



**Universitas Negeri Surabaya**  
**Faculty of Mathematics and Natural Sciences**  
**Biology Education Undergraduate Study Program**

Document Code

**SEMESTER LEARNING PLAN**

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Plant Nutrition	8420500298	Study Program Elective Courses	T=2	P=0	ECTS=3.18	7	April 27, 2023
AUTHORIZATION	SP Developer		Course Cluster Coordinator			Study Program Coordinator	
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Learning model	Case Studies
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Program Learning Outcomes (PLO)	<b>PLO study program that is charged to the course</b>
<b>PLO-8</b>	Able to make decisions based on data/information in order to complete tasks as part of his responsibilities in the work he has done
<b>PLO-10</b>	Able to design and carry out experiments in biology learning to obtain, analyze and interpret data to solve problems

Program Objectives (PO)	
<b>PO - 1</b>	Apply and communicate the concepts of plant nutrients and organism interactions for mineral nutrient availability (CPL-2, CPL-3).
<b>PO - 2</b>	Applying the concept of nutritional science in overcoming problems related to mineral nutrients in everyday life based on identifying and recognizing symptoms of deficiency and excess of mineral nutrients for plants (CPL-2, CPL-3).
<b>PO - 3</b>	Have the spirit of ecopreneurship, research or quality control that can be developed and applied related to plant nutrients (CPL-7)
<b>PO - 4</b>	Make the right decisions based on information and data analysis, and be able to provide guidance in choosing various alternative solutions independently and in groups in the field of plant nutrients (CPL-9)
<b>PO - 5</b>	Have an independent, honest and responsible attitude by applying the concepts and principles of nutritional science in a safe daily life (CPL-10)

PLO-PO Matrix			
	P.O	PLO-8	PLO-10
	PO-1		
	PO-2		
	PO-3		
	PO-4		
	PO-5		

PO Matrix at the end of each learning stage (Sub-PO)																	
	P.O	Week															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	PO-1																
	PO-2																
	PO-3																
	PO-4																
	PO-5																

**Short Course Description**  
 This course discusses the nutrient elements needed by plants to support optimal plant growth, including their classification, absorption mechanisms carried out by plants both through roots and leaves and the involvement of these elements in vital processes such as photosynthesis, Nitrogen metabolism, and other processes related to the assimilation of nutrients. This includes discussing the consequences of nutrient deficiencies and excesses for plants as well as how to practically diagnose these nutrient deficiencies and excesses. Studies on plant symbiosis with other microorganisms related to nutrient availability are also subject to study, for example with Rhizobium, Mycorrhiza, phosphate solubilizing bacteria and other microorganisms. The decomposition process that occurs in the soil is related to the availability of nutrients and allelochemical compounds in the soil as a result of this process is also included in this study material. In this course, methods regarding the rhizosphere are also studied, for example in relation to marginal land, rhizosphere gradients and the nutrients contained in each rhizosphere gradient. This course is presented in the form of theory and practice to facilitate various process skills (minds on activity and hands on activity) which will be used to solve problems in the field of plant nutrition and its application to support the growth of the spirit of ecopreneurship, research and quality control related to nutrient science. Learning is packaged with a student-certified learning approach using various methods according to the characteristics of the material, for example presentations, discussions, and practicum or other learning strategies.

**References**

**Main :**

- Marschnew, H. 1986. *Mineral Nutrition of Higher Plant*. London: Academic Press
- Resh, h. M. 1989. *Hydroponic Food Production*. California: Woodbridge Press Publishing company
- Yuni Sri Rahayu. 2018. Hara Tanaman dan Asimilasinya. Surabaya: Unesa Press.
- Bergmann, W. 1992. Nutritional Disorders of Plants (Development, Visual and Analytical Diagnosis. Jena: Gustav Fischer Verlag.
- Taiz, L. dan Zeiger, E. 2010. Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.
- Rahayu, YS, Yuliani, Dewi, SK. 2021. Penyakit Tanaman Akibat Defisiensi Unsur Hara. Surabaya: Unesa Press.

