Characteristics of irrigated soils of Bukhara region intended for cotton sowing

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Abstract. The work is devoted to the study of the characteristics of irrigated soils of the Zhondarsky district of the Bukhara region, intended for sowing cotton. The acreage allocated for the cultivation of agricultural crops should have appropriate indicators that ensure not only high yields, but also high-quality products. Since many soils of the territory of Uzbekistan, including the Bukhara oasis, are highly saline, research work was carried out on the territory. Along with the other twelve regions, the irrigated soils of the Bukhara region are moderately saline, although there are some farms in which the land is characterized by a high degree of salinity. Among the districts and cities with a high level of salinity, as an example, we can take the soils of the Karakul and Olot districts of the Bukhara oasis. Due to the fact that these areas are located in the desert zone of the region, the salinity level is high due to the low amount of precipitation. The indicators of the content of biogenic elements and the mineral composition of the studied soil samples, the total salt content in the composition of soil samples were studied. The content of soluble ions, the content and studies of the main elements that ensure soil fertility such as humus, phosphorus, nitrogen, potassium and their mobile forms, as well as concentrations of soluble salts in the form of anions, cations and macronutrients have shown that the studied soil belongs to the depleted type of sulfate-chloride salinization.

1 Introduction

It is known that the acreage allocated for the cultivation of agricultural crops should have appropriate indicators that ensure not only high yields, but also high-quality products. Unfortunately, along with other countries such as Ukraine, Kazakhstan, China, Moldova, the territory of Uzbekistan, along with Turkmenistan, occupies the first place, in which 80% of the acreage is saline fields of various types. It can be seen from the data in Fig.1 that mainly the Central Asian countries (Uzbekistan, Turkmenistan and Kazakhstan) have high salinity indicators. So, for example, salinization is sulfate, chloride, phosphate, and sometimes silicate. All this makes the soil infertile and dead [1-3].

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The main reasons affecting the degree of degradation of soil resources in some countries of the world are as follows:

- Low biological activity
- Salinity, aridity
- Necrosis, absence of biogenic elements, beneficial microorganisms

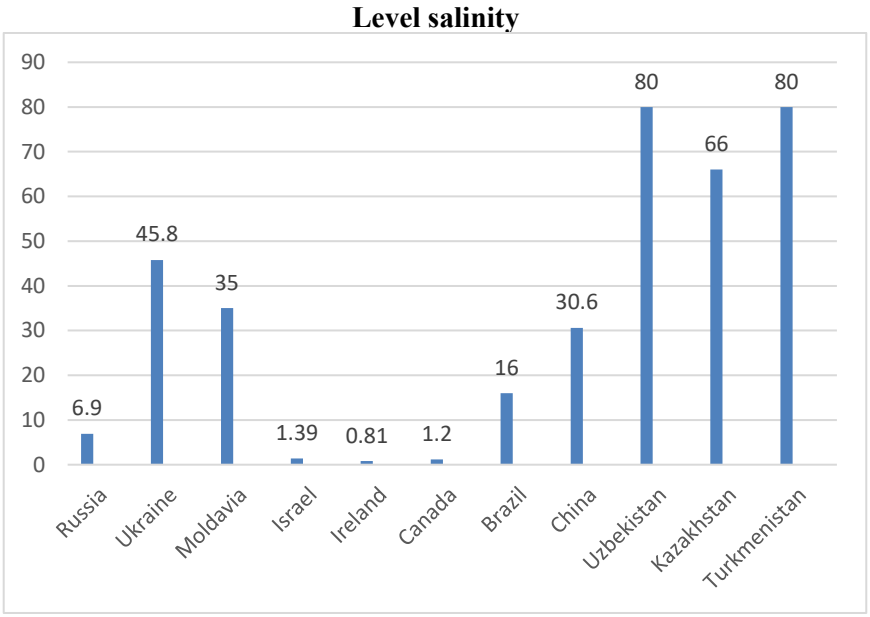

Fig. 1. Indicators of saline territories of various countries of the world.

