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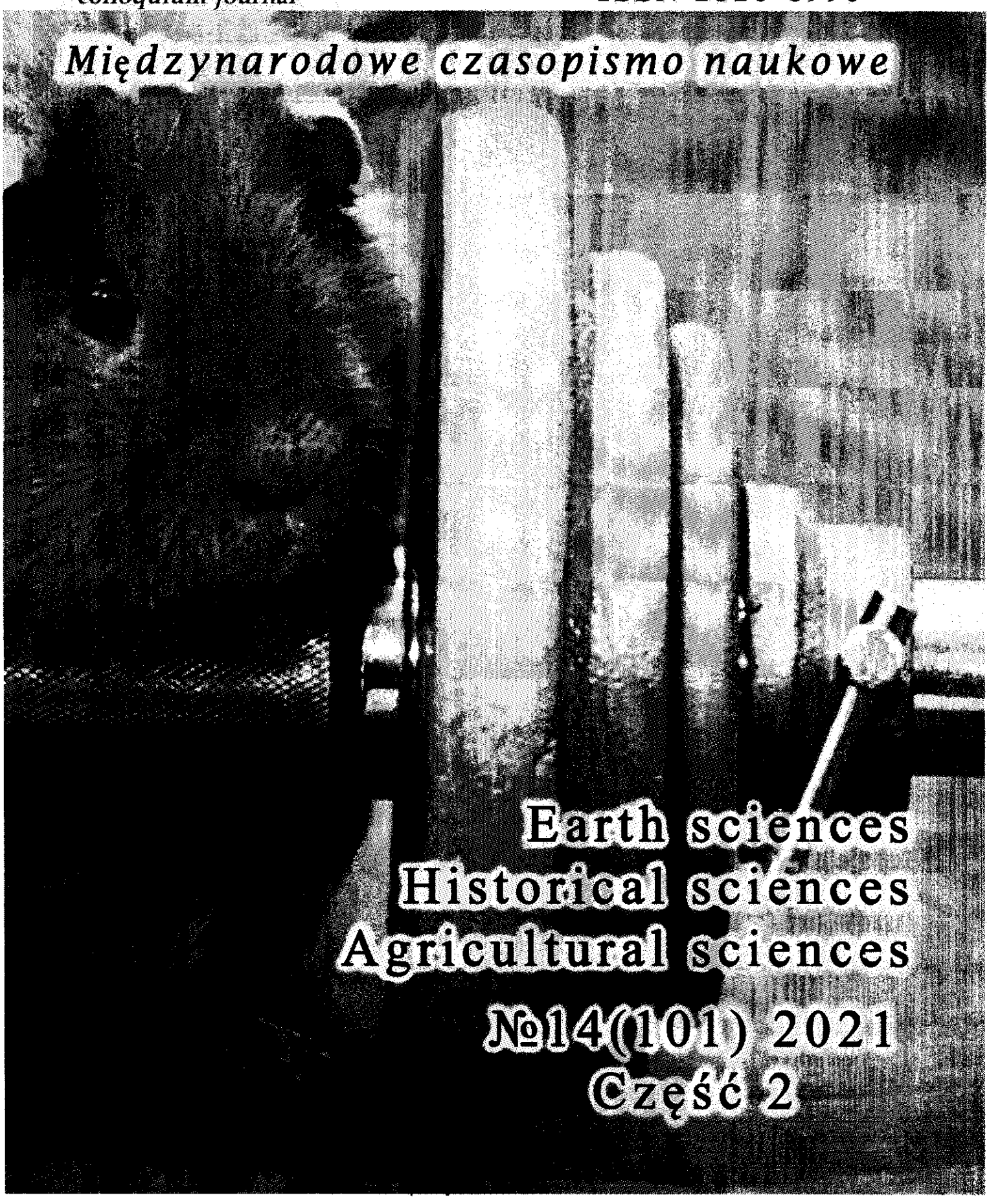

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XIX века, а в настоящее время ее разводят в 36 регионах [4].

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AGROECOLOGICAL ASSESSMENT OF SOIL CONDITION OF KHMILNYTSKYI DISTRICT OF VINNYTSIA REGION

Abstract.