**Supporters:**

**Supporting lecturer**  
 Prof.Dr. Yuni Sri Rahayu, M.Si.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [ Estimated time]		Learning materials [ References ]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline ( offline )	Online ( online )		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

1	Describe the criteria for essential nutrients and the mechanism of their absorption in the roots.	<ol style="list-style-type: none"> <li>1.a. Explains the introduction to nutritional science;</li> <li>2.b. Explain the definition and classification of essential plant nutrients;</li> <li>3.c. Explain the mechanisms of ion absorption by individual cells and roots;</li> <li>4.d. Distinguish between short distance transport and long distance transport.</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. UTS weight 20%</li> <li>4. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 30%</li> <li>5. UAS weight 30%</li> <li>6. Essay questions are accessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>Lecturers facilitate student-centered learning through case studies and group discussions and are responsible for finding concepts (based on literature reviews) regarding the criteria for essential nutrients and mechanisms for their absorption in roots based on natural phenomena that occur every day. Furthermore, facilitate the presentation of results based on explanations/solutions to related natural phenomena/symptoms.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes Read and underline the important concepts of essential nutrient criteria and the mechanism of absorption in the roots.</p> <p>Structured: 2x60 minutes Make 2 X 50 practical reports</p>	-	<p><b>Material:</b> a. Introduction to Nutrient Science b. Definition and classification of essential plant nutrients c. Mechanism of ion absorption by individual cells and roots d. Short distance transport and Long distance transport. <b>Reader:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p>	5%
2	Distinguish between the concepts of transport through xylem and phloem and their relationship to plant production results.	<ol style="list-style-type: none"> <li>1.a. Compare transport through xylem and phloem and their regulation;</li> <li>2.b. Comparing the "source and sink" process of plant nutrients and its response to production results.</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>3. UAS weight 30%</li> <li>4. UTS weight 20%</li> <li>5. Essay questions are accessed together during UTS and UAS</li> <li>6. Practicum/Report is assessed as an assignment with a weight of 30%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>Lecturers facilitate student-centered learning through:</p> <ol style="list-style-type: none"> <li>1. Animation of water and mineral transport, transport through phloem, opening stomata</li> <li>2. Images of nutrient transport, mechanisms for opening stomata</li> </ol> <p>Based on media no. 1 and 2, students carry out individual activities beforehand by reading case references related to transport through xylem and transportation through phloem which has been carried out in a structured manner (case study). Then the lecturer facilitates student-centered learning through student group discussions about the concept of transport through xylem and transport through phloem based on the reference analysis that has been carried out.</p> <p>Based on the results of the group discussion, students convey ideas and solutions and present the results of the discussion</p> <p>Face to face: 2x50 minutes Independent: 2x60</p> <p>Structured minutes : 2x60 minutes Make a PPT and present the results of the discussion based on case studies regarding the transport process through xylem and phloem as well as the "Source and Sink" process 2 X 50</p>	-	<p><b>Material:</b> a. Transport through xylem and phloem and their arrangement b. The process of "source and sink" of plant nutrients and its response to production results. <b>Reader:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. Transport through xylem and phloem and their arrangement b. The process of "source and sink" of plant nutrients and its response to production results. <b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology</i>. California: The Benjamin/Cummings Publishing Company, Inc.</p>	5%

