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DEVELOPMENT OF PHYSICAL CHEMICAL AND BIOLOGICAL BASES OF MONITORING PARAMETERS OF ANTHROPOGENIC IMPACT ON THE SYSTEM OF MODERN AGRICULTURE IRRIGATION AND RAINFED AREAS SOUTHEAST OF KAZAKHSTAN

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ABSTRACT

nowadays, soil pollution by fertilizers and pesticides ecosystems are global problem. Contamination of the soil with large amounts of fertilizers and pesticides primarily affects the biological properties of the soil. Many authors have shown devastating impact of high standards of fertilizers and chemical pesticides on soil biota. Many researchers studied problem of influence of chemicals on soil biological activity, both in country and abroad. Similar studies were also conducted in the Republic of Kazakhstan, but in most cases they were fragmentary.

Comparative analysis of different methods to assess the biological activity of the soil in the area of irrigation and rainfed southeastern Kazakhstan was done on the basis of comprehensive research. Types of soil invertebrates reagents, which should be used as bio indicators for monitoring contamination of soil with pesticides and heavy metals has identified

Keywords: soil, fertilizers, pesticides, irrigation, monitoring

INTRODUCTION

Modern farming requirements are based on the necessity of the intensification to increase of environmentally safe agricultural production. But intensification is often carried out by widely use of chemical methods, intensive soil cultivation with high pesticide load, leading to a drop in soil fertility, its deficiency of organic matter; reduction of its biodiversity and, in complex, to poor product quality crops.

One of the fundamental problems of soil science is knowledge of the essence of soil formation processes and the formation of soil fertility. In this regard, using living organisms as biological indicators to environmental changes, along with physical and chemical parameters, results in necessity of development of a set of criteria for selection of indicator species. These include biological activity of soils (mesofauna, enzymes). Soil invertebrates, along with other soil characteristics, may be used as bioindicators.

Soils are contaminated by various harmful chemicals, pesticides, fertilizers, agricultural, industrial wastes and wastes of municipal enterprises. Chemical compounds introduced to soil accumulate and lead to a gradual change in chemical and physical properties of soil, reducing the number of living organisms, degrading its fertility. Due to the fact that soil is an essential element of the biosphere and plays a critical role in society throughout the world it is extremely important to study its current condition and changes under the influence of human activities [1-3].

The novelty of our study, in contrast to the existing work in the literature, is based on the study of influence of anthropogenic impacts on soil biological activity in comparison with its main indicators, which allows to establish the soil fauna correlative connection with major traditional indicators of soil fertility, and significantly enhances their ecological importance in the assessment of agricultural techniques in agricultural production.

Thus, at the present time it is necessary to have such methods of assessment of soil contamination that could give an objective view of state of soil that is how it is able to perform its intended function. The considered methods, such as biodiagnosics of contaminated soils, meet the requirements of modern research of contaminated soils.

Biodiagnosics of soil contamination is fairly simple method that is able to give a realistic assessment of soil condition. This was made possible after years of research, when the most informative indicators objectively reflecting the level and the effects of pollution and do not require the expensive equipment for their determination were found.

As it was shown by recent studies, fertilizers, and pesticides have a negative impact on soil biota. Using of pesticides can lead to restructuring of the environmental situation in soil, changing its biocenosis, oppressing one group of soil organisms and stimulate expansion of other, representatives of which are capable of producing phytotoxic substances and thereby aggravate the negative effect of the chemicals [4].

However, in Kazakhstan such researches have a fragmented character, soil animals and their effects on soil properties have been studied poorly. The reason for the relatively poor knowledge of soil animals is not only the complexity of the conditions for the existence of organisms in the soil, but also the difficulty of observation and study of the soil fauna due to the opacity and density of habitat. And, despite the importance of soil fauna in the soil-forming process, in Kazakhstan it is still poorly understood, especially in the agro-technical influences in irrigation and rainfed areas of south-eastern Kazakhstan. Lack of information on the biological activity in this area, the underestimation of the role of soil invertebrates and their value in the formation and reproduction of soil fertility, lack of methods of biodiagnosics and indication of soil identified the relevance and need for systemic research in this direction.

