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INFLUENCE OF PESTICIDES ON THE NUMBER AND SPECIES COMPOSITION OF SOIL INVERTEBRATES OF SOUTH-EAST KAZAKHSTAN

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Abstract. The paper presents the results of the impact of pesticides on the biological activity of soils, as well as an environmental assessment of the state of meadow-chestnut soil in 4th crop rotation with the establishment of diagnostic indicators that reduce biological activity. Physical, chemical and biological properties of soils under crops of fruit–bearing crop rotation (corn, barley, rapeseed, soy) in the meadow–chestnut soil of the South–east of the Republic of Kazakhstan were studied. The results of chromatographic analysis of soil samples for the content of pesticides are shown. A study of meadow-chestnut soils by the degree of change in biological activity was conducted to determine their relative resistance to pesticide contamination. The obtained data revealed the degree of resistance of meadow-chestnut soils to pesticide contamination. The species of soil invertebrates, as well as soil enzymes that should be used as bioindicators for monitoring the contamination of meadow-chestnut soils with pesticides, were identified. The results obtained will expand knowledge about changes in the biological activity of meadow-chestnut soils under the influence of pesticide contamination in the ecosystems of South-East Kazakhstan.

Key words: meadow-chestnut soil, pesticides, soil mesofauna, biological activity, ecology, chromatographic analysis.

INTRODUCTION

Agricultural production in modern circumstances is impossible without the use of pesticides. Recognizing the undoubted positive effect of the use of pesticides in various spheres of human economic activity, data are gradually accumulating on the negative consequences of using such drugs [1].

Regardless of the form and method of application, pesticides enter the soil, accumulate in it, and affect soil biota. The need to study the interaction of pesticides with soil fauna is due to the crucial role of soil organisms in creating soil fertility and soil detoxification from xenobiotics [2]. Therefore, the development of a microbiological method for soil treatment from pesticides is important [3]. In this regard, the search and construction of microbial strains - destructors of pesticides and their introduction into natural ecosystems are underway [4–7]. It also seems relevant to replace toxic pesticides with new type of drugs that are less polluting and can collapse under the influence of soil organisms.

In our studies, we set ourselves the task of identifying the effect of pesticides on the abundance and species composition of soil invertebrates in south-east Kazakhstan.

As you know, the level of potential soil fertility depends not only on quantitative and qualitative indicators of the content of humus and the complex of nutrients that determine its nutritional regime, but it is also determined by biological activity.

A lot of work has been devoted to the study of the role of biological activity in the soil-forming process, in the decomposition of organic substances and the influence of human activities on changes in soil fauna.

Currently, soil pollution with pesticides has become global. Their entry into the soil in large quantities primarily affects the biological properties of the soil: the number of soil animals decreases, invertebrates of the saprotrophic layer die, in which the consumption and decomposition of organic residues occurs. In contaminated soils, along with microorganisms, such indicators of humus content and soil pH regulators as earthworms die. The calcium carbonate produced in earthworms in the glands neutralizes the soil acids passing through the digestive tract of these animals, therefore, the coprolites secreted by them have a higher pH value than soils. Bacteria abundantly develop in coprolites. Coprolites are centers of formation of specific associative microbial communities.

For most soil invertebrates, the limits of resistance to increased pesticides are quite large.

Pesticides are an environmental factor that has emerged in nature due to the widespread use by humans of foreign compounds to control weeds and pests of cultivated plants. Pesticides can change the biological properties of soils, partially disrupt or lead to a complete loss of their fertility. In addition, pesticides also change the more conservative features of ecosystem soils, such as the humus state, structure, and pH.

Among other soil types, meadow-chestnut soils have a relative degree of resistance to pollution in general and to pesticides. However, they are not always able to withstand the effects of pollutants. Meadow-chestnut soils play a significant role in agricultural production in southeast Kazakhstan and throughout the country, therefore, a decrease in their fertility because of contamination with chemicals is a dangerous trend.

The impact of pesticides, as well as an environmental assessment of the state of soils in the biocenoses of the region's ecosystems, is carried out by establishing several diagnostic indicators that reduce biological activity. These indicators are widely used in monitoring the pollution of ecosystem soils with pesticides. The above is one of the most important aspects of the relevance of the selected topic.

