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IRRIGATED LIGHT GREY SOILS, THEIR BIOGEOCHEMICAL AND AGROCHEMICAL PROPERTIES

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Abstract
The article provides information on the agrochemical properties of light gray soils of the Asaka district . Preliminary research data on the chemical composition and nutrients of these soils are presented. The biogeochemical properties of irrigated light gray soils are described.

Keywords: light gray soils, mechanical composition, biogeochemistry, microelements, agrochemical properties, nitrogen, phosphorus, potassium.

Introduction

The issues of increasing soil fertility and stabilizing crop yields are recognized at the state level as one of the main directions of agricultural development in the Republic of Uzbekistan . The Law of the Republic of Uzbekistan " On the rational use of land resources in agriculture " (2017, No. ZRU-445) and the Resolution of the President of the Republic of Uzbekistan "On measures to improve agrotechnical measures and increase the volume of agricultural production" (2020, PQ-4721) are aimed at increasing soil fertility and ensuring the effective use of mineral fertilizers . This study studied the influence of soil environment and microelement composition on cotton yield on irrigated light- colored loamy soils .

According to the founder of biogeochemistry, VI Vernadsky, "Organisms in nature cannot exist in real life in an autonomous state, separate from the earth's crust" [1]. From this point of view, one of the main tasks of biogeochemistry is to reveal the role of the earth's crust, in particular the soil and the diverse living organisms in it, on the Earth.

The accumulation of plant masses is influenced by a number of geochemical factors, in particular, the bedding pattern of rocks , their chemical composition, and the chemical and physical properties of soils [8]. These processes of influence were substantiated by prominent scientists of their time , Vernadsky, Vinogradov , and their students [1, 9].

At present, no single complete idea has been created that would fully explain the composition of

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the soil and the various processes occurring in it. The genesis, biological and chemical, physicochemical processes of soils are determined by their elemental composition [2]. In this regard, it can be said that almost all elements from the periodic table of chemical elements created by DI Mendeleev can be found in the soil composition [6]. The elemental composition of soils is considered its first and main characteristic, determines the fertility and genesis of soils and helps to distinguish the genetic layers of soils. For example: in the carbonate-illuvial layer, C and Ca are abundant, and N and P are almost absent [4]. In the humus-accumulative layer, N, C and P are abundant. In addition, the potential fertility index is determined in different soils depending on the degree of salinity, soil pollution [2], and poisoning with various chemicals . In this regard, it is natural that determining the elemental composition of soils plays a key role. Therefore, studying the elemental composition of soils and explaining their distribution and migration processes are among the main problems of soil science, and are interconnected with soil geochemistry, biogeochemistry, and geochemistry.

different phases of elements, i.e. solid, liquid and gas, determines their geochemical properties. In light gray soils , rather than taxonomically , only the soil content of biomicroelements such as Cu, B, Zn, Co and Mn has been studied, and their movement through plants and soil has not been studied.

of the biogeochemical properties of elements in soil, water , and plant systems. Among the Uzbek scientists, MM Toshkoziyev, LAG Ofurova, G. Yu. Yuldashev, MTI Isagaliyev, Sh. Khatamov, D. Kholdarov contributed to the development of the science of soil biogeochemistry.

Macro- and microelements, biogeochemical processes can occur in different ways during soil formation. In addition to the properties of the elements, environmental factors also play a significant role in the migration process of microelements [1, 8]. The nature of element differentiation is very variable depending on the pH of the soil environment.

Small hydrated ions are formed by easily mobile elements. Large ones are formed by large and slow moving ions. Therefore, different energies are required for the hydration of ions with small and large radii. We can determine this through energy constants.

One of the tasks of soil geochemistry is to study the brief history of chemical elements , and not much work has been done in this regard, but methodological works have been created by AI Perelman, NSKasimov, and MAGlazovskaya [7, 8].

The decomposition of organic matter by microorganisms is also an important geochemical feature of soil formation. Because oxidation-reduction processes occur during the decomposition of matter . In this process, complex organic matter is oxidized to form simple salts and gases [1]. Oxidizing substances are reduced. Depending on the soil environment, elements such as Fe, Al, Zn, Cr, Mn and Mo can also act as oxidizing and reducing substances [1].