The aim is to assess the agrochemical condition of soils and justify measures to reduce their pollution by heavy metals within the Khmilnytskyidistrict.In accordance with the set goal it is necessary to solve the following tasks: to take soil samples for laboratory tests; to carry out agrochemical assessment of soils of the settlement; to study the intensity of soil contamination with heavy metals (lead, cadmium); to investigate the level of concentration of microelements-toxicants in soils (zinc, copper);to optimize measures to reduce the intensity of soil contamination with heavy metals and trace elements, as well as measures to improve agro-ecological indicators.According to research, chernozems are highly degraded medium loam, which predominate in the Khmilnytskyidistrictare characterized by neutral acidity, humus content is high, so these soils are enriched with plenty of organic matter, which is positive for their use in agriculture.

According to soil studies on the content of mobile forms of trace elements, it can be concluded that the content of boron and manganese is within normal limits. The sulfur content is low and the iron content is very low. Magnesium content is also increased.

Analyzing soil contamination with lead, cadmium, zinc and copper, we note that their content was lower than the MPC by 8.1 times, 5.38, 21.4 and 5.0 times, respectively. The highest content of heavy metals in the soil was observed for zinc, compared to lead, cadmium and copper, it was 1.44, 8.23 and 1.78 times higher, respectively.The hazard ratio of heavy metals was the highest for copper. Introduction of integrated agriculture, based on a combination of positive aspects of alternative and intensive farming systems.

It is necessary to optimize the structure of land and sown areas, to introduce soil protection technologies for growing crops, to strengthen state control over land use, to provide funding for land protection and soil protection measures.

Keywords: *monitoring, soil, concentration, heavy metals, quality, indicators, trace elements, humus.*

Man in agricultural activities, using land, water, plant, animal and energy resources, provides himself primarily with food, while creating a greater impact on nature than in any other activity.

Producing enough food to provide the world's population with food is one of many complex, interdependent problems. Another important problem is the quality of food, the presence in it of the body's necessary proteins, vitamins, trace elements, etc.It is also important to manage the world's agricultural systems, which should be done in such a way as to minimize the harmful effects on the environment of food production and distribution.

Soil is a major, independent component of the natural environment and the biosphere in general, a limited, indispensable and difficult to renew natural resource that performs important functions: productive, environmental, social and information. Currently, the issues of the role and importance of soils, their balanced use, management, protection and combating degradation have reached a global level [2].

Carried out an assessment of the agrochemical condition of soils and justification of measures to reduce their pollution by heavy metals within the Khmilnytskyidistrictof Vinnytsia region [7].

Soil is the basis for harvesting crops, the main wealth on which our existence depends. It is the main means of agricultural production, the main source of food [1].

The importance of improving the efficiency of land use in agriculture, taking into account the environmental factor, as well as the lack of research on this issue determine the relevance of this study.

However, the problem of environmentally safe land use is insufficiently studied, especially in terms of the use of soil protection methods of tillage, which have a positive effect on its quality and reduce the cost of growing crops [3].

Agriculture is closely linked to the use of natural resource potential and, consequently, is accompanied by environmental pollution. Irrational use of natural resources has a significant impact on ecosystems, and sometimes it leads to the fact that some areas and even regions become a zone of ecological or natural disaster.Since agricultural production plays a dominant role in solving the food problem of the state, its main task is not only to preserve the potential of fertile lands, but also the rational use of all natural resources in this area, especially land, water, minerals, climate, biological , as well as solar energy [4].

Scientists point to four main causes of soil degradation. The first - erosion, mechanical destruction of soils by water and wind.

The second - desertification, aridization - more and more soils become unsuitable for agriculture due to drying. Third - toxicity, contamination of soils with various anthropogenic substances, including due to improper irrigation.Fourth - direct losses due to the allocation of agricultural land for urban buildings, roads, airfields, etc. In these conditions, the central place is occupied by the problem of land protection, which in a relatively short time went beyond the direct protection of land and became important for the preservation of land as a major component of the biosphere [6].

