

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

Department of Plant Protection named after A.K. Mishnov

APPROVED
Head of the Department of Plant Protection
named after A.K. Mishnov

_____ **Vlasenko V.A.**

“ _____ ” _____ **2019 p.**

ACADEMIC PROGRAM OF THE DISCIPLINE
Plant Resistance to Pests

Specialty: Graduate Studies 202 «Plant Protection and Quarantine»

Faculty: *Agrotechnologies and Natural Resources*

2019 – 2020 academic year

The academic program of the discipline *Plant resistance to pests* for the postgraduates training of higher education level “Doctor of Philosophy” (Ph.D.) for specialty *202 Plant Protection and Quarantine*

The project team consists of:

Head of the Department of Plant Protection
named after A.K. Mishnov ,D.Sc., Professor

Vlasenko V.A.

Associate Professor, Department of Plant Protection
named after A.K. Mishnov

Demenko V.M.

The academic program was approved by the *Department of Plant Protection named after A.K. Mishnov*, “02” May 2019 (Minutes No.23)

Head of the Department of Plant Protection
named after A.K. Mishnov _____

V.A. Vlasenko

Approved:

**Dean of the faculty of Agrotechnologies
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_____ **I.M. Kovalenko**

Methodist of Educational Department

_____ **H.O. Baboshyna**

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Description of the discipline

Name of indicators	Field of study, program subject area, higher education level	Characteristics of the discipline	
		full-time education	extramural education
Amount of credits – 4,0	Field of study: : 20 «Agrarian Sciences and Food»	<i>Selective</i>	
	Specialty: 202 Plant Protection and Quarantine		
Modules – 2		The year of training:	
Content modules: 4		2019-2020-й	
		year	
		2	
		Semester	
Total workload– 120		4	
Hours per week for full-time education: classroom learning – 8,0 individual learning – 2,9	Higher education level: <i>Doctor of Philosophy</i>	Lectures	
		44 hours	
		Practical classes	
		44 hours	
		Individual work	
		32 hours.	
Assessment:			
		credit	

The ratio of classroom learning hours to individual learning ones is (%):
for full-time education – 73,3/26,7 (88/32)

2. The purpose and objectives of the discipline

The purpose of the discipline is postgraduates' acquisition of knowledge, abilities, skills for the successful implementation of professional and scientific activities on plant immunity to pests, the general characteristics and the relationship of phytophage insects with plants, the forms and mechanisms of plant resistance to pests, plant breeding for resistance to phytophage insects.

Objectives: the ability to solve complex problems in the field of professional, research and innovative activities, the creation of new holistic knowledge and professional training in plant protection and quarantine to understand the mechanisms of plant protection against pests, the characteristics of the interaction of organisms on population, biochemical and molecular levels, understanding the features of plant breeding for resistance to phytophage insects

As a result of the study of the discipline, third-level higher education students must know:

- - theoretical bases and mechanisms of plant resistance to pests, features of parasitism of harmful organisms, genetics of plant resistance and pathogenicity of microorganisms, features, and specificity of plant breeding for pest resistance

- - the main species of polytrophic and specialized pests on different crops and perennial crops, as well as their entomophagy, which limit the number of pests in victims and hosts on which they develop;
- methods for identification of harmful organisms, entomophages, carry out phytosanitary diagnostics of insects by mechanisms of control and management of harmful organisms in agrobiocenoses
- - regularities of development and distribution of harmful organisms and development scientifically-based protective measures to control widespread and quarantine harmful organisms;
- - technological schemes of effective control of harmful organisms based on regular knowledge and skills in the field of entomology;
- long-term studies of the pest circulation with the development of a methodology for controlling pests at the species and population levels at agricultural entities of target and nontarget purposes;
- predicting models, complex economic thresholds of phytophage harmfulness, the protective effect of beneficial organisms, energy-saving and environmental technologies for efficient cultivation of crop promising varieties and hybrids and organic farming;
- standards of academic integrity and scientific ethics
- **Be able to:**
 - - analyze pest populations, assess plants for pest resistance
 - - have professional knowledge; formulate ideas and concepts in academic or professional work;
 - find solutions in plant protection and quarantine, have sufficient competence in independent research methods, be able to interpret their results;
 - - use knowledge and skills in solving specialized problems of plant protection and quarantine;
 - - analyze the results of studies of morphology, biology, ecology, physiology of harmful organisms and assess the significance of indicators;
 - participate in professional training, discussions;
 - - identify, summarize and solve problems arising during professional activity, and create a sense of responsibility for the work;
 - - realize national and world standards for plant protection and quarantine, research following the methods
 - - combine different technological research practices to solve typical professional problems;
 - - undertake an individual-educational scientific program, self-study;
 - - use innovative scientific creativity;
 - - carry out high-quality scientific search, processing, analysis, and integration of acquired scientific knowledge.

