

CHANGES IN THE MORPHOLOGY AND AGROCHEMICAL PROPERTIES OF TYPICAL GRAY SOILS UNDER IRRIGATION

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Abstract

In this scientific article, the morphological and agrochemical properties of newly irrigated typical sierozem soils were studied. The research results showed that there are significant differences in the content of humus, organic matter, and mobile nutrients N-NO₃, P₂O₅, K₂O in the soil horizons. The upper layer 0-30 cm contains the richest humus and nutrients, the C:N ratio is 7.51, and high mobility creates optimal conditions for growth. The middle layers (30-56 cm) are characterized by a decrease in humus and nutrients, medium and heavy loamy mechanical composition, as well as a rich content of carbonate spots and fine gravel. The lowest layer, with a humus content of 56-80 cm and minimal mobile nutrients, provides mechanical stability of the soil by being skeletal and gravelly. Thus, it has been established that soil fertility in irrigated typical sierozem soils is directly related to the morphological features of the horizons, humus content, and the mobility of nutrients. These results will serve as a scientific basis for planning agrotechnical measures and optimizing the plant nutritional balance.

Keywords: Soil morphology, agrochemistry, humus, mobile nutrients, soil layer, fertility, assessment, plant relationships.

Introduction

Today, the main source of agricultural production is soils used in intensive irrigated agriculture. Despite the fact that these soils are found in the sierozem and desert zone, they are subjected to erosion and salinization under the influence of various processes, in particular, irrigation. Soils need to be protected from such negative processes and require increasing their fertility, preservation, and efficient use.

It is known that under the influence of soil-forming factors, soil is formed from parent rocks. In this process, new morphological and chemical features appear in the parent rocks, including the formation of new substances, structural fragments, various pollen, and new formations. The resulting soil consists of layers characterized by a number of morphological features. Thus, the resulting matter differs from parent rocks in terms of its fertility and morphological properties, and based on these characteristics, soil can be distinguished from rocks or parent rocks [1, 5, 6].

By studying the processes of soil formation, it is possible to determine what type of soil is formed. V.V. Dokuchaev identified the most important morphological features of the soil. In particular, the change in soil color from layer to layer is one of the most important indicators. Color, in turn, is closely related to the chemical, physicochemical, biological, and biogeochemical processes in



this layer [1, 2, 3]. From this point of view, the mineral composition of parent rocks directly affects the rate of removal of soil elements and the formation of morphological layers [1]. With the help of spectral reflection (Vis-NIR) methods, it is possible to quickly classify different soil horizons, which allows determining the morphology of the soil and its biogeochemical properties [2]. At the same time, how pedogenesis processes differ in different geoclimatic conditions has been studied in detail through micromorphology [3].

Morphological and agrochemical changes in irrigated soils help to assess soil fertility [4]. Detailed information is provided on the soils of Uzbekistan and their morphological characteristics, as well as their formation from geological substrates [5]. Evolutionary processes and methods of increasing fertility in irrigated soils are analyzed in detail [6]. The fundamentals of soil chemistry and elemental metabolism, as well as chemical analysis methods, are presented on a scientific basis [7]. The composition and biogeochemical role of soil organic matter were also analyzed [8]. At the same time, methods for assessing soil fertility were studied based on morphological and chemical characteristics.

In addition, according to scientific sources, irrigated typical sierozem and meadow soils have low mass density, high porosity, and belong to the category of loams of medium mechanical composition. Humus content is 0.36-0.87%, mobile phosphorus 5.33-15.60 mg/kg, and exchangeable potassium 10 mg/kg [9]. Some soil types have high fertility due to their richness in high organic matter and nutrients, the diversity of soil microbiota, and a specific combination of trophic nutrient resources [10]. However, the morphological characteristics of some soil types change as a result of irrigation and cultivation, and the depth of the plowed layer, soil color, gypsum and carbonate layers are constantly changing [11].

Also, the mineral composition of parent rocks and soil formation processes play a key role in determining the morphology, chemical, and biogeochemical properties of soils. This research serves as an important scientific basis for assessing and effectively managing soil fertility in soils of vertical and horizontal zoning.