In studying the migration of elements according to soil-geochemical laws, it is very convenient to use the Clark concentration coefficient (CC) instead of percentages and milligrams . In addition to the Clark concentration coefficient (CC), it is also accepted to evaluate the migration of elements in the soil using coefficients such as the Clark distribution coefficient (Kt).

Biogenic migration processes are characterized by the biological absorption coefficient, that is, relatively mobile elements participate in the absorption in biological absorption. In other words, biogenic migration can be called a small cycle of biological substances [1].

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Information about the research object: Asaka district borders on Shahrikhan, Marhamat, Khojaabad districts and Kuva district of Fergana region. The area is 0.26 thousand km ^{2}. The main part of its soils consists of light gray soils , with a humus content of 1-2%, and a humus layer thickness of 10-14 cm. In light gray soils, which belong to the gray soil type , the amount of humus and hydrolyzable substances increases towards typical gray, dark and black soils, and accordingly, we can see that the amount of humic substance, which is important in the formation of soil structure, also increases. The carbonate content of the soils is on average 7-8% , and the carbonate layer thickness is up to 20 cm in the upper part and up to 100 cm in the lower part.

These soils have relatively weak biological accumulation of phosphorus, and their phosphorus content is lower than that of typical gray soils. The soil has a relatively high content of fixed phosphorus, but low levels of plant-available (mobile) phosphorus . Depending on the level of availability , mobile phosphorus averages 10-15 mg/kg, and it has been found that in some areas, due to the use of phosphorus fertilizers for many years, it can reach up to 35 mg/kg.

Soil research methodology: To study the quality and agrochemical properties of the light gray soils in which the research was conducted, Dokuchaev's soil field research method was used, and special analyzes and methods adopted in soil science and agrochemistry were used to determine the physical, physicochemical, and chemical properties of the soil.

that were the object of the study, a total of 6 main soil sections were excavated from the key areas selected using the above methods, and soil samples were taken from each of them, and morphological descriptions were given to these soils. In addition, pits and semi-pits were dug to determine the soil differences and delimit the boundaries of the study area, and morphological signs were determined. Genetic layers were separated from the excavated main pits, and an average of 400-500 g of soil samples were taken from each layer.

The mechanical composition of the soils, total nitrogen, phosphorus , and potassium contents, humus content, water absorption content, and dry matter were determined from the soil samples obtained.

soil, water and plant samples, the content of total and mobile nitrogen, phosphorus and potassium, and the content of absorbed cations is carried out on the basis of the methodological manual "Methods of agrochemical, agrophysical and microbiological studies in cotton-growing areas".

Research location and methodology: We conducted research in the soils of the Andijan ITS (scientific experimental station) of PSUEAITI, located in Asaka district, in April-November 2022. The soils of the research area are irrigated light gray soils . According to the mechanical composition of the soils, the content of large dust particles is 35-50%. Due to the sharply changing climate, the soils of this region are subject to salinity conservation.

Preliminary results of the study: In light gray soils , the total nitrogen content, in parallel with the humus content, is also lower than in other soil types. The total nitrogen content in the topsoil of irrigated light gray soils is about 0.05-0.09%, the amount of nitrogen reserves in a layer up to 1 m is 4.5-9.5 t/ha, of which hydrolyzable nitrogen is 70-110 mg (per 100 g of soil).

be seen from the table , the content of mobile nitrogen ($N\text{-}NO_3$), phosphorus (P_2O_5) and potassium (K_2O) decreases towards the lower layers of the soil. A sharp increase in the content of nitrogen and potassium was observed in the 30-60 cm layer of the soil, but the decrease in the content of mobile phosphorus was relatively less.