3. PROGRAM OF THE DISCIPLINE

Module 1. Immunity of plants to pests

Content module 1. Phytoimmunology as a science and discipline

Theme 1. The subject and objectives of the discipline "Plant resistance to pests"

The subject of the discipline. The content and objectives of the discipline. History of the development of the science of plant immunity.

Plant immunity to pests, its role, and place in modern intensive agriculture.

Directions and methods of modern plant immunity. The role of foreign and domestic scientists in the development of plant immunity. Importance of plant immunity in the world agro-industrial production.

History of formation and development of phytoimmunology.

Theme 2. Plant immunity

Mechanisms of plant protection. Categories of plant immunity. Inherited and induced plant immunity. Non-specific and specific immunity of plants

Passive plant immunity. Factors of passive plant immunity. Anatomical and morphological features of plants. Chemical composition of plants.

Active plant immunity. Factors of active immunity. Oxidative flash and activation of signaling systems. Hypersensitivity reaction. Formation of PR proteins, phytoalexins. Strengthening of structural barriers.

Learn about enzymes, toxins as mechanisms of pathogenicity of microorganisms.

Learn about elicitors of protective reactions.

Learn about models of intergenic interaction in pathosystems

Learn about plant resistance genes.

Phytotoxins and enzymes as a means of attacking pests.

Content module 2.

Theme 3. Relationships of plants and phytophages

Plant immunity to pests. Reasons for the spread of certain types of pests. Cultivation of resistant varieties and hybrids of crops

System: host plant - phytophage The difference between the systems: host plant - phytophage and fodder plant - phytophage. Relations of plants and phytophages.

Factors of plant resistance to phytophages. Groups of plant immunity factors. Categories of plant resistance to phytophages.

Methods of pest identification.

Study populations of the most common pests.

Factors affecting pest populations

Features of the pest relations with food plants.

Theme 4. Mechanisms of plant resistance to pathogens

Anatomical and morphological features of plants as a factor of plant resistance to phytophages. The impact of the anatomical and morphological characteristics of plants on the damage by pests. The impact of anatomical and morphological features of plants on the laying eggs by phytophages Antibiosis of plants.

Plant biochemical characteristics as a factor of plant resistance to phytophages. Nutritional value of a plant for phytophagous. Chemical composition of the plant. Impact of secondary metabolism on phytophages.

Plant growth and development as a factor in plant resistance to phytophages. Phenology of plants and phytophages. Changing the chemical composition of plants in different phases of vegetation.

Methods for assessing the plant resistance to pests.

Types of plant damage by chewing insects.

Types of plant damage by sucking insects.

The peculiarity of the system: phytophage - fodder plant.

Module 2. Plant selection for pest resistance

Content module 3. Plant immunity to pests

Theme 5. Plant resistance to phytophages

Active plant reactions as a factor of plant resistance to phytophages. The reaction of plants to insect enzymes. Metabolic disorders in plants.

Anatomical and morphological properties and resistance to pests. The resistance of sunflower. Wheat resistance.

Biochemical composition of plants and resistance to pests. The osmotic pressure of plant cellular juice. Biochemical composition of plants.

Assessment of corn resistance to damage by *Ostrinia nubilalis*.

