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

Department of physiology, biochemistry of plants and bioenergetics

**"APPROVED"**
Dean of Faculty of Plant protection,
Biotechnology and Ecology
Kolomiets Y.V.
23 " May 2024

"**APPROVED**"
on the meeting of physiology, biochemistry of plants
and bioenergetics department
Protocol № 10 from «22» May 2024
Head of Department
Svitlana Prylutska

"**REVIEWED**"
Guarantor EO 202 «Plant protection and quarantine»
**Myroslav Pikovskii**
Guarantor EO

# WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

# PLANT PHYSIOLOGY WITH BASICS OF BIOCHEMISTRY

Field of knowledge 20 "Agricultural sciences and food"
Specialization 202 Plant protection and quarantine
Educational program Plant protection and quarantine
Faculty of Plant Protection, Biotechnology and Ecology
Developers: docent, Ph.D. Babytskiy A.I., docent Ph.D. Nesterova N.G.

Kyiv – 2024

**Description of the course**
**«PLANT PHYSIOLOGY WITH BASICS OF BIOCHEMISTRY»**

| **Branch of knowledge, training direction, specialty, education level** | | |
|---|---|---|
| Educational degree | Bachelor | |
| Specialization | 202 «Plant protection and quarantine» | |
| Educational program | «Plant protection and quarantine» | |
| **Characteristics of the course** | | |
| Type | Compulsory | |
| Total number of hours | 120 | |
| Number of credits ECTS | 4 | |
| Number of content modules | 2 | |
| Course project (work) (if any) | None | |
| Form of control | Exam | |
| **Indicators of the discipline for full-time higher education** | | |
| | full-time form of higher education | part-time form of higher education |
| Course (year of study) | 2 | |
| Semester | 4 | |
| Lecture classes | 15 hours | |
| Practical, seminar classes | - | |
| Laboratory classes | 30 hours | |
| Self-study | 75 hours | |
| Individual assignments | - | |
| Number of weekly classroom hours for the full-time form of study:<br>auditory<br>independent work of student | <br>3 hours<br>5 hours | |

## 1. Purpose, objectives, and competencies of the course

The course "Plant Physiology with the basics of biochemistry" studies the mechanisms of the main life processes in plants, reveals the structural and functional organisation of plant systems of different levels of organisation, and substantiates ways to manage the plant organism to optimise crop production, plant protection and the protection of natural phytocenoses.

Purpose of studying the discipline "Plant Physiology with the basics of biochemistry" is to learn the laws of vital functions of plants, the disclosure of their mechanisms, forming an idea of structural and functional organization of plant systems at different levels and developing ways to control the plant organism.

Course objectives

1. Study of plant cell physiology - chemical and molecular composition of the cell, its structural components.
2. The study of the vital processes of the plant organism - water regime, photosynthesis, respiration, mineral nutrition.
3. Finding out the peculiarities of growth and development of the plant organism.
4. Study of physiology of reproduction, adaptation and mechanisms of plant stability, physiology of stress.

**Acquisition of competencies:**

***Integral competence (IC):*** Ability to solve complex specialised tasks and practical problems of professional activity in plant protection and quarantine and apply theoretical knowledge and methods of phytosanitary monitoring, inspection, analysis, examination, characterised by complexity and uncertainty of conditions.

***General competencies (GC):***

GC3. Knowledge and understanding of the subject area and understanding of professional activities.

GC6. Skills in using information and communication technologies for professional activities.

***Program learning outcomes (PLOs):***

PLOs4. Know and understand mathematics and natural sciences to the extent necessary for professional activities in plant protection and quarantine.

PLOs6. Correctly use appropriate methods of observation, description, identification, classification, cultivation of agrobiocenoses and maintenance of their stability to preserve natural diversity.

PLOs16. Know the main historical stages of development of the subject area.

## 2. Program and structure of the discipline for:

- full-time (part-time) higher education;
- reduced term of full-time (part-time) higher education

