



FACULTY OF AGRICULTURE  
GADJAH MADA UNIVERSITY



# **MODULE HANDBOOK**

## **Bachelor of Crop Protection**

ASIIN

An International Accreditation



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UNIVERSITAS GADJAH MADA  
FAKULTAS PERTANIAN  
DEPARTEMEN HAMA DAN PENYAKIT TUMBUHAN

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### FORMAL SPECIFICATION

Name of the programme (Original Language)	Program Studi Proteksi Tanaman
Name of the programme (English Translation)	Bachelor in Plant Protection
Final degree	Sarjana Pertanian (S.P.) / Bachelor in Agriculture
Standard period of study	4 years (8 Semester)
Credit points (according to ECTS)	144-160 SKS (253,5 ECTS)
Programme start date within the academic year (first time)	1985
Intake rhythm	Once a year starts in August
Expected intake number of students	70 students
Amount and type of fees (in EUR)	IDR 0-10,5 million/semester USD 0-728/semester
Faculty	Agriculture
Official contact person for publication on the web	Dr. Ir. Arif Wibowo, M.Agr.Sc.
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Address/E-mail	Jalan Flora No.1., Bulaksumur, Yogyakarta 55281, Indonesia, e-mail: <a href="mailto:hpt.faperta@ugm.ac.id">hpt.faperta@ugm.ac.id</a>
Website of Faculty	<a href="http://web.faperta.ugm.ac.id/">http://web.faperta.ugm.ac.id/</a>
Website of Study Programme	<a href="https://proteksi.faperta.ugm.ac.id/">https://proteksi.faperta.ugm.ac.id/</a>

Accreditation and certification

- A (Excellent Rank)-National Accreditation Body (BAN-PT), 5 years (2020-2025)
- ASIIN (Accreditation in Engineering Computer Sciences Natural Sciences Mathematics) Certification (2021-2026)

Head of Study Program,



Dr. Ir. Arif Wibowo, M.Agr.Sc.

**Table 1.4 Curriculum map of Plant Protection Study Program**

NO	CODE	SUBJECT COURSE	STATUS	ECTS	SEMESTER	PROGRAM LEARNING OUTCOME								
						A	A	K	K	K	PS	PS	U	U
						1	2	1	2	3	1	2	1	2
1	PNT20192105	Klimatologi Pertanian ( <i>Agroclimatology</i> )	C	4.5	I						v			
2	PNU20191101	Pengantar Ilmu Pertanian ( <i>Introduction to Agricultural Science</i> )	C	3.0	I						v			
3	PNU20191102	Botani ( <i>Botany</i> )	C	3.0	I						v			
4	PNA20191102	Agronomi ( <i>Agronomy</i> )	C	4.5	I						v			
5	PNE20191151	Manajemen dan Ekonomi Pertanian ( <i>Agricultural Management and Economics</i> )	C	4.5	I						v			
6	PNM20191101	Mikrobioma Pertanian ( <i>Agricultural Microbiomes</i> )	C	4.5	I						v			
7	PNH20191101	Perlindungan Tanaman ( <i>Plant Protection</i> )	C	4.5	I							v		v
8	UNU20191103	Pelatihan Pembelajaran Sukses Mahasiswa Baru ( <i>Success Skills</i> )	C	1.5	I	v	v							
9	PNU20192206	Bahasa Inggris Akademik (English for Academic Purposes)	C	3.0	II		v							
10	PNU20191203	Biokimia (Biochemistry)	C	3.0	II						v			
11	PNU20191204	Praktikum Biokimia (Laboratory Classes in Biochemistry)	C	1.5	II						v			
12	PNA20191251	Statistika Pertanian (Statistics for Agriculture)	C	3.0	II						v	v		

13	PNA20191203	Ekosistem Pertanian (Agricultural Ecosystem)	C	4.5	II						v			
14	PNA20191252	Genetika Pertanian (Agricultural Genetics)	C	4.5	II						v	v		
15	PNT20191202	Watak dan Sifat Tanah (Nature and Properties of Soil)	C	4.5	II						v			
16	PNP20191202	Penyuluhan dan Komunikasi Pertanian (Agricultural Extension and Communication)	C	4.5	II		v				v			
17	PNH20191202	Epidemiologi Penyakit Tumbuhan (Plant Disease Epidemiology)	C	3.0	II						v	v		
18	PNH20191203	Dinamika Populasi dan Ledakan Hama (Population Dynamics and Pest Outbreaks)	C	3.0	II						v			
19	PNH20192107	Fitopatologi (Phytopathology)	E	4.5	II EVEN			v			v	v		
20	PNA20192153	Perancangan Percobaan (Experimental Designs)	C	4.5	III						v	v		
21	PNH20192104	Hama Tanaman Pertanian (Agricultural Plant Pests)	C	4.5	III			v			v	v		
22	PNH20192105	Penyakit Tanaman Pertanian (Agricultural Plant Diseases)	C	4.5	III				v		v	v		
23	PNH20192106	Hama dan Penyakit Tanaman di Ruang Tertutup dan Pasca Panen (Agricultural Pests and Diseases in Closed Environment and Post-Harvest)	C	4.5	III						v			
24	PNH20192108	Zoologi Pertanian (Agricultural Zoology)	E	4.5	III ODD						v	v		
25	PNH20193118	Mikologi Pertanian (Agricultural Mycology)	E	4.5	III ODD						v	v		



41	PNH20193114	Pestisida Pertanian (Agricultural Pesticides)	C	4.5	V						v			
42	PNH20193115	Pengelolaan Habitat (Habitat Management)	C	4.5	V				v	v				
43	PNH20193116	Komponen Biologi Pengelolaan Hama Penyakit Tumbuhan (Biological Components of Plant Pests and Diseases Management)	C	4.5	V				v	v			v	
44	PNH20193117	Karantina Tumbuhan (Plant Quarantine)	C	3.0	V	v								
45	PNU20193108	Kerja Lapangan (Field Work)	C	3.0	V		v						v	v
46	PNU20194111	Kepemimpinan (Leadership)	C	1.5	VI	v								
47	PNU20193108	Kerja Lapangan (Field Work)	C	3.0	VI	v								
48	PNU20193209	Seminar (Seminar)	C	1.5	VI		v						v	v
49	UNU222001	KKN-PPM (Community Services Program)	C	6.0	VI	v								
50	UNU222002	Komunikasi Masyarakat (Public Communication)	C	3.0	VI	v	v							
51	UNU222003	Penerapan Teknologi Tepat Guna (Application of Practicable Technology)	C	3.0	VI			v						
52	PNH20193221	Patologi Serangga (Insect Pathology)	E	4.5	VI EVEN						v			
53	PNH20193222	Patologi Benih (Seed Pathology)	E	4.5	VI EVEN			v	v					
54	PNH20193223	Gulma dalam Perlindungan Tanaman (Weed in Plant Protection)	E	4.5	VI EVEN								v	
55	PNH20193224	Klinik Tumbuhan (Plant Clinic)	E	4.5	VI EVEN			v						v

56	PNH20193225	Kebijakan Perlindungan Tanaman (Plant Protection Policy)	E	3.0	VI EVEN	v				v				
57	PNH20193226	Pembiakan Massal Serangga (Insect Mass Production)	E	4.5	VI EVEN									v
58	PNU20193209	Seminar (Seminar)	C	1.5	VII		v						v	v
59	UNU222001	KKN-PPM (Community Services Program)	C	6.0	VII	v	v							
60	UNU222002	Komunikasi Masyarakat (Public Communication)	C	3.0	VII	v								
61	UNU22203	Penerapan Teknologi Tepat Guna (Application of Practicable Technology)	C	3.0	VII		v							
62	PNU20194110	Skripsi ( <i>Undergraduate thesis</i> )	C	9.0	VII					v			v	v
63	PNH20194128	Pengelolaan Vektor Penyakit Tumbuhan ( <i>Management of Plant Disease Vectors</i> )	E	4.5	VII ODD					v				
64	PNH20194129	Biologi Nematoda ( <i>Biology of Nematode</i> )	E	4.5	VII ODD			v	v					
65	PNH20194130	Apiologi ( <i>Apiology</i> )	E	4.5	VII ODD			v						
66	PNH20194131	Akarologi ( <i>Acarology</i> )	E	4.5	VII ODD			v						
67	PNH20194132	Bioteknologi Perlindungan Tanaman ( <i>Biotechnology of Crop Protection</i> )	E	4.5	VII ODD						v	v		
68	PNU20194110	Skripsi ( <i>Undergraduate Thesis</i> )	C	9.0	VIII					v			v	v

## Module Handbook of Phytopathology

Module designation	This course discusses the history and importance of plant diseases, the concept of plant disease and its development, the types of disease-causing agents (plant pathogens), and the interactions between plants and plant pathogens at the cellular, tissue, and plant population levels. The effects of environmental factors on plant diseases are discussed to understand their development. Diagnosis, management methods, and examples of plant diseases of significance in Indonesia are discussed, as well as careers in phytopathology.
Semester(s) in which the module is taught	Second Semester (Even Semester)
Person responsible for the module	Dr. Ir. Arif Wibowo, M.Agr.Sc
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Phytopathology

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are able to disseminate agricultural science concepts.</p> <p>Graduates are able to understand and apply plant protection concepts.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand the role of plant diseases in human life, particularly plant diseases [CPL3.1].</p> <p>Students are able to distinguish between healthy and diseased plants and how to identify plant diseases [CPL3.2].</p> <p>Students are able to understand the process and development of plant diseases through the interactions between the components of the disease triangle. [CPL3.2].</p> <p>Students are able to understand plant disease management strategies and their risks [CPL3.2].</p>
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## Module Handbook of Phytopathology

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Content	<p>Introduction, Course Contract, Important of Plant Disease</p> <p>Introduction to Plant Disease, Definition, Challenges of Recent Plant Pathology</p> <p>Carriers in Phytopathology</p> <p>Plant Pathology History and Concept: From the Past to Recent; Concept: Development of Plant Disease Definition</p> <p>Plant pathogens: microscopic, sub-microscopic, plant pathogen parasitic and abiotic disease</p> <p>Plant Disease symptoms and development of plant disease diagnosis</p> <p>Pathological processes in Plant Disease: Pathogenesis and Plant Response against pathogens</p> <p>Environmental Factors in Plant Disease Development</p> <p>Epidemiology in Plant Diseases</p> <p>Strategy in Plant Disease Management (1): Quarantine and Technical Culture</p> <p>Strategy in Plant Disease Management (2): Physical, Chemical and Biological Control</p> <p>The Role of Biotechnology in Plant Pathology: In Plant Disease Diagnosis</p> <p>The Role of Biotechnology in Plant Pathology: Strategy in Plant Disease Management</p> <p>Emerging and Re-emerging Disease: Examples, Pathogenesis and Management</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Phytopathology

Reading list	<p><b>Books:</b></p> <ol style="list-style-type: none"><li>1. Agrios, G. 2005. Plant Pathology 5th. Academic Press. Cambridge. 952p.</li><li>2. Haryono, S. 2006. Pengantar Ilmu Penyakit Tumbuhan. Gadjah Mada University Press. Yogyakarta. 754h.</li></ol> <p><b>Journals:</b></p> <ol style="list-style-type: none"><li>1. Jurnal Perlindungan Tanaman Indonesia (JPTI): <a href="http://jurnal.ugm.ac.id/jpti">http://jurnal.ugm.ac.id/jpti</a></li><li>2. Jurnal Fitopatologi Indonesia (JFI) : <a href="http://journal.ipb.ac.id/jfi">journal.ipb.ac.id/jfi</a></li><li>3. Jurnal Hama dan Penyakit Tumbuhan tropika : <a href="https://jhpttropika.fp.unila.ac.id">https://jhpttropika.fp.unila.ac.id</a></li><li>4. American Phytopathological Society (APS) : <a href="http://www.apsnet.org">www.apsnet.org</a></li><li>5. Other international journals</li></ol>
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## Module Handbook of Population Dynamics and Pest Outbreaks

Module designation	This course covers the theories, facts, and phenomena underlying population dynamics and pest outbreaks with a focus on tropical agriculture. The course is divided into two main parts: (1) Discussion of basic theories, examples, and analysis of how populations change and develop toward pest outbreaks, (2) Case studies on several key crops for each selected crop. The diversity and variety of agricultural ecosystems and landscapes of selected crops and pests will enrich students' understanding and motivate them to think contextually.
Semester(s) in which the module is taught	Second Semester
Person responsible for the module	Prof. Dr. Ir. Y. Andi Trisyono, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Population Dynamics and Pest Outbreaks

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are logical, critical, and innovative in communicating their ideas both orally and in writing to solve problems in crop protection.</p> <p>Graduates are able to work individually and in teams to ensure success in solving problems caused by pests.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand the theoretical basis and key factors of population dynamics and pest outbreaks [CPL4.1].</p> <p>Students are able to understand the impact of diversity, agricultural landscapes, seasonal cycles, climate change, and pest movement on the potential for pest outbreaks [CPL4.2].</p> <p>Students are able to explore and study the facts and factors underlying outbreaks of important agricultural pests and their management practices [CPL4.2].</p>
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## Module Handbook of Population Dynamics and Pest Outbreaks

