Agrophysical Properties Of Meadow-Serozem Soils Of The Mirzachul Oasis

Kurdashev Kudrat Davlyatovich
PhD In Biological Sciences, Uzbekistan

Gaziyev Umirzak Lapasovich
PhD In Agricultural Sciences, Uzbekistan

Alibekov Muslimbek Alibek O‘G‘Li
Teacher Of Gulistan State University Gulistan State University, Uzbekistan

Received: 18 Apr 2026 | Received Revised Version: 08 May 2026 | Accepted: 21 May 2026 | Published: 18 June 2026

Volume 08 Issue 06 2026 | Crossref DOI: 10.37547/tajabe/Volume08Issue06-02

Abstract

This article presents new data on the mechanical composition, geomorphological and lithological conditions, soil-forming materials, and general physical properties of irrigated meadow-serozem soils in the Mirzachul Oasis.

The soil formation conditions in the study area are hydromorphic (humid) and semi-hydromorphic (semi-humid) conditions, mainly serozem-meadow and meadow soils are widespread. Since the groundwater level (critical depth) in these soils is close to the soil surface, different degrees of salinity and gypsum content of the soil layers are observed. Accordingly, the study of its mechanical composition and general physical properties is also of great importance.

Keywords: Soil mechanical composition, serozem-meadow soil, salt crystals, soil particles, bulk density, specific gravity, total porosity, arable layer, fertility.

Cite This Article: Kurdashev Kudrat Davlyatovich, Gaziyev Umirzak Lapasovich, & Alibekov Muslimbek Alibek O‘G‘Li. (2026). Agrophysical Properties Of Meadow-Serozem Soils Of The Mirzachul Oasis. The American Journal of Agriculture and Biomedical Engineering, 8(06), 11–17. https://doi.org/10.37547/tajabe/Volume08Issue06-02

1. Introduction

The most important characteristics that determine soil fertility are its soil air, water physical, thermal regime, level of nutrient supply, and agrophysical properties. This is of great importance in improving the activity of microorganisms in the soil and in the optimal growth and development of plant roots. It is known that the mechanical composition of soils has an impact on many of its properties and determines the physicochemical, chemical, biological, water-holding and water-permeable capacity of the soil, relative resistance to soil cultivation, soil maturity, viscosity, compaction, subsidence, and other properties.

The Development Strategy of New Uzbekistan, designed for 2022-2026, sets the goal of "increasing the income of peasants and farmers by at least 2 times through intensive development of agriculture on a scientific basis, and increasing the annual growth of agriculture to at least 5 percent", and in order to achieve this goal, "Increasing and protecting soil fertility" has been identified as one of the main priority areas. Taking this into account, currently, many scientific research works are being carried out to increase soil fertility in modern farming and its use. In particular, the mechanical and physicochemical properties of soils are of great importance, and it is important to study such properties as their mechanical composition, density, specific gravity and porosity.

Literature Review

Taking into account the physical properties and structure of soils is of great importance in the effective use of land resources, the development of new technologies and methods for soil cultivation, irrigation, chemical and land reclamation activities. Effective land use in agriculture involves mechanical tillage of the soil, fertilization with various mineral and organic fertilizers, weed and insect control, irrigation and leaching at the required rates, which, in addition to affecting other soil properties, also affect its physical properties to varying degrees. Preventing and eliminating such negative processes in soils, preserving and restoring soil fertility remain one of the most pressing issues of today.

Restoring and increasing soil fertility is a long-term and costly process, and soil fertility is closely related to its general physical, physicochemical, agrochemical, biological and other indicators, as well as its mechanical composition. In addition, the thermal regime, moisture, and density of the soil strongly affect its physical and mechanical properties, and salt accumulation in soil layers, salinization processes, and water-salt regimes strongly affect its chemical properties, which greatly affects the amount of nutrients needed by plants [2,3].

In soil science, the study of the general physical, water, technological, and thermal properties and characteristics of soil is of paramount importance, therefore, the scientific study of the physical properties of soil is widely and clearly explained in the scientific works of leading scientists of our republic, M.U. Umarov, R. Kurvantaev [13], S. Abdullaev, L. Tursunov, R. Kurvantaev [1].

