Universitat Autònoma de Barcelona

2020/2021

Plant Development and Environmental Responses

Code: 43868
ECTS Credits: 6

Degree	Type	Year	Semester
4316231 Plant Biology, Genomics and Biotechnology	OT	0	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: english (eng)

Teachers

Mercè Llugany Ollé

External teachers

Ana Caño Delgado

Elena Monte

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María Coca

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Prerequisites

Basic knowledge of Plant Physiology, Genetics and Molecular Biology.

Objectives and Contextualisation

To transmit the knowledge necessary to understand the main processes of plant development, how these processes are organized, coordinated and adapted to different environmental conditions, including responses to stress. To know the molecular mechanisms and genetic networks regulating all the mentioned processes.

Competences

- Apply knowledge of functional mechanisms of various different organizational levels in plants to the characterization of growth and development processes of the whole plant organism.
- Apply knowledge of plant molecular genetics in different scientific and industrial areas.
- Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.

- Conceive, design, manage and develop a scientific, technical or industrial project in Biology and Biotechnology of plants and fungi, and be able to interpret and extract knowledge of the same.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning in the area of study and in relation to the scientific and business environment.
- Identify and use Bio-Computer Science tools to be applied to the genetic, evolutionary and functional study of plants.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Synthesize, and analyze alternatives and debate critically.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use and manage bibliographical information and computer resources in the area of study.
- Use scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Learning Outcomes

1. "Understand the molecular mechanisms and the ""logic"" of the genetic networks that regulate development in different environmental conditions."
2. Communicate and justify conclusions clearly and unambiguously to both specialised and non-specialised audiences.
3. Continue the learning process, to a large extent autonomously.
4. Design and implement a project to obtain plants that are more tolerant to different types of biotic and/or abiotic stress.
5. Design and implement a project to obtain plants that have adaptive advantages in their natural habitat.
6. Develop critical reasoning in the area of study and in relation to the scientific and business environment.
7. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
8. Know and apply appropriate tools to dissect the genetic networks that regulate plant development and the interactions between them.
9. Know and apply the methodology that is best suited to the genetic and molecular study of the different processes in plant development.
10. Know and apply the methodology that is best suited to the study of signalling routes and hormone interactions in the different stages of plant development and in plants' responses to biotic and abiotic stress.
11. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
12. Synthesize, and analyze alternatives and debate critically.
13. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
14. Use and manage bibliographical information and computer resources in the area of study.
15. Use scientific terminology to argue the results of research and present them in English both orally and in writing in an international environment.

Content

THEORY:

1. PLANT DEVELOPMENT

General concepts. Embryo development: Germination and Dormancy. Seedling development: light regulation, photoperiod regulation and interorganellar communication Vegetative development: Phytohormone action. Senescence, Reproductive development: Floral induction and development. Epigenetics in development.

2. ABIOTIC STRESS

Stress and tolerance: methods of study. Kinds of stress and resistance. Stress measurament. Soil-plant interaction. Rhizosferic processes. Water, salt and ionic stress. Stress tolerance and resistance: effects and mechanisms.

3. BIOTIC INTERACTIONS

Pathogen lifestyles. Plant defense repertoires. Cell death in plant-pathogen interactions. Pathogenic microorganisms: Bacteria, Oomycete and fungi, Viruses. Pathogenic insects and nematods. Trade-offs between biotic and abiotic stress. Trade-offs between biotic stress and development.

Methodology

Theoretical lectures: Within this module, master or expository lectures represent the main activity to be performed in the classroom and allow basic concepts to be transmitted to students in a relatively short time. They will be complemented with Powerpoint presentations, thus the methodology is mainly based on verbal communication, accompanied by visual schemes. Teacher's direct questions to students during the class are indicative of the student's degree of follow-up. Bibliographical references and other sources of 2 class are indicative of the student's degree of follow-up. Bibliographical references and other sources of information are given to foster self-study.

Seminars: They are work sessions, based on work proposed by the teachers that the students will work autonomously. The main purpose of the seminars in this subject is to promote the knowledge of the general and transversal competences of the students. The teaching methodology is based on the exposition and discussion of a scientific article in the classroom. Students have to search for and select an adequate article according to the quality criteria explained by the teacher.

Laboratory practices: Some of the topics covered in the theory class are visualized through laboratory testing. The student will get familiar with protocols and basic techniques of a Plant Physiology Lab.

The student will gain access the protocols and practical guides through the Virtual Campus.

Tutoring: In tutorials in groups or individually, the professor tries to help the students to solve their doubts about the concepts of the subject and guide them in their studies.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory practices	3.5	0.14	8, 9, 10, 6, 2, 3
Lectures	30	1.2	1, 8, 9, 10, 7, 5, 4, 13, 14, 15
Seminars	3	0.12	6, 2, 3, 12, 14, 15
Type: Supervised			
Tutorials	7	0.28	6, 7, 11, 2, 12
Type: Autonomous			
Personal study	90	3.6	7, 11, 3, 14
Preparation of seminars	12	0.48	6, 2, 3, 12, 13, 14, 15

Assessment

The evaluation is based on the following items:

Written exams: to evaluate the contents of the lectures. There will be two eliminatory tests corresponding to two equitable parts of the program. To be able to pass the subject, a minimum grade of 5 must be obtained in each of these parts. The weight of each partial exam in the theory note is 50%. The weight of the theory mark in the final grade is 55%.

