NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Chair of Agricultural Chemistry and Quality of Crop Products

"APPROVED"
Dean of the agrobiological faculty
Prof. _____ O.L. Tonha
"___" _____ 2022

DISCUSSED AND APPROVED
on the meeting of the chair of agricultural chemistry and quality of crop products named after O.I. Dushechkin
Report # 9, 16 of May 2022
Head of the chair
_____ A. Bykin

CONSIDERED
Guarantor EP _____ O.L. Tonha

SYLLABUS
Academic Discipline "AGRICULTURAL CHEMISTRY" for QL "Bachelor"

Specialty- Agronomy
Faculty agrobiological
Syllabus compiled by: Associate Professor Nadia Bordyuzha, DPh in Agrochemistry

Kyiv – 2022

1. **Description of Corse**

AGRICULTURAL CHEMISTRY

Branch of knowledge and Specialty	
Education and qualification level	_____ bachelor _____ (бакалавр, спеціаліст, магістр)
Specialty	_____201 “Agronomy”_____ (шифр і назва)
Line of education	____201 “ Agronomy ”_____ (шифр і назва)
Description of course	
Type	Normative
Total hour	120+120
Quantity of credits, ECTS	4+4
Quantity of modules	3+3
Coursework (якщо є в робочому навчальному плані)	The system of fertilizers application in agricultural farms (назва)
Control:	Exam

Indicators of discipline for full-time and distance learning

	full-time	**distance learning**
Year	2,3	
Term	4,5	
Lecture	30+30	
Laboratory works	30+30	
Coursework	CW	
Own training	60+60	
Number of auditorium hours a week	4+4 4+4	

2. **Goal and tasks and skills of academic discipline**

The goal of the course is mastering for bachelor of the agronomy in theoretical knowledge and practical skills into basic of plant nutrition, their chemical composition and nutrients take up, soil properties in interaction with plant nutrition and fertilizers application, fertilizers classifications, fertilizers types and kinds, fertilizers production, fertilizers using and fertilizers influence on environment. And, this discipline helps formation practical skills in determination of the level of the crop nutrients supply, levels of the nutrients supply of the soils, identify of the fertilizers kinds and fertilizers forms, their interaction with soils, determination of the soil need in soil melioration.

Learning objectives is to develop the students' knowledge and skills in the use of fertilizers to maintain soil fertility and increasing the yield and quality of crops.

Learning outcome of course is the student's ability as a specialist:

to provide the best conditions for plant nutrition based on fertilizer properties and their interaction with the soil;

to determine the most effective forms, timing and methods of fertilizer application;

to develop the system of fertilizer application for different soil-climatic

Upon completion of this course, students should be able to

know:

- state and prospect of agricultural chemicalization in Ukraine and all over the world;
- chemical composition of plants, characteristics of their nutrition and ways of its regulation;
- soil properties connected with plant nutrition and fertilizers application;
- methods of soil chemical melioration;
- mane types of mineral, organic fertilizers, modes of their manufacture and characteristics of usage; optimum conditions for storage and application;
- system of fertilization and agricultural chemistry service;
- fertilizers influence on the atmosphere.

be able to:

- to determine the plant nutrients supply level and provide optimum conditions of plant growing;
- to determine the necessity of chemical melioration realization and calculate the rate of meliorants;
- to be able to identify fertilizers and provide optimum conditions for their storage and transportation;
- to calculate rate and define forms and methods of fertilizers application; estimate economic and energy effectiveness of fertilizers application;
- to prevent biosphere contamination while fertilization.

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

п/п	Topic of the discipline	Hour			
		Full-time leaning			
		total	lecture	laboratory work	own work
For 2 level 4 semester					
Module 1. Chemical composition of plants and plant nutrition					
1	Agricultural chemistry, its objectives and main tasks.	7	2		5
2	Chemical composition of plants	11	2	4	5
3	Plant nutrition	12	2		10
5	Total for module	30	6	4	20
Module 2. Soil properties					
5	Soil composition, soil property	19	3	4	12
6	Soil sorption capacity	13	2		11
	Total for module	32	5	4	23
Module 3. Soil nutritive regimes					
7	Organic regime in soil	9	4	2	3
8	Nitrogen regime in soil	11	4	4	3
9	Phosphorus regime in soil	9	2	4	3
10	Potassium regime in soil	9	2	4	3
11	Soil acidity. Specify of soil acidity and plants	10	3	4	3
12	Soil alkalinity	9	2	4	3
	Total for module	57	17	22	18
	TOTAL, hours	**120**	**30**	**30**	**60**