According to K.M. Mirzajonov [12], in the saline areas of our republic, ceramic pipes were first used to drain groundwater in 1927 (current Syrdarya branch of RICSSPA). The ceramic pipes were buried underground to a depth of 1.5-2.5 meters, taking into account the depth of groundwater, and the interval was about 100 meters depending on the mechanical composition of the soil, and the flow of groundwater was directed to open ditches. The depth of groundwater subsidence and the level of salinity were studied over time across the area.

During their research, R. Kurvantayev and A. Musurmanov [9] thoroughly studied the physical and mechanical properties of irrigated soils of the Mirzashol oasis and determined the effect of mulching with various organic substances and minimal tillage on the growth and yield of cotton and wheat. Accordingly, in the variant with minimal tillage and the use of organic substances, an additional yield of 4-10 centners per hectare was achieved for wheat and 2.3-4.7 centners per hectare for cotton.

The study of the mechanical composition of soils and their agrophysical properties has been reflected in the scientific research work of many scientists of our republic, including the fact that another agrophysical indicator that determines soil fertility is the aggregate state of soils, namely the presence of water-resistant macro- and microaggregates [8].

According to R. Kurvantaev et al. [10], the mechanical composition participates in the control of all processes in the soil, and in turn serves as a key indicator in the development of all necessary measures in the field of soil use.

Research Object

The research object is the irrigated serozem-meadow soils of T. Akhmedov massif, Mirzaabad district, Syrdarya region.

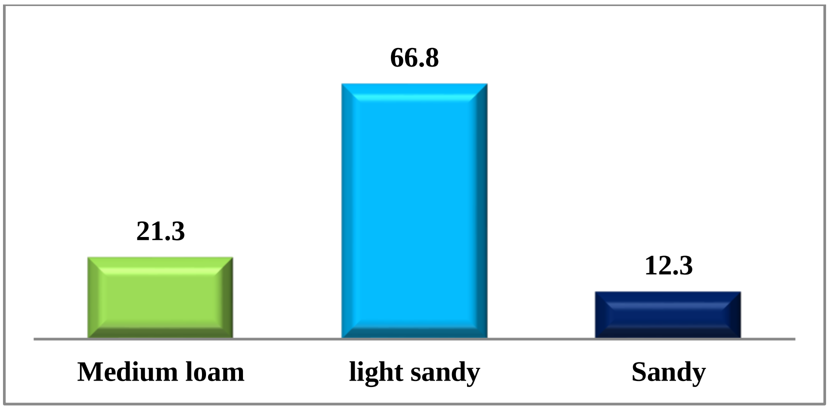
Research Methodology

The methods of analysis of soil map data of the studied areas, generalization of the results of comparative-geographic, soil-cartographic, laboratory-cameral-analytical studies, and assessment of the quality of massive irrigated lands are methods. The preparatory, field, cameral and cartographic work of the research was carried out on the basis of the adopted instructions [6], and laboratory-analytical work was carried out on the basis of generally accepted methodologies [11]. Determination of soil mechanical elements, classification and mechanical composition in laboratory conditions - according to the N.A. Kachinsky method by the pipette method [7]. General chemical analysis of the soil was carried out on the basis of the manuals of Ye.V. Arinushkina [5] and Uzbekistan Cotton Research Institute [14].

Discussion Of the Results

As a result of the years of continuous irrigation and use in agriculture, the soils of the studied area have formed a serozem-meadow soil, in the upper layer of which it is observed that the clay particles are washed to the lower layers and form an agroirrigation layer. The data obtained indicate that the soils of the studied area are distinguished by their multi-layeredness and diversity of mechanical composition. The content of large dust particles is higher in the irrigated sserozem-meadow soils of the region with medium and heavy mechanical composition than in other soils, and this was significantly observed in the subsoil layer.

According to the results of the field and laboratory analysis of the mechanical composition of the irrigated serozem-meadow soils of T. Akhmedov massif, which is the object of the study, it was determined that medium loamy soils account for 21.3% (365.5 ha), light loamy soils account for 66.8% (1144.7 ha), loamy soils account for 12.3% (211.4 ha), and medium and light loamy soils account for 88.1% of the massif. Such soils are considered the cultural soils of the region and are distinguished from other soils by their high filtration capacity and aeration processes (Picture 1).



