PORTFOLIO OF THE COURSE
OF PLANT PATHOLOGY (PPT 24315)

EVEN SEMESTER OF 2022

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STUDY PROGRAM OF PLANT PROTECTION
DEPARTMENT OF PLANT PEST AND DISEASE
FACULTY OF AGRICULTURE
UNIVERSITAS SRIWIJAYA

2022

I. INTRODUCTION

Plant pathology is the science the causes of plant diseases, the mechanisms by which diseases develop in plant and the way and means by which plant diseases can be managed orn controlled.

Course of Plant Pathology is compulsory course in curriculum of Plant Protection Study Program. The course is offered to third year students or semester V, from January to December. The course has no specific requirement and every student of semester V can attend the course. The course is delivered in the form of face-to- face lecturing and some topics are given in the form of practicum and case study. Assignments are given in the form of quiz, paper writing, project reports, and midterm and final examination. Both midterm and final examinations were in the form of answering question in short essays. For the last semester (even semester of 2022), the number of students attended the course was 78 students divided into 2 classes (A and B). All of the participants were the students of Plant Protection Study Program, Faculty of Agriculture, Universitas Sriwijaya.

This portfolio is an evaluation document of planning, implementing and evaluating the teaching and learning process of the course of Plant Pathology, and also the follow up of the evaluation results with required improvement. For the stated purposes, this portfolio consists of the followings point of interests:

1. Course description
2. Course implementation
3. Course evaluation
4. Reflection
5. Course improvement
6. Appendix

II. COURSE DESCRIOTION

The focus of the Plant Pathology course is on understanding the existence of plant diseases as one of the obstacles to agricultural production with all its aspects. The discussion includes the definition and boundaries of of healthy plants and unhealthy plants; plants pathogen (biotic and abiotic), fungal, bacterial, viral, phytoplasma and nematode diseases; the interaction of the host plant with the pathogen, the infection process starting from inoculation, pre-penetration, penetration, invasion, colonization, repruduction, dissimination and survival; interaction host-pathogen-environment, host plant response to pathogen infection; symptoms and signs of plant diseases; severity and incidence of plant diseases; damage and loss due to plant diseases and plant disease management

III. COURSE IMPLEMENTATION

Teaching Methods

Teaching and learning process of the course include face-to-face lecturing, either in the classroom or online via internet using Universitas Sriwijaya LMS, practical work in the laboratory, greenhouse and in the field, group discussion and project asignment. Assesment is conducted in several ways includiung quis, practical reports, mid term axamination, presentation and final examination.

Learning outcomes asigned to the course (Course Learning / CLO) and weekly competence (Sub-CLO) to be achived by students are systematically arranged in the semester learning plan (RPS) of the course (Appendix 1). The intended learning outcomes assigned to the course are as follow:

CLO-1: Students are able to master theoretical concepts and the history of plant diseases in depth

Sub-CLO 1: Studen are able to explain the history of disease development and the terminology of plant disease including their signs and symptoms.

CLO-2: Students are able to master theoretical concepts about the principles of disease from infection to interactions between plant-pathogens and the environment.

The achievement of the CLO-2 is divided and distributed to 5 Sub-CLOs which are driven by weekly learning materials. The Sub-CLOs are as follow:

Sub-CLO 2: Students are able to explain about the mechanism of parasitization and the development of plant disease.

Sub-CLO 3: Student are able to explain the factors that influence the development of the disease and the occurrence of disease epidemics

Sub-CLO4: Student are able to explain how plant defense to pathogen attack.

Sub-CLO 5: Students are able to explain the influence of disease on the metabolic processes of the infection plant.

Sub-CLO6: Students are able to explain the classification of plants pathogen

CLO-3: Students are able to recognize and measure plant damage caused by pests and plant diseases

The achievement of the CLO-3 is divided and distributed to 3 Sub-CLOs which are driven by weekly learning materials. The Sub-CLOs are as follow:

Sub-CLO 7: Student are able to explain plants disease cause by biotic factors.

Sub-CLO 8: Student are able to explain how abiotic pathogens can cause disease and damage in plants.

Sub-CLO 9: Student are able to explain how abiotic factor can cause damage to plant

CLO-4: Students are able to be able to utilize local biological resources for creative, innovative and environmentally friendly plant disease control

The achievement of the CLO-3 is divided and distributed to 4 Sub-CLOs which are driven by weekly learning materials. The Sub-CLOs are as follow:

Sub-CLO 10:Student are able to explain plant disease control tecniques

Sub-CLO11 Students are able to explain the diseases biolical control control.

Sub-CLO 12. Students are able to explain physical and chemical disease control techniques as well as technical control

Sub-CLO 13. Students are able to explain the integrated disease control techniques

CLO-5: Students are able to identify and modify local wisdom using the latest science and technology to be applied in site-specific plant protection practices

Sub-CLO 14: Students are able to explain the use of biotechnology in the identification and management of plant disease

Course Delivery

Teaching and learning process of the course of Plant Pathology was conducted in accordance to Indonesian National Standard of Higher Education which every credit of lecture should be delivered in face-to-face lecture delivery for 50 minutes, structured assignment for 60 minutes, and personal learning assignment for 60 minutes. Lecture was given in two ways of lecturing, face-to-face in the classroom and online lecturing via internet. Practical works were conducted mostly in shade house and green house, while laboratory was used only for plant virus inoculum preparation. Course delivery in the classroom was made as effective as possible and students were encouraged to be active during learning process. Group discussion was also arranged to give students more opportunity to participate in the learning process. Structured assignment was frequently given in the form of paper assignment. Students were given certain topics related to the learning materials and given time to complete the assignment. Personal learning commonly given in the form of reading recommended material to broaden their knowledge and insight related to plant pathology.

Two lecturers assigned as the teaching team of the course (Nurhayati and A. Muslim) took part in the lecturing process according to the topics determined in the Semester Lecturing Plan using the most suitable method to the materials delivered.

Assessment Method

During and after teaching and learning process, evaluations were made as parameters of the achievement made by students in relation to intended learning outcome (CLO) and sub-CLOs. Various methods of assessment were conducted in order to precisely measured the knowledge and skill gained by students after attending the source or weekly learning process. The assessment conducted included: paper assignment, quiz. practical report, midterm examination and final examination.

The relationship between assessment method and the measurement of achievement of each CLO of the course of Plant Pathology are presented in the following matrix.

Figure 1. Matrix showing the relationship between assessment method and the measurement of each CLO achievement

	Course Learning Outcomes (CLO)				
	CLO-1 (K-2)	CLO-2 (K-2)	CLO-3 (GS-4)	CLO-4 (SS-2)	CLO-5 (K-2)
CLO-1, cCLO-2: Students are able to master theoretical concepts about the principles of disease from infection to interactions between plant-pathogens and the environment	Paper assignment 1, write a short essay on the history of plant pathology ; the stage of plant infection and the factors that influence diasease (Lectures 1 and 2; weight 5%)				
		Quiz on the explanation of stage of plant infection by pathogens, disease sign and symptoms (Lecture 3, weight 5%)			
			Paper assignment 2,write essay on the infection pathogens on plant		

				Report on the practical weight 5%)	
CLO3: CLO-2. Student are able to master theoretical concepts of the principles of plant pathology start from interaction between plant-pathogen-environment	Midterm examination on history and development of plant phatology, infection , factors that influence plants disease development, plants defence, effect of pathogen infection on plants fisiology and plants disease cause by biotic factors (Lecture 1, 2, 3, 4, 5, 6, 7 and 8; weight 35%)				
CLO3: Students are able to recognize and measure plant damage caused by pests and plant diseases					Paper assignment 3,Group presentation on plant diseases caused by biotic factors: fungi, bacteria, viruses, nematodes and factors that influence them Lectures 11 and 12, weight 5%)

CLO 4. CLO5: Students are able to utilize local biological resource for creative, innovative and environmentally friendly plant disease control.			Final exam on plant disease epidemiology and plants disease management and control (Lecture 9,10, 11, 12,13 and 14;weight 40%)

The teaching team leader coordinated the evaluation process and determined the scoring system (Apendix 2). Grading of evaluation scores had been determined by the Rector of Universitas Sriwijaya for years and was used to converse numerical grade to letter grade as shown in Table 1.

Table 1. Universitas Sriwijaya grading system

No	Numerical grade	Letter grade	Grade point
1	86-100	A	4
2	71-85	B	3
3	56-70	C	2
4	40-55	D	1
5	<40	E	0

As presented in the above matrix, assessments were conducted 7 times to assess the CLO achievement. Each assessment was designed to assess the achievement of certain CLO or combination of two or more CLO. The details of each assessment are as follow:

1. Assignment 1.
   Student were assigned to write essay on the history and development of plant pathology, ; the stage of plant infection and the factors that influence disease. The essay should explain the interaction between pathogen-host-environment. The essay must be written with citation at least 3 reputable journals. students were given one week time to complete the essay. This assignment was aimed at evaluating the achievement of **CLO1**, sub-CLO 1 and 2 (An example of of student work sheet is attached in appendix).

2. Quiz
   Quiz is done at the end of third lecture. Students were asked to answer questions on the stage of infection, sign dan symptoms. The first question asked students to explain how the plant disease infection occur and the factors that influence it, and the second question asked students to explain what the difference between sign and symptoms. This quiz was to evaluate the achievement of CLO 1, sub-CLO 3 (An example of of student work sheet is attached in appendix).

3. Assignment 2
   Students were assigned to write assay on environmental factors influencing the development and epidemic of plants disease. The students had to be able to explain how the environmental factors (biotic or abiotic factors) can be trigger and determine the severity of disease and cause disease epidemics. This assignment was to evaluate the achievement of CLO1 Sub-CLO4 and 5.

4. Report of practical works.
   After conducting some practical works, students had to write practical reports at the end of semester. The practical works consisted of disease infection in plants, environmental factors and plant diseases, the influence of pathogenic infections on plant physiological processes, infection of fungal, bacterial, viral and nematode on plants. This assignment was to evaluate the achievement of CLO1 Sub-CLO 7 and 8 (An example of of student work sheet is attached in appendix).

5. Midterm examination
   Midterm examination was conducted in the eight week covering lectures 4,5,6,7,7. Since the Sub-CLO 4 and 5 had been assessed using Assignment 2, the weight of these 2 lectures in the midterm exam was only 5%, the same as the weight of lectures 7 and 8 which had been used to assess the Sub-CLO 7 ad 8 through practical works reports. Only the achievement of Sub-CLO 6 was fully assessed through midterm examination 8 (An example of of student work sheet is attached in appendix).

6. Assignment 3
   Students were assigned to write essay on plant abiotic disease on food crops and horticultural crops, including their distribution, symptom development, effect to yield losses, transmission and control or management. Students were instructed to focus on abiotic diseases infecting tropical crops, especially those commonly cultivated in Indonesia.This assignment was to evaluate the achievement of CLO3, Sub-CLO 11 and 12.

7. Final examination
   Final examination was conducted at the end of the semester covering lectures 9, 10, 11, 12, 13 and 14. Since the Sub-CLO 11 and 12 had been assessed using Assignment 3, the weight of these 2 lectures in the final exam was only 4%. The weight of other lectures just as written in the RPS. In the final exam, students were order to write essay to answer several questions proportionally related to learning material given in the lectures 9 to 14. Total weight of final exam was 40%. This assignment was to evaluate the achievement of CLO 2, CLO 3, and CLO 4; Sub-CLO 9 to 14 8 (An example of of student work sheet is attached in appendix).

Lecturing Evaluation

1. **Attendance evaluation**
   Lecturers and students' attendance were evaluated and the result are presented in the following table.

Table 2. Lecturer and students' attendance in the course of Plant Virology, Even Semester 2022.