Assessment of wheat resistance to damage by *Anisoplia austriaca*.

Assessment of wheat resistance to damage by *Haplothrips tritici*.

Plant tolerance to pest damage, its types.

Theme6. Factors of plant resistance

Plant growth and development, and plant resistance to pests Wheat resistance. The pear resistance.

Biological properties of plants and resistance to pests. The resistance of cereals. The resistance of potatoes.

Plant pest resistance. The resistance of wheat to frit fly. The resistance of wheat to Hessian fly. The resistance of grape to phylloxera.

Assessment of soy resistance to *Vanessa cardui*.

Assessment of pea resistance to pea weevil.

Assessment of beet resistance to sugarbeet weevil

Phytophage variability and the problem of loss to resistance varieties.

Content module 4. Assessment of plant resistance to pests

Theme 7. Selection for plant immunity

Anthropogenic factors and plant immunity. Features and specificity of selection for immunity. History of plant breeding for pest resistance.

Immunological bases of creation of plants resistant to pests. The effect of narrowing the genetic diversity of plant resources. Narrowing the genetic foundations of modern sorts. Use in breeding genes evolutionarily unrelated to plant resistance genes

Assessment of potato resistance to the Colorado potato beetle.

Assessment of sunflower resistance to sunflower moth.

Assessment of rapeseed resistance to rape blossom beetle.

The strategy of selection for immunity.

Theme 8. Plant immunity to pests

Creating a resistant variety to pests. Immunological model of the variety. Selection of parental forms. Methods for creating resistance donors (distant hybridization, experimental mutagenesis, biotechnology).

Plant immunity to pests. Studying resistance to donors. Variety formation. Formation of selection for immunity.

Ways to increase the efficiency of varieties resistant to pests. Creating varieties based on major resistance genes. Creation of varieties with polygenic resistance. The combination of specific and racial-specific resistance.

Assessment of cabbage resistance to cabbage white butterfly

Assessment of apple resistance to the codling moth

Assessment of currant resistance to the currant clearwing

Assessment of plant resistance to the pests.

4. Structure of the discipline

Names of content modules	workload					
	full-time education					
	total	l	p	lab	ind . a.	ind. w
1	2	3	4	5	6	7
Module 1. Plant immunity to pests						
<i>Content module 1. Phytoimmunology as a science and discipline</i>						
Theme 1. The subject and objectives of the discipline "Plant Resistance to Pests"	8	4				4
Theme 2. Plant immunity	18	6	8			4
Total for content module 1	26	10	8			8
<i>Content module 2. Mechanisms of plant resistance to pests</i>						

Names of content modules	workload					
	full-time education					
	total	l	p	lab	ind. a.	ind. w
1	2	3	4	5	6	7
Theme 3. Relations of plants and phytophages	16	6	6			4
Theme 4. Mechanisms of plant resistance to pathogens	16	6	6			4
Total for content module 2	32	12	12			8
Total for module 1	58	22	20			16
Module 2. Plant breeding for pest resistance						
<i>Content module 3. Plant immunity to pests</i>						
Theme 5. Plant resistance to phytophages	16	6	6			4
Theme 6. Factors of plant resistance	16	6	6			4
Total for content module 3	32	12	12			8
<i>Content module 4. Assessment of plant resistance to pests</i>						
Theme 7. Breeding for plant immunity	14	4	6			4
Theme 8. Plant immunity to pests	16	6	6			4
Total for content module 4	30	10	12			8
Total module 2	62	22	24			16
<i>Total workload</i>	120	44	44			32

