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Main Properties of Rainfed Typical Serozem Soils Distributed in Parkent District, Tashkent Region

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Annotation: This article presents information on the current state, characteristics, mechanical composition, CO2 carbonates, and the amount of nutrients and humus in the rainfed typical serozem soils distributed in the Parkent district of the Tashkent region.

Keywords: typical serozem soil, humus, nutrient elements, supply level, mechanical composition, carbonates.

Introduction. Today, the world's total area of land used for agriculture is 1.6 billion hectares, of which 1.3 billion hectares (81%) are rainfed. Rainfed agriculture accounts for 60 percent of the world's agricultural production in various climatic conditions. The most effective methods of non-irrigated farming are practiced in the temperate zone of Europe, followed by the subtropical and humid tropical regions of North America»[1]. Currently, degradation processes are occurring mainly in areas where rainfed agriculture is practiced. Taking this into account, one of the important tasks is to develop scientifically based measures aimed at preventing negative processes such as degradation of the rainfed soil cover - humus depletion, nutrient depletion, and soil erosion.

In the world, special attention is paid to the restoration, protection and increase of the productivity of soils used for arable farming, to the identification and prevention of negative processes occurring in them in a number of priority areas: including the identification of changes in soil cover during arable farming and factors limiting the productivity of arable soils and eliminating their negative impact, the assessment and mapping of the productivity of arable soils, the development of measures and technologies to reduce their erosion and the impact on the growth and development of agricultural crops.

Today, a set of measures is being developed to widely involve the soils of the foothills and foothills of our republic in arable farming, improve their agrochemical and agrophysical properties, assess the level of soil productivity and increase it, and certain results are being achieved. The Action Strategy for the Development of the Republic of Uzbekistan for 2017-2021 sets important tasks for "... the continuous development of agricultural production, further strengthening the country's food security, further improving the land reclamation condition, expanding the production of environmentally friendly products, and significantly increasing the export potential of the agricultural sector." In this regard, it is important to conduct

[1] http://www.fao.org.

comprehensive research on the soils of arable areas, determine the properties and characteristics of soils and the factors affecting them, and determine their qualitative level of productivity.

Meeting the food demand of the population of our republic is directly related

to the effective use of currently used mainly irrigated, as well as fallow and pasture lands in accordance with modern requirements, land resources and their condition, especially the level of soil fertility, based on the reforms being carried out. Therefore, increasing the efficiency of use and the level of productivity of irrigated and fallow land covers currently used in agriculture, preserving, restoring and protecting them remains one of the most important priorities.

The level of study of the problem. Scientific research on morphogenetic properties of dry soils and increase and evaluation of their productivity was carried out by D.S. from foreign and republican scientists. Bulgakov, I.A. Dubrovina, V. Medvedev, A.A. Speedt, B.S. Ukenov, T.G. Mueller, I.A. Nalder, S. Westarn, Z. Bai, J.K. Saers, A.Z. Genusov, B.V. Gorbunov, B.V. Kimberg, M.U. Umarov, A.M.Rasulov, H.M.Makhsudov, L.Tursunov, I.T.Turapov, O.Tojiev, R.K.Kuziev, N.Yu.Abdurakhmonov, O.E.Hakberdiev, L.A.Gafurova, M.F.Fakhrutdinova, G.M.Nabieva, G.T.Jalilova, N.I.Shadieva and many other scientists conducted researches that comprehensively studied the genesis, geography, ecology, erosion, biological activity, agrochemical and agrophysical properties of soils, and provided information on the problems of maintaining and increasing their productivity.

Information on the study of soils common in the arable regions of Central Asia began in the 50s-60s of the 19th century. Many scientists, including A.M. Rasulov,

M.B. Bakhodirov, G.A. Lavranov, H.M. Makhsudov, M.Yu. Yunusov, I. Bobokhuzhaev, P.Uzokov, P.I. Fedotov and many others, have conducted research in different years on the properties of rainfed soils, the main indicator determining their productivity, i.e. the preservation and increase of humus content. In this regard, the works of I.V. Tyurin are especially noteworthy [1].

G.A. According to Lavronov, the humus content in virgin lands within the boundaries of the rainfed arable land was around 2.5 percent, but three years after the new development, this indicator was 1.49 percent, and as a result of annual soil cultivation, there was a tendency for increased water and wind erosion and a decrease in the amount of nutrients that plants could absorb [2, 3].

Research object and methods. The study area was selected as the rainfed typical serozem soils distributed in the “Changi 2” massif of Parkent district of Tashkent region.