Class	Lecturer attendance	Student attendance
A and B	Nurhayati : 8 times	Number of students: 78
	A. Muslimti : 7 times	Student with ≥85% attendance: 80
		Student with <85% attendance: 2

2. Teaching evaluation

Teaching and learning process evaluation was conducted by delivering questionnaire to students at the end of the semester. The questionnaire to evaluate learning process was attached in Appendix 3. In general, the students' opinion about the learning process can be summarized as follow:

1) Most, but not all, learning materials delivered in the course were in accordance to the subject detailed in the Semester Learning Plan (RPS).
2) Students could easily find learning resources in the library and internet
3) The way the lecturer teaching in the classroom was very good and could lead the class comfortably.
4) Lecturers were not always arrived in the class room on time and sometimes left the classroom before the time was over. Some times the lecturer came to the classroom about 10-minute late.
5) The way lecturer communicated with students was excellent and very satisfying.
6) Questions given in the quiz and exams were expectable as outlined in the RPS
7) The difficulty of midterm and final exams was acceptable because most questions were in line with the material delivered in the course.
8) The score of every exam was predictable and students were given opportunity to take remedial exam when necessary. However, students were less satisfied with the transparence of the marks they got, since not all exam work sheet or answer sheet were given back to students after being marked.
9) Most, but not all, of learning materials were uploaded in the E-learning system
10) All structured assignment were in accordance with those declared in RPS
11) All examination were conducted according to schedule in the RPS
12) Lectures were delivered 15 times including examination, not exactly the same as written in the RPS, 16 meetings.

Based on the summary of the lecturing process evaluation, lecturers of Plant Phatology need to uploading learning material in e-learning system before the lecture starts so that students can understand the material well. The final score of lecturing process evaluation of Plant Pathology showed that Nurhayati and A. Muslim got good

3. Result Evaluation

1) Student grade achievement

Final score and grade achieved by students at the end of semester derived from proportional accumulation of various assessment method conducted to evaluate the achievement of learning outcome of the lecture and also of each learning subject. Methods of assessment and contribution weight of each method are presented in Table… and the score grading follow the Universitas Sriwijaya regulation as presented in Table 3.

Table 3. Method of assessment and contribution weight to the final score

No	Assessment method	Weight (%)
1	Paper assignment 1	5
2	Quiz	5
3	Paper assignment 2	5
4	Practical works reports	5
5	Midterm examination	35
6	Paper assignment 3	5
7	Final exam	40

Table 4. Score grading

Letter grade	Numerical grade
A	85 up to 100
B	71 up t0 84,99
C	56 up to 70,99
D	41 up to 55,99
E	0 up to 40,99

The distribution of grades attained by students in the class of Plant Virology 2022 are presented in the following Table 4, where we can see the most students (69.23%) could achieve the highest grade (A) and 23 student (29.48%) achieved grade B and unfortunately there were 1 students could not completely attend the class and retreated from the course.

Table 4. Distribution of grades achievement of the students attending Plant Virology 2022

No	Letter grade	Numerical students
1	A	54
2	B	23
3	C	1
4	D	0
5	E	0

2) CLO achievement

In the evaluation of CLO achievement, each student was evaluated for his/her achievement on intended learning outcome (CLO) consisted of CLO_1, CLO_2, CLO_3 and CLO_4 (Appendix 3). The CLO achievement was calculated and evaluated individually or each student of the class (Appendix 4). Similar to the fact that most of the students (70.51%) gained grade A, the CLO achievement also showed the same results, that most students (81.37%) could achieve all CLO (1 to 4) and only few students fail to achieve the CLOs. The percentage of the students got grade C was the same as the percentage of students fail to pass all CLOs, but the name of the student was the same. The achievement of the CLO was generally very good. Only 1 student totally failed to achieve all CLOs due to his failure in attending the course seriously, failed to meet the class attendance requirements. However, there were also students to achieve CLOs but succeeded in acheiveing other CLOs. 11 students failed to achieve CLO_1, 19 students failed to achieve CLO_2, 17 students failed to achieve CLO_3, 3 students failed to achieve CLO_4, and 18 students failed to achieve CLO_5. In the calculation of the classroom achievement, surprisingly, the average score of the class was 98.71% at grade B and above and the achievement of CLO was as expected because the class succeeded to achieve all CLOs. Only 1 student who failed all CLOs.

IV. REFLECTION

Based on the evaluation results, the grade achieved by students attending Plant Pathology course in even semester of 2022 was very satisfying because only one student failed to comple the course due to inevitable reason. The CLO achievement also satisfying and the failure only one student to achieve all CLOs was understandable because the passing grade for CLO achievement was set high namely 85 or higher. However, based on learning process, grade and CLO evaluation, it is clear that there is something that did not work as expected and needed correction that all lecturers should have been aware of.

V. FOLLOW UP ACTION

Based on the evaluation results, some improvements are required inrelation to the preparation, delivery and evaluation of the course of Plant Pathology. The correction is necessary to avoid similar situation occur again in the future, and to reduce the failure of CLO achievement, lecturers should improve their course material and closely follow the RPS. The lecturers also have to pay more attention to their punctuality, since some students protested about the late coming of lecturers to the classroom. Leaning materials should be uploaded in the e-learning system as early as possible to give students more time to read before attending the lecture. Furthermore, students wanted the lecturers to give back their exams answers sheet despite the fact that the lecturers have announced the marks of the exams. Above all, every one involved in the learning process of Plant Pathology has to update and upgrade material and method of the lecture to guarantee that good grade and high LCO achievement are relevant to the latest condition of the knowledge and technology around Plant Pathology.

Appendix 1. SLP/Semester Learning Plan of Plant Phatology

SRIWIJAYA UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF PEST AND PLANT DISEASE
PLANT PROTECTION STUDY PROGRAM

SEMESTER LEARNING PLAN (SLP)

A. COURSE IDENTITY

Subject	: Plant Pathology	Code: PPT 2208	Semester : 5	Credit : 3 (2-1)
Course material	: Plant Pest Organisms			
Course description	: This course discusses and studies the history and development of plant diseases, interactions between pathogens, hosts and the environment, signs and symptoms of disease attacks, the influence of environmental factors on infection and disease development, plant defenses against pathogens, causes of abiotic and biotic diseases, biotic pathogens, fungi , bacteria, viruses and others, Management and control of plant diseases			
CLO-	CLO-1: Students are able to master theoretical concepts and the history of plant diseases in depth (P-1) CLO-2: Students are able to master theoretical concepts about the principles of disease from infection to interactions between plant-pathogens and the environment (P-2) CLO-3: Students are able to recognize and measure plant damage caused by pests and plant diseases (KK-1) CLO-4: Students are able to be able to utilize local biological resources for creative, innovative and environmentally friendly plant disease control (KK-4) CLO-5: Students are able to identify and modify local wisdom using the latest science and technology to be applied in site-specific plant protection practices (KK5)			
Lecturer support	: Prof. Dr. Nurhayati (NH), Prof. Dr. Ir. A. Muslim, M.Agr		Responsible Lecturer	: Prof. Dr. Nurhayati (NH),

B. Learning Program

CLO	Final Skills expected at each stage of learning (Sub-CLO-)	Subject	Reference	Learning method and time	Description of independent tasks and time	Indicator	Weigh t (%)	Lecturer
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CLO-1	**Sub-CLO-1**: Able to explain the history of plant diseases, definitions, signs and symptoms of disease.	History and development of plant diseases; terminology/definition of plant diseases	Semangun H (2006), Ronald, P.C (2006) and Agrios G.N. (1978)	Lecture TM1 (2x50')	- Reading college contracts and RPS (2x60') -Individual assignments on the history of plant diseases (2x60')	Accuracy in explaining the boundaries of plant disease	5	NH
CLO-2	**Sub-CLO-2**: Able to explain about the mechanism of parasitization and the development of plant diseases.	The stages of plant infection by pathogens and their development and factors that influence it.	Ronald, P.C (2006); Agrios G.N. (1978)	Lecture TM2 (2x50') Discussion of the topics discussed followed by question and answer	-Individual assignments on the process of infection in plants (3x60')	Accuracy in explaining the stages of infection by pathogens in plants	5	NH
	Sub-CLO-3. Able to explain the factors that influence the development of the disease and the occurrence of disease epidemics.	Environmental factors that influence disease development. and epidemics of plant diseases	Ronald, P.C (2006) Agrios G.N. (1978) and Campbell, C. Lee (1990)	Lecture TM3 (2x50') Quiz (1x 60')	Internet searching about journals related to diseases and factors that influence the occurrence of plant diseases(3x60')	The ability to explain the factors that play a role in the development of the disease and the occurrence of disease epidemics.	8	NH
	Sub-CLO-4: Able to explain and describe how plants defense to pathogen attack	Plant defense against pathogenic infections	Ronald, P.C (2006); Agrios G.N. (1978)	Lecture TM4 (2x50') Practice on plant response to pathogen infection and	Assigment about plant defense against pathogens with citation of at least 5 references from international journals (2x60')	The ability to explain how plants can defend themselves from pathogenic infection.	8	NH

				report generation (2x60')				
	Sub-CLO-5: Able to explain the influence of disease on the metabolic processes of the infection plant	Effect of pathogenic infection on plant physiological processes	Ronald, P.C (2006); Agrios G.N. (1978)	Lecture TM5 (2x50') Discussion of the topics	Assigment about effects of pathogenic infections on plant physiology (2x60')	Accuracy and ability to explain how the effect of pathogenic infection on various physiological processes in plants	7	NH
CLO-3	**Sub-CLO-6** Able to explain of classification of plants pathogens	Classification of plants pathogens	Semangun H (2006). Agrios G.N. (1978)	Lecture TM6 (2x50')	Group presentation on classification of plant pathogens (3x60')	Accuracy and ability to explain the class of pathogens that can cause disease in plants	6	NH
	Sub-CLO-7 Able to explain the class of parasitic (biotic) pathogens in plants	Plant diseases caused by biotic pathogens	Semangun H (2006). Ronald, P.C (2006)	Lecture TM7 (2x50')	Practical report on fungal, bacterial, nematode and viral infections (2x60')	Accuracy and Ability to explain how the infection of biotic pathogens such as fungi, nematodes, viruses, bacteria etc.	6	NH
	MIDDLE SEMESTER EXAM (60 minutes)							
	Sub-CLO-8: Able to explain how biotic pathogen can cause diesase dan damage in plants	Disease cause fungy, bacteria, namatodes, virus.	Semangun H (2006). Agrios G.N. (1978)	Lecture TM8 (2x50')	assignment compiles a paper on abiotic diseases (2x60')	ility to explain how biotic factors can cause damage to plants.	7	AM
	Sub-CLO-9 Able to explain how abiotic factors cause	Plant diseases caused by abiotic factors (temperature, fertilizer,	Agrios G.N. (1978)	Lecture TM9 (2x50') Discussion	presentation on abiotic pathogens (2x60)')	ility to explain how biotic factors can cause damage to plants.	7	AM

	damage to plants	pollution, etc.)		60')				
CLO-4	**Sub-CLO-10**: Able to explain plant disease control techniques	Plant disease management and control (chemical, biological, physical, technical culture,)	Agrios G.N. (1978)	Lecture TM10 (2x50') Individual assignment to make a paper on plant disease control (2x60')	Internet searching about journals of plants diseases management and control (2x60')	Ability to explain disease management techniques	9	AM
	Sub-CLO-11: Able to explain the disease biological control techniques	Biological disease control	Agrios G.N. (1978)	Lecture TM11 (2x50')	group presentation assignments (2 x60'	Ability to explain the use of biological agents as biological plant disease control agents	8	AM
	Sub-CLO-12: Able to explain physical and chemical disease control techniques as well as technical culture	Disease control physically, chemically and technically culture	Agrios G.N. (1978)	Lecture TM12 (2x50')	preparation of practical reports (2x60')	Ability to explain physical, chemical and cultural plant disease control techniques	7	AM
	Sub-CLO-13: Able to explain integrated disease control techniques	Integrated disease control	Agrios G.N. (1978)	Lecture TM13 ((2x 60')	preparation of practicum reports (2x60')	Ability to explain integrated plant disease control techniques	8	AM
CLO-5	**Sub-CLO-14**: Able to explain the use of biotechnology in the identification and management of plant diseases	. Biotechnology and Plant Diseases	Agrios G.N. (1978)	Lecture TM13 (2x50')	The group assignment to present PPT on the use of molecular biology in the identification and management of plant diseases (3x60')	Accuracy in explaining the use of biotechnology in the identification and management of plant diseases	9	AM
SEMESTER FINAL EXAM (120 minutes)								

Work load: lectures 1400 minutes t, practicum 1360 minutes, Structural assignment 1440 minutes , Self=study 1440 minutes ,exam 220 minutes. Total 5860 minutes = 97,666 hours = 3,91 ECTS

Referensi:

Agrios GN. 2005. Plant Pathology. Academic Press.
Semangun, H (2006) Pengantar ilmu penyakit tumbuhan.Gajah Mada University Press
Campbell (1990). Introduction plant diseases epidemiology. Wiley-Interscience;1 edition..4550
Ronald, C. P (2007). Plant-pathogen interaction.Humana Press Inc.

