
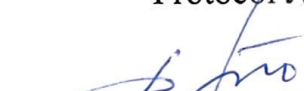
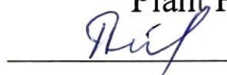


**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL  
SCIENCES OF UKRAINE**

V.F. Peresyphkin Department of Phytopathology

**“APPROVED”**  
Dean of the Faculty of Plant Protection,  
Biotechnologies and Ecology  
  
Yulia KOLOMIETS  
“18<sup>th</sup>” May 2023

**“APPROVED”**  
V.F. Peresyphkin Department of Phytopathology  
Protocol № 10 from “18<sup>th</sup>” April 2023  
Head of the Department  
  
Dmytro GENTOSH

**“CONSIDERED”**  
Guarantor of education program  
Plant Protection and Quarantine  
  
Myroslav PIKOVSKYI

**WORKING EDUCATIONAL PROGRAM OF ACADEMIC DISCIPLINE  
“GENERAL PLANT PATHOLOGY”**

Specialty	202-Plant Protection and Quarantine
Educational program	Plant Protection and Quarantine
Faculty	Plant Protection, Biotechnologies and Ecology
Developed by	Voloshchuk N.M., associate professor, Dr. PhD Bashta O.V., associate professor, Dr. PhD

## 1. Description of Discipline “General Plant Pathology”

<b>Area of expertise, specialty, educational program, degree</b>				
Field of knowledge	<i>20 Agricultural science and Food</i>			
Educational degree	<i>Bachelor</i>			
Specialty	<i>202 Plant Protection and Quarantine</i>			
Educational program	<i>Plant Protection and Quarantine</i>			
<b>Characteristics of discipline</b>				
Kind	Regulatory			
Total hours	240			
Number of credits ECTS	8			
Number of modules	4			
Course project (work)	CW			
Форма контроля	Credit / Exam			
<b>Indicators discipline for full-time and external learning</b>				
	Full-time education		External form of education	
Student's Year	3	3	3	4
Semester	5	6	6	7
Lectures	30 h	30 h	4 h	4 h
Practical, seminar classes	-	-		-
Laboratory classes	45 h	45 h		
Independent work	45 h	45 h	116 h	116 h
Individual tasks	-	-	-	-
Number of weekly hours for full-time education: classroom independent student work	6 h	6 h		

## 2. Purpose, tasks and competencies of the educational discipline

"General plant pathology" is one of the main profiling disciplines in training a specialist in plant protection and quarantine. It has a close connection with many general biological and special disciplines: botany, plant physiology, microbiology, virology, biotechnology, soil science, general agriculture, plant breeding, selection and seed production, fruit growing, vegetable growing, agrochemistry, mycology, agricultural phytopathology, zoology, general and agricultural entomology, etc., due to common objects and research methods.

**The goal of general phytopathology** as a science is to study the pathological process of plants, the etiology of diseases, the role of biotic and abiotic factors in their appearance and development, and to find out the factors that restrain the spread of pathogens and the diseases they cause.

During the implementation of the program, students study various groups of microorganisms pathogenic to plants, their parasitic properties, specialization and systematic position.

### **The task of general phytopathology is:**

- To acquaint students with the pathological process in a plant,
- To study the reasons for the regularity of the spread and development of plant diseases and to be able to establish the influence of environmental factors on these phenomena
- Master the classic and modern methods of diagnosing plant diseases with subsequent identification of their causative agents;
- Based on signs of manifestations on the plant, establish the etiology of the disease;
- Be able to plan and develop preventive and curative measures to prevent plant diseases and reduce crop losses from diseases

As a result of studying general phytopathology, the student should:

to know the diagnostic signs and types of diseases, methods of identification of pathogens, having mastered the theoretical issues of their biology, ecology, systematics and ways of spreading;

to be able to independently determine the types of diseases, establish their causative agents and taxonomic groups, justify measures that prevent the appearance of epiphytotia and limit the development of diseases caused by them.