№ п/п	Topic of the discipline	Hour			
		Full-time leaning			
		total	lecture	laboratory work	own work
For 3 level 5 semester					
Module 1. Chemical melioration, Fertilizers, their properties and classification					
13	Soil chemical melioration	13	2	6	5
	Fertilizers, their properties and classification	7	2		5
14	Nitrogen fertilizers. Solid and fluid nitrogen fertilizers. Transformation of nitrogen fertilizers.	13	4	4	5
15	Phosphate fertilizers. Retrogradation. Recommendations for fertilizers application.	12	3	4	5
16	Potassium fertilizers. Recommendations for fertilizers application.	12	3	4	5
	Total for module	44	12	12	20
Module 2. Multinutrient fertilizers and special fertilizers, Organic fertilizers					
17	Multinutrient fertilizers. Technology of multinutrient fertilizers application	13	4	4	5
18	Micronutrient fertilizers. Modern classification of micronutrients. Chelated micronutrient fertilizers	13	4	4	5
19	Biofertilizers	8	1	2	5
20	Organic fertilizers: characteristic and types of fertilizers.	9	2	2	5

	Manure and composts.				
21	Organic fertilizers: Poultry manure, Green manure, Peat. Technology of organic fertilizers application.	9	2	2	5
	Total for module	26	5	6	15
Module 3. Fertilizers management					
22	Fertilization system. Nutrients balance.	10	2	-	8
23	Fertilizers and environment protection	8	1	-	7
	Total for module	18	3	-	15
	TOTAL, hour	**120**	**30**	**30**	**60**
	Coursework	46			
	TOTAL, hour	**240**	**60**	**60**	**120**

4. Themes of laboratory activities

№	Topic	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. Ashing of plant material and determination of nitrogen content using Nessler reagent	2
2	The determination of quality of plant production. Optical method of sugar determination in the sugar beet roots. Determination of gluten in wheat flour.	2
3	Soil analysis. The principles of soil sampling and handling. Establishment of regularity between soil nutrient content and fertilization. The determination of nitrate-nitrogen and mobile phosphorus and exchangeable potassium by Chyrikov method	6
4	The determination of neutralizing value of liming materials for calculation of the rate of lime materials application.	2
5	The determination of physical properties of mineral fertilizers	2
6	Qualitative analysis of nitrogen fertilizers. Methods of nitrogen determination in fertilizers. Quantitative analysis of nitrogen mass quota of nitrogen in ammonium salts (in ammonium form using formaldehyde)	6
7	Qualitative analysis of phosphorus fertilizers. Quantitative determination of total phosphorus in fertilizers using yellow phosphorus-vanadiummolybdenum complex	6
8	Qualitative analysis of potassium fertilizers. Methods of potassium determination in fertilizers. Quantitative determination of potassium in fertilizers using flame photometry	6
9	Qualitative analysis of compound and microfertilizers	4
10	Fertilizers determination test	2
11	Organic fertilizers: characteristic and types of fertilizers.	2
12	Fertilizers distribution in crop rotation and determination of the farm saturation with organic and mineral fertilizers.	10
13	Balance-sheet method of fertilizers rate determination.	8
14	Ecology-agrochemical estimation of soils	2

5. Test questions for final assessment

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL UKRAINE			
"Bachelor" 201 - " Agronomy"	Chair of Agricultural Chemistry and product quality by O.I. Dushechkin 20___/20___	**Variant** **№ 1** “Agricultural chemistry”	**“Approved”** Head of the chair _____ Bykin A.V. 20 p.

Examination questions

1. Available (soluble and soluble in weak organic acids) forms of phosphorus in the soil, its transformation

2. Amide nitrogen fertilizers (fertilizers name, formula, content of element, interaction with the soil, the effect on the soil and the plant, application)

Tests of various types

1. Which fertilizers are contained the next elements			
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

2. The role of liquid phase in plant nutrition is	
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

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

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

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

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

7. In which form plants can take up phosphorus from the soil:	
1	P
2	P_2O_5
3	PO_4
4	$H_2PO_4^-$, HPO_4^{2-}

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

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

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

7. Learning methods
Verbal, visual, practical

8. The forms of knowledge control
Modules, exam

9. Parameters for estimation of students' knowledge

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
90-100	Perfectly	Credited
74-89	Well done	
60-73	Satisfactory	
0-59	Bed	not credited

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): $R_{DIS} = R_{HP} + R_{AT}$.

10. Methodical support

1. Agrichultural chemistry https://elearn.nubip.edu.ua/course/view.php?id=2292
2. https://elearn.nubip.edu.ua/course/view.php?id=3884
3. Агрохімія: Програма навчальної дисципліни для підготовки фахівців ОКР «бакалавр» напряму 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., Ященко Л.А. та ін. К.: Аграрна освіта, 2014. 23 с.