Appendix 2. Rubric of assignment

Appendix 2.1. Rubric of paper assignment

Value	Criteria	Result
90-100	Complete summary of all cases (6 cases) of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control)	
80-89	Complete summary of 5 cases of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control)	
70-79	Complete summary of 4 cases of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control)	
60-69	Complete summary of 3 cases of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control))	
50-59	Complete summary of 2 cases of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control)	
40-49	Complete summary of 1 cases cases of plant Phatology covering all aspects of plant disease (History and development of plant diseases, the process of infection in plants; plant defense against pathogens; effects of pathogenic infections on plant physiology; abiotic diseases; plants diseases management and control)	

Appendix 2.1. Rubric of project report

Value	Criteria	Result
90-100	Complete and correct assessment of plant Pathology: 1) disease infection on plant; symptom and sign; 2) isolation, reisolation and identification ;3). Abiotic pathogen and 4) effect plants disease on plants and 5) physiology plant disease management	
80-89	Complete and correct 4 aspect assessment of plant Pathology	
70-79	Complete and correct 3 aspect assessment of plant Pathology	
60-69	Complete and correct 2 aspect assessment of plant Pathology	
50-59	Complete and correct 1 aspect assessment of plant Pathology	

Appendix 3

QUESTIONNAIRE FOR THE FEEDBACK OF TEACHING PROCESS
PLANT PROTECTION STUDY PROGRAMME
FACULTY OF AGRICULTURE, UNIVERSITAS SRIWIJAYA

All students of Plant Protection Study Programme are expected to fill out this questionnaire honestly. This questionnaire is designated to appreciate and or to criticize the performance of all lecturers in Teaching Process conducted in Plant Protection Study Program, Faculty of Agriculture, Universitas Sriwijaya. No student's personal information, e.g. Name, ID Number, Mobile Number, et cetera, are requested. Students need to tick (√) the option beside the number in box of every question which is chosen.

Evaluated lecturer's name :…….
Subject taught :…….

1	Suitability of course content to those published in Semester Learning Plan	Unsuitable	Less suitable	Suitable	Very suitable
		1	2	3	4
2	Easiness of getting learning resources	Not easy	Less easy	Easy	Very easy
		1	2	3	4
3	Teaching approach	Not interesting	Less interesting	Interesting	Very interesting
		1	2	3	4
4	Classroom management	Fairly good	Good	Very good	excellent
		1	2	3	4
5	Timekeeping ability	Unpunctual	Less punctual	Punctual	Very punctual
		1	2	3	4
6	Communication skill	Ineffective	Less effective	Effective	Very effective
		1	2	3	4
7	Suitability of questions in examinations to the course content	Unsuitable	Less suitable	Suitable	Very suitable
		1	2	3	4
8	Difficulty of question in the examinations	Very easy	Easy	Less difficult	Difficult
		1	2	3	4
9	Closeness of gained mark with student's expectation	Far	Close	Very close	Precise
		1	2	3	4
10	Availability of learning materials in the e-learning system	Not uploaded	Uploaded in the same day of lecture	Uploaded within three days before lecture's day	Uploaded a week before lecture's day
		1	2	3	4
11	Suitability of assignments to course content published in Semester Learning Plan	Unsuitable	Less suitable	Suitable	Very suitable
		1	2	3	4
12	Execution of midterm and final examinations	Not done at all.	Done, but not as scheduled	Done as scheduled, but different from schedule in Semester Learning Plan	Done as scheduled in Semester Learning Plan
		1	2	3	4
13	Number of lectures delivered for the entire semester.	Less than 12 times	12-13 times	14-15 times	16 times
		1	2	3	4

This part will be filled in by Study Program Administrator or Quality Assurance Task Staff

Final score = $\frac{\Sigma x_i}{Nz} \times 100$

X_i = score of each answered question
N = number of question
Z = highest score

Predicate

< 55: not good
55-70: fairly good
>70-85: good
>85: very good

Conclusion : …….

Appendix 4. Score sheet of the course of Plant Phatology

PROGRAM STUDI : PLANT PROTECTION
ACADEMIC YEAR : 2021/2022 (EVEN SEMESTER)
COURSE : PALNT PATHOLOGY (3 CREDIT)
ROOM : R. BAKRI HAMID
LECTURER : PROF. DR. IR. NURHAYATI, M.SI. / PROF. DR. IR. A. Muslim, M.Agr.
TIME : SENIN (11:10 - 12:50 WIB)

NIM	NAMA	Assignment 1	Quiz	Assignment 2	Assignment 3	Practical works	Mid term	Final exam	Final score	Grade	CLO achievement				
											CLO1	CLO2	CLO3	CLO4	CLO5
05081181924002	Rian Adrian	85	80	85	85	75	90	92	88,8	A	Yes	Yes	Yes	Yes	No
05081181924004	Herdinawati	85	86	85	87	86	85	92	88,05	A	Yes	Yes	Yes	Yes	Yes
05081181924005	Lidya Karlina	85	82	78	85	85	88	86,5	86	A	Yes	Yes	No	Yes	Yes
05081181924006	Ria Lestari	85	82	78	85	85	70	92,5	82,25	B	Yes	Yes	Yes	Yes	Yes
05081181924009	Indah Wulan Suci	85	86	85	87	86	86	92	88,35	A	Yes	Yes	Yes	Yes	Yes
05081181924012	Cindi Azzahra	85	86	86	87	86	80	91,5	86,1	A	Yes	No	No	Yes	Yes
05081181924076	Nurcahaya Purba	87	86	87	87	88	84	91	87,55	A	Yes	Yes	Yes	Yes	Yes
05081181924012	Siti Mahani	85	86	86	87	86	80	91,5	87,215	A	Yes	No	Yes	Yes	Yes
05081181924079	Anggun Damar Adelia	85	86	84	85	85	84	88,5	86.05	A	Yes	Yes	Yes	Yes	Yes
05081181924082	Meri Agustin	85	86	86	87	86	85	92	88,05	A	Yes	Yes	Yes	Yes	Yes
05081281924019	Meirizqi Nurlailatus	85	82	78	85	85	85	93,5	87,9	A	Yes	No	Yes	Yes	Yes
05081281924021	Shinta Amalia Rahmadani	86	90	88	85	86	80	81,5	82,35	B	Yes	Yes	No	Yes	Yes

05081281924021	Shakeilla Aretha Zelika	88	88	85	86	88	84	89	86,75	A	Yes	Yes	Yes	Yes	Yes
05081281924029	Hesti	85	86	86	87	86	80	81,5	82,1	B	Yes	No	No	Yes	Yes
05081281924031	Ester Maharai	85	75	75	70	85	85	88	84,45	B	Yes	No	No	Yes	No
05081281924033	Farid Algifani	88	88	85	86	88	85	87	86,3	A	Yes	Yes	Yes	Yes	Yes
05081281924034	Muhammad Alfatih	85	86	69	85	85	84	91	86,3	A	Yes	Yes	No	Yes	Yes
05081281924037	Mutiara Raihana Alifia	85	86	86	87	86	84	89	86,5	A	Yes	No	Yes	Yes	Yes
05081281924039	Ardhansyah Pradana Maulana	85	75	75	70	85	80	88	82,7	B	Yes	No	No	Yes	No
05081281924040	Amarisya Shafa Luzia	85	90	82	87	86	80	93,5	86,9	A	Yes	Yes	Yes	Yes	Yes
05081281924041	M. Bagas Tiyantara	85	86	69	85	85	80	94,5	86,3	A	Yes	No	Yes	Yes	Yes
05081281924043	Andes Triani	85	88	77	80	85	82	93	86,65	A	Yes	Yes	Yes	Yes	No
05081281924044	Muhammad Asdhyshani	85	91	78	76	85	80	94	86,35	A	Yes	Yes	Yes	Yes	No
05081281924069	Yusi Ananda	85	90	85	85	85	80	92	86,3	A	Yes	Yes	Yes	Yes	Yes
05081281924070	Nyayu Farlania Wulandari	85	88	86	85	86	82	91	86,6	A	Yes	Yes	Yes	Yes	Yes
05081281924075	Zahratul Fauzia	85	86	86	87	86	57	91,5	78,05	B	Yes	No	Yes	Yes	Yes
05081181924079	Ego Alpian	85	88	78	79	85	82	92,5	86,45	A	Yes	Yes	Yes	Yes	No
05081281924080	Loviga BR Bangun	85	89	80	80	86	82	91	86,1	A	Yes	Yes	Yes	Yes	No
05081381722045	Wanda Helmi	0	0	0	80	0	75	85,5	64,45	C	No	No	No	No	No

	Riansyah														
0508381924047	Khairunnisa Putri	88	97	74	85	86	73	98,5	86,45	A	Yes	Yes	Yes	Yes	Yes
0508381924048	Azzahra Nur Dwi Lestaria	85	90	76	79	85	85	92	87,3	A	Yes	Yes	Yes	Yes	No
05081381924053	Rohima Rahmah	85	86	69	85	85	85	94,5	88,05	A	Yes	Yes	No	Yes	Yes
05081381924054	Roni Saleh Ardiansyah	85	90	76	74	85	80	84,5	82,3	B	Yes	Yes	No	Yes	No
05081381924055	Erdi Mefiyanto	85	90	76	79	85	70	94	82,85	B	Yes	Yes	Yes	Yes	No
05081381924056	Putri Gina	85	75	75	70	85	70	92,5	81	B	Yes	No	No	Yes	No
05081381924058	Rilwa Wallingga	86	89	86	85	85	70	88	81,2	B	Yes	No	Yes	Yes	Yes
05081381924059	Raudhatul Fatricia	85	90	76	74	85	80	95	86,5	A	Yes	Yes	Yes	Yes	No
05081381924060	Dwi Rahayu Putri Sianipar	85	90	76	74	85	70	96,5	83,6	B	No	No	Yes	Yes	Yes
05081381924063	Muhammad Hasanul Ichsan	73	93	75	64	85	77	99,5	86,25	B	No	Yes	Yes	Yes	No
05081181924001	Vira Puspitasari	86	85	83	85	86	86	99	90,95	A	Yes	Yes	Yes	Yes	Yes
05081181924003	Dhanillo Djulian	73	88	79	85	85	82	92	86	A	No	Yes	Yes	Yes	Yes
05081181924007	Karina Ayuningtian	73	88	79	85	85	82	93,5	86,6	A	No	Yes	Yes	Yes	Yes
05081181924010	Miftah Ajengtiyas Nursyahidah Rahman	86	85	85	86	88	85	91	87,65	A	Yes	Yes	Yes	Yes	Yes
05081181924011	Nurul Triagtin	85	80	75	85	85	80	82	81,3	B	Yes	No	No	Yes	Yes
05081181924013	Setya Ayu Dwintha	88	85	86	87	88	88	99	89,79	A	Yes	Yes	Yes	Yes	Yes

05081181924071	Ella Aprilia	86	90	80	86	88	80	95	87,5	A	Yes	Yes	Yes	Yes	Yes
05081181924014	Della Aprilia	85	87	78	85	85	80	93	86,2	A	Yes	No	Yes	Yes	Yes
05081181924015	Irfan Mohandis Haraki	86	74	80	85	85	84	93	87,1	A	Yes	No	Yes	Yes	Yes
05081181924017	Messa Syaputri	86	74	78	85	87	82	93,5	86,6	A	Yes	No	Yes	Yes	Yes
05081181924018	Rizki Putri Amalia	85	85	83	86	86	90	94,5	90,55	A	Yes	Yes	Yes	Yes	Yes
05081181924022	Khairi Sardilla	76	80	80	74	80	90	91	87,4	A	No	Yes	Yes	No	No
05081181924029	Muhari	85	88	85	86	86	82	89,5	86	A	Yes	Yes	Yes	Yes	Yes
05081181924024	Deo Datus Cristy Putra Sirait	85	85	70	85	85	87	82	83,75	B	Yes	Yes	No	Yes	Yes
05081181924027	Ranti Nur Fadillah	82	84	84	85	85	88	86	86,2	A	No	Yes	Yes	Yes	Yes
05081181924028	Husaini Purnama Aji	85	88	88	87	87	80	93,5	87,15	A	Yes	Yes	Yes	Yes	Yes
05081181924032	Winda Pratiwi	85	84	85	85	86	87	86,5	86,3	A	Yes	Yes	Yes	Yes	Yes
05081181924035	Agustian Kandila	64	90	81	85	85	80	89	83,85	B	No	Yes	Yes	Yes	No
05081181924036	Hana Elia Azzahra	85	90	78	86	86	80	96,5	87,58	A	Yes	Yes	Yes	Yes	Yes
05081181924038	Helmi Saputra	82	83	73	86	86	87	97,5	89,85	A	No	Yes	Yes	Yes	Yes
05081181924045	Shera Margareta	75	83	82	70	85	87	89,5	86,00	A	No	Yes	Yes	Yes	No
05081181924072	Tika Rahmawati	77	77	85	85	86	85	96	88,65	A	Yes	Yes	Yes	Yes	No
05081181924073	Raja Modar Lubis	86	80	74	86	85	90	96	90,4	A	Yes	Yes	Yes	Yes	Yes