When studying saline soils of natural and agrotechnogenic landscapes of the Southern Urals, R.R. Sulaimanov correctly noted that, throughout the history of the development of soil science, saline soils have been one of the main objects of research in many countries of the world. This is explained, firstly, by the wide spread of saline soils in different regions of the Earth, and secondly, by the fact that salinization is one of the main genetic properties and reclamation features of soils of arid and semiarid regions, as well as a property limiting their fertility. And, finally, thirdly, salinity is one of the main signs of the unfavorable ecological state of lands [Saline..., 2006]. The purpose of R.R. Sulaimanov was the study of the processes of formation of saline soils in natural and agrotechnogenic landscapes, the transformation of their properties and regimes during the development of salinity, the search for environmentally sound methods of their melioration and reclamation [3].

In different regions, saline soils differ significantly in properties, genesis, and, consequently, in methods of reclamation, which causes differences in their development, rational use and control of salinization. In the Southern Urals, within the Republic of Bashkortostan, the area of saline soils of agricultural land is small and amounts to 29.5 thousand hectares, saline-saline - 30.8 thousand hectares.

However, the area of saline soils due to the increasing xerophytization of the climate on the one hand, the presence of the oil industry and reclamation systems (irrigation, drainage) on the other hand, is constantly increasing. All this leads to a significant decrease in soil fertility, a decrease in productivity and a deterioration in the quality of agricultural products.

2 Methods

In order to take timely and adequate measures to prevent salinization and salinization of soils and to develop environmentally acceptable and economical ways of their use and restoration, a comprehensive study of saline soils in natural and agrotechnogenic conditions of the region is necessary [3].

At the same time, it should be particularly noted the use of environmentally friendly drugs that have high efficiency and infusion abilities and reduce the toxic effects of salts of various types present in the composition of the soil. Along with the other 12 regions, the irrigated soils of the Bukhara region are saline to a moderate degree, although there are some farms in which the land is highly saline.

Therefore, modern approaches to their bioremediation with the use of microbiological preparations containing halophilic and halotolernate types of microorganisms or enzymes that bring mineral salts into usovoemable forms for the nutrition of cultivated crops in these soils are required.

3 Results and discussion

Characteristics of soil lands and research materials. Soil samples intended for study were taken in the spring period of 2022 from a depth of 0-30 cm. For the experiments, soil chatterboxes were prepared, which were subjected to the study of the amount of salts, types of salts, toxic salts, electrical conductivity, humus content, macro and microelements, biogenic composition and soil types.

This soil belongs to the type of gray-brown soils formed on the rocky surfaces of ancient hills, but annually irrigated. There is a lot of gravel and pebbles in the structure of such soils. The parent rock lies in a low-power (3-5 m) layer, there is a layer of gravel under it. In the upper layer of the soil, the humus content is 0.2- 0.3%. The thickness of the humus is 25-35 cm. There is little nitrogen in the composition of the soil, but a lot of phosphorus. Carbonates make up 5-7%. Such soils at a depth below 20-30 cm are saturated with sulfate and chloride salts [4].

The gray-brown soils of this farm are infertile. Silt deposition on such soils, salt washing and fertilization increases their fertility. Takyr and takyr soils are common on ancient alluvial plains, especially in river deltas, in depressions at the mountain foothills.

Alluvial-meadow soils occupy large areas in the deltas of such large rivers as the Amu Darya, Syr Darya, or and others. Due to the fact that irrigation agriculture has been practiced on these lands for a long time, the subsurface waters here lie at a depth of 1-2 m, at the same time, the salinity of the soil is quite high. The humus content in them is 1-1.5%. Alluvial-meadow soils are quite fertile, but they are quickly salinized [3-5].

4 Conclusions

DIAGNOSTICS of irrigated soil of Bukhara region. The irrigated soils of the republic are the main wealth and the main breadwinner of the people. The productivity of all branches of agricultural production and the rise of the economy depend on the state of fertility of these soils and their rational use. In the economy of the republic, cotton growing is one of the main branches of agriculture. However, in recent years, cotton yields have been growing very slowly. Irreversible doses of applied fertilizers for cotton no longer give a noticeable effect. Despite the long-term use of fertilizers in the cotton growing area about.7054 irrigated lands of the republic are still characterized by a low content of nitrogen and phosphorus available to plants and about 40% are low in potassium. More

than half of irrigated lands are low in organic matter [2]. According to our research and studies, it was determined that the soil of the Jondor region belongs to the merozems formed at the foot of the Tien Shan, Pamir-Alay, Kopetdag mountain systems, as well as on the gentle slopes of the mountains. This type of soil is common at an altitude of 250-300 m to 1000-1100 m above ocean level in the north, and at an altitude of 1400-1500 m in the south. The humus content in the composition of soils increases with increasing height, and soils become more fertile. For example, if the composition of light gray soils contains 1.0-1.5% of humus, in typical ones — up to 1.5-2.5%, then in dark gray soils of mountains — 2.5-4.0%. The main areas of irrigation agriculture in Central Asia are located in the serozem belt. (Soils of Central Asia, 9 358 11-03-2018, 16:00 Physical Geography of Central Asia).

