

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY**

Department of Plant Protection named after Ass.Pr. Mishnov A.K.

**"APPROVED"
Head of the Department of Plant
Protection named after
Ass.Pr. Mishnov A.K.**

**“_____” _____ 2019
_____ (V.A. Vlasenko)**

CURRICULUM OF THE EDUCATIONAL DISCIPLINE

**MOLECULAR ASPECTS OF THE RELATIONSHIP OF PLANTS AND THEIR
PARASITES**

Specialty: 202 “Plant Protection and Quarantine”

Faculty: Agrotechnologies and Natural Resource Management

1. Profile of the course

Names of the indicators	Area of knowledge, direction of training, educational and qualification level	Characteristics of the discipline	
		full-time education	shortened period
Number of credits - 4	Area of knowledge: 20 “Agrarian Sciences and Provision”	<i>Selective</i>	
Modules – 2	Speciality: 202 “Plant Protection and Quarantine”	Year of training:	
Content modules: 5		2019-2020	
		Course	
Total (hours) - 120		1	
		Semester	
		2	
	Lectures		
Weekly hours for full-time study: classroom: – 2	Higher education level: <i>third (educational-scientific)</i> Higher Education Degree: Phylosophy Doctor (PhD)	12 год.	
		Practical classes, seminars	
		Practicals	
		24 год.	
		Individual work	
		Individual classes: 84	
		Type of control: credit	

1. The purpose and objectives of the discipline

Purpose: to form students' professional knowledge about the peculiarities of molecular interaction of plants with pathogens, types and features of parasitism of phytopathogenic microorganisms, genetics of plant resistance to harmful organisms.

Objectives: understanding of genetic mechanisms of protection in plants against harmful organisms, features of interaction of organisms at biochemical and molecular levels.

As a result of studying the discipline, the student must:

know:

- molecular mechanisms of plant resistance to disease and pests;
- molecular features of parasitism of harmful organisms;
- genetics of plant resistance and pathogenicity of microorganisms;

be able to:

- determine the nature of the interaction of plants and microorganisms;
- determine the degree of parasitism of pathogens;
- to determine the trophism of microorganisms.
- determine the virulence and aggressiveness of pathogens.

General applicant competencies

Code	General competencies (GC)
GC 1	Ability to learn, master modern knowledge, self-improve and form a systematic scientific outlook.
GC 2	Ability to analyze and evaluate modern scientific achievements critically, to have synthesis of holistic knowledge, complex problem solving.
GC 3	Ability to abstract creative thinking, identify, receive, systematize, synthesize and analyze information from various sources with the use of modern information technologies in scientific activity.
GC 5	Ability to generate new ideas and make reasonable decisions to achieve goals.
GC 8	Ability to take initiative, take responsibility, motivate people and move toward a common goal.
GC 11	Ability to prepare scientific texts, present, discuss, and debate scientific results in their scientific work in native and foreign languages, sufficient for full understanding, demonstrating a culture of scientific verbal and written language.

Professional applicant competencies

Code	Professional Competencies (PC)
PC 1	Ability to apply methods for identification and identification of harmful organisms, to carry out scientifically sound phytosanitary diagnostics in agrobiocenoses and to control and control the density of harmful organisms.
PC 2	Ability to develop effective scientific models and technological schemes for identifying regulated objects in order to ensure compliance with phytosanitary measures in import-export products and the latest crop management systems.
PC 3	Ability to identify the laws of development and spread of a complex of harmful organisms and to develop scientifically sound protective measures.
GC 5	Ability to develop technological schemes of effective control of a complex of harmful organisms on the basis of regular knowledge and skills in the field of entomology, phytopathology and herbology.
GC 6	Ability to carry out laboratory studies, analyze the relationships of plants and harmful organisms with the development of a methodology for the management of harmful organisms at species and population levels at agricultural sites, both

intended and non-intended.

Expected Outcomes of the Discipline

Curriculum results

Code	Curriculum results(CR)
CR 3	To have up-to-date advanced conceptual and methodological knowledge in performing scientific and/or professional activities and at the border of subject areas of knowledge, guided by the principles of academic integrity and scientific ethics.
CR 7	Be able to work with various sources, carry out, process, analyze and organize the information received. Understanding of scientific articles in the field of the chosen specialty. Ability to work with up-to-date bibliographic and abstract databases, as well as scientometric platforms such as Web of Science, Scopus etc.
CR 8	Be able to critically analyze, evaluate and synthesize new scientific ideas, various information sources, scientific literature, research of domestic and foreign authors on plant protection and quarantine. Keep up with the latest developments in the industry and find scientific sources relevant to the field of scientific interest of the applicant. Analyze information sources, identify contradictions and previously unsolved problems or parts of them, formulate working hypotheses.
CR 9	Understand the peculiarities of structure and be able to prepare scientific papers (monographs, scientific articles, etc.), following the principles of academic integrity. It is qualified to reflect the results of scientific researches in scientific articles published both in professional Ukrainian publications and in publications that are included in international scientometric bases.
CR 14	Initiate, organize and conduct comprehensive plant protection and quarantine studies that lead to new knowledge.
CR 21	Provide a combination of different technological methods of scientific research, including laboratory, to solve typical professional problems, taking into account national and world standards for plant protection and quarantine. Perform research according to methodologies.

