PORTOFOLIO

COURSE:

PLANT BIOTECHNOLOGY
(PAG 306316)

TEACHING TEAM:

Dr. Ir. Mery Hasmeda, M.Sc.
Dr. Ir. E. S. Halimi, M.Sc.
Dr. Fikri Adriansyah, S.Si.

AGRONOMY STUDY PROGRAM
FACULTY OF AGRICULTURE
UNIVERSITAS SRIWIJAYA

2022

A. COURSE IDENTITY

Module designation	Plant Biotechnology	
Code	PAG 306316	
Semester (s) in which the module is taught	5th semester/3rd year	
Person responsible for the module	1. Dr. Ir. Mery Hasmeda, M.Sc. 2. Dr. Ir. E. S. Halimi, M.Sc. 3. Dr. Fikri Adriansyah, S.Si.	
Language	Indonesian	
Relation to curriculum	Compulsory Course	
Teaching methods	1. Lectures (explanation, discussion) 2. Structured assignment (i.e.: article reading and review) 3. The class size 30-75 students per class 4. Contact hours for lecture are 23.33 hours per semester Total hours practical is 19.83 hours per semester	
Workload (incl. Contact hours, self-study hours)	1. Lectures (2 x 50 minutes) per week or 23.33 hours per semester 2. Structured assignment (i.e.: article reading and review): 2 x 60 minutes per week or 24 hours per semester 3. Self-study: 2 x 60 minutes per week or 24 hours per semester	
Credit points	3 credits (equivalent with 3.79 ECTS)	
Requirements according to the examination regulations	-	
Module objectives/intended learning outcomes CLO=Course Learning Outcomes	After completing this course, a student is expected to:	
	CLO1	Students are able to master theoretical concepts of plant biotechnology in general and their relationship to agronomy in general.
	CLO2	Students are able to master the theoretical concept of the latest plant biotechnology and its application to agronomy.
	CLO3	Student are able to appropriate decisions in the context of solving problems related to plant biotechnology issues in there are of expertise, based on the results of analysis of information and data.
	CLO4	Students are able to design, implement and evaluate the biotechnology methods into the development/improvement of local plants.
	CLO5	Students are able apply several creatives and innovative idea of plant biotechnology methods into research and business.
Content	1. Definition, scope and application of biotechnology. 2. DNA, Function, Structure and Isolation. 3. Enzymes of DNA modification. 4. Principles of genetic engineering. 5. Cloning vector. 6. Technique of DNA Analysis. 7. Tissue culture and hybrid technique. 8. Cell and protoplasm fusion. 9. Introduction of marker method for plant breeding. 10. Introduction of marker method for plant breeding. 11. Application of biotechnology in agriculture	

	12. Transgenic plant for yield and quality improvement. 13. Transgenic plant for technology and increase of chemical compound. 14. Consequences of using genetic engineering.
Examination forms	Quiz, Mid-terms and Final Examination 1. Essays questions 2. Practical works 3. Writing Case Paper 4. Oral presentation
Media employed	LCD, whiteboard, websites
Reading List	1. Lodish, H., Brek, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H., Matsudaira, P. 2007. Molecular Cell Biology. W.H Freeman and Company. 2. Hawkersfored, M.J., Buchner, P. 2001. Molecular Analysis of Plant Adaption to the Environment. Kluwer Academic Publishers. 3. Daniell, H., Chase, C. 2004. Molecular Biology and Biotechnology of Plant Organelles Chloroplast and Mitochondria. Springer. 4. Kang, M.S., Priyadarshan, P.M. 2007. Breeding Major Food Staples. Blackwell Publishing. 5. Acquaah, G. 2012. Principles of Plant Genetics and Breeding, 2nd Edition. Wiley-Blackwell. 6. Xu, Y. 2010. Molecular Plant Breeding. International Maize and Wheat Improvement Centre (CIMMYT), China. 7. Kang, M.S. 2002. Quantitative Genetics, Genomics and Plant Breeding. CABI; 2nd edition. 8. Bharadwaj, D.N. 2019. Advanced Molecular Plant Breeding; Meeting the Challenge of Food Security. Apple Academic Press. 9. Prasad, M.N.V., Strzalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. Kluwer Academic Publishers. 10. Kole, C. 2007. Genome Mapping and Molecular Breeding in Plants. Technical Crops. Spinger. 11. Kahl, G., Meksem, K. 2004. The Handbook of Plant Functional Genomics. Willey-Blackwell. 12. Research publications related to plant biotechnology.

B. STUDY LEARNING PLAN

Course Name : Plant Biotechnology
Code/Credits : PAG 306316
Course Status : Mandatory

Short Description

The course of Plant Biotechnology is a compulsary course in the 2015 of the Agronomy Study Program. Plant biotechnology have become one of the important course. The course is offered to third-year students or semester V, from January to December. The course has no specific requirement and every student of semester V can take the course. The course is given through face-to-face lectures, assignments, projects and practicum. Assignments are given following course learning outcomes (CLO) every week such scientific writing, making PPT. Projects are given by case study through collecting some references on special topic such basic of plant biotechnology methods. Practicum adjusted by CLO to understand well topic from lecture and the student write reports. The evaluating of outcomes assigned to the course (CLO) and weekly competence (Sub-CLO) to be achieved by students are systematically arranged in the semester learning plan (RPS) of the course in middle and end semester such as midterm test and final test. For the last semester (even the semester of 2022), the number of students who attended the course was 65 students divided into 2 classes (A and B). All of the participants were the students of Agronomy Study Program, Faculty of Agriculture, University Sriwijaya.

Objectives

This course is more devoted to understanding plant biotechnology that are directly or indirectly related to the world of agriculture. The course syllabus includes: Definition , scope and application of biotechnology plant biotechnology; DNA, function, structure and Isolation; enzymes of DNA modification; principles of genetic engineering; cloning vector; technique of DNA Analysis; tissue culture and hybrid technique; cell and protoplasm fusion; Introduction of marker method for plant breeding 1; introduction of marker method for plant breeding 2; application of biotechnology in agriculture; transgenic plant for yield and quality improvement; transgenic plant for technology and increase of chemical compound; consequences of using genetic engineering.