| Names of content modules and topics | Number of hours | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | full-time education | | | | | | | correspondence form of training | | | | | |
| | weeks | total | included | | | | | total | included | | | | |
| | | | lec | prac | lab. | ind. | in.w. | | lec | prac | lab. | ind. | in.w. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| **Content module 1. Plant cell physiology and patterns of water exchange** | | | | | | | | | | | | | |
| Topic 1 Introduction. Subject, purpose and tasks, directions and methods of modern plant physiology. History of the formation of plant physiology as a science | 1 | 14 | 2 | | 2 | | 10 | 2 | 2 | | 1 | | 4 |
| Topic 2. Plant cell physiology | 3 | 17 | 3 | | 4 | | 10 | | | | | | 10 |
| Topic 3. Water exchange of plants | 5 | 23 | 2 | | 6 | | 15 | 4 | | | 2 | | 10 |
| **Total hours:** | | **54** | **7** | | **12** | | **35** | | **2** | | **3** | | **24** |
| **Content module 2. Energy processes of the plant organism and physiology of nutrition, growth and development of plants** | | | | | | | | | | | | | |
| Topic 1. Photosynthesis | 7 | 20 | 2 | | 8 | | 10 | 4 | | | 1 | | 10 |
| Topic 2. Plant respiration | 9 | 16 | 2 | | 4 | | 10 | 2 | | | | | 10 |
| Topic 3. Mineral nutrition of plants | 11 | 14 | 2 | | 2 | | 10 | | | | 2 | | 10 |
| Topic 4. Plant growth and development, adaptation of plants to environmental conditions | 13 | 16 | 2 | | 4 | | 10 | | | | | | 10 |
| **Total hours:** | | **66** | **8** | | **18** | | **40** | | | | **3** | | **40** |
| **The total number of hours:** | **15** | **120** | **15** | | **30** | | **75** | **72** | **2** | | **6** | | **64** |

## 3. Topics of laboratory classes

| № | Topic title | Number of hours |
|---|---|---|
| 1. | Structure of a plant cell | 1 |
| 2. | Determination of membrane permeability | 2 |
| 3. | The phenomenon of plasmolysis and deplasmolysis in plant cells | 2 |
| 4. | Determination of sucrose activity | 2 |
| 5. | Determination of the rate of water absorption by a plant | 2 |
| 6. | Determination of stomata condition by infiltration method | 2 |
| 7. | Determination of plant tissue tension by the method of strips | 2 |
| 8. | Dependence of transpiration intensity on environmental conditions | 2 |
| 9. | Physical and chemical properties of pigments | 4 |
| 10. | Distribution of pigments by paper chromatography | 2 |
| 11. | Determination of chlorophyll concentration by photocolorimetric method | 2 |
| 12. | Determination of photosynthesis intensity by gasometric method | 2 |
| 13. | Detection of enzymes of oxidative electron transport chains | 2 |
| 14. | Determination of the intensity of plant respiration | 2 |
| 15. | Microchemical analysis of ash | 2 |
| | **Total:** | **30** |

## 4. Topics for individual work

| № | Topic title | Number of hours |
|---|---|---|
| 1. | History of phytophysiology development in Ukraine | 5 |
| 2. | Plant cell membrane as a factor of compartmentalization | 5 |
| 3. | Features of physiological processes in a plant cell | 5 |
| 4. | Biochemical composition of a plant cell | 5 |
| 5. | Determination of indicators of water metabolism of plants | 5 |
| 6. | Biological and ecological features of plants with different pathways of photosynthesis | 5 |
| 7. | Physiological features of photosynthesis | 5 |
| 8. | Calculation of photosynthetic parameters | 5 |
| 9. | Determination of the intensity of plant respiration | 5 |
| 10. | Determination of the respiratory coefficient of plants | 5 |
| 11. | Physiological features of plant mineral nutrition | 5 |
| 12. | Calculation of nutriens | 5 |
| 13. | Physiological features of plant growth and development | 5 |
| 14. | Physiological features of plant morphogenesis regulation | 5 |
| 15. | Фізіологічні закономірності розвитку стійкості рослин | 5 |
| | **Total**: | **75** |

## 5. Means of diagnosing learning outcomes:

- exam;
- module tests;
- abstracts;
- defense of practical works;
- presentations and oral reports.

## 6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.)
- practical method (laboratory, practical classes);
- visual method (method of illustrations, method of demonstrations);
- work with educational and methodological literature (note-taking, abstracting, annotating, reviewing, writing an abstract, preparing a presentation and report);
- video method (remote, multimedia, web-based, etc.);
- independent work (completion of tasks).

## 7. Methods of evaluation:

- examination;
- oral or written questioning;
- module testing;
- team projects;
- abstracts, essays;
- defense of practical work;
- presentations and speeches at scientific events.