3	Describe the mechanism of nutrient absorption through leaves and apply this concept in everyday life.	<p>1.a. Explain the absorption and release of plant nutrients by leaves and other plant parts;</p> <p>2.b. Explain the difference between fertilizing via leaves and fertilizing via soil;</p> <p>3.c. Explain the concept of nutrient availability (available) for plants.</p>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>3. UAS weight 30%</li> <li>4. UTS weight 20%</li> <li>5. Essay questions are accessed together during UTS (meeting 8) and UAS (meeting 16)</li> <li>6. Practicum/Report is assessed as an assignment with a weight of 30%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>Lecturers facilitate student-centered learning through students' active discussions about the absorption and release of plant nutrients by leaves and other plant parts. Previously, students were individually facilitated to independently review related concepts regarding nutrient absorption through leaves. Next, a case study is given about the advantages and disadvantages of fertilizing plants through leaves and solutions and explanations. Students conduct active group discussions to seek explanations/solutions regarding fertilization through plant leaves and present the results of their group work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes Read and rediscover the concept of absorption and release of plant nutrients by leaves and other plant parts, fertilization and the concept of nutrient availability for plants and the concept of nutrient availability (available) for plants</p> <p>Structured: 2x60 minutes Make resume table of differences between foliar fertilization and root fertilization 2 X 50</p>		<p><b>Material:</b> a. Absorption and release of plant nutrients by leaves and other plant parts. b. Difference between fertilizing through leaves and fertilizing through soil c. The concept of nutrient availability (available) for plants</p> <p><b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology</i>. California: The Benjamin/Cummings Publishing Company, Inc.</p> <p><b>Material:</b> a. Absorption and release of plant nutrients by leaves and other plant parts. b. Difference between fertilizing through leaves and fertilizing through soil c. The concept of nutrient availability for plants</p> <p><b>Library:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p>	5%
4	<ol style="list-style-type: none"> <li>1. Describe the definition, function, deficiency and excess of macro nutrients for plants.</li> <li>2. Describe the symptoms of deficiencies and excesses of macro nutrients that occur in plants</li> <li>3. Describe the actions that should be taken to overcome them based on the results of the analysis.</li> </ol>	<ol style="list-style-type: none"> <li>1.a. Explain the definition, function, deficiency and excess of macro nutrients for plants.</li> <li>2.c. Explain the actions that will be taken to overcome deficiency symptoms that occur in plants</li> <li>3.b. Identify symptoms of deficiencies and excesses of macro nutrients that occur in plants</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Essay questions are accessed together during UTS and UAS</li> <li>3. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>4. UTS weight 20%</li> <li>5. UAS weight 30%</li> <li>6. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Practice/Performance</p>	<p>The lecturer facilitates students using guided discovery by using LKM in groups, discussing, to discover concepts (definition, function, deficiency and excess of macro nutrients for plants.) and presenting the results of their group work</p> <p>Face to face: 2x50 minutes Independent: 2x60 minutes Reading and discovering reconceptualization of the definition, function, deficiency and excess of macro nutrients for plants.</p> <p>Structured: 2x60 minutes Create a resume of grouping tables, forms of availability, function and symptoms of deficiency of plant macronutrients 2 X 50</p>		<p><b>Material:</b> a. Definition, function, deficiency and excess of macro nutrients for plants b. Symptoms of deficiency and excess of macro nutrients c. Actions that will be taken to overcome deficiency symptoms that occur in plants.</p> <p><b>Library:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. Definition, function, deficiency and excess of macro nutrients for plants b. Symptoms of deficiency and excess of macro nutrients c. Actions that will be taken to overcome deficiency symptoms that occur in plants.</p> <p><b>Library:</b> Rahayu, YS, Yuliani, Dewi, SK. 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p>	5%