Mapping of Course Learning Outcomes (CLO)-Program Learning Outcomes (PLO)

CLO	Description	PLO*			
		AV	KC	GS	SS
CLO1	Students are able to master theoretical concepts of plant biotechnology in general and their relationship to agronomy in general.	8	5	1,8	2,8

CLO2	Students are able to master the theoretical concept of the latest plant biotechnology and its application to agronomy.	**8**	**5**	**1,8**	**2,8**
CLO3	Student are able to appropriate decisions in the context of solving problems related to plant biotechnology issues in there are of expertise, based on the results of analysis of information and data.	**8**	**5**	**1,8**	**2,8**
CLO4	Students are able to design, implement and evaluate the biotechnology methods into the development/improvement of local plants.	**8**	**5**	**1,8**	**2,8**
CLO5	Students are able apply several creatives and innovative idea of plant biotechnology methods into research and business.	**8**	**5**	**1,8**	**2,8**

AV = Attitude and Value; **KC** = Knowledge Competence; **GS** = General Skills; **SS** = Specific Skills

*Details are in the Study Program Curriculum file

Course Outlines:
Face-to-Face:

No.	Course materials	Duration (face-to-face) (minutes)	CLO				
			1	2	3	4	5
1	Definition, scope and application of biotechnology	110	v				
2	DNA, Function, Structure and Isolation.	110	v				
3	Enzymes of DNA modification.	110		v			
4	Principles of genetic engineering.	110	v	v	v	v	
5	Cloning vector.	110		v	v	v	
6	Technique of DNA Analysis.	110	v	v			v
7	Evaluation (1-6)	110			v	v	
8	Tissue culture and hybrid technique.	110	v	v	v		v
9	Cell and protoplasm fusion.	110		v	v	v	
10	Introduction of marker method for plant breeding 1.	110	v		v		v
11	Introduction of marker method for plant breeding 2.	110		v	v	v	v
12	Application of biotechnology in agriculture	110	v	v	v	v	
13	Transgenic plant for yield and quality improvement.	110			v	v	v
14	Transgenic plant for technology and increase of chemical compound.	110		v	v		v
15	Consequences of using genetic engineering.	110	v		v		
16	Evaluation (7-16)	110		v	v		

Outcomes and Assessment

During and after the lecture learning process, evaluation is carried out as a parameter of the achievement achieved by students in relation to the desired learning outcomes (CLO) and sub-CLO. Various assessment methods are carried out to accurately measure the knowledge and skills acquired by students after participating in weekly learning resources or processes. Assessment evaluation is the task of making presentations, scientific papers, practicum reports, midterm exams and final exams.

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

No.	Week	Sub-CLO	Assessment	Percentage of score weight to final score (%)
CLO-1	I	Sub-CLO 1: Students are able to explain the concepts and the scope of plant biotechnology.	Ask and answer question (face-to-face). At least 5% of students in the class are able to answer the question correctly	
CLO-2	II	Sub-CLO 2: Students are able to explain function, structure and the principle of DNA isolation technique	Ask and answer question (face-to-face). At least 5% of students in the class are able to answer the question correctly Assignment on searching and reviewing scientific article	
	III	Sub-CLO 3: Students are able to explain structure and function of modifier enzymes of DNA.	Ask and answer questions (face-to-face). At least 5% of students in the class are able to answer the question correctly Assignment	
	IV	Sub-CLO 4: Students are able to explain the basic concept of plant genetic engineering.	Ask and answer questions (face-to face). At least 5% of students in the class are able to answer the question correctly.	
	V	Sub-CLO 5: Students are able to explain the basic concept of vector cloning methodsin development of new varieties.	Ask and answer questions (face-to-face).	
	VI	Sub-CLO 6: Students are able to explain several techniques or methods of plant DNA isolation/extraction.	Ask and answer questions (face-to-face). Assignment	
	VII	EVALUATION I (I to IV)	Essay exams Discussion on the answers of the essay exams	35
CLO-2	VIII	Sub-CLO 7: Students are able to explain the definition of tissue culture and hybrid technique.	Ask and answer questions (face-to-face). Assignment	
CLO-3	IX	Sub-CLO 8: Students are able to explain appropriate decisions in the	Ask and answer questions (face-to-face).	

		context of solving problems in there are of expertise, based on the results of analysis of information analysis on the latest plant biotechnology methods and/or issues etc. such as cell fusion and protoplasm fusion	Assignment	
CLO-4	X	Sub-CLO 9: Students are able to explain the use of MAS methods in plant breeding programs.	Ask and answer questions (face-to-face). Assignment	
	XI	Sub-CLO 10: Students are able to design one of biotechnology methods such as methods into the plant breeding programs.	Ask and answer questions (face-to-face). Assignment	
	XII	Sub-CLO 11: Students are able to are able to design, implement and evaluate MAS methods into plant breeding programs.	Ask and answer questions (face-to-face). Assignment	
CLO-5	XIII	Sub-CLO 12: Students are able to explain the concept of plant biotechnology (Transgenic plat) to improve yield and quality.	Ask and answer questions (face-to-face). Assignment	
	XIV	Sub-CLO 13: Students are able to design the technology of development of transgenic plant improve yield and quality	Ask and answer questions (face-to-face).	
	XV	Sub-CLO 14: Students are able to are able to explain the consequences in the development of transgenic plants	Ask and answer questions (face-to-face). Assignment	
	XVI	EVALUATION II (VIII-XVI)		40