### **Competence acquisition:**

#### **Integral competence (IC):**

The ability to solve complex specialized tasks and practical problems of professional activity in plant protection and quarantine and to apply theoretical knowledge and methods of phytosanitary monitoring, inspection, analysis, expertise characterized by complexity and uncertainty of conditions.

#### **General competences (GC)**

GC 2. Ability to apply knowledge in practical situations.

GC 3. Knowledge and understanding of the subject area and understanding of professional activity.

### **Program Learning Outcomes (PLO)**

*PLO 6.* Correctly use appropriate methods of observation, description, identification, classification, cultivation of objects of agrobiocenoses and maintenance of their stability in order to preserve natural diversity.

*PLO 16.* Know the main historical stages of development of the subject area.

### 3. The program and structure of the academic discipline for:

- full-time full-time (correspondence) form of education;
- reduced period of full-time (correspondence) education.

Titles of modules and themes	Amount of hours										
	Full time, hrs.					External, hrs.					
	total	including				total	including				
l		p	lab	ind.	indiv.w.		l	p	lab	ind.	indiv.w
<b>Content module 1. The concept of plant diseases</b>											
Introduction	1	1				1	1				
1.1. The history of the development of phytopathology	7	3			4						6
1.2. Pathological process and its variability	7	1		2	4						7
1.3. Harmfulness of plant diseases	5	1		2	2						5
1.4. Classification of plant diseases	9	1		4	4						9
1.5. Types of plant diseases	9	1		4	4						9
1.6. Non-infectious plant diseases	12	4		4	4						12
1.7. Infectious diseases	12	4		4	4						12
<b>Together according to the content module 1</b>	<b>62</b>	<b>16</b>		<b>20</b>	<b>26</b>	<b>62</b>	<b>1</b>				<b>61</b>
<b>Content module 2. Pathogens of plant diseases</b>											
2.1. Properties of pathogens that determine disease-causing processes in plants	8	2		2	4	8	1				7
2.2. Bacteria and actinomycetes, mycoplasmas and rickettsia	10	2		4	4	10					10
2.3. Viruses and viroids	10	2		4	4	10					10
2.4. Flower parasites	8	2		2	4	8					8
2.5. Morphological, biological and pathogenic properties of lower fungi, their taxonomy.	22	6		12	4	22					22
<b>Together according to the content module 2</b>	<b>58</b>	<b>14</b>		<b>24</b>	<b>20</b>	<b>58</b>	<b>1</b>				<b>57</b>
<b>Content module 3. Dynamics of development and spread of infectious plant diseases</b>											
3.1. Morphological, biological and	28	12		12	4	28	1				27

pathogenic properties of higher fungi, their taxonomy												
3.2. Penetration of pathogens into the plant	10	2		4		4	10					10
3.3. The influence of environmental conditions on infection	10	2		4		4	10					10
3.4. Ways and methods of spread of the infectious beginning	8	2		2		4	8					8
3.5. The concept of areas and epiphytotypic diseases	8	2		2		4	8					8
<b>Together according to the content module 3</b>	<b>64</b>	<b>20</b>		<b>24</b>		<b>20</b>	<b>64</b>	<b>1</b>				<b>63</b>
	<b>Content module 4. Діагностика хвороб рослин. Принципи побудови захисних заходів</b>											
4.1. Methods of diagnosing plant diseases. Molecular diagnostic methods.	14	2		8		4	14	1				14
4.2. Methods and means of protecting plants from diseases:												
4.2.1. Compliance with agrotechnical requirements for growing plants	7	1		2		4	7					7
4.2.2. Immunological method of plant protection	5	1		2		2	5					5
4.2.3. Biological method	10	2		4		4	10					10
4.2.4. Physico-mechanical method	5	1		2		2	5					5
4.2.5. Chemical method	8	2		2		4	8					8
4.2.6. Quarantine measures	7	1		2		4	7					7
<b>Together according to the content module 4</b>	<b>56</b>	<b>10</b>		<b>22</b>		<b>24</b>	<b>56</b>	<b>1</b>				<b>55</b>
<b>Total hours</b>	<b>240</b>	<b>60</b>		<b>90</b>		<b>90</b>	<b>240</b>	<b>4</b>				<b>236</b>
Course project (work) on <u>General Plant Pathology</u>		-	-	-		-		-	-	-		-
<b>Total hours</b>		-	-	-		-		-	-	-		-