## 8. Distribution of points,

that higher education applicants receive. The assessment of the knowledge of higher education applicants is based on a 100-point scale and is converted into national grades in accordance with Table 1 of the current "Regulations on Exams and Tests in NULES of Ukraine"

| Student rating, points | National grade based on exam results | |
|---|---|---|
| | Exams | Credits |
| 90-100 | Excellent | Passed |
| 74-89 | Good | |
| 60-73 | Satisfactory | |
| 0-59 | Unsatisfactory | Not passed |

In order to determine the rating of a student (listener) in the discipline $\mathbf{R_{dis}}$ (up to 100 points), the rating from the exam $\mathbf{R_{ex}}$(up to 30 points) is added to the rating of a student's academic work $\mathbf{R_{aw}}$ (up to 70 points): $\mathbf{R_{dis} = R_{aw} + R_{ex}}$

## 9. Educational and methodological support:

- electronic training course of the discipline (on the educational portal of NULES of Ukraine eLearn - https://elearn.nubip.edu.ua/course/view.php?id=1118) ;
- lecture notes and presentations (in electronic form);
- textbooks, manuals, workshops;
- methodological materials for studying the discipline for full-time and part-time students.

## 10. Recommended sources of information

### Main literature


1. Plant physiology: a textbook / S.V. Prylutska, A.I. Babytskyi, N.H. Nesterova, T.A. Tkachenko, P.Y. Drozd - Kyiv: NUBiP of Ukraine, 2023. 224 p.
2. Musienko M.M. Plant Physiology: Textbook (for students of higher educational institutions) - K.: Lybid, 2005. - 808 p.
3. Musienko M.M. Plant Physiology: Textbook - K.: Phytosociocenter, 2001. - 392 p.
4. Makrushyn M.M., Makrushyna E.M., Peterson N.V. et al. Physiology of agricultural plants with the basics of biochemistry - K.: Urozhay, 1995. - 352 p.
5. Makrushyn M.M., Makrushyna E.M., Petersen N.V., Menshikov M.M. Plant Physiology - Vinnytsia: "New Book", 2006. - 416 p.
6. Polishchuk L.K. Plant Physiology: A textbook for students of natural sciences faculties of pedagogical institutes. - K.: Vysha Shkola, 1971. - 400 p.
7. Samoilenko T.G., Samoilenko M.O., Rozhok O.F. Workshop on plant physiology: Study guide. - Mykolaiv: MNAU, 2013. - 431 p.
8. Romaniuk N.D., Tsvilynyuk O.M., Mykievych I.M., Terek O.I. Plant Physiology: A textbook for students of biological faculties of higher educational institutions: Pyramid, 2005. 160 p.
9. Nikolaychuk V.I., Belchgazi V.Y. Physiology and biochemistry of plants: Study guide for students of biological specialties of higher educational institutions - Uzhhorod: UzhNU, 192 p.
10. Bryon O.V., Chykalenko V.G., Slavnyi P.S., Merezhynskyi Y.Y., Bilanovskyi M.F. Plant Physiology: Workshop. - K.: Higher School, 1995. - 191 p.
11. Kozhukalo V.E., Marchenko O.M., Suray O.O. Methodical instructions for laboratory and practical classes for students of agrobiological faculties. - K.: NAU Publishing Center, 2006. - 46 p.
12. Methodical recommendations for laboratory classes in the discipline "Plant Physiology" for students of agrarian universities of agronomic specialties. - K.: Phytosociocenter, 2000. - 64 p.
13. Kazakov E.O. Methodological bases of setting up an experiment in plant physiology. - Kyiv: Phytosociocenter, 2000. - 272 p.
14. Musienko M.M. Photosynthesis. - K.: Higher School, 1995. - 247 p.

## Supporting literature

1. Hrytsayenko Z.M., Hrytsayenko O.A., Karpenko V.P. Methods of biological and agrochemical research of plants and soils. - K.: CJSC "Nichlava", 2003. - 320 p.
2. Kostylov O.V., Romanenko O.V. Biology and ecology of autotrophic organisms. - K.: Phytosociocenter, 1999. - 192 p.
3. Musienko M.M., Parshikova T.V., Slavnyi P.S. Spectrophotometric methods in the practice of physiology, biochemistry and plant ecology. - Kyiv: Phytosociocenter, 2001. - 200 p.
4. Rudyshyn S.D. Fundamentals of plant biotechnology. Textbook for higher agricultural institutions. - Vinnytsia, 1998. - 234 p.

## Information resources

1. Plant Physiology https://goo-gl.su/W4tYoy
2. Photosynthesis https://goo-gl.su/ozqA4t8
3. Plant Physiology http://www.plantphysiol.org/
4. Photosynthesis https://www.youtube.com/watch?v=sQK3Yr4Sc_k
5. Mineral nutrition of plants https://www.youtube.com/playlist?list=PLKlDmF-iIyAljqtM4XB1ojpOC_iw1s3fN