Indicators in Monitoring of Anthropogenous Influences

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Abstract:

At present, soil pollution of ecosystems with fertilizers and pesticides has become global. Their entry into the soil in large quantities primarily affects the biological properties of the soil. Many authors show the destructive effect of fertilizers and chemical pesticides on soil biota. Many researchers, both in our country and abroad, were involved in the problem of the effect of chemicalization on the biological activity of the soil. Similar studies were conducted in the Republic of Kazakhstan, but in most cases they were fragmentary.

The purpose of our research is to study the effect of pesticides and fertilizers on biological activity and trace elements for the use of these indicators in monitoring anthropogenic influences in the system of modern farming of the irrigation zone and the bogs of the southeast of Kazakhstan.

In accordance with this goal, the following tasks will be accomplished: To determine the effect of fertilizers and pesticides on the biological activity of soils in the system of modern farming in the irrigation zone and the bogs of southeast Kazakhstan; To study the effect of pesticides and fertilizers on the humus state, the content of nitrogen, phosphorus, potassium and trace elements available for plants in the soil for use in monitoring anthropogenic impacts; To determine the dependence of the change in biological activity on the nature of the pesticide, its content in the soil of the studied ecosystems; With the help of a set of indicators to develop the most effective way to diagnose different levels of soil contamination with fertilizers and pesticides affecting the biological activity of soil in the irrigation zone and the bogs of southeast Kazakhstan

Over the past 10-12 years, the use of fertilizers and pesticides has decreased significantly, while the decline in crop yields has been less pronounced and even in certain favorable years, an increase in the yield of cereals has been observed.

Biochemical processes of transformation of organic substance in the soil are made with active participation of enzymes which accelerate biochemical reactions many times.

Results of our research has shown that enzymatic activity of the meadow-chestnut soil is subjected to essential changes not only by pesticides and fertilizers, but also by features of the cultivated culture. Invertazive activity of the soil fluctuates under crops of corn 9,3 to 10,5 mg depending on types of fertilizers. Settlement norms of fertilizers promote decrease in invertazive activity whereas it has considerably increased of manure injection (Table 1).

Table 1. Enzymatic activity of the meadow-chestnut soil by cultures of a crop rotation depending on mineral fertilizers

Experiment	Corn		Colza	
	Definition terms			
	I term	II term	I term	II term
Invertazive activity, glucose mg on 1 g of the soil				
Control	10,0	8,50	9,5	8,20
Settlement norm	9,00	8,00	8,00	7,90
Manure, 30 т/hectare	9,70	8,50	10,0	8,70
Urease activity, NH3 mg on 1 g of the soil in 24 hours				
Control	0,90	0,90	0,65	0,70
Settlement norm	1,00	0,90	0,95	0,65
Manure, 30 т/hectare	1,30	1,45	0,90	0,55
Dehydrogenase activity, TFF mg on 1 g of the soil in 24 hours				
Control	0,50	0,45	0,50	0,50
Manure, 30 т/hectare	0,45	0,60	0,55	0,65
Settlement norm	0,70	0,65	0,78	

As there is shown in table 2, invertazive activity of the soil by culture of colza is a little lower, than by corn that is especially noticeable in the first time of definition that it is connected first of all with morphology and development of root system by this period. Regularity of influence of fertilizers is the same, as well as by crops of corn.

Fertilizers have affected dynamics of urease and dehydrogenase activity of the soil, at the same time, dehydrogenase activity unlike invertazive not so strongly changes from application of fertilizers and features of culture of a crop rotation.

To the second term of selection, urease activity decreases significantly, especially at the settlement norm of fertilizers.

Many researchers [1,2] the possibility of use of activity of enzymes as an indicator of biological activity and fertility of soils was established. Among soil enzymes the most indicative and sensitive at the characteristic of a biological state and level of fertility of soils, indicators of activity of an invertaza, enzymes from a class a hydromanhole and dehydrogenase and from a class of oxidoreductases are widely applied.

