

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

**DEPARTMENT OF AGRICULTURAL CHEMISTRY AND  
QUALITY OF CROP PRODUCTS**

**“APPROVED”**

Dean of the faculty of plant protection,  
biotechnologies and ecology

Ph.D. \_\_\_\_\_ Yu. Kolomiets  
“ \_\_\_\_ ” \_\_\_\_\_ 2022

**REVIEWED AND APPROVED**

at the meeting of the department of Agricultural  
Chemistry and Quality of Crop Products  
Protocol #9, 16 of May 2022  
Head of the Department  
Ph.D. \_\_\_\_\_ A. Bykin

**CONSIDERED**

Guarantor EP \_\_\_\_\_ O.L. Kliachenko

**SYLLABUS**

**Academic Discipline “AGRICULTURAL CHEMISTRY”  
for QL “Bachelor” (101)**

**Specialty- Ecology**

**Faculty** of plant protection, biotechnologies and ecology

**Syllabus compiled by:** Associate Professor Nadia Bordyuzha,  
PhD in Agronomy

**DESCRIPTION OF CORSE****AGRICULTURAL CHEMISTRY**

<b>Field of knowledge, direction, specialty, education and qualification level</b>		
<b>Education level</b>	bachelor	
<b>Specialty</b>	101 Ecology	
<b>Training direction</b>	101 Ecology	
<b>Characteristics of training programme</b>		
Type	Normative	
The total number of academic hours	90	
Number of ECTS credits allocated	3	
Number of modules	3	
Forms of cotrol	Examination	
<b>Indicators of academic discipline for full-time and part-time forms of training course</b>		
	<b>Full-time</b>	<b>Part-time</b>
Year (course)	III	
Semester	6	
Number of lectures	15	
Laboratory sessions (activities)	15	
Independent study	30	
Number of hours a week		
Full-time leaning:		
auditorium	4	
own training –	2	

## **2. Goal and objectives of academic discipline**

### **THE OBJECT AND ASSIGNMENTS OF THE COURSE**

**Goal of the course is** to form a system of special knowledge and skills in the field of agrochemical analysis and reproduction of soil fertility, taking into account the agro-ecological properties of fertilizers, the development of practical skills using their environment.

The subject of the discipline "Agrochemistry" is the agrochemical mechanism of soil and plant under the influence of anthropogenic factors - fertilizers, formation and use of their potential to optimize both agrochemical and environmental criteria of integrated indicators of human agricultural activity - soil fertility and crop productivity.

The main tasks of the discipline "Agrochemistry" are to get acquainted with the basics of theory and practice of fertilizer use and their impact on the environment; practicing skills to solve practical problems related to the justification of rational use of fertilizers taking into account their agri-environmental properties, development and implementation of crop fertilization systems, as well as finding effective measures to reduce anthropogenic pressure on soil and plants while obtaining economic benefits of fertilizers.

#### **As a result of studying the discipline the student must:**

##### **know:**

1. basic ecological functions of agrochemistry;
2. main ways to regulate plant nutrition;
3. agrochemical and ecological properties of soil;
4. agroecological properties of fertilizers and their effect on soil and plant;
5. the effect of fertilizers on the functioning of ecosystems;
6. fertilizer application system and agrochemical service.

##### **be able:**

1. to determine ecologically safe norms of fertilizers and ways of their application;
2. recognize fertilizers and provide optimal conditions for their storage and transportation;
3. develop a plant nutrition system, taking into account the environmental characteristics of fertilizers;
4. to prevent pollution of the biosphere during the use of fertilizers;
5. determine the economic and energy efficiency of their application.

##### **Practical skills:**

##### **General skills:**

- Knowledge and understanding of the subject area and understanding professional activity;
- Ability to apply knowledge in practical situations;
- Skills to carry out safe activities;
- Ability to search, process and analyze information from various sources;
- Ability to work in a team;
- The desire to preserve the environment

##### **Special skills:**

- Basic knowledge of the main divisions of agrochemistry
- Ability to use fertilizers scientifically, taking into account their chemical and physical properties, interaction with soils and crops specify, and environmental impact.