<p>Content</p>	<p>Introduction: Population theory and understanding pest outbreaks</p> <p>Principles and population growth: population growth, carrying capacity, and environmental resistance.</p> <p>Evolutionary Strategy</p> <ul style="list-style-type: none"> <li>• Adaptation, Constraints, Trade-Offs, and Resource Allocation</li> <li>• Fecundity Variation Hypothesis</li> <li>• Reproductive Time</li> <li>• Adult Lifespan -&gt; Depends on Environmental Support &amp;/or Stress</li> <li>• Migration</li> <li>• Effect of System Diversity</li> <li>• Foraging Movements and the Role of Natural Enemies</li> <li>• Physiological Phases Depend on Insect Population Density (Annual Review of Entomology, 1999) -&gt; Wandering Locust</li> <li>• Pest Dispersal, Pest Movement, and Yield Decline</li> </ul> <p>Seasonal Adaptation and Climate Change</p> <ul style="list-style-type: none"> <li>• Environmental Regulation of the Seasonal Cycle</li> <li>• Seasonal Adaptation</li> <li>• Seasonality, Life History Evolution, and Speciation</li> <li>• Seasonality, Climate Change, and IPM</li> </ul> <p>Corn Pests: Fall Armyworm and Asian Corn Borer</p> <p>Soybean Pests: <i>Phaedonia inclusa</i> and <i>Helicoverpa armigera</i></p> <p>Discussion of Compound Interest Disease Development.</p> <p>Oil palm pests: <i>Oryctes rhinoceros</i></p> <p>Tea pests: Leafhoppers and <i>Helopeltis</i> sp.</p> <p>Cabbage pests: Diamondback Moth and <i>Crociodolimia binotalis</i></p> <p>Cabbage pests: Diamondback Moth and <i>Crociodolimia binotalis</i></p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Population Dynamics and Pest Outbreaks

Reading list	<p>Primary:</p> <ol style="list-style-type: none"><li>1. Kogan, M. 1986. Ecological Theory and Integrated Pest Management Practice. John Wiley &amp; Sons, NY.</li><li>2. Price, P. W. R. F. Denno, M. D. Eubanks, D. L. Finke and I. Kaplan. 2011. Insect Ecology: Behaviors, Populations, and Communities. Cambridge University Press, NY.</li><li>3. Tauber, M. J., C. A. Tauber, and S. Masaki. 1986. Seasonal Adaptations of Insects. Oxford University Press, NY.</li><li>4. Annual Review of Entomology. 1999. Volume 44: 317-341.</li></ol>
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## Module Handbook of Plant Disease Epidemiology

Module designation	This course is conducted to gain an understanding of plant diseases in a population, as an effort to understand the principles and application of epidemiological principles in plant disease control. The main topics of this course are the limitations and terms in epidemiology, the role of environmental factors in the development of plant diseases until the epidemic occurs, as well as the types of pathogen spread and pathogen spreading agents. Furthermore, the application of epidemiology from a quantitative perspective so that students can better understand its application in the field, especially in relation to the application of control principles. Students are expected to be able to practice critical, analytical, and creative thinking, and be able to express their opinions orally through interactive discussions. In addition, students are able to explore plant diseases in relation to space and time, and prepare plant disease control strategies based on epidemiological principles.
Semester(s) in which the module is taught	Second Semester
Person responsible for the module	Prof. Ir. Achmadi Priyatmojo, M. Sc., Ph.D., IPU
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 50-60 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2 credit points

## Module Handbook of Plant Disease Epidemiology

Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to explain the types of pathogen distribution and understand early detection of plant diseases through infection levels [CPL2.1].</p> <p>Students are able to explain the factors that influence disease development and the occurrence of epidemics [CPL2.2].</p> <p>Students demonstrate independent and analytical thinking based on their understanding of the knowledge they have acquired [CPL2.2].</p> <p>Students are able to present the material they have learned in the form of a report and express it effectively in a systematic manner [CPL2.2].</p>

## Module Handbook of Plant Disease Epidemiology

Content	<p>Introduction: Background and objectives of the plant disease epidemiology course</p> <p>Discussion of the epidemiology limitations and classification of plant diseases</p> <p>Discussion of epidemics, endemics, and pandemics</p> <p>Discussion of types of pathogen distribution and population dynamics of airborne pathogens</p> <p>Discussion of types of pathogen distribution and population dynamics of waterborne and insect-borne pathogens</p> <p>Discussion of types of disease distribution patterns</p> <p>Discussion of the development of simple interest disease.</p> <p>Discussion of the development of compound interest disease.</p> <p>Discussion of the application of initial inoculum source (X<sub>0</sub>) suppression in disease control.</p> <p>Discussion of the application of time manipulation (t) in disease control.</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Primary :</p> <ol style="list-style-type: none"> <li>1. Campbell, C.L. &amp; Madden, L.V. 1990. Introduction of Plant Disease Epidemiology. Wiley-Interscience</li> <li>2. Nagaradjan, S. &amp; K. Muralidharan. 1995. Dynamics of Plant Diseases. Allied Publisher Limited. New Delhi India</li> <li>3. Van der Plank, JE 1963. Plant diseases: Epidemics and Control. Academic Press New York and London</li> <li>4. Jurnal Perlindungan Tanaman Indonesia</li> <li>5. Phytopathology (APS)</li> <li>6. Plant Disease (APS)</li> </ol>

## Module Handbook of Agricultural Plant Pests

Module designation	The Plant Pest Science course examines pests as a group of animals that are important components of the ecosystem. Pests act as herbivores, carnivores, dispersers, pollinators, decomposers, and have other important roles. Therefore, this course discusses aspects of pest biology, including taxonomy, anatomy, physiology, behavior, as well as taxonomy and sociobiology. In addition, this course also discusses the impacts of insects, both positive and negative, on humans and the environment. Students who take this course are expected to master the identification of important pests in the agricultural sector and understand pest bioecology. After completing this course, students are expected to be able to explain the role and function of pests in nature and their economic value, understand the basic biological aspects of insects including morphology, anatomy, physiology, behavior, and ecology, and be able to explain insect classification techniques based on morphology, anatomy, function/role, and economic value.
Semester(s) in which the module is taught	Third Semester
Person responsible for the module	Ir. Nugroho Susetya Putra M.Si., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Agricultural Plant Pests

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Crop Protection
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Students are able to explain the role and function of insects in nature, as well as their economic value to humans [CPL2.1].</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to explain basic aspects of insect biology, including morphology, anatomy, physiology, behavior, and ecology [CPL2.2].</p> <p>Students are able to explain insect classification techniques based on morphology, anatomy, function/role, and economic value [CPL2.2].</p>
Content	<p>Introduction: The role and function of insects in nature</p> <p>Insect morphology</p> <p>Insect anatomy</p> <p>Insect physiology</p> <p>Insect growth, development, and reproduction</p> <p>Insect taxonomy and classification</p> <p>Insect behavior and interactions with the environment</p> <p>The influence of abiotic factors on insects</p> <p>Insects: Hosts, natural enemies, and competitors</p>
Examination forms	High Order Thinking Skills Examination

## Module Handbook of Agricultural Plant Pests

Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Primary :</p> <ol style="list-style-type: none"><li>1. Gullan, P.J. &amp; P.S. Cranston. 2005. The insects. An outline of entomology. Blackwell Publishing, Massachussets.</li><li>2. Speight, M.R., M.D. Hunter, &amp; A.D. Watt. 2008. Ecology of insects. Concepts and applications. Wiley-Blackwell, Chicester.</li><li>3. Jurnal dan sumber-sumber lain yang terkait.</li></ol>

## Module Handbook of Agricultural Pests and Diseases in Closed Environment and Post-Harvest

Module designation	This course discusses post-harvest products and the quality required in the global trade system. Post-harvest product damage due to biotic, mechanical, and physical factors. Types of post-harvest pests and diseases; morphological, biological, and ecological factors. Post-harvest product handling and storage systems: packaging, storage techniques. Warehousing: requirements, ecology, and management. Post-harvest pest and disease management and control: monitoring, control techniques.
Semester(s) in which the module is taught	Third Semester
Person responsible for the module	<b>Prof. Dr.Ir. Fransiscus Xaverius Wagiman, S.U.</b>
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Agricultural Pests and Diseases in Closed Environment and Post-Harvest

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students understand pest and disease issues, as well as their management and control in indoor crops.</p> <p>Students will be able to explain the processes and challenges in post-harvest commodity handling, as well as methods to maintain the quality and nutritional value of products until they reach the end consumer.</p> <p>Students will be able to explain the morphology and bioecology of pests, pathogens, mycotoxins, pest attack symptoms, and disease symptoms in post-harvest products and their processed products.</p> <p>Students will be able to explain and implement effective handling and storage systems, manage warehouses effectively, and control pests and diseases to maintain the quality of post-harvest products and their processed products.</p>
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## Module Handbook of Agricultural Pests and Diseases in Closed Environment and Post-Harvest

Content	<p>Pest problems, management, and control in plants under closed conditions.</p> <p>Physical, physiological, nutritional, and quality characteristics of post-harvest commodities and their processed products as required by the global trade system.</p> <p>Deterioration and damage to post-harvest commodities and their processed products by pests, sources of pest infestation, periods of pest infestation, and the types of losses caused.</p> <p>Morphology and bioecology of pest types, symptoms of pest attacks on post-harvest products and their processed products.</p> <p>Handling and storage systems for post-harvest commodities and their processed products.</p> <p>Ideal warehouses and warehouse management, handling, packing, and storage techniques for post-harvest products and their processed products.</p> <p>Post-harvest pest management and control systems: monitoring and control techniques.</p> <p>Disease problems in plants under closed conditions.</p> <p>Management and control of plants under closed conditions.</p> <p>Physiological damage, biotic, mechanical, physical, and mycotoxin-related diseases in post-harvest produce.</p> <p>Post-harvest fresh produce handling, packaging, and storage.</p> <p>Morphology and bioecology of pathogenic fungi and disease symptoms in post-harvest fresh produce.</p> <p>Morphology and bioecology of pathogenic bacteria and disease symptoms in post-harvest fresh produce.</p> <p>Post-harvest disease management and control systems: monitoring and control techniques.</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Agricultural Pests and Diseases in Closed Environment and Post-Harvest

Reading list	<ol style="list-style-type: none"><li>1. Haines, CP. 1991. Insects and arachnids of tropical stored products: their biology and</li><li>2. identification. (A training manuals). 2nd ed. (revised). Natural Resources Institute, Central Avenue, UK. 246p.</li><li>3. Hall, D.W. 1970. Handling and storage of food grain in Tropical and subtropical areas. FAO, Rome</li><li>4. Kader, A.A. 1992. Postharvest Technology of Horticultural Crops.</li><li>5. Wills, RHH, TH Lee, D. Graham, WB McGlasson, and EG Hall. 1981. Post Harvest: An introduction of the Physiology and Handling of Fruit and Vegetables New South Wales Univ. Press. Australia.</li><li>6. Baur, F.J. (Ed.). 1985. Insect Management for Food Storage and Processing. American Association of Cereal Chemists. St. Paul. Minnesota. 384 p.</li><li>7. BIOTROP. 1986. Biotrop Third Training Course on Pests of Stored Products. Volume IIA and IIB. Compilation of Lecture Notes. Bogor, Indonesia.</li><li>8. Cotton, R.T. 1963. Pests of stored grain and grain products. Burgess Publishing Company.</li><li>9. Minneapolis, Minnesota. 318 p.</li><li>10. Harris, K.L. and C.J. Lindbad. 1976. Postharvest Grain Loss Assessment Methods. A Manual of Methods for the Evaluation of Postharvest Losses. American Association of Cereal Chemicals. 193 p.</li><li>11. Justice, O.L. and L.N. Bass. 1978. Principles and practices of seed storage. Agriculture Handbook Number 506. Science and Education Administration. USDA, Washington, D. C. 289 p.</li><li>12. Wagiman, F. X. 2014. Postharvest pests and their management (Hama Pasca Panen dan Pengelolaannya). Gama Press, Yogyakarta.</li><li>13. Anonim. .... Training notes on insect and mite identification and biology. Modules I and II.</li><li><b>14.</b> Tropical Products Institute. Ministry of Overseas Development, London. 116p.</li></ol>
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## Module Handbook of Agricultural Plant Pests

Module designation	This course discusses the introduction and in-depth study of important pests in Indonesia. In addition, this course also discusses major and minor pests in Indonesia as well as the differences between plant pest organisms including insects, mites, nematodes, and vertebrates. The material is in-depth regarding the biotaxonomy, classification, and bioecology of major plant pest species in Indonesia. Furthermore, damage caused by plant pests is reviewed in terms of the economic value of each pest species. The resulting damage is also reviewed in more depth regarding the symptoms of attacks that indicate the presence of pest species. The introduction of pest organisms and specific symptoms of damage caused by these pests will be presented and discussed in detail and comprehensively including pests on rice, corn, soybeans, tea, cocoa, cashew nuts, coconuts, sugar cane, cabbage, potatoes, tomatoes, chilies, mangoes, durian, rambutan, snake fruit, guava, roses, apples, oranges, soursop, medicinal plants and ornamental plants.
Semester(s) in which the module is taught	Third Semester
Person responsible for the module	Dr. Tri Harjaka, S.P., M.P.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 20-30 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Agricultural Plant Pests