When soil is contaminated with pesticides, a decrease in the number of micro-mesofauna is observed. However, not in all cases a decrease in the number of soil invertebrates was observed. We noted an increase in the total number of mesofauna. This is due to the death of sensitive invertebrates and the active development of resistant forms [8].

An increase in the number due to soil pollution with various pesticides is characteristic of microscopic fungi *Fusarium oxysporuni, Phoma niarchalii*. They have less sensitivity to the effects of these substances. The stability of fungi is explained by their physiological characteristics. In the process of life, they secrete organic acids, which neutralize the toxic effect of pesticides, forming complexes with them that are less toxic than free ions [9].

Soil pollution by pesticides leads to changes in the species composition of soil microbocenoses. A significant decrease in the species diversity (by 30 %) of the complex of soil myxomycetes of the families *Reticulariaceae, Cribrariaceae* and an increase in the absolute dominance of a small number of species: *Fusarium oxysporuni, Phoma niarchalii*. Moreover, unusual for normal conditions appear in the fungal community of contaminated soil, obviously myxomycetes resistant to pesticides of the classes *Dictyosteliomycetes, Protosteliomycetes, Myxomycetes*.

Myxomycetes with phytotoxic properties often become dominant, which negatively affects seed germination and the development of plant seedlings. The effect of pesticides on the amount of yeast in the soil, as well as on the green parts of plant seedlings. An increase in the number of epiphytic yeast from 6 million/g to 22.5 million/g indicates a low state of vegetation in contaminated areas [10].

The novelty of our research, in contrast to the available works in the scientific literature, is based on the study of the effect of the main agricultural practices on the physicochemical and biological properties of soils in southeast Kazakhstan. In Kazakhstan, physicochemical and biological studies of soils are fragmented, while scientific knowledge of the management of modern soil-forming processes in traditional and agro-technical systems of farming and increasing soil fertility in Kazakhstan requires a systematic study of soil fauna in conjunction with physical-geographical, pedagogical ecological and human factors.

Similar studies are carried out in neighboring countries [11-13] in various soil and climatic conditions. So, in the south-east Russia, in Belarus, data are presented on the nature of the action of pesticides on populations of soil complexes. The ambiguity of the reactions of soil organisms using preparations of different chemical nature and different directions of action is shown. The characteristics of bioassay and bioindication methods for the presence of pesticides in the environment are described. A distinctive feature of our studies from existing works in the scientific literature is the study of the physicochemical and biological properties of soils under crops of crop rotation (corn, barley, rapeseed, soybeans) on meadow chestnut soil in the southeast of the republic, which makes it possible to determine soil pollution by heavy metals , pesticides and radionuclides.

The main function of enzymes in contaminated soils is to transform pollutants to simple and less toxic products [14]. The high practical importance of soil enzymes is determined by technogenesis, urbanization, climate change, which constantly negatively affect the soil and the environment as a whole [15].

As a result of the studies, an assessment was made of the degree of sensitivity to various chemical elements of pesticides on the biological activity of soils. The results obtained suggest that, in contrast to abundance indicators, the species composition of soil organisms can be used as a criterion for a qualitative assessment of the degree of pesticide exposure to soil.

OBJECTS AND METHODS

Field experiments were laid in the UOS "Agrouniversitet" on irrigated meadow – chestnut soil in a 4-field crop rotation, deployed in space and time with alternation: 1 - corn; 2 - soybeans; 3 - rapeseed; 4 - barley.

In soil samples, the determination according to generally accepted methods is humidity using the gravimetric method, total humus according to I.V. Tyurin, specific gravity - by the pycnometric method, bulk mass using Kachinsky drill, general porosity - by the calculation method to determine biological indicators: soil mesofauna - the method of manual disassembly according to Gilyarov [16].

The activity of soil enzymes (dehydrogenase, urease, invertase) according to the method of A.Sh. Galstyan [17] and the method of Hoffmann and Pallauf in the modification of F.Kh. Khaziev [18].

When determining insect larvae, the identifier of insect larvae living in the soil is used [19].

Method for determination of pesticide residues.

The determination of the active substances of imidacloprid and lambda-cyhalothrin was carried out by chromatographic analysis methods.