Assignment

No.	Week	Assignment Instructions	Submission Methods	Weight (%)	CLO				
					1	2	3	4	5
1	II	Students search, discuss and review a scientific article regarding definition, scope and application of biotechnology. The selected papers are those published in international journals. The results of the review are written on a power point slide of a maximum of 3 pages.	Print out	20% to total score in the Evaluation I	v	v			
2	III	Students search literature for DNA, function, structure and Isolation.and summarize it in one page of writing	Print out	20% to total score in the Evaluation I	v	v			
3	VI	Summarizing article related to enzymes of DNA modification (no more than 25 words)	Soft file in CD	4% to total score in the Evaluation I	v				
4	VIII	Summarizing article related to principles of genetic engineering	Soft file in CD	4% to total score in the Evaluation II	v				
5	IX	Explaining cloning vector (typed in a doc file)	Soft file in CD	4% to total score in the Evaluation II	v				
6	X	Summarizing the technique of DNA Analysis	Soft file in CD	4% to total score in the Evaluation II	v				
7	XI	Explaining the tissue culture and hybrid technique	Soft file in CD	4% to total score in the Evaluation II			v	v	
8	XII	Reviewing video related to introduction of marker method for plant breeding (max 5 pages in a doc file)	Upload in E-Learning	10% to total score in the Evaluation II			v	v	
9	XIII	Students are asked to calculate and analyse genetic data	Upload in E-Learning	10% to total score in the Evaluation II			v	v	
10	XV	Students are asked to design the development transgenic plant for yield and quality improvement	Upload in E-Learning	10% to total score in the Evaluation II			v	v	

Laboratory Practicum:

No.	Topics	Duration	CLO				Activities in Laboratory
			1	2	3	4	
1	DNA Plant Isolation/Extraction 1	170	v				Pre-test, explanation from assistant, practice according to the practical manual, writing the results in worksheet, approval by assistant.
2	DNA Plant Isolation/Extraction 2	170	v	v			
3	Horizontal Electhrophoresis	170		v	v		
4	Polymerase Chain Reaction 1	170		v	v	v	
5	Tissue Culture	170		v	v		
6	Polymerase Chain Reaction 2	170		v	v	v	
7	Genetic Data Analyses	170		v	v	v	
	Distribution of weight in the lab practicum score: Pre-Test (20%), practicum report (20%), participation (10%), final practicum exam (50%). All student should have 100% of presence in the laboratory, and for those who are unable to attend lab practicum, she/he must take a follow-up practicum at another time. Percentage of score weight of laboratory practicum to final score is 25%.						

Contribution of Course Assessment to PLO

Course Assessment	**AV**	**KC**	**GS**	**SS**	**Type**
Assignments	8	5	1,8	2,8	Formative
Questions in Quiz	8	5	1,8	2,8	Summative
Questions in Mid-Term	8	5	1,8	2,8	Summative
Questions in Final Exam	8	5	1,8	2,8	Summative
Lab Practicum	8	5	1,8	2,8	Formative

Assignment Assessment Rubric

No.	Criteria	Weight (%)	Score			
			≥ 86	71-85.99	56-70.99	40-55.99
			Excellent	Good	Enough	Bad
1	Format and presentation of written assignment	10	The assignment is presented in accordance with the instructions	There are parts (10%) of the assignment not in accordance with the instructions	There are parts (25%) of the assignment not in accordance with the instructions	There are haff of the assignment not in accordance with the instructions
2	Discussion in the written assignment	50	Information to support the discussion in the assignment is adequate, and the discussion is well organized	Information to support the discussion in the assignment is adequate; however the information is not well written	Information to support the discussion in the assignment is adequate; however the information is copied and pasted in the assignment without paraphrasing	There is not enough information in the assignment. It is just a compilation of information derived from internet searching
3	Publication year of literature	15	Most of literatures cited are up-to	Most of literatures cited are	Most of literatures	There is no literature cited

	cited in the assignment		date (≤ 5 years)	between 5-10 years	cited are (≥ 10 years	
4	Number of literatures cited in the assignment	15	There are ≥ 3 literature cited	There are ≤ 3 literature cited	One literature cited	There is no literature cited
5	Submission time	10	Assignment is submitted before the deadline	Assignment is submitted one day after the deadline	Assignment is submitted two days after the deadline	Assignment is submitted after two days from deadline

Benchmark for Scoring

The course coordinator will coordinate the evaluation process and determine the scoring system (Appendix 2). The evaluation score grading has been determined regulation of Sriwijaya University. Values are converted as numeric to letter values as shown in Table

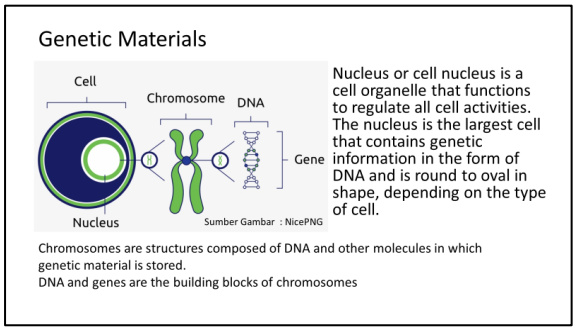
No.	Range of Score	Grade	Description
1	86.00 - 100.00	A	Excellent
2	71.00 – 85.99	B	Good
3	56.00 – 70.99	C	Fair
4	40.00 – 55.99	D	Bad
5	<40.00	E	Worst

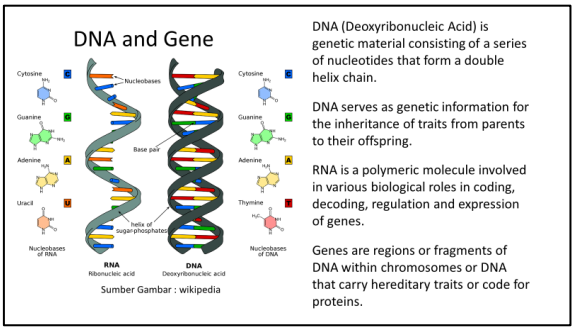
Remedial Exam:

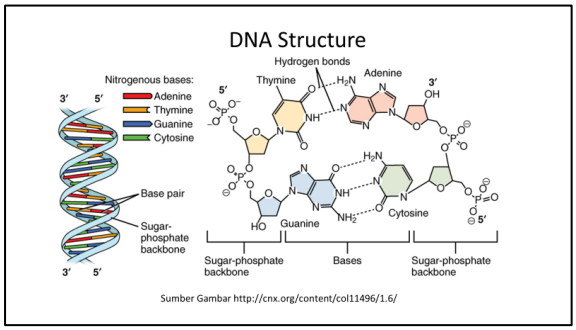
Students are allowed to join Remedial Exam if the score is under 60 out of 100.