Picture-1. Mechanical composition of irrigated soils of T. Akhmedov massif, in percent

It is observed that the lower genetic layers of the studied soil sections are replaced by soils of light sandy mechanical composition. This has a positive effect on the water permeability of the soils and serves to partially prevent the leaching of easily soluble salts in the soil surface layer to the lower layers and salinization.

According to the results of laboratory analysis of soil samples taken from the array (cross-section-1), the topsoil layers of weakly saline soils are mainly medium, light, and heavy, and partially sandy, with a lighter mechanical composition towards the lower layers of the soil profile. Of these, it was found that the amount of physical clay (<0.01 mm) particles in the silt layer was 19.7-34.1%, large dust (0.05-0.01 mm) particles was 21.4-53.2%, medium dust (0.01-0.005 mm) particles was 3.2-6.4%, fine dust (0.005-0.001 mm) particles was 9.5-15.1%, while the physical sand particles were large sand (>0.25 mm) 0.8-4.8%, medium sand (0.25-0.1 mm) 0.7-6.7%, fine sand (0.1-0.05 mm) 14.7-47.6%, and silt (0.001 mm) particles were 5.7-12.6% (Table 1).

Table 1

Mechanical composition of irrigated serozem-meadow soils.

<table>
<tr><th rowspan="3">№</th><th rowspan="3">Depth of layer, cm</th><th colspan="7">Soil particle distribution (%), particle size (mm)</th><th rowspan="3">Physical clay,mm
<0,01</th><th rowspan="3">Name by mechanical composition</th></tr>
<tr><th colspan="3">Sand</th><th colspan="3">Dust</th><th>Il</th></tr>
<tr><th>>0,25</th><th>0,25-0,1</th><th>0,1-0,05</th><th>0,05-0,01</th><th>0,01-0,005</th><th>0,005-0,001</th><th>0,001</th></tr>
<tr><td colspan="11">Slightly saline</td></tr>
</table>

1	0-26	0,8	1,1	14,7	53,2	4,8	15,1	10,3	30,2	Medium loam
	26-48	0,3	0,7	19,6	45,3	6,4	15,1	12,6	34,1	Medium loam
	48-85	4,8	6,5	46,6	21,4	3,2	10,3	7,2	20,7	light sandy
	85-108	4,8	7,0	46,8	21,5	3,2	9,5	7,2	19,9	Sandy
	108-159	3,4	6,7	47,6	22,6	3,6	10,4	5,7	19,7	Sandy
Moderately saline										
2	0-27	5,4	11,4	12,4	48,2	6,8	10,4	5,4	22,6	light sandy
	27-49	5,1	11,2	13,2	49,5	5,9	9,2	5,9	21,0	light sandy
	49-87	2,2	3,4	18,4	35,1	7,9	18,7	14,3	40,9	Medium loam
	87-112	2,3	5,7	21,2	39,1	5,4	15,1	11,2	31,7	Medium loam
	112-167	1,9	5,2	27,0	37,4	4,4	13,7	10,4	28,5	light sandy
Highly saline										
3	0-29	6,5	4,5	4,8	50,8	5,6	15,1	12,7	33,4	Medium loam
	29-46	1,6	4,4	16,9	42,1	6,4	15,1	13,5	35,0	Medium loam
	46-86	5,1	10,1	12,3	50,1	5,9	10,2	6,3	22,4	light sandy
	86-120	4,8	10,6	11,4	47,2	7,8	11,4	6,8	26,0	light sandy
	120-160	4,3	11,4	12,7	52,3	4,7	9,7	4,9	19,3	Sandy

In moderately saline (cross-section 2) soils, the amount of physical clay (<0.01 mm) particles in the topsoil layer is 21.0-40.9%, of which large dust (0.05-0.01 mm) particles are 35.1-49.5%, medium dust (0.01-0.005 mm) particles are 4.4-7.9%, fine dust (0.005-0.001 mm) particles are 9.2-18.7%, and of physical sand particles, large sand (>0.25 mm) particles are 1.9-5.4%, medium sand (0.25-0.05 mm) particles are 3.4-11.4%, fine sand (0.1-0.05 mm) particles are 11.4-27.0%, and silt particles (0.001 mm) are 1.0-1.5%. It consists of various mechanical compositions, amounting to 5.4-14.3%.