The determination of imidacloprid was performed by high performance liquid chromatography with diode-matrix detection. Liquid chromatograph with an Agilent 1100 diode array detector (Agilent, USA). Chromatography conditions: steel column XDB-C18 with a length of 150 mm, an inner diameter of 4.6 mm and a grain size of 5 microns. The column temperature was 25^0C, the mobile phase was acetonitrile: H_2O in a ratio of 50:50, the flow rate of the eluent was 1.0 ml/min, and the working wavelength was 280 nm. The volume of injected aliquots of the standard and analyzed solutions of 20 μl. The retention time of imidacloprid is 1.58 ± 0.05 min (Figure 1).

The range of detectable concentrations is 0.1 - 1.0 μg/ml. The detection limit of imidacloprid is 0.005 mg/l. The detection limit in the analysis of imidacloprid was calculated by determining the signal-to-noise ratio in samples with a known concentration of imidacloprid.

Quantitative determination of lambda-cyhalothrin in the samples was carried out by gas chromatography with mass spectrometric detection from liquid extracts in hexane. Gas chromatograph with a mass spectrometric detector 6890N/5973N (Agilent, USA), equipped with a Combi-Pal autosampler (CTC Analytics, Switzerland) with the ability to automate the injection of liquid samples.

Chromatography was performed using a J&W DB-35ms capillary column (Agilent, United States) with a length of 30 m, an inner diameter of 0.25 mm, and a film thickness of 0.25 μm at a constant carrier gas velocity of 1.0 ml/min. The volume of the sample introduced into the injector of the gas chromatograph is 2 μl. The sample was injected in the non-dividing mode at an injector temperature of 270^{0}C.

Detection limits: lambda-cyhalothrin in the soil - 0.007 mg/kg. The detection limits of the method for determining lambda-cyhalothrin in samples were calculated by determining the signal-to-noise ratio in samples with a known concentration of lambda-cyhalothrin, then calculating the concentration of lambda-cyhalothrin corresponding to a signal to noise ratio of 10/1. The completeness of extraction of lambda-cyhalothrin from the soil is 88 %.

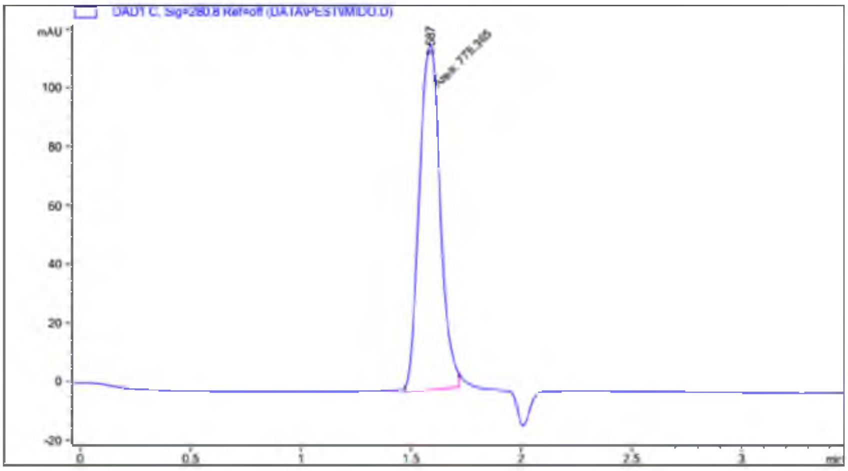

Figure 1 - Chromatogram of the retention time of the calibration solution of imidacloprid (C = 10 μg/ml)

The program for heating the column of a gas chromatograph: initial temperature 40^{0}C, heating to 280^{0}C at a speed of 15^{0}C/min (shutter speed 5 min). The total chromatographic time was 21 minutes. The temperatures of the quadrupole and the MSD ion source were 150 and 230^{0}C , respectively. The retention time of lambda-cyhalothrin at given chromatographic parameters is 18.1 ± 0.2 min (Figure 2).

Mass spectrometric detection of lambda-cyhalothrin was carried out in the monitoring mode of the selected m/z (SIM) ions - 181, the ion registration time was 100 ms. The mass spectrum of lambda-cyhalothrin is shown in Figure 3.