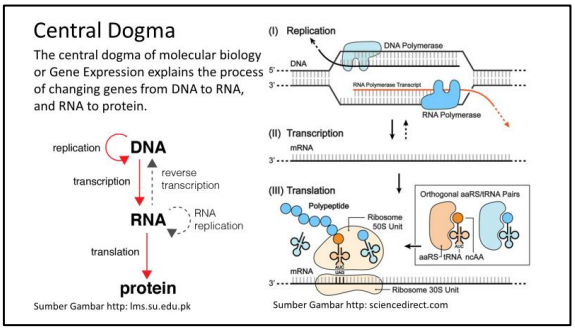
Course materials in Power Point Slides

Course Material 1









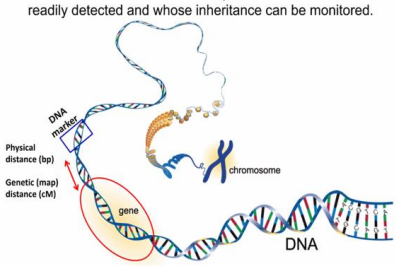
Molecular Biology

- Scope and Definition of Molecular Biology Molecular Biology (Molecular Biology Studies), studies the foundations of the process of replication, transcription and translation of genetic material.

Principle

- Analyzing chemical components at the cellular or tissue level
- Manipulating cell or tissue components
- Analyze gene structure
- Changing the structure of genes through DNA manipulation

A molecular marker is a DNA sequence which can be readily detected and whose inheritance can be monitored.



Course Material 2

How can molecular markers help?

Molecular markers allow working with genotype information directly

↓

Analyze the effect of the genotype on the phenotype

↓

Provide the breeder a tool to look into the 'black box' of the genotype

Plant breeding synopsis

For most annual crops

Genetic resources

↓

Traits of interest and breeding objectives

↓

Crosses/Introgression into agronomically valuable variety

↓

Trials and release of variety

8 -12 years

↓

Producers

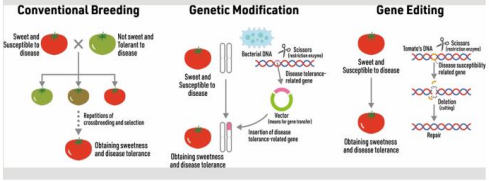
↓

Consumers

Long Process!

(>25 years for perennial crops)

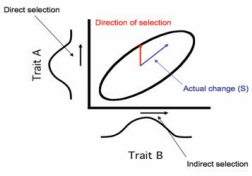
What are the differences among the three existing breeding technologies: conventional breeding, genetic modification, and gene editing ?



Applications

- Cultivar identification
- Understanding genetic relationships
- Analysis of diversity
- Tagging economically important genes
- **Marker assisted selection**

Marker Assisted Selection: The same concept as selection using correlated traits



Selection acting only on trait A will lead to a change in trait B. This happens even though there is no selection acting on trait B

…but, trait A can be affected by the environment!

What is the accuracy of selecting trait B using trait A?

r_g (AB) x H^2 (A)

Why use molecular (DNA) markers in breeding?

The accuracy of selecting trait B using Marker A:

r_g (AB) x H^2 (A)

r (AB) x 1.0 → Marker Assisted Selection!

r (AB) = recombination fraction (linkage) between A and B

How to increase the accuracy?

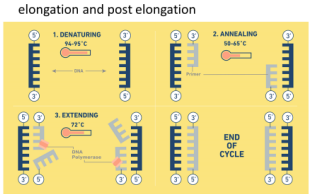
Find variants within the gene → gene marker

The Procedure of QTL analysis:

- **Make a cross and generate marker data**
  - Type of mapping population, type of marker system
- **Generate linkage map**
  - Genome size, Genome coverage
- **Collect phenotypic data**
  - Evaluate in uniform environment, multiple environments
  - Take care of location affects
  - May need data transformation (approach normal distribution)
- **Map QTL**
  - Single marker analysis
  - Interval Mapping
  - Composite Interval Mapping

PCR Process

- The PCR process broadly includes the stages of denaturation, annealing, and elongation.
- Pre-denaturation, denaturation, annealing, elongation and post elongation



Sumber Gambar http: https://www.technologynetworks.com/

- Denaturation is the process of heating DNA so that the double strands open and produce two single strands of DNA;
- Annealing is the step where the primer is allowed to bind to a single strand of DNA.
- Elongation, a temperature-stable DNA polymerase synthesizes complementary DNA strands starting at the primer and using the exposed DNA strand as a template.

Course Material 3

THE USE OF GENETIC MARKERS IN PLANT BREEDING

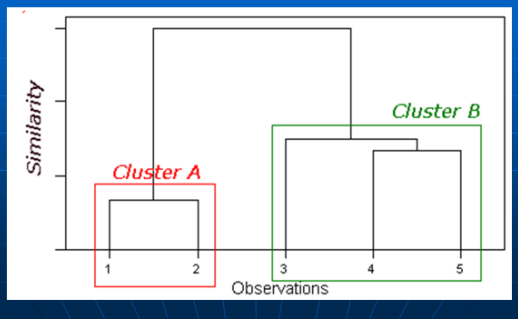
Use of Molecular Markers

- ✓ Clonal identity,
- ✓ Family structure,
- ✓ Population structure,
- ✓ Phylogeny (Genetic Diversity)
- ✓ Mapping
- ✓ Parental analysis,
- ✓ Gene flow,
- ✓ Hybridisation

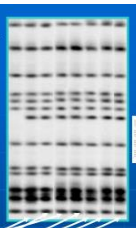
Genetic Diversity

- ✓ Define appropriate geographical scales for monitoring and management (epidemology)
- ✓ Establish gene flow mechanism
- ✓ Identify the origin of individual (mutation detection)
- ✓ Monitor the effect of management practices
- ✓ Manage small number of individual in ex situ collection
- ✓ Establish of identity in cultivar and clones (fingerprint)
- ✓ Paternity analysis and forensic

Genetic Diversity



Clonal Identity



fingerprints

seeds, plantlets

early selection of the good allele

Mapping

The determination of the position and relative distances of gene on chromosome by means of their linkage

- ❑ Genetic map

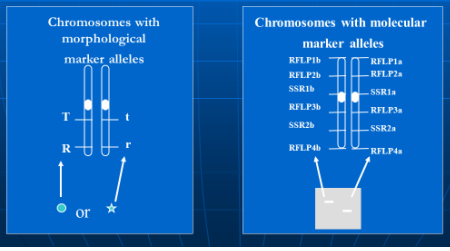
A linear arrangement of genes or genetic markers obtained based on recombination

- ❑ Physical map

A linear order of genes or DNA fragments

Genetic Maps

Molecular markers (especially RFLPs and SSRs) can be used to produce genetic maps because they represent an almost unlimited number of alleles that can be followed in progeny of crosses.