5	Describe the definition, function, deficiency and excess of macro nutrients for plants. Describe the symptoms of deficiencies and excesses of macro nutrients that occur in plants. Describe the actions that should be taken to overcome them based on the results of the analysis.	<ol style="list-style-type: none"> <li>1.a. Explain the definition, function, deficiency and excess of macro nutrients for plants.</li> <li>2.b. Identify symptoms of deficiencies and excesses of macro nutrients that occur in plants</li> <li>3.c. Explain the actions that will be taken to overcome symptoms of macro nutrient deficiency that occur in plants</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. UAS weight 30%</li> <li>3. UTS weight 20%</li> <li>4. Essay questions are accessed together during UTS and UAS</li> <li>5. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>The lecturer facilitates students using guided discovery by using LKM in groups, discussing, to discover concepts (definition, function, deficiency and excess of macro nutrients for plants.) and presenting the results of their group work</p> <p>Face to face: 2x50 minutes Independent: 2x60 minutes Reading and discovering reconceptualization of the definition, function, deficiency and excess of macro nutrients for plants.</p> <p>Structured: 2x60 minutes Create a resume of grouping tables, forms of availability, function and symptoms of deficiency of plant macronutrients 2 X 50</p>		<p><b>Material:</b> a. Definition, function, deficiency and excess of macro nutrients for plants b. Symptoms of deficiency and excess of macro nutrients c. Actions that will be taken to overcome deficiency symptoms that occur in plants. <b>Library:</b> Yuni Sri Rahayu, 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. Definition, function, deficiency and excess of macro nutrients for plants b. Symptoms of deficiency and excess of macro nutrients c. Actions that will be taken to overcome deficiency symptoms that occur in plants. <b>Library:</b> Rahayu, YS, Yuliani, Dewi, SK, 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p>	5%
6	Describe the definition, function, deficiency and excess of micro nutrients and additional nutrients for plants (Beneficial Mineral Element; definition, Na, Si, Co, Se, Al, and others). Identify symptoms of deficiencies and excesses of micronutrients and additional nutrients that occur in plants to determine the actions that should be taken to overcome them based on the results of the analysis. Explain the actions that will be taken to overcome symptoms of micronutrient deficiency and additional nutrients (Beneficial Mineral Elements);	<ol style="list-style-type: none"> <li>1.a. Explain the definition, function, deficiency and excess of micro nutrients and additional nutrients for plants.</li> <li>2.b. Identify symptoms of deficiencies and excesses of micro nutrients and additional nutrients that occur in plants</li> <li>3.c. Explain the actions that will be taken to overcome symptoms of micronutrient deficiency and additional nutrients that occur in plants</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Essay questions are accessed together during UTS and UAS</li> <li>3. UAS weight 30%</li> <li>4. UTS weight 20%</li> <li>5. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>The lecturer facilitates students using guided discovery by using LKM in groups, discussing, to discover concepts (definitions, functions, deficiencies and advantages of micro nutrients and additional nutrients for plants.) and presenting the results of their group work</p> <p>Face to face: 2x50 minutes Independent: 2x60 minutes Read and rediscover the concept of the definition, function, deficiency and excess of micronutrients for plants.</p> <p>Structured: 2x60 minutes Create a resume of grouping tables, forms of availability, function and symptoms of plant nutrient deficiency 2 X 50</p>		<p><b>Material:</b> d. Definition, function, deficiency and excess of micro nutrients for plants e. Symptoms of deficiency and excess of micro nutrients f. Actions that will be taken to overcome symptoms of micro nutrient deficiency that occur in plants. <b>Library:</b> Yuni Sri Rahayu, 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> d. Definition, function, deficiency and excess of micro nutrients for plants e. Symptoms of deficiency and excess of micro nutrients f. Actions that will be taken to overcome symptoms of micro nutrient deficiency that occur in plants. <b>Library:</b> Rahayu, YS, Yuliani, Dewi, SK, 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p>	5%