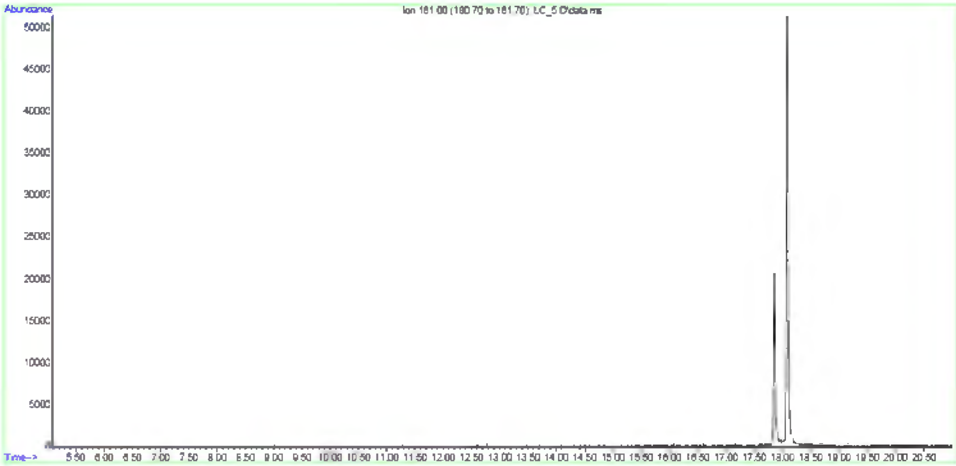

Figure 2 - Chromatogram, retention time and spectrum of the calibration solution of lambda-cyhalothrin (C = 10 µg/ml)

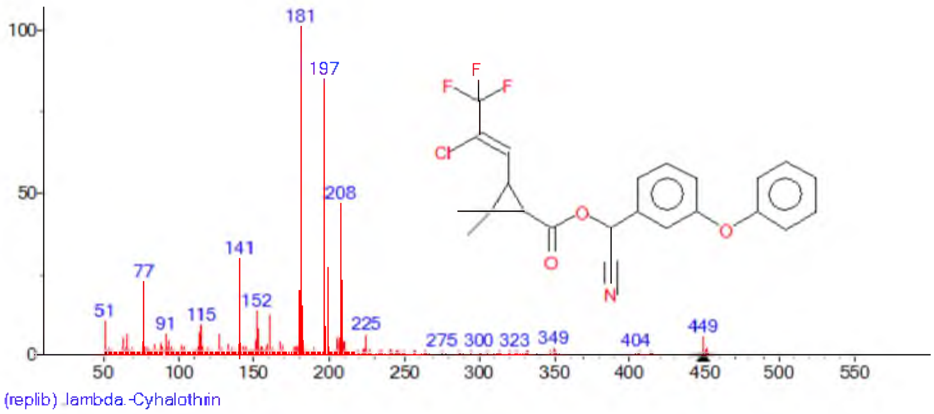

Figure 3 - Mass spectrum lambda-cyhalothrin

RESULTS AND ITS DISCUSSION

As a result of studies, it was found that when pesticides were contaminated, the number of soil invertebrates in the studied meadow chestnut soils in most cases decreased. The most sensitive to soil pollution by lambda-cyhalothrin were *Chrisomelidae Elateridae, Chloropidae, Pyraustidae*.

The meadow chestnut soils of the foothill plain of Zailiysky Alatau have a dark chestnut color of the humus horizon, the thickness of which reaches 30-40 cm.

The morphological description of the section laid in the experimental plot is given below. The section was laid south of the central estate of the village of Saymasay, Enbekshikazakh District, Almaty Region in the «AgroUniversity».

Relief: piedmont plain, soil boils (HCl) from the surface over the entire profile.

It can be seen from the morphological description of the section that the profile of meadow – chestnut soils is stretched, moisture increases with depth, rust spots are noted in the lower horizons, the humus horizon is well structured, and medium compacted.

Apah $\frac{0-24}{24}$	dark gray, moist, medium compacted, finely lumpy, strongly penetrated by roots, loamy, transition to the next horizon clear in color
A $\frac{24-32}{8}$	dark gray, moist, finely lumpy, denser than overlying, earthworm passages and their coprolites are found in abundance, porous, heavy loamy, transition to the next horizon is clear in color, penetrated by roots
B $\frac{32-59}{27}$	grayish, moist, compacted, finely lumpy, porous, many moves of earthworms and their coprolites, as well as rodents, the moves of mice are filled with humus, cut by the roots of plants, heavy loamy, transition to the next horizon is gradual in color
BC $\frac{59-103}{45}$	light gray, moist, wet below, porous, finely granular lumpy, coprolites of earthworms are rare, cut by the roots of plants, heavy loam, rare rust spots, with 103 cm ground water

According to the granulometric composition, the described soil belongs to heavy loamy, coarse dust. Particles larger than 3 mm are in most cases absent. The content of coarse particles is also insignificant. In the distribution of them along the profile, no definite pattern is observed. Coarse dust predominates. The distribution along the profile of the silt fraction indicates a noticeable predominance of fine particles in the middle and lower layers of the soil.