QTL (Quantitative Trait Loci)

- ✓ A locus or DNA segment that carries more genes coding for an agronomic or other traits
- ✓ Individual loci responsible for quantitative genetic variation
- ✓ Region in the genome containing factors influencing a quantitative trait
- ✓ Region identified by statistical association

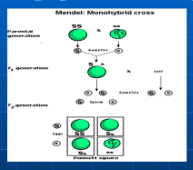
QTL Mapping

- ✓ A set of procedures for detecting genes controlling quantitative traits (QTL) and estimating their genetics effects and location
- ✓ Localizing and determining a segment of DNA that regulate quantitative traits
- ✓ Detecting and locating gene having an effect on a quantitative traits

⇒ To assist selection
Marker Assisted Selection

Types of traits

Single gene trait: seed shape



Multigenic trait; ex: plant growth
=Quantitative Trait Loci

Marker Assisted Selection

- ✓ Breeding for specific traits in plants is expensive and time consuming
- ✓ The progeny often need to reach maturity before a determination of the success of the cross can be made
- ✓ The greater the complexity of the trait, the more time and effort needed to achieve a desirable result
- ✓ The goal to MAS is to reduce the time needed to determine if the progeny have trait
- ✓ The second goal is to reduce costs associated with screening for traits
- ✓ If you can detect the distinguishing trait at the DNA level you can identify positive selection very early.

CONVENTIONAL PLANT BREEDING

large populations consisting of thousands of plants

PHENOTYPIC SELECTION

Salinity screening in phytotron

Bacterial blight screening

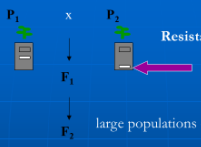
Phosphorus deficiency plot

Glasshouse trials

Field trials

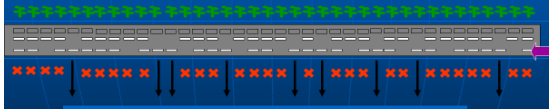
MARKER-ASSISTED BREEDING

Susceptible



Resistant

large populations consisting of thousands of plants



MARKER-ASSISTED SELECTION (MAS)

Method whereby phenotypic selection is based on DNA markers

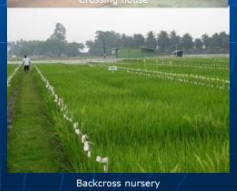
Advantages of MAS

- **Simpler method compared to phenotypic screening**
  - Especially for traits with laborious screening
  - May save time and resources
- **Selection at seedling stage**
  - Important for traits such as grain quality
  - Can select before transplanting in rice
- **Increased reliability**
  - No environmental effects
  - Can discriminate between homozygotes and heterozygotes and select single plants

Potential benefits from MAS

- more accurate and efficient selection of specific genotypes
  - May lead to accelerated variety development
- more efficient use of resources
  - Especially field trials

Crossing house



Backcross nursery

Achievement of CLO (Indralaya Class)

Study Program : Agronomy
Academic Year : 2021/2022 (ODD Semester)
Course : Plant Biotechnology
Room : RKC1201
Schedule : Wednesday (09:10-12:00)

No	NIM	Name	EV1	EV2	EV3	Final Score	Grade	Overal Assesment
1	05091181924001	MUHAMMAD FEDRIAN	85	87	86	86,2	A	Achieved
2	05091181924002	MUHAMMAD FEBRYAN PRATAMA	85	85	90	87	A	Achieved
3	05091181924004	LINDA SULISTIANI	85	83	90	86,2	A	Achieved
4	05091181924005	NOURISH HARITUA SITINJAK	85	85	84	84,6	B	Not Achieved
5	05091181924006	PUTRI LIA ANANDA	85	85	86	85,4	B	Not Achieved
6	05091181924007	ANGGI PURNAMA SARI	85	83	86	84,6	B	Not Achieved
7	05091181924008	RIZKA RAHMAWATI	85	87	86	86,2	A	Achieved
8	05091181924009	CAHYANI FADILLAH	85	87	88	87	A	Achieved
9	05091181924010	ALYA MAHARDIKA PUTRI IRANI	85	85	90	87	A	Achieved
10	05091181924011	DINDA ASARI	85	87	86	86,2	A	Achieved
11	05091181924012	LILY NUR FADHILAH	85	85	86	85,4	B	Not Achieved
12	05091181924013	REGITA RAMALYA	85	85	90	87	A	Achieved
13	05091181924015	RAWINDA GUSRIFANI	85	86	90	87,4	A	Achieved
14	05091181924016	PUTRI AGUSTINA LESTARI	85	84	85	84,6	B	Not Achieved
15	05091181924017	SRI APRILIANI	85	83	90	86,2	A	Achieved
16	05091181924018	LISA AMELIA	85	83	87	85	B	Not Achieved
17	05091181924095	NOVI INDASARI	85	86	88	86,6	A	Achieved
18	05091281924019	RIZKY BUDIYANI FADIL MUHAMMAD NASRULLAH	85	82	86	84,2	B	Not Achieved
19	05091281924020	AHMAD FAUZI	85	85	85	85	B	Not Achieved
20	05091281924021	INDRA ADVENT SIMAMORA	85	77	86	82,2	B	Not Achieved
21	05091281924022	THERESIA APRILA SARENG	85	86	95	89,4	A	Achieved
22	05091281924024	LILI SAFITRI DONY	85	83	87	85	B	Not Achieved
23	05091281924025	AMANAH KAMILATUNNISAH	85	83	86	84,6	B	Not Achieved
24	05091281924026	MUHAMMAD AL GHIFARI	85	72	86	80,2	B	Not Achieved
25	05091281924027	RINALDY SITORUS	85	85	86	85,4	B	Not Achieved
26	05091281924028	JUNITA MURNI SIAHAAN	85	84	86	85	B	Not Achieved
27	05091281924031	ASSIFA INTAN CAHYANI	85	85	90	87	A	Achieved
28	05091281924032	SHABINA RARAKANA NURDUWANATI.JDR	85	80	90	85	B	Not Achieved
29	05091281924033	APRILIA ANGGUN PUTRISARI	85	86	95	89,4	A	Achieved
30	05091281924034	LARAS INDAH LESTARI	85	77	88	83	B	Not Achieved
31	05091281924035	KHARISMA	85	77	86	82,2	B	Not Achieved
32	05091281924036	ANNISA SALSABILA	85	83	88	85,4	B	Not Achieved
33	05091281924038	IHZA BASTARI CAHYA	85	72	90	81,8	B	Not Achieved
34	05091281924091	ADE RIZKI MUFARAZ	85	85	89	86,6	A	Achieved
35	05091281924093	ALHILLAL SYAFAAT	85	85	90	87	A	Achieved
36	05091281924094	TIARA NANDA FRANSISKA	85	84	90	86,6	A	Achieved
37	05091281924096	NADIA RAHMA	85	85	86	85,4	B	Not Achieved
38	05091281924097	NABILAH PUTRI CAHYA	85	85	89	86,6	A	Achieved
39	05091281924098	LILI ANGGRAINI	85	86	89	87	A	Achieved
40	05091281924099	ANGGUN SEPTIANI	85	86	87	86,2	A	Achieved
41	05091281924100	YUPITA SARI REZEKI	85	86	87	86,2	A	Achieved
42	05091281924101	ADELLA SAFIRA RAHMAN	85	83	87	85	B	Not Achieved
43	05091281924102	GRETA SMARADANA PATRIAVERA	85	83	85	84,2	B	Not Achieved
44	05091281924103	ZERIKA REGINA RAMADHAN FITRI	85	87	86	86,2	A	Achieved
45	05091281924104	SIYAM TRIYANI	85	79	95	86,6	A	Achieved