#### 4. Topics of seminar classes

№	Topic name	Hours
1	Not provided for in the working curriculum	
2		

#### 5. Topics of practical classes

№	Topic name	Hours
1	Not provided for in the working curriculum	
2		

#### 6. Topics of laboratory classes

№	Topic name	Hours
1	Discoloration of the material, coloring and fixation of preparations. Infection of plants with pathogens. Observation of the development of a living object and pathological changes in a plant.	4
2	Determining the harmfulness of diseases by their symptoms and distribution.	2
3	Acquaintance with visual signs of diseases according to their classification.	4
4	Symptoms of diseases. Types, their manifestation	4
5	Acquaintance with the symptoms of diseases arising under the influence of abiotic factors.	4
6	External signs of damage to plant organs by pathogens belonging to different groups of parasitism.	2
7	The ability of pathogens to infect certain types of plants. The role of minimal infectious load in the occurrence of infection.	2
8	Morphological features of phytopathogenic bacteria. Types of bacterial plant diseases. Staining of phytopathogenic bacteria, fixation, artificial infection of plants.	4
9	Morphological properties of actinomycetes, rickettsial mycoplasmas.	2
10	Symptoms of viral plant diseases. Determining whether the latter belong to the groups of mosaics and yellows. Artificial infection of healthy plants with viral pathogens as evidence of disease infectivity. Diagnosis of plant viral diseases.	2
11	Morphological features of viroids.	2
12	Symptoms of mistletoe, coryza and lupus. Mechanism of	2

	plant infection.	
13	Sensitivity of lower fungi to abiotic factors. Antagonism of fungi within the species and relative to other organisms. Fundamentals of mushroom taxonomy. The principles of dividing them into taxonomic groups. Class Plasmodiophoromycetes.	2
14	Principles of dividing them into taxonomic groups Class Chytridiomycetes.	6
15	The principles of dividing them into taxonomic groups Class Oomycetes.	2
16	The principles of dividing them into taxonomic groups Class Zygomycetes.	2
17	Signs of mycelium according to which mushrooms belong to higher ones. Penetration into the plant.	6
18	Systematics of higher fungi. Class Ascomycetes	6
19	Systematics of higher fungi. Class Basidiomycetes	4
20	Systematics of higher fungi. Mitosporous fungi	2
21	Infection of plants with pathogens under different regimes of temperature, moisture and presence of light.	2
22	Direct and passive transmission of pathogens from diseased plants or their individual organs to healthy ones.	2
23	Emergence of epiphytotia under different conditions of meteorological condition, pathogen and resistance of varieties (simulate these factors and predict epiphytotia).	6
24	Methods of diagnosing plant diseases. Laboratory methods of diagnosis	4
25	Molecular diagnostic methods	2
26	Simulate various agrotechnical backgrounds affecting the development of certain groups of diseases.	2
27	The role of the variety in the development of plant diseases. Specify the varieties with increased resistance of various agricultural crops against diseases.	2
28	The influence of fungi of the second order and their producers on the growth and development of phytopathogenic fungi.	2
29	Determining the quality of infected and healthy seeds as proof of the need to clean them. Methods of thermal disinfection of seeds.	2
30	The influence of chemical plant protection agents on the germination of spores and the development of mycelia of pathogens.	2
<b>Total</b>		<b>90</b>

## 7. Topics of independent studies



From Module № 1 "Concepts about plant diseases"

№	Topic name	Hours
1	Determination of harmfulness of diseases	5
2	Symptoms of diseases by etiology	5
3	Types of disease manifestations	5
4	Acquaintance with the symptoms of diseases arising under the influence of abiotic factors	5
5	External signs of damage to plant organs by pathogens belonging to different groups of parasitism	6
<b>Total</b>		<b>26</b>