### 3. The structure of the curriculum of academic discipline for full-time form of training

№	Themes and modules to be covered	Hour			
		Full-time			
		total	lecture	laboratory work	independent study
<b>Module I. Agrochemical properties of soil and chemical composition of plants</b>					
1	Agroecological functions of agrochemistry and chemical composition of plants		1	1	3
2	Agroecological properties of soil		2	2	3
3	Soil chemical melioration (liming and gypsum application)		2	2	3
	<b>Total for module</b>		<b>5</b>	<b>7</b>	<b>9</b>
<b>Module 2. Assortment of fertilizers and their agroecological properties</b>					
5	Fertilizers, their properties and classification		1		2
6	Nitrogen and nitrogen fertilizers		2	2	3
7	Phosphorus and Phosphate fertilizers		1	2	3
8	Potassium and potash fertilizers		1		3
9	Multinutrient fertilizers		2	2	3
10	Micronutrient fertilizers		2	2	1
11	Organic fertilizers		1		5
12	Bacterial fertilizers		1		5
	<b>Total for module</b>		<b>10</b>	<b>8</b>	<b>21</b>
	<b>TOTAL, hour</b>		<b>15</b>	<b>15</b>	<b>30</b>

### 4. Themes of laboratory activities

#	Name of theme	Number of hours
1	Plant analysis. The principles of plants sampling and handling. Determination of necessity of fertilizers application using analysis data. Diagnosis of plant nutrition and fertilizers requirements.	2
2	The soil analysis. The principles of soil sampling and handling. The determination of nitrates in soil	2
3	Qualitative analysis of the nitrogen fertilizers. Methods of nitrogen determination in fertilizers. Qualitative analysis of nitrogen fertilizers	2
4	Qualitative analysis of phosphorus fertilizers. Derermination of phosphorus in soil by Kirsaniv method. Qualitative analysis of phosphate fertilizers	2
5	Qualitative analysis of potassium fertilizers. Methods of potassium determination in soil. Qualitative analysis of potassium fertilizers	4
6	Qualitative analysis of compound and microfertilizers.	4
	<b>Totally</b>	<b>15</b>

## 5. Test questions for final assessment

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
"Bachelor"  101 - " Ecology "	Department of Agricultural Chemistry and Quality of Crop Products	<b>VARIANT № 1</b>  "Agricultural chemistry"	<b>"Approved"</b> Head of the department  _____ Bykin A.V.
<b>Examination questions</b>			
1. Available (soluble and soluble in weak organic acids) forms of phosphorus in the soil, its transformation			
2. agroecological aspects of amide nitrogen fertilizers			

### Tests of various types

<b>1. Which fertilizers are contained the next elements</b>			
1	N, P	A	Potassium nitrate
2	N, K	B	Diammonium phosphate
3	N	C	Nitroammophoska
4	Cu, Zn	D	Urea
5	N, P, K	E	Microfertilizers

<b>2. The role of liquid phase in plant nutrition is</b>	
1	Direct source of organic compounds for plants
2	Contains main supply of the plant nutrients
3	Direct source of nutrients for plants
4	Direct source gas for plants

<b>3. Forms of soil potassium directly available to plants are:</b>	
1	mineral (structural)
2	non-exchangeable (fixed or difficultly available)
3	exchangeable
4	potassium in soil solution
5	potassium of microbes bodies, plant residues

<b>4. Cultures are VERY SENSITIVE TO ACIDITY that show high respond to liming even on weak acid soils:</b>	
1	Lupine, tea bush, serradella
2	Wheat, corn, barely, sunflower
3	Oats, ray, buckwheat
4	Alfalfa, clover, sugar beet

<b>5. Process of nitrogen transformation that is able only in aerobic conditions at temperature 26-28 C:</b>	
1	

<b>6. Soil ability to form insoluble and not readily soluble compounds by interaction between soil ions termed</b>	
1	Chemical absorbing capacity
2	Biological absorbing capacity
3	Mechanical absorbing capacity
4	Physical absorbing capacity
5	Physical-chemical absorbing capacity

<b>7. In which form plants can up take phosphorus from the soil:</b>	
1	P
2	P <sub>2</sub> O <sub>5</sub>
3	PO <sub>4</sub>
4	H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> , HPO <sub>4</sub> <sup>2-</sup>

<b>8. Time of the most effective action of hard liming material after its application</b>	
1	1-st year
2	2-4-th years
3	5-6-th years
4	The second period of a crop rotation

<b>9. Calculate the amount of ammonium nitrate (physical mass) to provide 70 kg/ha N</b>	
1	

