

The Level Damage of the Soil in the Vineyards of the Fergana Valley

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Abstract This article discusses the study of the composition of soils in vineyards planted in household plots in the Fergana Valley. During research conducted on the topic of phytoparasitic nematodes in the Fergana Valley's vineyards, it became necessary to study the physical, chemical, and bioecological properties of the region's soils. For this purpose, the soils of the vineyards in this area were analyzed. The aim of the study is to examine the soils of vineyards in the Fergana Valley region. By studying the composition of the soil, it becomes possible to assess the bio-ecological characteristics of phytoparasitic nematodes found in vineyard soils.

Keywords Acidic environment, Alkaline environment, Salinization, Organic matter, Efficiency, Fergana Valley

1. Introduction

The analysis of the lithological-geomorphological, hydro-geological, soil-climatic conditions, and human irrigation-agricultural activities in the Fergana Valley demonstrates the necessity of identifying the significant and unique patterns of agrochemical indicators, as well as assessing and forecasting changes in the reclamation state of irrigated soils. The compositional characteristics, fertility levels, and geochemistry of the soils in the vineyards of the Fergana Valley are highly diverse. One of the most important factors is the parent rock, which is prevalent in arid climatic conditions and contains various migratory elements [5]. In the irrigated lands of the Fergana Valley, irrigation, salt formation in the soil, its movement and accumulation, and the resolution of meliorative issues have been studied comprehensively. The mechanical composition of the soil plays a crucial role in the movement, redistribution, and accumulation of dissolved salts in water both vertically and horizontally within the soil profile, as well as during the leaching process. Therefore, in analyzing salt accumulation and secondary salinization processes in irrigated lands, and in assessing the soil-reclamation-ecological condition, special attention is given to the mechanical composition of the soil, which is considered one of the main factors influencing soil salinization [12].

The genesis of soils, their fertility levels, the migration patterns of elements that are mobile and absorbed through plant roots, as well as their accumulation and stratification in soil layers and groundwater, along with secondary salinization

processes induced by irrigation, exhibit unique characteristics and patterns in the irrigated lands of the valley. The need to study these aspects highlights the relevance of these analyses for understanding the nematodes living around and within the roots of grapevines. This further underscores the importance of these investigations in assessing soil conditions.

2. Material and Methods

The mechanical and microaggregate composition of the soil was determined using N.A. Kachinskiy's (1965) method, while water absorption analysis and the assessment of humus, total nitrogen, phosphorus, potassium, and their mobile forms, carbonates, and gypsum content in the soil were conducted following the guidelines in E.V. Arinushkina's "Rukovodstvo po khimicheskomu analizu pochvy". The composition of exchangeable cations was analyzed using Pfeffer's method, and other analyses adhered to the standardized methods established by UzNIXI in 1977. For data processing, B.A. Dospekhov's comparative methodology was used, along with the "Mikroelement" program developed by R.Q. Kuziyev and G. Yuldashev for computer-based analysis. Additionally, the reserves of humus, other nutrients, and salts in saline soils were determined with high precision and efficiency using rapid methods developed by D. Kholdarov and G. Yuldashev for electronic computation. Geochemical studies were performed based on the methodological approaches of Perelman and Glazovskaya. Mathematical and statistical analyses were carried out using the dispersion method in Microsoft Excel. The soil of the Fergana Valley is diverse. In the floodplain terraces along the Syrdarya River (ancient floodplain) and areas up to 400 meters in altitude, meadow, meadow-swamp, and variously saline soils are widespread. In plains, ravines, and alluvial fans at elevations

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between 400 and 800 meters, gray and dark gray soils are found. At altitudes of 800 to 1200 meters, light gray, dark gray, and typical gray soils dominate. These soils contain up to 4% humus [13].