5. Themes and plan of lectures (full-time education)

No.	Theme	Workload
1	Theme 1. The discipline of plant resistance to pests 1. The subject of the discipline. 2. The content and objectives of the discipline. 3. History of the development of the science of plant immunity.	2
2	Theme 2. Plant immunity to pests, its role, and place in modern intensive agriculture 1 Directions and methods of modern plant immunity. 2. The role of foreign and domestic scientists in the development of plant immunity. 3. Importance of plant immunity in the world agro-industrial production	2
3	Theme 3. Mechanisms of plant protection 1. Categories of plant immunity. 2. Inherited and induced plant immunity. 3. Non-specific and specific immunity of plants.	2
4	Theme 4. Passive plant immunity 1. Factors of passive immunity of plants. 2. Anatomical and morphological features of plants. 3. Chemical composition of plants.	2
5	Theme 5. Active plant immunity 1. Factors of active immunity. 2. Oxidative flash and activation of signaling systems. 3. Hypersensitivity reaction. 4. Formation of PR proteins, phytoalexins. 5. Strengthening of structural barriers	2
6	Theme6. Plant immunity to pests 1. Reasons for the spread of certain types of pests.	2

No.	Theme	Workload
	2. Cultivation of resistant varieties and hybrids of crops.	
7	Theme 7. System: host plant - phytophage. 1 The difference between the systems: host plant - phytophage and fodder plant - phytophage. 2. Relations of plants and phytophages.	2
8	Theme 8. Factors of plant resistance to phytophages. 1. Groups of plant immunity factors 2. Categories of plant resistance to phytophages.	2
9	Theme 9. Anatomical and morphological features of plants as a factor of plant resistance to phytophages. 1. The impact of the anatomical and morphological characteristics of plants on the damage by pests. 2. The impact of anatomical and morphological features of plants on the laying eggs by phytophages 3. Antibiosis of plants.	2
10	Theme 10. Plant biochemical characteristics as a factor of plant resistance to phytophages. 1. Nutritional value of a plant for phytophagous 2. Chemical composition of the plant. 3. Impact of secondary metabolism on phytophages.	2
11	Theme 11. Plant growth and development as a factor in plant resistance to phytophages. 1. Phenology of plants and phytophages. 2. Changing the chemical composition of plants in different phases of vegetation.	2
12	Theme12. Active plant reactions as a factor in plant resistance to phytophages 1. The reaction of plants to insect enzymes. 2. Disorders of metabolism in plants.	2
13	Theme 13. Anatomical and morphological properties and resistance to pests 1. Sunflower resistance. 2. Wheat resistance.	2
14	Theme 14. Biochemical composition of plants and resistance to pests 1. The osmotic pressure of cellular juice of plants. 2. Biochemical composition of plants.	2
15	Theme 15. Plant growth and development, and plant resistance to pests 1. Wheat resistance. 2. Pear resistance.	2
16	Theme 16. Biological properties of plants and resistance to pests. 1. The resistance of cereals. 2 The resistance of potatoes.	2
17	Tema 17. The resistance of plants to damage by pests 1. The resistance of wheat to <i>Oscinella frit</i> .	2

No.	Theme	Workload
	2. The resistance of wheat to Hessian fly. 3 The resistance of grape to phylloxera. .	
18	Theme 18. Anthropogenic factors and plant immunity 1. Features and specifics of selection for immunity. 2. History of plant breeding for pest resistance.	2
19	Theme 19. Immunological bases of creation of plants resistant to pests 1. The effect of narrowing the genetic diversity of plant resources. 2. Narrowing of genetic bases of modern varieties. 3. Use in breeding genes evolutionarily unrelated to plant resistance genes.	
20	Theme 20. Creating a resistant variety to pests 1. Immunological model of the variety. 2. Selection of parental forms. 3. Methods for creating resistance donors (distant hybridization, experimental mutagenesis, biotechnology).	2
21	Theme 21. Plant immunity to pests 1. Study of donor resistance. 2. Formation of a variety. 3. Formation of selection by selection for immunity.	
22	Theme 22. Ways to increase the efficiency of varieties resistant to pests 1. Creating varieties based on major resistance genes. 2. Creation of varieties with polygenic resistance. 3. The combination of specific and racial-specific resistance	2
	Ра30М	44