7	Design a recommendation pocket book project to identify symptoms of deficiencies and excesses of macro nutrients, micro nutrients and additional nutrients in surrounding plants. Recommend actions to be taken to overcome symptoms of deficiency of macro nutrients, micro nutrients and additional nutrients (Beneficial Mineral Elements)	<p>1.a. Designing a recommended pocket book project to identify symptoms of deficiency and excess of macro nutrients, micro nutrients and additional nutrients in surrounding plants</p> <p>2.b. Recommend actions to be taken to overcome symptoms of deficiency of macro nutrients, micro nutrients and additional nutrients (Beneficial Mineral Elements)</p>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>3. UAS weight 30%</li> <li>4. UTS weight 20%</li> <li>5. Essay questions are accessed together during UTS and UAS</li> <li>6. Practicum/Report is assessed as an assignment with a weight of 30%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment</p>	<p>Lecturers facilitate students using the PJBL learning model. The resulting product is a Pocket Book of Recommendations for diagnosis of symptoms of deficiency and excess nutrients that appear in surrounding plants. 1. The first stage of PJBL: The lecturer asks students a basic question (authentic problem), namely how to diagnose symptoms of deficiency and excess of nutrients that appear in the plants around us? and what is the control solution?</p> <p>2. Second stage of PJBL: Students are asked to design and develop products starting from: identifying needs (topics, book materials, book systematics, observation mechanisms, determining nutrients and plants).</p> <p>Next, students will present the results of their designs, which include product design and development, which have been prepared so that students get input from other groups and lecturers.</p> <p>Stage 3 of the PJBL is preparing a schedule and agreeing on a product results monitoring schedule which is agreed upon after the UTS.</p> <p>Face to face: 2x50 minutes Independent: 2x60 minutes Structured: 2x60 minutes</p> <p>Facilitate students to use diagnostic keys to diagnose symptoms of nutrient deficiency and excess in plants 2 X 50</p>		<p><b>Material:</b> a. The key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in the plant c. Actions to be taken to overcome additional deficiency symptoms (Beneficial Mineral Element); definitions, Na, Si, Co, Se, Al, and others that occur in plants <b>Library:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. The key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in the plant c. Actions to be taken to overcome additional deficiency symptoms (Beneficial Mineral Element); definitions, Na, Si, Co, Se, Al, and others that occur in plants <b>Library:</b> Rahayu, YS, Yuliani, Dewi, SK. 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. The key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in the plant c. Actions to be taken to overcome additional deficiency symptoms (Beneficial Mineral Element); definition, Na, Si, Co, Se, Al, and others that occur in plants. <b>Reference:</b> Bergmann, W. 1992. <i>Nutritional Disorders of Plants (Development, Visual and Analytical Diagnosis</i>. Jena: Gustav Fischer Verlag.</p>	6%
8	UTS	<ol style="list-style-type: none"> <li>1.1. Define the classification of essential plant nutrients</li> <li>2.7. Compare the role of symbiotic microorganisms on plants and the acquisition of nutrients</li> <li>3.2. Describe the mechanism of absorption by individual cells and roots</li> <li>4.3. Distinguish between short distance transport and long distance transport mechanisms</li> <li>5.4. Compare transport through xylem and phloem and their regulation</li> <li>6.5. Compare the plant nutrient "source and sink" process and its response to production results</li> <li>7.6. Compare the process of fertilizing through leaves and fertilizing through soil</li> </ol>	<p><b>Criteria:</b> UTS 20%</p> <p><b>Form of Assessment :</b> Test</p>	- 2 X 50		<p><b>Material:</b> Nutrient Transport Mechanisms, Plant Nutrients and Their Assimilation, Deficiency of Nutrient Elements <b>Library:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> Plant diseases and how to diagnose them. <b>Reference:</b> Rahayu, YS, Yuliani, Dewi, SK. 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p>	10%