Module 1.

Content module 1. Features of the interaction of pathogens and plants

Topic 1: Types of interaction between microorganisms and plants. Neutralism, amensalism, commensalism, competition, mutualism, symbiosis, predation, parasitism.

Topic 2. Features of phytopathogens. Trophism of microorganisms. Saprotrophs, biotrophs, necrotrophs. Interaction of plants with microorganisms with different trophies.

Topic 3. Specialization of parasites. The main types of specialization of pathogens.

Content module 2. Pathogenesis in plant infestation by pathogens

Topic 4. Pathological process. Stages of pathological process. Features of pathogenesis in mycosis and bacteriosis. Features of pathogenesis in viral plant diseases.

Content module 3. Horizontal pathosystem

Topic 5. Parasite attack factors. Pathogen penetration, spread of infection by the plant.

Topic 6. Factors of plant resistance. Anatomical and morphological factors of plant resistance, regulation of ontogenesis and repair of lesions, biochemical factors of stability.

Module 2.

Content module 4. Vertical pathosystem

Topic 7. Avirulence genes and their products. Molecular interpretation of genetic data. The role of elicitors. Avirulence genes.

Topic 8. Resilience genes and their products. Stability studies by classical genetics. Stability studies by molecular genetics.

Content module 5. Active response of the plant to invading pathogens

Topic 9. Signal transduction. Types of signaling systems.

Topic 10. Hypersensitivity reaction. Morphological change of cells in apoptosis and necrosis. Genes that are involved in the death of plant cells.

Topic 11. Immune response to phytopathogen infection. Phytoalexins. PR proteins, phenylpropanoids, glycoproteins.

Topic 12. Virulence genes and their products. Suppressors, pathotoxins, enzymes for degradation of antimicrobial compounds.

Content modules and topics	Hours											
	full-day studying						shortened period					
	Total	incl.					total	incl.				
		lec	p	lab	ind	self		lec	p	lab	ind	self
1	2	3	4	5	6	7	8	9	1	11	12	13
Module 1.												
<i>Content module 1. Features of the interaction of pathogens and plants</i>												
Topic 1: Types of interaction between microorganisms and plants.	4	2	2									
Topic 2. Features of phytopathogens.	6	2	4									
<i>Content module 2. Pathogenesis in plant infestation by pathogens</i>												
Topic 4. Pathological process.	2	2										
<i>Content module 3. Horizontal pathosystem</i>												
Topic 5. Parasite attack factors.	8	2	6									
Topic 6. Factors of plant resistance.	7	1	6									
Total		9	18									
Module 2.												
<i>Content module 4. Vertical pathosystem</i>												
Topic 7. Avirulence genes and their products.	10				10							
Topic 8. Resilience genes and their products.	3	1	2									
<i>Content module 5. Active response of the plant to invading pathogens</i>												
Topic 9. Signal transduction.	6	2	4									
Topic 10. Hypersensitivity reaction.	10				10							
Topic 11. Immune response to phytopathogen infection.	54				54							
Topic 12. Virulence genes and their products.	10				10							

Total (hours)		3	6		84							
Total (hours)	120	12	24		84							

5. Topics and Plan of Lectures

No	Topic and plan	Number of hours
1	Topic 1: Types of interaction between microorganisms and plants. Neutralism, amensalism, commensalism, competition, mutualism, symbiosis, predation, parasitism.	2
2	Topic 2. Features of phytopathogens. Trophism of microorganisms. Saprotrophs, biotrophs, necrotrophs. Interaction of plants with microorganisms with different trophies.	2
3	Topic 3. Specialization of parasites. The main types of specialization of pathogens.	2
4	Topic 4. Parasite attack factors. Pathogen penetration, spread of infection by the plant.	2
5	Topic 5. Factors of plant resistance. Anatomical and morphological factors of plant resistance, regulation of ontogenesis and repair of lesions, biochemical factors of stability. Avirulence genes and their products. Molecular interpretation of genetic data. The role of elicitors. Avirulence genes.	2
6	Topic 6. Signal transduction. Types of signaling systems.	2
	Total	12

6. The topics of laboratory work

No	Topic	Number of hours
1	Determination of the type of parasitism of microorganisms.	2
2	Determination of type of trophism in microorganisms.	2
3	Determination of the type of specialization of phytopathogens.	2
4	Acquaintance with toxins and features of their formation by microorganisms.	2
5	Study of features of phytohormone formation during pathogenesis.	2
6	To study the effect of wax taint on the infestation of wheat flour plants (<i>Erysiphe graminis f. tritici</i>).	2
7	Study of amylase activity of fungi of the genera <i>Alternaria</i> and <i>Fusarium</i> .	2
8	Influence of volatiles on the growth and development of fungi on nutrient media.	2
9	Study of elicitors	2
10	Study of the effectiveness of immunocytophyte application	2
11	Study of phytoalexin activity of potato tubers with different plant resistance	2
12	Gaining information about resistance genes in different plants, skills in using databases.	2
	Total	24