<b>10. Complex multinutrient fertilizers are:</b>	
1	Monoammonium Phosphate (MAP)
2	Ordinary superphosphate (OSP)
3	Potassium Chloride
4	Diammonium Phosphate (DAP)
5	Ammonium Nitrate
6	UAN – urea ammonia nitrate

## 7. Teaching methods

Verbal, visual, practical

## 8. Forms of control

Modules, exam

## 9. Evaluation and grading

According to “Regulations about Module-Rating System of students’ teaching and estimation of their knowledge” (NULES of Ukraine, 27.12.2019, #1371), student’s knowledge are estimated in points (maximum 100) according to following table:

Student rating, balls	The definition ECTS mark	
	exam	Final test
<b>90-100</b>	<b>Perfectly</b>	<b>Credited</b>
<b>74-89</b>	<b>Well done</b>	
<b>60-73</b>	<b>Satisfactory</b>	
<b>0-59</b>	<b>Bed</b>	<b>not credited</b>

To determine the rating of the student (listener) for mastering the discipline  $R_{DIS}$  (up to 100 points) the obtained rating for certification (up to 30 points) is added to the rating of the student (listener) for academic work  $R_{NR}$  (up to 70 points):  $R_{DIS} = R_{HP} + R_{AT}$ .

## 11. Required and recommended literature

### Methodical support

1. Електронний навчальний курс <https://elearn.nubip.edu.ua/enrol/index.php?id=4362>
2. Агрохімія: Програма навчальної дисципліни для підготовки фахівців ОКР «бакалавр» напрямку 06.090105 «Захист рослин» у вищих навчальних закладах II-IV рівнів акредитації Мінагрополітики та продовольства України / Городній М.М., Каленський В.П., Логінова І.В., Яценко Л.А. та ін. – К.: Аграрна освіта, 2014. – 23 с.
3. Bordyuzha N., Yaschenko L. **AGROCHEMICAL CHEMISTRY**. Manual for the laboratory classes in “Agrochemical chemistry” for students of QL “Bachelor” in studying in English for faculty of plant protection, biotechnology and ecology– 202 – “Plant protection and plant quarantine”. 2018. 78 p.

1. Яценко Л.А. Агрохімія: методичні вказівки до вивчення розділу «Система застосування добрив» для студентів ОКР «Бакалавр» напряму «Захист рослин». – К., 2012. – 46 с.

2. Яценко Л.А. Агрохімія: методичні рекомендації до вивчення дисципліни для студентів заочної форми навчання ОКР «Бакалавр» за напрямом 6.090105 – «Захист рослин» / Яценко Л.А. – К.: Вид-во НУБіП України, 2013. – 46 с.

#### **Basic literature**

1. Bordyuzha N., Yaschenko L. **AGROCHEMICAL CHEMISTRY**. Manual for the laboratory classes in “Agrochemical chemistry” for students of QL “Bachelor” in studying in English for faculty of plant protection, biotechnology and ecology– 202 – “Plant protection and plant quarantine”. 2018. 78 p.
2. Agricultural Chemistry: Manual / М.М. Gorodniy, I.V. Prystash, P.M. Kyveryga. – К., 2011. – 234 p.
3. Агроекологічні властивості добрив: підручник / Марчук І.У., Яценко Л.А. - К.: Копмринт, 2016 - 268 с.
4. Агрохімія: Підручник / М.М. Городній. – К.: Арістей, 2008. –933 с.
5. Агрохімія: Підручник / М.М. Городній, А. В. Бикін, Л.М. Нагаєвська. – К.: Алефа, 2003. – 786 с.
6. Агрохімічний аналіз: Підручник / М.М. Городній, А.В. Бикін та ін. / За ред. М.М. Городнього. – К.: Арістей, 2007. – 624
7. Лісовал А.П. Система застосування добрив / Лісовал А.П., Макаренко В.М., Кравченко С.М. . – К.: Вища шк., 2002. – 318 с.
8. Марчук І.У. Добрива та їх використання / Марчук І.У., Макаренко В.М., Розстальний В.Є.. – К.: Арістей, 2014. –263 с.
9. Яценко Л.А. Агрохімія: методичні вказівки до вивчення розділу «Система застосування добрив» для студентів ОКР «Бакалавр» напряму «Захист рослин». – К., 2012. – 46 с.