6. Themes of practical classes

No.	Theme	Workload
1	Theme 1. Learn about enzymes, toxins as mechanisms of pathogenicity of microorganisms.	2
2	Theme 2. Learn about elicitors of protective reactions.	2
3	Theme 3. Learn about models of intergenic interaction in pathosystems	2
4	Theme 4. Learn about plant resistance genes.	2
5	Theme 5. Methods of pest identification.	2
6	Theme 6 Study populations of the most common pests.	2
7	Theme 7. Factors affecting pest populations	2
8	Theme 8. Methods for assessing the plant resistance to pests.	2
9	Theme 9. Types of plant damage by chewing insects.	2

10	Theme 10. Types of plant damage by sucking insects.	2
11	Theme 11. Assessment of corn resistance to damage by <i>Ostrinia nubilalis</i> .	2
12	Theme 12. Assessment of wheat resistance to damage by <i>Anisoplia austriaca</i> .	2
13	Theme 13. Assessment of wheat resistance to damage by <i>Haplothrips tritici</i> .	2
14	Тема 14. Assessment of soy resistance to <i>Vanessa cardui</i> .	2
15	Theme 15. Assessment of pea resistance to pea weevil.	2
16	Theme16. Assessment of beet resistance to sugarbeet weevil	2
17	Theme 17. Assessment of potato resistance to the Colorado potato beetle	2
18	Theme 18. Assessment of sunflower resistance to sunflower moth.	2
19	Theme 19. Assessment of rapeseed resistance to rape blossom beetle.	2
20	Theme 20. Assessment of cabbage resistance to cabbage white butterfly	2
21	Theme 21. Assessment of apple resistance to the codling moth	2
22	Theme22. Assessment of currant t resistance to the currant clearwing	2
	Total	44

7. Individual work

No.	Theme	Workload
1	History of formation and development of phytoimmunology	4
2	Phytotoxins and enzymes as a means of attacking pests	4
3	Features of the relationship of pests with food plants	4
4	System: phytophagus - fodder plant	4
5	Plant tolerance to pest damage, its types	4
6	Phytophage variability and the problem of loss of resistance varieties	4
7	The strategy of selection	4
8	Analysis of plant resistance to pests	3
	Total	32

8. Learning methods

1. By the source of knowledge:

1.1. **Verbal:** story, explanation, lecture, instruction.

1.2. **Visual:** demonstration, illustration.

1.3. **Practical:** laboratory method, practical work

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

- 2.1. *Analytical.*
3. **Methods of training by the nature and level of independent mental activity of postgraduates.**
- 3.1. Problem (problem-informational)
- 3.2. Research
- 3.4. Explanatory-demonstrative
- 3.5. Personalized learning
- 3.6. Differentiated instruction
- 3.7. Learning through request
4. **Active learning methods** – using technical means of teaching, occupational training, using training and controlling tests, the use of supporting lecture notes.
5. **Interactive learning technologies** – using multimedia technologies,

9. Methods of control

1. ECTS 100 – point scale rating
2. Intermediate control during the semester (intermediate attestation)
3. Multicriteria assessment of current work of postgraduates:
 - the level of knowledge demonstrated in practical, laboratory classes;
 - activity during the discussion of the issues raised in the classes;
 - results of performance and defense of practical works;
 - self-study of the theme as a whole one or particular issues;
 - test results.
4. Assessment during project defense and credit pass is conducted by a collegial group of academic staff by the creation of a commission.

10. Distribution of points got by postgraduates

Current control and individual work								IW	Modules and Individual work	Attestation	Total
Module 1 – 35 points				Module 2 – 35 points							
CM 1 – 17 points		CM 2 – 18 points		CM 3 – 17 points		CM 4 – 18 points					
T1	T2	T3	T4	T5	T6	T7	T8	15	85	15	100
8	9	9	9	8	9	9	9		(70+15)		

Rating scale: national and ECTS

Rating in points (for all types of educational activity)	Rating scale ECTS	Rating national scale	
		exam, term paper (project, thesis), industrial practice.	credit
90 – 100	A		

82-89	B	good	Pass
74-81	C		
64-73	D	satisfactory	
60-63	E		
35-59	FX	unsatisfactory (with the possibility of reassembly)	Failed with a possibility to retake the credit test
1-34	F	Unsatisfactorily (with the obligatory repeated course)	Filed with obligatory repeated course)

