

**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**SUMY NATIONAL AGRARIAN UNIVERSITY**

**Biotechnology and phytopharmacology department**

**"APPROVED"**

Head of the biotechnology and  
phytopharmacology department

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«\_04\_» \_\_\_\_\_ 05\_\_\_\_\_ 2019

**EDUCATIONAL - TRAINING PROGRAM**

**PLANTS IN EXPERIMENT**

**Postgraduate students 1 year of study**

**postgraduate and doctoral studies**

**Sumy - 2019-2020**

Educational training program "*Plants in experiment*"

The program was developed by A.A. Podhaetskii, doctor of Agricultural Sciences, professor \_\_\_\_\_

The program was approved at the meeting of the department of biotechnology and phytopharmacology

Minutes №33 from 04.05.2019

Head of the department \_\_\_\_\_ A.A. Podhaetskii

Approved

Head of the post graduate studies department \_\_\_\_\_

I.V.Lozyńska

Methodist of training department \_\_\_\_\_

H.O.Baboshyna

Registered in electronic database : « \_\_\_\_\_ » \_\_\_\_\_ 2019

## 1. Description of the training discipline

Name of indicates	Field of study, training direction, educational level	Characteristics of training discipline
		Full-time education
Quantity of credits -3,0	Field of study: <i>20 Agrarian science and sulppies</i>	Normative
Modules -3		Year of study
Content modules - 3		2019-2020
Individual scientific-research task: <i>Peculiarities of plant organisms in research.</i>		Year of study
		2
		Semester
Total amount of study hours -90	2	
	Lectures	
		22 hours
Weekly study hours for full-time education: classroom hours - 3 Individual work - 2	Post graduate study	Practical classes, seminars
		22 hours
		Individual students' work
		46 hours
		Type of checking
		exam

Note:

the ratio of the number of hours of class to independent and individual work is: 44/46 (49/51%).

## 2. Purpose and task of the training discipline

*Purpose:* to form in postgraduates students the right approaches in planning, organizing, conducting of researches, as well as the correct interpretation of the obtained data, which must, of course, be statistically processed with proofs of their authenticity and materiality of the difference between the options; to prove to young scientists that a plant is a complex biological object with numerous numerical connections, which have a clearly expressed bipolar structure and are characterized by the existence of physiological fields whose change will surely affect all parts of plants that are included in the field

*Task of the discipline:* mastering by postgraduates students the levels of organization and systematic performance of experiments; the correct determination of the place of the plant in the study, taking into account, if possible, all factors that may affect the results of the study; to learn how to choose the object of the experiment correctly, to interpret the results correctly.

*Subject of the discipline:* the relationship between the plant and the biotic and abiotic factors of the environment in which it is present, as well as the rate of response of the genotype to them.

Postgraduates student should:

*Know*

basic provisions of the systematic approach in the process of studying plant organisms; levels and types of scientific research with plants; the physiological nature of the processes that occur in plants under changing external conditions; types, mechanisms of statistical and dynamic resistance of plants to experimental conditions; factors affecting plant productivity and crop formation; basic principles of experiment organization; approaches to evaluate the source material in the study.

*Possess*

- determine the impact of individual factors on plant productivity; -
- use general rules for growing plants in the experiment;
- to conduct an experiment using water, hydroponic, aerial crops;
- to plan the experiment, organize it;

- use statistical analysis of the experiment.

Total amount of study hours, set aside the syllabus for the study of discipline, make 3,0 credits or 90 study hours, including 22 hours for lectures, 22 hours for practical classes and 46 hours for individual work. The program is divided into modules. Module control is carried out in the form of test control work and includes verification of individual tasks and work.

#### **General competences which should master the applicant**

<b>code</b>	<b>General competences</b>
3K 1	Ability to learn, master modern knowledge, self-improve and form a systematic scientific outlook
3K 2	Ability to critically analyze and evaluate modern scientific achievements, synthesis of holistic knowledge, complex problem solving
3K 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.
3K 5	Ability to generate new ideas and make informed decisions to achieve goals.
3K 8	Ability to take initiative, take responsibility, motivate people and move toward a common goal.
3K 11	Ability to prepare scholarly texts, present, discuss, debate and debate scientific results in their scientific work in national and foreign languages, to an extent sufficient for full understanding, demonstrating a culture of scientific verbal and written language.