At present time, there are environmental problems in Kazakhstan, connected to the accumulation of significant amounts of forbidden and useless old pesticides [5]. In Kazakhstan and neighborhood countries of CIS more than 700 pesticides, belonged to the different classes of chemical compounds, over the past 30 years have been of practical use. Kazakhstan imports more than 230 pesticides from abroad. For today, there is more than 250 pesticides (toxic chemicals) are registered in Kazakhstan. Every year a list of registered pesticides is updated with new chemicals. A list of pesticides (toxic chemicals), which are produced in Kazakhstan, is also updated. In addition,

of storage facilities do not correspond to the number of stored toxic chemicals

In the past few decades, more and more attention has been paid to trace analysis of pollutants in environmental systems and biological objects. It should be noted that in recent years the equipment of laboratories involved in the analysis of pesticides in biological objects, plants and soil, has been improved markedly. More efficient chromatographic methods such as gas chromatography of high resolution began to use for the quantitative determination of pesticides.

Similar and related alternative researches are not carried out in Kazakhstan. Works on the reconstruction of the soil fauna in order to increase the natural fertility of soil, mainly through the introduction of useful species, have been carried out in the CIS countries and abroad [7-8].

Involving soil-zoological studies allows to determine the effects in the agricultural and industry activities and in the evaluation of pollution by industry waste, heavy metals, fertilizers, pesticides and radionuclides.

Over the past 10-12 years, the use of fertilizers, pesticides has been decreased significantly, while reducing crop yields did not happen so much, and even in some good years, an increase in the yield of grain crops was observed.

In particular, as noted by several authors [9-12], in dealing with changes in soil under the influence of anthropogenic impacts applied methods of analysis of agrochemical and physical properties of soil can not serve as diagnostic features, because they do not reflect the changes occurring in the soil, and soil organisms that are sensitive to changing conditions have the advantage for the purposes of soil diagnostics. Therefore, it is important to the methods of biological activity in the study of human impact on soil is not only important, but necessary. This is especially important in the study of the changes occurring in the soil, through the systematic application of fertilizers, herbicides, insecticides, and, especially with high doses of fertilizers.

Work on the development of physico-chemical and biological bases of monitoring indicators of anthropogenic impacts in the system of modern agriculture in irrigation and rainfed areas of south-east of Kazakhstan, will serve as the basis for:

monitoring of soil fertility in the development of modern technologies of cultivation of crops in different crop rotations under irrigation and rainfed conditions;

indication and biodiagnosics of soils;

biodiagnosics of efficiency and ecological compatibility of agrotechnical and agro-chemical methods of improving soil fertility in biological farming system.

A recommendation on the use of biological indicators, together with physico-chemical indicators as environmental monitoring of soil and compliance with the principles of biological farming will be made for farmers producing environmentally friendly products, for agricultural production controlling bodies, as well as for variety of scientific and educational institutions that train specialists in the field of biology, zoology, biotechnology and agriculture. The results can be used by specialists of sanitary inspection, biologists, chemists, soil scientists, farmers and environmentalists.

The effect of various anthropogenic factors on the dynamics of soil invertebrates in comparison with its main indicators will be studied for the first time in conditions of irrigation and rainfed areas of south-east of Kazakhstan that allows to set the correlative relationship of soil fauna with major traditional indicators of soil fertility, and significantly enhance their ecological importance in the assessment of agrotechniques in agricultural production.

The research is competitive in domestic and foreign markets, as it is intended to develop criteria for the biological assessment of agrotechnical methods in the system of modern agriculture in irrigated and rainfed areas of south-eastern Kazakhstan. Optimal indicative property of soil biological activity, along with other indicators, helps to create optimal soil fertility, providing high productivity of the studied crops and allowing to get an increased crop yield relative to the blank samples without using the factors of biologization - corn c/ha; flax seeds 2.5-3.5 c/ha; rapeseed 2.0-4.0 c/ha; soybean seeds 3.0-4.5 c/ha; barley - 4.5-6.0 c/ha; green mass of corn 23-100 c/ha; net production and respective safety of the conditions. The results of this research can be used in large and small scale farming areas of rainfed and irrigated agriculture areas with the long-term average rainfall of 280-450 mm per year. In these farms recommended tillage systems and fertilizer use will provide annual addition of at least 4-5 c/ha of grain yield at the current levels of grain yields in the range 13-14 c/ha. According to the results of the research, further work on the implementation of developments in the economies of the area will be carried out.

The aim of our research is to study the influence of different systems of application of fertilizers, pesticides and agro techniques, physical chemical characteristics of soil on the living component of soil environment in long-term stationary experiments, and, based on them, to develop monitoring parameters of anthropogenic impact in the system of modern agriculture in irrigation and rainfed areas of south-eastern Kazakhstan.