RESEARCH OBJECT AND METHODS

The object of the research is the farm "Kushon Roxi Safet" in the territory of the Dustlik massif of the Kasansay district of the Namangan region, on an area of 90 hectares. Irrigated typical sierozem soils. The main research method was the morphogenetic and cross-sectional methods of V.V. Dokuchaev, chemical and physical analyses of the obtained soil samples were carried out using the manual "Guide to Chemical Analysis of Soils."

Research Results

The existing soils in the world have different morphological characteristics and layers. Even virgin and irrigated soils of the same type differ. These differences depend on soil-forming factors, the intensity of the influence of the anthropogenic factor, and others. For closer familiarization with such cases, we present below one of more than 20 sections taken from irrigated typical gray soils taken from the research object.

Soil samples were taken by the envelope method from 0-30 cm, 30-42 cm, 42-56 cm, 56-60 cm. The obtained samples were partially dried in the shade in field conditions, and preliminary office work was carried out.





Ah 0-30 cm. The arable layer is gray, the upper layer is dry, moisture increases towards the lower part and is considered moist. It has a weakly dense, medium and heavy loamy, granular crumbly structure, and in the upper part of the layer there are many roots, especially fresh onion roots and weed root parts. Traces of soil creatures, worm tracks, are abundant in the lower part of the layer. Gravel particles are occasionally found. Transition to the next layer by density and color.

Ah-h 30-42 cm. In a moist state, the subsoil horizon is dark gray, after slight drying it appears light gray, slightly moist, slightly dense, of medium and heavy mechanical composition, has a cloddy structure. It has many roots. Insect paths are encountered, that is, traces of carbonates are visible in the lower part of the layer from the lesions, there are small gravel and stone fragments, the ability to move to the next layer is gradual in color.

V 42-56 cm. Yellowish-gray with whitish spots, medium loamy, slightly compacted, relatively high moisture, i.e., clearly noticeable, plant roots are found. Insects have roots. Corbanian spots are abundant, white blisters are found. The carbonate illuvial layer is rich in gravel and stones of various sizes. The transition to the next layer is sharp in color and mechanical composition.

S 56-60 cm. It has a yellowish-gray color, is rich in stones, and upon separation of the stones, accumulation of carbonates can be observed in the whites. Rock-gravel layer, i.e., deluvium, parent rocks consisting of proluvium.

The obtained soil profiles are characterized by various horizons and morphological features, indicating the physicochemical and biogeochemical features of each horizon. These results create an important scientific basis for determining the influence of the internal structure, mineral composition, and anthropogenic factors of irrigated and virgin soils, as well as assessing their fertility.

Also, in accordance with the morphological characteristics of irrigated typical sierozem soils, its fertility, the content of humus, the total and mobile amount of nutrients suitable for plant assimilation, favorable physical and physicochemical conditions are associated, and the fertility, i.e., agrochemical indicators of the studied soils are presented in the table below.

In this regard, when assessing the fertility of the studied irrigated typical sierozem soils, the thickness of the humus horizon, the quantity and quality of nutrients, as well as the depth of occurrence and the degree of skeletonality of the rocky-gravel horizon are important indicators.

1-Table. Agrochemical properties of irrigated typical sierozem soils

Depth, cm	Humus, %	SO ₂ %	Gross, %			C:N	Mobility, mg/kg		
			N	P	C		N-NO ₃	P ₂ O ₅	K ₂ O
0-30	1.22	7.51	0.11	0.191	1.91	7.2	27.5	25.0	263.
30-42.	0.85	8.01	0.09	0.177	1.90	6.2	30.1	22.1	211.
42-56.	0.65	8.50	0.07	0.130	1.70	5.9	10.1	28.3	230.
56-80	0.27	8.60	0.03	0.127	1.81	6.4	-	-	240.

According to the data in the table above, the agrochemical properties of the studied irrigated typical sierozem soils showed significant differences across the horizon. The upper layer 0-30 cm is rich in humus and contains 1.22%, mobile forms of nutrients in large quantities - N-NO₃ - 7.2 mg/kg, P₂O₅ - 27.5 mg/kg, K₂O - 263 mg/kg. In this layer, the C:N ratio is 7.51, which indicates good absorption of organic substances by plants.