Seminars: Participation in the seminars and the quality of the works presented will account for 25% of the final mark.

Assistance, attitude and participation will be valued by a 20% maximum.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Assistance and participation	20	0	0	6, 11, 2, 12, 15
Seminar evaluation	25	1.5	0.06	1, 7, 11, 2, 3, 12, 13, 14, 15
Written exams	55	3	0.12	1, 8, 9, 10, 6, 11, 2, 5, 4

Bibliography

Plant hormones: physiology, biochemistry and molecular biology (book)

Davies, P. 2013. Springer Science & Business Media. ISBN 9401104735, 9789401104739. doi: 10.1007/978-94-011-0473-9

Hormonal Interactions in the Regulation of Plant Development.

Vanstraelen and Benkov. 2012. *ANNU. REV. CELL DEV. BIOL.* 28:463-87

Seed Dormancy and Germination

Bentsink L. and Koornneef M. 2008 *THE ARABIDOPSIS BOOK 6*: e0119. https://doi.org/10.1199/tab.0119

Two Faces of One Seed: Hormonal Regulation of Dormancy and Germination.

Shu et al. 2016. *MOL. PLANT*. 9, 34-45.

PIFs: systems integrators in plant development

Leivar and Monte. 2014. *PLANT CELL,* 26: 56-78

Molecular Control of Grass Inflorescence Development

Zhang and Yuan. 2014. *ANNU. REV. PLANT BIOL.* 65:553-78

Leaf Development

Tsukaya. 2013. *THE ARABIDOPSIS BOOK 11*: e0163. https://doi.org/10.1199/tab.0163

Photomorphogenesis

Arsovski et al. 2012 *THE ARABIDOPSIS BOOK 10*: e0147.. https://doi.org/10.1199/tab.0147

Shade Avoidance

Casal, J. 2012 *THE ARABIDOPSIS BOOK 10*: e0157. https://doi.org/10.1199/tab.0157

Flower Development

Alvarez-Buylla, LR et al. 2010. *THE ARABIDOPSIS BOOK 8:* e0127. https://doi.org/10.1199/tab.0127

Molecular plant-microbe interactions (book)

Bouarab et al. 2009. ISBN 9781845935740. doi: 10.1079/9781845935740.0000

Plant immunity: towards an integrated view of plant-pathogen interactions.

Dodds Rathjen. *NAT REV GENET*. 2010 Aug;11(8):539-48. doi: 10.1038/nrg2812.

Centrality of host cell death in plant-microbe interactions.

Dickman et al. *ANNU REV PHYTOPATHOL*. 2013;51:543-70. doi: 10.1146/annurev-phyto-081211-173027.

Dying two deaths - programmed cell death regulation in development and disease.

Huysmans et al. *CURR OPIN PLANT BIOL.* 2017 Feb;35:37-44. doi: 10.1016/j.pbi.2016.11.005.

The Top 10 oomycete pathogens in molecular plant pathology.

Kamoun et al. *MOL PLANT PATHOL*. 2015 May;16(4):413-34. doi: 10.1111/mpp.12190.

The Top 10 fungal pathogens in molecular plant pathology.

Dean et al. *MOL PLANT PATHOL*. 2012 May;13(4):414-30. doi: 10.1111/j.1364-3703.2011.00783.x.

Top 10 plant pathogenic bacteria in molecular plant pathology.

Mansfield et al. *MOL PLANT PATHOL*. 2012 Aug;13(6):614-29. doi: 10.1111/j.1364-3703.2012.00804.x.

Top 10 plant viruses in molecular plant pathology.

Scholthof et al. *MOL PLANT PATHOL*. 2011 Dec;12(9):938-54. doi: 10.1111/j.1364-3703.2011.00752.x.

Top 10 plant-parasitic nematodes in molecular plant pathology.

Jones et al. *MOL PLANT PATHOL*. 2013 Dec;14(9):946-61. doi: 10.1111/mpp.12057.

How rhizobial symbionts invade plants: the Sinorhizobium-Medicago model.

Jones KM. et al. *NAT REV MICROBIOL.* 2007 Aug;5(8):619-33.

Mechanisms underlying beneficial plant-fungus interactions in mycorrhizal symbiosis.

Bonfante P, Genre A. *NAT COMMUN*. 2010 Jul 27;1:48. doi: 10.1038/ncomms1046. Review.

Mechanisms to Mitigate the Trade-Off between Growth and Defense.

Karasov TL. *PLANT CELL.* 2017 Apr;29(4):666-680. doi: 10.1105/tpc.16.00931.

Disease resistance or growth: the role of plant hormones in balancing immune responses and fitness costs.

Denancé et al. *FRONT PLANT SCI.* 2013 May 24;4:155. doi: 10.3389/fpls.2013.00155.