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students will be able to identify and understand important agricultural pests in Indonesia and explain the types of pest attack symptoms in each plant part.</p> <p>Students will understand the distribution patterns of agricultural plant pests in Indonesia.</p> <p>Students will understand the host range of each insect on various agricultural commodities.</p> <p>Students will understand the life cycles of major insect pests on different crops.</p>

## Module Handbook of Agricultural Plant Pests

Content	<p>An introduction to the importance of economics in agriculture.</p> <p>Major insect pests of rice (identification, biology, characteristics, and symptoms).</p> <p>Major pests of corn (identification, biology, characteristics, and symptoms).</p> <p>Major pests of soybeans (identification, biology, characteristics, and symptoms).</p> <p>Major pests of tea and cocoa (identification, biology, characteristics, and symptoms).</p> <p>Major pests of coconut and sugarcane (identification, biology, characteristics, and symptoms).</p> <p>Major pests of cabbage, potatoes, tomatoes, and chili peppers (identification, biology, characteristics, and symptoms).</p> <p>Major pests of mango, durian, and rambutan (identification, biology, characteristics, and symptoms).</p> <p>Major pests of snake fruit and guava (identification, biology, characteristics, and symptoms).</p> <p>Major pests of citrus, apple, and soursop (identification, biology, characteristics, and symptoms).</p> <p>Major pests of medicinal and ornamental plants (identification, biology, characteristics, and symptoms).</p> <p>Unique morphology of pests that attack agricultural crops, including their symptoms and damage.</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Kalshoven 1981. The Pest of Crops in Indonesia. PT IchtiarBaru – Van Hoeve.</p> <p>Jakarta.</p>

## Module Handbook of Agricultural Mycology

Module designation	The Introduction to Agricultural Mycology course primarily examines the general characteristics of various fungi, according to their classification, and the various factors that influence their survival. This course aims to provide students with an understanding of various fungal species, especially those that can cause plant disease, based on their morphological characteristics, both macroscopically and microscopically. This is crucial because it relates to the process of identifying the causes of plant disease, which ultimately leads to methods for managing these plant diseases.
Semester(s) in which the module is taught	Third Semester (Odd Semester)
Person responsible for the module	Dr. Suryanti, SP, MP
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-50 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Agricultural Mycology

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates will master the identification of important pests in agriculture.</p> <p>Graduates will be competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>They will understand and explain the characteristics of fungi, their classification, and their general role in agriculture.</p> <p>They will understand the factors that influence fungal growth.</p> <p>They will understand and explain the general classification of living things, the classification of fungi, and their development.</p> <p>They will understand and explain the mutualistic symbiosis between fungi and their host plants.</p>
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## Module Handbook of Agricultural Mycology

Content	<p>Introduction</p> <p>History and Development of Mycology</p> <p>The Importance of Fungi in Human Life</p> <p>General Morphology of Fungi</p> <p>Growth and the Living Environment</p> <p>Fungal Growth</p> <p>Factors Affecting Fungal Growth</p> <p>Fungal Nutrition and Metabolism</p> <p>Classification</p> <p>Classification of Living Things According to the 5 Kingdoms</p> <p>Fungal Classification</p> <p>Explanation of Fungal Classification, Reproduction, and Role</p> <p>Phycomycetes</p> <p>Ascomycetes</p> <p>Explanation of Fungal Classification, Reproduction, and Role</p> <p>Deuteromycetes</p> <p>Basidiomycetes</p> <p>Mycorrhiza</p> <p>Definition of Mycorrhizae</p> <p>The Role of Mycorrhizae in Agriculture</p> <p>Interactions Between Mycorrhizal Fungi and Their Host Plants</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Agricultural Mycology

Reading list	<p>Books</p> <ol style="list-style-type: none"><li>1. Agrios, G. 2005. Plant Pathology 5th. Academic Press. Cambridge. 952p.</li><li>2. Haryono, S. 2006. Pengantar Ilmu Penyakit Tumbuhan. Gajah Mada University Press. Yogyakarta. 754h.</li></ol> <p>Journals:</p> <ol style="list-style-type: none"><li>1. Jurnal Perlindungan Tanaman Indonesia (JPTI): <a href="http://jurnal.ugm.ac.id/jpti">http://jurnal.ugm.ac.id/jpti</a></li><li>2. Jurnal Fitopatologi Indonesia (JFI) : <a href="http://journal.ipb.ac.id/jfi">journal.ipb.ac.id/jfi</a></li><li>3. American Phytopathological Society (APS) : <a href="http://www.apsnet.org">www.apsnet.org</a></li><li>4. Other international journals</li></ol>
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## Module Handbook of Agricultural Plant Diseases

Module designation	Discusses the definition and significance of important agricultural plant diseases. Introduction to important diseases in food crops, horticultural crops, and plantation crops, including disease symptoms and ecology, pathogens that cause, survive, and spread. Management of important agricultural plant diseases on a regional scale. Emerging Infectious (plant) Diseases (EIDs) globally are related to pathogen evolution, world population mobility, and climate change.
Semester(s) in which the module is taught	Third Semester
Person responsible for the module	Prof.Ir. Achmadi Priyatmojo, M.Sc, Ph.D. IPU
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Agricultural Plant Diseases

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests (diseases) in agriculture.</p> <p>Graduates are competent in understanding the bioecology of pests (diseases).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand important food crop diseases (P1; P2).</p> <p>Students are able to understand important horticultural crop diseases (P1; P2).</p> <p>Students are able to understand important plantation crop diseases (P1; P2).</p>
<p>Content</p>	<p>Introduction: Economic Losses Due to Plant Diseases</p> <p>Important Diseases of Food Crops (staple and horticultural crops) Caused by Prokaryotes</p> <p>Important Diseases of Food Crops (staple and horticultural crops) Caused by Viruses</p> <p>Important Diseases of Plantation Crops Caused by Prokaryotes and Viruses</p> <p>Management of Important Plant Diseases Caused by Prokaryotes and Viruses</p> <p>Student Presentations</p> <p>Important Fungal Diseases of Food Crops</p> <p>Important Fungal Diseases of Horticultural Crops</p> <p>Important Fungal Diseases of Plantation Crops</p> <p>Pathogen Survival and Epidemiology of Important Fungal Plant Diseases</p> <p>EIDs of Fungal Plant Diseases</p> <p>Management of Important Fungal Plant Diseases</p> <p>Student Presentations</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Agricultural Plant Diseases

Reading list	<p><b>Books:</b></p> <ol style="list-style-type: none"><li>1. Semangun, H. Penyakit-Penyakit Tanaman Pangan di Indonesia. Gadjah Mada University Press. Yogyakarta.</li><li>2. Semangun, H. Penyakit-Penyakit Tanaman Hortikultura di Indonesia. Gadjah Mada University Press. Yogyakarta.</li><li>3. Semangun, H. Penyakit-Penyakit Tanaman Perkebunan di Indonesia. Gadjah Mada University Press. Yogyakarta.</li><li>4. Compendium of plant diseases</li></ol> <p><b>Journals:</b></p> <ol style="list-style-type: none"><li>1. Jurnal Perlindungan Tanaman Indonesia</li><li>2. Jurnal Fitopatologi Indonesia</li><li>3. Plant Disease and Plant Pathology Journals</li></ol>
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## Module Handbook of Plant Pathogenic Prokaryotes

Module designation	<p>Plant Pathogenic Prokaryotes is a course that teaches students to recognize groups of microbes, bacteria, and phytoplasmas that cause plant disease. This course covers the importance of these microbes in plant disease, their classification, identification, and detection in association with plants and/or their presence in the environment, their distribution, survival, pathogenesis, and control. This topic aims to provide students with a deeper understanding of plant disease-causing bacteria and phytoplasmas and the control of their life cycles.</p> <p>The learning method is carried out through classroom lectures with active discussions on current issues of global and national exposure, and laboratory experiments to analyze student-isolated bacterial isolates, test their biochemical, physiological, and molecular properties, and examine the interactions of pathogens with their host plants. Assessment methods are conducted by observing students' active participation in asking questions and providing opinions during lectures and labs, quizzes or assignments, exams, and lab reports.</p>
Semester(s) in which the module is taught	Third Semester (Odd Semester)
Person responsible for the module	Prof. Dr. Tri Joko, S.P., M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 40-50 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Plant Pathogenic Prokaryotes

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Plant protection, Phytopathology
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates will master the identification of important pests in agriculture.</p> <p>Graduates will be competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>They will be able to diagnose plant diseases caused by prokaryotes.</p> <p>They will understand the pathogenesis mechanisms that cause disease in their hosts, and their modes of spread and survival.</p> <p>They will be familiar with techniques for preventing and managing diseases caused by prokaryotes.</p>

## Module Handbook of Plant Pathogenic Prokaryotes

<p>Content</p>	<p>Introduction and Course Contract</p> <p>Importance and History of Research on Diseases Caused by Prokaryotes</p> <p>Taxonomy of Plant Pathogenic Prokaryotes</p> <p>Diagnosis of Plant Diseases Caused by Prokaryotes: Morphological, Physiological, and Biochemical Identification</p> <p>Serological and Molecular Identification</p> <p>Disease Physiology</p> <p>Genetics of Pathogenic Bacteria</p> <p>Pathogenesis and Infection Process - Molecular Interactions</p> <p>Plant Resistance to Prokaryotes</p> <p>Life Cycle and Distribution of Plant Pathogenic Prokaryotes</p> <p>Epidemiology of Prokaryotic Plant Diseases</p> <p>Infection and Disease Development</p> <p>Traditional Management (Exclusion, Technical Culture, Chemicals)</p> <p>Biological and Mechanical Management</p> <p>Examples of Important Plant Diseases Caused by Bacteria (Identification, Physiology, and Management)</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Plant Pathogenic Prokaryotes

Reading list	<ol style="list-style-type: none"><li>1. Plant Bacteriology. Clearence I Kado 2010 APS. ISBN 0890543887, 9780890543887 336 pp</li><li>2. Plant-Associated Bacteria. Samuel S. Gnanamanickam 2007</li><li>3. Fundamental of Plant Bacteriology. M Goto 1992</li><li>4. Virulence Mechanisms of Plant-Pathogenic Bacteria. Eds: Nian Wang, Jeffrey B. Jones, George W. Sundin, Frank White, Saskia Hogenhout, Caroline Roper, Leonardo De La Fuente, and Jong Hyun Ham 2015. ISBN 978-0-89054-444-0</li><li>5. Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications. P. Vidhyasekaran 2002. ISBN 1-56022-924-1</li><li>6. Sustainable Approaches to Controlling Plant Pathogenic BacteriaV. Rajesh Kannan, Kubilay Kurtulus Bastas, 2015 CRC Press ISBN 9781482240535</li><li>7. Laboratory Guide for Identification of Plant Pathogenic Bacteria, 3rd Ed. Edited by N.W. Schaad, J.B. Jones, and W. Chun 2001. ISBN 0-89054-263-5</li><li>8. Phytoplasmas: Genomes, Plant Hosts and Vectors. Phyllis G. Weintraub, Phil Jones 2010</li></ol>
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## Module Handbook of Plant Virology

Module designation	<p>The Plant Virology course is designed to equip students in the Plant Protection Study Program with the comprehensive knowledge of viruses as the cause of plant disease. This course comprehensively covers the history of the discovery and development of plant virology, the definition of viruses, their types, how viruses replicate and transmit, their bioecology, and how to diagnose and treat them. After completing this course, students will possess the core competencies to explain viruses, their mechanisms of infection and spread within the host, the environmental factors that influence them, how they are transmitted, how they are identified, and how they are managed.</p> <p>Lectures will be delivered in a conventional manner combined with student-centered learning (SCL) methods. This approach ensures that students not only achieve core competencies but also develop the courage to actively express their ideas and critically evaluate the material presented. Lectures are delivered in class through face-to-face sessions and discussions. To enrich the material, students are given independent assignments related to the material. Students are also given group assignments to write papers on a pathogen by summarizing and presenting them from various reputable journals. Quizzes will be given several times without a schedule. Through discussions and seminars, students practice critical, analytical, and creative thinking. Through various learning methods, students are also expected to be able to present scientific reports both orally and in writing.</p> <p>To achieve competency in the form of skills, students are guided to directly identify various types of plant viruses, conduct isolation and characterization, inoculation, diagnosis, and management through hands-on laboratory and field experiments. The results of the experiments are presented in a written report. A response is given at the end of the practicum. Character education is also taught in this course, particularly in the areas of honesty and discipline.</p>
Semester(s) in which the module is taught	Third Semester (Odd Semester)
Person responsible for the module	Dr. Ir. Sedyo Hartono, M.P.
Language	Bahasa Indonesia/Indonesian Language

## Module Handbook of Plant Virology

Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Plant protection, Phytopathology
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>After completing the Plant Virology course, students will be able to understand the importance of plant viruses in agricultural ecosystems and comprehensively explain viruses as plant pathogens.</p> <p>Perform plant virus diagnosis using various methods.</p> <p>Learn how to control plant viruses effectively and efficiently.</p> <p>Become active, independent, analytical students who are confident in communicating both verbally and in writing, based on the scientific knowledge they have acquired.</p>