In recent years searches of diagnostic methods of impurity of soils by means of enzymatic reactions are conducted.

We have defined activity of an invertaze and dehydrogenase to give the comparative characteristic of biological activity on the explored soils. The irrigated soils – the meadow-chestnut soil and on a bogara – the light brown soil were analysed.

Invertaziveactivity

Invertaze is the most indicative and studied. Availability of this enzyme in the soil is caused by activity of microorganisms, mesofauna and plants in which root allocations a big share make an exoenzyme of an invertaze. It catalyzes disintegration of carbohydrates-sugars on aquired forms – glucose and fructose, thereby, providing a carbohydrate metabolism in the soil. It is revealed that invertaze activity well correlates with humus, a biogenic and its indicator is used at the characteristic of types, subtypes of soils, degree of a culture, credibility, influence of cultural plants, and also degree of impurity of soils by techno genic substances. On activity of an invertaze the estimated gradation on degree of impurity of soils is offered by pesticides and heavy metals. According to this gradation, soils in which activity of an invertaze in comparison with uncontaminated decreases by 25% are carried to low polluted; to midpolluted – 25-50% and high polluted more than 50%.

In table 2 sizes of activity of an invertaze are specified in the explored soils.

Table 2. Invertaze activity of the explored soils (an average for 2016)

Type of soil	**Layer, cm**	**IA in glucose mg on 1 g of the soil for 4 h.**
Meadow-chestnut	0-10	15,58
	10-20	13,10
Lightbrown	0-10	9,78
	10-20	7,56

From the provided table it is visible that activity of an invertaze is high on the explored soils. High activity of an invertaze on the studied soils corresponds to the maintenance of a humus in the soil [3,4]. The quantity of an invertaze varies depending on type of the soil and on depth of a soil layer. Most of all enzyme of an invertaze is concentrated in a layer of 0-10 cm and the greatest activity of an invertaze is noted in the meadow-chestnut soil (irrigated) and the smallest activity of enzyme on the light brown soil (bogar).

Dehydrogenase activity

One of active biocatalysts of oxidation-reduction reactions is the dehydrogenase – the enzyme participating in biological transformations of organic compounds in the soil. The biological origin of a dehydrogenase, will be coordinated accurately with total number of microorganisms, humus and other parameters of soil fertility. Dehydrogenase most objectively reflects total biological activity and fertility of soils. The fertile soil is the more activity of a dehydrogenase. Results of the analysis of dehydrogenase activity of soils are shown in table 3.

Table 3. Activity of a dehydrogenase in various soils (an average for 2016)

Type of soil	Layer, cm	DA in glucose mg on 1 g of the soil for 24 h.
Meadow-chestnut	0-10	0,396
	10-20	0,182
Lightbrown	0-10	0,353
	10-20	0,182

Apparently, from these tables (table 2, 3) the explored soils have various level of activity of a dehydrogenase and have the same picture, as activity of an invertaze. Enzyme of a dehydrogenase, as well as invertaze is generally concentrated in a layer of 0-10 cm. Level of dehydrogenase activity on the meadow-chestnut soil is higher, than on the light brown soil.

So, the explored soils have various level of the biological activity determined by quantity of an invertaze and dehydrogenase which settle down in the following order:

meadow-chestnut > light brown.

Physical and chemical indicators of the soil on a live component of the soil environment in long stationary experiences

In the soil samples which are selected with the item Saimasai and Almalybak were p, p '-DDE in trace quantities is found. In the majority of the studied soil samples with the item Saimasai organochlorine pesticides (HOP), except samples of the soil No. 1, 16 and 19 haven't been found (Figure 1). In samples of the soil No. 1, 16 and 19 are found by DDE and DDD in very small quantities. According to the obtained data, in the soils selected with the item Almalybak DDE in the range from 0,7 to 1,8 mkg/kg are found. These concentration are trace as the maximum allowable concentration of organochlorine pesticides makes 100 mkg/kg.