In the topsoil of highly saline (cross-section 3) soils, the amount of physical clay (<0.01 mm) particles is 19.3-35.0%, of which large dust (0.05-0.01 mm) particles are 42.1-52.3%, medium dust (0.01-0.005 mm) particles are 5.6-7.8%, fine dust (0.005-0.001 mm) particles are 10.4-15.1%, large sand (>0.25 mm) particles are 1.6-6.5%, medium sand (0.25-0.05 mm) particles are 1.6-6.5%, fine sand (0.1-0.05 mm) particles are 4.8-16.9%, and silt (0.001 mm) particles are 1.0-1.5%. It was found to be 4.9-13.5%.

Based on the results of the study, the amount of large dust and fine sand particles in the topsoil of the area is relatively dominant, which increases the likelihood that this was formed under the influence of irrigation and agrotechnical measures over many years. The positive side of these particles is their ability to improve water-air aeration in the soil, air permeability, and ease of tillage. The mechanical composition of soils is of great agronomic importance and is one of the important aspects determining the irrigation regime and land reclamation measures. Heavy sandy and clayey soils, due to their high viscosity and cohesion under the influence of salinity, resist working tools during tillage, creating a number of inconveniences.

The data obtained from the study of the study area show that due to the continuous irrigation of the soils of the region for many years, salt ions and clay particles washed down from the upper layers have formed a certain thickness of agroirrigation layer in the subsoil and lower layers, and it is in this layer that gypsum has accumulated in large quantities. This situation has caused the soil layers to become denser to varying degrees, creating a unique hard layer. These soils require regular and timely agrotechnical measures, the widespread use of organic and non-traditional fertilizers, crop rotation, and the use of irrigation water within the established norms.

Soil density (volumetric mass) is its main and most important physical characteristic, which significantly affects the water, air, heat regime and the biological activity of plants and soil animals. Taking into account the varying degrees of salinity of these soils, the location of the salt crystals in their composition causes the compaction of the soil layers.

The degree of compaction of the soils of the region was determined according to the classification developed by V.A. Rozhkov, A.G. Bondarev et al. (2002) (Table 2). Accordingly, the irrigated meadow-serozem soils of the massif with varying degrees of gypsum were divided into groups of soils with mainly weakly compacted arable layers, moderately compacted sub-arable layers, and strongly and very strongly compacted soils due to the high content of gypsum and the thickness of the gypsum layer in some soil sections.

Table-2.

Soil density classification.

№	Density level	Soil bulk density, g/cm³
1	Uncompacted (new ploughed)	<1,2
2	Slightly compacted	1,2-1,3
3	Moderately compacted	1,3-1,4
4	Severely compacted	1,4-1,5
5	Very strongly compacted	>1,5

The general physical properties of soils are one of the most important properties that determine their fertility. It was found that the bulk density (BD) of the studied soils varies in different indicators depending on the mechanical composition of the soil, and its density.

It was found that the bulk density of the studied massif soils increases in saline, moderately and strongly saline soils compared to non-saline soils, and the difference between them varies significantly. Of these, the bulk density of the soils in the plow layer and subplow layers was 1.33-1.65 g/cm3, with the highest indicator recorded in the middle part of the profile of the strongly saline soil containing a large number of salt crystals.

It was found that the specific gravity (SG) of the soils varies between 2.57-2.68 g/cm3. Total porosity (TP) - the more humus-converted humus in the soil, the more granular and porous the soil is and improves the water-physical, air, and thermal properties of the soil. The porosity of these irrigated serozem-meadow soils was studied and amounted to 37-50%. It was found that in the middle part of the strongly compacted soil profile, the porosity decreased to 37% (Table 3).