## Module Handbook of Plant Virology

Content	<p>General explanation and course contract, as well as the importance of plant viruses as a component of the ecosystem</p> <p>History of the discovery and current development of plant viruses</p> <p>Nomenclature of plant viruses</p> <p>Symptom recognition</p> <p>Plant viruses as macromolecules and packages of genetic information</p> <p>Plant virus replication</p> <p>Plant virus transmission and spread</p> <p>Plant virus ecology and epidemiology</p> <p>Plant virus isolation and purification</p> <p>Fundamentals of plant virus diagnosis</p> <p>Plant virus management</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Plant Virology

Reading list	<ol style="list-style-type: none"><li>1. Agrios, G.N. 1994. Plant Pathology. Fourth Ed. Acad. Press. San Diego.</li><li>2. Bos, L. 1983. Introduction to Plant Virology. Pudoc. Wageningen. The Netherlands.</li><li>3. Duncan, J.M. and L. Torrance (Ed.). 1992. Technique for Rapid Detection of Plant Pathogens. Blackwell Sci. Publ.</li><li>4. Hampton, R.O. E.M. Ball, S.H. de Boer (Eds). 1990. Serological Methods. APS Press. Minnesota.</li><li>5. Hull, R. 2002. Mathews' Plant Virology. Fourth Ed. Acad. Press. San Diego.</li><li>6. Matthews, R.F. 1992. Fundamental of Plant Virology. Acad. Press. California.</li><li>7. Triharso. 1992. Pengantar Virologi Tumbuhan. Gama Press. Yogyakarta.</li><li>8. van Regenmortel, M. H. V. C. M. Fauquet, D. H. L. Bishop, E. B. Carstens, M. K. Estes, S. M. Lemon, J. Maniloff, M. A. Mayo, D. J. McGeoch, C. R. Pringle &amp; R. B. Wickner. (Eds.) (2000). Virus Taxonomy. Seventh Report of the International Committee on Taxonomy of Viruses, Academic Press. San Diego:</li><li>9. Foster, G.D. and Taylor S.C. 1998. Method in Molecular Biology: Plant Virology Protocols. Humana Press Inc. New Jersey.</li><li>10. Dijkstra, J &amp; C.P. de Jager. 1998. Practical Plant Virology. Protocols and Exercises. Springer Lab. Manual.</li></ol>
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## Module Handbook of Agricultural Zoology

Module designation	This lecture provides knowledge about the principles and concepts of animal science (zoology) in agricultural ecosystems. The lecture is divided into four parts, namely (1) introduction: basic principles and concepts of bioecology, roles, and functions of animals in agricultural ecosystems, (2) classification of animals found in agricultural ecosystems, (3) concepts of population dynamics and factors that play a role, and (4) sustainable management of animals found in agricultural ecosystems.
Semester(s) in which the module is taught	Third Semester (Odd Semester)
Person responsible for the module	Alan Soffan, S.P., M.Sc., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 40-50 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Agricultural Zoology

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are able to disseminate agricultural science concepts.</p> <p>Graduates are able to understand and apply crop protection concepts.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students understand the basic concepts and principles of zoology.</p> <p>Students understand the role and function of animals in agricultural ecosystems.</p> <p>Students understand strategies for managing both beneficial and harmful animal populations in a sustainable environment.</p>
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## Module Handbook of Agricultural Zoology

Content	<p>Introduction: Basic concepts and principles of zoology</p> <p>Biology (morphology, anatomy, physiology, and behavior)</p> <p>Animal interactions with the abiotic and biotic environment</p> <p>The role and function of animals in agricultural ecosystems</p> <p>Herbivores: pests and pollinators</p> <p>Natural enemies</p> <p>Organic matter decomposers</p> <p>Soil cultivators</p> <p>Pathogen vectors</p> <p>Classification of the Animal Kingdom:</p> <p>Vertebrates</p> <p>Invertebrates</p> <p>Bioecology and classification of the Nematoda Phylum</p> <p>Bioecology and classification of the Arthropod Phylum</p> <p>Bioecology and classification of the Mollusca Phylum</p> <p>Bioecology and classification of the Vertebrata Phylum</p> <p>Principles of animal population dynamics:</p> <p>Causal factors: emigration, immigration, birth, and death</p> <p>Patterns and mechanisms of population dynamics</p> <p>Invasiveness and potential damage by animals on crops</p> <p>Management strategies for beneficial and harmful animals in agricultural ecosystems</p> <p>Decision-making and management processes.</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Agricultural Zoology

Reading list	<ol style="list-style-type: none"><li>1. Dempster, J.P., 1975. Animal population ecology. Academic Press.</li><li>2. Hickman, C.P. et al., 2017. Integrated principles of zoology. 7th edition. McGraww-Hill Education, New York.</li><li>3. Miller, S.A. et al., 2004. Zoology. McGraw-Hill Science. New York.</li></ol>
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## Module Handbook of Agricultural Entomology

Module designation	The Agricultural Entomology course examines insects as a group of animals that are important components of ecosystems. Insects act as herbivores, carnivores, dispersers, pollinators, decomposers, and have other important roles. Therefore, this course discusses aspects of insect biology, including taxonomy, anatomy, physiology, behavior, as well as taxonomy and sociobiology. In addition, this course also discusses the impacts of insects, both positive and negative, on humans and the environment. Students who take this course are expected to master the identification of important pests in the agricultural sector and understand pest bioecology. After completing this course, students are expected to be able to explain the role and function of insects in nature and their economic value, understand the basic biological aspects of insects including morphology, anatomy, physiology, behavior, and ecology, and be able to explain insect classification techniques based on morphology, anatomy, function/role, and economic value.
Semester(s) in which the module is taught	Fourth Semester (Even Semester)
Person responsible for the module	Alan Soffan, S.P., M.Sc., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Agricultural Entomology

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Crop Protection
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to explain the role and function of insects in nature, as well as their economic value to humans [CPL2.1].</p> <p>Students are able to explain basic aspects of insect biology, including morphology, anatomy, physiology, behavior, and ecology [CPL2.2].</p> <p>Students are able to explain insect classification techniques based on morphology, anatomy, function/role, and economic value [CPL2.2].</p>
Content	<p>Introduction: The role and function of insects in nature</p> <p>Insect morphology</p> <p>Insect anatomy</p> <p>Insect physiology</p> <p>Insect growth, development, and reproduction</p> <p>Insect taxonomy and classification</p> <p>Insect behavior and interactions with the environment</p> <p>The influence of abiotic factors on insects</p> <p>Insects: Hosts, natural enemies, and competitors</p>
Examination forms	High Order Thinking Skills Examination

## Module Handbook of Agricultural Entomology

Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Primary:</p> <ol style="list-style-type: none"><li>1. Gullan, P.J. &amp; P.S. Cranston. 2005. The insects. An outline of entomology. Blackwell Publishing, Massachussets.</li><li>2. Speight, M.R., M.D. Hunter, &amp; A.D. Watt. 2008. Ecology of insects. Concepts and applications. Wiley-Blackwell, Chicester.</li><li>3. Jurnal dan sumber-sumber lain yang terkait.</li></ol>

## Module Handbook of Agricultural Nematology

Module designation	The Agricultural Nematology course is designed to provide an in-depth understanding of nematodes, which play a vital role in agricultural ecosystems, as well as skills in managing their impacts on crops. This course covers a variety of topics, including nematode identification, life cycles, interactions with plants, and nematode control methods in crop cultivation systems. With a solid understanding of nematodes, students are expected to be able to apply these concepts in crop protection and agricultural land management. The main objective of this course is to develop graduates with competencies in nematology and the ability to apply them to crop cultivation systems, particularly in the context of crop protection. Upon completion of this course, students are expected to be able to explain the importance of nematodes in agricultural ecosystems. Students' understanding and skills will be assessed through evaluations of the Midterm Exam, Final Exam, personal assignments, creativity in discussions, class participation, presentations, and discipline in submitting assignments.
Semester(s) in which the module is taught	Fourth Semester (Even Semester)
Person responsible for the module	Prof. Dr. Ir. Siwi Indarti, M.P.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 20-30 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Agricultural Nematology

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are able to disseminate agricultural science concepts.</p> <p>Graduates are able to understand and apply crop protection concepts.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students can explain the role of nematodes in agriculture and master laboratory techniques in nematology, including nematode identification [CPL2.1].</p> <p>Students can explain the role of nematodes in agriculture and master laboratory techniques in nematology, including nematode identification [CPL2.2].</p> <p>Students can explain the mechanisms of nematode interaction with their hosts and the symptoms they cause in their hosts [CPL2.2].</p> <p>Students can understand and explain methods for managing parasitic and non-parasitic nematodes and their role in sustainable agricultural ecosystems [CPL2.2].</p>

## Module Handbook of Agricultural Nematology

Content	<p>Introduction:</p> <ul style="list-style-type: none"><li>a) Scope of Agricultural Nematology</li><li>b) History of Agricultural Nematology</li><li>c) The Role of Nematology in Agriculture</li><li>d) Problems with Plant-Parasitic Nematodes, Including in Indonesia</li></ul> <p>Methodology</p> <p>Nematode Sampling and Handling Techniques</p> <p>Nematode Extraction-Isolation and Fixation Methods</p> <p>3. Methodology</p> <p>Nematode Specimen Preparation/Preparation</p> <p>Nematode Identification</p> <p>Nematode Propagation</p> <p>4. Nematode Morphology and Classification:</p> <p>General Nematode Morphology (Plant Parasites and Non-Plant Parasites)</p> <p>Nematode Anatomy</p> <p>5. Nematode Morphology and Classification:</p> <p>Morphology of Various Orders and Families of Plant-Parasitic Nematodes</p> <p>6. Nematode Classification:</p> <ul style="list-style-type: none"><li>a) Classification (Group Arrangement) of Nematodes</li><li>b) Classification of Nematodes Based on Feeding Behavior</li></ul> <p>7. Nematode Classification:</p> <ul style="list-style-type: none"><li>a) Classification of Nematodes Based on Morphological Characteristics at the Plant Level Order and Genus Level</li><li>b) Morphology of Entomopathogenic Nematodes</li></ul> <p>8. Nematode Ecology:</p> <p>The Influence of Abiotic and Biotic Factors on Nematode Growth</p> <p>Nematode Population Dynamics</p> <p>9. Nematode Ecology</p> <p>Nematode Migration, Distribution, and Dispersal</p> <p>Factors Influencing Nematode Migration and Distribution</p> <p>10. Important Nematodes in Agriculture:</p>
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## Module Handbook of Agricultural Nematology

	<p>Groups of Non-Plant-Parasitic Nematodes and Their Role in Agriculture</p> <p>11. Interactions of Parasitic Nematodes with Hosts:</p> <p>a) Nematode Biology</p> <p>b) Types of Plant-Parasitic Nematode Parasites</p> <p>c) Symptoms of Nematode Infestation</p> <p>12. Important Nematodes in Agriculture:</p> <p>a) Important Plant-Parasitic Nematodes, Their Biology, and Economic Impacts</p> <p>13. Nematode Management</p> <p>a) Principles of Plant-Parasitic and Non-Plant-Parasitic Nematodes Management</p> <p>b) Plant-Parasitic Nematode Control Techniques</p> <p>c) Concept of Integrated Plant-Parasitic Nematode Management</p> <p>14. Management Nematodes</p> <p>Student Presentation on the topic of managing plant-parasitic nematodes</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Agricultural Nematology

Reading list	<ol style="list-style-type: none"><li>1. Anonim, 2001. Handbook of Laboratory Techniques for Use with Plant, Soil and Entomophilic Nematodes. The Univ. of Adelaide and CSIRO div. Of Entomology. 26p.</li><li>2. Ayoub, Sadek M.1977. Plant Nematology "An agricultural training Aid". State of California, Dept. of Food and Agriculture Division Services. Sacramento, California</li><li>3. Barker, K.R.; C.C. Carter; and J.N. Sasser. 1985. An Advanced Treatise on Meloidogyne, Vol. II: Methodology. North Carolina State Univ. Graphics. 223p.</li><li>4. Bedding, R.; R. Akharst; &amp; H. Kaya. 1993. Nematodes and the Biological Control of Insect Pests. CSIRO Public. Victoria, Australia. 177p</li><li>5. Decker, H. 1981. Plant Nematodes and Their Control. Amerind publishing co.pvt.Ltd. New Delhi. 540p</li><li>6. Luc, M.; R.A. Sikora; &amp; J. Bridge. 1990. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. C.A.B. International Inst. of Parasitology. Wallingford, UK. 629p</li><li>7. Norton, D.C. 1978. Ecology of Plant Parasitic Nematodes. John Wiley &amp; Son, Inc. USA.268p.</li><li>8. Singh, R.S &amp; K. Sitaramaiah. 1993. Plant Pathogens: The plant Parasitic Nematodes. Science Publ. U.S.A.</li><li>9. Southey, J.F. 1986. Laboratory Methods for Work with Plant and Soil Nematoda. London: Her Majesty's Stat. Office. 202p.</li><li>10. Veech, J.A. and D.W. Dickson. 1987. Vistas on Nematology: A commemoration of the twenty-fifth anniversary of the Society of Nematologists. Soc. of Nematologists Inc. Hyattsville, Maryland. 509p</li></ol>
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## Module Handbook of Integrated Pest Management