46	05091281924105	MARTINA ANGELIA PURBA	85	89	86	87	**A**	**Achieved**
47	05091381924043	MUHAMMAD HAFIZH ALFARISI	85	87	86	86,2	**A**	**Achieved**
48	05091381924047	ACIL ABDUL RAHMAT	85	80	87	83,8	**B**	**Not Achieved**
49	05091381924054	RANI MARINA	85	70	86	79,4	**B**	**Not Achieved**
50	05091381924055	FENTI MONICA	85	82	86	84,2	**B**	**Not Achieved**
51	05091381924058	ZENDI ALHAMAMI	85	83	88	85,4	**B**	**Not Achieved**
52	05091381924068	MIFTAHUL JANNAH	85	86	88	86,6	**A**	**Achieved**
53	05091381924072	NYOTO HERMAWAN	85	85	85	85	**B**	**Not Achieved**
		AVERAGE PERCLASS	**85,00**	**83,38**	**85,00**	**85,44**		
		ACHIEVEMENT	**Achieved**	**Achiecved**	**Achieved**	**Achieved**		

Achievement of CLO (Palembang Class)

Study Program : Agronomy
Academic Year : 2021/2022 (ODD Semenster)
Course : Plant Biotechnology
Room : RKC1201
Schedule : Wednesday (09:10-12:00)

No	NIM	Name	EV1	EV2	EV3	Final Score	Grade	Overal Assesment
1	05091181924014	AFIFAH ZAHWA	85	80	86	83,4	B	**Not Achieved**
2	05091381924044	MEGA SARIANA PANJAITAN	85	86	89	87	A	**Achieved**
3	05091381924045	HILWA HILMANA	85	85	86	85,4	B	**Not Achieved**
4	05091381924046	FAUZIAH SALSABILA PUTRI	85	83	88	85,4	B	**Not Achieved**
5	05091381924049	RAHMAT HIDAYATULAH	85	83	90	86,2	A	**Achieved**
6	05091381924050	UMEIR HAEKAL	85	80	84	82,6	B	**Not Achieved**
7	05091381924051	HAMDI YASEIR	85	82	87	84,6	B	**Not Achieved**
8	05091381924052	WIWINDRA	85	82	88	85	B	**Not Achieved**
9	05091381924056	TRIA MEILANI	85	80	86	83,4	B	**Not Achieved**
10	05091381924057	MUHIBBAN PUTRA KENCANA	85	80	86	83,4	B	**Not Achieved**
11	05091381924059	KELVIN RIZKY ARYADUTA SEMBIRING	85	75	86	81,4	B	**Not Achieved**
12	05091381924060	RIZKI SIMANJUNTAK	85	85	86	85,4	B	**Not Achieved**
13	05091381924061	MUHAMMAD NAUFAL FAKHRIAL	85	83	83	83,4	B	**Not Achieved**
14	05091381924062	OCHTAVIA PUTRI HAMIDIA	85	80	86	83,4	B	**Not Achieved**
15	05091381924063	RUBEN PAKPAHAN	85	86	85	85,4	B	**Not Achieved**
16	05091381924065	DELLAH TIAN SAPUTRI	85	76	85	81,4	B	**Not Achieved**
17	05091381924066	NURAINI	85	78	83	81,4	B	**Not Achieved**
18	05091381924067	KHUSNUL NUR LINDA	85	80	83	82,2	B	**Not Achieved**
19	05091381924069	YONATHAN IMMANUEL SIAHAAN	85	82	85	83,8	B	**Not Achieved**
20	05091381924070	HILAL NUR MUHIDIN	85	82	87	84,6	B	**Not Achieved**
21	05091381924071	MAYSYURO	85	77	80	79,8	B	**Not Achieved**
22	05091381924073	TRI OKTAPRIANSYAH	85	85	86	85,4	B	**Not Achieved**
23	05091381924074	NIR LIANSA AKRAM	85	77	88	83	B	**Not Achieved**
24	05091381924075	YASHA PERMATASARI	85	83	89	85,8	B	**Not Achieved**
25	05091381924076	HUDZAIFAH MUHDAR	85	70	84	78,6	B	**Not Achieved**
26	05091381924077	DESTY DIANA SARI	85	72	87	80,6	B	**Not Achieved**
27	05091381924078	SUCI SEPTRIANDA	85	80	89	84,6	B	**Not Achieved**
28	05091381924080	PURNAMA INDAH	85	82	86	84,2	B	**Not Achieved**
29	05091381924083	IREY YOLANDA	85	85	86	85,4	B	**Not Achieved**
30	05091381924084	NAOMI JUNITA SILABAN	85	80	86	83,4	B	**Not Achieved**
31	05091381924086	MUHAMMAD NAUFAL AKBAR	85	70	86	79,4	B	**Not Achieved**
32	05091381924087	HERA APRILIANI	85	85	88	86,2	A	**Achieved**
33	05091381924088	WIDIAWATI	85	86	83	84,6	B	**Not Achieved**
34	05091381924089	PUTRI VALENTINE	85	79	86	83	B	**Not Achieved**

