GYPSIFEROUS SOILS OF JIZZAKH STEPPE AND THEIR BIOLOGICAL ACTIVITY

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Abstract. In the article materials are presented on the investigations of alterations’ regularities in the quantity and distribution of physiological groups of microorganisms (bacteria, fungi, actinomycetes, nitrogen fixers, nitrifiers, denitrifiers, aerobic cellulose decomposing bacteria, butyric acid bacteria) in gypsum soils. Determination of the influence of gypsum content and degree of salinization on enzymatic activity (catalase, peroxidase, polyphenol oxidase) and soil respiration, as well as on their alterations over the seasons of year; indicators of biological activity (BA), total relative biological activity (TBA) of soils, indicators on soil degradation have been developed.

Keywords: gypsiferous soils, biological activity, respiration, morphogenetic, agrochemical, chemical and general physical properties of soils

Introduction

At the present time, investigations are conducted in the world: on determination of genesis (origin) and elicitation the properties of gypsiferous soils, on research of alterations in soil cover during irrigation, on elimination of negative impacts on the soil, identification of the factors causing soil gipsation, on development of technologies to reduce the effects on growth and development agricultural crops taking into account soil gipsation. However, scientific investigations on the enzymatic activity, “soil respiration” properties, humus amount, and salinity level of gypsiferous soils, the dynamics of changes over the seasons of year, soil indicators of degradation, biological activity indicators (BA), and the determination of the correlation between the properties of gypsum soils territories were not adequately performed.

Methods and materials

Soil sampling was selected by genetic horizons, observations and laboratory analyzes of soils were carried out on the basis of methodological guidelines, such as “Methods of agrochemical, agrophysical and microbiological research in irrigated soils of cotton areas”, methods of E.V. Arinushkina and methods of research of physical properties of soils and grounds of A.F. Vadyunina and Z.A. Korchagina.

Agrochemical and physical properties of soils of the investigated object are determined under laboratory conditions by the following methods: humus - by Tyurin method; gross nitrogen, phosphorus and potassium - according to
Gritsenko, Maltseva, Smith; mobile phosphorus and potassium - according to Machigin, Protasov; CO₂ carbonates - by acidimetric method; gypsum SO₄ - in a salt extract; water-soluble salts - by method of water extraction according to Machigin; available forms of zinc, copper and manganese - according to Kruglova method; mechanical structure with treatment by GMP - according to Bratcheva; specific gravity - by pycnometric method; volumetric weight - Kaczynski’s cylinder; porosity - by calculation.

Soil microflora was determined by following methods: total quantity of microorganisms that assimilate organic forms of nitrogen (ammonificators) - on meat-peptone agar (MPA), actinomycetes - on starch-ammonia agar (SAA), microscopic fungi - on Chapek's medium, nitrogen-fixers - on liquid Ashby medium, nitrifying agents - on Vinogradsky liquid medium, denitrifiers - on Giltay medium, aerobic cellulose-destroying microorganisms - on Hutchinson-Clayton liquid medium, butyric acid bacteria - on Rushman liquid medium. Data on the accounting of microorganisms were processed according to McCredy table.

Soil respiration intensity - according to Shtatnov method in Koleshko modification. Soil enzymes activity was determined by the methods of soil enzymology described by F.Kh. Khaziyev [1972]: catalase by the gasometric method according to Kruglov and Paromenskaya, peroxidase and polyphenol oxidase - according to Karagina and Mikhailovskaya. Mathematical and statistical analysis of research results was performed by B. A. Dospekhov method.

Results and discussing

According to morphological indicators, soils of the investigated areas are distinguished by the presence of the following main morphological properties: relatively weak humus layer, the presence of a sod layer in the soil section of virgin soils on gypsum content and salinity, CO₂ on the presence of carbonates throughout the soil profile, distinct development of microaggregates and soil compaction down by profile.

At determination of salinization type and degree, content of easily soluble salts in their composition was taken into account. Depending on the quantity and distribution of salts along the profile, the following soils were identified: non-saline, weak, medium, strongly saline and salt marshes. The chlorine content in the soils is a small amount and is 0,003-0,056%, in highly saline horizons its amount reaches 0,203-0,262%. In most cases, the type of salinization is sulphate, in places it is chloride-sulphate. According to recalculation on the basis of CaSO₄*2H₂O in the soil composition, the amount of SO₄ gypsum varies from 10-17% to 37-41%.

According to the investigations results of general physical properties of soils, low amount of the volumetric mass, relatively high specific gravity, and the correspondingly high amount of porosity express a homogeneous characteristic of sierozem soils in the upper zoning in terms of mechanical composition. Relatively high volume mass of soils formed on layered proluvial horizons was noted in soil horizons with maximum gypsum content.

Activity of studied enzymes in all soil types decreases down the profile. According to the results of research of the seasonal dynamics of enzymatic activity of Jizzakh steppe soils, it follows that the hydrothermal conditions in gypsum soils are of great importance in the biochemical processes occurring in the soils. Relatively high activity of enzymes was noted in the upper humus and non-gypsum soil horizons. In spring, a higher enzymatic activity of the soil was observed compared to autumn. In arid climatic conditions, that is, in conditions of low precipitation, there is a change in the seasonal dynamics of enzymatic activity under the influence of air and soil temperature during the summer. These
processes are interconnected, and the highest level is noted in spring, in summer there is a slight decrease, and by autumn a noticeable increase.

