

Module Handbook of Soil and Plant Microbiology

Module designation	Soil and Plant Microbiology is a course designed specifically for students from Agricultural Microbiology study program, Department of Agricultural Microbiology, Faculty of Agriculture. This course studies the existence, role and interactions between microorganism that inhabit soil bodies with soil fertility and environmental quality.
Semester(s) in which the module is taught	Fourth Semester
Person responsible for the module	Ir. Donny Widiyanto, Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	<i>Elective Course</i>
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment. Details: 1. Lectures 2. Assignment (Individual and Group) 3. Discussion 4. Midterm 5. Final Exam 6. Laboratory Work
Workload (incl. contact hours, self-study hours)	<ul style="list-style-type: none"> - Lectures = 2 SKS x 50 minutes x 16 meetings = 1.600 minutes = 26,67 hours = 26,67 hours/30hours = 0,89 ECTS - Assignment = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS - Self Study = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS - Practicum = 1 SKS x 170 minutes x 16 meetings = 2.720 minutes = 45,33 hours = 45,33 hours/30hours = 1,51 ECTS <p>Total Workload = 4,54 ECTS</p>
Credit points	<i>2/1 Credit Points</i>
Required and recommended prerequisites for joining the module	<i>Biology of Microorganisms</i>

<p>Module objectives/intended learning outcomes</p>	<p><i>Program Learning Outcomes (PLO):</i></p> <p><i>PLO1: Able to explain theoretical concepts of biology microorganism and develop microbial-based technology to increase plant production and environmental services.</i></p> <p><i>PLO2: Able to describe the latest methodology in the field of microbiology to create environmentally friendly and sustainable agricultural development.</i></p> <p><i>PLO3: Able to select, utilize and manage the potential of microbes and microbiomes to build industrial and agricultural systems.</i></p> <p><i>Course Learning Outcomes (CLO):</i></p> <p><i>CLO1: Students can explain the fundamental concepts of soil and plant microbiology, as well as their role and impact on the environment.</i></p> <p><i>CLO2: Students can identify the soil microbial diversity and master the method of detection.</i></p> <p><i>CLO3: Students can explain about the technologies used for waste management in soil and environment.</i></p>
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Content	<ol style="list-style-type: none"> 1. <i>Introduction: Definition, History and Scope of Soil and Plant Microbiology (1 meeting)</i> 2. <i>Soil as Microbial Habitat: Component of soil (solid, liquid and gas), Environmental factors affecting soil and plant life, microbial distribution in soil and plants (1 meeting)</i> 3. <i>Components of Soil Microbes: types and classification of soil and plant microbes, the activity of soil and plant microbes, the role of soil and plant microbes, and micro-interactions of soil and plant microbes (1 meeting)</i> 4. <i>Introduction to Biogeochemical Cycles in Soil: biogeochemical cycles in soil, cycle linkages, and environmental factors affecting the biogeochemical cycles (1 meeting)</i> 5. <i>Organic Material Dynamics: organic matter and its properties, organic matter decomposition and composting technology (1 meeting)</i> 6. <i>The Phosphorus Cycle: the presence of P in soil, P cycle in nature, phosphate solubilizing microbes, mycorrhiza, environmental factors affecting the availability of P (1 meeting)</i> 7. <i>The Nitrogen Cycle: nitrogen cycle, N mineralization, N immobilization, nitrification, denitrification, factors affecting nitrification and denitrification, effects of nitrification and denitrification on the environment, symbiotic and non-symbiotic nitrogen fixation, nitrogen-fixing microbes, environmental factors affecting nitrogen fixation (2 meetings)</i> 8. <i>The Sulphur Cycle: the presence of S compound in soil, S cycle by soil microbes, environmental factors affecting S cycle (1 meeting)</i> 9. <i>Alteration of Metal Elements (Micro-Element Cycle): the presence of metal elements in soil, alteration of metal elements by microbes, environmental factors affecting metal elements alteration in soil (1 meeting)</i> 10. <i>Utilization of Soil Microbes: as a biofertilizer, biocontrol agent, biodegradation and bioremediation agent, producer of biomass and bioenergy, and microbes as a factor in climate change (1 meeting)</i> 11. <i>Methods for Studying Soil Microbes: sampling techniques, methods for culturable and unculturable microbes (1 meeting)</i> 12. <i>Students Seminar (1 meeting)</i> 13. <i>Materials Review (1 meeting)</i>
Examination forms	<i>High Order Thinking Skills Examination</i>
Study and examination requirements	<i>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</i>

<p>Reading list</p>	<p><i>Main References:</i></p> <ol style="list-style-type: none"> 1. Van Elsas, J.D., Trevors, J.T., Rosado, A.S., and Nanipieri, P. 2019. <i>Modern Soil Microbiology</i>. 3rd Edition. Taylor & Francis, Boca Raton. 2. Eldor A. Paul. 2014. <i>Soil Microbiology, Ecology, and Biochemistry</i>. 4th Edition. Academic Press. 3. Tapan Kumar Adhya, Banwari Lal, Balaram Mohapatra, Dhiraj Paul, Subhasis Das (eds.). 2018. <i>Advances in Soil Microbiology: Recent Trends and Future Prospects: Volume 1: Soil-Microbe Interaction [1 ed.]</i>. Springer. 4. Dixon, G.R. and Tilston, E.L. 2010. <i>Soil Microbiology and Sustainable Crop Production</i>. Springer Dordrecht Heidelberg London New York 5. Varma, A., Abbot, L., Werner, D., and Hamp, R. 2008. <i>Plant Surface Microbiology</i>. Springer-Verlag Berlin Heidelberg New York 6. Bardgett, R. 2005. <i>The Biology of Soil</i>. Oxford University Press, Oxford. 7. Sylvia, D.M., Fuhrmann, J.J., Hartel, P.G., and Zuberer, D.A. 2005. <i>Principles and Applications of Soil Microbiology</i>. Pearson Education Inc., New Jersey. 8. Gillings, M. and Holmes, A. 2004. <i>Plant Microbiology</i>. Garland Science/BIOS Scientific Publishers, New York. <p><i>Additional references:</i></p> <ol style="list-style-type: none"> 1. <i>Scientific journals related to soil and plant microbiology</i> 2. <i>Laboratory Classes in Soil and Plant Microbiology Handbook</i>
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