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 from 16.05.2022
Head of the Department
Ph.D. _____ A. Bykin

CONSIDERED
Guarantor EP _____ M. Yo. Pikovskii

SYLLABUS
Academic Discipline "AGRICULTURAL CHEMISTRY" for QL "Bachelor" (202)

Specialty- Plant protection and Plant Quarantine
Faculty of plant protection, biotechnologies and ecology
Syllabus compiled by: Associate Professor Nadia Bordyuzha, PhD in Agrochemistry

Kyiv – 2022

1. **DESCRIPTION OF CORSE**

AGRICULTURAL CHEMISTRY

Field of knowledge, direction, specialty, education and qualification level		
Education and qualification level	bachelor	
Specialty	202 “Protection and Plant Quarantine	
Training direction	202 “Protection and Plant Quarantine	
Characteristics of training programme		
Type	Normative	
The total number of academic hours	120	
Number of ECTS credits allocated	4	
Number of modules	3	
Forms of cotrol	Exam	
Indicators of academic discipline for full-time and part-time forms of training course		
	Full-time	**Part-time**
Year (course)	III	
Semester	V	
Number of lectures	15	
Laboratory sessions (activities)	30	
Independent study	75	
Number of hours a week Full-time leaning: auditorium own training −	 3 5	

2. Goal and objectives of academic discipline
THE OBJECT AND ASSIGNMENTS OF THE COURSE

Goal of the course is to provide the theoretical knowledge and practical skills of fertilizers application in crop rotation, to study the principles of management by soil fertility and plant quality depending on the specific conditions of the crop region growing.

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 zones of Ukraine.

Upon completion of this course, students should be able to

know:

- the chemical composition of plants, characteristics of their nutrition and ways of its regulation;
- the soil properties connected with plant nutrition and fertilizers application;
- the methods of soil chemical melioration;
- the types of mineral and organic fertilizers;
- the system of fertilizers application and agricultural chemistry service;

be able to:

- to determine the plant nutrients supply level and provide optimum conditions of plant growing;
- to determine the necessity of chemical melioration and calculate the rate of meliorants;
- to identify fertilizers and provide optimum conditions for their storage and transportation;
- to calculate rate and define forms and methods of fertilizers application;
- to 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

№	Themes and modules to be covered	Hour			
		Full-time			
		total	lecture	laboratory work	independent study
Module 1. Chemical composition of plants and Soil properties					
1	Agricultural chemistry, its objectives and main tasks.	9	1	2	6
2	Chemical composition of plants, plant nutrition and methods of it's regulation	8		2	6
3	Agrochemical, agrophysical and biological properties of soil in connection with plant nutrition and fertilization	14	2	6	6
4	Soil chemical melioration (liming and gypsum application)	12	2	4	6
	Total for module	***43***	***5***	***14***	***24***
Module 2. Fertilizers, their properties and classification					
5	Fertilizers, their properties and classification	5			5
6	Nitrogen fertilizers	9	2	2	5
7	Phosphate fertilizers	9	2	2	5
8	Potassium fertilizers	9	2	2	5
9	Micronutrient and multinutrient fertilizers	9	2	2	5
10	Organic and bacterial fertilizers	5			5
	Total for module	***46***	***8***	***8***	***30***
Module 3. Fertilizers management					
11	Fertilization system. Nutrients balance	16	2	6	10
12	Fertilizers and environmental pollution. Agrochemical service	13		2	11
	Total for module	***31***	***2***	***8***	***21***
	TOTAL, hour	120	15	30	75

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 determination of plant production quality. The determination of gluten in wheat flour.	2
3	The soil analysis. The principles of soil sampling and handling. The determination of nitrates in soil by ionselective method. The determination of mobile phosphorus and exchangeable potassium by Chyrikov method	6
4	Determination of neutralizing ability of limestone materials. The calculation of the rate of lime materials application.	4
5	Qualitative analysis of the nitrogen fertilizers. Methods of nitrogen determination in fertilizers. Qualitative analysis of nitrogen fertilizers	2

6	Qualitative analysis of phosphorus fertilizers. Qualitative analysis of phosphorus fertilizers	2
7	Qualitative analysis of potassium fertilizers. Methods of potassium determination in fertilizers. Qualitative analysis of potassium fertilizers	2
8	Qualitative analysis of compound and microfertilizers.	2
10	Fertilizers distribution in crop rotation and determination of the farm saturation by organic and mineral fertilizers.	4
11	Balance-sheet method of fertilizers rate determination.	4
	Totally	**30**

6. Test questions for final assessment

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
"Bachelor" 202 - " Plant Protection Plant Quarantine "	Department of Agricultural Chemistry and Quality of Crop Products	**Variant** **№ 1** "Agricultural chemistry"	**"Approved"** Head of the department _____ Bykin A.V.
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 up take 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. Teaching methods

Verbal, visual, practical

8. Forms of 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. Required and recommended literature

Methodical support

1. Електронний навчальний курс https://elearn.nubip.edu.ua/course/view.php?id=198
2. Агрохімія: Програма навчальної дисципліни для підготовки фахівців ОКР «Бакалавр» напряму 2 «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.
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. Ященко Л.А. Агрохімія: методичні вказівки до вивчення розділу «Система застосування добрив» для студентів ОКР «Бакалавр» напряму «Захист рослин». – К., 2012. – 46 с.
2. 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.

Supplemental materials

1. 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.
2. Лісовал А.П., Макаренко В.М., Кравченко С.М. Система застосування добрив. – К.: Вища шк., 2002. – 318 с.
3. Агрохімічний аналіз: Підручник / М.М. Городій, А.П. Лісовал, А.В. Бикін та ін.; За ред. М.М. Городнього. – К.: Арістей, 2005. – 468 с.
4. Tisdale S.L., Nelson W.L., Beaton J.D. Soil Fertility and Fertilizers. – Mew York: Macmillan Publishing Company, 1985. – 754 p.
5. 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.

IT resources

https://elearn.nubip.edu.ua/course/view.php?id=198	Agrocultural chemistry
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. 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.

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.

Module II

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.

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 10

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.

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 11

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.

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 12

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.