Volume 3, Issue 4, April - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

CERTAIN FERTILITY INDICATORS OF SOILS IN THE AGROTEXSERVIS AND CHBN MASSIFS OF BESHARIQ DISTRICT, FERGANA REGION

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Abstract

This article presents the impact of salinization on the fertility indicators of irrigated meadow soils in the Beshariq district of Fergana region. According to the collected data, when studying the fertility indicators, it was found that soil fertility was positively affected, although an increase in the degree of salinization was identified. One of the fertility indicators of the studied soils, based on their mechanical composition, was found to be light, medium, and heavy sandy, with some areas being sandy. The article also discusses the need for specific agronomic measures to be implemented in these soils.

Keywords: Irrigated meadow soil, fertility indicators, mechanical composition, salinization, degree of salinization, type of salinization, Agrotexservis and CNBN massifs.

Introduction

Soil fertility, its formation, elements, and limiting factors have been extensively studied by many researchers across various regions, with specific conclusions made for soils characteristic to each area. In particular, the irrigated saline soils in Fergana region have been researched by many scholars, with a focus on the meadow soils that have formed in these areas. These studies have comprehensively covered issues related to soil fertility, its formation, and its improvement. Our conducted research is dedicated to these issues, with the primary aim of determining the changes in fertility indicators of meadow soils under the influence of salinization, as well as identifying the problems associated with increasing soil fertility [1,6,9,12].

To achieve this goal, the study focuses on investigating the properties and characteristics of irrigated meadow soils in the region, specifically examining the changes resulting from human agricultural activities, particularly irrigation, and the factors affecting soil fertility in these areas. The tasks set include drawing conclusions based on the study of these influencing factors [3,4,11].

Currently, over 50% of the 4,304.32 thousand hectares of irrigated land in our country are affected by varying degrees of salinization. Scientific studies and field experiments have demonstrated that cotton yields in lightly salinized soils decrease by 20-30% compared to non-salinized fertile soils,

Volume 3, Issue 4, April - 2025
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by 40-60% in moderately salinized soils, and by as much as 80% in strongly salinized soils. The area under study, i.e., Beshariq district in Fergana region, has a total of 25,308 hectares of irrigated land, of which 13,654.25 hectares (54%) are affected by various degrees of salinization [2,5,16,17].

Given these issues, it is essential to thoroughly study the main properties and meliorative-ecological condition of the irrigated lands in the region, in order to prevent secondary salinization processes and successfully address reclamation issues. Based on newly obtained data, recommendations for the washing of salt from the studied soils, taking into account their mechanical composition, degree and type of salinization, and the average amount of salts in the upper root layer (0-1m), as well as other necessary agromeliorative measures, need to be scientifically justified. This remains one of the most urgent issues today [7,8].

Research Object and Methods

The research focuses on the meadow soils of the Agrotexservis and CHBN massifs in Beshariq district, Fergana region. The research methods and laboratory experiments were conducted based on widely accepted standard procedures. Soil fertility indicators were determined through various methods. The study utilized genetic-geographical, profile-geochemical, stationary-field, and chemical-analytical methods. The research was carried out in field, laboratory, and chamber conditions according to standard soil science techniques. The chemical analyses were performed in an internationally ISO-certified laboratory in the field of soil science. Specifically, the procedures for soil sample collection, storage, and laboratory experiments were conducted in accordance with the GOST:17.4.3.01–83 Interstate Standard, which governs state standards for sample handling and analysis. The study of soil properties with disrupted fertile layers followed GOST:17.4.2.02–83, while chemical analyses of soils were based on the guidebook "Chemical Composition of Soils" by Y.V. Arinushkina. The analysis included determining the calcimagnesium content (GOST 26428-85), gypsum content using the express method, water absorption, pH levels (GOST 26423-85), soil density (GOST 5180-84), and humus content using the Tyurin method (GOST 26213-91). The mechanical and granulometric composition of the soil was determined using the Kachinskiy method (O'zDSt 817-97). The microbiological analysis followed the methods outlined in M. Zvyaginsev's "Methods of Soil Microbiology and Biochemistry" and the commonly accepted dilution method used by the Microbiology Institute for analyzing microbial groups. The analysis of soil enzyme activity was based on F.X. Khaziev's "Methods of Soil Enzymology." Statistical processing was conducted using the Microsoft Excel program based on the B.A. Dospexov method.