11. Required and recommended literature

BASIC LITERATURE

1. L. Yaschenko. N. Bordyuzha. Agricultural chemistry. Manual for studying of subject "Agricultural chemistry" in lesson classes for students of QL "Bachelor" of the 201- Agronomy. 2019. 106 p.
2. L. Yaschenko. N. Bordyuzha. Agricultural chemistry. Manual for the writing of the course project in "Agricultural chemistry" for students of QL "Bachelor" in studying in English for agrobiological faculty.201- Agronomy. 2019. 46 p.
3. I. Loginova. L. Yaschenko. Agricultural chemistry. Manual of the laboratory classes in "Agricultural chemistry". Soil and fertilizers testing. 2017. 48 p.

4. Agricultural Chemistry: Manual / M.M. Gorodniy, I.V. Prystash, P.M. Kyveryga. – K, 2007. – 234 p.
5. Агрохімія: Підручник / М.М. Городній, А. В. Бикін, Л.М. Нагаєвська. – К.: ТОВ "Алефа", 2003. – 786 с.
6. Якість грунтів та сучасні стратегії удобрення: Підручник / Дж. Гофман, О. Ван Клімпут, М. Бьоме, С. Городній та ін.; Під ред. Дж. Гофмана та М.М. Городнього. – К.: Арістей, 2004. – 488 с.
7. Лісовал А.П., Макаренко В.М., Кравченко С.М. Система застосування добрив. – К.: Вища шк., 2002. – 318 с.
8. Агрохімічний аналіз: Підручник / М.М. Городій, А.П. Лісовал, А.В. Бикін та ін.; За ред. М.М. Городнього. – К.: Арістей, 2005. – 468 с.
9. Tisdale S.L., Nelson W.L., Beaton J.D. Soil Fertility and Fertilizers. – Mew York: Macmillan Publishing Company, 1985. – 754 p.
10. Brandy N.C. The nature and properties of soils / Nyle C. Brady, Ray R. Weil. – 13th ed. – Upper Saddle River, New Jersey "Prentice Hall". – 2002. – 960 p.

ADDITIONAL LITERATURE

1. Власюк П.А. Биологические элементы в жизни растений. – К.: Наукова думка, 1969. – 460 с.
2. Nutritional Disorders of Plants: Development, Visual and Analytical Diagnosis / Ed. by Werner Bergmann. – Jena; Stuttgart; New York: G. Fisher, 1992. – 741 p.
3. Miller R.W., Gardiner D.T. Soil in our environment. – New Jersey, 2001. – 750 p.
4. Soils in our environment / Raymon W. Miller, Duane T. Gardiner. – 9th ed., 1997.
Soils: an Introduction / Michael J. Singer, Donald N. Munns. – Upper Saddle River, New Jersey "Prentice Hall". – 1996. – 480 p.

INTERNET RECOURSES

http://www.fertilizer.com	US Fertilizer Corporation
http://www.fertilizer.org/ifa	International Fertilizer Industry Association
http://www.efma.org	European Fertilizer Manufacturers Association
http://www.ifdc.org	An International Center for Soil Fertility and Agricultural Development
http://fao.org	Food Agricultural Organization
http://www.tfi.org	The Fertilizer Institute

PROGRAM OF DISCIPLINE
SUBJECT-MATTER
of lectures on AGRICULTURAL CHEMISTRY

Module I.

LECTURE 1

Introduction. Scientific and technological progress and food problem solving in Ukraine and all over the world. Trends of food production increasing and improvement of competitive capacity of plant production.

World fertilizer production and consumption. Status and prospects for organic and mineral fertilizers application. The future demand for fertilizers.

The role of organic and mineral fertilizers in crop yield increasing, quality improvement, maintenance and increasing of soil fertility. Importance of fertilization with balanced macro- and micronutrients.

Necessity of joint application of fertilizers and pesticides.

Agricultural chemistry as a theoretical basis for agricultural service in Ukraine and in world.

The objective of agricultural chemistry and its place in the system of sciences. Assignments of agrochemistry. Methods of research in agricultural chemistry. Field, green-house and lysimetric methods of investigations. Procedure of research and its importance for determination of fertilization effectiveness. Composition of experiment's scheme. Laboratory methods of investigation.

History of the agricultural chemistry development and the most important periods of formation of views to plant nutrition. Contribution of foreign and Ukrainian scientists to the development of views to plant nutrition and fertilization of crops. Scientific school of agricultural chemistry in Ukraine.