35	05091381924090	KASMIRANDA	85	85	90	87	A	**Achieved**
		AVERAGE PE CLASS	**85,00**	**80,69**	**86,09**	**83,71**		
		ACHIEVEMENT	**Achieved**	**Achieved**	**Achieved**	**Achieved**		

Percentage of CLO Achievement (Indralaya Class)

No.	Evaluation	Max. Score	Score	CLO1	CLO2	CLO3	CLO4	CLO5
1	QUIZ	100	85,00		√			
2	MID-TERM	100	83,38	√	√	√	√	√
3	FINAL EXAM	100	85,00		√	√	√	√
	Total	300	253,38	83,38	253,38	168,38	168,38	168,38
				83,38	84,46	84,19	84,19	84,19
	Minimum achievement is 80			√	√	√	√	√

Percentage of CLO Achievement (Palembang Class)

No.	Evaluation	Max. Score	Score	CLO1	CLO2	CLO3	CLO4	CLO5
1	QUIZ	100	85,00		√			
2	MID-TERM	100	80,69	√	√	√	√	√
3	FINAL EXAM	100	86,09		√	√	√	√
	Total	300	253,38	85,00	251,78	166,78	166,78	166,78
				85,00	83,92	83,78	83,78	83,78
	Minimum achievement is 80			√	√	√	√	√

	UNIVERSITAS SRIWIJAYA **FAKULTAS PERTANIAN** **JURUSAN BUDIDAYA PERTANIAN** **PROGRAM STUDI AGRONOMI**
	RENCANA PEMBELAJARAN SEMESTER

A. IDENTITAS MATA KULIAH

Mata kuliah	Bioteknologi Tanaman	Kode: PAG 306316	Semester: 2	sks: 3 (2-1)
Bahan kajian	Bioteknologi Tanaman			
Deskripsi mata kuliah	Mata kuliah ini secara spesifik membahas perkembangan bioteknologi tanaman, prinsip, teknik dan aplikasinya dalam upaya peningkatan produksi atau pengembangan varietas tanaman. Pembahasan mata kuliah ini meliputi DNA, fungsi, struktur dan prinsip isolasi; enzim restriksi pemodifikasi DNA; vector kloning, DNA dan rekayasa genetik; teknik-teknik analisis pada aras DNA; kultur jaringan dan teknik hybrida (kultur jaringan penunjang biotek); fusi sel, fusi protoplast; pengenalan metode ”Marker” untuk kegiatan pemuliaan tanaman; aplikasi bioteknologi dalam perkembangan pertanian: peningkatan hasil dan kualitas, teknologi dan produksi senyawa kimia serta konsekuensi penggunaan bioteknologi. Mata kuliah ini telah diperkaya dengan sejumlah mata kuliah keahlian dan pendukung yang saling berkait dan sebagian bersifat pengayaan dan penemuan diantaranya adalah Biokimia Tanaman, Bioteknologi Tanaman dan Pemuliaan Tanaman Modern.			
CPMK	CPMK-1: Mampu menginternalisasi nilai, norma dan etika akademik (CP-STN8) CPMK-2: Menguasai konsep teoritis perkembangan iptek mutakhir dalam budidaya tanaman yang dapat diaplikasikan pada masyarakat (CP-KIP5) CPMK-3: Mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada di bawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri (CP-KBP8) CPMK-4: Mampu mengaplikasikan dan memodifikasi kearifan lokal dengan menggunakan ilmu dan teknologi mutakhir untuk diterapkan dalam praktek budidaya tanaman dengan spesifik lokasi (CP-KBP12) CPMK-5: Mampu mengaktualisasikan ide-ide kreatif dan inovatif terkait teknologi budidaya tanaman menjadi kegiatan komersial (CP-KBP18)			
Dosen pengampu	1. Dr. Ir. Mery Hasmeda, M.Sc. 2. Dr. Ir. E. S. Halimi, M.Sc. 3. Dr. Fikri Adriansyah, S.Si.	Dosen Penanggung jawab : Dr. Ir. Mery Hasmeda, M.Sc.		

