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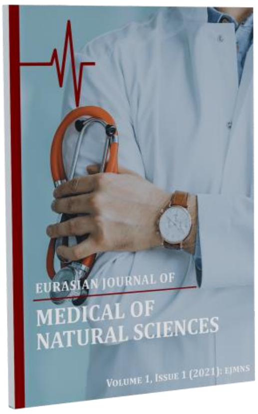

PROPERTIES AND MANAGEMENT OF IRRIGATED MEADOW-SAZ SOILS IN CENTRAL FERGANA: ENHANCING SOIL PRODUCTIVITY AND COTTON YIELD

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ABSTRACT
This article examines the properties of irrigated meadow-saz soils in Central Fergana and evaluates strategies to enhance their agricultural productivity. A comprehensive analysis of soil characteristics, including salinity, gypsum content, and mechanical composition, is paired with agrochemical and innovative agronomic practices. Focused on improving cotton yields, the study integrates traditional soil management techniques with non-conventional methods such as foliar feeding and optimized planting densities. Recommendations for sustainable soil use are provided, supported by empirical findings from recent experiments.

Introduction

The development and transformation of soil properties under the influence of long-term agricultural practices are critical in determining soil fertility and ecological balance. In Central Fergana, irrigated meadow-saz soils face challenges such as salinity, low nutrient levels, and limited water retention capacity. These challenges necessitate targeted interventions to sustain agricultural productivity. Additionally, soils in neighboring regions, such as Syrdarya, offer insights into broader strategies for soil improvement. This article integrates scientific findings on soil management and crop optimization to address these challenges.

Mechanical Composition and Physical Properties

Irrigated meadow-saz soils in Central Fergana predominantly comprise heavy and medium sands, transitioning to lighter sands in deeper layers. The clay content ranges from 14.1% to 46.4%, with sand particles accounting for 53.5% to 74.4%. These compositions significantly influence soil properties such as porosity, moisture retention, and nutrient availability. The upper layers exhibit higher porosity and nutrient content, supporting crop growth, while deeper layers pose challenges due to reduced fertility.

Gray-meadow soils in the Syrdarya region share similarities, with a medium-loamy structure. Clay content decreases from 47.7% in the top layer to 35.6% at lower depths, while dust particles dominate, enhancing water retention but complicating nutrient assimilation.

The specific weight of these soils varies slightly, increasing from 2.64 g/cm^3 to 2.67 g/cm^3 with depth.

Salinity and Gypsum Content

The salinity of meadow-saz soils ranges from weak to moderate, influenced by gypsum levels varying from low (0–10%) to moderate (20–40%). Gypsum, a critical component, directly impacts soil structure and water management. In gray-meadow soils, gypsum concentrations increase significantly in lower layers, from 0.255% at the surface to 2.8% in deeper horizons, exacerbating salinity and hydromorphism. Effective desalinization and gypsum management practices are essential for maintaining soil productivity in both regions.

Table 1: Gypsum Content in Meadow-Saz and Gray-Meadow Soils	
Soil Type	Gypsum Content (%)
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Meadow-Saz (Upper Layer)	0–10
Meadow-Saz (Lower Layer)	20–40
Gray-Meadow (Upper Layer)	0.255
Gray-Meadow (Lower Layer)	2.8

Nutrient Distribution and Challenges

Humus and nutrient content are higher in soils with heavier granulometric compositions. Upper soil layers in meadow-saz soils contain 1.034–1.298% humus, which decreases with depth. Nitrogen, phosphorus, and potassium levels also decline in lower horizons. Similarly, gray-meadow soils exhibit low humus content (0.44–0.98%) and gross nitrogen levels (0.042–0.088%). Phosphorus concentrations range between 0.258% and 0.295%, while potassium levels generally fall below 1.35%, necessitating improved fertilization strategies.

Table 2: Nutrient Content in Meadow-Saz and Gray-Meadow Soils			
Soil Type	Nitrogen (%)	Phosphorus (%)	Potassium (%)
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Meadow-Saz (Upper Layer)	0.071–0.087	0.34	1.08
Meadow-Saz (Lower Layer)	0.045–0.052	0.09	0.415
Gray-Meadow (Upper Layer)	0.088	0.295	1.00
Gray-Meadow (Lower Layer)	0.042	0.258	1.12

Agricultural Practices to Enhance Cotton Yield

Recent experiments on irrigated meadow-saz and gray-meadow soils demonstrate that combining traditional agrochemical practices with innovative techniques significantly improves agricultural productivity. Key strategies include:

1. **Non-Traditional Agronomic Methods**:

- Foliar feeding, applied 4–5 times during the growing season, enhanced nutrient uptake and reduced reliance on root feeding.
- Row planting densities of 120,000–140,000 plants/ha increased yield potential.

2. **Soil Preparation and Cultivation**:

- Comprehensive soil preparation involving plowing, leveling, and desalinization improved soil physical properties.
- Deep loosening (rixleniye) was performed multiple times to enhance root development and water infiltration.

3. **Optimized Fertilization**:

- Annual application of mineral fertilizers (N, P_2O_5, K_2O) improved crop performance, with variations tailored to specific soil and crop conditions.
- In gray-meadow soils, specific fertilizer regimes adapted to low humus and nitrogen levels are critical for optimizing nutrient availability.

Experimental Results

Field trials conducted from 2017 to 2019 demonstrated significant yield increases, with cotton production reaching 36.1–41.3 c/ha. Variants utilizing foliar feeding and higher planting densities consistently outperformed control groups, achieving up to a 17.2 c/ha yield increase. Proper irrigation practices further supported these outcomes by maintaining optimal soil moisture levels, particularly in saline conditions.

In gray-meadow soils, optimized irrigation and reclamation strategies enhanced soil fertility and reduced salinity impacts. The integration of agrochemical and physical soil management practices yielded improvements in nutrient mobility and crop performance.

Table 3: Cotton Yield Based on Agronomic Practices

Variant	Yield (c/ha)
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Control	23.8
Traditional Methods	31.4
Innovative Methods	36.5
Combined Methods	41.3

Environmental and Economic Considerations

Adopting foliar feeding reduced the accumulation of heavy metals and radioactive elements in the soil, promoting environmental sustainability. Additionally, non-traditional methods minimized input costs while enhancing yields, offering economic advantages for farmers. In gray-meadow soils, improving water-physical properties, such as porosity and capillary moisture capacity, further supports sustainable farming practices.

Recommendations for Sustainable Soil Management

To optimize the productivity of irrigated meadow-saz and gray-meadow soils, the following practices are recommended:

1. Implement desalinization measures to reduce soil salinity.
2. Enhance nutrient management through balanced fertilization and foliar feeding.
3. Utilize row planting schemes and adjust planting densities based on crop requirements.
4. Conduct regular deep loosening to improve soil aeration and water permeability.
5. Monitor soil salinity and gypsum levels to tailor reclamation strategies effectively.
6. Improve water management practices to ensure optimal moisture levels in saline-prone soils.

Conclusion

Integrating traditional soil management practices with innovative agronomic techniques offers a sustainable pathway to enhance the productivity of irrigated meadow-saz and gray-meadow soils. The findings underscore the importance of adaptive management strategies in addressing soil fertility challenges while ensuring environmental and economic benefits. Collaboration among researchers, farmers, and policymakers is essential for implementing these strategies at scale.

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