Theory of plants productiveness. Main laws of agricultural chemistry and their role to increase fertilizer use efficiency. Plant growth and development factors.

LECTURE 2

Chemical composition of plants, plant nutrition and methods of it's regulation.

Chemical composition of plants and factors determine it. Plant production quality indices and fertilizers influence on biological quality of agricultural production. Hygienic quality of plant production.

Nutrients essential for normal growth and development of plants. Macro- and microelements, chemical forms available for plants. Role of nutrients in plant nutrition. Functional disorders caused by deficiency or excess of nutrients.

LECTURE 3

Plants nutrition, its types. Air and root nutrition, their interrelation. Modern concept of nutrients uptake and assimilation by plants. Source of nutrients and their compounds taken up by plants. Influence of environmental conditions on plant nutrition and fertilizers effectiveness.

LECTURE 4

Plants growth stages and nutrient uptake. Dynamics of nutrients utilization during the vegetation period of plants. Period of intensive nutrients uptake, deficient, insufficient, critical, toxic and excessive nutrient levels.

Pesticides influence on plant nutrition and physiological-biochemical processes in plants.

Diagnosis of plant nutrition and fertilizers requirements. Plant observation, plant tissue testing, plant analysis, soil testing, express-diagnosis and tools to diagnose the nutritional status of crops.

Module II

LECTURE 5

Agrochemical, agrophysical and biological properties of soil in connection with plant nutrition and fertilization. Soil composition. Soil phases and their interrelation. Properties of mineral and organic soil parts. Forms of compounds in the soil that contain main nutrients. Soil organic matter. Humus and its necessity for soil fertility and plant nutrition. Ways of humus losses prevention.

LECTURE 6

Soil absorbing capacity, its types (mechanical, physical, biological, chemical, physico-chemical) and role in soil-fertilizers interaction and plant nutrition. Soil adsorbing complex, its composition and structure in different soil types. Exchangeable and non-exchangeable adsorption of cations by soil. Cations absorbing capacity and absorbed cations composition in different soil types. Adsorption of anions by soil.

Agrochemical characteristics of main soil types and fertilization effectiveness. Supply of nutrient for plants on different soils.

Influence of systematic fertilization on soil properties and fertility.

Dependence of pesticides effectiveness and rates on soil properties.

Module III

LECTURE 7

Organic cycle. Organic sources for plant nutrition. Organic reserves in soil. Forms of soil Organic and their interaction with soil. Organic transformations in soil

LECTURE 8

Nitrogen cycle. Nitrogen sources for plant nutrition. Nitrogen reserves in soil. Importance of nitrogen biological fixation and leguminous plants for soil nitrogen enrichment. Forms of soil nitrogen and their interaction with soil. Nitrogen transformations in soil (aminization, ammonification, nitrification, denitrification, volatilization of ammonia). Nitrogen losses. Use of nitrification and urease inhibitors for nitrogen losses prevention.

Nitrogen mass balance in the agroecosystem.

LECTURE 9

Phosphorus in soil. Forms of phosphorus in soil and their importance for plant nutrition. Phosphorus transformation in acid and alkaline soils. Phosphate retrogradation. Phosphorus mass balance in agroecosystem.

LECTURE 10

Potassium in soil. Forms of potassium in soil and their importance for plant nutrition.

LECTURE 11

Soil chemical melioration (liming and gypsum application). Soil pH, percentage of base saturation, soil buffering capacity. Types of soil acidity (active, potential: exchangeable and hydrolytical). Soil classification depending on soil solution pH. Reaction of crops on soil acidity and effectiveness of liming.

Functional role of calcium and magnesium in plant nutrition.

Interaction of liming materials with soil. Influence of lime on neutralization of soil acidity and elimination of toxic influence of aluminum and manganese on plants growth. Influence on soil colloids coagulation and improvement of soil agrochemical and agrophysical properties. Influence of lime on soil organic matter decomposition, nutrients mobilization and macro- and microelements availability for plants.

LECTURE 12

Determination of lime requirement. Lime rate calculation for soils of different types, with different acidity and texture, humus content, for different crops in crop rotations. Lime activity duration. Determination of lime residual effects and necessity of repeated liming.

Liming materials: hard, soft calcareous rocks and carbonated industrial wastes. Neutralizing value or calcium carbonate equivalent of liming materials**.**

Terms of lime application and methods of placement. Lime application in crop rotations of different soil-climatic zones of Ukraine. Liming effectiveness. Importance of liming for soil pathogenous microflora depression and increasing of plants protection from diseases.

Importance of liming for neutralizing of physiologically acid fertilizers on acid soils.