The heavy particle size distribution determines the unfavorable physical properties of the soil: stickiness in the wet state, compaction and hardening upon drying, which in turn leads to high resistance during plowing and to a clumpy surface of the field. Meadow – chestnut soil is characterized by moderate humus content.

The following regularity should be noted in the distribution of humus along the profile: its relatively high content in the upper horizon sharply, more than doubles, decreases upon transition to the next subarable horizon. A further decrease in the humus content occurs gradually, stretching to a considerable depth.

The content of gross nitrogen in the soil is low and amounts to 0.12 %, which is why the ratio of humus carbon to total nitrogen is wide. In this case, it varies between 10–12, that is, a wider (as compared to zonal soils) ratio of humus carbon to total nitrogen in comparison with zonal analogues.

The gross content of phosphoric acid in the humus horizon does not go beyond 0.13–0.21 %, which characterizes a low level of security.

The amount of CO_2 varies from 5.82 to 7.35 %, with a minimum in the upper horizon and a maximum in the lower. An increase in the percentage of CO_2 with increasing depth occurs gradually, which is apparently associated with hydrogenic accumulation.

The results of the analysis of water extraction (Table 1) show that the arable and subsurface horizons of the described soil are not saline, but at the same time there is a small but toxic amount of normal carbonates in the lower horizons, which leads to weak salinization of the soil and an average degree of alkalinity of the soil solution. The dry residue in the upper horizons does not exceed 0.166 %. The maximum salt is in the middle of the profile.

This distribution indicates the pulling up of water-soluble salts from deep horizons. Of the anions, the HCO_3– ion prevails with a low content of sulfate and chlorine ions. It should be noted that normal carbonates are found in the profile. Its amount along the profile is unevenly distributed. They are absent in the humus horizon (0–32 cm), its content in the parent rock is not high, and in the middle part of the profile it is within the toxicity range for plants (> 0.001 %).

Table 1 - Data of the water extract of the soil section of the meadow – chestnut soil

Indicators	Values			
Depth, cm	0–24	24–32	32–59	59–103
pH	7,8	7,9	8,1	8,3
Dry residue, %	0,166	0,173	0,184	0,269
CO_3^{2-}, mEq / %	-	-	0.0038 / 0,125	0.0140 / 0,465
HCO_3^-, mEq / %	0.9788 / 0,0597	0.8361 / 0,0512	1.774 / 0,1082	2.033 / 0,1242
Cl^-. mEq / %	0.0790 / 0,0025	0.0674 / 0,0020	0.1174 / 0,0035	0.1493 / 0,0045
SO_4^{2-}, mEq / %	0.4201 / 0,0203	0.488 / 0,0235	0.292 / 0,0141	0.291 / 0,0142

The amount of sodium absorbed from the number of absorbed bases in the humus horizon is less than 5 %. But at the same time, it should be noted that the increased content of magnesium in the profile and sodium in the lower part, the second half-meter layer allows us to attribute these horizons to slightly saline.

Table 2 - The Composition and content of the absorbed base in meadow – chestnut soil

Depth, cm	The amount of absorbed bases in mEq / 100 g of soil	Content of the amount, %		
		Ca^{+2}	Mg^{+2}	Na^+
0–24	18,30	76,7	21,9	1,8
24–32	18,80	64,0	32,0	4,3
32–59	16,20	74,5	19,0	7,5
59–103	12,45	72,7	16,3	11,6

The data in Table 2 show that the amount of absorbed bases will be 18-16 mEq in the upper horizons, with a predominance of calcium. Its content reaches 64-77 % of the total absorbed bases.

Figure 4 shows quantitative indicators of the most important physical and water – physical properties of meadow – chestnut soils. The specific gravity ranges from 2.65-2.76 g/cm^3, gradually increasing with depth.