Module designation	This course provides knowledge and understanding of the concepts, tactics, strategies, and implementation of integrated pest management for any commodity. Furthermore, it examines the development of these concepts and their implementation by farmers in the field.
Semester(s) in which the module is taught	Fourth Semester
Person responsible for the module	Prof. Dr. Ir. Witjaksono, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 60-70 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Integrated Pest Management

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates will be able to understand the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students will be able to understand the principles of integrated pest management [CPL2.3].</p> <p>Students will be able to prepare the basic components of integrated pest management [CPL2.3].</p> <p>Students will be able to design the implementation of IPM programs for key agricultural commodities, specific to specific locations and problems [CPL2.3].</p>
<p>Content</p>	<p>History and Background of IPM</p> <p>Theoretical and Conceptual Basis of IPM: Ecology I</p> <p>Theoretical and Conceptual Basis of IPM: Ecology II</p> <p>Theoretical and Conceptual Basis of IPM: Economics</p> <p>Problems Faced in IPM Implementation</p> <p>Basic Practices and Experiences of IPM.</p> <p>Inventory of Local Potential for Pest Population Control</p> <p>Implementation of Concepts and Programs: How IPM is Implemented and Previous Efforts Globally.</p> <p>IPM Implementation Steps: What and How</p> <p>IPM Implementation Steps: How and Why</p> <p>IPM Method Selection I: Basic Components</p> <p>IPM Method Selection II: Component Development</p> <p>Method Selection Based on References for IPM Technology Development.</p> <p>IPM Implementation Evaluation Simulation</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Integrated Pest Management

Reading list	<p><b>Books</b></p> <ol style="list-style-type: none"><li>1. Untung, K. 2007. Prinsip Pengendalian Hama Terpadu. Gajah Mada University Press, Yogyakarta. 273 p.</li><li>2. Jan Oudejans, 2007, Perkembangan Pertanian di Indonesia, Gajah Mada University Press</li></ol> <p>Dharam P Abrol and Uma Shankar 2012. Integrated Pest Management: Principles and Practice</p>
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## Module Handbook of Monitoring, Surveillance, and Forecasting

Module designation	This course consists of six major topics, namely (1) External and internal factors that regulate population dynamics and life tables; (2) Analysis of important factors; (3) Data collection methods; (4) Studying and reviewing existing models; (4) Developing models for monitoring, surveillance, and forecasting; and (6) Decision making and management.
Semester(s) in which the module is taught	Fourth Semester
Person responsible for the module	Prof. Dr. Tri Joko, S.P., M.Sc
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>e.g. lecture, lesson, lab works, project, seminar etc.</p> <p>Lecture are conducted in the class with ... students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	

## Module Handbook of Monitoring, Surveillance, and Forecasting

<p>Module objectives/intended learning outcomes</p>	<p>Graduates are able to understand and apply the concept of plant protection.</p> <p>Students are able to identify internal and external factors that regulate the population dynamics of insect pests and diseases [CPL3.2].</p> <p>Students are able to understand and evaluate developed monitoring, surveillance, and forecasting models [CPL3.2].</p> <p>Students are able to design forecasting models for insect pests and diseases [CPL3.2].</p> <p>Students are able to understand and explain the mechanisms of biological control agents in controlling target pests, diseases, and weeds, biological control techniques, biological control program management, and the application of biological control in practice.</p>
<p>Content</p>	<p>Introduction: theory, life tables, and population dynamics</p> <p>Examining internal and external factors that regulate insect pest populations</p> <p>Analyzing factors influencing pest populations</p> <p>Sampling techniques</p> <p>Data collection: GIS, drones, etc.</p> <p>Studying and reviewing existing models</p> <p>Student project: Identifying important factors for developing a specific insect pest forecasting model</p> <p>Decision-making and management processes.</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>
<p>Reading list</p>	

## Module Handbook of Vertebrate Pests

Module designation	This course discusses the importance of vertebrate pests in agricultural ecosystems. The material covered includes the classification of vertebrate pests, the morphological, biological, and ecological characterization of various types of vertebrate pests, as well as strategies and technologies for vertebrate pest control. This course aims to ensure that graduates are able to identify important pests in agriculture and understand pest bioecology. After completing the course, students are expected to have knowledge of basic zoological concepts, the functions and roles of animals in agricultural ecosystems, and strategies for managing animal populations in a sustainable environment. In addition, students are also expected to be able to develop skills, competencies, and creativity in vertebrate pest management and control efforts based on the principles of Integrated Pest Management (IPM), to prevent and minimize the impact of economic and ecological losses caused by vertebrate pests.
Semester(s) in which the module is taught	Fourth Semester (Even Semester)
Person responsible for the module	Dr. Tri Harjaka, SP, MP
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Vertebrate Pests

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students understand the basic concepts and principles of zoology [CPL2.1].</p> <p>Students understand the functions and roles of animals in agricultural ecosystems [CPL2.2].</p> <p>Students understand strategies for managing both beneficial and detrimental animal populations in a sustainable environment [CPL2.2].</p> <p>Students are able to develop skills, competencies, and creativity in vertebrate pest management and control efforts based on an integrated pest management (IPM) system to prevent and/or minimize the economic and ecological impacts caused by vertebrate pests [CPL2.2].</p>

## Module Handbook of Vertebrate Pests

Content	<p>Introduction: Problems and economic impacts of vertebrate pests</p> <p>Rats: morphology, bioecology, control measures</p> <p>Squirrels: morphology, bioecology, control measures</p> <p>Hedgehogs: morphology, bioecology, control measures</p> <p>Wild boar: morphology, bioecology, control measures</p> <p>Macaca; morphology, bioecology, control measures</p> <p>Bats; morphology, bioecology, control measures</p> <p>Birds; morphology, bioecology, control measures</p> <p>Civets; morphology, bioecology, control measures</p> <p>Elephants; morphology, bioecology, control measures</p> <p>Ecological and economic-based vertebrate pest management; IPM</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p><b>Primary :</b></p> <ol style="list-style-type: none"> <li>1. Priyambodo, S. 2003. Buku Praktikum Vertebrata Hama. Lab. Vertebrata Hama, Jurusan HPT, Fakultas Pertanian IPB.</li> <li>2. Priyambodo, S. 2005. Bioekologi dan Pengelolaan Tikus. Pusat Kajian Hama Terpadu, Departemen Proteksi Tanaman. Fakultas Pertanian IPB.</li> <li>3. Sianturi, J., H. T. Widarto, M. Sinaga, T. Saragih, M. Thahir, N. I. Kuntarti. 2006.</li> <li>4. Pengendalian Hama Terpadu Bajing. Balai Pengembangan Proteksi Tanaman Perkebunan Sumatera Utara. Medan.</li> <li>5. Singleton, G., L. Hinds, H. Leirs &amp; Z. Zhang (eds.). 1999. Ecologically-Based Management of Rodent Pests. ACIAR, Canberra.</li> <li>6. Singleton, G. R., L. A. Hinds, C. J. Crebs &amp; D. M. Spratt (eds.). 2003. Rats, Mice and</li> <li>7. People: Rodent Biology and Management. ACIAR, Canberra.</li> </ol>

## Module Handbook of Plant Quarantine

Module designation	Understanding agricultural quarantine, its importance in cross-border trade, agricultural production at the national and international levels, quarantine regulations, sanitary and phytosanitary (SPS) measures, pest and disease risk analysis, and international cooperation.
Semester(s) in which the module is taught	Fifth Semester
Person responsible for the module	Dr. Ir. Arman Wijonarko, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 50-60 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Plant Quarantine

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students understand the importance of plant quarantine.</p> <p>Students understand the role of plant quarantine at the national and international levels.</p> <p>Students understand and implement plant quarantine within and between regions within the country and between countries.</p> <p>Students are able to serve as consultants for importing and/or exporting companies.</p>
<p>Content</p>	<p>Definition, concept, and history of plant quarantine abroad and in Indonesia</p> <p>The importance of quarantine in international trade in agricultural commodities</p> <p>Public awareness of plant quarantine</p> <p>Sanitary and Phytosanitary (SPS) Regulations</p> <p>Pest Risk Analysis</p> <p>Alien Species</p> <p>International Standards for Phytosanitary Measures (ISPM)</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>
<p>Reading list</p>	<p>FAO, 2018. International Standards for Phytosanitary Measures. IPPC. Newest edition. <a href="http://www.ippc.int">www.ippc.int</a></p> <p>Suputa, 2008. Karantina Tumbuhan (PNH 3006). Hand Out. Program Studi Ilmu</p> <p>Hama Tumbuhan. Fakultas Pertanian UGM. Yogyakarta. 25 p.</p>

## Module Handbook of Biological Components of Plant Pests and Diseases Management

Module designation	This course discusses the definition and concept of biological control, along with its history. Furthermore, the role of biological control in agricultural trade and as a key component of integrated pest management is also discussed in depth. Subsequent topics include natural enemies and biological control agents, plant pathogens, and weeds. It is also important for students to understand the potential of biological control agents in controlling pests, plant pathogens, and weeds. Finally, biological control techniques, biological control program management, and their practices are discussed.
Semester(s) in which the module is taught	Fifth Semester
Person responsible for the module	Prof.Dr.Ir. Triwidodo Arwiyanto, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Biological Components of Plant Pests and Diseases Management

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand and explain the definition, concept, history, and importance of biological control of pests, plant pathogens, and weeds in IPM and in agricultural trade. (P3)</p> <p>Students are able to understand and explain the types of natural enemies and biological control agents of pests, plant pathogens, and weeds. (P3)</p> <p>Students are able to understand and explain plant ecosystems and the potential of biological control agents for pests and weeds, as well as the role of host plants and the environment in controlling plant pathogens. (P3)</p> <p>Students are able to understand and explain the mechanisms of biological control agents in controlling target pests, diseases, and weeds, biological control techniques, biological control program management, and the application of biological control in practice. (P3)</p>
<p>Content</p>	<p>Definition, concept, and history of biological control of pests, plant pathogens, and weeds.</p> <p>Biological control of pests, plant pathogens, and weeds in IPM and in agricultural trade.</p> <p>Natural enemies and biological agents that control pests, plant pathogens, and weeds.</p> <p>Plant ecosystems and the potential of biological control agents, as well as the role of host plants and the environment in biological control.</p> <p>Mechanisms of biological control for controlling pests, plant pathogens, and target weeds.</p> <p>Biological control techniques and management of biological control programs.</p> <p>Biological control in practice, from planning to evaluation.</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>

## **Module Handbook of Biological Components of Plant Pests and Diseases Management**

Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
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## Module Handbook of Biological Components of Plant Pests and Diseases Management

Reading list	<p><b>Books Biological Pest Control</b></p> <ol style="list-style-type: none"><li>1. Coppel, H. C. and J. W. Mertins. 1977. Biological Insect Pest Suppression. Springer-Verlag, New York.</li><li>2. Davis, D. W., S. C. Hoyt, J. A. McMurtry, and M. T. AliNiasee. 1979. Biological Control and Insect Pest Management. University of California.</li><li>3. Debach, P. and D. Rosen. 1991. Biological Control by Natural Enemies, 2nd ed. Cambridge University Press, Sydney.</li><li>4. Hoy, M. A. and D. C. Herzog. 1985. Biological Control in Agricultural IPM systems. Academic Press, New York.</li><li>5. Mangoendihardjo, S. dan E. Mahrub. 1983. Diktat Kuliah Pengendalian Hayati. Ridgway, R. L. and S. B. Vinson. 1976. Biological Control by Augmentation of Natural Enemies. Insect and Mite Control with Parasites and Predators. Plenum Press, New York</li><li>6. Wagiman, F.X. 2006. Pengendalian Hayati Hama Kutu Perisai Kelapa Menggunakan Predator Chilocorus. Gama Press, Yogyakarta.</li><li>7. Tanada and Kaya. 1993. Insect Pathology. Academic. New York. 666 p</li><li>8. Fuxa and Tanada. 1987. Epizootiology of Insect Diseases. John Wiley. New York</li></ol> <p><b>Biological Weeds Control</b></p> <p>Harley, K. L. S. and I. W. Forno. 1992. Biological Control of Weeds. A Handbook for practitioners and students.</p> <p><b>Biological Control of Plant Diseases</b></p> <ol style="list-style-type: none"><li>1. Boucias &amp; Pendland. 1998. Principle of Insect Pathology. Kluwer Academic. London. 550 pp.</li><li>2. Baker, K. F. and R. J. Cook. 1974. Biological Control of Plant Pathogens. W. H. Freeman.</li><li>3. San Fransisco Cook, R. J. and K. F. Baker. 1983. The Nature and Practice of Biological Control of Plant Patogens. The APPS Press. St. Paul Minnesota.</li></ol> <p><b>Journals:</b></p> <ol style="list-style-type: none"><li>1. Jurnal Perlindungan Tanaman Indonesia (JPTI): <a href="http://jurnal.ugm.ac.id/jpti">http://jurnal.ugm.ac.id/jpti</a></li><li>2. Jurnal Fitopatologi Indonesia (JFI) : <a href="http://journal.ipb.ac.id/jfi">journal.ipb.ac.id/jfi</a></li></ol>
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## Module Handbook of Biological Components of Plant Pests and Diseases Management