Module III

LECTURE 13

Gypsum application on alkaline soils and solonetz. Determination of gypsum application requirement and rate of gypsum materials application calculation. Gypsum interaction with soil and improvement of soil physical-chemical and agrochemical properties. Gypsum application influence on plant nutrition (in particular sulfur nutrition). Terms of gypsum application and methods of placement in crop rotations of different zones of Ukraine. Gypsum application effectiveness. Gypsum materials used for application.

Development of estimative documentaries for soil chemical melioration.

LECTURE 14

Fertilizers, their properties and classification. Fertilizers classification by origin (organic, mineral and bio-fertilizers), by method of production (natural, industrial), by mode of action (direct and indirect; quick-acting, slow-acting), by physical state (solid, liquid and gaseous), by the number of nutrients (single-nutrient or straight fertilizers, and multinutrient fertilizers). Fertilizers types and forms. Active substance of fertilizers.

Physical properties of fertilizers that influence fertilization effectiveness (humidity, hygroscopicity, moisture capacity, freedom from caking, spreading property, texture).

Fertilizer dose and rate. Terms of fertilization [basal application, preplant fertilization, fertilizers application at sowing or planting, top-dressing (side-dressing and foliar dressing)]. Methods of fertilizers placement [overall application (broadcasting, sprinkler application, powdering) and localized fertilizers placement (row or band placement), fertigation]. Time of fertilizers application.

Physiological reaction of fertilizers.

Role of organic and mineral fertilizers in intensive root microflora development and prevention of pathogenic microflora evolution.

LECTURE 15

Nitrogen fertilizers. Functional role of nitrogen in plant growth and development. Plant nutrition with ammonium and nitrate nitrogen. Plants nitrogen deficiency symptoms. Danger of nitrogen fertilizers excessive application for increasing of plant infectious diseases development.

Nitrogen fertilizers manufacture. Forms of nitrogen fertilizers and main fertilizer nitrogen materials: ammoniacal (anhydrous ammonia, aqua ammonia); ammonium (ammonium sulphate, ammonium chloride); nitrate (sodium nitrate, calcium nitrate); ammonium–nitrate (ammonium nitrate, ammonium nitrate-sulfate); amide (urea). urea-ammonium nitrate (UAN solutions). Slow-acting nitrogen compounds. Nitrogen fertilizers interaction with soil. Nitrogen fertilizers application to different crops on different soils. Technology of nitrogen fertilizers application. Recommended fertilizer rates for different crops. Determination of the necessity of nitrogen fertilizers application in top-dressing. Coefficients for utilization of nitrogen from nitrogen fertilizers by crops. Means for increasing nitrogen fertilizers effectiveness.

Influence of nitrogen on crop yield and crop quality.

Role of nitrogen fertilizers in plant resistance to pests and diseases.

LECTURE 16

Phosphate fertilizers. Functional role of phosphorus for plants growth. Phosphorus sources for plants. Phosphorus uptake by plants. Phosphorus deficiency symptoms.

Rock phosphate ores used for phosphate fertilizers manufacture (phosphorite, apatite), world and Ukrainian deposits. Technology of phosphate fertilizers manufacture. Phosphate fertilizers classification by the number of substituted atoms of hydrogen in phosphoric acid and by solubility in different solvents. Groups of phosphate fertilizers: water-soluble (monosubstituted): ordinary superphosphate, triple or concentrated superphosphate; citrate-soluble (disubstituted): dicalcium phosphate or precipitate; citric acid soluble (disubstituted): basic slag or thomas slag, phosphate slag; not-readily soluble (trisubstituted): rock phosphate. Interaction of phosphate fertilizers with soil and fertilization effectiveness increasing on different soil types of Ukraine. Coefficients for utilization of phosphorus from fertilizers and phosphate fertilizers residual effect. Fertilization rates and technologies of phosphate fertilizers application to different crops.

Importance of phosphate fertilizers for improvement of plant nutrition, yield increasing, high quality of production obtaining and prevention of plant diseases.

LECTURE 17

Potassium fertilizers. Functional role of potassium for plant nutrition. Sources of potassium and its uptake by plants. Potassium plants deficiency symptoms. Role of potassium for drought-resistance, frost-resistance and plant protection from diseases.

Potassium ores deposits in Ukraine and in the world. Potassium fertilizers manufacture. Groups of potassium fertilizers depending on mode of production: row potassium salts; concentrated (potassium chloride or muriate of potash, potassium sulfate, sulfate of potash magnesia, potassium carbonate); composite (30% and 40% potassium salt, potassium electrolyte). Chlorinated and chlorine-free potassium fertilizers, their effectiveness for crops in different soil-climatic zones of Ukraine. Potassium fertilizers interaction with soil and ways of fertilization effectiveness increasing. Fertilization rates and technology of potassium fertilizers application to different crops. Coefficient for potassium utilization from fertilizers.