9	Develop a recommendation based on the results of the diagnosis of the symptoms that appear on the plant	<p>1.a. Skilled in using the key to diagnose nutrient deficiencies and excesses in plants.</p> <p>2.b. Skilled in preparing recommendations based on the results of diagnosis of deficiency and excess symptoms that appear in plants</p> <p>3.c. Skilled in presenting project results</p>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. UAS weight 30%</li> <li>3. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>4. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>5. Essay questions are accessed together during UTS and UAS</li> <li>6. UTS weight 20%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment</p>	<p>Continuing to the 4th PjBl stage, namely the Monitoring Stage. Students, through their groups, were asked to present the progress of the recommended book on symptoms of deficiency and excess of nutrients which had been completed &gt; 75%. Based on the progress presentation, lecturers and other students will provide input.</p> <p>To improve and develop the book products produced. In addition, it was agreed that the product would be produced at the 15th meeting and evaluation and reflection and publication of the product would be carried out.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes Structured Assignment: 2x60 minutes In groups create a project to compile a book containing recommendations based on the results of the diagnosis of the symptoms that appear on plants.</p> <p>Make recommendations for actions to be taken to overcome deficiencies and excesses of nutrients in plants 2 X 50</p>		<p><b>Material:</b> a. Key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in plants. c. Actions that will be taken to overcome symptoms of deficiency of macro, micro and additional nutrients (Beneficial Mineral Elements) that occur in plants . <b>Library:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. Key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in plants. c. Actions that will be taken to overcome symptoms of deficiency of macro, micro and additional nutrients (Beneficial Mineral Elements) that occur in plants . <b>Reference:</b> Rahayu, YS, Yuliani, Dewi, S.K. 2021. <i>Plant Diseases Due to Nutrient Deficiency</i>. Surabaya: Unesa Press.</p> <p><b>Material:</b> a. Key to diagnosing nutrient deficiencies and excesses in plants. b. Recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in plants. c. Actions that will be taken to overcome symptoms of deficiency of macro, micro and additional nutrients (Beneficial Mineral Elements) that occur in plants . <b>Reference:</b> Bergmann, W. 1992. <i>Nutritional Disorders of Plants (Development, Visual and Analytical Diagnosis</i>. Jena: Gustav Fischer Verlag.</p>	6%
10	Describe the mechanism of nitrogen fixation by Rhizobium (biological fixation Nitrogene) so that you can apply it in everyday life to help overcome soil fertility problems	<p>1.a. Explain the mechanism of nitrogen fixation by rhizobium</p> <p>2.b. Explain the application of Rhizobium to help problems in everyday life</p>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. UAS weight 30%</li> <li>4. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>5. Essay questions are accessed together during UTS and UAS</li> <li>6. UTS weight 20%</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>The lecturer facilitates students in groups and discussing, to discover the concept of the mechanism of nitrogen fixation by rhizobium based on case studies encountered in natural phenomena or symptoms that occur and and present the results of their group work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes Reviewing literature to find the concept of the mechanism of nitrogen fixation by rhizobium</p> <p>Structured: 2x60 minutes Making a resume about the application of rhizobium to help with problems in everyday life 2 X 50</p>		<p><b>Material:</b> a. Mechanism of nitrogen fixation by rhizobium b. Rhizobium to help with problems in everyday life <b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology</i>. California: The Benjamin/Cummings Publishing Company, Inc.</p>	5%

11	Describe the role and mechanisms of mycorrhiza and phosphate solubilizing bacteria in order to apply them in everyday life to help overcome related problems.	<ol style="list-style-type: none"> <li>1.a. Explain the role of mycorrhiza in everyday life</li> <li>2.b. Explain the mechanism of mycorrhiza that can be applied in everyday life</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>4. UAS weight 30%</li> <li>5. UTS weight 20%</li> <li>6. Essay questions are assessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Practical Assessment</p>	<p>The lecturer facilitates students in groups and discussing, to find concepts based on case studies about the role of mycorrhiza in everyday life and its mechanisms and present the results of their group work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes</p> <p>Reviewing literature in the form of research results published in journals regarding the role of mycorrhiza in the agricultural sector</p> <p>Structured: 2x60 minutes</p> <p>Making a report on the results of a literature review regarding the role of mycorrhiza in the agricultural sector 2 X 50</p>		<p><b>Material:</b> a. The role of mycorrhiza in everyday life b. Mycorrhizal mechanisms that can be applied in everyday life</p> <p><b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.</i></p> <p><b>Material:</b> a. The role of mycorrhiza in everyday life b. Mycorrhizal mechanisms that can be applied in everyday life</p> <p><b>Reader:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation. Surabaya: Unesa Press.</i></p>	6%
12	Describe the role and mechanisms of mycorrhiza and phosphate solubilizing bacteria in order to apply them in everyday life to help overcome related problems.	Explain the nature of soil pathogenic bacteria and their relationship to soil health	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>4. UAS weight 30%</li> <li>5. UTS weight 20%</li> <li>6. Essay questions are assessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Practical Assessment</p>	<p>The lecturer facilitates students in groups and discussing, to find concepts based on case studies about the role of solvent bacteria in everyday life and their mechanisms and present the results of their group work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes</p> <p>Reviewing literature in the form of research results published in journals regarding the role of solvent bacteria in the agricultural sector</p> <p>Structured: 2x60 minutes</p> <p>Making a report on the results of a literature review regarding the role of solvent bacteria in the agricultural sector</p> <p>Lecturers facilitate student-centered learning, through case studies in life symptoms/phenomena by prioritizing the facilitation of active discussions to discover concepts related to the nature of soil pathogenic bacteria and their relationship to soil health and presenting the results of the group's work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes</p> <p>Read and write in groups and write the results of a literature review in a journal research results about the nature of soil pathogenic bacteria and their relationship to soil health</p> <p>Structured: 2x60 minutes</p> <p>Make a report on the results of a literature review regarding the nature of soil pathogenic bacteria and their relationship to soil health 2 X 50</p>		<p><b>Material:</b> a. The role of phosphate solubilizing bacteria in everyday life b. Mechanisms of phosphate solubilizing bacteria that can be applied in everyday life</p> <p><b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.</i></p> <p><b>Material:</b> a. The role of phosphate solubilizing bacteria in everyday life b. Mechanisms of phosphate solubilizing bacteria that can be applied in everyday life.</p> <p><b>Reference:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation. Surabaya: Unesa Press.</i></p>	6%