11. Methodical support

1. Робоча навчальна програма навчальної дисципліни [Robocha navchalna prohrama navchalnoi dystsypliny]
2. Інформаційне та навчально-методичне забезпечення усіх учасників освітнього процесу здійснюється за допомогою веб-сайту Сумського національного аграрного університету (<https://snau.edu.ua/>), який містить інформацію про освітні програми, навчальну, наукову та виховну діяльність, структурні підрозділи, контакти, репозиторій, наукові бібліотеки та читальні зали тощо. [Informatsiine ta navchalno-metodychne zabezpechennia usikh uchasnykiv osvitnoho protsesu zdiisniuietsia za dopomohoiu veb-saitu Sums'koho natsionalnoho ahrarnoho universytetu (<https://snau.edu.ua/>), yakyi mistyt informatsiiu pro osvichni prohramy, navchalnu, naukovu ta vykhovnu diialnist, strukturni pidrozdily, kontakty, repozytorii, naukovi biblioteku ta chytalni zaly toshcho]
3. Імунітет рослин. Методичні вказівки щодо проведення лабораторних занять та самостійної роботи для студентів 4 курсу денної форми навчання з напрямку 202 "Захист і карантин рослин" /Суми: СНАУ. - 2017. - 36 с. [Imunitet roslyn. Metodychni vkazivky shchodo provedennia laboratornykh zaniat ta samostiinoi roboty dlia studentiv 4 kursu dennoi formy navchannia z napriamu 202 "Zakhyst i karantyn roslyn" /Sumy: SNAU. - 2017. - 36 s.]

12. Recommended literature

Basic literature

- Гордеева Е. И. Крюкова А. В., Курбатова З. И. Иммунитет растений: учебное пособие. Великие Луки, 2011. 127 с. [Hordeeva E. Y. Kriukova A. V., Kurbatova Z. Y. Ymmunitet rastenyi: uchebnoe posobyue. Velykye Luky, 2011. 127]
- Иммунитет растений: краткий курс лекций аспирантов / Т.М. Хорошева, Л.И. Чекмарева // ФГБОУ ВПО "Саратовский ГАУ". Саратов, 2013. 69 с. [Ymmunitet rastenyi: kratkyi kurs lektsyi aspyrantov / T.M. Khorosheva, L.Y. Chekmareva // FHBOU VPO "Saratovskiy GAU". Saratov, 2013. 69 s.]
- Імунітет рослин: Підручник / [М.Д. Євтушенко, М.П. Лісовий, В.К. Пантелеєв, О.М. Слюсаренко]; за ред. М.П. Лісового. К.: Колоб'іг, 2004. 304 с. [Imunitet roslyn: Pidruchnyk / [M.D. Yevtushenko, M.P. Lisovyi, V.K. Panteleev, O.M. Sliusarenko]; za red. M.P. Lisovoho. K.: Kolobih, 2004. 304 s.]
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- Лемеза Н. А., Сидорова С. Г. Иммунитет растений: практикум для студентов биол. фак. Минск: БГУ, 2008. 96 с. [Ymmunitet rastenyi y selektsyia na ustoichyvost k

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Supplementary literature

- Айзенман Б.Б., Смирнов В.В., Бондаренко А.С. Фитонциды и антибиотики высших растений. Киев: Наук. думка, 1984. 280с. [Aizenman B.B., Smyrnov V.V., Bondarenko A.S. Fytontsydy y antybyotyky vysshykh rastenyi. Kyev: Nauk. dumka, 1984. 280s.]
- Борьба с болезнями растений: Устойчивость восприимчивость. /Под ред. Стейплза Р., Теннисина Г. М.: Колос, 1984. 293с.[Borba s bolezniamy rastenyi: Ustoichyvost vospruyumchyvost. /Pod red. Steiplza R., Tennyssyna H. M.: Kolos, 1984. 293s. .]
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