Influence of potassium fertilizers on crop yield increasing, quality improvement and plant diseases prevention.

Module IV

LECTURE 18

Micronutrient fertilizers. Functional role of zinc, copper, manganese, molybdenum, cobalt and boron in plant growth. Sources of micronutrients and their uptake by plants. Diagnostic of plant supply with micronutrients and deficiency symptoms. Role of micronutrients for decreasing of plant affection by pests and diseases.

Content of micronutrients in soil, their forms and interaction with soil. Influence of soil factors on micronutrients availability for plants.

Micronutrient fertilizers classification. Assortment of micronutrient fertilizers (zinc, copper, manganese, molybdenum, cobalt and boron fertilizers) and effective technology of their application. Micronutrient chelates. Effectiveness of joint application of micronutrient fertilizers and pesticides. Herbicide compatibility with fertilizers.

Micronutrient fertilizers efficiency to crops on different soil types of Ukraine and their influence on crop yield and quality.

LECTURE 19

Multinutrient fertilizers. The importance of balanced fertilization for normal plants growth and development and increasing of their resistance to stress situations.

Multinutrient fertilizers manufacture and classification: by the number of nutrients (double, triple); by the mode of production: complex (monoammonium phosphate, diammonium phosphate, ammonium polyphosphate, potassium nitrate), compound (nitrophos, nitrophoska, nitroammophos, nitroammophoska, ammoniated superphosphates), mixed or blended fertilizers. Liquid compound fertilizers and suspensions. Multinutrient fertilizers with micronutrients. Possibilities of mixing fertilizers. Technology of multinutritnt fertilizers application and their advantages comparing with strait fertilizers.

LECTURE 20

Bacterial fertilizers (bio-fertilizers) and growth activators. Importance of soil microorganisms. Microbial seed inoculants for leguminous plants (rhyzotrophin, nitragin) and factors that influence nitrogen fixation effectiveness. Bio-fertilizers based on free-living microorganisms (phyzophil, azotobacterin). Phosphate-mobilizing microorganisms (phosphobacterins). Technology of bio-fertilizers application.

Use of growth activators in plant production for plant growth guidance.

LECTURE 21

Organic fertilizers. Role of organic fertilizers for soil fertility inprovement, improvement of the conditions of plant growth and rising the effectiveness of mineral fertilizers. Advantages of

organic-mineral fertilization of crops. Importance of organic fertilizers for decreasing of plants infestation by pests and diseases.

Manure (farmyard or stable manure, slurry or litterless manure), its composition and characteristics of application.

Litter materials and importance of litter. Processes during storage of farmyard manure. Manure depending on the rate of decomposition: fresh manure, semi-rotted manure, rotted manure, fine manure. Manure storage: field dung-heap, dung-yard. Conditions of manure storage. Ways of losses decreasing during storage. Technology of manure application in different soil-climatic zones of Ukraine to different crops. Importance of manure in green-houses. Coefficients for utilization of main nutrients from manure.

Litterless manure, characteristics of its storage, transportation and application.

Importance of manure disinfection against patogenic microflora, pests and weed seeds.

Liquid manure, its chemical composition and technology of application. Decreasing of nitrogen losses from liquid manure.

LECTURE 22

Poultry manure, its composition, storage and coefficients for utilization of nutrients by crops. Application of poultry manure to different crops.

Sapropel, its composition and application to different crops.

Peat, types and kinds of peat, botanical composition and content of nutrients. Peat properties (ash percentage, moisture capacity, absorption capacity). Peat application in agriculture.

Composts, importance of organic sources composting. Importance of microbiological processes in nutrient transformation in available for plants forms. Composts based on peat and other agricultural and industrial wastes. Their importance for crop fertilization.

Vermicompost and liquid biohumus. Technology of production and application. Use of vermicompost derivatives for prevention elimination of plant diseases.

Green manure and its role for soil enrichment by organic matter, nitrogen and other nutrients. Crops used as green manure. Forms of green manure (fool, mowing, stubble). Technology of green manure growing and application. Role of crops grown as green manure in weed control.

Module VI

LECTURE 23

Fertilization system. Technologies of storage of liquid and solid mineral and organic fertilizers. Technologies of mineral and organic fertilizers application.

Idea of fertilization system in crop rotation and its importance. Facts that should be taken into consideration when fertilizers system is being developed (national economy significance of crop, crop characteristics, soil-climatic conditions, soil and plant management). Principles and order of farm fertilization system development. Chemical melioration in crop rotation. Organic fertilizers placement in crop rotation.