One of the most painful problems of agricultural ecology is excessive chemicalization. Currently, agriculture is increasingly using chemicals to kill pests, pesticides. Excessive use of mineral fertilizers, in particular nitrogen, leads to an increase in the content of nitrates in food, which is dangerous to human health.Reducing livestock in livestock production leads to a decrease in the use of organic fertilizers and increases the use of mineral fertilizers [5].

Modern agricultural technologies for maximum effect must be adapted to soil and climatic conditions. We have identified priorities that can be the basis of modern farming systems: optimization of the content of organic matter in the soil, mobile forms of nutrients; achieving a deficit-free balance of humus and nutrients in the soil; protection of soils from erosion; reclamation of acid and solonetzic soils;elimination of moisture deficiency; protection of soils from pollution, overcompaction, overwetting; elimination of moisture deficiency.

The costs of implementing the main measures for soil protection are about 41-48 billion UAH / year, in particular at the expense of state, local budgets and land users [6].

An important aspect is the use of international experience in environmental protection of land use. The world has accumulated many examples of progressive land use that deserve to be studied and used as much as possible.International activities need to be intensified in order to develop an effective strategy to protect soils from degradation. Today in the world, in particular in Europe, a modern soil protection policy is being formed, which is based on the following principles: independence from land ownership; soil monitoring on uniform principles; zoning of the territory with the allocation of soils "hot spots",with unfavorable properties.

The source of information about soils is monitoring. The main features of European soil monitoring: independence from departmental influence; accessibility of the population to information on the condition of soils.

When toxic substances get into this environment, they can stay in it for a long time with the initial danger, pass into plants, then animals and food into the human body. Therefore, the system of monitoring the condition of the soil cover due to anthropogenic impact is an important component of environmental monitoring.

One of the most toxic soil contaminants is heavy metals. They can get into the soil with mineral fertilizers, limestone materials, pesticides, exhaust gases of vehicles, with emissions from industrial enterprises.

Natural soil pollution is the result of heavy metals and their various forms from parent rocks and deep ore deposits. Under conditions of intense anthropogenic impact, the inflow of heavy metals into the agroecosystem exceeds its protective properties. This reduces the yield and quality of crop products, making it dangerous for humans and animals.

Today, heavy metals occupy one of the first places among man-made pollutants. Large industrialized agglomerations are powerful sources of pollution of all components of the environment.A great danger in the modern ecosystem is soil contamination with such elements as lead, zinc, copper and cadmium. Their adverse effects lead to an increase in mortality, morbidity, so the research topic is relevant [2].

In agriculture, intensive use of fertilizers, especially mineral and chemical ameliorants, causes changes in the quantitative composition of heavy metals. These elements are in natural fertilizers natural impurity, their size depends on initial raw materials (agroruds) and technologies of its processing.Heavy metals are well absorbed by soils, form sparingly soluble compounds with phosphates and hydroxides, which contributes to their gradual accumulation in the soil environment. This leads to an increase in the toxic potential of the soil, affects its biological activity, causes pathological changes in the course of biological processes, the accumulation of harmful substances in crops.The accumulation of heavy metals in the soil affects its fertility and microbiological activity. Heavy metal pollution is one of the factors that determine crop productivity and agricultural product quality. Toxicity of heavy metals to plants is determined not by their gross content in the soil, but mainly by the content of their mobile compounds.

Therefore, the research we conducted on land resources in the Khmilnytskyi district is important for further research.

The ecological situation on the territory of Khmilnytskyi district remained relatively stable.

Volumes of emissions from stationary sources into the atmosphere according to statistics for Khmilnytskyidistrict, taking into account emissions from Khmilnyk for the last period were small: they accounted for about 3.5% of the total regional (5.4 thousand tons; of which emissions from Khmilnyk - 5.1 thousand tons).Emission density per 1 km of the territory of the district averages 4.3 tons (in the city of Khmilnyk - 245 tons), per 1 person - 86.3 kg. Indicators in the district as a whole are much lower than the regional averages (5.9 tons and 98.4 kg, respectively).

The study of the agroecological condition of agricultural soils was carried out on such indicators as the concentration of lead, cadmium, zinc and copper, manganese, cobalt in the soil.

Selection of soils to study their intensity of heavy metal contamination was performed by the envelope method.