	<ol style="list-style-type: none"><li>3. American Phytopathological Society (APS) : <a href="http://www.apsnet.org">www.apsnet.org</a></li><li>4. Other international journals</li></ol>
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## Module Handbook of Habitat Management

Module designation	A habitat is a place where living things live. All living things require a conducive habitat for their survival and sustenance. In an agricultural environment (agroecosystem), living things consist of plants, herbivores, carnivores, and decomposers. All require a suitable habitat to thrive, find mates (for some organisms), and reproduce. In relation to plant protection, habitat management is an environmentally friendly method of controlling plant pests (OPT) by modifying the habitat to make it suitable for plants but unsuitable for pests. Habitat management also aims to provide opportunities for beneficial microbes to reproduce.
Semester(s) in which the module is taught	Fifth Semester
Person responsible for the module	Prof. Dr. Ir. Witjaksono, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Crop Protection, Integrated Pest Management

## Module Handbook of Habitat Management

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates will master the identification of important pests in agriculture.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Understand the concept of living habitat and why it needs to be managed.</p> <p>Understand habitat management for beneficial microorganisms to thrive.</p> <p>Understand the relationship between habitat management and plant protection.</p>
<p>Content</p>	<p>Introduction: The Link Between Habitat Management and Plant Protection</p> <p>The Impact of Climate Change on Plant Diseases</p> <p>Microbiome and Ecosystem Interactions for Sustainable Disease Management</p> <p>Utilization of Resistant Plants for Plant Health</p> <p>GAP for Plant Disease Management</p> <p>Examples of Habitat Management for Disease Management (I)</p> <p>Examples of Habitat Management for Disease Management (II)</p> <p>Biodiversity in Agroecosystems</p> <p>Food Chains in Agroecosystems</p> <p>Cultivation Techniques (Technical and Physical)</p> <p>Cultivation Techniques (Resistant Varieties)</p> <p>Suppressive Soil</p> <p>Environmental Engineering - 1</p> <p>Environmental Engineering - 2</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Habitat Management

Reading list	
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## Module Handbook of Agricultural Pesticides

Module designation	This course covers five different aspects related to pesticide use in agriculture as follows: the importance of pesticides in different agricultural systems and eras; different pesticides in relation to pests and targets and their toxicity; health and environmental issues; MoA of different pesticides; proper use of pesticides and unintended impacts of pesticides on target pests, the environment, and human health; and pesticide management from registration to disposal.
Semester(s) in which the module is taught	Fifth Semester
Person responsible for the module	Prof.Dr.Ir. Edhi Martono M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 70-80 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Agricultural Pesticides

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Understand the role of pesticides in agricultural production systems, particularly in crop protection, past, present, and future.</p> <p>Identify various types of pesticides based on their target market, mode of entry, mode of action, application, and toxicity indicators, and utilize these skills to make informed choices.</p> <p>Understand the potential benefits and risks of pesticide use.</p> <p>Be able to make informed decisions when using pesticides, adhering to IPM and health principles. Understand the pesticide fate process, from registration to disposal.</p>
<p>Content</p>	<p>Learning system; Definition of pesticides; History of pesticide use; Pesticides in modern agricultural systems, IPM, organic, and sustainable farming</p> <p>Definition of toxicity, toxicity indicators and their determination methods, acute and chronic toxicity</p> <p>Pesticide classification</p> <p>Pesticide formulations and adjuvants</p> <p>Labels, dosage, concentration, and spray volume</p> <p>Definition, types, mode of action, and mode of entry</p> <p>Classification and mode of action</p> <p>Resistance and resurgence</p> <p>Pathogen resistance and resistance management</p> <p>Physical and biotic degradation, half-life, pesticide persistence</p> <p>Definition, significance of residues, NOAEL, MRL, ADI</p> <p>When and how pesticides are used according to IPM principles. Registration through disposal</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>

## Module Handbook of Agricultural Pesticides

Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<ol style="list-style-type: none"><li>1. Ware, G. W. 1989. The Pesticide Book. Thomson Publications, Fresno, CA. 336 p.</li><li>2. Wheeler, W. B. (ed.), 2002. Pesticide in Agriculture and the Environment. Marcel Dekker, Inc., New York, NY. 330 p.</li><li>3. Marer, P.J., M.L. Flint &amp; M.W. Stimmann. 1988. The Safe and Effective Use of Pesticides. Uni. of California, Statewide Integrated Pest Management Project. Division of Agriculture and Natural Resources. Publication 3324, 387 p.</li></ol>

## Module Handbook of Weed in Plant Protection

Module designation	Characterization and role of weeds as Plant Pest Organisms (as pathogens and pests, hosts of biological agents, sources of resistance, the influence of weeds in microclimates, and weeds as sources of biopesticides), interactions between weeds and other pests, environmental factors that influence weed development, weed management strategies (prevention, technical culture, physical, biological, and chemical), biotechnological approaches in weed management, optimization of the role of weeds in IPM, and integration between IPM and Integrated Weed Management (IWM).
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Adyatma Irawan Santosa, SP, MSc
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Weed in Plant Protection

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are able to understand and apply the concept of plant protection.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand the concept of weeds as a subsystem of Plant Pest Organisms [CPL3.2].</p> <p>Students are able to understand the status of weeds as pest organisms [CPL3.2].</p> <p>Students are able to integrate weed management into Integrated Pest Management. [CPL3.2].</p>
<p>Content</p>	<p>Introduction to Weed Ecology</p> <p>Yield Loss and Damage Caused by Weeds</p> <p>Weed Reproduction and Spread</p> <p>Weed-Plant Interactions</p> <p>Basic Weed Control Techniques</p> <p>Biological and Chemical Weed Control</p> <p>Biotechnological Approaches to Weed Control</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Weed in Plant Protection

Reading list	<p>Primary</p> <ol style="list-style-type: none"><li>1. Naylor, R.E.L. 2002. Weed Management Handbook (9th Ed.). Blackwell Science, Melbourne, Victoria, 433p.</li><li>2. Rana, S.S. &amp;M.C. Rana. 2016. Principles and Practices of Weed Management. Department of Agronomi, Colloge of Agriculture, CSK Himachal Pradesh Krishi, ishavidyalaya, Palumpur, 138p.</li><li>3. Somowiyarjo. S. 2019. Gulma Dalam PHT (in preparation)</li><li>4. Widyastuti, A., N.S. Putra, &amp; S. Somowiyarjo. 2019. Implementasi PHT dalam Pengelolaan Gulma (in preparation)</li><li>5. Tjitrosoepomo, G. 1985. Morfologi Tumbuhan. Gadjah Mada University Press, Yogyakarta, 266p.</li></ol>
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## Module Handbook of Plant Protection Policy

Module designation	This course is a mandatory course for students in the Plant Protection Study Program to produce graduates who not only master the technical or scientific aspects of plant protection, but also understand plant protection governance, including institutions, policies, strategies, and implementation at the farmer level, local and central government, and the role of the private sector in plant protection. This course also discusses the importance of plant protection in both the domestic and global markets.
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Ir. Arman Wijonarko, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2 credit points
Required and recommended prerequisites for joining the module	Crop Protection

## Module Handbook of Plant Protection Policy

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand the importance of Policies and Regulations in Agriculture, the objectives and scope of Plant Protection Legislation in Indonesia, and Plant Protection institutions at the central and regional levels [CPL2.3].</p> <p>Students are familiar with pesticide regulations at the regional and central levels [CPL2.3].</p> <p>Students are familiar with several examples of Plant Protection Policies for food crops, plantations, and horticulture [CPL2.3].</p>
<p>Content</p>	<p>The Importance of Policies and Regulations in Agriculture, as well as the Objectives and Scope of Plant Protection Legislation in Indonesia</p> <p>Scope of Plant Protection Legislation in Indonesia and Plant Protection Institutions at the National and Regional Levels</p> <p>Strategies and mechanisms for implementing plant protection policies in Indonesia.</p> <p>Early warning, surveillance, and monitoring systems for plant pests (OPT).</p> <p>Pest management and control based on the applicable legal and institutional framework.</p> <p>Regional and National Pesticide Regulation and Management</p> <p>Plant Protection Policies for Food Crops, Plantations, and Horticulture</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Plant Protection Policy

Reading list	<p>Books</p> <ol style="list-style-type: none"><li>1. Untung, K. 2007. Kenijakan Perlindungan Tanaman. (Regulatory in Crop Protection). Gadjah Mada University Press, UGM. Yogyakarta.</li></ol>
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## Module Handbook of Insect Pathology

Module designation	This course will enable students to understand the causes of disease in insect pests, the development of insect populations due to insect pathogens, the classification of insect pathogenic microbes, techniques for developing insect pathogens, and their application in plant protection programs. The course material provides theory and real-world examples of insect diseases in the field. The material is presented in the form of theory, discussion, and direct observation both in the laboratory and in the field. At the midpoint and at the end of the course, students are tested in writing, including answering questions, completing assignments at least three times per semester, and compiling reports on laboratory/field observations (practicums). Assessment is also carried out through oral presentations conducted individually or in groups.
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Ir. Arman Wijonarko, M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points

## Module Handbook of Insect Pathology

Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand the principles of epizootiology [CPL3.1].</p> <p>Students are able to understand the characteristics and bioecology of microbes that are pathogenic to insects [CPL3.2].</p> <p>Students are able to differentiate and analyze infections caused by biotic and abiotic factors and understand the insect immune system. [CPL3.2].</p> <p>Students are able to understand the advantages and disadvantages of microbes as biological agents and their prospects [CPL3.2].</p>

## Module Handbook of Insect Pathology

Content	<p>Limitations/Understanding of Insect Pathology and its Historical Development</p> <p>Interactions between insects and microbes, mutualism, amensalism, and parasitism</p> <p>Biotic and abiotic diseases in insects</p> <p>Terminology in insect pathology (infection, virulence, pathogenicity)</p> <p>Insect pathogenic fungi (entomopathogenic fungi)</p> <p>Insect pathogenic bacteria (entomopathogenic bacteria)</p> <p>Insect pathogenic viruses (entomopathogenic viruses)</p> <p>Nematodes as parasites and insect pathogens (entomopathogenic nematodes)</p> <p>Insect pathogenic microsporidia and protozoa</p> <p>Epizootiology</p> <p>Development of insect pathogenic strains</p> <p>Insect pathology techniques (isolation, propagation, bioassay, application, and evaluation)</p> <p>Application of insect pathogens in Integrated Pest Management (IPM)</p> <p>Current developments in Insect Pathology</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Insect Pathology

Reading list	<ol style="list-style-type: none"><li>1. Vega, E.F., and Kaya, H.K. 2012. Insect Pathology. Second Edition. Academic Press. 490 p.</li><li>2. Tanada. Y. and Kaya, H.K. 1993. Insect Pathology. Academic Press. 666 p</li><li>3. Boucias, D.G. and Pendland, J.C. 1998. Principles of Insect Pathology. Kluwer Academic. 537 p</li><li>4. Rolf, J and Reynolds, S.E (edt.) 2009. Insect Infection and Immunity. Oxford Biology. 254 p</li><li>5. Hajek, A. E., Glare, T.R., and O'Callaghan, M. 2010. Use of Microbes for Control nad eradication of Invasive arthropods. Springer. 366 p</li><li>6. Miller, L.K. (edt.) 1997. The Baculovirus. Plenum. 447 p</li><li>7. Lacey, L.A., and Kaya, H.K. (edt). 2000. Manual of Techniques in Invertebrate Pathology. Kluwer Academic. 911.p</li></ol>
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## Module Handbook of Plant Clinic

Module designation	The Plant Clinic course is designed to achieve core competencies: the skills and abilities to identify plant pests and pathogens, diagnose plant damage and diseases, and provide recommendations for pest and disease control. Students are also equipped with the skills to handle plant samples, preserve specimens, and create a wet herbarium.
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Suputa, S.P., M.P.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 40-50 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Plant Clinic

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are logical, critical, and innovative in communicating their ideas, both orally and in writing, to solve problems in plant protection.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to handle plant samples infested by pests and pathogens [CPL2.1].</p> <p>Students are able to identify pests and diagnose plant diseases [CPL2.1].</p> <p>Students are able to recommend pest and plant disease control measures [CPL4.2].</p> <p>Students are able to communicate their results clearly and responsibly and prepare well-written reports [CPL4.2].</p>
<p>Content</p>	<p>Assistance and Introduction</p> <p>Control of Identification Tools and Their Application</p> <p>Handling of Plant Samples Affected by Pests and Diseases</p> <p>Preparing Dried Preserves</p> <p>Preparing Wet Herbariums</p> <p>Pest Identification and Plant Disease Diagnosis</p> <p>Preparing Written Diagnostic Reports and Control Recommendations</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Plant Clinic