3. Research Results

The Fergana Valley is an oval-shaped depression with a basin-like relief, stretching 300 km from west to east and 70–120 km from north to south. This depression is characterized by a sharp contrast in relative elevations. The unique shape of the relief, along with an open expanse of 9–10 km to the west, allows western winds to enter freely and persist for extended periods. The central part of the valley corresponds to the Central Fergana deserts, while around it, a chain of semi-desert areas with gray soils (bo'z tuproqlar) is located [1,7]. The entire history of the Fergana Valley is associated with the introduction and deposition of "strong currents," as well as the movement and accumulation of geochemical compounds. Gypsum, rich, and saline zones act as barriers along the main migration flow, with their formation occurring under the influence of a complex series of processes, at varying degrees of activity and intensity. Throughout all stages of soil cover development in the valley, the process of salt accumulation has periodically shifted over large areas, or changed its migration zones under tectonic influence, gradually forming in specific smaller regions with distinct lithological, geomorphological, and hydrogeological characteristics [7,12]. When determining soil fertility levels, it is crucial to consider the mineral and organic fertilizers used in horticulture, along with their compositional properties. This is because the amounts of mobile elements, even at the same levels, can reflect different salinity levels depending on the soil's fertility conditions, and at the same time, can exert varying degrees of toxicity to plants. For example, the amount of salts at 0.8% dry residue in soils with sulfate salinity types indicates mild salinity, while soils with chloride-sulfate salinity types show moderate salinity, and soils with sulfate-chloride salinity types exhibit strong salinity. The increase in the salinity level in soils with the same amount of salts is associated with the shift from sulfate salinity to sulfate-chloride salinity, which is linked to the corresponding increase in chloride ion concentration [10]. In the studied soils, the

total cation exchange capacity (CEC) ranged from 13.12 to 17.42 meq/100g. The soil profile showed that both the upper and lower layers exhibited low to moderate cation exchange capacity. The calcium content was notably high, ranging from 49.55% to 57.26%, while magnesium content ranged from 39.45% to 46.50%. Together, calcium and magnesium accounted for 96.0% to 97.1% of the cation exchange complex. The calcium content in the exchangeable layer was observed to be 1.0 to 1.5 times higher than magnesium. Potassium and sodium contents ranged from 1.08% to 1.46% and 1.84% to 2.49%, respectively, making up 2.92% to 3.95% of the cation exchange complex (Table 1).

"The amount of humus in the driving layers of the soils collected for analysis is 1.538%, while the humus content in the sub-driving layers is 0.721%. The total nitrogen content in the driving and sub-driving layers is 0.109% and 0.090%, respectively. According to the current classification, the driving layer is found to be moderately supplied with humus. The amount of carbonates in the soil is 6.126% in the driving layer, decreasing to 4.335% in the lower layers. The total phosphorus content in these soils is 0.234% in the driving layer. In the lower layers, it decreases to 0.092–0.090%. The total potassium content in the genetic layers of the soils is 0.70–1.28%. Potassium was recorded as 1.28% and 1.10% in the driving and sub-driving layers, respectively. The available phosphorus in these soils is low in the driving layer, ranging from 10.05 mg/kg to 28.61 mg/kg in the genetic layers. The exchangeable potassium in these soils in the driving layer is 151 mg/kg, indicating that it belongs to the potassium-deficient group (Table 2).

If the rN level is below 7, the soil is acidic. An rN level of 7.0 is considered neutral, while a range from 7 to 9 indicates alkalinity. An rN range of 6.8 to 7.2 is considered close to neutral. In most agricultural lands in Uzbekistan, the rN indicator ranges between 7 and 8, meaning the soils are weakly alkaline. According to the rN data in Table 2, the rN values of the studied soils fluctuate between 7.69 and 7.76, indicating alkalinity. The mobile form of lead (Pb) was determined based on the scale developed by X.T. Riskiyeva, with the permissible amount set at 10 mg/kg. The concentration of lead (Pb) in the soil samples ranged from 11.7 to 14.7 mg/kg, which is 1.2 to 1.5 times higher than the permissible amount (REM), as determined in (Figure 1).

Table 1. The cation exchange capacity (CEC) in the studied soil samples

Toil cross-section №	Depth sm	Ca mg/ekv	Mg mg/ekv	K mg/ekv	Na mg/ekv	Total	Ca %	Mg %	K %	Na %
1	0-20	10	7,2	0,192	0,326	17,72	56,44	40,64	1,08	1,84
	20-40	6,5	6,1	0,192	0,326	13,12	49,55	46,50	1,46	2,49
	40-60	9	6,2	0,192	0,326	15,72	57,26	39,45	1,22	2,07