To determine the content of mobile forms of nitrogen, phosphorus, potassium, calcium, magnesium accepted sampling standards.

Depending on the purpose of the study, the size of the test site, the number and type of sample should correspond to those listed in table 1.

Table 1

Requirements for soil sampling

The purpose of research	The size of the test site		Number of samples
	homogeneous soil covering	inhomogeneous soil covering	
The content of chemicals in the soil	From 1 to 5 hectares	From 0.5 to 1 hectare	At least one pooled sample
Definition of physical properties and structure of the soil	From 1 to 5 hectares	From 0.5 to 1 hectare	From 3 to 5 spot samples on one soil horizon

The weight of the pooled sample should be about 1 kg. Samples taken for chemical analysis should be packaged, transported and stored in chemically neutral containers.

Agroecological passport of a field or land plot is a document that certifies the state of soil fertility and its dynamics.

The main indicators that determine the fertility of field soils are: the content in the arable layer of humus, nitrogen (easily hydrolyzed), mobile phosphorus, metabolic potassium and trace elements (manganese, zinc, copper, boron), as well as soil acidity (pH), the amount of absorbed bases, soil density, the maximum possible reserves of productive moisture in the layer 0-100cm.

In order to establish agrochemical parameters of the soil, we analyzed the results of selected soil samples in the studied areas (Table 2).

Table 2

Ecological and agrochemical indicators of soil

Agrochemical indicators	Units of measurement	Scientific research of test methods	Content in the soil	Actual value
Acidity pH(salt)		DSTU ISO 10390-2007	neutral	6,5
Humus	%	GOST 26213-91	high	4,98
Nitrogen is hydrolyzed (by Cornfield)	mg / kg	DSTU 7863-2015	low	133
Mobile phosphorus,P_2O_5 (according to Chirikov)	mg / kg	DSTU 4115-2002	very high	404
Potassium exchange,K_2O (according to Chirikov)	mg / kg	DSTU 4115-2002	very high	710
Exchangecalcium	mg-eq / 100 g of soil	GOST 26487-85	increased	14,10

Thus, highly degraded chernozems of medium loam, which predominate in Khmilnytskyi district, are characterized by neutral acidity, humus content is high, so these soils are enriched with plenty of organic matter, which is positive for their use in rural agriculture.

The content of mobile phosphorus and exchangeable potassium is characterized by very high indicators, which may mean that mineral fertilizers applied in the village are mostly high in terms of phosphorus and potassium. The content of hydrolyzed nitrogen is low, so it is recommended to apply nitrogen fertilizers or sow perennial legumes, which will enrich the soil with nitrogen.

In addition to macronutrients (N, P, K, Ca, Mg, S), 14 more elements are important in plant nutrition for growing high and sustainable crop yields. The most important are the six elements - B, Mn, Cu, Zn, Co, Mo.Due to the fact that their content in soils is quite small (0.01 - 0.001% on dry matter), they are called trace elements, and fertilizers that contain them - microfertilizers. Most micronutrients are required for normal plant growth and development because they perform important physiological functions. Thus, trace elements are part of enzymes, vitamins, hormones and other biologically active substances and play an important role in the synthesis of proteins, carbohydrates, fats and vitamins.With the optimal provision of plants with trace elements, their development and maturation of seeds is accelerated, resistance to diseases and pests is increased, the effect of external adverse factors - drought, low and high temperatures of air and soil is weakened.In addition, they protect plants from bacterial and fungal diseases (flax bacteriosis, cork spot of apples, rotten beet hearts, gray spot and graininess of cereals, rosette of fruit, various chlorosis diseases), but unlike pesticides, this is due to increased plants.Throughout the growing season, plants feel the need for essential trace elements. Trace elements cannot be replaced by other substances, and their deficiency must be compensated. Only then can you get quality products that meet the optimal content for a particular type of sugars, amino acids, vitamins [5].

Plants can use microelements only in water-soluble form (mobile forms of microelement), their immobile forms become suitable after the course of complex biochemical processes with the participation of soil humic acids. In most cases, these processes are very slow, under irrigation, a significant part of the mobile forms of trace elements can be washed away.