#### **Supplemental materials**

1. Вирощування екологічно чистої продукції рослинництва / За ред. Є.Г. Дегодюка – К.: Урожай, 1992. –317 с.
2. Методичні вказівки з охорони ґрунтів / Греков В.О., Дацько Л.В., Жилкін В.А., Майстренко М.І. та ін. – К., 2011. - 114 с.
3. Прикладна біохімія та управління якістю продукції рослинництва: Підручник / М.М. Городній, С.Д. Мельничук, О.М. Гончар та ін. / За ред. М.М. Городнього. – К.: Арістей, 2006. – 484 с.
4. Минеев В.Г. Агрохимия: Учебник / Минеев В.Г. – М.: Изд-во МГУ, Изд-во «КолосС», 2004. – 720 с.
5. Лісовал А.П. Методи агрохімічний досліджень: навч. посіб / А.П. Лісовал. – К.: Видавничий центр НАУ, 2001. – 247 с.
6. Церлінг В.В. Диагностика питания сельскохозяйственных культур: Справочник / В.В. Церлінг. – М.: Агропромиздат, 1990. – 235 с.

#### **IT resources**

1. Агрохімія: підручник / Господаренко Г.М. <http://pidruchniki.com/76145/agropromislovist/agrohimiya>
2. Добрива - каталог <http://pesticidov.net/pesticidu/dobrivovo/>
3. Екологічні дослідження застосування мінеральних добрив // Збірник матеріалів II-го Всеукраїнського з'їзду екологів з міжнародною участю [http://eco.com.ua/sites/eco.com.ua/files/lib1/konf/2vze/zb\\_m/0140\\_zb\\_m\\_2VZE.pdf](http://eco.com.ua/sites/eco.com.ua/files/lib1/konf/2vze/zb_m/0140_zb_m_2VZE.pdf)
4. Карта ґрунтів України [Електронний ресурс] - Режим доступу: <http://geomap.land.kiev.ua/agrochemical.html>

5. Перелік основних нормативних документів у галузі ґрунтознавства, агрохімії та охорони ґрунтів / Балюк С.А. - Харків, 2009. - 37с. [Електронний ресурс] - Режим доступу: <http://www.issar.com.ua/downloads/docs/standarty.pdf>
6. Україна та ФАО [Електронний ресурс] - Режим доступу: <http://www.fao.org/documents/card/ru/c/2de225eb-644f-4027-a854-b9e58ef1d18d/>



**PROGRAM OF DISCIPLINE**  
**SUBJECT-MATTER**  
**of lectures on AGRICULTURAL CHEMISTRY**

**Module 1. Agrochemical properties of soil and chemical composition of plants**

**Topic 1 Agroecological functions of agrochemistry and chemical composition of plants**  
**- 4 hours.**

**Introduction.** Prospects for chemicalization and the environment. The state of prospects for the production and application of environmentally friendly fertilizers for the manufacture and use of local fertilizers, crop rotation elements as a basis for alternative in order to obtain environmentally friendly products. The subject and methods of agrochemistry and its relationship with other agri-environmental disciplines. Historical review of the development of agrochemistry. Chemical composition of plants and its changes under the influence of fertilizers and man-made factors. Plant nutrition and methods of its regulation.

**Topic 2 Agroecological properties of soil - 4 hours.**

Agroecological properties of soil due to plant nutrition and fertilizer application. Chemical ameliorants and plant protection products. Mineral and organic part of the soil, components and role in plant nutrition. Physico-chemical, ecological and biological properties of soil and their influence on the nutrition of cultivated plants. Modern and methods of agroecological assessment of soils.

**Topic 3 Chemical reclamation of soils - 2 hours.**

The role and place of chemical reclamation of soils in improving their agroecological phytosanitary condition, increased productivity of crops and quality of crop products. The ratio of crops and soil microflora to the reaction of soil solution. Influence of components of chemical ameliorants on soil properties, reduction of toxic action of aluminum. iron. manganese and other factors that change the reaction of the soil solution. Range of limestone materials, their agroecological and agrochemical characteristics and features of use. Chemical reclamation of solonchaks as the main condition for increasing soil fertility with alkaline reaction.

**Module 2. Range of fertilizers and their agroecological properties**

**Topic 4 Mineral fertilizers, classification and properties - 2 hours.**

Classification of fertilizers. Organic and mineral fertilizers, their origin and methods of production. Classification of mineral fertilizers: by the content of the active substance, by the number of elements in the composition, by the shape of the element they contain. Terms and methods of fertilizer use. Feeding: basal, foliar. The concept of norm and dose of the active substance. Classification of fertilizers by agroecological indicators: the level of toxicity, the presence of harmful impurities.