#### **Expected results of training discipline**

<b>Code</b>	<b>Program results</b>
PRN 2	Have a thorough knowledge of the subject area and understanding of the profession, knowledge of the works of leading domestic and foreign scientists, fundamental work in the field of research, to formulate the purpose of their own scientific research as a component of the civilization process
PRN 4	Know the procedure for establishing information value and quality of literary and stock sources
PRN 6	Be able to critically analyze, evaluate and synthesize new scientific provisions and ideas
PRN 7	Initiate, organize and conduct comprehensive research in research and innovation
PRN 8	To formulate a scientific problem with regard to the values of modern society and the state of its scientific development, working hypotheses of the problem under study, which should extend and deepen the state of scientific research in the field of agronomy
PRN 10	To conduct professional interpretation of received materials on the basis of modern software using existing theoretical models, to create own object-theories
PRN 15	Be able to work with different sources, implement, 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 and others. Scientific literature on the current state and tendencies of development of world and national science on the development of modern ecological-adapted cultivation technologies. Ability to critically analyze various information sources, scientific literature, research of domestic and foreign authors on the development of modern ecologically-adapted cultivation technologies. Ability to keep abreast of the latest developments in agricultural production and agronomy and to find scientific sources relevant to the field of scientific interests of the applicant. Knowledge, understanding, skills and ability to use citation rules and references to sources used, rules for bibliographic design. Knowledge and understanding of the content and order of calculation of basic quantitative scientometric indicators of scientific activity efficiency (citation index, Hirsch index (h-index), impact factor). Ability to analyze information sources, identify contradictions and previously unsolved problems or parts of them, formulate working hypotheses

### The correlation of the results of the discipline with the program results

Компетентности	PRN 2	PRN 4	PRN 6	PRN 7	PRN 8	PRN 10	PRN 15
CK 1	*		*	*	*		*
CK 2		*	*	*		*	*
CK 3	*	*	*	*			
CK 4		*	*	*	*		
CK 8	*		*	*	*	*	
CK 9	*		*		*	*	*

CK 1. Ability to formulate a scientific problem, develop working hypotheses, determine relevance, purpose, tasks that need to be accomplished to achieve the goal, evaluate the resources needed and time to implement, which involves a deep rethinking of existing and creating new holistic knowledge and / or professional practice.

CK 2. Ability to integrate research into agro-industrial production and agronomy.

CK 3. Ability to have information on the current state and tendencies of development of world and domestic agro-technologies of cultivation of crops.

CK 4. Ability to formalize professional applied problems in the field of agro-industrial testing, to algorithmize them.

CK 8. Ability to process the obtained experimental data, to establish analytical and statistical relationships between them and the studied parameters based on the use of standard mathematical packages of information processing.

CK 9. Ability to develop a system of experimental research for practical confirmation of theoretical assumptions and to implement it in the agro-technological process.

Modules which divide the educational process.

**Content module 1.** *Main positions of the experiments in the direction of plants in experiment.*

**Topic 1. Main positions of system approach in learning plants organisms.** Features of plant organisms, compared with other living things. Basic requirements for research with plant organisms.

**Topic 2. Relationship between plants, soil, meteorological conditions, anthropological factors.** Influence on processes occurring in soil plants, meteorological conditions, phytopathogenic situation. Ingredients of plant productivity.

**Topic 3. Modern conceptual principles of experimental and statistical support of experiments with plants.** Levels of organization and systematicity in plant research. Feature of statistical support of experiments.

**Topic 4. Environmental Approach to Determining Major Factors of Impact on Plants.** Zoning of research. System of variety testing and entering of varieties in the Register of plant varieties of Ukraine.

**Content module 2.** *Adaptability of plants to the environment.*

**Topic 5. Types of adaptive response in plants.** Understanding the essence of adaptation. Levels of organization of processes in plants and adaptability of the latter to external conditions.

**Topic 6. Resistance of plants to stress factors.** Mechanisms of static resistance of plants. Mechanisms of dynamic plant stability.

**Topic 7. Premature and anticipatory reactions of plants.** Premature plant responses as a way to adapt to external conditions. Anticipatory reactions of plants to external conditions.

**Topic 8. Productivity and Harvest.** Plant biomass production during photosynthesis. Factors that affect plant productivity.