Most trace elements are active catalysts that accelerate a number of biochemical reactions. The combined action of trace elements significantly enhances their catalytic action. Often only their combination can ensure the normal development of

plants. Trace elements also affect the formation of biocolloids and the direction of biochemical processes.Thus, manganese regulates the ratio of divalent and trivalent iron in cells. The ratio of iron: manganese should be more than 2. Copper protects against the destruction of chlorophyll and allows you to increase the rate of nitrogen and phosphorus almost twice. Boron and manganese intensify the process of photosynthesis after freezing plants. An unfavorable ratio of nitrogen, phosphorus and potassium can cause diseases of plants treated with microfertilizers.

Compared with macronutrients, the content of micronutrients in soils is low. Thus, the average content of mobile boron in the soils of Ukraine varies between 0.1-2.0 mg / kg, molybdenum - 0.03-0.60, zinc 0.2-2.0, manganese - 25-190 mg / kg. Therefore, not all soils can fully meet the needs of plants for trace elements.

The main reason for the deficiency of micronutrients is primarily their poor availability to plants. According to agrochemical studies, most soils in Polissya are well supplied with manganese and satisfactory copper, but they contain little boron, molybdenum, zinc.Forest-steppe soils are rich in manganese, sufficiently supplied with copper, satisfactory molybdenum, weak boron and zinc. In soils with a high content of humus and heavy particle size distribution, the content of trace elements is high. But here there is a lack of them in a form accessible to plants.

It is established that microelements in the form of inorganic salts show efficiency only on acid soils. In soils with a reaction close to neutral, their effectiveness is reduced tenfold. In neutral and slightly alkaline soils, inorganic salts can not contain trace elements in water-soluble, in a form accessible to plants, and their effectiveness is close to zero.This is due to their transition to sparingly soluble forms (hydroxides, carbonates) and a sharp cessation of availability for assimilation by plants.

For plants, the use of trace elements is more effective in the form of metal complexates (chelates), which have a number of advantages. Thus, chelates are stable on all types of soils, regardless of their acidity level.

Manure is an essential source of micronutrient removal. However, only at the rate of 13.5 tons of manure per 1 hectare of crop rotation area under the organo-mineral fertilizer system, their removal by crops, except for manganese and boron, is almost compensated.

Table 3

Grouping of soils by the content of mobile forms of microelements

№ group	The content of the element	mg per 1 kg of soil			
		Boron	Manganese	Copper	Zinc
I	Very low	<0,15	<15	<0,70	<0,30
II	Low	0,15-0,22	15,0-20,0	0,70-1,00	0,30-0,50
III	Average	0,23-0,33	20,1 -30,0	1,01-1,50	0,51 -0,70
IV	Increased	0,34-0,50	30,1 -45,0	1,51 -2,20	0,71-1,00
V	High	0,51-0,70	45,1-70,0	2,21 -3,30	1,01-1,50
VI	Very high	>0,7	>70	>3,30	>1,50

According to soil studies on the content of mobile forms of trace elements (Table 3), we can conclude that the content of boron and manganese is within normal limits. The sulfur content is low and the iron content is very low. Magnesium content is also increased.

Table 4

The content of mobile forms of trace elements in soils v. Maryanivka

Moving form of the microelement	Units of measurement	Scientific research of test methods	Content in the soil	Actual value
Mobile boron	mg / kg	GOST 10 156-88	very high	2,86
Mobile manganese	mg / kg	DSTU 4770.1-0017	very high	21,36
Mobile sulfur	mg / kg	DSTU 8147-2015	GOST 10 156-88	5,3
Mobile magnesium	mg-eq / 100g of soil	GOST 26487-85	increased	2,42
Mobile iron	mg / kg	DSTU 4770.1-0017	verylow	1,56

Trace elements in the soil play an important role in plant nutrition. As iron and sulfur content are low, sulfur and iron-containing micro fertilizers can be used as a recommendation.

The ecological condition of the field is determined by the level of contamination by radionuclides (Cs137, Sr90), heavy metals (cadmium (Cd), lead (Pb), copper (Cu), zinc (Zn)). reclamation, to establish systematic work to increase soil fertility.