Research Results

Certain fertility indicators of the Agrotexservis and CHBN massifs were selected for analysis. One of the fertility indicators, general humus, is explained as follows: Humus is a relatively stable, dark-colored organic compound complex in the soil, which is formed as a result of the biological and biochemical transformation (decay and synthesis of complex new substances) of dead plant and animal organisms [13,15].

Humus is released from the decomposition of plant residues under the influence of microorganisms, in the form of carbon, carbon dioxide, nitrogen, phosphorus, sulfur, nitrates, and sulfates, as well as in the form of compounds that are easily assimilated by plants.

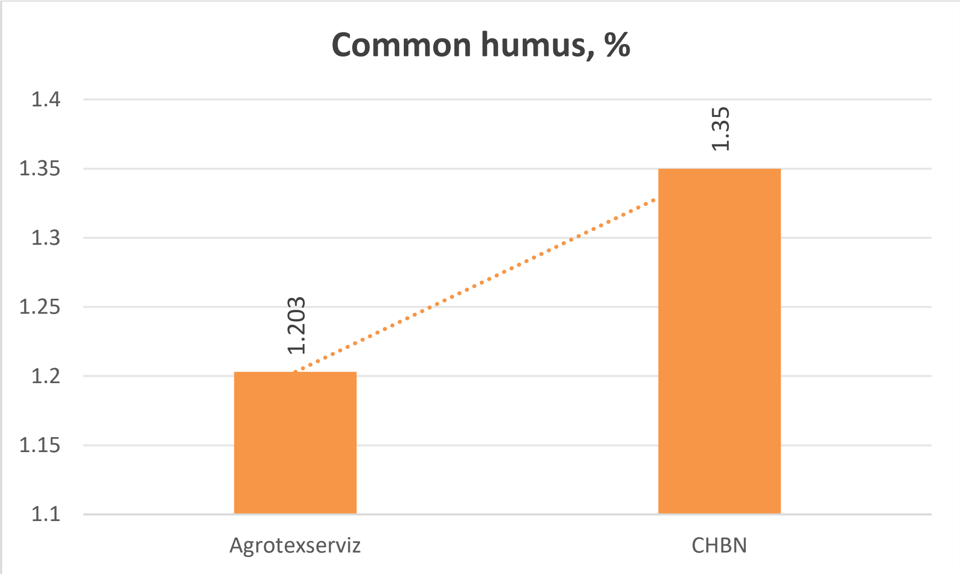

Figure 1. Humus content in the studied soils of the massifs.

According to the analysis results, the total humus content in the Agrotexservis massif soils was 1.203%, while in the CHBN massif, this indicator was 1.350%. It is evident that the total humus content in the CHBN massif soils slightly exceeds that of the Agrotexservis soils. Nitrogen is one of the key elements that plays a decisive role in soil fertility and plant nutrition. It exists in both organic and inorganic forms and actively participates in the biological processes of the soil ecosystem.

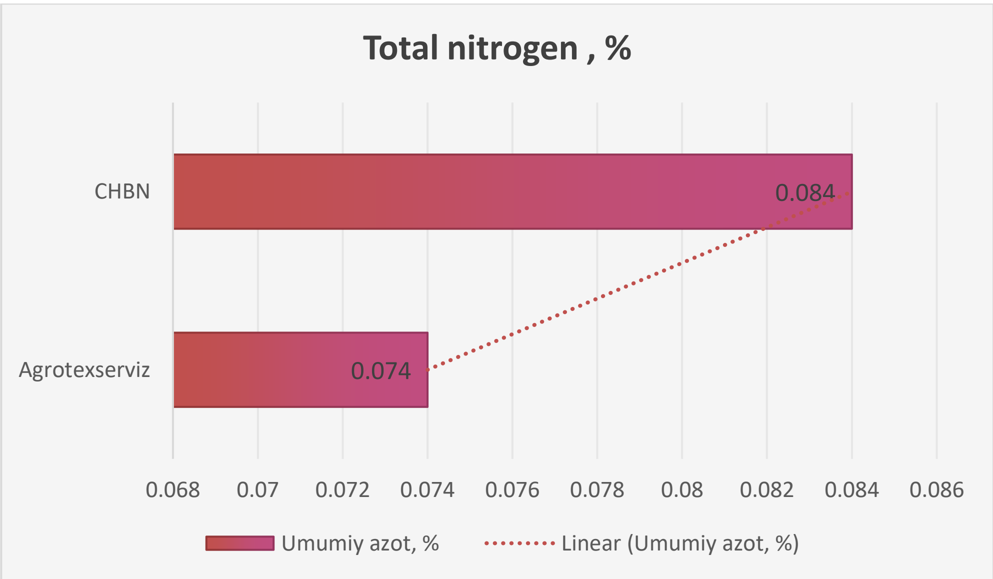

Figure 2. Total nitrogen content.