**Topic 9. Modeling in Plant Research.** Basic approaches in choosing a model object in plant research. Reproducibility in research on plants. Convenience of the model object.

**Content module 3.** *General rules for growing plants in the experiment.*

**Topic 10. The purpose of the experiment and the selection of methods for its implementation.** General rules for growing plants. The purpose of the experiment and the selection of methods for its implementation.

**Topic 11. Types of experiments and their features.** Laboratory experiments on organ parts and seedlings. Vegetation experiments. Water and hydroponic culture. Aeronics.

**Topic 12. Dosage of influence and dynamics of observations.** Determination of dose effect. Paradoxical effect. Dynamics of observations.

### 3. Structure of the training discipline

Name of content modules and topics	Full-time education			
	total	including		
		lectures	Practical classes	Individual work
1	2	3	4	5
<b>Module 1. Main positions of the experiments in the direction of plants in experiment.</b>				
<i>Content module 1. Main positions of the experiments in the direction of plants in experiment.</i>				
<b>Topic 1.</b> Main positions of system approach in learning plants organisms	8	2	2	4
<b>Topic 2.</b> Relationship between plants, soil, meteorological conditions, anthropological factors	10	2	4	4
<b>Topic 3.</b> Modern conceptual principles of experimental and statistical support of experiments with plants.	8	2	2	4
<b>Topic 4.</b> Environmental Approach to Determining Major Factors of Impact on Plants	8	2	2	4
<b>Total</b>	<i>34</i>	<i>8</i>	<i>10</i>	<i>16</i>
<b>Module 2. Adaptability of plants to the environment.</b>				
<i>Content module 2. Adaptability of plants to the environment.</i>				
<b>Topic 5.</b> Types of adaptive response in plants	8	2	2	4
<b>Topic 6.</b> Resistance of plants to stress factors	6	2	-	4
<b>Topic 7.</b> Premature and anticipatory reactions of plants	6	2	--	4
<b>Topic 8.</b> Productivity and Harvest	6	-	2	4
<b>Topic 9.</b> Modeling in Plant Research	8	2	2	4
<b>Total</b>	<i>34</i>	<i>8</i>	<i>6</i>	<i>20</i>
<b>Module 3. General rules for growing plants in the experiment.</b>				
<i>Content module 3. General rules for growing plants in the experiment.</i>				
<b>Topic 10.</b> The purpose of the experiment and the selection of methods for its implementation	8	2	2	4
<b>Topic 11.</b> Types of experiments and their features	8	2	2	4
<b>Topic 12.</b> Dosage of influence and dynamics of observations	6	2	2	2
<b>Total</b>	<i>22</i>	<i>6</i>	<i>6</i>	<i>10</i>
<b>Total hours</b>	<b>90</b>	<b>22</b>	<b>22</b>	<b>46</b>

#### 4. Topics and plans of lectures

№	Topics' name	Amount
1	2	3
1	<b>Topic 1. Basic provisions of the systematic approach for the study of plant organisms.</b> Features of plant organisms, compared with other living things. Basic requirements for research with plant organisms.	2
2.	<b>Topic 2. Relationship between plants, soil, meteorological conditions, anthropological factors.</b> Influence on processes occurring in soil plants, meteorological conditions, phytopathogenic situation. Ingredients of plant productivity.	2
3	<b>Topic 3. Modern conceptual principles of experimental and statistical support of experiments with plants.</b> Levels of organization and systematicity in plant research. Feature of statistical support of experiments.	2
4	<b>Topic 4. Environmental Approach to Determining Major Factors of Impact on Plants.</b> Zoning of research. System of variety testing and entering of varieties in the Register of plant varieties of Ukraine.	2
5	<b>Topic 5. TNPIadaptive reaction in plants.</b> Understanding the essence of adaptation. Levels of organization of processes in the plant and adaptability of the latter to external conditions.	2
6	<b>Topic 6. Resistance of plants to stress factors.</b> Mechanisms of static resistance of plants. Mechanisms of dynamic plant stability.	2
7.	<b>Topic 7. Premature and anticipatory reactions of plants.</b> Premature plant responses as a way to adapt to external conditions. Anticipatory reactions of plants to external conditions.	2
8.	<b>Topic 8. Modeling in Plant Research.</b> Basic approaches in choosing a model object in plant research. Reproducibility in studies of 3 plants. Convenience of the model object.	2
9	<b>Topic 9. The purpose of the experiment and the selection of methods for its implementation.</b> General rules for growing plants. The purpose of the experiment and the selection of methods for its implementation.	2
10.	<b>Topic 10. Types of experiments and their features.</b> Laboratory experiments on organ parts and seedlings. Vegetation experiments. Water and hydroponic culture. Aeronics.	2
11.	<b>Topic 11. Dosage of influence and dynamics of observations.</b> Determination of dose effect. Paradoxical effect. Dynamics of observations.	2
	<b>Total</b>	<b>22</b>