In the investigated soils, a decrease of respiration intensity is observed down the profile. Based on the obtained results, it can be stated that the intensity of respiration in the soil depends on soil formation processes and soil properties.

According to the results of microbiological analyzes, gypsum content in the studied soils influences on microbiological activity of salted soils.

High activity of microorganisms was noted in weakly gypsy, non-saline, typical sierozem soils, in comparison with medium and strongly gypsy, to varying degrees saline, meadow, sierozem-meadow-meadow and meadow-saline soils.

Table 1 Readings of biological activity (BA) of gypsum soils of Jizzakh steppe

<table>
<thead>
<tr>
<th>Gypsum Content</th>
<th>Catalase</th>
<th>Polyphenol oxidase</th>
<th>Peroxidase</th>
<th>Ammonifiers</th>
<th>Nitrifiers</th>
<th>Fungus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2%</td>
<td>13.2</td>
<td>8.6</td>
<td>7.3</td>
<td>5000</td>
<td>110</td>
<td>98</td>
</tr>
<tr>
<td>Low Gypsum</td>
<td>10.0</td>
<td>7.5</td>
<td>6.8</td>
<td>1800</td>
<td>30</td>
<td>82</td>
</tr>
<tr>
<td>Medium Gypsum</td>
<td>6.3</td>
<td>4.8</td>
<td>5.2</td>
<td>910</td>
<td>16</td>
<td>62</td>
</tr>
<tr>
<td>High Gypsum</td>
<td>4.0</td>
<td>3.4</td>
<td>2.6</td>
<td>760</td>
<td>16</td>
<td>60</td>
</tr>
<tr>
<td>Very High Gypsum</td>
<td>2.4</td>
<td>1.8</td>
<td>1.2</td>
<td>250</td>
<td>1.5</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 2 Indicators of degradation of gypsiferous soils of Jizzakh steppe

<table>
<thead>
<tr>
<th>Gypsum Content</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0%</td>
<td>15.6</td>
</tr>
<tr>
<td>2.0%</td>
<td>13.4</td>
</tr>
<tr>
<td>3.0%</td>
<td>11.2</td>
</tr>
<tr>
<td>4.0%</td>
<td>9.0</td>
</tr>
<tr>
<td>5.0%</td>
<td>6.8</td>
</tr>
<tr>
<td>6.0%</td>
<td>4.6</td>
</tr>
<tr>
<td>7.0%</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Comprehensive study of BA value of gypsum soils with different
physicochemical, microbiological, and biochemical properties, as well as with an unequal soil structure, can clarify their ecological and genetic features, and can also clarify the extent of the impact of natural and environmental factors on soil fertility. Based on the results obtained, indicators of degradation for gypsum soils are recommended (table 2).

As a result of complex investigations, connection of total biological activity of soils was noted not only with the specific properties of the soil, but also the relationship with the surrounding system and processes.

At investigation of correlation between the properties of the soil in gypsum soils, a direct correlation was observed between microbiological and enzymatic activity with the content of gypsum \((r = 0.70-0.90)\), this reflects dependence of gypsum soils on biological properties, as well as fertility and degradation processes in soils. Thus, all investigated soils are characterized by individual interconnection systems. As a result, it is possible to determine some general regularity of region’s soils.

**Conclusion**

Among the investigated groups of microorganisms, it is observed predominance of ammonifiers, actinomycetes occupy the second place in the number, and next place is occupied by nitrogen-containing and denitrifying bacteria, as well as cellulose-destroying microorganisms and fungi. It was noted low content of butyric and nitrifying bacteria. Change in the number of microorganisms by the seasons of the year, the subtypes of the soil, and the depth of the soil horizon can be explained by a lack of moisture and a weak accumulation of organic matter along the soil profile. In soil types, a decrease in biological activity is observed as the gypsum content increases.

In the studied soils, various effects of soil gypsum content, degree of salinization on the number of physiological groups of microorganisms, enzyme activity and carbon dioxide \((\text{CO}_2)\) emission were determined. There was a decrease of biological activity \((\text{BA})\) of soils according to the degree of gypsation: non-gypsy soils — weakly gypsy soils — medium-gypsum soils — strongly gypsum soils — very strongly gypsum soils.

The correlation between the number of microorganisms, enzyme activity, the content of humus and nutrients \((r = 0.70-0.90)\) in soils can be used as a test to determine the amount of gypsum and manage it.

**REFERENCES**

17. Ямнова И.А, Голованов Д.Л. – Морфотипы гипсовых горизонтов на разнообразных иерархических уровнях организации почвенных покровов аридных территорий (Джизак, Узбекистан). Materialy V s"yezda Vserossiyskogo obschestva pochvovedov im. V.V.Dokuchayeva, Rostov-na-Donu, 18-23 avgust, 2008.-258 s.