NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Faculty of Plant Protection, Biotechnology and Ecology

Chair of Agricultural Chemistry and Quality of Crop Products

"APPROVED"
Dean of the faculty
Ph.D._____ M. Dolia
"___" _____ 2015

DISCUSSED AND APPROVED
on the meeting of the chair of agricultural chemistry and quality of crop products named after O.I. Dushechkin
Report # 11, 20 of May 2015
Head of the chair
_____ A. Bykin

SYLLABUS OF THE COURSE

"AGRICULTURAL CHEMISTRY"

Line of education 6. 090105 " Plant protection "
Specialty 6.090105 "Plant protection"
Faculty of plant protection, biotechnology and ecology
Lecturer Dr. L. Yashchenko

Kyiv – 2015

Syllabus based on the Model of the curriculum of discipline, which was approved in 2014 for bachelors direction 6.090105 "Plant protection" (specialty "Plant protection") in universities II-IV accreditation levels.

The program considered and approved by the Academic Council of the Faculty of plant protection, biotechnology and ecology
Report # , «__» _____ 2015.

“APPROVED”
Head of the Academic Council of the Faculty
Professor Dolia M.

THE OBJECT AND ASSIGNMENTS OF THE COURSE

The assignments of the course

The assignment of the course is to build up the theoretical knowledge and practical skills of fertilizers application in crop rotation, determination of nutrients cycle on farm taken into consideration the zones of crop production, plants features and their sorts characteristics. The knowledge of agricultural chemistry allow to provide the best conditions for plants nutrition taking into account fertilizers properties, their interaction with soil. Using knowledge of agrochemistry future specialist will be able to determine the most effective forms, terms and methods of fertilizers application.

Requirements to knowledge and skills gained during studying of the course

As a result of agricultural chemistry studying students have to get knowledge about:

- 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.

Students have to be able after mastering the course:

- 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.

DESCRIPTION OF CORSE
AGRICULTURAL CHEMISTRY

Branch of knowledge and Specialty	
Branch of knowledge	0901 «Agriculture and Forestry» (шифр і назва)
Line of education	6. 090105 “ plant protection ” (шифр і назва)
Specialty	6. 090105 “ plant protection ” (шифр і назва)
Education and qualification level	bachelor (бакалавр, спеціаліст, магістр)
Description of course	
Type	Normative
Total hour	108
Quantity of credits, ECTS	3
Quantity of modules	3
Coursework (якщо є в робочому навчальному плані)	- (назва)
Control:	Examination

Indicators of discipline for full-time and distance learning

	full-time	**distance learning**
Year	2015	2016
Term	5	6
Lecture	30	8
Laboratory works	30	4
Own training	48	96
Number of hours a week Full-time leaning: auditorium own training −	 2 3	

The structure of the course of "Agricultural chemistry"

Corse: **Time of education:** full-time department	**Line of education education and qualification level**	**The characterization of corse**
Quantity of credits, ECTS: ***3,0*** Module: **3** Total, hour: ***108*** Number of hours a week ***6***	Direction of training **6.090105 -** plant protection The specialty **6.090105 -** plant protection The education and qualification level **bachelor**	Year: ***3*** Term: ***5*** Lecture ***30 год.*** Laboratory works: ***30 год.*** Own training: ***48 год.*** Control: ***examination***

THE INDICATIVE STRUCTURE OF CORSE

№ п/п	**Topic ot the discipline**	**Lectures**	**Laboratory works**	**Own works**
Module 1. **Chemical composition of plants and Soil properties**				
1	Agricultural chemistry, its objectives and main tasks.	2	1	4
2	Chemical composition of plants, plant nutrition and methods of it's regulation	2	2	2
3	Agrochemical, agrophysical and biological properties of soil in connection with plant nutrition and fertilization	2	1	4
Module 2. Fertilizers, their properties and classification				
4	Soil chemical melioration (liming and gypsum application)	2	2	6
5	Fertilizers, their properties and classification	2	4	4
6	Nitrogen fertilizers	2	4	4
7	Phosphate fertilizers	2	4	4
8	Potassium fertilizers	2	4	4
9	Micronutrient fertilizers	2		4
10	Bacterial fertilizers (bio-fertilizers) and growth activators	2		4
11	Organic fertilizers	2	4	6
Module 3. Fertilizers management				
12	Fertilization system	4	2	4
13	Nutrients balance	2	2	4
14	Fertilizers and environment protection	2		4