Table 3

General physical properties of irrigated serozem-meadow soils

Cross-section number	Depth, cm	Bulk density, g/cm³	Specific gravity, g/cm³	Total porosity, %
Slightly saline				
1	0-26	1,33	2,66	50
	26-48	1,37	2,68	49
	48-85	1,38	2,66	48
	85-108	1,36	2,64	48
Moderately saline				
2	0-27	1,40	2,57	46
	27-49	1,43	2,59	45
	49-87	1,38	2,60	47
	87-112	1,35	2,61	48
Strongly saline				
3	0-29	1,42	2,67	47
	29-46	1,46	2,69	46
	46-86	1,65	2,65	37
	86-120	1,59	2,62	39
	120-160	1,43	2,66	46

The top layer of these soils, depending on its mechanical composition and humus content, has a porosity of up to 50% in the most fertile soils. Typically, humus-rich, structural soils are characterized by the highest porosity, with a total porosity of 60-70% [4, 15]. In addition to soil aggregates and humus, this porosity is due to the voids formed by microorganisms and plant roots living in the soil.

Factors affecting soil compaction include excessive movement of heavy machinery during tillage, the effects of irrigation and saltwater leaching, and the increase in dust particles as a result of chemical erosion of soil particles.

Conclusion

In conclusion, it should be noted that in the studied area, the proportion of soils with a light sandy mechanical composition is relatively dominant, accounting for 66.8% of the total irrigated area, of which the amount of large dust particles prevails along the profile of the soil sections. It was found that depending on the degree of salinity of these soils, the bulk density increases in the layer where salt crystals accumulate. In these soils, the specific gravity and total porosity are also observed to change in accordance with the bulk density, since they are inextricably linked with the bulk density.

Along the profile of the soils of this region, it is observed that the lower part is lightened and alternates with light sandy and sandy loamy soils. Taking this into account, great attention should be paid to the irrigation regime in the region, and the productive use of soils should be achieved primarily by implementing agrotechnical and agro-ameliorative measures in a timely manner without delay, maintaining open and closed ditches in a constant working condition, maintaining the level of groundwater at a normal level, and correctly implementing the crop rotation system with a scientific approach, which will allow maintaining and increasing the fertility of these soils and obtaining higher yields from them.

References

1. Abdullaev S. Tursunov L. Kurvontaev R. Recommendations for improving the physical and structural condition of irrigated soils in Uzbekistan to