The rainfed soils of Parkent district consist mainly of low-elevation (hilly) foothill areas, and rainfed typical serozem soils are widespread in this area. Parkent district is formed by loess deposits, is connected to low-elevation foothill areas, and is located in the geomorphological region of the IV upper terrace of the Chirchik river.

Geographically, Parkent district is located 48 km east of Tashkent, on the western slopes of the Chatkal mountain range of the Middle Tien Shan. It is surrounded by mountains, and its relief consists of mountainous plains, hills and mountain ranges. The climate of the district is also divided into vertical zones and is distinguished by its diverse characteristics.

The climate of the selected region is sharply variable and dry. The average annual air temperature is 14°C. Summer is dry and hot. The average temperature in July is 27-29°C. In summer, the temperature rises to 45-46°C. The growing season is 220 days. Annual precipitation is 180-220 mm, falling mainly in winter and spring. In summer, due to strong evaporation, upper soil layers on groundwater are partially saline [4].

Field soil research and office-analytical work were carried out according to generally accepted methods developed at the Institutes of Soil Science and Agrochemistry and Soil Research Institute, including the “Instructions for conducting soil research and compiling soil maps for maintaining the State Land Cadastre” and E.V. Arinushkina’s “Guide to Chemical Analysis of Soils” [5, 6].

In 1967-1971, scientists from the Institute of Soil Science and Agrochemistry B.V. Gorbunov and G.M. Konobeeva conducted scientific research on the creation of methodological manuals for determining the level of fertility of loamy soils and assessing their fertility. Based on the data obtained, a manual entitled “Rainfed soils of Uzbekistan and their qualitative assessment” was published in 1975. By 1993, a methodological manual entitled “Methodological instructions for the assessment of the quality of rainfed soils of farms of the Republic of Uzbekistan” was developed. These manuals used natural-agricultural districts as the main scale for assessing the quality of alluvial soils, and in addition, reducing coefficients were established based on factors that negatively affect the productivity of agricultural crops - the mechanical composition of the soil and the degree of leaching, and the skeletal structure of soils.

Research results and their analysis. ***Mechanical composition of soils.*** Rainfed soils are mainly located in areas with a wide undulating, hilly relief, on typical and dark serozem soils formed on the surface of loess deposits. The profile of rainfed soils is characterized by high moisture content, development of plant cover, decomposition and mineralization of its residues under anaerobic conditions, and chronic erosion processes. Therefore, the soils of rainfed areas are characterized by arable layers, a darker color than the lower sub-arable layers, the formation of a humus layer, less compaction of the sub-arable layer than the sub-arable layer, and occasional washing of carbonates.

In rainfed soils, the constant supply of moisture to plants, along with other factors, has a greater impact on soil properties, especially the mechanical composition of the soil. Since the moisture capacity of soils with a heavy mechanical composition is relatively high, it is possible to provide plants with water for a longer period of time than soils with a light mechanical composition, and as a result, the yield from plants is larger. That is why the productivity of such soils is relatively high in the conditions of rainfed farming.

It was noted that the rainfed typical serozem soils of the study area in the “Changi 2” massif of the Parkent district of the Tashkent region are mainly of medium and heavy loamy mechanical composition (Table 1).

The amount of physical clay particles (<0.01 mm) in the profile of these soils fluctuates widely, ranging from 46.9-53.3% in heavy sands and 42.1-44.5% in medium sands (Table 1).

Table 1. Mechanical composition of rainfed typical serozem soils of Parkent district Changi 2 massif

Section No.	Depth, cm	Amount of soil particles in %, size in mm								Mechanical composition
		sand			dust			silt	physical clay (<0.01	
		>0,25	0,25-0,1	0,1-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001		