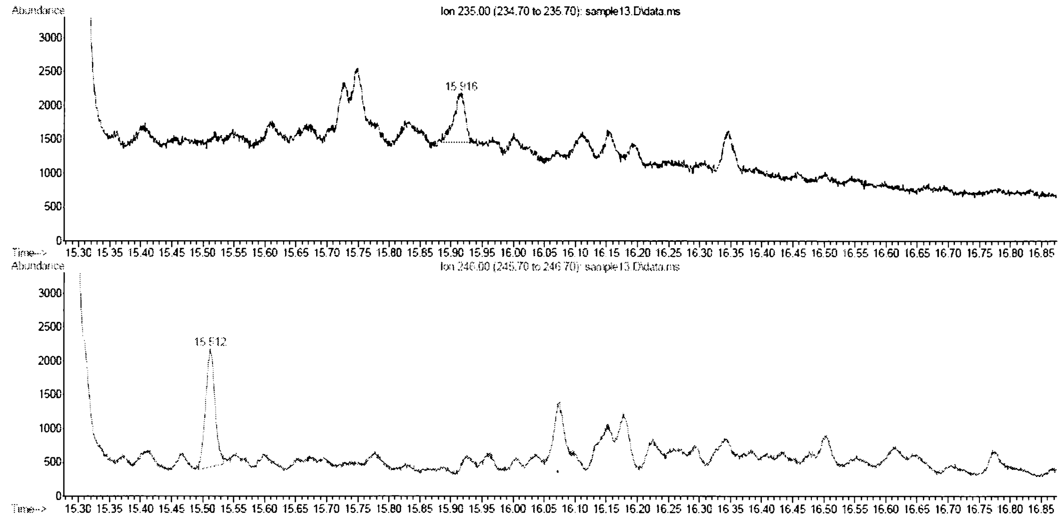

Fig 1. Chromatogramm GC-MS received in the analysis of a soil sample №16

Definition of HOP in the soil by GC-EZD method

The analysis was carried out on the gas chromatograph 7890A (Agilent, the USA), MultiPurpose Sampler (Gerstel, Germany) equipped avtosamplerom. The sample of 1,0 ml with the help autosample was entered into the device for test input heated to 250 °C in the mode without division of a stream. For division used the capillary column DB-35MS (Agilent, the USA) 30 m long, with an internal diameter of 0,25 mm and film of 0,25 microns thick. Gas carrier (helium of the A brand) was given in the mode of constant speed of a stream, a component of 1,0 ml/min. (average linear speed of a stream of 36 cm / c). Temperature of the thermostat of a column was programmed from 40 °C (endurance of 1 min.) to 160 °C (endurance of 5 min.) with a speed of heating of 5 °C/min. with the subsequent heating to 280 °C (endurance of 5 min.) with a speed of 5 °C/min. Detecting was carried out on the electron-capture detector (EZD) on time of keeping of the corresponding pesticides (Agilent, the USA).

For maintenance of reliability of the analyses carried out the single analysis with pure solvent, for the purpose of confirmation of lack of the analyzed substances and for elimination of the disturbing components from the previous analyses.

Construction of calibration dependences

For creation of calibration dependences 3 standard solutions p, p '-DDT have been prepared, for p, with p' - DDD, p, p '-DDE of 1 ml and concentration of each component 1; 5; 10 and 50 mkg/l from the certified mixes of the corresponding pesticides with concentration of 100 mg/l. All solutions have been prepared in N hexane. The prepared samples were analyzed by method of a gas chromatography with electron-capture detecting (GC-EZD). The analysis of each test was carried out twice. Data of calibration dependences of HOP are presented in table 4.

Table 4. Data of calibration dependences of HOP

Name of pesticide	**Range of concentration, mkg/l**	**Equation direct**	**Approximation coefficient**
p,p'-ДДТ	1-50	y = 47.925x	$R^2 = 0.9774$
p,p'-ДДЭ	1-50	y = 674.05x	$R^2 = 0.9998$
p,p'-ДДД	1-50	y = 627.34x	$R^2 = 0.9975$

All received calibration dependences are linear in the range of concentration of 1-50 mkg/l. Coefficients of approximation (R2) for each HOP have made more than 0,97.