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Table 1 **humus, total NPK and N-NO $_3$, P $_2$ O $_5$, K $_2$ O in the soils of the study area**

Soil layer, cm	Humus , %	Nitrogen		Phosphorus		Potassium	
		Total %	N-NO 3	Total %	Characteristic , (P 2 O 5) mg / kg	Total %	Exchangeable (K $_2$ O) mg / kg
0-5	1.21	0.095	10.1	0.138	26.0	2.0	203
5-15	0.80	0.062	10.1	0.132	10.4	1.83	201
20-30	0.29	0.036	4.6	0.138	4.8	1.83	201
55-65	0.21	0.028	2.1	0.133	4.6	1.74	140
90-100	0.24	0.021	1.6	0.129	4.9	1.74	112
130-140	0.16	0.020	1.0	0.126	6.3	1.66	88
175-185	0.19	0.020	0.0	0.126	6.1	1.71	86

We can describe their main genetic and agronomic characteristics. Soils are classified and divided into types and subtypes based on their mechanical composition. The soils of the key areas where the study was conducted and samples were taken are medium loam soils according to their mechanical composition, and the correct and systematic agrotechnical measures and organic and mineral fertilizers that have been carried out for many years have had a positive effect on the mechanical composition of the soils.

Table 2 **Mechanical composition of soils in the study area**

Soil layers , cm	Fractional weight , % (measurement , mm)						
	>0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001	<0.01
5-15	0.4	22.2	42.6	7.4	15.4	12.0	34.8
18-28	0.6	18.6	45.8	9.3	13.2	12.5	35.0
40-50	0.7	17.4	44.0	8.1	14.3	15.5	37.9
80-90	1.8	14.8	43.0	11.6	14.0	14.8	40.4
130-140	4.4	17.1	46.5	8.4	10.7	12.9	32.0
210-220	2.3	16.5	47.6	9.9	10.6	13.1	33.6

According to water absorption analysis, salinity occurs mainly in the upper layers and is 0.1-1.0% (at 100-120 cm) .

When conducting water absorption analysis of soil samples taken from key areas, no salts causing salinity, such as potassium and sodium ions, were detected in the 0-15 cm layer of the soil. It was determined that salts, such as Mg ions, were present in very small quantities.

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Table 3 **Salinity level of soils in the study area , %**

Soil layers , cm	Dense residue	Total alkalinity , NSO 3	Cl	SO 4	Ca	Mg	K+Na
0-5	0 .068	0.035	0.003	0.006	0.015	No	No
5-14	0.040	0.027	0.003	0.008	0.0123	0.001	No
18-28	0.042	0.028	0.003	0.009	0.007	No	0.009
40-50	0.40	0.029	0.003	0.009	0.007	0.001	0.007
80-90	0.916	0.017	0.010	0.799	0.020	0.002	0.033
130-140	1,105	0.011	0.026	0.718	0.189	0.004	0.108
210-220	0.591	0.007	0.080	0.929	0.007	0.003	0.191

Turpok environment when detected this soils pH value in the range of 7.8 -8.3 that our view possible .

The flatness of the zone of light gray soils is very convenient for its development and irrigation. Light gray soils have poor reclamation and agrotechnical properties due to the high content of gypsum. The lack of humus and nutrients, as well as the dissolution of gypsum as a result of irrigation, cause the topsoil to subside and heave, which leads to deterioration.

As a result of frequent leveling of the soil surface, the infertile gypsum layer rises to the surface and the surface of the earth becomes infertile. Due to strong filtration, groundwater and salts rise to the upper layer, causing the earth to become saline. Therefore, it is recommended to use water sparingly when irrigating such lands.

The experimental plot is irrigated with light gray soils that have been cultivated for more than 50 years. The soils are medium and heavy loam in terms of mechanical composition, with a depth of non-saline groundwater of 3-3.5 meters , and are low in mineralization (2.5-3g/l).

Conclusion

The term biomicroelements B, Cu, Zn, Mn, Mo and Cr in light gray soils is a relative concept, and is based on the amount and physiological roles of these elements in soil and plants, their role in increasing soil fertility and improving crop yield. These elements are well studied compared to other microelements. The biogeochemical properties of biomicroelements are expressed in terms of their concentration coefficient (CC), local migration coefficient (Km), Clark distribution (Kt), biological absorption coefficient (Ax) and geochemical barriers.

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