									mm)	
23	0-23	3,5	1,0	8,8	38,2	18,3	20,7	9,5	48,5	Heavy loamy
	23-47	2,2	0,4	9,9	36,6	15,1	23,9	11,9	50,9	Heavy loamy
	47-85	2,5	0,5	11,9	40,5	11,9	23,1	9,5	44,5	Medium loamy
	85-115	1,5	0,5	12,9	42,9	14,3	19,9	8,0	42,1	Medium loamy
	115-142	0,7	0,5	16,1	38,2	15,1	20,7	8,7	44,5	Medium loamy
28	0-27	2,0	1,4	19,5	32,6	19,1	11,1	14,3	44,5	Medium loamy
	27-47	3,8	0,4	24,3	27,8	15,1	12,7	15,9	43,7	Medium loamy
	47-70	8,5	1,8	18,2	24,6	17,5	12,7	16,7	46,9	Heavy loamy
	70-118	4,5	1,5	16,9	26,2	20,7	18,3	11,9	50,9	Heavy loamy
	118-145	5,5	0,8	24,5	26,2	17,5	15,1	10,3	42,9	Medium loamy
31	0-28	0,5	1,5	16,1	31,0	12,7	23,1	15,1	50,9	Heavy loamy
	28-45	5,0	0,4	13,5	31,0	19,1	19,1	11,9	50,1	Heavy loamy
	45-80	1,0	0,5	19,0	30,2	21,5	17,5	10,3	49,3	Heavy loamy
	80-126	1,0	0,6	18,9	28,6	22,3	17,5	11,1	50,9	Heavy loamy
	126-151	1,2	3,5	16,6	25,4	20,7	19,9	12,7	53,3	Heavy loamy

A number of soil sections (23, 28, 31-k) mainly consist of heavy loamy according to the mechanical composition of the upper tillage layer, and the amount of physical clay particles (<0.01 mm) in them fluctuates widely and is 48.5-51.7% (Table 2).

Among the mechanical elements, large dust particles (0.05-0.01 mm) take the leading place, its amount fluctuates between 22.3-36.6%, fine sand particles (0.1-0.05 mm) take the second place, their amount is 9.9-24.6%, medium dust particles (0.01-0.005 mm) 9.5-18.3% amounts up to (Table 2).

Table 2. Mechanical composition of typical loamy serozem soils of Parkent district Changi 2nd massif

Section No.	Depth, cm	Amount of soil particles in %, size in mm								Mechanical composition
		sand			dust			silt	physical clay (<0.01 mm)	
		>0,25	0,25-0,1	0,1-0,05	0,05-0,01	0,01-0,005	0,005-0,001	<0,001		
6	0-23	3,5	0,7	9,9	36,6	18,3	19,1	11,9	49,3	Heavy loamy
9	0-25	3,5	1,0	13,6	30,2	18,3	19,1	14,3	51,7	Heavy loamy
13	0-27	3,9	0,7	24,6	22,3	9,5	20,7	18,3	48,5	Heavy loamy
20	0-24	2,9	1,0	20,6	26,2	17,5	17,5	14,3	49,3	Heavy loamy
22	0-27	9,5	0,6	16,8	24,6	10,3	26,2	11,9	48,5	Heavy loamy

Agrochemical properties of soils. In rainfed soils, organic matter - humus - plays a special role in the accumulation and long-term retention of moisture. Soils for agricultural crops should contain humus and a number of nutrients in sufficient quantities. Organic matter is of great importance in the formation of soil formation and productivity. The quantity and quality of this organic matter, consisting of plant and animal remains, determine the productivity, production capacity, and its positive and negative characteristics. Humus is of great importance in the processes, changes, and the emergence of new properties in the soil.

Organic matter in the soil has the ability to accumulate and retain a large amount of nutrients and moisture due to its high water absorption capacity and capacity. As is known, the amount of humus in soils varies depending on their origin, soil-climatic conditions, degree of erosion and other factors. Thus, the level of humus in soils is considered one of the main indicators of their productivity, and most of the agronomic properties of soils depend on the amount, reserves and quality of organic matter [7].

The amounts of humus, total and mobile nitrogen, phosphorus and potassium were studied in soil samples taken from genetic layers of rainfed typical serozem soils of the key area of the “Changi 2” massif of the Parkent district of the Tashkent region. Humus is of great importance in maintaining and increasing soil productivity. Humus accumulates in its composition nitrogen and ash elements necessary for plants. The amount of humus in the soil and its quality have a significant impact on the physicochemical, physical, agrochemical, biological and other properties of soils. The amount of humus in the soil composition is also greatly influenced by their genesis and mechanical structure. The amount of humus and total nitrogen in the topsoil layer of soils fluctuates between 0.706-1.098% and 0.036-0.052%, respectively, and decreases steadily towards the parent rock layers. In the subsoil layer, the amount of humus and total nitrogen was 0.670-0.972% and 0.034-0.048%, decreasing towards the parent rock. The ratio of carbon to nitrogen (C:N) is observed along the soil profile at 9.83-13.38 (Table 3).