Table 5

The intensity of heavy soil pollutionmetals, mg / kg

Heavy metals	Actual content	Maximum permissible concentration	Hazard factor
Lead	0,74	6,0	0,12
Cadmium	0,13	0,7	0,18
Zinc	1,07	23	0,04
Copper	0,60	3,0	0,2

Analyzing soil contamination with lead, cadmium, zinc and copper, we note that their content was lower than the MPC by 8.1 times, 5.38, 21.4 and 5.0 times, respectively. The highest content of heavy metals in the soil was observed for zinc, compared to lead, cadmium and copper, it was 1.44, 8.23 and 1.78 times higher, respectively.

The hazard factor of heavy metals (Fig. 1) was the highest for copper.

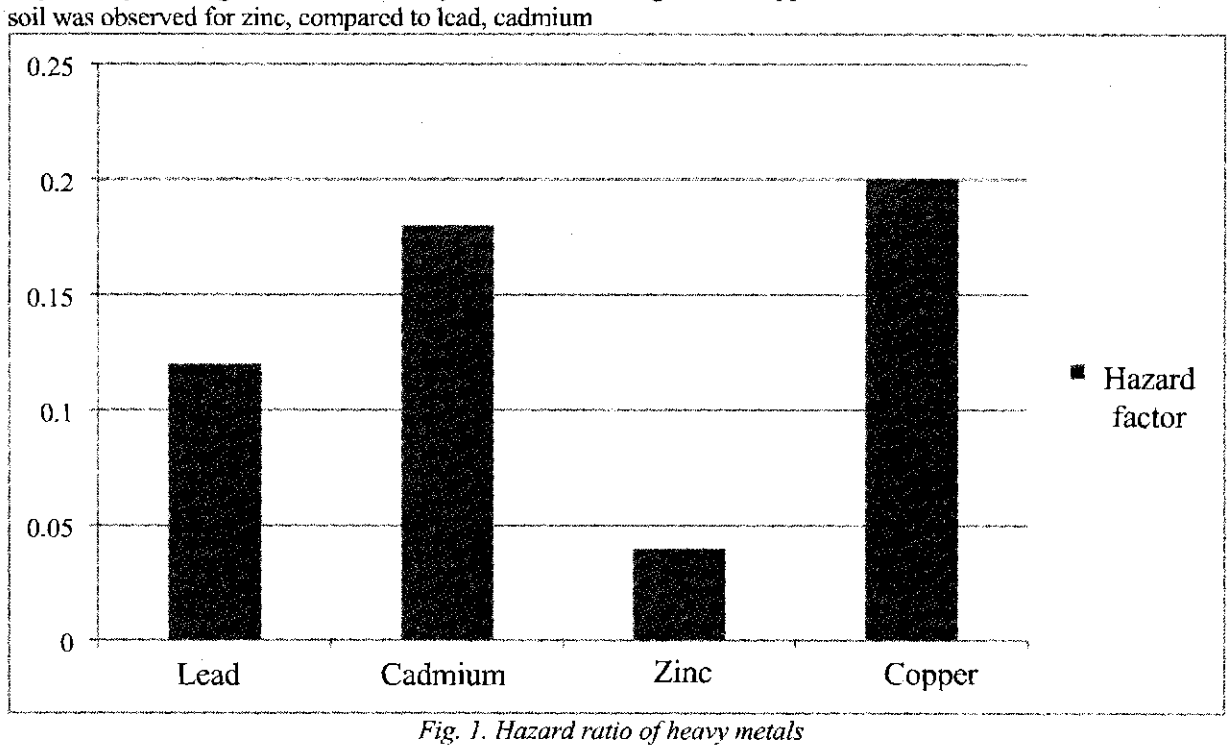

Fig. 1. Hazard ratio of heavy metals

Compared to lead, cadmium and zinc, it was 1.66, 1.11 and 5.0 times higher, respectively.

The strategy of improving the condition of soils and increasing their fertility includes:

Use of a ploughless tillage system. It is necessary to pass to the minimum cultivation. With traditional methods, we lose moisture, and hence the harvest. Minimal treatment helps retain moisture.