05081181924074	Tezzia Nofetra	85	90	85	85	85	80	84,5	83,3	B	Yes	Yes	No	Yes	Yes
05081181924081	Meini Fitriana	85	84	85	85	86	80	92	86,05	A	Yes	Yes	Yes	Yes	Yes
05081181924083	Nur Amalia	78	82	74	70	86	88	97,5	89,3	A	No	Yes	Yes	Yes	No
05081381924046	Nanda Wahyu Suryana	85	82	73	85	85	80	97	87,3	A	Yes	No	Yes	Yes	Yes
05081381924049	Sarah Cahyani A	87	86	85	86	86	88	97	91,10	A	Yes	Yes	Yes	Yes	Yes
05081381924050	M. Muis	87	86	86	88	88	88	84	86,15	A	Yes	Yes	Yes	Yes	Yes
05081381924051	Edho Arya Saputra	85	90	72	70	73	80	87,5	82,5	B	Yes	Yes	No	No	No
05081381924052	Fahmi Nur Ilhan Fajar	87	86	85	86	86	86	95,5	89,80	A	Yes	Yes	Yes	Yes	Yes
05081381924057	Lutfiah Putri Azzahra	85	90	85	85	85	80	79,5	81,30	B	Yes	Yes	No	Yes	Yes
05081381924061	Muhammad Wildan A G	85	90	85	85	85	80	87	84,30	B	Yes	Yes	Yes	Yes	Yes
05081381924062	Novi Ariska	86	86	85	87	86	86	86	86,00	A	Yes	Yes	Yes	No	Yes
05081381924064	Harlin Nasution	85	84	86	70	85	78	84,5	81,6	B	Yes	No	Yes	Yes	No
05081381924046	Reydo Nugraha	85	90	82	68	85	80	89,5	84,3	B	Yes	Yes	Yes	Yes	No
05081381924046	Fera Fadlia Amy	85	90	82	68	85	80	90	84,5	B	Yes	Yes	Yes	Yes	Yes
05081381924067	Ajeng Tri Mughny	85	78	81	85	86	78	89	83,65	B	Yes	No	Yes	Yes	Yes
05081381924068	Pendi Lukito	85	90	80	85	85	80	82	82,05	B	Yes	Yes	No	Yes	Yes
										Yes	88%	74%	78,2%	94,9%	71.79%
										No	11%	25%	21,7%	5,1%	28%

CLO Calculation for the class of Plant Pathology

Assessment	Course material	Weight	Score	W.S	Score of each CLO				
					CLO-1	CLO 2	CLO 3	CLO 4	CLO 5
Assignment 1	Lecture 1 &2	0,05	85,04	4,25	85,04				
Quiz	Lecture 3	0,05	83,74	4,18		83,74			
Assignment 2	Lecture 4 , 5,6	0,05	81,13	4,05			81,13		
Practical reports	Lecture 7 & 8	0,05	86,21	4,31				86,21	
Assigment 3	Lecture 11 & 12	0,05	85,52	4,27					85,52
Midterm exam	Lecture 1-8	0,35	81,83	28,64		81,83			
Final exam	Lecture 9-14	0,40	90,43	36,17			90,43		
Final score				89,89	85,04	165,57	171,56	86,21	85,52
Maximum score				A	100	200	200	100	100
CLO achievement					85,04	82,78	85,78	86,21	85,52
Grade, Yes for CLO achievement >85 and No for CLO achievement <85)				A	**Yes**	**No**	**Yes**	**Yes**	**Yes**

CLO Calculation for individual student in the class Plant Pathology (Fahmi Nur Iham Fajar)

Assessment	Course material	Weight	Score	W.S	Score of each CLO				
					CLO-1	CLO 2	CLO 3	CLO 4	CLO 5
Assignment 1	Lecture 1 &2	0,05	87	4,35	87				
Quiz	Lecture 3	0,05	86	4,3		86			
Assignment 2	Lecture 4 ,5	0,05	85	4,25			85		
Practical reports	Lecture 7 & 8	0,05	86	4,3				86	
Assigment 3	Lecture 11 & 12	0,05	86	4,3					86
Midterm exam	Lecture 1-8	0,35	86	30,1		86			
Final exam	Lecture 9-14	0,40	95,5	38,2			95,5		
Final score				89,5	87	172	180,5	86	86
Maximum score				A	100	200	200	100	100
CLO achievement					87	87	90,25	86	86
Grade, Yes for CLO achievement >85 and No for CLO achievement <85)				A	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Appendix: Sample midterm exam

PLANTS DISEASE SCIENCE MIDDLE EXAM QUESTIONS
Lecturer : Prof.Dr.Ir.Nurhayati, M.Sc.

MULTIPLE CHOICE QUESTIONS
Choose the correct answer!

1. Disease can be defined as
   A. Interaction between plants and the environment
   B. Interaction between plants and pathogens
   C. Interaction between plant, host and environment
   D. A condition in which one or more plant metabolic processes are disrupted due to pathogen attack
2. For the purposes of observing diseases in plants, it can be done by looking at the
   A. Sign
   B. Symptoms
   C. Pathogens
   D. Luka
3. Examples of the types of symptoms
   A. Spot
   B. Gall
   C. Cancer
   D. All the answers above are correct
4. Mosaic is a typical symptom of attack
   A. Bacteria
   B. Virus
   C. Nematodes
   D. Mushroom
5. The ability of a pathogen to cause disease is called
   A. Virulence
   B. Incubation
   C. Pathogenicity
   D. Incubation
6. The time between infection and the onset of symptoms is known as
   A. Latent period or period
   B. The period or period of dormancy
   C. Period or incubation period
   D. Malignant period or period
7. Plant disease will only occur if:
   A. There are susceptible and pathogenic plants
   B. There are plants and the environment
   C. There are pathogens and the environment
   D. There are susceptible plants, virulent pathogens and a suitable environment
8. The relationship between 2 organisms in which one benefits and the other is harmed is called:
   A. Sapropitism
   B. Parasite
   C. Parasitism
   D. Saptopit
9. An organism that is usually a saprophyte but in certain circumstances can become a parasite is called:
   A. Facultative parasites
   B. Obligate parasite
   C. Facultative saprophytes

D. Obligate saprophytes.

10. The series of events involved in the development of a disease including the stages of development of the pathogen and its effects on the host is called
    A. Disease cycle
    B. Penetration
    C. Infection
    D. Dessimination
11. The part of the pathogen that can infect plants is often referred to as
    A. Mycelia
    B. Inoculum
    C. Spores
    D. hyphae
12. Plant defense against pathogens consists of
    A. 2 categories
    B. 3 categories
    C. 4 categories
    D. 5 categories
13. The defense structures that plants can form exist
    A. 3 types
    B. 4 types
    C. 5 types
    D. 6 types
14. Layers that function to inhibit pathogen invasion and protect the spread of parogenous toxins are:
    A. Abscission layer
    B. Layer of cork
    C. Wax coating
    D. Cuticle layer
15. The abscission network can function as
    A. Retaining the spread of pathogenic toxins
    B. Pathogen colonization barrier
    C. Invasion of pathogens
    D. Isolation of pathogens
16. Soft rot is generally a symptom of an attack
    A. Virus
    B. Bacteria
    C. Nematodes
    D. Mushroom
17. Parasites are
    A. Organisms that live outside or inside other organisms and obtain food from these organisms
    B. Organisms landing on plant surfaces
    C. Organisms that infect plants
    D. Organisms that invade plants
18. An organism that can live only on dead matter is called
    A. Facultative saprophytes
    B. Obligate parasite
    C. Obligate Saprophyte
    D. Facultative parasites

19. The stage of contact between the pathogen and the plant structure where infection may occur is called the stage:
    A. Inoculation
    B. Infection
    C. Invasion
    D. Colonization
20. The type of inoculum exists
    A. 6 kinds
    B. 5 kinds
    C. 4 kinds
    D. 2 kinds
21. Viruses invade tissues by moving from cell to cell
    A. intercellular
    B. Intracellular
    C. Intercellular and intracellular
    D. xylem
22. Most fungi spread in all plant tissues (leaves, stems and roots), also grow directly in cells as … mycelium
    A. intercellular
    B. Intracellular
    C. Intercellular and intracellular
    D. xylem
23. Pathogens that generally require vectors to infect plants are
    A. Mushroom
    B. Virus
    C. Bacteria
    D. Nematodes
24. Chlorosis, mosaic on plants due to pathogen attack can cause
    A. High chlorophyll
    B. High Growth Substance
    C. Low chlorophyll
    D. Low growth substances
25. Pathogen attacks can result in cuticle destruction and stomatal dysfunction, thereby increasing the … process
    A. Photosynthesis
    B. Translocation
    C. Respiration
    D. Transpiration

COMPLEX MULTIPLE CHOICE (READ TERMS)

CHOOSE ONE OR MORE CORRECT ANSWER with the following possibilities:

- Choices 1,2,3 are correct (A)
- Choices 1 and 3 are correct (B)
- Options 2 and 4 are correct (C)
- Choice 4 is correct (D)
- All choices are correct (E)

26. Pathogens can move from one plant to another through
    1. Wind
    2. Water
    3. Vector
    4. Plant parts
27. Plant pathogens can infect plants
    1. Directly with mechanical pressure
    2. Water
    3. Through natural holes
    4. Air
28. Structural resistance of plants to pathogens prior to infection include:
    1. Trichoma
    2. Wax coating
    3. Cuticle thickness
    4. Enzyme
29. Trichoma can serve as
    1. Plant protection against pathogen infection
    2. the place where insects attach
    3. Reduces water retention on the plant surface so that it is not suitable
    4. Collecting rainwater
30. Fungi can infect plants through
    1. Mechanical Pressure
    2. Natural hole
    3. Wounds
    4. Vector
31. Vascular pathogens can cause
    1. The death of the host
    2. Partially closed stomata resulting in stomata dysfunction
    3. Opening of stomata
    4. Decreased chlorophyll and cessation of *C . photosynthesis*
32. Plant pathogenic nematodes can be distinguished by:
    1. Endoparasites
    2. Ectoparasites
    3. Ecto and endoparasite
    4. Saprophyte
33. Fungal inoculum can be
    1. Spore
    2. hyphae
    3. Mycelium
    4. Sclerotia
34. Bacteria generally infect plants through
    1. Wound
    2. Mechanical stress

3. Natural hole
4. vector

35. Pathogens complete their life cycle in one growing season are called pathogens
    1. cyclic tetra
    2. polycyclic
    3. Politics
    4. monocyclic
36. Pathogens whose life cycle is more than once per season are pathogens:
    1. cyclic tetra
    2. monocyclic
    3. Politics
    4. polycyclic
37. Based on their life cycle, pathogens are grouped into:
    1. monocyclic pathogen
    2. polycyclic pathogens
    3. Polyetic Pathogens
    4. polythenic pathogens
38. Root pathogens can
    1. Affect root function
    2. affect water absorption
    3. inhibit the production of root hairs
    4. decrease root cell permeability
39. Plants infected with pathogens generally have an increased respiratory rate so that
    1. Enzyme activity in respiration reactions also increases
    2. Growth substance activity increases
    3. There is accumulation and oxidation of phenolic compounds
    4. There is accumulation and reduction of phenolic compounds
40. Generally pathogens that can cause epidemics ..
    1. spread by water
    2. Spread by the wind
    3. Spread by agricultural tools
    4. Distributed by vector

Appendix : AN. Example Final eaxamination

Nama: Khairunnisa Putri
NIM : 05081381924047
Plant Disease Science Final Exam

1) Name and explain at least 6 diseases that cause deadly diseases to humans, starvation, death and losing wars, destroying industries, changing habits, depriving the country of foreign exchange, and lowering farmers' incomes!
    1. Ergotism disease (Holy fire) causes death in humans due to swelling of body parts to stump.
    2. South American leaf blight by the fungus *Microcyclus ulei*, destroys rubber plantations in Brazil
    3. Rust disease (Hamelia vastatrix) on coffee plants that causes changes in human habits from drinking coffee to drinking tea.
    4. Cacoa swollen shoot disease in cocoa due to virus attack resulted in the destruction of 140 million cocoa trees in Ghana
    5. Late Blight disease changed the politics of a country and made the country bankrupt, lost the war
    6. Potato scurvy caused by *Stretomyces scabies* so that the price of potatoes and apples fell due to *Podeshaera leucetricha*, the skin was brownish

2) Possibly >50% of plant diseases caused by abiotic factors:

    a. Name the abiotic factors answer:
    1. state of the soil/nutrients
    2. environment
    3. Inappropriate physical condition
    4. pollution
    5. light
    6. pesticide injury
    7. Inappropriate technical culture treatment

3) Explain how to distinguish disease attacks caused by abiotic factors and disease attacks caused by plant pathogens (biotic)!
    Answer:
    What distinguishes it is that disease attacks caused by abiotic factors/non-living factors are non-infectious, while disease attacks caused by plant pathogens (biotic) are infectious. The causes of abiotic diseases include nutrients, temperature, light and others, while the causes of biotic plant diseases are fungi, bacteria, viruses, nematodes and others.