Volume 3, Issue 4, April - 2025
ISSN (E): 2938-3781

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In Figure 2, the total nitrogen content in the Agrotexservis massif soils was 0.074%, while in the CHBN massif, it was 0.084%. It is evident that, when compared to humus, the higher humus content in the CHBN massif is associated with the higher nitrogen content. The slightly lower humus content in the Agrotexservis massif is also reflected in the total nitrogen content.

Total phosphorus encompasses all forms of phosphorus present in the soil (organic, mineral, and mobile). It is an important factor in determining soil fertility. Phosphorus (P) in the soil is one of the essential nutrients for plants, playing an active role in root development, flowering, fruit formation, and energy metabolism processes. Insufficient phosphorus results in slow plant growth, with leaves turning dark green or purple, leading to reduced yields [10,11,14].

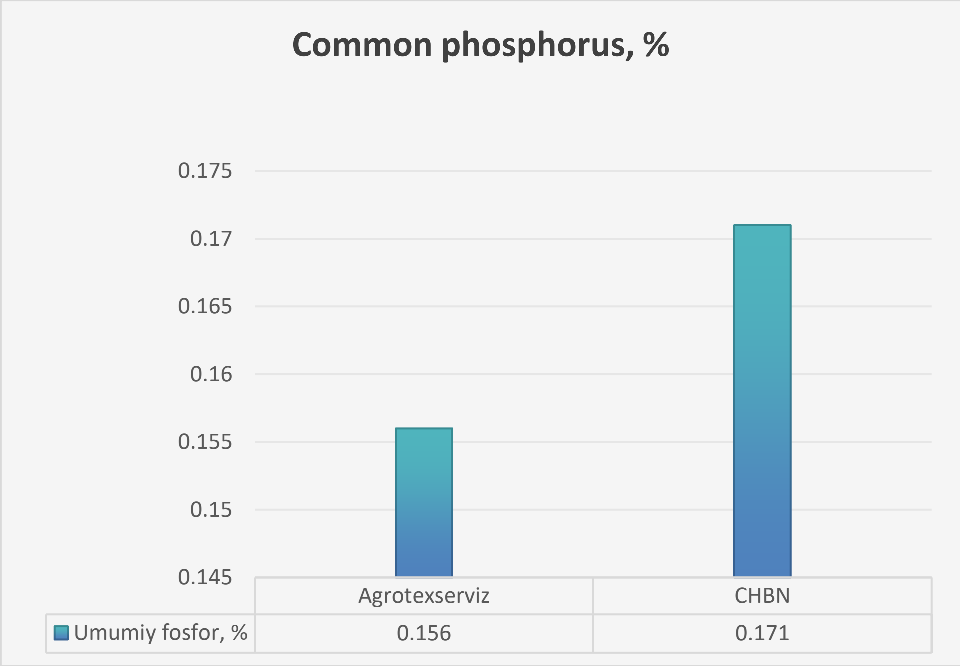


Figure 3. Phosphorus content in the Agrotexservis and CHBN massifs (in %).

According to Figure 3, the total phosphorus content in the Agrotexservis massif soils was 0.156%, while in the CHBN massif, it was 0.171%. It is evident that the total phosphorus content in the CHBN massif soils slightly exceeds that in the Agrotexservis soils.

Another fertility indicator, total potassium, is as follows:

Total potassium encompasses all forms of potassium in the soil (mineral, exchangeable, organic). It plays a vital role in plant growth and development. Potassium (K) in the soil is one of the three primary nutrients (NPK) for plants and plays a significant role in the plant's ability to retain water, resistance to diseases, sugar production, and fruit ripening. A deficiency of potassium results in the leaves of plants turning yellow at the edges, drying out, and a decrease in yield quality.