The bulk mass of the upper horizons is relatively small 1.22-1.26 g/cm^3, its sharp increase is observed only from a meter depth. In this regard, the overall porosity of the upper horizons is rather high 53-52 %. Compaction begins with a layer deeper than 80 cm.

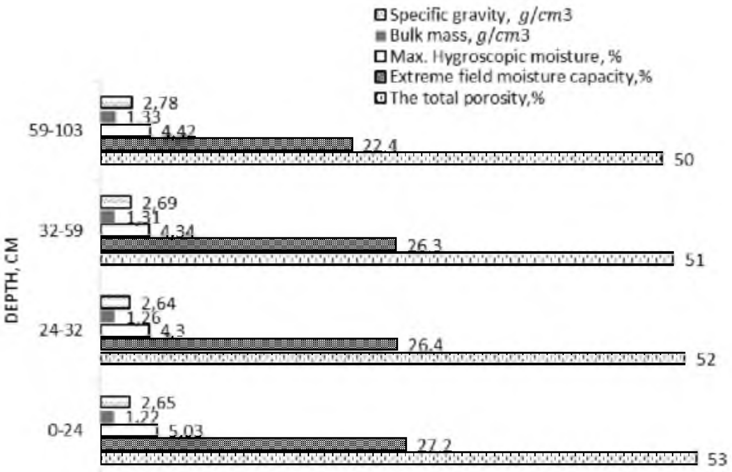

Figure 4 - Physical and water – physical properties of meadow chestnut soil

The maximum field moisture capacity in the upper twenty-centimeter layer of the soil is low 26.4-27.2 %, with a depth its value decreases to 22.4 %. The maximum hygroscopicity due to the heavy particle size distribution reaches 5.03 % in the upper horizons, decreasing with a depth of 4.42 %.

Data on the determination of water permeability allow us to note that soils, despite the heavy particle size distribution, have a satisfactory absorption rate, the average coefficient of water permeability on virgin soil is 0.9 mm/min, which is facilitated by well-defined macroaggregation and high porosity.

The humus content in the arable horizon is 4.48%, which gradually decreases with depth. The content of total nitrogen - 0.219 % of phosphorus average - 0.183 %. According to the availability of accessible nutrients, the soils of the experimental plot are characterized as medium-sized with easily hydrolyzed nitrogen - 87 mg/kg and high potassium - 435.4 mg/kg According to the content of mobile phosphorus, it belongs to the group of low-secured - 26 mg/kg of soil.

The physicochemical parameters of the meadow – chestnut soil selected from the village of Saimasay, Almaty region, were determined.

We found that the decrease in soil humus content is explained by its mineralization by soil invertebrates, as well as the toxicity of the studied pesticides - imidacloprid, lambda-cyhalothrin (Table 3).

Table 3 - The effect of pesticides on the content of humus in meadow chestnut soil %

Pesticide	Duration, day	Soil pesticide content				
		Control	1 MPC	10 MPC	100 MPC	HCP_{05}
Imidacloprid	7	2,85	3,01	3,23	3,19	0,27
	30	2,84	2,85	2,91	3,00	0,32
	180	3,20	3,05	3,10		0,34
	HCP_{05}	0,27	0,26	0,24	0,28	
Lambda-cyhalothrin	7	2,88	3,02	3,10	3,06	0,34
	30	2,84	3,14	3,42	3,15	0,32
	180	3,19	3,26	3,23	0,29	0,35
	HCP_{05}	0,26	0,29	0,40		

Contamination of meadow-chestnut soil with pesticides in several experimental variants influenced even such a stable indicator as the content of humus in the soil. Moreover, the values of the soil humus content in some decreased from 4 % to 2.7 %. This decrease in humus content depends not only on the activity of soil invertebrates, but also on the action of oppressed representatives of soil invertebrates of the saprotrophic level, preparing organic residues in the soil, to the activities of destructors.

As a result of the studies, the effect of pesticides on dehydrogenase, invertase, and urease was established. Pesticides in most cases inhibited the action of the studied enzymes. The average values calculated using the NDS05 analysis of variance revealed that, when contaminated at a dose of 1 MPC and 10 MPC, the dehydrogenase activity in meadow chestnut soil was significantly higher than in the control (without contamination), and at a dose of 100 MPC it was lower. This dependence is observed on the seventh day from the onset of pollution. On the thirtieth day from the onset of pollution, another dependence is observed: the dehydrogenase activity in soil samples is significantly higher at a dose of 1 MPC and 10 MPC, as well as in 100 MPC. Almost the same dependence is observed with the action of lambda-cyhalothrin.