4) State the characteristics of fungi, especially parasitic fungi
    Answer:
    The characteristics of parasitic fungi are that they have ectophytic or endophytic hyphae, the ectophytic mycelium is on the surface of the host plant, while the endophytic mycelium is in the host plant tissue and can grow intercellularly (between cells) or intracellularly (into cells). The ectophytic and intercellular hyphae form a houstorium into the cell to obtain nutrients. The shape of the houstorium can be round or root-like.

Mention at least 4 names of diseases and their causes caused by pathogenic fungi.

Answer:

1. False rust disease in winged bean is caused by *Synchytrium psophocarpi* (Mushroom division Mastigomycota)
2. wart disease on potato tubers caused by *Synchytrium endobioticum* (Mushroom division Mastigomycota)
3. Potato blight is caused by *Phytophthora infestans*
4. Downy mildew in maize is caused by *Peronosclerospora maydis*
5. Damping off disease caused by *Pythium debaryanum* polipag in rosella
6. Lanas disease in tobacco by *Phytophthora nicotianae*

5) Name 6 genera of bacteria that cause disease in plant

Answer:

1. Agrobacterium
2. Corynesbacterium
3. Erwinia
4. Pseudomonas
5. Streptomyces
6. Xanthomonas
7. Xylella

Name 3 diseases and their causes caused by bacteria

Answer:

1. Pustule disease or boils on soybeans is caused by the bacterium *Xanthomonas axonopodis*
2. Soybean blight is caused by the bacterium *Pseudomonas savastanoi*
3. Soft rot is caused by *Erwinia carotovora*
4. Gallbladder crown tumor disease by the bacterium *Agrobacterium vitis*

6) Describe the characteristics of MLO (Mycoplasma like organism) that is, it does not have a true wall, reproduces by budding and binary fission, is parasitic and does not have spores. Example of disease: devil's broom disease

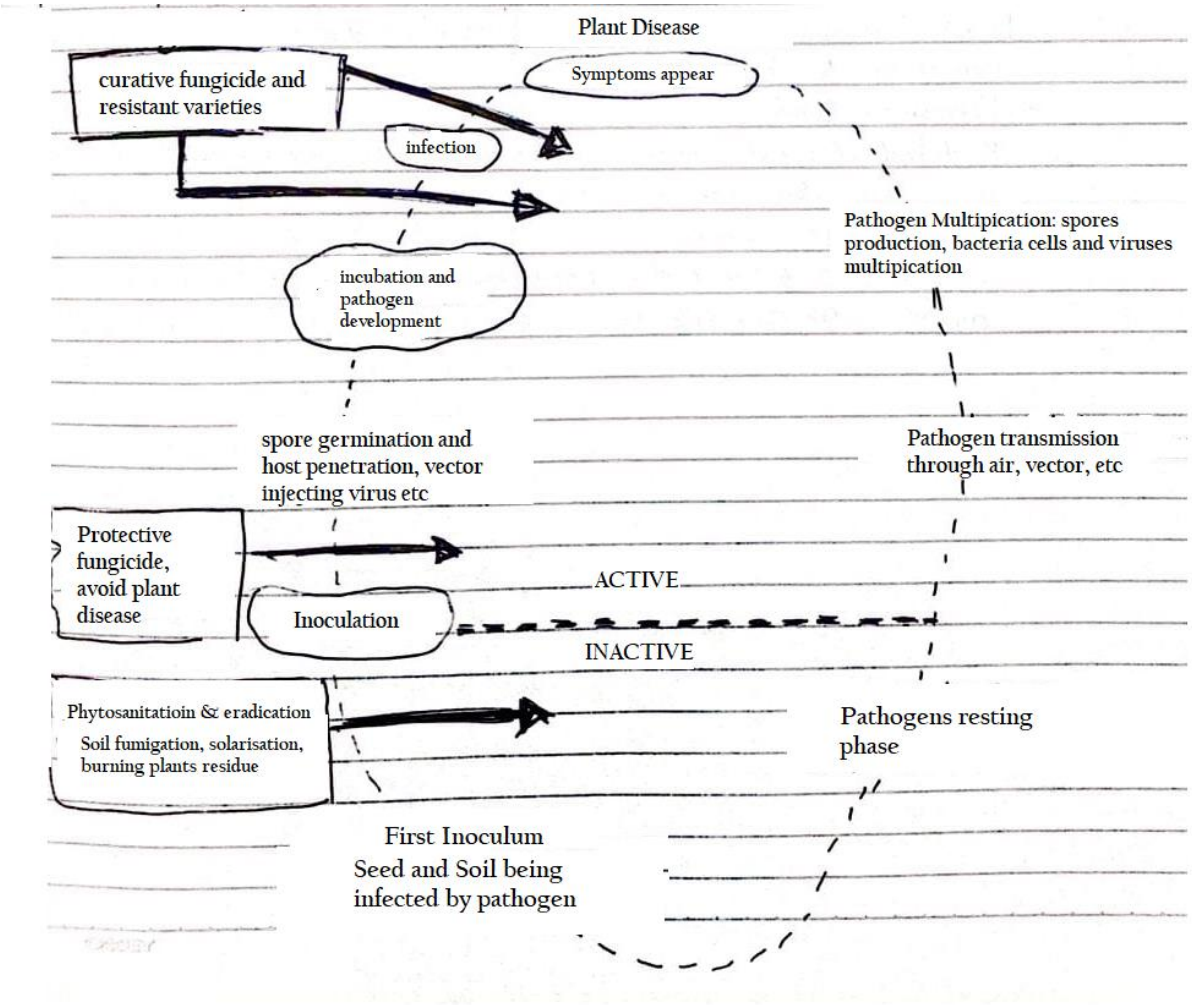
Characteristics of BLO (Bacteria like organism), which is always in the phloem tissue, has a membrane with a thickness of 25 n, spreads through vectors, for example disease: CUPD in oranges

What is a viroid and give an example of a disease?

Answer:

Viroids are particles that are similar to viruses but consist only of ribonucleic acid without a protein coat. One of the diseases caused by viroids is a disease of spare parts in coconut that once destroyed coconut plantations in the Philippines.

7) Describe general principles and strategies for plant disease control



8) One of the most important plant disease control is physical control.
Explain what is meant by physical control.
Answer:

Physical control is an act of control by manipulating a situation by using physical factors such as raising the temperature, solarization, lighting settings, and others.

Name and explain 5 kinds of physical control!
Answer:

1. Burning
   Uprooting and burning of scattered plant parts (eradication)
2. Soil Heating
   Heating a pipe like a fork with holes then flowing with hot steam, the top soil is covered with cells or eternity boards, the temperature can reach 90^{o}C and can kill Pseudomonas solanacea.
3. Compost heating
   Compost sometimes carries disease inoculum can be heated with a hot steam boiler 55-60^{o}C
4. Seed heating
   Seeds either from tubers or cuttings can be freed from pathogens by hot water treatment and hot air treatment
5. Heating fruits Mangoes to avoid Colletotrichum gloeosporioides can be soaked at 55^{o}C for 5 minutes or 51^{o}C for 15 minutes

Appendix; An Example Assigment

PATHOGEN SPREADING MECHANISM AND FACTORS

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CHAPTER I
INTRODUCTION

Transmission and spread of pathogens can be influenced by several factors such as dispersal by wind, rain, insects, seeds, other plant buds, and humans (Machmud et al., 2012). The part of the pathogen or pathogen that is carried by a certain agent that makes contact with the plant is called the inoculum or infectious agent. Thus the inoculum is part of the pathogen or the pathogen itself that can cause disease in plants. In fungi or fungi, the inoculum can be mycelium, spores, or sclerotium (Moghbeli et al., 2017). In bacteria, mycoplasma, and viruses, the inoculum is in the form of individual bacteria, individual mycoplasmas, and the virus particles themselves. In parasitic plants, the inoculum can be either plant fragments or seeds from the parasitic plant. In nematodes, the inoculum can be eggs, larvae, or adult nematodes (Agustamia et al., 2016).

The inoculum of most pathogens is carried to the plant host passively by wind, water and insects. The air inoculum is always in the air, then lands on the plant surface not only because of gravity but is carried away by rain. Pathogens can survive by infecting the host repeatedly or called the chain of infection in the host plant. Where the chain of infection is divided into two types, namely continuous and discontinuous. There are five types of infection chains available for plant pathogens, namely alternative hosts, alternative hosts, epiphytic phase, saprophytic phase, and resting phase. Various distribution patterns of diseased plants; Random, Aggregate, Regular, Patch, Flat gradient, and Steep gradient of the five most dangerous distribution patterns, namely aggregation and random patterns. Inoculum of seed-borne pathogens can be transmitted in at least four different ways: mixing with the seed, attaching to the seed, becoming embedded in the seed or attacking the embryo within the seed. There are three main methods for preventing or managing disease: trying to remove parasites from planting material by physical (eg heat treatment) or chemical means (eg fungicide dips or dust, systemic chemicals or fumigants).

CHAPTER II
LITERATURE REVIEW

2.1. Plants Pathogens

Pathogens are biotic agents that can cause infectious diseases, such as bacteria, fungi, nematodes, and viruses. Pathogens can cause physiological functions in plants to not run normally. These physiological functions include, among others, division and differentiation as well as cell development, absorption of water and nutrients from the soil and their translocation, metabolism, reproduction and storage of nutrients, but most pathogens have a limited host range. Assuming environmental conditions favor the development of pathogens (Agrios, G.N. 1988).

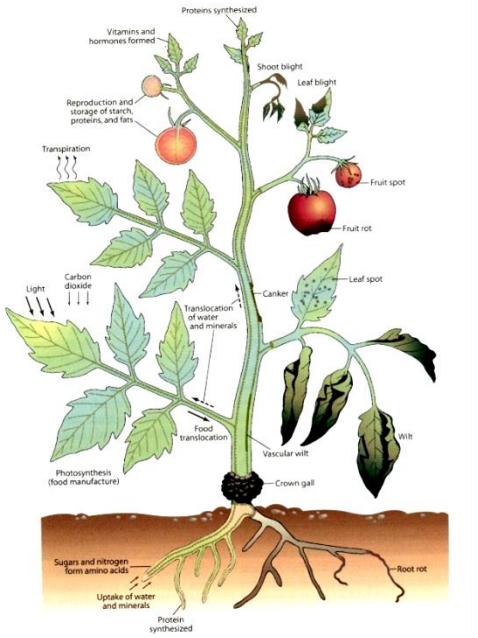

Figure 2.1. Schematic representation of basic plant functions (left) and types of interference with functions (right) caused by pathogens.

Source:http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pd

2.2. Pathogens and Their Relationships with Plant Diseases

Disease symptoms in plants are influenced by interactions between three main factors, namely virulent pathogens, susceptible host plants, and supportive environment. These three factors help/support each other to cause a disease in plants. In the concept of the disease triangle, if the three components are not met, then the symptoms of the disease will not appear. Therefore, the system is known as the disease triangle (Figure 2).