The total phosphorus content in the arable layer varies between 0.25-0.32%, in the sub-arable layer between 0.24-0.29%, and in the lower layers between 0.12-0.18%. The total potassium content varies according to the genetic layers of the soils, ranging from 1.368-1.584% in the arable layers, and in the middle and lower parts of the profile, it fluctuates between 1.008-1.500%, which is lower than in the arable layer (Table 3).

The arable layers of the soils of the studied area are very poorly (<15 mg/kg), poorly (15-30 mg/kg) and moderately (30-45 mg/kg) supplied with mobile phosphorus. The subsoil contains less phosphorus than the upper layer and is observed around 6.11-27.78 mg/kg (Table 3).

Potassium is one of the elements highly demanded by plants. Therefore, the soil composition should provide sufficient potassium for plants. The exchangeable potassium content in the subsoil of the study area is 210-386 mg/kg. This indicates that the soils belong to the groups with very low, low, medium and high potassium content (<100; 101-200; 201-300; 301-400 mg/kg) (Table 3).

In the profile of typical serozem soils, carbonates are observed to increase towards the lower layer, that is, the parent rock layers (5.70% in the plow layer of section 28, 7.39% in the lower 118-145 cm. layer), and this phenomenon is directly related to the mechanical composition and water-physical properties of the soils (Fig. 1).

Table 3. The amount of humus and nutrients in typical loamy serozem soils of "Changi 2-plot" massif, Parkent district

Section number	Depth, cm	Total, %					Mobile, mg/kg		CO_2 carbonates, %
		Humus	N	C:N	P_2O_5	K_2O	P_2O_5	K_2O	
23	0-23	0,706	0,036	11,27	0,32	1,584	40,00	210	10,66
	23-47	0,670	0,034	10,23	0,29	1,500	21,67	170	11,77
	47-85	0,560	0,028	12,42	0,21	1,008	27,78	196	11,45
	85-115	0,550	0,024	12,08	0,18	1,045	12,50	208	11,77
	115-142	0,490	0,020	12,60	0,14	1,080	12,78	192	9,34
28	0-27	1,098	0,050	12,73	0,32	1,560	19,17	386	5,70
	27-47	0,972	0,048	11,74	0,24	1,500	10,28	247	4,01
	47-70	0,990	0,045	12,76	0,20	1,464	10,00	278	3,96
	70-118	0,954	0,043	12,86	0,18	1,320	9,17	141	8,97
	118-145	0,900	0,046	11,34	0,12	1,128	8,89	140	7,39
31	0-28	0,882	0,052	9,83	0,25	1,368	10,56	280	8,97
	28-45	0,810	0,038	12,36	0,24	1,344	8,89	144	10,03
	45-80	0,654	0,037	10,29	0,14	1,224	6,67	86	12,40
	80-126	0,594	0,030	11,48	0,15	1,224	6,39	79	11,77
	126-151	0,612	0,026	13,38	0,12	1,128	6,11	84	10,40

