INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Microbial association and biofertilizers			Field of study	Biology and biochemistry		
Master in	Biotechnological Engineering			School	School of Agriculture		
Academic Year	2020/2021	Year of study	1	Level	2-1	ECTS credits	5.0
Type	Semestral	Semester	1	Code	5010-509-1101-00-20		

Workload (hours)	135	Contact hours	T	TP	PL	TC	S	E	OT	O
			25	-	25	-	-	-	4	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tuturial; O - Other

Name(s) of lecturer(s): Margarida Maria Pereira Arrobas Rodrigues, Paula Cristina Santos Baptista, Anabela Rodrigues Lourenço Martins

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the basic soil-plant relationships and their effect on the bioavailability of nutrients.
2. Known the biology of the rhizosphere and microbial associations.
3. Known the current state of knowledge concerning the rhizosphere microorganisms in the various aspects related to agronomy, genetics, physiology and biochemistry.
4. Known the several groups of rhizosphere microorganisms with importance as biofertilizers.
5. Apply the technologies developed for the application of rhizosphere microorganisms in sustainable agriculture

Prerequisites

Before the course unit the learner is expected to be able to:
Not Applied

Course contents

Soil properties that affect the microbial activity. Cycles of nitrogen and phosphorus in the soil and role of these nutrients to plants. Rhizosphere Biology. Rhizosphere soil. Symbiotic nitrogen fixing forms in leguminous plants and in non-leguminous trees; non-symbiotic (free-living, associative or endophytic) N2- fixing forms. Mechanism of biological nitrogen fixation in leguminous plants. Phosphate solubilisation. Endo-and ectomycorrhizae. Biofertilizers. Organisms with biofertilizer value.

Course contents (extended version)

1. Soil-plant relations
   - Soil concept and constituents
   - Physical, chemical and biological soil properties
   - Soil quality indicators
2. N and P nutrient cycles
   - Importance of N in the terrestrial globe. Role in ecosystems
   - Transformation of nitrogen in ecosystems
   - Importance of P in the terrestrial globe. Role in ecosystems
   - Phosphorus transformation in ecosystems
3. Rhizosphere biology
   - Endorhizosphere, rhizoplane and ectorhizosphere
   - Root Exudates: composition, roles and factors affecting root exudates
   - Rhizosphere-inhabiting microflora
   - Plant-microbe interactions in the rhizosphere (beneficial, neutral, detrimental)
   - Role of rhizosphere microorganisms in the improvement of plant fitness
4. Significance of bacteria in the rhizosphere
   - Nitrogen Fixation: Symbiotic and non-symbiotic nitrogen fixing forms
   - Phosphate solubilisation: phosphate-solubilizing microorganisms
5. Significance of mycorrhizal fungi
   - Endo- and ectomycorrhizae
   - Mechanisms of mycorrhizal associations: endo- and ectomycorrhizas
   - Effect of mycorrhizal association on nutrient uptake from the soil
   - Mycorrhiza helper bacteria (MHB)
6. Biofertilizers
   - Biofertilizer concept
   - Importance of biofertilizers for sustainable agriculture models
   - Organisms with biofertilizer importance
   - Biofertilizers market: biotechnology and applications.
   - The production of compost as a biofertilizer. Process and organisms involved.

Recommended reading

1. Smith S. , Read D. (2008) Mycorrhizal Symbiosis, 3rd Edition. Academic Press.
2. Rai M. K. (2006) Handbook of Microbial Biofertilizers. The Hawworth Press. Inc.
3. Tilak KVBR, Pal KK, Dey R (2010) Microbes For Sustainable Agriculture. International Publising House.
4. Deshmukh A. M. , Khoragade R. M. , Dixit, P. P. (2007) Handbook of biofertilizersnand biopesticides. Oxford Book Company.
5. Lichtfouse E. (2009) Genetic engineering, biofertilisation, soil quality and organic farming. Lichtfouse, E. (Ed). Springer.

Teaching and learning methods

Lectures using power point presentations. Lectures notes deposited in the e-learning resources. Laboratory classes: laboratory work and exercises.

Assessment methods

1. Continuous evaluation - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 30% (The exam includes a practical component. Minimum score of 8.0 val is required)
   - Final Written Exam - 30% (The exam includes a practical component. Minimum score of 8.0 val is required)
   - Work Discussion - 40% (Oral presentation of review works)
2. Final evaluation - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100% (The exam includes a practical component. Approved with a grade equal to or greater than 9.5 in 20.)

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Language of instruction

English

Electronic validation

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16-11-2020	17-11-2020	17-11-2020	17-11-2020

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