Figure 2.2. Triangle of interactions between pathogens, plants, and the environment in causing disease.

2.3. Spread of Plant Diseases

Transmission and spread of pathogens can be influenced by several factors such as dispersal by wind, rain, insects, seeds, other plant buds, and humans Figure 2.3 (Machmud et al., 2012)

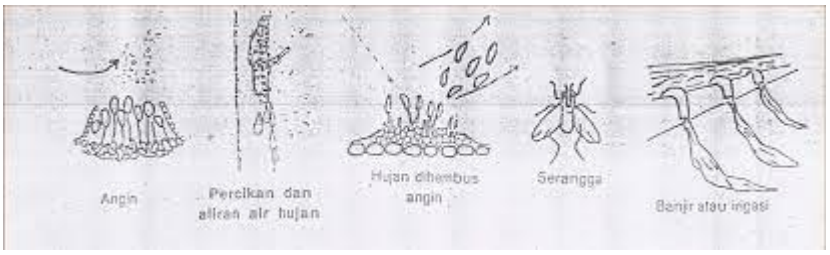

Figure 2.3. Factors for the spread of plant pathogens

Source: https://www.google.com/url

In the field, pathogens that attack cassava can infect other host plants such as cultivated plants or weeds (Figure 2.4). The fungus *Cercospora henningsii*, which causes brown spot disease in cassava, can also infect wild relatives of cassava, namely *Manihot glaziovii* and *M. plauhynsis* (Msikita et al. 2000; Ambang et al. 2007). The white root fungus, Fomes lignosus is a polyphagous pathogen.

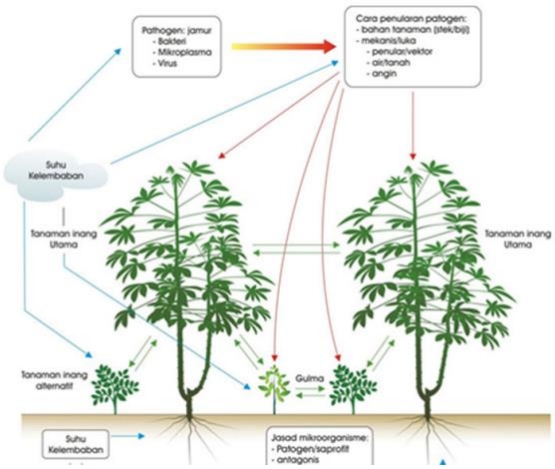

Figure 2.4. System pathology of cassava with the environment (Bioecology and Epidemiology, 1979).

In addition to attacking cassava plants, it can also infect rubber, tea, or other annual plants (Semangun 2006). *Xanthomonas campestris pv. manihotis*, which causes bacterial blight, can also attack *Manihot apii*, *M. glaziovii* and *M. palmate* plants and *Euphorbia pulcherrima* and *Pedilanthus tithymaloides* (Dedal et al. 1980; Hillock and Wydra 2002). Ralstonia solanacearum, the cause of

bacterial wilt disease, was found to be able to infect several types of weeds such as: *Amaranthus spinosus, Synedrella nodiflora, Vinca rosea, Ageratum conizoydes, Bidens pilosa, Crassicephalum crepidoides, Elentheranthera ruderalis, Eupatorium odoratum, Sphilateso paniculata indicum, Heensis, C. , C. diffusa, Euphorbia prunifolia, E. hirta, Phylanthus sp., Croton hirtus, Basilium polytacion, Pogostemon auriculaia, Sesbania rostata, Spigelia anthelmia, Physalis angulate, Lantana camara* (Nakagawa 1978; Machmud 1992).

2.3.1. Spread by wind

The spread of disease by wind is air-borne; such as spores of pathogenic fungi on leaves, stalks and fruit. Dispersal by wind includes: (a) lifting the inoculum into the air (take-off); (b) moving inoculum from one place to another (flight); (c) placing the inoculum on its host from the atmosphere (deposition) (Fig. 2.5). An example of leaf spot disease caused by the fungus *Helminthosporium sp* (Sacc.) is thought to be the fungus defending itself on weeds, as a saprophyte on the remains of sick wheat plants, and in seeds (Sudjno, 1986). *Helminthosporium sorokianum* conidium is dispersed by the wind. Soot dew (*Leveillula taurica*) Disease pathogen transmitted by wind. Symptoms of the attack are marked by the presence of white powdery spots on the upper and lower surfaces of the leaves. Affected leaves turn yellow, die and fall. The optimum conditions for the development of this disease are at a temperature of 15.6-32^{o}C and shaded. Spores are sensitive to temperatures > 32^{o}C and direct sunlight.

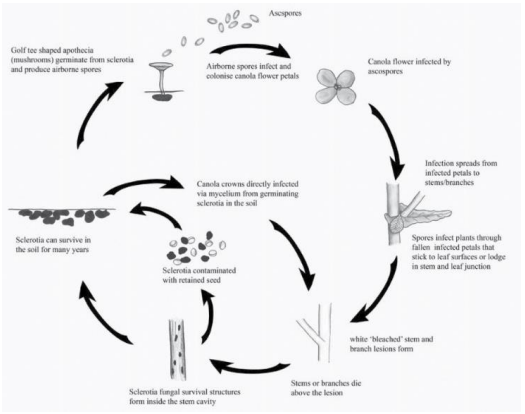

Figure 2.5. Schematic of the mechanism of the spread of disease by the wind. Leaf spots (*Septoria chrysanthemi Allesch*, and *S. leucanthemi* Sacc. et Speg.) Symptoms of *S. chrysanthemi* attack are black spots on the leaves. The spots are round and well demarcated, while S. leucanthemi spots are brown, large round shape up to 3 cm long and have clear circles. In the spots caused by *S. chrysanthemi* there is a fungal fruiting body (picnidium) which has a width of 150 - 250 cm, and contains a tubular conidium, 3 - 4 cells, measuring 50 - 80 x 2 - 3 cm. S. leucanthemi has a larger conidium, measuring 100 - 130 x 4 - 5 cm. Disease will develop if the intensity of light is less, humidity is high, the spacing is too close, and the application of nitrogen fertilizer is too much. This disease rarely attacks in the dry season.

2.3.2. Spread by Water or Rain

The spread of disease by water or rain is water-borne. The presence of water droplets or rain on the bacterial exudate causes the bacterial cells to be scattered and spread to various places of contact or

penetration. The availability of water needed for fungal spores to germinate or bacteria for penetration accelerates the occurrence of infection in plants. Bacterial blight, X. campestris pv. manihotis spreads through the use of infected seedlings and by splashing rainwater (Lozano 1976; Lozano 1986).

2.3.3. Spread by Insects

Insects will deposit or leave the inoculum they carry to the injured plant part (due to the insect feeding process) (Figure 2.6).

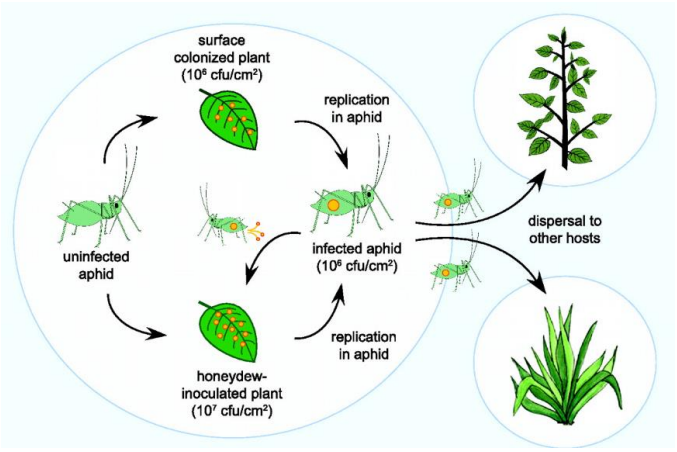

Figure 2.6. Schematic of the spread of pathogens by insects

Transmission of the virus can take place by direct contact, through aphid insects, soil, and seeds. Direct contamination occurs through injury to plants due to plant maintenance activities, animals, and implementers in the field, or other causes. Direct contamination can be caused by agricultural implements used in pruning, weed control, and plowing. Seed contamination can occur in diseased fruit. The location of the virus is in the external mucilage, testa, and endosperm. The virus is also stable and easily transmitted from seed to nurseries and plantations. TMV is an oblige parasite or living cell tissue. This virus infects plants through wounds. Plant parts that are susceptible to contact with TMV will soon become infected. TMV can survive for months on planted soil, water and forest soil. A number of TMV strains in medicinal plants have been described almost all over the world, where these viruses can be distinguished from others by host reactions, but not in tobacco. (Wardanah 2007). Likewise, diseases caused by viruses, spread through the use of virus-infected plant seeds. Mosaic disease caused by African cassava mosaic virus (ACMV) and brown streak disease (Brown streak disease) caused by Cassava brown streak virus (CBSV), besides being transmitted through infected plant seeds, the spread of disease in the field is carried out by infectious insects (vector) is the whitefly Bemisia tabaci (Dubern 1994; Maruthi et al. 2005).

2.3.4. Spread by Seeds (Seed-borne) and Other Plants

Pathogen survival and spread can occur by means of plant parasites surviving and spreading in plant material and in clone propagation material and in seeds. wherein the inoculum of seed-borne pathogens can be transmitted in at least four different ways namely by mixing with the seed, adhering to the seed, becoming embedded in the seed or attacking the embryo within the seed (Hammond-Kosack & Jones, 1996).

Plants can be contaminated by pathogens for example in vegetative propagation where the inoculum is carried on plant parts used for vegetative propagation. almost all groups of plant parasites can be spread in this way. Many plant species are propagated exclusively by vegetative clones taken from the parent plant. These species are highly susceptible to disease transmission. Organs used for vegetative propagation of plants include tubers (egpotato), cuttings or cuttings (cassava, sugar cane, sweet potato), tubers (daffodils) and tubers (gladiolus, taro), runners or stolons (strawberry), suckers (bananas). , bamboo), rhizomes (ginger, turmeric) and buds (fruit trees). If the parent plant is sick, it is likely that the vegetative offspring from the parent plant will also get sick.

Seeds produced on diseased plants or healthy plants on diseased plants can be contaminated or infected with plant parasites. Seed-borne pathogens usually persist for a long time in or on contaminated or infected seed. As a result, they can be dispersed over great distances in commercial seed distribution. Within a plant, infected seeds usually result in the development of foci of infection at random so the pathogen must also have other means of dispersal to distribute it within the plant during the growing season. Inoculum of seed-borne pathogens can be transmitted in at least four different ways. It can (i) mix with the seed, (ii) attach to the seed, (iii) become embedded in the seed or (iv) invade the embryo within the seed.

2.3.5.1. Pathogens Mixed with Seeds

Mixed pathogens include sclerotia from *Sclerotinia sclerottorumin* in sunflower seeds and sclerotia (ergots) from *Ctautcepspurpurea* in cereal and grass seeds). Seeds of parasitic plants such as dodder may also mix with host species seeds (Collinge, 2020). The inoculum mixed with the seed can often be physically separated from the seed by flotation (eg brine), the gravity method or by sieving. The three methods depend on differences in the specific gravity or size of the seed and mixed inoculum. However, the available procedures for separating inoculum mixtures are often difficult to implement, time consuming and uneconomical. Therefore, it is better to prevent the inoculum from contaminating the seeds in the first place. There are several ways to do this. For example, in some climatic areas contamination of prairie grass seed with ergot can be minimized by mowing or grazing the pasture early in the season, when inoculum is most likely to be produced, and allowing it to seed and harvest later in the season when climatic conditions are less. favorable for disease development. It is also possible to plant seed crops in locations where the environment is suitable for seed formation but not favorable for disease development.

2.3.5.2. Patogen Menempel pada Benih

The embedded seed-borne inoculum of many fungal and bacterial pathogens is transmitted as a result of the inoculum adhering to the seed surface. Inoculum transmitted in this way includes the conidia of fungi such as *Alternaria spp. (*Fig. 2.8).,*Drechs Leraspp*. and teliospores of smut fungi that infect seedlings (eg bunt fungus, *Tillettacaries* and smut fungus *Urocystis agropgri*, both of which infect wheat). Bacterial cells *Xanthomonas campestns pv. campestris* (causes brassica black rot) and *X. campestris pv. malvacerum* (the cause of bacterial blight on cotton) can be propagated as an inoculum that adheres to the seed. Adherent seed-borne inoculum can often be killed by treating the seeds with chemicals. For example, smut teliospores and seed-infecting fungi can be destroyed by treating the seeds with a fungicide either as a dry dust treatment or as a wet mud treatment.