B. PROGRAM PEMBELAJARAN

CPMK	Kemampuan Akhir yang diharapkan di setiap tahapan pembelajaran (Sub-CPMK)	Pokok bahasan	Referensi	Metode pembelajaran dan waktu	Deskripsi tugas mandiri dan waktu	Indikator	Bobot (%)	Dosen

CPMK-1	**Sub-CPMK1**: Mampu menjelaskan definisi dan ruang lingkup bioteknologi tanaman.	Pendahuluan, a. Definisi bioteknologi dan ruang lingkup bioteknologi tanaman. b. Norma dan etika dalam kegiatan bioteknologi tanaman.	1,3,11	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 5 referensi untuk menjawab pertanyaan tentang sejarah dan perkembangaan (2x60'): a. Bioteknologi tanaman, dan istilah-istilah mengenai bioteknolgi tanaman. b. Norma dan etika dalam pemanfaatan tanaman sebagai objek dalam penelitian bioteknologi tanaman	Ketepatan dalam menjelaskan tentang sejarah dan perkembangan bioteknologi tanaman dan istilah-istilah dalam bioteknologi tanaman.	5	
CPMK-2	**Sub-CPMK2**: Mampu menjelaskan fungsi, struktur dan prinsip isolasi DNA.	DNA; Fungsi, Struktur dan Prinsip Isolasi.	2,4,5,6,8	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 3 referensi yang berkaitan fungsi, struktur dan prinsip isolasi DNA (2x60').	Ketepatan dalam menjelaskan fungsi, struktur dan prinsip isolasi DNA.	7,5	
	Sub-CPMK3: Mampu menjelaskan struktur dan fungsi dari Enzym-enzym pemodifikasi DNA.	Enzym-enzym pemodifikasi DNA.	1,3,8,9	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] Tugas mengenai Enzym-enzym pemodifikasi DNA (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok (3x60').	Ketepatan Ketepatan dalam menjelaskan struktur dan fungsi dari Enzym-enzym pemodifikasi DNA.	7,5	

	Sub-CPMK4: Mampu menjelaskan konsep dasar-dasar rekayasa genetik tanaman.	Dasar-dasar Rekayasa Genetik.	2,4,5,7,11	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan praktikum tentang konsep dasar-dasar rekayasa genetik tanaman (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan (2x60'), dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan tentang konsep konsep dasar-dasar rekayasa genetik tanaman.	7,5	
	Sub-CPMK5: Mampu menjelaskan definisi, metode dan teknik serta pengaplikasian vector cloning dalam pengembangan varietas tanaman.	Vektor Kloning	1,3,11	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan praktikum vektor kloning (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan (2x60'), dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan definisi, metode dan teknik serta pengaplikasian vector cloning dalam pengembangan varietas tanaman.	7,5	
	Sub-CPMK6: Mampu menjelaskan dan melakukan berbagai Teknik dalam Analisa DNA.	Teknik Analisis DNA	2,4,6,8,10	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan praktikum tentang teknik analisa DNA (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan dan melakukan Analisa DNA.	7,5	
	Sub-CPMK7: Mampu menjelaskan definisi kultur jaringan dan melakukan teknik hybrida.	Kultur Jaringan dan Teknik Hybrida	1,2,4,9,11	Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan praktikum tentang kultur jaringan dan teknik hybrida (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan	Ketepatan dalam menjelaskan dan melakukan kultur jaringan dan teknik hybrida.	7,5	

				Tugas terstruktur menjawab tugas perorangan (2x60').	menyusun laporan praktikum (3x60').			
UJIAN TENGAH SEMESTER (120')								
CPMK-3	**Sub-CPMK8**: Mampu menjelaskan fusi sel dan fusi protoplasma.	Fusi Sel dan Fusi Protoplasma		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan Praktikum tentang Fusi Sel dan Fusi Protoplasma (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan konsep fusi sel dan fusi protoplasma.	7,5	
CPMK-4	**Sub-CPMK9**: Mampu menjelaskan dan menerapkan konsep metode marker untuk pemulian tanaman.	Pengenalan Metode Marker untuk Pemulian Tanaman I		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan Praktikum tentang pemulian tanaman I (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan dan menerapkan konsep metode marker untuk pemulian tanaman.	7,5	
	Sub-CPMK10: Mampu menjelaskan dan menerapkan konsep metode marker untuk pemulian tanaman.	Pengenalan Metode Marker untuk Pemulian Tanaman II		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan Praktikum tentang pemulian tanaman II (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan dan menerapkan konsep metode marker untuk pemulian tanaman.	7,5	
	Sub-CPMK11: Mampu menjelaskan dan menerapkan aplikasi	Tanaman Traansgenik untuk Peningkatan Hasil dan Kualitas		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')]	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi	Ketepatan dalam menjelaskan dan menerapkan aplikasi bioteknologi dalam bidang pertanian.	7,5	

	bioteknologi dalam bidang pertanian.			dan Praktikum tentang aplikasi bioteknologi dalam bidang pertanian (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').			
CPMK-5	**Sub-CPMK12**: Mampu menjelaskan konsep dari tanaman traansgenik untuk peningkatan hasil dan kualitas.	Tanaman Traansgenik untuk Peningkatan Hasil dan Kualitas.		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan Praktikum tentang tanaman traansgenik untuk peningkatan hasil dan kualitas (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan (2x60').	Ketepatan dalam menjelaskan dan mengaplikasikan tanaman traansgenik untuk peningkatan hasil dan kualitas.	7,5	
	Sub-CPMK13: Mampu menjelaskan konsep dari tanaman trasngenik untuk teknologi dan peningkatan senyawa kimia.	Tanaman Trasngenik untuk Teknologi dan Peningkatan Senyawa Kimia		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] dan Praktikum tentang tanaman trasngenik untuk teknologi dan peningkatan senyawa kimia (2x60'). Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan dan menyusun laporan praktikum (3x60').	Ketepatan dalam menjelaskan dan mengaplikasikan tanaman trasngenik untuk teknologi dan peningkatan senyawa kimia.	7,5	
	Sub-CPMK14: Mampu memahami dan menjelaskan konsekuensi penggunaan bioteknologi.	Konsekuensi Penggunaan Bioteknologi		Kuliah tatap muka (diskusi dan tanya jawab) [TM: 1x(2x50')] Tugas terstruktur menjawab tugas perorangan (2x60').	Mencari dan mempelajari minimal 10 referensi untuk menyusun materi presentasi kelompok, menjawab tugas perorangan (2x60').	Ketepatan dalam menjelaskan konsekuensi penggunaan bioteknologi.	7,5	

UJIAN AKHIR SEMESTER (120')		

Work load: Contact hours for lecture are 23.33 hours per semester.Total hours practical is 19.83 hours per semester. Lectures (2 x 50 minutes) per week or 23.33 hours per semester. Structured assignment (i.e.: article reading and review): 2 x 60 minutes per week or 24 hours per semester. Self-study: 2 x 60 minutes per week or 24 hours per semester. 3 credits (equivalent with 3.79 ECTS).

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