An analysis of the data on the mesofauna on the studied experimental variants (meadow – chestnut) showed that the common species are insect larvae from the family *Carabidae, Scarabaeidae, Formicidae*, since these species have plasticity (the ability to inhabit a wide variety of biotopes). The dominant species are insect larvae - *Formicidae, Scarabaeidae.*

It was established that the quantitative and qualitative composition of the soil mesofauna is associated with a specific soil type, it turned out that the larvae are from the family *Chrisomelidae, Elateridae*, and *Chloropidae, Pyraustidae* are associated with more humus-rich, moisture-rich soils (meadow – chestnut soils). Mesofauna, along with other soil characteristics, may well be used as a bio-indicator. It has been established that the species composition of soil organisms can be used as a criterion for a qualitative assessment of the degree of impact of pesticides on soils.

As a result of the studies, an assessment was made of the degree of sensitivity to various chemical elements of pesticides of certain types of invertebrates: *Formicidae, Scarabaeidae, Chrisomelida, Pyraustidae*. The results obtained suggest that, in contrast to abundance indicators, the species composition of soil invertebrates can be used as a criterion for a qualitative assessment of the degree of impact of pesticides on the soil.

It was revealed that soil pollution with pesticides leads to changes in the functioning of soil invertebrates. Soil pollution with pesticides leads to a change in the structure and composition of soil invertebrate complexes, which is manifested in a decrease in species diversity and a change in the occurrence of species. When conducting research, the phenomenon of "concentration of dominance" was observed, i.e. preservation in the soil of only some types of mesofauna of soils with high occurrence (*Formicidae, Scarabaeidae.*). We found that under the influence of the same pesticides, the similarity of mushroom complexes in different zonal soil types increases. Thus, there is a danger of destroying the primary and the formation of atypical for natural soil-ecological conditions communities of microorganisms under the influence of high levels of pollution.

We found that pollution with chemicals affects the activity of biochemical processes in the soil. They alter its enzymatic activity. According to the degree of resistance to pollution, the enzymes studied in meadow – chestnut soil are located as follows: dehydraginase> invertase> urease.

Pesticides inhibit the activity of soil invertebrates. Contamination of meadow-chestnut soils with pesticides in several experimental variants influenced even such a stable indicator as the content of humus in the soil. In our opinion, the decrease in humus content depends on the action of oppressed representatives of soil invertebrate animals of saprotrophic level. These include the following representatives of soil invertebrates: the *Lumbricidae* family.

Our results indicate that according to the number of individual groups of mesofauna (phytophagous, zoophages, saprophagous), it is impossible to identify significant differences in the effect of pesticides on the soil at concentrations several times higher than the MPC. Significant changes in numbers are detected only when the concentration of the pollutant is two orders of magnitude higher than the MPC [20].

CONCLUSIONS

1 Pesticide contamination leads to a decrease in the biological activity of meadow-chestnut soil, resulting in a change of the following indicators: an increase in pH from 7.45 to 7.6, changes in the absolute density of representatives of soil animals: Formicidae, from 16.5 to 0.85 ind./m^2, Scarabaeidae from 13.5 to 0.7 ind./m^2; lumbricide from 22.3 to 0.9 ind./m^2, change in soil enzyme parameters: dehydrogenases from 7.3 to 8.1 %/g, invertase from 15.1 to 23.5 %/g.

2 Based on the studies, it was established that the meadow – chestnut soil of the foothill zone is well provided with organic matter and the initial humus content in the soil at the beginning of the studies is quite high both in the arable (4.44–4.65 %) and in the subsoil layer (4.41 –4.50 %) for all options and crop rotation fields. The influence of fertilizers and crop rotation on the dynamics of humus was determined at the end of the study.

3 It has been established that contamination with chemicals affects the activity of biochemical processes in the soil. They alter its enzymatic activity. According to the degree of resistance to pollution, the enzymes studied in meadow chestnut soil are located as follows: dehydraginase> invertase> urease.