#### 5. Practical classes topics

№	Topics' name	Amount
1	<b>Topic 1. Features that distinguish plant objects from others.</b> Getting new organs from plants.	2
2	<b>Topic 2. Agrometeorological support of research with plants. The wind rose.</b> Finding the sum of effective and active temperatures. Draw a wind rose for one of the months	2
3	<b>Topic 3. Calculation of average values.</b> Calculate the average value of one or two dissertation indicators.	2
4	<b>Topic 4. Ecological distribution of varieties.</b> Develop ecological characteristics for each of the zones of Ukraine.	2
5	<b>Topic 5. Adaptability in plants.</b> Describe the patterns of adaptability in plants.	2

6	<b>Topic 6. The components of productivity of basic crops.</b> Ingredients of productivity of wheat, potatoes, tomatoes.	2
7	<b>Topic 7. Factors that affect performance.</b> Describe the dependence of the crop on external factors.	2
8	<b>Topic 8. To substantiate the model of plant objects.</b> Describe the requirements for model objects. Give examples of them.	2
9	<b>Topic 9. Conditions for conducting vegetative experiments.</b> Describe the conditions necessary for proper conduct of vegetation experiments.	2
10	<b>Topic 10. Feature of field experience with plants.</b> Develop a field experiment scheme for a specific topic.	2
11	<b>Topic 11. The peculiarity of observations depending on the village. cultures.</b> Compare phenological and other cultural observations.	2
	<b>Total</b>	<b>22</b>

#### 6. Individual work

№	Topics' name	Number
1	<b>Topic 1.</b> Basic provisions of the systematic approach for the study of plant organisms.	4
2	<b>Topic 2.</b> Relationship between plants, soil, meteorological conditions, anthropological factors.	4
3	<b>Topic 3.</b> Modern conceptual principles of experimental and statistical support of experiments with plants.	4
4	<b>Topic 4.</b> Environmental Approach to Determining Major Factors of Impact on Plants. Zoning of research.	4
5	<b>Topic 5.</b> Types of adaptive response in plants.	4
6	<b>Topic 6.</b> Resistance of plants to stress factors.	4
7	<b>Topic 7.</b> Premature and anticipatory reactions of plants.	2
8	<b>Theme 8.</b> Productivity and Harvest.	4
9	<b>Topic 9.</b> Modeling in Plant Research.	4
10.	<b>Topic 10.</b> The purpose of the experiment and the selection of methods for its implementation.	4
11.	<b>Topic 11.</b> Types of experiments and their features	2
12.	<b>Topic 12.</b> The peculiarity of observations depending on the village. cultures	2
	<b>Total</b>	<b>46</b>

#### 7. Individual tasks

##### 1. Preparation of reports:

1. Basic provisions of the systematic approach for the study of plant organisms.
2. Relationship between plants, pounds, meteorological conditions, cultivation technologies.
3. Modern conceptual principles of experimental and statistical support of breeding research.
4. Physiological fields of plants.
5. Levels of organization of processes in plants and adaptability of the latter to external conditions.
6. Types of adaptive response in plants.
7. Mechanisms of static resistance of plants.
8. Mechanisms of dynamic plant stability.
9. Premature plant reactions.
10. Advance reactions of plants.
11. Plant biomass production during photosynthesis.
12. Factors that affect plant productivity.
13. Transport of assimilates into acceptor organs.
14. Realization of productivity in the system of a plant organism.