From Module №2 "Pathogens of plant diseases"

№	Topic name	Hours
1	The ability of pathogens to infect certain types of plants. The role of minimal infectious load in the occurrence of infection.	4
2	Morphological features of phytopathogenic bacteria. Types of bacterial plant diseases. Staining of phytopathogenic bacteria, fixation, artificial infection of plants. Morphological properties of actinomycetes, rickettsial mycoplasmas.	4
3	Symptoms of viral plant diseases. Determining whether the latter belong to the groups of mosaics and yellows. Artificial infection of healthy plants with viral pathogens as evidence of disease infectivity. Diagnosis of plant viral diseases.	4
4	Morphological features of viroids.	4
5	Floral parasites of plants. Mechanism of plant infection.	4
<b>Total</b>		<b>20</b>

From Module № 3 "Dynamics of Development and Spread of Infectious Plant Diseases"

№	Topic name	Hours
1	Signs of mycelium according to which mushrooms belong to higher ones. Penetration into the plant.	2
2	Systematics of higher fungi. Class Ascomycetes	2
3	Systematics of higher fungi. Class Basidiomycetes	2
4	Systematics of higher fungi. Mitosporous fungi	2
5	Infection of plants with pathogens under different regimes of temperature, moisture and presence of light.	2
6	Direct and passive transmission of pathogens from diseased plants or their individual organs to healthy ones.	5
7	Emergence of epiphytotia under different conditions of meteorological condition, pathogen and resistance of varieties (simulate these factors and predict epiphytotia).	5
<b>Total</b>		<b>20</b>

From Module № 4 "Diagnosis of plant diseases. Principles of construction of protective measures"

№	Topic name	Hours
1	Methods of diagnosing plant diseases. Laboratory methods of diagnosis	10
2	Molecular diagnostic methods	8
3	Methods and means of protecting plants from diseases	6
<b>Total</b>		<b>24</b>

## **8. Samples of control questions, tests to determine the level of knowledge acquisition by students**

1. Concept of pathological process in plants.
2. Evolution and types of parasitism. Specialization of phytopathogenic organisms.
3. Phytopathogenic fungi - general characteristics, classification, structure and reproduction.
4. Parasitic flowering plants.
5. Dynamics of plant infectious diseases.
6. Immunity of plants to infectious diseases.
7. Methods of protecting plants from diseases.
8. History of phytopathology development
9. Classification of plant diseases
10. Types of plant diseases by etiology
11. Types of plant diseases by symptoms
12. Infectious diseases of plants
13. Causes and features of non-infectious plant diseases
14. The influence of human activity in the occurrence of plant diseases
15. The relationship between infectious and non-infectious plant diseases
16. Main systematic categories. Scheme of subordination of taxonomic categories. A brief description of the main systematic groups of fungi
17. Characteristics of oomycetes
18. Characteristics of chytrid fungi
19. Characteristics of zygomycetes
20. Characteristics of the Basidiomycetes class
21. Characteristics of the Ascomycetes class
22. Describe actinomycetes - potential pathogens of plant diseases
23. Describe bacteria - potential pathogens of plant diseases
24. Describe viruses - potential pathogens of plant diseases
25. Positive and negative role of fungi, bacteria and actinomycetes in growing plants
26. Phytoplasmas are pathogens of plant diseases
27. Viroids are pathogens of plant diseases
28. Describe the causative agents of powdery mildew diseases of plants
29. Describe the causative agents of rust diseases of plants
30. Describe one-house and two-house owners. Describe pathogens with a complete and incomplete development cycle
31. Characteristics of anamorphic fungi. Systematic position of fungi of the class Deuteromycetes
32. Describe the stages of the pathological process
33. Infectious load, how to determine it
34. What are the ways in which pathogens of plant diseases spread and penetrate plant tissues
35. Describe the incubation period