We conducted an agrochemical analysis of the constituent components and elements of the soil in which cotton is cultivated with variable crop rotation with wheat studied (Tables 1-3) [1].

Table 1. Agrochemical analysis of the soil: Bukhara region (Jondor district).

No. The image of the soil	**Place of soil sampling**	**The degree of salinity of the soil Ece, dS/m**	**Assessment of the degree of salinity by Ece, type of salinization**	**pH**	**Indicator**	**Standard pH soils**
1	Bukhara (under cotton)	1.12	unsalted soil of chloride-sulfate type	8.1	Medium - alkaline	7.0

From the data in Table -1 it can be seen that the degree of salinity of soil samples is 1.12, the pH is -8.1, which refers to the type unsalted soil of the chloride-sulfate type is medium–alkaline, which exceeds the norm of -7.0.

The study of the salt content of various macronutrients in the composition of the soil showed that the following salt complexes such as Ca(HCO3)2, CaSO4, MgSO4, Na2SO4, NaCl, MgC2 are relatively low concentrations and non-toxic salts were found within 0.058 %.

Table 2. Total salt content in the composition of soil samples, %.

№ Sample	**$Ca(HCO_3)_2$**	**$CaSO_4$**	**The amount Non-toxic salts**	**$MgSO_4$**	**Na_2SO_4**	**NaCl**	**$MgCl_2$**	**The amount of toxic salts**	**Sum of salts**
1	0.023	0.035	0.058	0.024	0.050	0.012	-	0.085	0.023

Further studies of the fertility of soil samples showed that the humus content is 0.828% with a norm of 0.91-1.35, and the carbon content is 0.48, the gross nitrogen forms are 0.063%. The assessment of the availability of humus, carbon and nitrogen content, i.e. nutrients turned out to be poor, which requires an increase in these criteria with the help of nutrients and biofertilizers (Table 3).

Table 3. The content of biogenic elements and the mineral composition of the studied soil samples. Humus content:

№ Sample	**Humus, %**	**Humus Carbon, % ($C_г$, %)**	**Security assessment**	**Humus, % norm**
1	0.828	0.48	poor	**0.91-1.35**

Table 4. The content of the main mineral elements and their assimilable forms in the soil samples of the Bukhara region.

Nitrogen content:

№ Sample	Gross forms of nitrogen, %	Evaluation secured news	Gross forms of nitrogen, % **norm**	Mobile forms assimilated by plants N-NO_3, мg/kg	Security assessment news	Mobile forms assimilated by plants N-NH_4, mg/kg **norm**
1	0.063	Poor	**0.09-0.12**	17.5	Very low	**30-50**

Phosphorus content:

№ Sample	Gross forms of phosphoru, %	Evaluation provided news	Total forms of phosphorus, % **norm for soil**	Mobile forms assimilated by plants P_2O_5, mg/kg	Security assessment news	Mobile forms assimilated by plants P2O5, mg/kg norm
1	0,120	Poor	**0,21-0,26**	40,0	Average	**46-60**

Potassium content:

№ Sample	Gross forms of potassium, %	Evaluation provided news	Gross forms of potassium, %, **norm for soil**	Mobile forms assimilated by plants K_2O, mg/kg	Security assessment news	Mobile forms assimilated by plants K2O, mg/kg **norm**
1	1,17	Poor	**1,8-2,4**	253	Average	**301-400**

The biogenic form of phosphorus from the initial total content is 0.120%, the potassium content is -1.15%, 0%, i.e. 2.5 times less than normal, the degree of availability of phosphorus and potassium is poor. (Table 4).