7. Individual tasks

No	Task	Number of hours
1	Topic 7. Avirulence genes and their products. Molecular interpretation of genetic data. The role of elicitors. Avirulence genes.	10

2	Topic 10. Hypersensitivity reaction. Morphological change of cells in apoptosis and necrosis. Genes that are involved in the death of plant cells.	10
3	Topic 11. Immune response to phytopathogen infection. Phytoalexins. PR proteins, phenylpropanoids, glycoproteins.	10
4	Topic 12. Virulence genes and their products. Suppressors, pathotoxins, enzymes for degradation of antimicrobial compounds.	10
5	Write an essay on the topic: Molecular Mechanisms of Wheat Protection Against Major Phytopathogens	44
	Total	84

9. Studying methods

1. Learning methods for the source of knowledge:

- 1.1. **Verbal:** rendering, explanation, conversation, lecture.
- 1.2. **Visual:** demonstration, illustration, observation.
- 1.3. **Practicals:** laboratory method, practical work.

2. Methods of learning by the nature of the logic of knowledge:

- 2.1. **Analytical;**
- 2.2. **Methods of synthesis;**
- 2.3. **Inductive method.**

3. Methods of teaching by the nature and level of students' independent mental activity:

- 3.1. **Problematic;**
- 3.2. **Partial Search (Heuristic);**
- 3.3. **Research;**
- 3.4. **Reproductive;**
- 3.5. **Explanatory and demonstrative method.**

4. Active teaching methods - the use of technical training tools, self-assessment of knowledge, the use of training and control tests, the use of supporting lecture notes.

5. Interactive learning technologies - use of multimedia technologies, cooperation of students.

In case of small groups, the following teaching methods are used:

- **Personalized Learning;**
- **Differentiated Instruction;**
- **Inquiry-based Learning.**

10. Control methods

1. Rating control over a 100-point ECTS rating scale;
2. Conducting intermediate control during the semester (intermediate certification);
3. Multicriteria assessment of students' current work:
 - the level of knowledge demonstrated in practical, laboratory and seminar classes;
 - activity during the discussion of the topics in the class;
 - results of laboratory work execution and protection;
 - self-study of the topic as a whole or individual issues;
 - test results;
 - written tasks in the course of control work;
 - writing an essay.

Assessment of the applicant is carried out by commission (the committee includes members of the department)

Direct consideration in the final assessment of the student's fulfillment of a specific

individual task:
essay/report

11. Rating of the student

Testing		Individual tasks	Attestation	Total
Content module 1	Content module 2	15	15	100
35 points	35 points			

Rating scale: national and ECTS

Sum of points for all kinds of educational activity	Assess ECTS	National Assessment Scale	
		for exam, course project (work), practice	for credit
90 – 100	A	excellent	passed
82-89	B	good	
75-81	C		
69-74	D	satisfactory	
60-68	E		
35-59	FX	unsatisfactory with the possibility of repass	unpassed with the possibility of repass
1-34	F	unsatisfactory with compulsory re-study of the discipline	unpassed with compulsory re-study of the discipline

11. Recommended literature

Basic

1. General and Molecular Phytopathology: Textbook / [Diakov Yu.T., Ozeretskovskaia O.L., Dzhavahia V.H., Bahirova S.F.]. - M.: PH: "Society of Phytopathologists", 2001. – 302p.
2. Plant Immunity: A Short Course of Lectures for Postgraduates / T.M. Khorosheva, L.I. Chekmarev // FGBOU VPO "Saratov SAU". - Saratov, 2013. - 69 p.
3. Fundamental phytopathology / edited by Yu.T. Dyakov. Moscow: KRASAND, 2012. 512 p.
4. Plotnikova L.Ya. Plant Immunity and Selection for Fisease and Pest Resistance / L.Ya. Plotnikova; ed. Yu. T. Diakov. - M.: Kolos, 2007. - 359 p.
5. Lemez N.A. Plant Immunity: A Workshop for Students of Biological faculty / N.A. Lemez, S. G. Sidorov. - Minsk: BSU, 2008. - 96 p.

Supplementary

1. Eisenman B.B., Smirnov V.V., Bondarenko A.S. Phytoncides and Antibiotics of Higher Plants. - Kyiv: PH: "Scientific Thought", 1984. - 280p.
2. Control of Plant Diseases: Sustainable Susceptibility / Ed. Staples R., Tennissina H. - Moscow: Kolos, 1984. - 293p.

12. Information resources

1. Dmitriev O. Secrets of Plant Immunity. - [Electronic resource] .- Article access mode: <http://www.mao.kiev.ua/biblio/jscans/2006-1-dmitriev.pdf>
2. Amanda B. Keener. How plants fight off pathogens. - [Electronic resource] .- Article access mode: <http://www.the-scientist.com/?articles.view/articleNo/45201/title/Plant-Immunity/>