In the majority of the studied samples of the soil which are selected in April trace quantities of p, p '-DDE have been found.

In samples of the soils selected in June from under cultures such as, corn, soy and beet, have also been found trace amounts of organochlorine pesticides, in particular p p '-DDE. In soil samples from under colza HOP haven't been found. In soil samples from under corn all three organochlorine pesticides have been found, however their concentration in the soil doesn't exceed threshold limit value (maximum allowable concentration = 100 mkg/kg).

In the soil samples which are selected in July trace quantities of p, p' - DDE have also been found.

Besides soil images samples of plants of cultures (leaves and stalks) have been selected and analysed. Results of the chromatographic analysis have shown that in a stalk of corn p, p '-DDD in number from 1,69 to 2,99 mkg/kg and in leaves of fodder beet of 1,11 - 2,7 mkg/kg collects. The found concentration of p, p' - DDE in other samples of plants are trace.

Chromatograms of soil and vegetable samples are presented in figures 2-3.

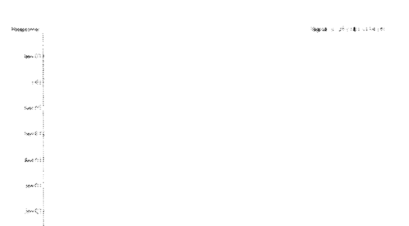

Fig 2. Chromatograms of the polluted HOP of a sample of the soil No. 13 (June)

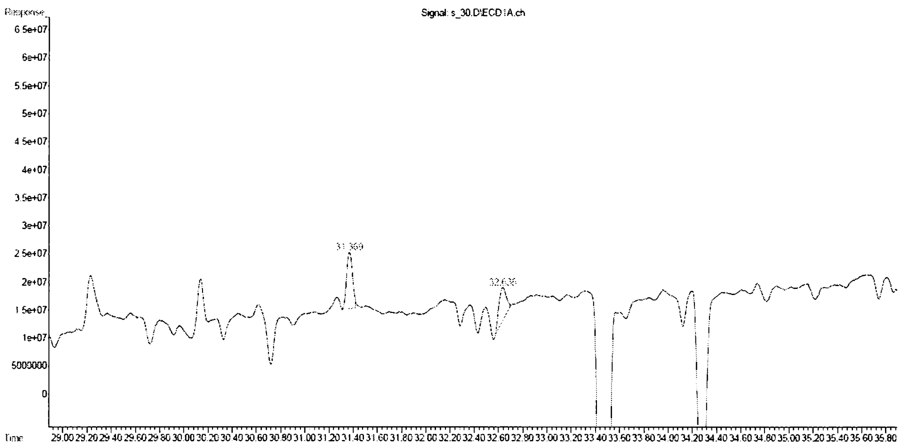

Fig 3. Chromatograms of the polluted HOP of a sample of the soil No. 18 (June)

Conclusion

The results of the chromatographic analysis of soil samples and plants on the maintenance of HOP have shown that in the majority of tests these connections are absent, and the found concentration of pesticides are trace and don't render harm.

It is established that the maintenance of HOP (organochlorine pesticides) in samples of the light brown soil in skilled crops of agriculture and crop production doesn't exceed their maximum allowable concentration.

It is established that pesticides are low toxic for Lumbricidae and are highly toxic even in insignificant quantities for representatives from the Carabida family.

It is established that mineral fertilizers depressed somewhat development of both useful, and harmful insects. Phosphoric and potash fertilizers separately, and also a combination of each of them with nitric didn't render noticeable influence on the number of wireworm. However at joint effect of phosphoric and potash fertilizers the quantity of wireworm has decreased by 2–3 times, and in combination with nitric – respectively by 4–6 times. At introduction of 30 t/hectare of manure of wireworm has decreased by 1,5 times, and at increase in a dose of manure up to 60 t/hectare – by 3 times in comparison with control.