13	Describe the nature of soil pathogenic bacteria and their relationship to soil health.	Explain the nature of soil pathogenic bacteria and their relationship to soil health	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>4. UAS weight 30%</li> <li>5. UTS weight 20%</li> <li>6. Essay questions are assessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment</p>	<p>Lecturers facilitate student-centered learning, through case studies in life symptoms/phenomena by prioritizing active discussion facilitation to discover concepts related to the nature of soil pathogenic bacteria and their relationship to soil health and present the results of their group work.</p> <p>Face-to-face: 2x50 minutes</p> <p>Independent: 2x60 minutes Read and write in groups and write the results of a literature review in a journal research results about the nature of soil pathogenic bacteria and their relationship to soil health Structured: 2x60 minutes Make a report on the results of a literature review regarding the nature of soil pathogenic bacteria and their relationship to soil health 2 X 50</p>		<p><b>Material:</b> Properties of soil pathogenic bacteria and their relationship to soil health <b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.</i></p>	6%
14	Describe the decomposition process and the role of allelopathy in relation to biological control.	<ol style="list-style-type: none"> <li>1.a. Explain the decomposition process</li> <li>2.b. Analyzing the role of allelochemical compounds related to biological control</li> </ol>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>4. UAS weight 30%</li> <li>5. UTS weight 20%</li> <li>6. Essay questions are assessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities</p>	<p>Lecturers facilitate student-centered learning, through case studies of the decomposition process and the role of allelopathy in natural phenomena that occur in everyday life by encouraging students to have active discussions in discovering concepts related to the decomposition process and the role of allelochemical compounds related to biological control and presenting the results of their group work .</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 3x60 minutes Read and write in groups and write the results of a journal review of research results on the role of allelochemic compounds related to biological control</p> <p>Structured: 2x60 minutes Make a report on the results of a literature review regarding the role of allelochemic compounds related to biological control 2 X 50</p>		<p><b>Material:</b> a. Decomposition process b. The role of allelochemical compounds related to biological control. <b>References:</b> Taiz, L. and Zeiger, E. 2010. <i>Plant Physiology. California: The Benjamin/Cummings Publishing Company, Inc.</i></p> <p><b>Material:</b> a. Decomposition process b. The role of allelochemical compounds related to biological control. <b>Reference:</b> Yuni Sri Rahayu. 2018. <i>Plant Nutrients and Their Assimilation. Surabaya: Unesa Press.</i></p>	5%