**Topic 5 Nitrogen and nitrogen fertilizers - 4 hours.**

Nitrogen as the main nutrient. form content and transformation in soil. Nitrogen cycle and balance in nature. Modern views on the role of various forms of nitrogen in the ecological condition of soil and crop products. The concept of biological nitrogen. Estimation of nitrogen losses from soil and fertilizers and their impact on the environment. Agroecological and ecological characteristics of nitrogen fertilizers, features of their use in the conditions of reformed agriculture. Ways to improve the quality and efficiency of nitrogen fertilizers. The role of nitrogen nutrition diagnostics in improving the quality of agricultural products.

**Topic 6 Phosphorus and phosphorus fertilizers - 4 hours.**

Problems of phosphorus in agriculture and measures to solve them. The role of phosphorus in plant life. Compounds and forms of phosphorus in soils. Chemical binding of phosphorus to soils and its agrochemical evaluation. Phosphorus ores of their origin and ecotoxicological assessment. Modern technologies for obtaining ballast-free phosphorus fertilizers. Classification. agroecological characteristics of phosphorus fertilizers. Features of industrial waste use as phosphorus fertilizers and their ecological assessment.

### **Topic 7 Potassium and potassium fertilizers - 2 hours.**

Physiological role of potassium in plant life. Potassium content and forms. The content and forms of potassium in the soil. Potassium cycle and balance in nature. Potassium ores, their composition and agroecological characteristics. Classification of potash fertilizers. Concentrated potash fertilizers. types, composition, properties and features of application taking into account the content of environmentally hazardous impurities .. Simple potash fertilizers, their composition and agroecological characteristics. Features of application of simple potassium fertilizers. Chlorine-free and local potassium fertilizers. Types, characteristics and applications of fertilizers containing calcium, magnesium, sulfur, iron. The impact of these fertilizers on the quality of agricultural products.

### **Topic 8 Complex fertilizers - 2 hours.**

Agroecological and economic advantages of complex fertilizers over simple ones. The current state of production and application of complex fertilizers in the world. Complex fertilizers. obtaining, characteristics, ecological effect on soil and plant. Methods of manufacture. composition, properties and features of application of combined fertilizers. New types of complex-mixed fertilizers. Modern experience in the preparation of mixtures and their use in advanced agricultural firms and farms.

### **Topic 9 Microfertilizers - 2 hours.**

The value of trace elements for plants. The content of the most common elements in the soil of the plant and their impact on the basic processes of life. Toxic effect of excessive content of these trace elements on the growth and development of plants and microflora. Microfertilizers as a basis for improving the quality of crop products. The main types of fertilizers containing boron, molybdenum, zinc, copper, manganese and other trace elements are their characteristics and the best ways to use them effectively. The place and role of microfertilizers in intensive technologies.

## **Module 3. Organic fertilizers**

### **Topic 10 Organic fertilizers - 2 hours.**

The value of manure and other organic fertilizers to increase the yield of agricultural crops and maintaining soil fertility. Manure as a source of nutrients and its role in replenishing organic matter. improving the physicochemical, agrochemical and biological properties of the soil. Ecotoxicological assessment of different types of manure. Types of manure, their chemical composition, methods of manure storage and the impact of secretions on the environment in different ways of its storage. Litter-free manure, composition, properties and applications. Features of cooking. storage and use of liquid and semi-liquid manure. Ecotoxicological action of litter-free manure. Peat and organic fertilizers based on it. Types and types of peat, their agro-ecological assessment and botanical composition. Nutrient content and basic properties of peat. The main ways of using peat taking into account its impact on the soil. The role of composts in replenishing stocks of organic fertilizers, utilization of organic residues, production waste and the production of valuable and environmentally friendly fertilizers. Types of composts, their chemical composition, manufacturing technology and features of use. Vermicomposts and their use for growing environmentally friendly plant products. Poultry manure, chemical composition and features of use. Agroecological and economic characteristics of green manure. role in replenishing stocks of organic matter and nutrients, technology of growing green manure crops. Features of using straw for fertilizer. Storage of solid and liquid, organic and mineral fertilizers in different areas of Ukraine

### **Topic 11 Bacterial fertilizers - 2 hours.**

The value of bacterial fertilizers. Classification of bacterial fertilizers, usage, application, agroecological effect.