In plant nutrition, the concentration of water-soluble nutrients in any biological fluids and mineral, organic substances, which are top dressing and nutritious for both plants and other biological organisms, is of great importance. The study of water-soluble ions and trace elements contained in the studied soil samples showed that the cross-natural content of the following substances, such as HCO3, Cl, SO4, Ca, Mg, Na+ To the specified elements, respectively, amounted to 0,034. 0,007. 0,045. 0,016. 0,005. 0,012. 0.101, while the dense soil residue was 0.112% (Table 5).

Table 5. Ion concentration (in water extract):

Content of soluble ions

№ Sample	EC 1:5 dS/m	ECe, dS/m	Dense residue,%	HCO_3	Cl	SO_4	Ca	Mg	Na+K	The sum of ions, %
1	0,28	**1,12**	0,112	0,034	0,007	0,045	0,016	0,005	0,012	0,101

The content of soluble ions, in mg/eq

№ Sample	HCO_3	Cl	SO_4	Sum of anions	Ca	Mg	Na+K	The amount is such new
1	0,560	0,197	0,936	1,694	0,800	0,395	0,501	1,696

№ Sample	Na/Cl	Assessment of salinity chemistry	SO_4 mg/eq	SO_4, т %	The amount of toxic salts, %	Assessment of the degree of salinization for irrigated lands			
						∑ т. salts, %	ECe, dS/m	Cl, %	Na, mg-eq/100 g of soil

1	2,5	X-C	0,70	0,03	0,06	unsalted soil of chloride - sulfate type			

The table also shows the content of soluble ions, of which the highest content of soluble ions was HCO3, it is 0.560 mg/eq. And the sum of anions is 1.694 mg/eq. Among the cations, the highest is Ca, it is 0,800 mg/eq. And the sum of cations is 1.696 mg/eq.

Our experiments on the study of physico-chemical properties, indicators of soil fertility have shown that the irrigated soil of the Jondor district, used as cotton–wheat annually with crop rotation, belongs to the dining types, saline and requires remediation with the inclusion of nutrients and biofertilizers, especially of microbial origin.

Usually, the proportion of soil fertility indicators is mainly humus content at a concentration of 0.91-1.35%, while the soil samples studied by us have 0.828%, which means 50% below the norm. Also, the gross forms of nitrogen, phosphorus, potassium and their mobile forms must correspond to the data given in Table 6.

Table 6. Norms of agrochemical indicators for soil.

№	Indicators	The norm for soils
1	Humus content, %	*0,91-1,35*
2	Gross forms of nitrogen, %	*0,09-0,12*
3	Gross forms of phosphorus, %	*0,21-0.26*
4	Gross forms of potassium, %	*1,8-2,4*
5	Mobile forms of ammonia nitrogen, N-$BH_{4.mg/kg}$	*30-50*
6	Mobile forms of phosphorus, $P_2 O_{5,\ mg/kg}$	*46-60*
7	Mobile forms of potassium, $K_2O,\ _{mg/kg}$	*301-400*

It should be noted that in various regions of the Republic, as well as in the Bukhara region, studies are being conducted concerning only physico-chemical properties, limited to the determination of bulk, clay parts, metallomagnetic impurities, moisture capacity and electrical conductivity. And work with the study of a whole complex of parameters that have an important impact on their fertility, biological activity, unfortunately, there is a lot of scant work.

The article provides information about the genesis and distribution of saline soils in the region of the Turan plain of Central Asia. It is shown that before the active development of irrigation in the twentieth century, the process of modern salt accumulation was manifested mainly in naturally hydromorphic soils. At the same time, it was regulated by natural floods on floodplain lands; it did not actively manifest itself in automorphic conditions. As a result of irrigation, there was a transition of natural automorphic soils into the category of irrigated hydromorphic. This led to the activation of salt accumulation processes even against the background of drainage with a depth of 2.5-3m. In the 21st century, new problems have arisen in the region: there is not enough fresh water; Aeolian salt transfer has intensified; climatic, environmental and social conditions have deteriorated. So, there is data concerning the study of the causes of salinization, foci and some properties of the soils of the regions of Central Asia [2].

Conducted by us in this way, deselination allows for the correct selection of soil remediation, the introduction of biological fertilizers, to regulate the concentration of fertilizers, etc., allowing not only to increase the yield of cultivated crops, but also to improve the quality properties of the expected harvest.

Research is continuing to study the microbial landscape of soils and the biological activity of these soils in order to increase the biological activity of soil, biogenic elements and, most importantly, for the organization of bio–earth farming in the Bukhara region.

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