Nutrients in the upper layer are characterized by high mobility and bioactivity, which creates favorable conditions for the initial growth stages of crops. If a decrease in humus and nutrients of 0.85-0.65% is observed in the middle layers of 30-56 cm, then the content of mobile nutrients decreases (N-NO₃ 5.9-6.2 mg/kg, P₂O₅ 10.1-30.1 mg/kg, K₂O 211-230 mg/kg. The C:N ratio is 8.01-8.50, which indicates a lower content of organic matter in the layers and their mineralization compared to the upper layer. This situation indicates a significant decrease in the nutrient supply for plant roots.

The lowest 56-80 cm layer is characterized by minimal humus content of 0.27% and low nutrient content, P₂O₅ and K₂O indicators are absent (-), which indicates that its main function is limited to mechanical stability and moisture retention. The C:N ratio in this layer reaches 8.60, which indicates the low biological activity of organic substances. As a result, in irrigated typical sierozem soils, the upper layers have high fertility, while the middle and lower layers play a limited role in terms of mechanical and nutrient supply. These results are an important scientific basis for soil management and plant nutritional balance planning.

Conclusion

In the studied irrigated typical sierozem soils, significant differences in morphological and agrochemical indicators were revealed. It was established that the 0-30 cm plowed layer is rich in humus, the mobility of nutrients is high, and the C:N ratio is favorable for plant growth and nutrient absorption. Morphologically, this layer has a dark gray color, has a cloddy and granular crumbly structure, and is distinguished by the density of roots and organic residues.

The middle layers, i.e., at 30-56 cm, are characterized by a decrease in humus and nutrients, the mechanical composition is medium and heavy loamy, cloddy, enriched with carbonate spots and fine gravel. The lowest layer, with a humus content of 56-80 cm and minimal nutrients, is yellowish-gray, composed of rocky-gravel and skeletal layers, the main function of which is mechanical stability and moisture retention.

Thus, it has been established that the fertility of irrigated typical sierozem soils is directly related to their morphological characteristics, the composition of organic matter, and mobile nutrients. These results serve as a scientific basis for soil management and agrotechnical planning.

REFERENCES

1. Rice A. M. et al. Influence of parent material mineralogy on forest soil nutrient release rates across a nutrient richness gradient //Geoderma. – 2024. – T. 451. – C. 117081.
2. Çullu M. A. et al. Rapid characterization of soil horizons for different soil series utilizing Vis-NIR spectral information //Geoderma Regional. – 2024. – T. 38. – C. e00853.
3. Gerzabek M. H. et al. Strong Differences in Pedogenesis on Lava Vs. Scoria Along a Hydroclimatic Gradient on Santa Cruz Island/Galápagos Archipelago (Ecuador)–Insights From Micromorphology //Spanish Journal of Soil Science. – 2025. – T. 15. – C. 14219.
4. Isagaliyev M. T., Isomiddinov Z. J. CHANGES MORPHOLOGICAL AND AGROCHEMICAL PROPERTIES OF IRRIGATED GRAY-BROWN SOIL //Scientific Bulletin of Namangan State University. – 2020. – T. 2. – №. 8. – C. 28-33.
5. Кузиев P.К., Сектименко В.Е. Почвы Узбекистана. – Т.: 2009. С. 352.



6. Қўзиев Р.Қ., Абдурахмонов Н.Ю. Суғориладиган тупроқларнинг эволюцияси ва унумдорлиги. – Т.: 2015. 212 б.
7. Химия почв: Учебник /Д.С.Орлов, Л.К.Садовникова, Н.И.Суханова. – М.: 2005. 558 с.
4. Семенов В.М., Когут Б.М. Почвенное органическое вещество. - М.: 2015. С. 47.
8. Қўзиев Р.Қ., Юлдашев Ғ.Ю., Акрамов И.А. Тупроқ бонитировкаси. – Т.: 2004. 128
9. Burkhanova D., Urmanova M. Morphological structure, agrophysical and agrochemical properties of irrigated typical gray and grass soils //E3S Web of Conferences. – EDP Sciences, 2023. – Т. 371. – С. 01020.
10. Abakumov E. et al. Abandoned agricultural soils from the central part of the Yamal region of Russia: Morphology, diversity, and chemical properties //Open Agriculture. – 2020. – Т. 5. – №. 1. – С. 94-106.
11. Turdimetov S. M. et al. Morphological features of mirzachol oasis soils and their changes //Acta Innovations. – 2024. – Т. 52. – С. 1-8.