Table 2. Amount of Humus, Nutrients, and rN in the Soil Composition

Soil cross-section №	Depth sm	Humus, %	N, %	P		K		CO ₂ , %	Soil pH
				%	мг/кг	%	мг/кг		
1	0-20	1,538	0,109	0,234	28,61	1,28	151	6,126	7,76
	20-40	0,721	0,090	0,068	12,39	1,10	129	4,335	7,69
	40-60	0,736	0,092	0,100	10,05	0,70	80	4,335	7,73

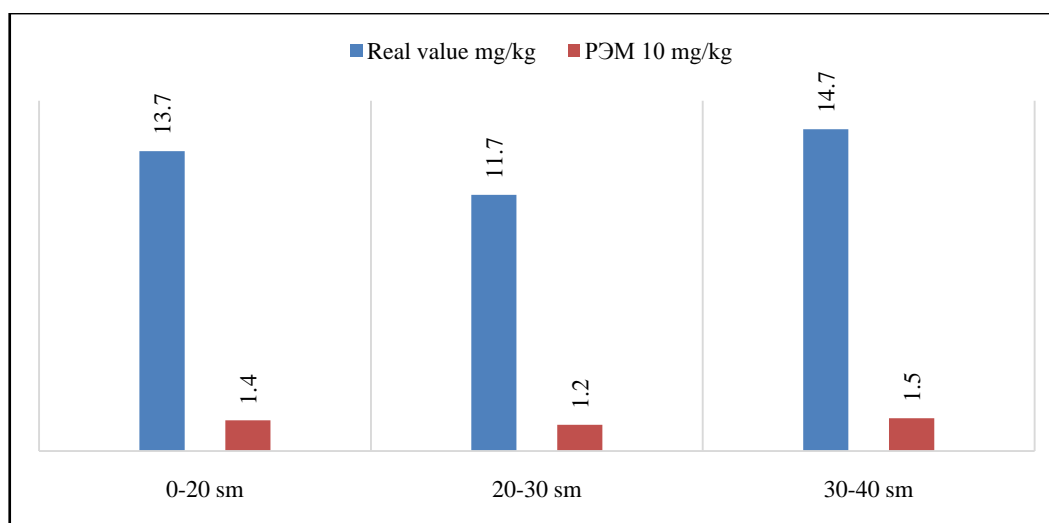


Figure 1. The Amount of Lead (Pb) Element in the Composition of the Soil Samples Collected

4. Conclusions

In this region, the formation and development of salinized soils, irrigated meadow-bog soils are influenced by mineralized (78 g/l, 7-9 g/l) saline waters, winds, and anthropogenic factors. The solution concentration in irrigated meadow-bog soils is relatively high, increasing from the upper to lower layers, reaching 11-18 g/l. With the increase in soil cultivation, this value decreases to 10-14 g/l. In layers in contact with saline waters, it fluctuates around 8-10 g/l. In the uppermost meter of salinized soils, this indicator reaches 210-280 g/l, and in layers in direct contact with saline water, it ranges from 81-98 g/l. Irrigated meadow-bog soils are poor in humus and nutrients, moderately saline, with an average concentration of harmful (toxic) salts around 0.6-0.7%. As irrigation continues, the salt concentration in older irrigated soils decreases to 0.25-0.40%. These soils are rich in gypsum and carbonates. The salt composition is dominated by MgSO_4 , which reflects the regional specificity of the soils. The upper layer of newly developed soils is weakly salinized (5-7% in relation to the exchangeable sodium adsorption ratio), while other layers, both new and old, remain unsalinized. Under the influence of irrigation and precipitation, salts leached from the upper layers do not accumulate in any specific layer but are continuously washed away. As a result, the amount of dry residue remains low (0.4–0.6%), and all cations and anions gradually increase from the top to the bottom along the soil profile. The exchange of cations in irrigated soils is related to their ion radius. Salinized soils are weakly and moderately salinized, with exchangeable sodium making up 8-12% of the exchangeable cation capacity. The cation exchange capacity of salinized soils ranges from 4.7-7.7 mg/equivalent, while in irrigated soils, it fluctuates between 5.0-9.6, which is considered a low value for them. The carbonate content in the soil is 6.126% in the plow layer, gradually decreasing to 4.335% in the lower layers. These indicators highlight the need for monitoring and regulating carbonate levels in the soils of Fergana Valley vineyards.

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