2.3.5.2. Pathogens Embedded in Seeds

Some seed-borne pathogens actually infect seeds by penetrating the seed coat and internal tissues. In other words they become embedded in the seed. During seed dormancy, the pathogen and the seed host tend to coexist. However, after germination, the pathogen becomes active and can kill or damage the seeds before or after emergence. Fungi such as some species, Alternaria Cercospora and Drechs Lera form mycelium on infected seeds. Fungal pycnidia such as some Septorta and Phoma species are frequently seen on infected seeds. Bacteria such as Xanthomono.s campestris pv. malvacerum, the cause of bacterial blight on cotton can also be transmitted through embedded inocula. It is often difficult to destroy the inoculum embedded in the seed because it is not destroyed by the contact biocide. For example, acid removal of cottonseed, a process that sterilizes the surface of the seed using concentrated sulfuric or hydrochloric acid, does not kill bacterial blight in the seed. Similarly, the application of a protective fungicide does not destroy the fungus embedded in the seeds. Heat treatment and systemic fungicides have been used successfully to destroy the embedded inoculum or kill the fungus after the seeds have germinated.

2.3.5.3. Attacking the Embryo Inside the Seed

Embryo-borne The inoculum of some pathogens becomes located in the embryo and/or endosperm or in tissues derived from the embryo sac. Inoculum of smut fungi that infect floretin such as Ustilago tritici and some bacteria such as Corgnebacterium michtganense pv. michiganense can be transmitted through seed embryos. About one-fifth of known plant viruses are transmitted through seeds. Most cases of seed transmission occur as a result of embryonic infection and it is only occasionally that virus carried in the testes has been shown to be responsible for seedling infection.

Infected seed can occur either from infection of the ovule from the parent or by pollination of the flower of a healthy plant with infected pollen. However, there are several confirmed examples of pollen transmission. Seed transmission rates range from about 15% for lettuce seed mosaic virus to more than 90% for tobacco spot virus in soybean seed. The success of transmission varies with virus strain and

species, cultivar, host plant species and family, plant growth conditions and plant age at the time of infection. Early infection of the plant usually increases the rate of seed-borne infection because there is a maximum chance for the ovule to become infected.

Seed transmission does not occur if the cytoplasmic connection through the plasmodesmata between the embryo and infected maternal tissue is lost. In most viruses, pollen transmission only results in seeds from being fertilized or infected. In some cases, the entire plant may be infected. Potato tuber viroids are transmitted by pollen as well as true seeds, although neither mode of transmission is likely to be commercially important. Control of embryonic seed-borne pathogens is difficult because of the position of the inoculum.

Systemic chemicals and hot water treatments provide the only means. Seed transmission does not occur if the cytoplasmic connections via the plasmodesmata between the embryo and infected maternal tissue are lost. In most viruses, pollen transmission only results in seeds from being fertilized or infected. In some cases, the entire plant may be infected. Potato tuber viroids are transmitted by pollen as well as true seeds, although neither mode of transmission is likely to be commercially important. Control of embryonic seed-borne pathogens is difficult because of the position of the inoculum. Systemic chemicals and hot water treatments provide the only means. Seed transmission does not occur if the cytoplasmic connections via the plasmodesmata between the embryo and infected maternal tissue are lost. In most viruses, pollen transmission only results in seeds from being fertilized or infected. In some cases, the entire plant may be infected. Potato tuber viroids are transmitted by pollen as well as true seeds, although neither mode of transmission is likely to be commercially important. Control of embryonic seed-borne pathogens is difficult because of the position of the inoculum. Systemic chemicals and hot water treatments provide the only thing the whole plant may be infected with. Potato tuber viroids are transmitted by pollen as well as true seeds, although neither mode of transmission is likely to be commercially important. Control of embryonic seed-borne pathogens is difficult because of the position of the inoculum. Systemic chemicals and hot water treatments provide the only thing the whole plant may be infected with. Potato tuber viroids are transmitted by pollen as well as true seeds, although neither mode of transmission is likely to be commercially important. Control of embryonic seed-borne pathogens is difficult because of the position of the inoculum. Systemic chemicals and hot water treatment provide the only

available means to kill the inoculum. However, with heat treatment it is often difficult to kill the inoculum without at the same time killing the seed embryo.

2.4. Distribution of Diseased Plants in the Field

Much information can be obtained by studying the distribution of diseased plants in a population. In particular, it can provide clues about the source of the pathogen inoculum or the nature of the vector. Six ways of spreading diseased plants in a population are shown in Figure 2.4 where the actual number of diseased plants in each plot is not important, only the pattern of distribution.

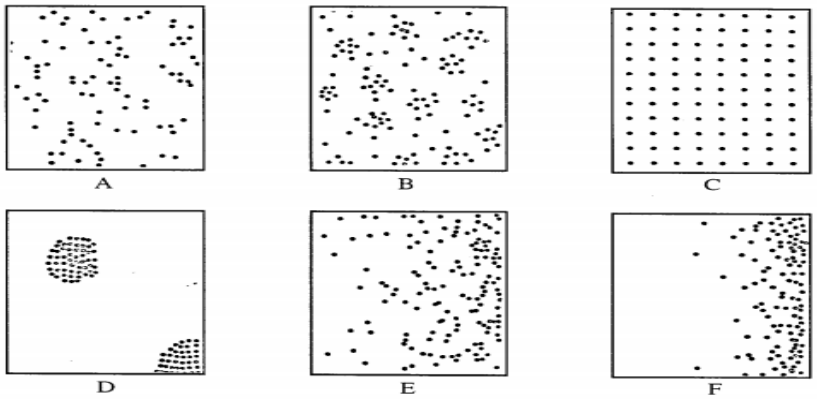

Figure 2.4. Distribution pattern of plant diseases in the field (A) Random, (B) Aggregation, (C) Regular, (D) Patches, (E) Flat gradient, (F) Steep gradient. (From Kerr, 1980).

Random distribution is not a very common form of disease distribution. This can be caused by a seed-borne infection or air inoculum that enters from a distant source. If the number of infections per unit plant area is calculated, the frequency of infected plants will follow a Poisson distribution. If the plant is a legume, a seed-borne infection may be suspected as this is very common in viral diseases of legumes. If non-legumes are involved, insect inoculum or air inoculum from a much more likely source.

The aggregation distribution is a very common distribution pattern for plant diseases. It usually shows a random distribution of inoculum followed by spread from diseased plants. For example, if the virus is transmitted by seed and after germination the virus is spread by aphids, the original random distribution will be lost and aggregation will occur. Similarly, seed-borne root infection-causing fungi can spread to nearby plants by randomly distributed distribution by root contact, by growth of hyphae through the soil or by movement of zoospores in the aqueous layer around soil particles.

With aggregation, the frequency of diseased plants usually follows a negative binomial distribution. There are currently a number of computer programs available that allow the analysis of spatial patterns of disease spread. In crop pattern analysis, the mean (m) and variance (v) of the studied sample population can be used to calculate the dispersion index, which indicates the presence of randomness or clustering, and to calculate the degree of aggregation of diseased plants. One such index is the Lloyd'sPatchiness Index (LPI) which quantifies how many times more individual dots are on average than if the pattern of dots were random.

Regular distribution usually does not occur in the field. A possible situation that could cause this pattern of distribution is where regularly spaced plantation crops have been uprooted and affect the soil so that when the area is replanted with other crops, there is a regular distribution of diseased plants. This, however, is the least likely. This can also occur in vegetatively propagated plants if all planting material is infected.

The distribution of the patch is a characteristic of soil borne diseases. The disease may be caused by soil-inhabiting organisms such as root rot fungi or anmatodes. Alternatively, diseases, such as viral diseases, can be transmitted by vectors that inhabit the soil (eg viruses transmitted by nematodes and

soil-borne fungi). If a viral disease is spread in spots, people will immediately consider the nematodes *Xtphtnema, Longidorus, Trichodorus* and *Paratrichodorus* and the soil fungi *Olpidium, Polgmgxa* and *Spongospores* as possible vectors because they transmit several viral diseases. If a soil-borne virus is suspected, a common testing procedure is to collect soil samples from diseased and healthy areas. The soil is transferred to the pot and susceptible plants are planted. Those that grow in the soil from disease patches must become sick while others must remain healthy. If this occurs, subsequent procedures may try to determine whether the disease was spread by nematodes or fungi. If the soil is still infective after air drying, the disease may be transmitted by fungi because some fungus-transmitted viruses can be contained in the resting spores of drought-resistant fungi. In all cases, however, the final stage is testing the particular organism for its ability to transmit the virus. Soil-dwelling organisms usually spread very slowly and the same can be said of viruses that are transmitted by soil-dwelling organisms. As expected, the conditions that favor the movement of the vector also support the spread of the virus it transmits. Nematodes only move in moist soil and consequently soil moisture affects the spread of viruses transmitted by nematodes.

The gradient distribution of disease is a very common pattern of disease distribution. They indicated that the source of the inoculum was outside the plant. Usually, the closer the inoculum source is to the plant, the steeper the gradient. If the inoculum source is remote, the gradient may disappear completely and a random distribution may occur. Other factors such as how the inoculum is spread can affect the slope of the gradient. Flying insects tend to provide a flatter gradient than creeping insects. The stronger a vector can fly, the flatter the gradient.

2.5. Phytophthora pathogens, symptoms in plants, and factors influencing the development of pathogens

Phytophthora comes from the Greek, phyto which means plant and phthora which means damage, this fungus is also called water fungus because in addition to soil and leaf areas, most of its life cycle can occur in water (Erwin and Ribeiro, 1996). *Phytophthora* grown on culture media or plant tissue in moist conditions, generally not pigmented, and when viewed under a microscope, the mycelium is hyaline in color. The mycelium is branched and has a tube-like structure. Growth generally occurs at the tips of hyphae (Andriyani et al., 2008).

Species *Phytophthora sp.* produce asexual spores under favorable environmental conditions (optimum temperature and humidity). Asexual spores are called sporangium. Sporangia are formed on sporangiophores. Sporangia vary in size and shape (ovoid, obovoid, ellipsoid, limoniform (like lemons) and pyriform (like pears). Sporangium germinates and roots form a germinate tube when in contact with plants (Erwin and Ribeiro, 1996). Zoospores are sexual spores. produced through the fusion of male (oogonia) and female (antheredium) gametes. Zoospores can spread through water splashes and water

flow on the soil surface. These spores have flagella that can help move closer to the host (Erwin and Ribeiro, 1996)

This fungus can survive in the soil and carry out its infection mainly through the soil and here it can form sporangium and spores that travel. The fungus is mainly dispersed by rainwater and irrigation water that flows over the soil surface. Infection to the base of the stem is aided by the presence of wounds, for example those caused by agricultural implements. In the garden *P. cactorum* can be carried away by the flow of water together with the soil. In addition, the fungus can be transported far because it is carried by the seeds (grafting) and the soil that accompanies these seeds (Semangun, 2000).

CHAPTER III. DISCUSSION

Pathogens are biotic agents that can cause infectious diseases, such as bacteria, fungi, nematodes, and viruses. Disease symptoms in plants are influenced by interactions between three main factors, namely virulent pathogens, susceptible host plants, and supportive environment. These three factors help/support each other to cause a disease in plants. In the concept of the disease triangle, if the three components are not met, then the symptoms of the disease will not appear. Therefore, the system is known as the disease triangle.

Transmission and spread of pathogens can be influenced by several factors such as spread by wind, rain, insects, seeds, other plant buds, and humans. The spread of disease by wind is air-borne; such as spores of pathogenic fungi on leaves, stalks and fruit. Dispersal by wind includes: (a) lifting the inoculum into the air (take-off); (b) moving inoculum from one place to another (flight); (c) placing the inoculum on its host from the atmosphere (deposition). An example of leaf spot disease caused by the fungus Helminthosporium sorokianum (Sacc.) is thought to be a fungus defending itself on weeds, as a saprophyte on the remains of sick wheat plants, and in seeds (Sudjno, 1986). Conidium helminthosporium sorokianum is dispersed by the wind. Soot dew (Leveillula taurica) Disease pathogen transmitted by wind. Symptoms of the attack are marked by the presence of white powdery spots on the upper and lower surfaces of the leaves. Affected leaves turn yellow, die and fall. The optimum conditions for the development of this disease are at a temperature of 15.6-32 oC and shaded. Spores are sensitive to temperatures > 32 oC and direct sunlight.