15	Applying the concept of nutritional science to the scope of the rhizosphere regarding the relationship between plants, soil and microorganisms.	<p>1.a. Analyze the Rhizosphere and its gradients in relation to plant nutrients: soil fertility, health and productivity</p> <p>2.b. Analyzing applications in natural phenomena or phenomena related to the scope of the Rhizosphere in relation to soil fertility (availability/availability of nutrients)</p>	<p><b>Criteria:</b></p> <ol style="list-style-type: none"> <li>1. Presentations are assessed as assignments with a weight of 30%</li> <li>2. Practicum/Report is assessed as an assignment with a weight of 30%</li> <li>3. Student activities and responses during learning activities, especially during presentations/practicum/assignments, are assessed as participation with a weight of 20%</li> <li>4. UAS weight 30%</li> <li>5. UTS weight 20%</li> <li>6. Essay questions are assessed together during UTS and UAS</li> </ol> <p><b>Form of Assessment :</b> Participatory Activities, Practice/Performance</p>	<p>The lecturer facilitates students in groups and discussions, to discover the concept of the rhizosphere and its gradient in relation to plant nutrients, fertility, health and soil productivity as well as the scope of the rhizosphere in relation to soil fertility (availability/availability of nutrients) based on related case studies that occurred in everyday life to get explanations/solutions to these phenomena and present the results of their group work.</p> <p>Face to face: 2x50 minutes</p> <p>Independent: 2x60 minutes Reviewing literature on the rhizosphere and its gradients in relation to plant nutrients, fertility, health and soil productivity</p> <p>Structured: 2x60 minutes Making a presentation related to the project assignment as part of the final evaluation of the product produced. 2 x 50</p>		<p><b>Material:</b> a. The rhizosphere and its gradients in relation to plant nutrients: soil fertility, health and productivity b. The scope of the Rhizosphere in relation to soil fertility (availability/availability of nutrients) <b>Reference:</b> <i>Yuni Sri Rahayu, 2018. Plant Nutrients and Their Assimilation. Surabaya: Unesa Press.</i></p>	5%
16	UAS	<ol style="list-style-type: none"> <li>1.1. Develop recommendations based on the results of the diagnosis of deficiency and excess symptoms that appear in the plant</li> <li>2.2. Analyze the role of Rhizobium in its application to overcome the problem of soil nitrogen deficiency</li> <li>3.3. Analyze the role of mycorrhiza in applications to overcome the problem of soil nutrient deficiencies</li> <li>4.4. Analyze the role of Phosphate Solubilizing Bacteria in applications to overcome the problem of soil P deficiency</li> <li>5.5. Analyze the role of allelochemical compounds related to biological control</li> <li>6.6. Explain the scope of the Rhizosphere in relation to soil fertility (availability/availability of nutrients)</li> </ol>	<p><b>Criteria:</b> UAS 30%</p> <p><b>Form of Assessment :</b> Test</p>			<p><b>Material:</b> Nitrogen Metabolism and Rhizobium, Mycorrhiza, Phosphate Solubilizing Bacteria, Soil Pathogens and Soil Health, Decomposition and Allelopathy, Rhizosphere <b>References:</b> <i>Marschnew, H. 1986. Mineral Nutrition of Higher Plants. London: Academic Press</i> <i>Resh, p. M. 1989. Hydroponic Food Production. California: Woodbridge Press Publishing company</i></p> <p><b>Material:</b> Nitrogen Metabolism and Rhizobium, Mycorrhiza, Phosphate Solubilizing Bacteria, Soil Pathogens and Soil Health, Decomposition and Allelopathy, Rhizosphere <b>Reader:</b> <i>Yuni Sri Rahayu, 2018. Plant Nutrients and Their Assimilation. Surabaya: Unesa Press.</i></p>	15%

**Evaluation Percentage Recap: Case Study**

No	Evaluation	Percentage
1.	Participatory Activities	55%
2.	Project Results Assessment / Product Assessment	9%
3.	Practical Assessment	6%
4.	Practice / Performance	5%
5.	Test	25%
		100%

**Notes**

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.

5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.