36. How to distinguish primary and secondary infection, their importance in the occurrence of plant disease
37. The general area and the area of harmfulness of the plant disease.
38. Conditions for epiphytotic development of diseases, types of epiphytota.
39. Forecast of the development of plant diseases
40. Types of resistance of plants against mycoses, bacteria, viruses
41. Preventive and therapeutic measures to protect plants from diseases.
42. Organizational and economic method of protecting plants from diseases
43. Selection and seed method of protecting plants from diseases
44. Agrotechnical method of protecting plants from diseases
45. Physico-mechanical method of protecting plants from diseases
46. Chemical method of protecting plants from diseases
47. Biological method of protecting plants from diseases
48. Quarantine of plants in relation to quarantine pathogens
49. True and false powdery mildew - characteristics of pathogens and symptoms. How are these diseases different?
50. Diagnosis of plant diseases.
51. Field and laboratory diagnostic methods
52. Molecular methods of disease diagnosis
53. Diagnosis of plant viral diseases
54. Diagnosis of fungal diseases of plants
55. Diagnosis of bacterial plant diseases
56. Asexual reproduction of fungi. The role of the anamorphic stage in the cycle of disease development
57. Sexual reproduction of fungi. The role of the teleomorphic stage in the cycle of disease development
58. Describe the types of fruiting bodies of marsupial mushrooms. Their significance for taxonomic distribution
59. The anamorphic stage of fungi using the example of a plant pathogen (choice of any)
60. The teleomorphic stage of fungi using the example of a plant pathogen (choice of any)

National University of Life and Environmental Sciences of Ukraine			
The first level of higher education (undergraduate) Specialty 202- Protection and quarantine of plants	V.F. Peresyphkin Phytopathology Department	Exam ticket № _ Discipline «General Plant Pathology»	Approved Head of department _____2023

***Exam questions***

*(Total score 10 points for answering each question)*

1	Development of the pathological process
2	Agrotechnical method of plant protection against diseases

**Test tasks of various types**  
(Maximum score of 10 points for answers to test tasks)

	<b>Question 1. The subject of studying general phytopathology is:</b>
1	Development of plants
2	The structure of a plant cell
3	Pathogens of plant diseases and methods of plant protection
4	Creation of resistant varieties
	<b>Question 2. A plant disease is:</b>
1	The state of the organism that arose and develops under the influence of the susceptible interaction between the plant, the disease-causing agent and environmental conditions, and is characterized by a violation of the physiology and productivity of plants.
2	The process of interaction between a plant, a disease-causing agent that is not capable of causing disease, and insusceptible environmental conditions
3	The process of spread of pathogenic agents capable of causing disease
4	The process of positive influence of environmental conditions on the plant
	<b>Question 3. What are the causes of non-infectious plant diseases:</b>
1	Abiotic environmental factors
2	The effect of pesticides on plants
3	Effect of fungi, bacteria, viruses on the plant
4	Action of nematodes, flower plant parasites
	<b>Question 4. The main task of general phytopathology is:</b>
1	Breeding of new strains of microorganisms
2	Carrying out artificial infection of plants with pathogens
3	Prevention of plant diseases and finding ways to reduce losses from them
4	Treatment with weakened strains of cultures of microorganisms of various types of plants
	<b>Question 5. The main reason for significant crop losses due to diseases is:</b>
1	Lack of compliance with agricultural techniques
2	Lack of mineral fertilization
3	Non-observance of timely protective measures to protect plants from diseases
4	Far distance of the seed composition from the field
	<b>Question 6. Infectious plant diseases are caused by:</b>
1	Fungi, viruses, bacteria
2	Meteorological conditions
3	Old dispute material
4	Acid rain
	<b>Question 7. The distribution of the range of diseases is influenced by:</b>
1	Acid rains
2	Use of disease-resistant varieties, weather conditions
3	The presence of non-aggressive, non-pathogenic strains, races, biotypes of pathogens
4	Far distance of the seed composition from the field