According the aim of the work following objectives will be done:

- to determine the impact of fertilizers and pesticides on the amount of major groups of soil mesofauna in the system of modern agriculture in rainfed and irrigated areas of south-eastern Kazakhstan;
- to identify species of soil invertebrates as indicators of soil contamination by pesticides and high rates of fertilizer;
- to examine the impact of pesticides and fertilizers on the biological activity, humus status, content of available forms of nitrogen, phosphorus, potassium and trace elements to plants in soil, for use of these indicators in monitoring of anthropogenic impacts;
- to establish biological activity variation as function of the nature of the pesticide;
- using a set of indicators, to develop the most effective way to diagnose different levels of soil contamination by fertilizers and pesticides that affect the biological activity of the soil in the irrigation and rainfed areas of south-eastern Kazakhstan.

Methods of research

The methodology of scientific research is based on using field experiments; laboratory and analytical work, including study of nutrient status and biological properties of soil, change the nature of fertility depending on the studied factors on background biologization rotations with low power consumption, chemical composition of plants,

environmental friendliness of products, methods of statistical processing of experimental data, residual effects of pesticides will be studied using gas chromatography and mass spectrometric detection.

Solution of tasks will be carried out by field tests with four crops of crop rotation on irrigated meadow-chestnut soil to establish optimal diets of oilseeds and legumes in rotation 4 pole deployed rotation in space and time.

Area of test site is 54m² (3.6 x 15), repetition experience 3-fold.

Fertilizers - ammonium nitrate content with 32-34% N; phosphorus - with simple superphosphate content 18-19% P₂O₅ and potassium - potassium sulfate content with 46-49% K₂O will be used as fertilizers. Cattle manure - vermicompost, cereal straw. Treatments are carried out in rainfed as follows:

Variants of fertilizers	Control	N ₆₀	P ₆₀	N ₆₀ P ₆₀
Plowing 22 cm	+	+	+	+
Flat-carved 22 cm	+	+	+	+
Flat-carved 10-12 cm	+	+	+	+
BD 5-6 cm	+	+	+	+
Zero cultivation	+	+	+	+

Combination of relatively geographical and comparative analytical methods will reveal features of profile distribution of soil invertebrates in physical-geographical aspect.

Soil sampling to determine physical and chemical properties and for biological studies will be carried out every 10 cm by taking with core sampler to a depth of 40 cm. There is a lack of soil invertebrates below 40 cm of soil depth, and that this lower limit for soil sampling.

Farming equipment in experiments is common for site. During the growing season of crop rotation soil samples to a depth of 0-20 cm, 20-40 cm and plant samples was selected on the main phases of growth and development. Recording harvest was carried out by the definition of reliability according to Dospekhov B.A.

Conventional methods for soil analysis was used: humidity is determined by gravimetric method, total humus - by Tyurin method by wet combustion of carbon oxidation of humus and its dichromate; specific gravity - pycnometric method; bulk density using Janovsky core; total porosity - calculation method; to determine the biological indicators - a method of manual disassembly according Gilyarova; gross forms of nitrogen, phosphorus from one sample according Gizburgu and Sheheglova; Kjeldahl nitrogen determination; calorimetric determination of phosphorus, potassium flame photometer; nitrate nitrogen by-Grandval Lyazhu, mobile phosphorus by Machigin B.A. method. Content of heavy metals was determined by conventional methods.

Developing methods will use significantly smaller volumes of organic solvents and waste substantially lower emissions of toxicants to environment in comparison with existing methods.

Expected results

Comparative analysis of different methods to assess biological activity of soil in irrigation and rainfed areas of south-eastern Kazakhstan will be carried out on the basis of comprehensive researches. Comparison of different types of soils rainfed and irrigation on the degree of change of biological activity and determination of their relative resistance to contamination at various rates of fertilizers and pesticides will be first done. Types of soil invertebrates reagents, which should be used as bio-indicators for monitoring contamination of soil with pesticides and heavy metals will be identified.

Optimal property indicative of soil biological activity, along with other indicators helps create optimal soil fertility, providing high productivity of studied crops and allowing relative to the control options without biologization factors to increase crop - corn c/ha; flax seeds 2.5-3.5 c/ha; rapeseed 2.0-4.0 c/ha; soybean seeds 3.0-4.5 c/ha; barley - 4.5-6.0 c/ha, green mass of corn 23-100 c/ha net production and product safety conditions for people's lives.

CONCLUSION

Results of this research can be applied in institutions searching for new high-efficiency natural bioactive compounds and production of biological products based on them, as well as in various scientific and educational institutions that train specialists in the fields of biology, biotechnology and agriculture.

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