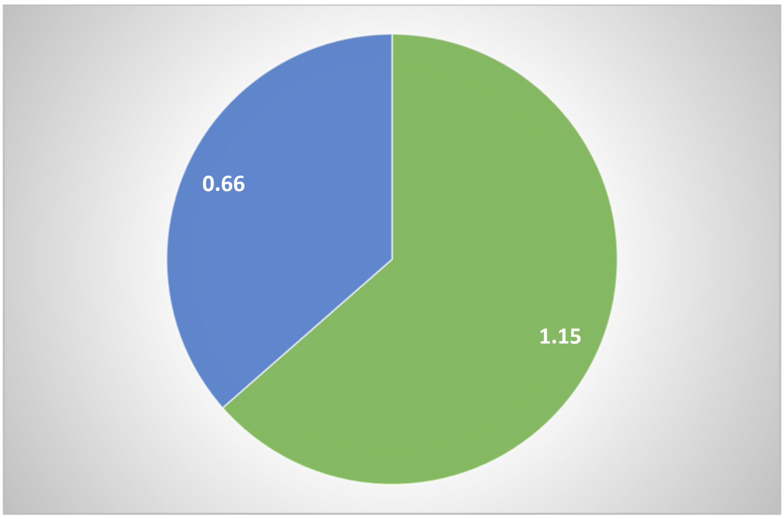
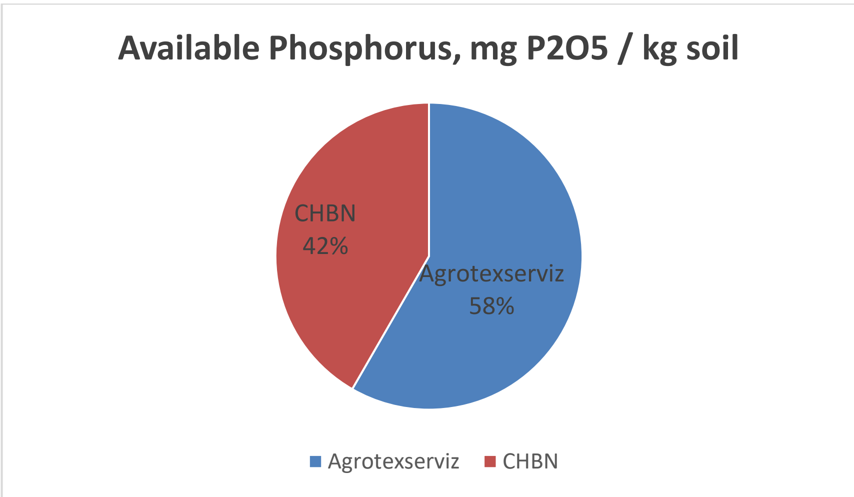


Figure 4. Potassium content in the soils of the region (in %).

The total potassium content in the Agrotexservis massif soils was 1.15%, while in the CHBN massif, it was 0.66%. Available phosphorus and exchangeable potassium are the forms of nutrients that plants can easily absorb from the soil. These are determined through agrochemical analyses and play an important role in assessing soil fertility.



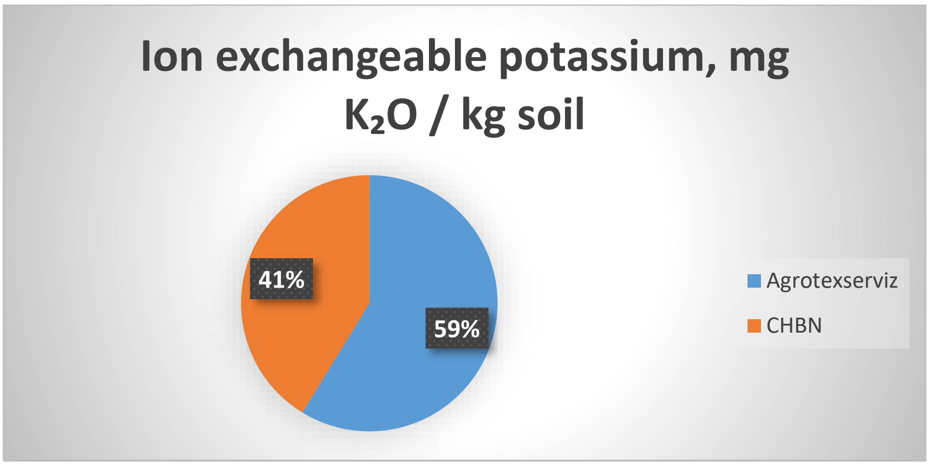


Figure 5. Available phosphorus and exchangeable potassium content.