There are five types of infection chains available for plant pathogens, namely alternative hosts, alternative hosts, epiphytic phase, saprophytic phase, and resting phase. Various distribution patterns of diseased plants; Random, Aggregate, Regular, Patch, Flat gradient, and Steep gradient of the five most dangerous distribution patterns, namely aggregation and random patterns. Various distribution patterns of diseased plants; Random, Aggregate, Regular, Patch, Flat gradient, and Steep gradient of the five most dangerous distribution patterns, namely aggregation and random patterns. Inoculum of seed-borne pathogens can be transmitted in at least four different ways: by mixing with the seed, attaching to the

seed, becoming embedded in the seed or attacking the embryo within the seed. There are three main methods for preventing or managing disease: trying to remove parasites from planting material by physical (eg heat treatment) or chemical means (eg fungicide or dust dips, systemic chemicals or fumigants).

By studying the mechanisms and factors that influence the spread of pathogens, we can carry out Integrated Control of Disturbing Organisms. Examples of stem rot disease at the base of pepper stems caused by the fungus Phytophthora sp. Spores of the disease-causing fungus can spread through drainage water, rainwater splashes on the soil surface, humans, animals, agricultural equipment, plant cuttings or diseased plant parts, plant seeds infected and through the air / wind. In addition, root rot disease can also be spread through contact with the roots of sick and healthy plants. so that the controls that can be carried out are; 1) Use healthy cuttings that are free of pathogens (cuttings should be taken from healthy plants), 2) Do not use soil from pepper gardens that have been attacked by root rot disease (sterile), 3) Set the shade so that it is not too humid, 4) Make canals drainage to avoid waterlogging, 5) At the time of seeding, biological agents are added to the polybags of the bacteria Pseudomonas fluorescens, Mycoriza and the fungus Trichoderma harzianum.

CHAPTER IV. CONCLUSION

Pathogens are biotic agents that can cause infectious diseases, such as bacteria, fungi, nematodes, and viruses. Disease symptoms in plants are influenced by interactions between three main factors, namely virulent pathogens, susceptible host plants, and supportive environment. These three factors help/support each other to cause a disease in plants. Transmission and spread of pathogens can be influenced by several factors such as spread by wind, rain, insects, seeds, other plant buds, and humans. By studying the mechanisms and factors that influence the spread of pathogens, we can carry out Integrated Control of Disturbing Organisms.

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Appendix . An Example Practicum Report

PRACTICUM REPORT

PLANT DISEASE SCIENCES

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CHAPTER 1. INTRODUCTION

1.1. Theoritical Base

Rice (*Oryza sativa*) is a food crop that is mostly consumed as a staple food in Indonesia. However, several plant-disturbing organisms attack rice and hinder rice productivity (Sunarsih et al., 2014). Diseases that attack rice plants can be caused by several kinds of pathogens such as fungi, bacteria, and viruses that affect rice production (Sopialena et al., 2019).

One of the most common pathogens is fungus. Rice blast disease is one of the diseases that can reduce rice productivity caused by the fungus *Pyricularia oryzae* (Wicaksono et al, 2017). Blast disease was initially a major problem in upland rice plants, but currently, blast disease also attacks lowland rice plants (Sucipto et al., 2015).

Isolation is a method used to transfer diseased plant parts to the media for further identification which is carried out aseptically (Syahputra et al., 2017). Blast disease caused by the fungus *Pyricularia oryzae* is generally controlled using fungicides. However, there are some harmful effects and it is recommended to use biological control using entomopathogenic fungi (Sopialena et al., 2019). The isolation method was carried out to obtain pure cultures. In this practicum, journals are used due to COVID-19 which limits all campus activities, including practicum. The results and discussion are supported by journals.

1.2. Purpose

The purpose of this practicum is for students to be able to separate pathogenic fungi from one another from diseased plants, so that pure cultures can be obtained.

CHAPTER 2. PRACTICUM EXECUTION

2.1. Time and Place

The time for the implementation of this practicum is on Wednesday, November 11, 2020 at 8.00 WIB. The place for this practicum is the Laboratory of the Semarang Class 1 Agricultural Quarantine Center which was adopted from the 2020 agricultural journal by (Sobianti et al., 2020).

2.2. Tools and Materials

The tools used in this practicum are as follows: 1) Bunsen & lighters; 2) Cover Glass; 3) Ose Needle; 4) Microscope; 5) Petridish; 6) Tweezers; and 7) Preparations.

The materials used in this practicum are as follows: 1) Alcohol; 2) Aquadest; 3) Hypochlorite Solution; 4) Sick Plants; and 5) Tissue.

2.3. Methods

The methods of this practicum which supported by the journal (Suciatmih et al, 2011) are as follows:

1. Take the infected rice leaf part 1 cm^2 with 0.5 cm healthy part and 0.5 cm sick part, the cutting is done aseptically
2. The diseased plant parts are immersed in an alcohol solution for 3 minutes and followed by a hypochlorite solution for 3 minutes
3. Rinse using aquadest 3 times
4. Air dry on a layer of tissue for about 3-4 hours (until dry)
5. Place on PDA media in petri dishes and label (date of isolation and host plant)
6. Incubated for 24 hours and any pathogens that appear include in the results is observed

CHAPTER 3. RESULTS AND DISCUSSIONS

3.1. Results

The results of the practical isolation of pathogenic fungi are as follows (Wicaksono et al., 2017).

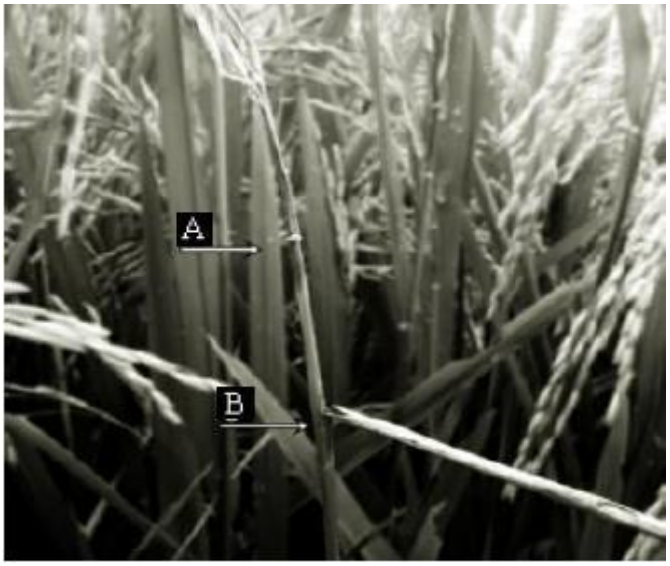

Figure 3.1.1 Symptoms of rice blast disease; (A) on the top stem segment (panicle neck); (B) in leaf axils

Macroscopic Observation Image Results

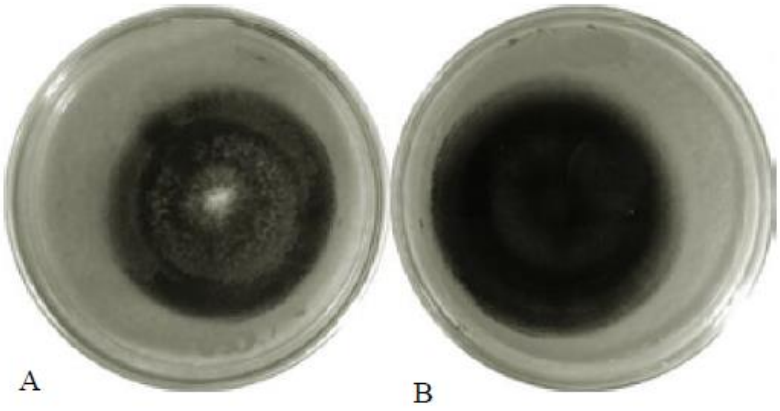

Figure 3.1.2 *Pyricularia oryzae* colonies on PDA media; Top view (A); bottom view (B)

Macroscopic Observation Image Results

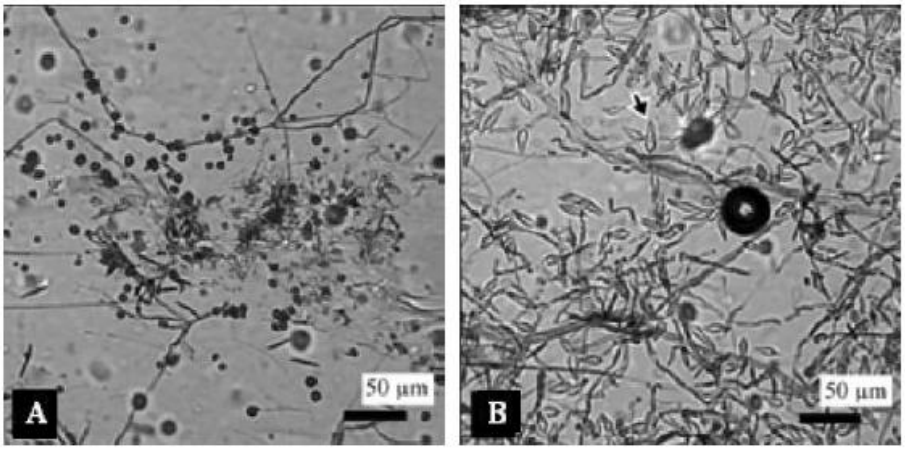

Figure 3.1.3. Conidium suspension from rice leaves with blast symptoms, no *Pyricularia oryzae* conidium (A) and rice panicle neck with blast symptoms, *Pyricularia oryzae* conidium found (B)

3.2. Discussion

In this practicum, a supporting journal is used for the isolation of pathogenic fungi. This is because the situation does not allow for the implementation of offline practicum. Isolation of the fungus on diseased rice leaves. Isolation of the fungus that causes spotting symptoms such as *P. oryzae* should begin with spore induction. In this method, the isolation process begins with conidia induction. The conidia induction process was carried out by moistening the symptomatic plant tissue. After the symptomatic plant tissue was moistened, the conidia formed on the tissue surface could be observed by cutting the symptomatic tissue into small pieces and then dissolving it in sterile water.

Conidia dissolved in sterile water were observed using a binocular microscope (Fig. 3.1.3). The process of induction of *P. oryzae* conidia from symptomatic plant tissue can only be done using a sample in the form of a panicle neck. The results obtained from several times of isolation with this method is the type of fungus *Fusarium sp.* and the rest of the fungal colonies did not grow. *Fusarium sp.* grows because the suspension that is poured does not only contain *P. oryzae* conidium In the process of taking conidium P. other conidia oryzae may be involved.

This can be overcome by diluting the suspension or taking *P. oryzae* conidium directly from the moistened panicle. Fungal colonies did not grow because the conidia did not germinate. Isolation from the panicle neck produces fungal colonies. The fungal colonies obtained were pure cultures because they grew from a single conidium taken directly from the humidified plant part of the symptomatic plant. However, these colonies did not form morphological characteristics such as conidium so that they could not be identified morphologically. The fungal colony obtained was probably *P. oryzae* because the colony grew from a single conidium of *P. oryzae*.

The morphology of the colonies *of P. oryzae* obtained was grayish black, thin in shape without air mycelium, forming a ring resembling a ring after growing almost to fill a petri dish in PDA

media (Figure 3.1.2). However, the colony morphology of *P. oryzae* may vary so that it can be different from the isolates obtained in this method. The panicle neck isolation method was chosen as the best method because it succeeded in isolating *P. oryzae* with the shortest and simplest process. This method produces a pure final isolate because it is grown from a single conidium.

This method has the disadvantage of the type of plant tissue sample that can be used only the panicle neck. Identification must also be done molecularly so it requires additional time and costs. This becomes an obstacle if the number of isolated samples is large.

CHAPTER 4. CONCLUSION

4.1. Conclusion

The conclusion in this practicum is that during the isolation of fungi in rice the fungus *Pyricularia oryzae* was obtained.

4.2. Recommendation

The recommendation from this practicum is that isolation must be done aseptically so as not to be contaminated.

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