Reading list	<p><b>Books</b></p> <ol style="list-style-type: none"><li>1. Shurtleff, M. C., &amp; C. W. Averre III. 1997. The Plant disease Clinic and Field Diagnosis of Abiotic Disease. American Phytopathology Society, St. Paul.</li><li>2. Haryono Semangun. 1998. Penyakit-Penyakit Penting pada Tanaman Hortikultura. Gadjah Mada University Press, Yogyakarta.</li><li>3. Semangun, H. 1996. Penyakit-Penyakit Tanaman Pangan. Gadjah Mada University Press. Yogyakarta.</li><li>4. Semangun, H. 2000. Penyakit-Penyakit Tanaman Perkebunan. Gadjah Mada University Press. Yogyakarta.</li></ol> <p><b>Journals</b></p> <ol style="list-style-type: none"><li>1. Priyatmojo, A., Escopalao, V.E., Tangonan, N.G., Pascual, C.B., Suga, H., Kageyama, K., &amp; Hyakumachi, M. 2001. Characterization of a new subgroup of <i>Rhizoctonia solani</i> anastomosis group 1 (AG 1-ID), causal agent of a necrotic leaf spot on coffee. <i>Phytopathology</i> 91: 1054-1061.</li><li>2. Priyatmojo, A., Yamauchi, R., Naito, S., Kageyama, K., &amp; Hyakumachi, M. 2002. Comparison of whole-cell fatty acid compositions of isolates of <i>Rhizoctonia solani</i> AG 2 from tobacco (Nt-isolates) and tulip (AG 2-t), AG 2-1 and AG-BI. <i>Journal of Phytopathology</i> 150: 283-288.</li><li>3. Priyatmojo, A., Yotani, Y., Hattori, K., Kageyama, K., &amp; Hyakumachi, M. 2001. Characterization of <i>Rhizoctonia</i> spp. causing root and stem rot of miniature rose. <i>Plant Disease</i> 85: 1200-1205.</li></ol>
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## Module Handbook of Seed Pathology

Module designation	This course discusses the importance of seed health in agriculture. Types of seed-borne pathogens. Mechanisms of pathogen development and transmission from plant tissue to seeds, and from seeds to plants. Methods for testing seed health. Seed management—seed-producing plants, seed-producing plants, seed storage, and seed treatment.
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Suryanti, S.P., M.P.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Plant protection, Phytopathology

## Module Handbook of Seed Pathology

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are expected to understand and explain the importance of seed health and various types of seed-borne pathogens. Furthermore, they must understand how disease is transmitted through seeds, both directly and through other means, and their impact on agriculture. Understanding how pathogens can penetrate seeds, the types of pathogens that can enter, and the mechanisms of infection, including the location of infection, contamination, and factors influencing pathogen spread in seeds, is also an important part of this course.</p> <p>Students are expected to understand and explain the process of disease transmission from plants to seeds and how pathogens in seeds can transmit disease to plants. Furthermore, they must understand the factors that allow pathogens to survive for long periods in seeds and the mechanisms of their spread, both in monocyclic and polycyclic disease cycles, including the survival of pathogens outside the seed.</p> <p>Students are expected to understand and explain methods for detecting seed-borne pathogens and the importance of seed health. In addition, they must understand various strategies for controlling seed-borne diseases, including inoculum exclusion and reduction, as well as cultural control techniques to prevent the spread of disease in plants.</p> <p>Students are expected to understand and explain the control of seed-borne diseases using physical and chemical methods. Furthermore, they must comprehensively examine pathogens carried by fungi, bacteria, viruses, submicroscopic organisms, and nematodes, and present their findings in written papers or papers, which are then presented in seminars within groups or teams.</p>
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## Module Handbook of Seed Pathology

Content	<p>The Importance of Seed Health and Various Types of Seedborne Pathogens</p> <p>Mechanisms of Seed-borne Disease Transmission and Their Impact on Agriculture</p> <p>Pathogen Penetration into Seeds and Types of Pathogens Infected</p> <p>Pathogen Infection in Seeds: Location of Infection and Pathogen Contamination in Seeds and Influencing Factors</p> <p>Plant-to-Seed Disease Transmission: Disease Development from Plant to Seed</p> <p>Seed-to-Plant Disease Transmission: Disease Transmission from Seeds Carrying Pathogens to Plants</p> <p>Factors that Affect Pathogen Survival in Seeds</p> <p>Disease Transmission (Monocyclic, Polycyclic), Pathogen Survival Outside Seeds</p> <p>Environmental Influences on Plant Disease Development</p> <p>Seedborne Pathogen Detection and Seed Health</p> <p>Seedborne Disease Control by Inoculum Exclusion and Reduction</p> <p>Seedborne Disease Control by Cultural Techniques</p> <p>Physical and Chemical Control of Seedborne Diseases</p> <p>Presentation of Seed Pathogens Caused by Fungi and Bacteria.</p>
Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.

## Module Handbook of Seed Pathology

### Reading list

#### A. Books:

1. Neergaard, P. 1977. Seed Pathology. Vol I. The MacMillan Press. London.
2. Maude, R. B. 1996. Seedborne Diseases and Their Control. CAB International, UK
3. Maryudani, Y.M.S. 2005. Petunjuk Praktikum Patologi Benih, Fak.Pertanian UGM, Yogyakarta
4. Annual Review of Phytopathology, 1966 (4): 311-343.

#### B. References:

5. Agarwal, P.C., Mortensen, C. N. and S. B. Mathur. 1989. Seed-borne diseases and seed health testing of rice. Danish Government Inst. of Seed Pathology for Developing Countries, Hellerup, Copenhagen, Denmark
6. Ball, S. and J. Reeves 1992. Application of rapid techniques to seed health testing. Prospect and potential p: 193-207. In Duncan, J. M. and L.Torrance. Techniques for rapid detection of plant pathogens.
7. ISTA. 1999. Seed science and technology: International rules for seedTesting. Int. Seed Testing Association, Switzerland.

#### C. Referensi lain (jurnal & internet)

1. Phytopathology
2. Plant Disease
3. Perlindungan Tanaman Indonesia
4. Hortikultura

## Module Handbook of Insects Mass Production

Module designation	The importance of insects for humans and nature encourages in-depth research into various aspects of insect life. Therefore, knowledge about mass breeding is essential to support the implementation of such research. The most important things about breeding are the topics discussed today (1) facilities and infrastructure, (2) nutrition and feed (made naturally), and (3) breeding techniques for several types of insects that have unique characteristics.
Semester(s) in which the module is taught	Sixth Semester (Even Semester)
Person responsible for the module	Dr. Tri Harjaka, SP, MP
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Insects Mass Production

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :            Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :            Students are able to understand the principles of insect mass breeding [CPL2.2].            Students are able to understand technologies related to insect production [CPL2.2].            Students are able to understand effective and efficient mass production strategies for insects [CPL2.2].</p>
<p>Content</p>	<p>Introduction: The Importance of Mass Insect Production            Mass Insect Production Facilities and Infrastructure            Insect Nutritional Requirements            Insect Feed (Natural and Artificial)            Techniques for Designing Insect Breeding, Mating, and Spawning Areas            Techniques for Preparing and Making Artificial Feed            Mass Breeding of Leaf-Eating Herbivorous Insects: Spodoptera Litura or Crocidolomia Binnotalis            Mass Production of Sucking Herbivorous Insects: Brown Planthoppers or Aphids            Mass Production of Root-Eating Insects: Whiteflies            Mass Production of Carnivorous Insects (Predators): Ladybugs            Mass Production of Carnivorous Insects (Parasitoids): Sugarcane Borer Parasites            Mass Production of Beneficial Insects: Honeybees or Silkworms</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Insects Mass Production

Reading list	<p>Primary :</p> <p>Johnson, G.S., 2005. Handbook to the construction and use of insect collection and rearing devices: A guide for teachers with suggested classroom applications. Springer.</p> <p>Smith, C.N., 1966. Insect colonization and mass production. Academic Press, New York and London.</p> <p>Additional :</p> <ol style="list-style-type: none"><li>1. Alvan, P. 1964. Entomological Techniques. "How to Work with Insects"</li><li>2. Anonim. ... IRRI News Letter. "Mass Rearing Methods of Insects"</li><li>3. Anonim. 1989. Laboratorium Pemiakan Masal Serangga. Buletin Ditjenbun: parasitoid, predator, pathogen.</li><li>4. Bernays, E.A. and R.F. Chapman. 1994. Host-plant selection by phytophagous insects. Chapman &amp; Hall, New York. 312 p.</li><li>5. Carde, R.T. &amp; Millar, J.C. 2004. Advances in Chemical Insect Ecology.</li><li>6. Cohen, A.C. 2005. Insect Diet.</li><li>7. Pritam Singh and R.F. Moore. 1985. Hand Book of Insect Rearing. Vol. I, II.</li></ol>
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## Module Handbook of Acarology

Module designation	This course explains the biological and ecological aspects of the Acari subclass, particularly regarding the relationship of these organisms to agricultural ecosystems. The biological aspects covered include the morphology, anatomy, and taxonomy of Acari, while the ecological aspects address the relationship between Acari and the abiotic environment and biotic components, such as host plants and natural enemies.
Semester(s) in which the module is taught	Seven Semester (Odd Semester)
Person responsible for the module	Dr. Ir. Nugroho Susetya Putra, M.Si., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 20-30 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Agricultural Zoology

## Module Handbook of Acarology

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to apply general morphological observation techniques for mites to identify the species of the organism (KK1).</p> <p>Students are motivated to observe mite bioecology in detail in the laboratory and in nature (KK2).</p> <p>Students are able to design mite control strategies based on learning outcomes in the laboratory and in nature (KK2).</p>
<p>Content</p>	<p>Morphological, Anatomical, and Bioecological Characteristics of Mites</p> <p>Relationships Between Mites and Host Plants and Natural Enemies</p> <p>Identification of Agricultural Pest Mites</p> <p>Formulation of Mite Control Strategies</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>
<p>Reading list</p>	<p>Books</p> <p>1. Gerald W. Krantz &amp; D. E. Walter, ed. (2009). A Manual of Acarology (3<sup>rd</sup> ed)</p>

## Module Handbook of Biology of Apiology

Module designation	Designing an undergraduate lecture series on honeybees entails the meticulous creation of comprehensive teaching units for each session. This process is aligned with specific course outcomes, focusing on various aspects of honeybees, including their ecological roles, anatomy, behavior, and significance in agriculture. The curriculum covers a blend of theoretical knowledge and practical skills, ranging from basic beekeeping techniques to advanced concepts like queen rearing and colony management. Emphasis is also placed on beekeeping entrepreneurship, preparing students for careers in this field. Each meeting integrates interactive elements, such as case studies, hands-on workshops, and guest lectures, to enrich the learning experience and ensure a well-rounded understanding of apiculture.
Semester(s) in which the module is taught	Seven Semester (Odd Semester)
Person responsible for the module	Dr. Suputa, S.P, M.P
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 10-20 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points

## Module Handbook of Biology of Apiology

Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Understand the importance of honeybees in their natural habitat.</p> <p>Understand the role of honeybees in agricultural systems as pollinators.</p> <p>Understand and apply beekeeping techniques, including developing new queens and establishing new colonies.</p> <p>Able to become beekeepers.</p>

## Module Handbook of Biology of Apiology

Content	<p>1: Introduction to Beekeeping and Course Overview Topics: Course objectives, introduction to beekeeping, its significance.</p> <p>2: Honey Bees in the Ecosystem Topics: The role of honey bees in natural habitats, ecosystem services.</p> <p>3: Anatomy and Physiology of Honey Bees Topics: Physical structure, life cycle of honey bees.</p> <p>4: Bee Behavior and Communication Topics: Understanding bee behavior, communication methods.</p> <p>5: Honey Bee Species and Varieties Topics: Different species and breeds of honey bees.</p> <p>6: Honey Bees as Pollinators in Agriculture Topics: Role in pollination, impact on crop production.</p> <p>7: Threats to Honey Bees Topics: Environmental threats, diseases, pests.</p> <p>8: Basic Apiculture Techniques Topics: Introduction to beekeeping equipment, hive management.</p> <p>9: Advanced Apiculture Techniques Topics: Seasonal management, honey extraction processes.</p> <p>10. Queen Rearing and Colony Expansion Topics: Techniques for rearing a new queen, expanding a colony.</p> <p>11. Beekeeping Challenges and Solutions Topics: Common beekeeping challenges, problem-solving techniques.</p> <p>12. Bee Products and Their Uses Topics: Products from beekeeping (honey, wax, etc.), their applications.</p> <p>13. Starting a Beekeeping Business Topics: Fundamentals of beekeeping entrepreneurship.</p> <p>14: Course Review and Final Assessment Topics: Recap of key learnings, discussion on future trends in beekeeping.</p>
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## Module Handbook of Biology of Apiology

Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Books</p> <ol style="list-style-type: none"> <li>Gullan, P.J. and P.S. Cranston. 2005. The Insects: an outline of entomology. Blackwell Publishing. pp. 304-312.</li> <li>Suputa &amp; A.T. Arminudin, 2013. Beternak Lebah. 2nd Edition. PT Citra Aji Parama Publisher. Yogyakarta. ISBN 978-979-3483-94-8.</li> </ol> <p>Journals:</p> <ol style="list-style-type: none"> <li>vanEngelsdorp D, Traynor KS, Andree M, Lichtenberg EM, Chen Y, Saegerman C, et al. (2017) Colony Collapse Disorder (CCD) and bee age impact honey bee pathophysiology. PLoS ONE 12(7): e0179535. <a href="https://doi.org/10.1371/journal.pone.0179535">https://doi.org/10.1371/journal.pone.0179535</a></li> <li>Watson, K and J A Stallins (2016). Honey Bees and Colony Collapse Disorder: A Pluralistic Reframing. Geography Compass 10/5 (2016): 222–236, 10.1111/gec3.12266.</li> </ol> <p>Website</p> <ol style="list-style-type: none"> <li>Use of common pesticide linked to bee colony collapse. <a href="https://www.hsph.harvard.edu/news/press-releases/colony-collapse-disorder-pesticide/">https://www.hsph.harvard.edu/news/press-releases/colony-collapse-disorder-pesticide/</a></li> </ol>

## Module Handbook of Biology of Plant Parasitic Nematodes

Module designation	<p>The course material in the Biology of Plant Parasitic Nematodes provides the foundation for managing plant-parasitic nematodes. Therefore, students studying the Biology of Plant Parasitic Nematodes are able to explain models for managing plant-parasitic nematodes. The Biology of Plant Parasitic Nematodes covers:</p> <ol style="list-style-type: none"> <li>1. Reproduction and life cycle of plant-parasitic nematodes</li> <li>2. Movement, distribution, and spread of plant-parasitic nematodes</li> <li>3. Symptoms of attack</li> <li>4. Adaptation to parasitism</li> <li>5. Management of plant-parasitic nematodes.</li> </ol> <p>The learning system implemented consists of theory, discussion, and practice in the laboratory and in the field. Students are given two assignments to present. To ensure a smooth learning process, students actively study literature in the form of reference books, research journals, and access the internet to learn about plant-parasitic nematodes and their bioecology. In each learning activity, students can actively express their knowledge through exercises in the form of class discussions and seminars on nematology in agriculture.</p>
Semester(s) in which the module is taught	Seven Semester (Odd Semester)
Person responsible for the module	Prof. Dr. Ir. Siwi Indarti, M.P.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 20-30 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>

## Module Handbook of Biology of Plant Parasitic Nematodes

Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	Plant Protection, Zoology, Agricultural Nematology
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates will master the identification of important pests in agriculture.</p> <p>Graduates will be competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students will be able to understand the reproduction and life cycle of plant-parasitic nematodes.</p> <p>Students will be able to understand how nematodes move, their invasion, and their feeding methods.</p> <p>Students will be able to understand attack symptoms and explain the mechanisms of symptom formation in hosts and parasitic adaptation.</p> <p>Students will be able to understand the internal and external factors that influence the behavior and population growth of plant-parasitic nematodes.</p> <p>Students will be able to understand the concept of integrated nematode management.</p>
Content	<p>Reproduction and life cycle of plant-parasitic nematodes</p> <p>Movement, distribution, and spread of plant-parasitic nematodes</p> <p>Symptoms of infestation</p> <p>Adaptation to parasitism</p> <p>Management of plant-parasitic nematodes.</p>
Examination forms	High Order Thinking Skills Examination

## Module Handbook of Biology of Plant Parasitic Nematodes

Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Barker, K.R.; G.A. Pederson and G.L. Windham. 1998. Plant and Nematode Interactions. Number 36 in the series Agronomy. Madison, Wisconsin, USA. 771 p.</p> <p>Dropkin, V.H. 1988. Introduction to Plant Nematology. John Willey Interscience Publication.</p> <p>John Willey and Sons, New York. 305 p.</p> <p>International Meloidogyne Project. 1976. Proceeding of the research Planning Conference on Root-knot Nematodes, Meloidogyne spp. North Carolina State University Raleigh. 106 p.</p> <p>Lee, D.L. and H.J. Atkinson. 1977. Physiology of Nematodes. New York Columbia University Press. 215 p.</p> <p>Luc, M.; R.A. Sikora and J. Bridge. 1990. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. C.A.B. International Inst. of Parasitology Wallingford, U.K. 629 p.</p> <p>Mulyadi. 2009. Nematologi Pertanian. Gadjah Mada University Press. 339 p.</p> <p>Norton, D.C. 1978. Ecology of Plant Parasitic Nematodes. John Willey and Sons. Inc. USA. 268 p.</p> <p>Wallace, H.R.1964. The Biology of Plant Parasitic Nematodes. New York. ST. Martin's Press Inc. 280 p.</p> <p>_____. 1973 Nematodes Ecology and Plant Disease. Great Britain by Alden &amp; Mowbray Ltd. Oxford. 228 p.</p>

## Module Handbook of Biotechnology of Crop Protection

Module designation	<p>This course is designed to equip students in the Department of Plant Pests and Diseases with three important concepts in the use of biotechnology:</p> <ol style="list-style-type: none"><li>1. Molecular identification of Plant Pest Organisms (OPT) and diagnosis of damage caused by PTO using molecular techniques</li><li>2. Host plant-pest interactions at the molecular level</li><li>3. Pest Management Based on Molecular Techniques</li></ol> <p>This course is a continuation of the Agricultural Biotechnology course taken in the previous semester, with an emphasis on the theoretical and practical aspects of plant protection. The theoretical aspects of molecular techniques are presented in 13 sessions, with the emphasis being placed on two areas: plant diseases (including viruses, bacteria, fungi, and nematodes), and insect pests. The theoretical aspects of plant protection biotechnology are evaluated in two exams: a midterm and a final exam. In addition to theoretical aspects, the Biotechnology course also emphasizes practical skills in the use of molecular techniques, such as DNA extraction from samples from symptomatic plants infected with plant diseases (viruses, bacteria, etc.) or from insect samples. DNA extraction is taught using basic techniques such as CTAB or the use of extraction kits. This extraction activity continues through to the sequence preparation stage. In addition to the wet lab activities, participants will also be introduced to several basic software applications for handling sequence data, including creating phylogenetic trees and submitting sequence data to GenBank. The total number of sessions for the practical activities ranges from 6-8.</p> <p>The Plant Protection Biotechnology course will be taught both conventionally (classically) and by combining student-centered learning (SCL) and outcome-based learning (OBL) concepts. Furthermore, this course will be designed and developed using the MOOC (Massive Open Online Course) concept. Lectures will be delivered in class through face-to-face sessions and discussions. To enrich the material, students will be given independent assignments related to the relevant material. Students will also be given group assignments to write papers relevant to plant protection biotechnology, summarizing data from various reputable journals. Through discussions, students will practice critical, analytical, and creative thinking.</p>
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## Module Handbook of Biotechnology of Crop Protection

Semester(s) in which the module is taught	Seven Semester (Odd Semester)
Person responsible for the module	Prof. Dr. Ir. Siti Subandiyah, M.Agr.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	<p>Lecture are conducted in the class with 20-30 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.</p> <p>Details:</p> <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Laboratory</li> <li>5. Field work</li> <li>6. Midterm</li> <li>7. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	<p>(Estimated) Total workload:</p> <p>Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)</p>
Credit points	2/1 credit points
Required and recommended prerequisites for joining the module	None

## Module Handbook of Biotechnology of Crop Protection

<p>Module objectives/intended learning outcomes</p>	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates are competent in understanding the principles and implementation of Integrated Pest Management (IPM).</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students are able to understand and explain the concept of molecular identification of plant pests (OPT) and diagnosis of pest damage.</p> <p>Students are able to understand and explain the interaction of host plants with pests at the molecular level.</p> <p>Students are able to understand and explain pest management based on molecular techniques.</p>
<p>Content</p>	<p>Introduction to molecular techniques used in the development of biotechnology in the field of plant protection (starting with DNA/RNA isolation, PCR, Next Generation Sequencing, and bioinformatics).</p> <p>Software (online and offline) for sequencing data processing (Nucleotide and Protein) (e.g., NCBI, DDJB, Bioedit, Modeller, Protein structure, primer design, etc.).</p> <p>Concepts of molecular pest identification (DNA Barcoding) and population genetics.</p> <p>Concepts and techniques for molecular disease detection and identification in important plants.</p> <p>Molecular Pathogenicity (survival, multiplication, and transmission outside the host, enzymes, toxins, hormones).</p> <p>Concepts of host plant susceptibility and resistance to disease or pest attacks at the molecular level.</p> <p>Current biotechnology for pest control (GMOs, Gene Silencing, Gene Editing, etc.).</p> <p>Biosafety and Biosecurity in the field of plant protection biotechnology.</p> <p>Industrial Biotechnology in Pest Management (Transgenic Plants, Industrial dsRNA Products, etc.).</p>
<p>Examination forms</p>	<p>High Order Thinking Skills Examination</p>
<p>Study and examination requirements</p>	<p>To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.</p>

## Module Handbook of Biotechnology of Crop Protection

Reading list	<ol style="list-style-type: none"><li>1. Thieman WJ, Palladino MA (2016) Introduction to Biotechnology: International Edition, 2 E, Question Bank</li><li>2. Renneberg R, Berkling V, Loroeh V (2016) Biotechnology for beginners. Academic Press, Renneberg R, Berkling V, Loroeh V (2008) Green biotechnology. Academic Press New York,</li><li>3. Altman A, Hasegawa PM (2011) Plant biotechnology and agriculture: prospects for the 21<sup>st</sup> century. Academic press,</li><li>4. Kwon YM, Ricke SC (2011) High-throughput next generation sequencing: methods and applications. Springer,</li><li>5. Dickinson M (2004) Molecular plant pathology. Garland Science,</li><li>6. Marshall G, Walters D (1994) Molecular biology in crop protection. Springer,</li><li>7. Higgs PG, Attwood TK (2013) Bioinformatics and molecular evolution. John Wiley &amp; Sons,</li></ol>
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## Module Handbook of Plant Disease Vector Management

Module designation	The Plant Disease Vector Management course is designed to complement and enrich students' understanding of plant disease management concepts, particularly those transmitted by vectors. The course covers the history, representative examples of vector-mediated plant diseases, the physiological and molecular background of vector-borne disease transmission, and finally the epidemiology and all possible management tactics to reduce or eliminate plant disease incidence. Although the course is not intended to have supporting practical activities, all detailed case studies, along with their management, will be presented at the end of the course, involving student participation through open discussion. Students are expected to utilize basic knowledge in plant disease management, zoology, basic entomology, and integrated pest management.
Semester(s) in which the module is taught	Seven Semester (Odd Semester)
Person responsible for the module	Dr. Adyatma Irawan Santosa, S.P., M.Sc.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	Compulsory Course
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment.  Details: <ol style="list-style-type: none"> <li>1. Lectures</li> <li>2. Assignment (Individual and Group)</li> <li>3. Discussion</li> <li>4. Midterm</li> <li>5. Final Exam</li> </ol>
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: Total workload of 2 SKS is estimated equal to 3.34 ECTS (a total of 45 hours for one semester)
Credit points	2 credit points

## Module Handbook of Plant Disease Vector Management

Required and recommended prerequisites for joining the module	None
Module objectives/intended learning outcomes	<p>Program Learning Outcomes (PLO) :</p> <p>Graduates master the identification of important pests in agriculture.</p> <p>Graduates are competent in understanding pest bioecology.</p> <p>Course Learning Outcomes (CLO) :</p> <p>Students understand the history and are able to cite important and representative examples of vector-borne plant diseases.</p> <p>Students understand the scientific background of epidemiology and vector-borne plant disease transmission.</p> <p>Students are able to design basic management tactics to reduce vector-borne plant diseases.</p>
Content	<p>History of management of plant disease by vector worldwide</p> <p>Major vector-borne plant diseases (viruses, procaryotes, fungi) in the world</p> <p>Major insect vectors in the world and their behavior-bio-physiology</p> <p>Transmission mechanism of Plant disease by vector</p> <p>Molecular basis of plant disease transmission by vector (from the point of view vectors, plant and plant disease)</p> <p>Epidemiology of plant disease transmitted by vector</p> <p>General management strategy for plant diseases transmitted by vectors</p> <p>Case studies of Rice virus transmitted by plant hopper (History and management tactics)</p> <p>Case studies of Plant virus transmitted by Whitefly (History and management tactics)</p> <p>Case studies of Plant bacterial and phytoplasma disease transmitted by insect vector (History and management tactics)</p> <p>Case studies of Plant viruses transmitted by Aphids (History and management tactics)</p>

## Module Handbook of Plant Disease Vector Management

Examination forms	High Order Thinking Skills Examination
Study and examination requirements	To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.
Reading list	<p>Books</p> <ol style="list-style-type: none"><li>1. Harris, K. F., &amp; Maramorosch, K. (Eds.). (2013). Pathogens, vectors, and plant diseases: approaches to control. Elsevier.</li><li>2. Brown, J. K. (Ed.). (2016). Vector-mediated transmission of plant pathogens. APS Press.</li><li>3. Maramorosch, K. (Ed.). (2012). Plant diseases and vectors: ecology and epidemiology. Elsevier.</li></ol>



# **FACULTY OF AGRICULTURE GADJAH MADA UNIVERSITY**

