquires knowledge on the main properties and characteristics of biomolecules in relation to the structures they form, on the enzyme properties, functions and regulation, on bioenergetics and trans-membrane transport, and on some main metabolic pathways and their regulation. In addition, students will develop familiarity with real-world case studies in plant nutrition, stress physiology, and industrial applications (e.g., biodiesel, bioplastics, microgreens production), as well as with professional opportunities through guest lectures and presentations of agro-industry representatives.
Course Topics	• Structure and functions of biological macromolecules: amino acids and proteins, carbohydrates and lipids (including case studies on phytosiderophores, intercropping strategies for Fe acquisition, protein folding, glutathione roles in photoprotection, phytochelatins and heavy metal detoxification). • The enzyme kinetics, inhibition, regulation of membrane and soluble enzyme systems; isoenzymes (including feedback regulation (EPSP synthase/glyphosate), allosteric regulation, environmental modulation of enzyme activity, and case studies such as root nitrate uptake and PM-ATPase modulation). • Bioenergetics: energy changes in biological systems, forecasting feasibility of reactions, exo- and endo-endergonic reactions and calculation of DeltaG and DeltaG0, and mechanisms of energy transfer. • Composition and functions of cell membranes: energy of trans-membrane transport, structure and function of membrane proteins, transport of ions and metabolites. (including solute transport (diffusion, active transport) and long-distance transport in xylem and phloem; resilience strategies such as callose deposition in grapevine) Root uptake of Nutrients, their transolcation and allocation at the leaf and fruit level. • Oxidative metabolisms: glycolysis and its regulation; tricarboxylic acid cycle and its regulation, the mitochondrial electron transport chain, oxidative phosphorylation, cyanide-resistant respiration, Beta-oxidation of fatty acids and glyoxylate cycle, the cycle of the pentose phosphate. • Photosynthesis: Pigments and their synthesis, light absorption and energy transfer, photosystems and bright reactions, photophosphorilation, incorporation and reduction of CO2, C3, C4 and CAM plants, photorespiration and glycolate metabolism

	(including TLC analysis of pigments and strategies to control the respiratory process in agricultural products). • Absorption and assimilation of nitrogen and sulfur compounds: mechanisms of trans-membrane transport, nitrate reduction, the GS-GOGAT system, sulfate reduction and assimilation. • Plant mineral nutrition: the biochemical role of macro- and micronutrients Laboratory activities • Preparation of hydroponic solutions and plant growth experiments. • Amino acid titration, size-exclusion chromatography, dialysis. • Isolation and purification of plasma membrane H+-ATPase. Spectrophotometry and protein quantification. • Production of biodiesel and soap from plant oils. Synthesis of starch-based bioplastics. Thin-layer chromatography (TLC) of leaf pigments. • In vitro and in vivo enzymatic assays (including FeIII-chelate reductase activity). Each activity is paired with self-assessment quizzes on the Teams platform.
Keywords	Plant Biochemistry Plant Physiology Enzyme Regulation Photosynthesis Plant Nutrition Laboratory Skills
Recommended Prerequisites	Basic knowledge of general, inorganic, and organic chemistry, as well as basic familiarity with laboratory work in chemistry.
Propaedeutic Courses	no
Teaching Format	The course consists of lectures during which the Professor presents the different topics. Practical lessons and laboratory activities conducted by the Teacher and the Teaching Assistants are also foreseen. Course topics will be presented using Power Point presentations and at the end of a single lesson a pdf copy will be distributed directly to students. Interactive learning methods include student-led presentations revisiting and summarizing the most important concepts of the last

	lecture, followed by Q&A sessions, group-based/cooperative exercises, online self-assessment quizzes, and open discussions for feedback on teaching and learning approaches.
Mandatory Attendance	no
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding of chemical transformations that matter undergoes in living organisms in relation to qualitative and quantitative aspects of both production practices and processing in agriculture. Capability in applying knowledge by developing practical laboratory skills and the ability to draw information out from practical laboratory activities in support/integration to the theoretical lessons. Making judgments based on the choice of analytical protocols, writing a report. Capability in presentation of the skills acquired with an appropriate language and use of technical and specific terms. Acquisition of learning strategies based on the use of technical information and knowledge updating.
Specific Educational Objectives and Learning Outcomes (additional info.)	• Develop the ability to connect biochemical and physiological concepts with practical agricultural applications through real-world case studies. • Strengthen problem-solving skills by designing and interpreting laboratory experiments related to plant metabolism, nutrition, and stress responses. • Enhance critical thinking through the analysis of scientific literature and the discussion of recent advances in plant biochemistry and physiology. • Improve teamwork, communication, and presentation skills through group-based activities and student-led summaries of lecture content. • Gain exposure to professional contexts and innovation in the agro-biotechnological sector through interaction with guest speakers/agro-industry representatives.
Assessment	Assessment is conducted via oral examination that includes: a) questions to assess the knowledge and understanding of the course topics. b) questions designed to assess the ability to transfer these skills to case studies of crop production. c) discussion of laboratory activities to evaluate the ability to apply

	theoretical knowledge in practical contexts. The oral exam may also include problem-solving questions and interpretation of experimental results discussed during the course.
Evaluation Criteria	Attribution of a single final mark. The evaluation considers the following criteria: • Knowledge and understanding of the subject matter (25%): depth, breadth, and accuracy of the student's knowledge of plant biochemistry and physiology, including theoretical concepts, and key facts and data. • Clarity and accuracy of the response (20%): ability to explain concepts in a precise, coherent, and structured way. • Mastery of language (10%): correct and consistent use of scientific and technical terminology in English. • Ability to connect topics (20%): capacity to integrate knowledge across different areas of the course and relate theory to practice. • Independence of judgment (15%): originality of thought, critical analysis, and problem-solving ability. • Interpretation of laboratory activities (10%): correct explanation of experimental procedures, results, and their significance. Performance levels: • Excellent (28–30 cum laude): comprehensive and in-depth knowledge of the subject, precise and well-structured answers, excellent mastery of terminology, strong and original connections between topics, independent reasoning, and accurate interpretation of laboratory work. • Good (25–27): solid and accurate knowledge with minor gaps, generally clear explanations, good use of terminology, relevant connections between topics, and mostly correct interpretation of laboratory work. • Satisfactory (22–24): adequate knowledge with some minor inaccuracies, clear but not always detailed answers, sufficient mastery of terminology, limited but correct connections between topics, and acceptable interpretation of laboratory activities. • Sufficient (18–21): essential knowledge of the main topics, answers that are generally correct but may lack detail or depth, basic use of terminology, minimal but relevant connections between topics, and basic but correct interpretation of laboratory

	activities.
Required Readings	D.L. Nelson, M.M. Cox, Lehninger principles of biochemistry, Freeman, New York, 2008
Supplementary Readings	Buchanan, B.B. Biochemistry & Molecular Biology of Plants, Published by Wiley-Blackwell (2009), ISBN: 9780943088396
Further Information	none
Sustainable Development Goals (SDGs)	Zero hunger, Industry, innovation and infrastructure, Life on land, Climate action, Responsible consumption and production