THE STRUCTURE OF COURSE

№ п/п	Topic ot the discipline	Hour			
		Full-time leaning			
		total	lecture	laboratory work	own work
Module 1. Chemical composition of plants and Soil properties					
1	Agricultural chemistry, its objectives and main tasks.	5	1	2	2
2	Chemical composition of plants, plant nutrition and methods of it's regulation	6	2	2	2
3	Agrochemical, agrophysical and biological properties of soil in connection with plant nutrition and fertilization	6	1	4	2
	Total for module	17	4	8	6
Module 2. Fertilizers, their properties and classification					
4	Soil chemical melioration (liming and gypsum application)	10	2	2	4
5	Fertilizers, their properties and classification	10	2		4
6	Nitrogen fertilizers	10	4	4	4
7	Phosphate fertilizers	12	4	4	4
8	Potassium fertilizers	10	4	4	4
9	Micronutrient fertilizers	4	2	2	4
10	Bacterial fertilizers (bio-fertilizers) and growth activators	4			4
11	Organic fertilizers	10	2	2	4
	Total for module	18	20	19	32
Module 3. Fertilizers management					
12	Fertilization system	8	2	2	4
13	Nutrients balance	8	2	2	4
14	Fertilizers and environment protection	4	2		2
	Total for module	20	6	4	10
	TOTAL, hour	**108**	**30**	**30**	**48**

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. Plants nutrition, its types. Air and root nutrition, their interrelation. Modern concept of nutrients uptake and assimilation by plants.

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.

Source of nutrients and their compounds taken up by plants. Influence of environmental conditions on plant nutrition and fertilizers effectiveness. 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.

LECTURE 3

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.

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 II

LECTURE 4

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.

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.

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 5

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 6

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 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.

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 7

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

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.

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 8

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

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.

LECTURE 9

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 10

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 11

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.

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 12

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 III

LECTURE 13

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 14

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 15

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.

Lecturer L. Yashchenko

SUBJECT-MATTER
OF THE LABORATORY WORKS

№	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 mobile phosphorus and exchangeable potassium using Chyrikov method	4
4	The determination of neutralizing value of liming materials for calculation of the rate of lime materials application.	2
5	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)	2
6	Qualitative analysis of phosphorus fertilizers. Quantitative determination of total phosphorus in fertilizers using yellow phosphorusvanadiummolybdenum complex	4
7	Qualitative analysis of potassium fertilizers. Methods of potassium determination in fertilizers. Quantitative determination of potassium in fertilizers using flame photometry	2
8	Qualitative analysis of compound and microfertilizers	2
9	Fertilizers determination test	2
10	Fertilizers distribution in crop rotation and determination of the farm saturation with organic and mineral fertilizers.	4
11	Balance-sheet method of fertilizers rate determination.	2

Lecturer L. Yashchenko

STRUCTURALLY LOGICAL SCHEME OF THE DISCIPLINE „AGRICULTURAL CHEMISTRY”

Module	Topic ot the discipline	Topic of the lectures	Topic of laboratory works	Estimation of success
1	**Introduction to agricultural chemistry**	Agricultural chemistry, its objectives and main tasks.	Principles of soil sampling and handling	Defense of LW, test control
	Chemical composition of plants	Chemical composition of plants, plant nutrition and methods of it’s regulation	Ashing of plant material and determination of nitrogen content using Nessler reagent Optical method of sugar determination in the sugar beet roots Determination of gluten in wheat flour.	
	Soil properties	Agrochemical, agrophysical and biological properties of soil in connection with plant nutrition and fertilization	Determination of mobile phosphorus and exchangeable potassium using Chyrikov method.	
2	**Fertilizers, their properties and classification**	Soil chemical melioration (liming and gypsum application)	Determination of neutralizing value of liming materials and calculation of lime materials application rate	Defense of LW, test control
		Fertilizers, their properties and classification		Defense of LW, test control
		Nitrogen fertilizers	Qualitative analysis of nitrogen fertilizers. Quantitative analysis of nitrogen mass quota of nitrogen in ammonium salts (in ammonium form using formaldehyde)	Defense of LW, test control
		Phosphate fertilizers	Qualitative analysis of phosphorus fertilizers Quantitative determination of total	Defense of LW, test control

			phosphorus in fertilizers using yellow phosphorus-vanadium-molybdenum co	
		Potassium fertilizers	Qualitative analysis of potassium fertilizers	Defense of LW, test control
		Micronutrient fertilizers	Qualitative analysis of multinutrient fertilizers and microfertilizers	Defense of LW, test control
		Multinutrient fertilizers	Qualitative analysis of multinutrient fertilizers and microfertilizers	Defense of LW, test control
		Bacterial fertilizers (bio-fertilizers) and growth activators		Defense of LW, test control
		Organic fertilizers		Defense of LW, test control
3	**Fertilizers management**	Fertilization system	Fertilizers distribution in crop rotation and determination of the farm saturation with organic and mineral fertilizers	Project, test control
		Nutrients balance	Balance-sheet method of fertilizers rate determination	Project, test control
		Fertilizers and environment protection		Test control
Final control - examenation				