Optimization of crop nutrition with macro- and micronutrients. Characteristics of nutrition and fertilization of main crops (weed, rye, barely, corn, sugar beet, potato, flax, pea, lupine, alfalfa). Fertilization of vegetables and fruit. Fertilization under irrigation. Agrochemical and technical aspects of precision farming. Prospects of PC use in agrochemistry.

LECTURE 24

Nutrient content and nutrient ratios in plants. Biological and farm nutrients removal with crops. Idea of nutrients balance in agriculture. Balance of humus, nitrogen, phosphorus and potassium in agroecosystem. Types of balance (out farm, biological, farm). Items of losses and income.

Fertilizers application rates determination (average recommended rates, balance-sheet method).

LECTURE 25

Fertilizers and environmental pollution. Main causes of environmental pollution with fertilizers and harmful effect on biosphere. Influence of fertilizers on lithosphere. Ways of soil contamination decreasing with trace metals. Influence of fertilizers on hydrosphere and atmosphere. Human health and fertilization.

Agrochemical service. Place and assignments of agrochemical service in farmers servicing. Associations and establishments of agrochemical service in Ukraine. Agrochemical soil monitoring.

CORSE WORK

1/ Nitrogen, phosphorus and potassium mass balance

The information about the farm, soils, growing areas of different crops, rate of organic and mineral fertilizers applied to the crops in the farm and average crop yields is given to the students. The task is to calculate mass balances of nitrogen, phosphorus and potassium on the farm using above Information and Examples.

Data of nutrient mass balance are used to characterize nutrient status in the field and to make a decision of additional fertilizers application or changes in current fertilizers practice. In the situation when nutrient removal is not compensated by nutrient input, it leads to soil fertility decreasing and thus to yield losses.

For new intensive varieties of the main crops characteristic increased nutrients removal. Also misbalance in nutrient composition can be present. Thus nutrient mass balance helps to control nutrients circle in the farm and to prevent soil exhaustion.

According to the data of Zakharchenko (1977) on chernozems the most favorable balance intensiveness is 80% for nitrogen, 130-150% for phosphorus and 80-100% for potassium. On sod-podsolic soils balance intensiveness should be not less than 110-120% for nitrogen, 170-200% for phosphorus and 100-115% for potassium.

As a conclusion characterize nutrients mass balance and give recommendations how to improve the situation on the farm.

2/ Developing the system of fertilizers application in crop rotation

Steps for developing the system of fertilizers application:

1. soil chemical melioration;
2. manure and other local fertilizers application in the crop rotation;
3. mineral fertilizers application;
4. estimating of the total requirement in fertilizer for the crop rotation;
5. estimating amounts of fertilizers per unit of the area in the crop rotation;
6. agrochemical and agroecological evaluation of the system of fertilizers application.

3/ Balance-sheet method for calculating optimal fertilizers rates

To pass the corsework you need to collect information about characteristics of different crops nutrition and recommendations for fertilizers application.

ПЕРЕЛІК
стандартів, які використовують під час вивчення дисципліни «Агрохімія»