	<b>Question 8. Non-infectious diseases are caused by:</b>
1	Fungi, viruses, bacteria
2	Lack of moisture, light, temperature
3	Viroids, mycoplasmas
4	Remains of plant remains
	<b>Question 9. What type of diseases are caused by mushrooms of the genus Tafrina:</b>
1	Rotten
2	Mummification
3	Spots
4	Necrosis
	<b>Question 10. Diseases include:</b>
1	Rotten
2	Formation of conidial sporulation
3	Damage to plant organs by insects
4	Debarking of trees

### 9. Teaching methods

The success of learning in general depends on the internal activity of students, on the nature of their activity, so the nature of activity, the degree of independence and creativity should be important criteria in choosing a method.

Explanatory - illustrative method. Students gain knowledge by listening to a story, a lecture, from educational or methodical literature, through an on-screen guide in a "ready-made" form. Perceiving and comprehending facts, assessments, conclusions, they remain within the limits of reproductive (reproductive) thinking. This method is used as widely as possible to transmit a large amount of information. It can be used to present and learn facts, approaches, assessments, conclusions.

Reproductive method. It is about applying what has been learned based on a pattern or rule. The activity of those who are taught is algorithmic, that is, it corresponds to instructions, orders, rules - in situations similar to the presented sample.

Problem presentation method. Using any sources and means, the teacher, before teaching the material, poses a problem, formulates a cognitive task, and then, revealing the system of proofs, comparing views, different approaches, shows a way to solve the task. Students become, as it were, witnesses and accomplices of scientific research.

Partial search, or heuristic method. Its essence is the organization of an active search for a solution to cognitive tasks proposed by the teacher (or independently formulated) either under the guidance of the teacher or on the basis of heuristic programs and instructions. The thinking process acquires a productive character, but it is gradually directed and controlled by the teacher or the students themselves on the basis of work on programs (in particular, computer ones) and with teaching

aids. Such a method, one of the varieties of which is a heuristic conversation, is a proven method of activating thinking, encouraging knowledge.

Research method. After analyzing the material, setting problems and tasks, and brief oral or written instruction, the trainees independently study the literature, sources, conduct observations and measurements, and perform other research activities. Initiative, independence, creative search are most fully manifested in research activities. The methods of educational work directly turn into methods that imitate and sometimes implement scientific research.

### **10. Forms of control**

Control of students' knowledge and skills (current and final) in the discipline is carried out according to the credit-module system of the organization of the educational process. The student's rating for mastering the discipline is determined on a 100-point scale. It consists of a rating for academic work, for the assessment of which 70 points are assigned, and a rating for attestation (exam) - 30 points.

Criteria for assessing the level of knowledge in laboratory, seminar and practical classes. In laboratory classes, each student performs individual tasks on each topic. The level of knowledge is assessed as: "excellent" - the student gives comprehensive, substantiated, theoretically and practically correct answers to at least 90% of questions, solutions to problems and laboratory exercises are correct, demonstrates knowledge of textbooks, manuals, instructions, makes generalizations and conclusions, and accurately prepares tasks, was present at the lectures, has a synopsis of the lectures or essays on the main topics of the course; "good" - when the student has knowledge of the material, but makes minor mistakes in the formation of terms, categories and calculations, but with the help of the teacher quickly orients himself and finds the right answers, has attended lectures, has a synopsis of lectures or essays on the main topics of the course; "satisfactory" - when the student gives the correct answer to at least 60% of the questions, or gives insufficiently substantiated, incomplete answers to all questions, makes gross mistakes, which are corrected with the help of the teacher. At the same time, the availability of a synopsis on the topic of tasks and independence is taken into account; "unsatisfactory with the possibility of retaking" - when the student gives the correct answer to at least 35% of the questions, or gives unreasonable, incomplete answers to all questions, makes gross mistakes. It has an incomplete synopsis of lectures.