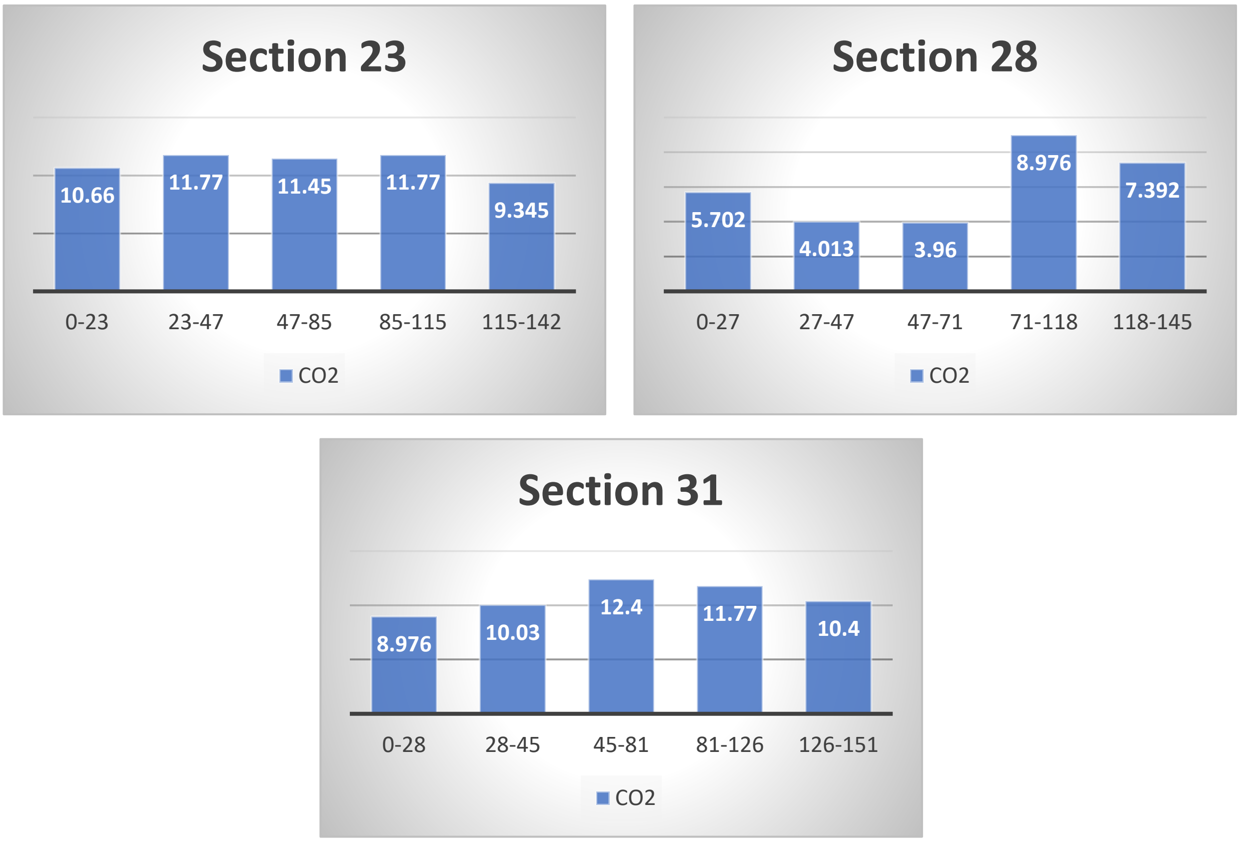

Figure 1. Carbonate content of CO2 in soils, %

The humus content in the topsoil of rainfed typical serozem soils studied in the “Changi 2” massif of Parkent district varies from 0.750% to 1.638%. In accordance with the humus content, the total nitrogen content is also relatively high, amounting to 0.045-0.090% in topsoil. The ratio of carbon to nitrogen (C:H) in topsoil is 8.93-11.16. The total phosphorus content in topsoil is 0.20-0.29%, and the total potassium content is 1.248-1.704% (Table 4).

The content of mobile phosphorus in topsoil of the studied sections is 29.44-43.05 mg/kg. According to the level of mobile phosphorus supply, they belong to the group of soils with an average (30-45 mg/kg) supply (Table 4). The amount of exchangeable potassium in the topsoil is 280-537 mg/kg, which indicates that these soils belong to the groups with an average (200-300 mg/kg), high (300-400 mg/kg), and very high (>400) supply of exchangeable potassium (Table 4).

Table 4. The amount of humus and nutrients in typical loamy serozem soils of "Changi 2-plot" massif, Parkent district

Section number	Depth, cm	Total, %					Mobile, mg/kg		CO_2 carbonates, %
		Humus	N	C:H	P_2O_5	K_2O	P_2O_5	K_2O	
6	0-26	1,638	0,089	10,67	0,22	1,632	43,05	453	-
9	0-23	1,494	0,082	10,56	0,20	1,704	29,44	537	-
13	0-25	0,750	0,045	9,66	0,26	1,584	36,94	384	-
20	0-27	1,386	0,090	8,93	0,29	1,296	30,83	283	-
22	0-24	1,116	0,058	11,16	0,22	1,248	32,78	280	-

Conclusion

The data on the mechanical composition of the rainfed typical serozem soils of the “Changi 2” massif of the Parkent district were analyzed, and it was shown that the soils of the region consist mainly of heavy loams, and some positive and negative aspects of such mechanical composition soils in the cultivation of rainfed crops were indicated. Some recommendations were developed for the effective use of the rainfed soils of the region and their protection from various degradation processes.

The levels of humus and mobile nutrients (NPK) of the rainfed typical serozem soils were noted, and information on the erosion of the rainfed soils of the region, salinity in some places, and the reasons for the susceptibility of the soils to negative processes were identified.

Information on the general aspects of the distribution of CO2 carbonates along the soil profile in the studied rainfed typical serozem soils was presented. The special role of carbonates in the fertility and productivity of soils was indicated.

Currently, research is being conducted on the possibility of obtaining higher yields from rainfed soils by studying the problems existing in the region rainfed soils and introducing developed agrotechnical, agro-ameliorative, agrophysical, and water and wind erosion control measures.

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