4 The toxic effect of pesticides on the biological activity in the ecosystem manifests itself in the first time after pollution, when their number in the soil decreases significantly. These include representatives of the families Chrisomelidae, Elateridae, Chloropidae, Pyraustidae.

5 Pesticides inhibit the activity of soil invertebrates. Contamination of meadow-chestnut soils with pesticides in several experimental variants influenced even such a stable indicator as the content of humus in the soil. The decrease in humus content, in our opinion, depends on the action of oppressed representatives of soil invertebrates of the saprotrophic level, Lumbricidae.

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ТҮЙІН

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ҚАЗАҚСТАННЫҢ ОҢТҮСТІК-ШЫҒЫСЫНДАҒЫ ТОПЫРАҚ ОМЫРТҚАСЫЗДАРЫНЫҢ САНЫ МЕН ТҮР ҚҰРАМЫНА ПЕСТИЦИДТЕРДІҢ ӘСЕРІ

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Жұмыста пестицидтердің топырақтың биологиялық белсенділігіне әсер ету нәтижелері келтірілген, сондай-ақ биологиялық белсенділікті төмендететін диагностикалық көрсеткіштерді белгілей отырып, 4 егістікте ауыспалы егіс айналымындағы шалғындық–каштан топырағының жай-күйіне экологиялық баға берілді. Республиканың оңтүстік-шығысындағы шалғынды-каштан топырағында жеміс–ауыспалы егіс дақылдарының (жүгері, арпа, рапс, соя) негізіндегі топырақтың физика-химиялық және биологиялық қасиеттері зерттелді. Топырақ үлгілеріндегі пестицидтердің құрамына хроматографиялық талдауының нәтижелері көрсетілген. Шалғынды-каштан топырақтарына олардың пестицидтермен ластануына қатысты тұрақтылығын анықтау мақсатында биологиялық белсенділіктің өзгеру дәрежесі бойынша зерттеу жүргізілді. Алынған деректер шалғынды-каштан топырақтарының пестицидтермен ластануына тұрақтылық дәрежесін анықтауға мүмкіндік берді. Топырақтық омыртқасыз жануарлардың түрлері, сондай-ақ шалғынды-каштан топырақтарының пестицидтермен ластануын мониторингілеу үшін биоиндикатор ретінде пайдалану қажет топырақтық ферменттер анықталды. Алынған нәтижелер Қазақстанның оңтүстік-шығыс экожүйелерінде пестицидтермен ластанудың әсерінен шалғынды-каштан топырақтарының биологиялық белсенділігінің өзгеруі туралы білімді кеңейтуге мүмкіндік береді.

Түйінді сөздер: шалғынды-қоңыр топырақ, пестицидтер, мезофауна топырақ, биологиялық белсенділік, экология, хроматографиялық талдау.

РЕЗЮМЕ

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ВЛИЯНИЕ ПЕСТИЦИДОВ НА ЧИСЛЕННОСТЬ И ВИДОВОЙ СОСТАВ ПОЧВЕННЫХ БЕСПОЗВОНОЧНЫХ ЮГО-ВОСТОКА КАЗАХСТАНА

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В работе приведены результаты воздействия пестицидов на биологическую активность почв, а так же дана экологическая оценка состояния лугово-каштановой почвы в 4–х польном севообороте с установлением диагностических показателей, снижающих биологическую активность. Изучены физико–химические и биологические свойства почв под культурами плодосменного севооборота (кукуруза, ячмень, рапс, соя) на лугово–каштановой почве юго–востока республики. Показаны результаты хроматографического анализа почвенных образцов на содержание пестицидов. Проведено исследование лугово-каштановых почв по степени изменения биологической активности с целью определения их относительной устойчивости к загрязнению пестицидами. Полученные данные позволили выявить степень устойчивости лугово-каштановых почв к загрязнению пестицидами. Выявлены виды почвенных беспозвоночных животных, а так же почвенные ферменты, которые необходимо использовать в качестве биоиндикаторов для мониторинга загрязнения лугово-каштановых почв пестицидами. Полученные результаты позволят расширить знания об изменении биологической активности лугово-каштановых почв под влиянием загрязнения пестицидами в экосистемах юго-востока Казахстана.

Ключевые слова: лугово-каштановая почва, пестициды, мезофауна почв, биологическая активность, экология, хроматографический анализ.