According to the analysis, the available phosphorus content in the Agrotexservis massif was 21.0%, while in the CHBN massif, it was 15.0%. It is evident that the available phosphorus content in the Agrotexservis massif soils slightly exceeds that in the CHBN soils. The available potassium content in the Agrotexservis massif soils was 393.5%, while in the CHBN massif, it was 275.6%. This shows that, when compared to available phosphorus, the higher content of available phosphorus in the Agrotexservis massif is associated with the higher content of available potassium. The slightly lower available phosphorus content in the CHBN massif is also reflected in the available potassium content.
Chlorine (Cl) is an important element for the soil, and its presence plays a significant role in soil salinization and the formation of saline soils. Chlorine (Cl) is crucial in determining the salinization processes and chemical properties of the soil, as well as influencing soil fertility and agricultural crops. Chlorine in the soil primarily exists in the form of chloride salts, which affect the soil's chemical and physical properties and play an important role in soil salinization processes. Water-soluble salts in the soil, such as ammonium sulfate ($(NH_4)_2SO_4$), potassium sulfate (K_2SO_4), and calcium sulfate (gypsum, $CaSO_4 \cdot 2H_2O$), are found as compounds. SO_4^{2-} ions can freely move in the soil solution and are easily absorbed by plant roots. Sulfate plays an important role in determining the salinization type of the soil. In saline soils, the content of sulfate, sulfate-chloride, and other chlorine (Cl) compounds in the Agrotexservis massif was 0.033%, while in the CHBN massif, it was 0.16%.
One of the fertility indicators, SO_4, which represents the sulfates in the soil's water-soluble salts, is an important mineral form of sulfur that is essential for plant nutrition.
Sulfates in the soil primarily exist in the form of salts, and they constitute the main part of harmful salts in the soil. The water-soluble salts in the soil, such as SO_4, amounted to 0.556% in the Agrotexservis massif, while in the CHBN massif, it was 0.649%.
One of the factors influencing soil fertility and plant growth is microorganisms. Microorganisms living in the soil (bacteria, fungi, protozoa, actinobacteria, and other microscopic organisms) ensure the health of the soil and increase its fertility. They improve the chemical, physical, and biological properties of the soil through various biological processes.
Ammonifiers are microorganisms that decompose nitrogenous organic compounds (proteins, amino acids) and produce ammonia (NH_3). This process is known as ammonification and plays an important role in increasing soil fertility.
Ammonifier microorganisms decompose organic nitrogen compounds (plant residues, animal waste) in the soil, releasing ammonia (NH_3) in the process. These microorganisms play an essential role in enhancing soil fertility, as the ammonia produced is later converted into nitrates through the nitrification process, which plants can absorb.
In the studied soils, the number of ammonifiers was 40 million in the Agrotexservis massif and 42 million in the CHBN massif. The number of microscopic fungi in the Agrotexservis massif was 45 thousand, while in the CHBN massif, it was 30 thousand. The number of oligonitrophils in the Agrotexservis massif was 1,600,000, while in the CHBN massif, it was 6,400,000. It is evident that in the CHBN massif soils, the number of ammonifiers and oligonitrophilic bacteria is slightly higher compared to the Agrotexservis massif. However, microscopic fungi in the Agrotexservis massif showed a slight superiority.

Volume 3, Issue 4, April - 2025
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Conclusion

Soil fertility indicators are closely linked to the soil-forming factors: climate, relief, parent rocks, and natural and cultivated plants. However, the level of fertility, especially the character of land use, plays a significant role in determining soil fertility. The most important factors influencing soil fertility include the sufficient availability of nutrients necessary for plant development, the presence of water that plants can absorb, good soil aeration, the soil's granulometric composition, its structural state, and the presence of toxic substances (acids, alkalis, salts, etc.). The soil reaction and other factors also contribute to fertility. The combination of these characteristics defines the level of soil's cultivated condition.

All elements of fertility are interconnected. A change in one of these factors will affect others as well. Different plants have varying demands on soil fertility, and depending on plant biology, soil that is fertile for one type of plant may not be fertile for another. Evaluating soil fertility through its indicators is the process of determining how suitable the soil is for plants. Based on this evaluation, decisions are made on what crops to plant, what fertilizers are needed, and whether any land reclamation work is necessary.

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