15. Factors affecting crop formation.
16. Basic approaches in choosing a model object in plant research.
17. Reproducibility of objects in studies with plants.
18. The main provisions of the experiment with plants.
19. General rules of plant cultivation in experiments.
20. The purpose of the experiment and the selection of methods for its implementation.
21. Laboratory experiments on organ parts and seedlings.
22. Vegetation experiences their advantages and disadvantages.
23. Aquatic cultures in research with plants.
24. Hydroponic culture in research with plants.
25. Airport culture in research with plants.
26. Vegetative-field and micro-field experiments.
27. Field experiment with plants.
28. The nature of variability in a field breeding experiment.
29. The value of the initial hypothesis in the choice of parameters for the study.
30. Choice of dose of factor influence and dynamics of observations.
31. Integrated plant status indicators in the experiment.
32. Processing of the results of the experiment.
33. The importance of instrumentation in conducting experiments with plants.
34. Difference of signs by metric and statistical features.
35. One-dimensional statistical analysis of the results of the breeding experiment.
36. Methodical features of genetic value assessment of starting material.
37. Assessment of breeding value of starting material by association of traits.
38. Assessment of the genetic value of the starting material for posterity.

#### *2. Preparation of presentations:*

1. Levels of research with plants.
2. Types of scientific research with plants.
3. Differences in physiological processes at the level of cells and the body as a whole.
4. An ecological approach in determining the major factors influencing plant growth and development.
5. The rate of flow of physiological processes at different levels of plant organization.

### **8. Methods of learning**

#### **1. Methods of learning by the source of knowledge**

- 1.1. **Verbal:** discourse, explanation, conversation (heuristic and reproductive), lecture, coaching, etc.
- 1.2. **Visual:** demonstration, illustration, observation.
- 1.3. **Practical:** laboratory method, practical work, exercise.

#### **2. Active methods of learning:**

Use of technical means, excursions, meteorological training, group research, use of training and control tests, use of supporting notes.

**In case when groups are not of great number of students the following methods of learning are used:**

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

### **9. Methods of control**

1. Rating control over a 100-point ECTS rating scale
2. Intermediate control during the semester (module tests)
3. Multicriteria assessment of students' current work:
  - the level of knowledge demonstrated in practical, laboratory classes
  - activity during the discussion of the issues raised in the class;

- results of laboratory work execution and protection;
- independent study of the topic as a whole or of individual issues;
- fulfillment of analytical and calculation tasks;
- writing abstracts, reports;
- test results

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

4. Direct consideration in the final assessment of the student's fulfillment of a specific individual task:

- Scientific research work.

#### 11. Distribution of points received full-time students

Current testing			Together modules and individual work	Exam	Total
Content module 1	Content module 2	Content module 3	55+15=70		
15 points	20 points	20 points	70	30	100

#### Rating scale: national and ECTS

amount of points for all kinds of activities	Rate ECTS	Rate (national scale)
		for exam
90-100	A	excellent
82-89	B	good
75-81	C	
69-74	B	satisfactory
60-68	E	
35-59	PX	Unsatisfactory with the possibility to re-pass
1-34	P	Unsatisfactory with the obligatory re-studying the subject

#### 11. Recommended literature

1. Verhunova I.M. Fundamentals of mathematical modeling for the analysis and prediction of agronomic processes / I.V.Verhunova. – K. –Nora-print. – 2000. -145 p.
2. Stenzenko I.V. System modeling / I.V.Stenzenko. – Cherkass. – 2010. – 482 p.
3. Didora V.G. Methods of scientific research in agronomy / V.G.Didora, O.F.Smahlil, E.R. Ermantraut, oth. – K.: Tsentr uchbovoi literatury. – 2013. – 206 p.
4. Burtniak I.V. Simulation modeling / I.V.Burtniak. – Ivano-Frankivsk. – 2011. – 126 p.
5. Tomashevskii V.M. System modeling / V.M.Tomashevskii. – K.: Vydavnycha grupa VNU. – 2005. – 367 p.
6. Hryshchuck Yu.S. Basics of the scientific research / Yu.S. Hryshchuck. – Kharkiv NTU: KhPI. – 2008. – 232 p.
7. Chumak V.L. Basics of the scientific research / V.L.Chumak, S.V.Ivanov, M.R.Maksimiuik. – K.: “NAU-druk”. – 2009. – 355 p.
8. Khamkhanov K.M. Basics of experiment planning / K.M. Khamkhanov . – Ulan-Ude. – 2001. – 53 p.