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To the Question of the Study of the Ecological State of Steppe Soils

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Abstract

This article presents conclusions about the ecological state of steppe soils, which were obtained as a result of the EPR (Electronic paramagnetic resonance) spectroscopy method and the microbiological method. The selection of soil samples for the study was carried out in the steppes of different territories: Voronezh region; Rostov Region; Volgograd Region; Republic of Kalmykia. It was revealed that free radicals were present in all soil samples.

Keywords: EPR (Electronic paramagnetic resonance) spectroscopy, free radicals, microbiological soil activity, cellulose, ecological state of soils, steppe, laboratory.

Аннотация

В данной статье представлены выводы об экологическом состоянии степных почв, которые были получены в результате проведения метода ЭПР спектроскопии и микробиологического метода. Отбор образцов почв для исследования проводился в степях на разных территориях: Воронежская область; Ростовская область; Волгоградская область; Республика Калмыкия. В результате проведения опыта было выявлено, что свободные радикалы присутствуют во всех образцах почвы.

Ключевые слова: ЭПР спектроскопия, свободные радикалы, микробиологическая активность почв, целлюлоза, экологическое состояние почв, степь, лаборатория.

Introduction

Man is constantly changing natural ecosystems to meet his needs. Human economic activity entails drastic changes in all components of biocenoses. The plowing of the steppes gradually leads to the disappearance of many elements of the former biocenosis, and the constant use of soils in agriculture sphere leads to their depletion of nutrients [3].

The current pace of road construction and operation, the increase in tourist facilities increases the burden on the environment. There are almost no studies devoted to assessing the resistance of soils to pollution by heavy metals. It is advisable to determine the degree of soil resistance to chemical pollution using biodiagnostic methods [5, 7].

The description of the research

The following equipment was used to study the soil in the laboratory of the Kuban State University: prepared material (soil); laboratory mortar and pestle; quartz cuvettes; scales; acetone; cotton wool [2].

A small amount of soil was poured into a laboratory mortar, and then it was grounded with a special pestle. A clean cuvette was wiped clean with acetone, placed on the scales and its weight was recorded, after which a soil sample was poured into the cuvette. The cuvette with the soil sample was weighed on the scales and then inserted into the resonator to obtain an EPR signal. Spectra are recorded for 2 minutes. The EPR signal was recorded on a monitor and technically saved for the further processing. The course of work was repeated several times to study all samples [6, 1].

To determine the microbiological activity of soils, the following equipment was used: soil, containers, nylon bags and filter paper, scales.

Soil samples with a volume of 200 cm³ were placed into the plastic containers. Nylon bags were weighed with pieces of filter paper (5–10 cm).

In the experiment, 27 sachets were used (3 sachets per soil sample). After the weight of the bags was fixed, they were placed into a container so that the soil sample completely covered the nylon bag. The object was watered for a month to a moisture content of 60% of the field moisture capacity at a temperature of 25 °C. At the end of the experiments, the bags with filter papers were removed from the soil, dried, freed from soil residues and weighed. Then, the calculation of cellulolytic activity was performed [4].

The selection of soil samples for the study was carried out in the steppes in different territories. The selection was carried out in the upper soil horizons.

Sampling areas were: 1) Voronezh region; 2) Rostov Region; 3) Volgograd Region; 4) Republic of Kalmykia.

Table 1

Total data of the study of soil samples

<i>Sample №</i>	<i>Point</i>	<i>Sampling location</i>	<i>Sampling depth, cm</i>	<i>Sample mass M, mg</i>	<i>Concentration of free radicals, C, 10⁻⁹ mol/g</i>
1	T.201	Voronezh region, agricultural land	0-10	0.29	1.22
2	T.201	Voronezh region, agricultural land	10-20	0.22	1.09
3	T.101	Rostov Region Alekseevskiy District	0-10	0.25	0.54
4	T.101	Rostov Region Alekseevskiy District	10-20	0.33	0.25
5	T.132a	The field after the sunflower is prepared for sowing	0-10	0.3	1.208
6	T.160	Volgograd Region	0-10	0.19	1.00
7	T.160	Volgograd Region	10-20	0.23	1.19
8	T.32	Republic of Kalmykia	0-5	0.25	0.011
9	T.32	Republic of Kalmykia	5-10	0.23	0.315

Due to the experiment, it was revealed that free radicals were present in all soil samples.

So, according to the table 1, it can be seen that soil samples from the Voronezh region exhibit the highest paramagnetic activity (1,22). The least paramagnetic activity is shown by soil samples taken from the territory of Kalmykia (0,011).

Figure. 1. Concentration of free radicals in soil samples

According to the diagram (Fig. 1), it can be seen that the highest concentration of free radicals is in sample 1 (Voronezh region) and sample 5 (field after sunflower), and the lowest – in sample 8 (Kalmykia).

Paramagnetic activity can be explained by the fact that the upper horizons are subject to ground fall of herbaceous vegetation and its active processing under conditions of restoration of the natural state of the system of humic substances.

Based on the calculations, a diagram was done (Fig. 2), on which it is possible to see the difference in the cellulolytic activity of soils, expressed in the degree of decomposition of cellulose, between the objects of study.

The diagram (Fig. 2) shows that the strongest cellulolytic activity is observed in the soil from the Rostov region (Alekseevskiy district). The percentage of decomposed cellulose ranges from 14,39% to 40,69%. This means that the soil contains a large number of cellulose-destroying microorganisms, which is associated with a small anthropogenic load in the selected area of the territory.

Figure. 2. Cellulolytic activity of soils, %

The lowest cellulolytic activity was found in the soil of the Voronezh region. The percentage of decomposed cellulose ranges from 6,03% to 6,7%. Such indicators are probably due to high anthropogenic load, lack of vegetation cover, and possible contamination of the soil with heavy metals [4, 5].

Conclusion

Paramagnetic activity depends on the characteristics of soil formation and changes due to the definite depth. The reason for this may be the exploitation and disturbance of the soil, as well as other natural processes.

In the soil samples taken from the territory of the Voronezh region and the field prepared for sowing, the highest concentration of free radicals appears (1,22 and 1,208), but the lowest percentage of decomposed cellulose is observed (6,7% and 6,03%).

In soil samples taken from the Rostov region, the lowest concentration of free radicals appears (0,54 and 0,25), but there is a high percentage of decomposed cellulose (40,69% and 14,39%).

This may be thanks to the fact that biological productivity is higher in the upper soil layers, and this contributes to the natural processing of various residues of grassy vegetation and animals deposits.

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To the Question of Inventory of Flora Species Diversity of «Dolgaya Spit» of the Krasnodar Territory

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Abstract

The article examines the state of floristic diversity of higher vascular plants of the nature monument “Dolgaya Spit” (Yeisk district). The floristic diversity of the “Dolgaya Spit”, including 133 plant species based on the study of steppe, littoral and anthropogenically altered communities was established. The data on the taxonomic structure of the flora, the occurrence of species, the number of rare plant species are given in the research. Phytocenoses on the “Dolgaya Spit” are subject to significant anthropogenic impact, which requires the development of regulated sustainable recreational nature management.

Keywords: “Dolgaya Spit”, rare species, littoral, biodiversity, Eastern Azov region, protected areas.