АНАЛІЗ ГРУНТУ	
ДСТУ 4287:2004	Якість ґрунту. Відбирання проб. — Вперше (зі скасуванням ГОСТ 28168-89)
ДСТУ 3980-2000	Ґрунти. Фізико-хімія ґрунтів. Терміни та визначення
ДСТУ ISO 11074-2:2004	Якість ґрунту. Словник термінів. Частина 2. Пробовідбирання (ISO 11074-2:1998, IDT)
ДСТУ 4288:2004	Якість ґрунту. Паспорт ґрунту
ДСТУ 4362:2004	Якість ґрунту. Показники родючості ґрунтів
ДСТУ 4768:2007	Якість ґрунту. Порядок проведення робіт з хімічної меліорації кислих ґрунтів
ДСТУ ISO 11464-2001	Якість ґрунту. Попереднє обробляння зразків для фізико-хімічного аналізу (ISO 11464:1994, IDT)
ДСТУ 4289:2004	Якість ґрунту. Методи визначання органічної речовини. — Вперше (зі скасуванням ГОСТ 26213-91)
ДСТУ ISO 10390-2001	Якість ґрунту. Визначання pH (ISO 10390:1994, IDT)
ДСТУ ISO 11048-2001	Якість ґрунту. Визначання водорозчинних та кислоторозчинних сульфатів (ISO 11048:1995, IDT)
ДСТУ 4114-2002	Ґрунти. Визначання рухомих сполук фосфору і калію за модифікованим методом Мачигіна. — Вперше (зі скасуванням в Україні ГОСТ 26205-91)
ДСТУ 4115-2002	Ґрунти. Визначання рухомих сполук фосфору і калію за модифікованим методом Чирикова. — Вперше (зі скасуванням в Україні ГОСТ 26204-91)
ДСТУ 4405:2005	Якість ґрунту. Визначання рухомих сполук фосфору і калію за методом Кірсанова в модифікації ННЦІГА — Вперше (зі скасуванням ГОСТ 26207-91)
ДСТУ 4770.2:2007	Якість ґрунту. Визначення вмісту рухомих сполук цинку в ґрунті в буферній амонійно-ацетатній витяжці з pH 4,8 методом атомно-абсорбційної спектрофотометрії
ДСТУ 4770.3:2007	Якість ґрунту. Визначення вмісту рухомих сполук кадмію в ґрунті в буферній амонійно-ацетатній витяжці з pH 4,8 методом атомно-абсорбційної спектрофотометрії
ДСТУ 4770.6:2007	Якість ґрунту. Визначення вмісту рухомих сполук міді в ґрунті в буферній амонійно-ацетатній витяжці з pH 4,8 методом атомно-абсорбційної спектрофотометрії
ДСТУ 4770.9:2007	Якість ґрунту. Визначення вмісту рухомих сполук свинцю в ґрунті в буферній амонійно-ацетатній витяжці з pH 4,8 методом атомно-абсорбційної спектрофотометрії
ДОБРИВА	
ДСТУ 4884:2007	Добрива органічні та органомінеральні. Терміни та визначення понять
ДСТУ EN 12944-1:2005	Добрива, вапнувальні матеріали та меліоранти ґрунту. Словник термінів. Частина 1. Загальні терміни (EN 12944-1:1999)
ДСТУ EN 12944-2:2005	Добрива, вапнувальні матеріали та меліоранти ґрунту. Словник термінів. Частина 2. Терміни стосовно добрив (EN 12944-2:1999)
ДСТУ EN 12946:2005	Вапнувальні матеріали. Визначення вмісту кальцію і магнію

	комплексометричним методом (EN 12946:2000, IDT)
ДСТУ ISO 5306-2003	Добрива. Вимоги до протоколів відбирання проб (ISO 5306:1983, IDT)
ДСТУ ISO 7742-2003	Добрива тверді. Скорочування проб (ISO 7742:1988, IDT)
ДСТУ ISO 5314-2003	Добрива. Визначення вмісту амонійного азоту. Титрометричний метод після дистилювання (ISO 5314:1981, IDT)
ДСТУ ISO 5315-2003	Добрива. Визначення загального вмісту азоту. Титрометричний метод після дистилювання (ISO 5315:1984, IDT)
ДСТУ ISO 5317-2003	Добрива. Визначення вмісту водорозчинного калію. Готування аналізованого розчину (ISO 5317:1983, IDT)
СОУ 01-37-498:2006	Азотні добрива. Технологія використання. Основні положення
СОУ 01-37-499:2006	Фосфорні добрива. Технологія використання. Основні положення
СОУ 01-37-500:2006	Калійні добрива. Технологія використання. Основні положення
СОУ 01-37-501:2006	Мікродобрива. Технологія використання. Основні положення
СОУ 01-37-502:2006	Комплексні добрива. Технологія використання. Основні положення
СОУ 01-37-503:2006	Органічні добрива. Технологія використання. Основні положення
ГОСТ 20851.3-93	Удобрения минеральные. Методы определения массовой доли калия
ГОСТ 30181.6-94	Удобрения минеральные. Метод определения массовой доли азота в солях аммония (в аммонийной форме формальдегидным методом)
ГОСТ 30181.3-94	Удобрения минеральные. Метод определения массовой доли азота в удобрениях, содержащих азот в нитратной форме
ГОСТ 27980-88	Удобрения органические. Методы определения органического вещества
ГОСТ 26714-85	Удобрения органические. Метод определения золы
ГОСТ 26715-85	Удобрения органические. Методы определения общего азота
ГОСТ 26718-85	Удобрения органические. Метод определения общего калия
ГОСТ 26717-85	Удобрения органические. Метод определения общего фосфора
ГОСТ 26716-85	Удобрения органические. Методы определения аммонийного азота
ГОСТ 30181.5-94	Удобрения минеральные. Метод определения массовой доли амидного азота в сложных удобрениях (спектрофотоколориметрический метод)
ГОСТ 30181.2-94	Удобрения минеральные. Метод определения суммарной массовой доли азота в однокомпонентных удобрениях (в аммонийной и амидных формах без отгонки аммиака)