increase their productivity. Tashkent, 2004, 63 p.
2. Abdurakhmanov, N., Sobitov, O. L., Mansurov, S., Qalandarov, N., Kurdashev, K., Pulatov, M., ... & Abdullayev, J. (2024). Agrochemical properties of gray-pasture soils under irrigation of mirzachol oasis. In BIO Web of Conferences (Vol. 141, p. 02002). EDP Sciences.
3. Абдурахмонов, Н. Ю., Собитов, У. Т., & Курдашев, К. Д. АГРОФИЗИЧЕСКИЕ СВОЙСТВА В РАЗЛИЧНОЙ СТЕПЕНИ ГИПСИРОВАННЫХ ОРОШАЕМЫХ ЛУГОВО-СЕРОЗЕМНЫХ ПОЧВ. В журнале представлены научные обзоры, статьи проблемного и научно-практического характера, 5.
4. Абдурахмонов, Н. Ю., Хасанович, Қ. А., & Курдашев, К. Д. (2024). СУҒОРИЛАДИГАН ЎТЛОҚИ-БЎЗ ТУПРОҚЛАРНИНГ МЕЛИОРАТИВ ҲОЛАТИ. Science and innovation, 3(Special Issue 21), 503-506.
5. Arinushkina E.V. Guide to chemical analysis of soils/ Moscow State University, 1970, p. 487.
6. "Instructions for conducting soil surveys and compiling soil maps for maintaining the state land cadastre" Normative documents on land use, land management and land cadastre. Tashkent, 2013, 52 pages.
7. Kachinsky N.A. Soil Physics. Moscow, Higher School, 1970.
8. Kurvantaev R., Musurmanov A., Masharipov N., Khudoynazarova N. // Changes in the general physical properties of soils of the Mirzachul oasis under the influence of mulching and minimal tillage. Collection of materials of the Republican scientific and practical conference on the topic “Innovative technologies of production in diversified farms”. Bukhara, 2016.
9. Kurvantaev R, Musurmonov A. Educational and methodological complex on soil physics. 2010. 121 pages
10. Kurvontoyev R., Musurmanov A., U’rozboev I., Sultanov S. Changes in nutrients under the influence of mulching and minimal tillage of irrigated soils. Collection of materials of the Republican scientific and practical conference “Resource-saving methods based on natural compounds”. - Gulistan, 2016. –P. 42-46.
11. Methods of agrochemical analysis of soil and soil in Central Asia. UzPITI, 1977. - S. 214.
12. Mirzajonov K.M. Proceedings of the Republican Scientific and Practical Conference dedicated to the International Earth Day on the topic "Current Issues in Pakhtashilik and Prospects for Its Development". - Tashkent, 2009. - P. 10-15.
13. Umarov M.U., Kurvantaev R. Povyshenie plodorodiya oroshaemyx pochv putem regulirovaniya ix fizicheskix svoystv. - Tashkent, "Science", 1987, -106 p
14. "Methodological instructions for the assessment of irrigated soils of the Republic of Uzbekistan" (co-authors). Normative documents on land use, land management and land cadastre. Tashkent, 2005, 24 pages.
15. Хурдашев, К. (2022). ГИПСЛАНИШ ЖАРАЁНИНГ ТУПРОҚ УНУМДОРЛИГИГА ТАСИРИ. Наука и инновации , 1 (Д5), 198-202.
16. Khojaeva, N. D., Urazbaev, I. U., Ruzikulova, Z. U., & Gaziev, U. L. (2021). Some Agrotechnical Properties of Local Durum Wheat Variety" Istiklol". Annals of the Romanian Society for Cell Biology, 25(4), 6191-6197.
17. Yo’ldoshbek, S. S. T. M. (2023). The Effect of Processing on Acorn Series Intervals on Soil Agrophysics As Well As Fiber Quality. INNUC, 1(1), 163-168.
18. Lapasovich, G. U. (2025). IMPACT OF WATER CONSUMPTION INDICATORS ON THE YIELD OF COTTON VARIETIES CULTIVATED UNDER DIFFERENT ROW SPACINGS AND IRRIGATION REGIMES. Confrencea, 6(6), 162-166.
19. Gaziyev, U. L. (2025, April). G ‘O ‘ZANI SUG ‘ORISH TARTIBINI BELGILASHDA CHEKLANGAN DALA NAM SIG ‘IMINING AHAMIYATI. In INTERNATIONAL SCIENTIFIC AND SCIENTIFIC-TECHNICAL CONFERENCE “WATER-ENERGY AND FOOD SECURITY IN THE CONTEXT OF GLOBAL CLIMATE CHANGE AND WATER SCARCITY” (Vol. 1, No. 1, pp. 56-58).
20. Gaziyev, U. L. (2024). TURLI XIL QATOR ORALIG ‘IDA EKILADIGAN G ‘O ‘ZA NAVLARINING SUG ‘ORISH TARTIBINI BELIGILASHNING AHAMIYATI. Science and innovation, 3(Special Issue 21), 155-157.
21. Zafarjonzoda, R. Z., & Lapasovich, G. O. U. (2024). MIKROORGANIZMLARNING TUPROQDAGI AHAMIYATI. Central Asian Journal of Multidisciplinary Research and Management Studies, 1(7), 108-111.
22. Muxitdinovich, T. S., Lapasovich, G. U., & Qizi, G. S. A. (2024). ZAMONAVIY SHAROITDA ORGANIK ANOR PLANTATSIYALARINI TASHKIL ETISH VA EKOLOGIK SOF ANOR MAHSULOTLARINI YETISHTIRISH. Central Asian Journal of Multidisciplinary Research and Management Studies, 1(8), 4-8.
23. Gaziyev, U. L. (2024). TURLI XIL QATOR ORALARIDAGI YANGI G ‘O ‘ZA NAVLARI

EKILGAN MAYDONNING TUPROQLARI VA ULARNING AGROKIMYOVIY XOSSALARI. Science and innovation, 3(Special Issue 30), 64-67.