LEARNING METHODS

Verbal, visual, practical

THE FORMS OF KNOWLEDGE CONTROL

Modules, exam

PARAMETERS FOR ESTIMATION OF STUDENTS KNOWLEDGE

According to "Regulations about Module-Rating System of students' teaching and estimation of their knowledge" (NULES of Ukraine, 2015), student's knowledge are estimated in points (maximum 100) according to following table:

National mark	Estimation of ECTS	By definition of ECTS	Rating, points
Excellent	**A**	**Excellent** - perfect answer with insignificant mistakes	**90 – 100**
Good	**B**	**Very good** - above the average level with a few errors	**82 – 89**
	C	**Good** - correct answer in whole with a few gross errors	**74 – 81**
Satisfactory	**D**	**Satisfactory** - quite good answer, but with a great deal of errors	**64 – 73**
	E	**Sufficient** - answer satisfies a minimum requirements	**60 – 63**
Unsatisfactory	**FX**	**Unsatisfactory** - is necessary to study additionally for receiving of positive mark	**35 – 59**
	F	**Unsatisfactory** - is needed the repeated course of study	**0 – 34**

Basic rules for rating calculation:

1. Marks penal student got if he missed 50% of lectures and more than 3 LW without serious reason (max. 5 points).
2. Student cannot be allowed to do exam if he/she was passed more than 1 LW without followed performing it in additional time.
3. If student got less than 42 marks during the term he/she is not allowed to pass exam.
4. If student got more than 60 marks during the term he may not pass exam and get marc according to the marc table. It is necessary to pass exam for students who have more than 42 and less than 60 points.
5. If student get less than 60 points on exam these points are not added to the Study rating and student has mark corresponding his/her Study rating.

To control student's knowledge following tests are performed**:**

Module	Educational Activity	Grades
Module 1	Laboratory work 1. Determination of plants nutrient status using plant sap test (by V.V. Tserling)	3
	Laboratory work 2 Wet ashing of plant tissue (by Hynzburg). Determination of nitrogen content using Nessler reagent	5
	Laboratory work 3 Optical method of sugar determination in the sugar beet roots	10
	Laboratory work 4 Determination of gluten in wheat flour	7
	Laboratory work 5 Determination of mobile phosphorus and exchangeable potassium using Chyrikov method.	8
	Laboratory work 6 Determination of neutralizing value of liming materials and calculation of lime materials application rate	10
	Own training 1 Historical review of agricultural chemistry development	10
	Own training 2 Visual diagnosis of plant nutrition	7
	Own training 3 Agrochemical characteristics of main soil types of ukraine and fertilization effectiveness	10
	Module test 1	30
	Total for Module 1	**100**
Module 2	Laboratory work 7 Qualitative analysis of nitrogen fertilizers. *Nitrogen balance*	5
	Laboratory work 8 Quantitative analysis of nitrogen mass quota of nitrogen in ammonium salts (in ammonium form using formaldehyde)	3
	Laboratory work 9 Qualitative analysis of phosphorus fertilizers. *Phosphorous balance*	5
	Laboratory work 10 Qualitative analysis of potassium fertilizers. *Potassium balance*	5
	Laboratory work 11 Qualitative analysis of multinutrient fertilizers and microfertilizers	2
	EXPERIMENTAL CONTROL WORK Determination of mineral fertilizers	10
	Own training 4 Work-shop Characteristics of nutrition and fertilization of main crops (wheat, rye, barely, corn, sugar beet, potato, flax, pea, lupine, alfalfa). Fertilization of vegetables and fruit.	10
	Module test 2	60
	Total for Module 2	**100**
Module 3	Laboratory work 12 Fertilizers distribution in crop rotation and determination of the farm saturation with organic and mineral fertilizers	40
	Laboratory work 13 Balance-sheet method of fertilizers rate determination	35

	Own training 5 Organic fertilizers	10
	Module test 3	15
	Total for Module 2	**100**
Final test		100

1. Module tests:
- Module I: Lectures 1-2, LW 1-6 (10 questions, max. 30 points)
- Module II: Lecture 3-6, LW 7-11 (20 questions, max. 60 points)
- Module III: Lecture 7, LW 12-13 (5 questions, max. 15 points)

2. Presentation of information of crop fertilization (Work-Shop) (1 crop for each student, max. 7 points). Each student has to prepare information about fertilization of chosen crop and make a small presentation during laboratory work (5-12 weeks). This point is not for choosing.