Planning crop rotations for 5-7 years ahead with the mandatory inclusion of 30% of legumes. Planning crop rotations for such a long period can be a difficult task, because there are certain market needs that farmers want to track and take into account. However, you need to learn to work with long-term planning to get a good harvest.

Application of manure compost. Now livestock farming has significantly decreased, so there are problems with the application of sufficient amounts of organic fertilizers. However, the application of compost must be made a mandatory stage of agricultural production. The technology of composting does not matter much.

Work with plant remains. This is useful not only for the soil, but also for agricultural production itself. Destructors should be used to peel the stubble, and nitrogen-fixing bacteria should also be used.

The use of greens and perennial herbs. Without greening on some soils today it is impossible to get a good harvest. Green manure should be used at least once every 5 years.

The use of biological products for plant protection. Biologics are a good tool for growing crops. Biologicals are being developed very intensively in Europe today, new strains of bacteria and new approaches are being sought. In 10 years, they can provide organics with a good tool for growing crops. There are similar factories in Ukraine, but they need more time, because so far they are building capacity. In general, now large chemical companies are actively engaged in biological protection.

Work with soils in a complex, the account of all layers of soil when carrying out agrotechnical actions. Mykola Bykov advises to work with all layers of soil: not only surface 5 cm, but also a layer of 15 cm, which will accumulate capillary moisture, and a layer of 40 cm, which must absorb moisture from the surface layers.

The problem of burning crop residues (straw), which still exists in Ukrainian fields, should be mentioned separately. It's actually burning money. This is the loss of nitrogen, which could enrich the soil - 1 ton of straw contains up to 80 kg of nitrogen. In addition, combustion stops the processes in the soil, 2-3 cm destroys the entire biota. This is a significant loss that can be avoided by stopping the burning of crop residues.

To address the problem of restoring soil fertility in order to achieve their neutral level of degradation, Ukraine must have a clear strategy for soil protection, prevention and control of land degradation, which includes the effective functioning of soil protection programs and laws, strict control over their implementation, monitoring, mandatory rationing of anthropogenic loads, responsibility of the government and all land users, compliance with the recommended and introduction of the latest soil protection technologies.

To increase soil fertility and achieve a neutral level of degradation, it is necessary to: develop proposals for draft laws and regulations on soil monitoring; prepare a Concept and recommendations for ensuring a neutral level of soil degradation; to create a soil information center; to revive stationary experiments on the study of soil processes and regimes, directions of soil evolution under the predicted climate change; to adapt agricultural technologies. The implementation of the National Action Plan to Combat Soil Degradation, which includes a list of relevant measures for the period up to 2030, will help address this issue.

The system of ecological and economic use of lands must have an environmental, resource-saving character and provide for the preservation of soils. Land protection and their rational ecological and economic use should be carried out on the basis of an integrated approach to land use as complex natural formations (ecosystems), taking into account their zonal and regional characteristics. One of the areas of rational use of agricultural land is the intensification of the use of modern innovative technologies for growing crops. This area of improvement is capital-intensive but effective, including from an environmental point of view.

Currently, an inventory, cadastral assessment of land, a state system for managing the quality of land resources and its place in public administration and the principles of delimitation of responsibilities of the state, landowners and land users for the protection of land resources. The main role in ecological balancing and reproduction of land resources belongs to the state.

Highly degraded medium-loam chernozems, which predominate in the Khmilnytskyi district, are characterized by neutral acidity, humus content is high, so these soils are enriched with plenty of organic matter, which is positive for their use in agriculture.

According to soil studies on the content of mobile forms of trace elements, it can be concluded that the content of boron and manganese is within normal limits. The sulfur content is low and the iron content is very low. Magnesium content is also increased.

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Introduction of integrated agriculture, based on a combination of positive aspects of alternative and intensive farming systems;it is necessary to optimize the structure of land and sown areas, to introduce soil protection technologies for growing crops, to strengthen state control over land use, to provide funding for land protection and soil protection measures;to introduce ecological education of the population, to hold seminars, trainings with heads of agricultural enterprises, to develop ecological movement in Ukraine by creation of various ecological organizations and reduce the use of mineral fertilizers, instead increase the use of organic fertilizers.

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