Final (general assessment) course of the academic discipline. It is the sum of ratings (points) obtained for separate evaluated forms of educational activity: current and final testing of the level of mastery of theoretical material during classroom classes and independent work (modular control); assessment (points) for performing laboratory studies. The final grade is issued after a full study of the academic discipline, which is derived as the sum of intermediate grades for the content modules. The final assessment of the level of knowledge consists of a rating from the academic work, for the assessment of which 70 points are assigned, and a rating from the attestation (exam) - 30 points.

### 11. Distribution of points received by students

The student's knowledge is assessed on a 100-point scale and translated into national assessments according to the table. 1 "Regulations on examinations and assessments at NUBiP of Ukraine" (order on implementation dated 04.26.2023, protocol No. 10)

Student rating, points	The assessment is national for the assembly results	
	exams	credits
90-100	excellent	credited
74-89	good	
60-73	satisfactory	
0-59	unsatisfactory	not credited

To determine the student's (student's) rating for mastering the Rdis discipline (up to 100 points), the obtained rating from the certification (up to 30 points) is added to the student's (student's) rating for the RPR educational work (up to 70 points):

$$R_{dis} = R_{EW} + R_{AT}$$

### 12. Educational and methodological support

Scientific and methodological support of the educational process includes: state education standards, curricula, educational programs from all normative and selective educational disciplines; programs of educational, industrial and other types of practices; textbooks and training aids; instructional and methodical materials for seminar, practical and laboratory classes; individual educational and research tasks; control works; text and electronic versions of tests for current and final control, methodical materials for organizing students' independent work.

An electronic educational course General Phytopathology was developed from the discipline /Bashta O.V., Voloshchuk N.M., website: URL: <https://elearn.nubip.edu.ua/couse/view.php?id=1081>

1. Bashta O.V., Voloshchuk N.M., Vuyek A.O., Gentosh D.T., Pikovsky M.Y., Artemchuk I.P. Methodological recommendations for educational practice in phytopathology for applicants of the first (bachelor) level of higher education, specialty 202 Protection and quarantine of plants Kyiv: Editorial and publishing department of NUBiP of Ukraine. 2023. 78 pages.
2. Bashta O.V., Vuyek A.O. Workbook for performing laboratory work in General Phytopathology for students of the first (bachelor) level of higher education, specialty 202 Protection and quarantine of plants. Kyiv: Editorial and publishing department of NUBiP of Ukraine. 2023. 128 pages.

3. Bashta O.V., Voloshchuk N.M. Methodical guidelines for writing a coursework on general phytopathology for students of the BA "Bachelor" specialty 202 "Protection and Quarantine of Plants". Kyiv: Editorial and publishing department of NUBiP of Ukraine. 2022. 12 p.
4. Bashta O.V., Voloshchuk N.M., Vuyek A.O. Methodical instructions for laboratory work on general phytopathology for students of the BA "Bachelor" specialty 202 "Protection and Quarantine of Plants". Kyiv: Editorial and publishing department of NUBiP of Ukraine. 2022. 95 p.

### **13. Recommended Literature**

#### **Main:**

1. Modern Approaches in Plant Pathology. Elite Publishing House. 2023. 321 pp.
2. Principles of Plant Pathology. Mishra R. C. & Singh R. (eds.). 2023. 19 pp. <https://www.researchgate.net/publication/370025309>
3. Plant Pathology Concepts and Laboratory Exercises Third edition. – CRC Press. – 2016. – 598 p.
4. The Study of Plant Disease Epidemics. Laurence V. Madden, Gareth Hughes, and Frank van den Bosch, 2017 <https://doi.org/10.1094/9780890545058>
5. Venbrux M, Crauwels S and Rediers H. Current and emerging trends in techniques for plant pathogen detection. *Front. Plant Sci.* 2023. 14:1120968. doi: 10.3389/fpls.2023.1120968

#### **Addition literature:**

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2. Mapuranga J, Zhang N, Zhang L, Chang J, Yang W. Infection Strategies and Pathogenicity of Biotrophic Plant Fungal Pathogens. *Front Microbiol.* 2022 Jun 2;13:799396. doi: 10.3389/fmicb.2022.799396.
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