4. Additional points: Abstract (max. 5 points, see list of topics below).

ESTIMATION OF STUDENTS KNOWLEDGE:

In-line test			Rating of education work, Rнр	Rating of additional work, Rдр	Penal rating, Rштр	Final test (examination)	Total estimation, point
Module I	Module II	Module III					
0-100	*0-100*	*0-100*	0-70	0-20	0-5	0-30	0-100

Lecturer L. Yashchenko

ABSTRACT

Student can prepare abstract and make a presentation of the topics that are not discussed in lectures. For this activity student can get 1-10 additional points.

Requirements: Times New Roman 14pt, 1.5 line-to-line spacing, page grounds: left - 3.0 cm, bottom and top – 2 cm, right 1.5 cm, 25-30 pages. **Chapters**: Introduction, Basic part, Conclusions, Literature cited (no less than 5). **Report**: 10 min (no more!)

TOPICS

1. Fertilizers in a changing world (*history of fertilizers application and present situation*).
2. Fertilizer production and consumption.
3. Fertilizers in the Ukrainian market
4. Green-house experiment with fertilizers
5. Lysimetric experiment in agricultural chemistry
6. Field experiment with fertilizers. Methodology of field trails
7. Modern devices for agrochemical analysis (elements of precision farming)
8. Tools to diagnose the nutritional status of crops
9. Precision agriculture
10. Site-specific management (variable-rate fertilization). Spatial variability mapping
11. Remote sensing. Important factors affecting yields
12. History of agricultural chemistry development. Justus von Liebig (1803-1873)
13. D.I. Pryanishnikov and his role in agricultural chemistry development.
14. Contribution of Ukrainian scientist to agricultural chemistry. Contribution of scientists of national agricultural university to agricultural chemistry.
15. Environmental factors that influence plant growth (*temperature, moisture supply, radiant energy, composition of atmosphere, gas content of the soil, soil reaction, biotic factors*)
16. Theories of plant nutrition. The nutrition uptake by the plants in the different growth stages
17. Importance of balanced fertilization
18. Influence of nutrients on produce quality. Produce quality and human and animal health
19. Importance of visual diagnosis and deficiency symptoms
20. Diagnosis by soil testing
21. Diagnosis by plant analyses
22. Agrochemical characteristics of soils of Ukraine (*soil type or zone for choice*)
23. Influence of liming on microbiological processes in soil and plant protection
24. Humus and its importance for soil fertility
25. Nitrogen fertilization and environmental issues
26. Site-specific and real-time n management
27. Importance of leguminous plants as a source of n
28. Phosphorus fertilization and environmental issues
29. Soil and fertilizer sulfur
30. Joint application of fertilizers and crop protection chemicals
31. Importance of organic fertilizers for soil fertility
32. Fertilizers storage
33. Safety measures when working with fertilizers
34. Fertilization system in Ukrainian Polissya
35. Fertilization system in Forest Steppe zone of Ukraine
36. Fertilization system in Steppe zone of Ukraine
37. Fertilization of orchards
38. Fertilization of meadows and pastures.
39. Fertilization and environment protection
40. Ways of nitrogen losses reduction
41. Fertilization and human health
42. Agrochemical service in Ukraine. Fertilization and plant protection

Practical work

1. Collection of fertilizers (*tagged: Name, Content + characteristic of application*).
2. Map of N, P_2O_5 or K_2O (with comments of usage by the example of farm).

Lecturer L. Yashchenko

Methodical support

1. 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.
2. Ященко Л.А. Агрохімія: методичні вказівки до вивчення розділу «Система застосування добрив» для студентів ОКР «Бакалавр» напряму «Захист рослин». – К., 2012. – 46 с.
3. Ященко Л.А. Агрохімія: методичні рекомендації до вивчення дисципліни для студентів заочної форми навчання ОКР «Бакалавр» за напрямом 6.090105 – «Захист рослин» / Ященко Л.А. – К.: Вид-во НУБіП України, 2013. – 46 с.

Basic literature

1. Agricultural Chemistry: Manual / M.M. Gorodniy, I.V. Prystash, P.M. Kyveryga. – K, 2007. – 234 p.
2. Агрохімія: Підручник / М.М. Городній, А. В. Бикін, Л.М. Нагаєвська. – К.: ТОВ “Алефа”, 2003. – 786 с.
3. 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.
4. Лісовал А.П., Макаренко В.М., Кравченко С.М. Система застосування добрив. – К.: Вища шк., 2002. – 318 с.
5. Агрохімічний аналіз: Підручник / М.М. Городій, А.П. Лісовал, А.В. Бикін та ін.; За ред. М.М. Городнього. – К.: Арістей, 2005. – 468 с.
6. Tisdale S.L., Nelson W.L., Beaton J.D. Soil Fertility and Fertilizers. – Mew York: Macmillan Publishing Company, 1985. – 754 p.
7. 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