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CORRELATION ANALYSIS OF ANION AND CATION QUANTITIES IN SOIL WHEN STUDYING SALT TOLERANCE OF LICORICE PLANTS

Islamova G. A.
Assistant of the Department of "Communal and
Labor Hygiene" of the Tashkent State Medical University
e-mail: islamovagulnora91@gmail.com

Abstract
The study revealed patterns of adaptation of the investigated smooth licorice species to moderately and severely saline soils, improvement of soil agronomic conditions, humus enrichment, increased fertility, and above-ground biomass formation. The practical value of the work is in developing scientifically grounded recommendations for sustainable implementation and advancement of licorice planting technologies in soils with moderate salinity levels of 1.3-1.6% and high salinity levels of 1.6-2.5%.
In studying the salt tolerance of licorice to enhance the reclamation status of irrigated lands through bio-reclamation, the quantitative relationship between anions and cations in moderately and severely saline soils was determined using correlation methods following laboratory analyses.

Keywords: Land reclamation, plant, licorice, soil salinization, anion, cation, agricultural technology, biological reclamation, correlation, linear equation, nonlinear equation, mathematical equation.

Introduction

Part of the strategic policy pursued in our country is to gradually increase the volume of cultivation of licorice and other medicinal plants by creating special plantations in suitable areas for their growth, using natural areas rationally and using intensive cultivation technologies.
Smooth licorice is a phreatophyte plant that grows well in areas close to groundwater. It requires a large amount of water for proper growth and development /18,000/20,000 m3 ha/. When analyzing the origin of the plant, it was revealed that it has a high tolerance to soil salinity. Under natural conditions, smooth licorice can grow in soils with 1.5% sulfate and up to 0.5% chloride salts [1].
There are secondarily re-salted lands in Uzbekistan. They are idle and reclamation of these lands requires a lot of money. It would be advisable to use these lands for the production of smooth sugar cane. It is known that experiments conducted in this direction have yielded positive results .
In terms of importance, shirinmia is mainly used for three purposes:
I. As a raw material (root and rhizome) in food, medicine, and chemistry.
II. As fodder in livestock farming (the above-ground part is nutritious food)

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III. In agriculture, improving the reclamation condition of cultivated lands (improving soil structure and reducing salt)

Another characteristic of the sweetgum is that it absorbs and evaporates a lot of groundwater during its growth, which significantly reduces groundwater levels. In addition, its long and densely grown stems completely cover the ground, reducing evaporation from the upper part of the soil, reducing salinity in the upper part, and improving its meliorative condition [2].

2-2.5 tons of cuttings cut into a length of 13-15 cm are used per hectare, when the sweet potato is propagated from rhizomes and cuttings. When planting cuttings, you can use a cotton seeder. That is, the seeder is thrown into the open ditches with 4 people sitting behind it. Then, by closing the row gaps, it is possible to ensure that the pencils fall into a moist place. It will be appropriate if this event is carried out in March. The reason is that soil moisture is high in March. There is a lot of precipitation in April. For this reason, it is ensured that the niches in the pen become blue for 2 months. Watering events are carried out 1 time in May-June and 2 times in July-August. [3].

Since the licorice plant is rich in a number of beneficial properties, it is advisable to plant it, multiply it, and create large plantations. The licorice plant removes soil salinity, improves the agrotechnical condition of the soil. During our scientific research, we determined the bioremediation properties of salt-tolerant licorice plant specimens distributed in the Tashkent region, and a recommendation is made to plant licorice plants on saline soils and unusable land reserves of our country.

Research methodology and object

Our research was conducted at the experimental site of the “Botanical Garden” medicinal plant exposition named after Academician F.N. Rusanov at the “Institute of Botany” of the Urfa Academy of Sciences and on the saline lands of the “Hikmatli” farm in the Syrdarya region. We collected samples from root cuttings of the licorice plant, which is widespread in the wild in various districts of the Tashkent region, and conducted experiments on clean and saline soils.

1. Observation methods: Tashkent region and "Botanical Garden" experimental area.
2. Experiments: Licorice plant experiment (DST-22840-99) [4].
3. Analysis: comparison of the obtained results (DST-22840-77) [5].
4. Phenological and biometric observations: conducted according to the methods of conducting field experiments of the Uzbekistan Cotton Institute [6].
5. Soil analysis: the amount of water-soluble salts (carbonate anion, chlorine anion, sulfate anion, calcium cation, magnesium cation, sodium and potassium cations) was studied according to the soil science and farming methodology [7].

The obtained results and their scientific analysis

The process of changing the amount of anions and cations in certain saline lands by growing the biomeliorating plant sweet mica in saline lands is presented in connection with the improvement of the reclamation condition of saline lands, the development and practical application of measures for their rational use.

the Tashkent region, Parkent and Syrdarya regions, samples of 3-4-year-old root cuttings of the yam plant were taken, and soil samples were taken from the saline lands of the “Hikmatli” farm in

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the Syrdarya region. The saline soil was prepared for analysis in laboratory conditions (GOST 26213-84). When studying the properties and characteristics of the soil, soil samples brought from the field were prepared in advance for analysis. The analyses were performed on dried, crushed and sieved 1-millimeter soils. Some analyses were performed on soils taken from the field and preserved in their natural state [8].

Table 1 Samples taken from moderately saline soils of "Khikmatli" farm, Syrdarya region (June 2021)

Horizon, cm	HSO ₃ `	Cl`	SO4 ``	Ca``	Mg``	Na` +K`	Dry residue
0-10	0.022	0.164	1,082	0.231	0.089	0.136	1.724
10-20	0.018	0.232	0.980	0.273	0.034	0.055	1.59
20-30	0.0 25	0.141	0.541	0.182	0.034	0.0 7 9	1
30-50	0.021	0.107	0.545	0.168	0.027	0.059	0.927
0-50	0.02 5	0.093	0.927	0.26 6	0.06 2	0.0 9 0	1.462

Table 2 Samples taken from highly saline soils of "Khikmatli" farm, Syrdarya region (June 2021)

Horizon Cm	HSO ₃ `	C l`	SO4``	Ca``	Mg``	Na`+K`	Dry residue
0-10	0.01 1	0.41 8	1, 6 0	0, 2 7	0.032	0.89	3.221
10-20	0.010	0.071	0.88	0.17	0.032	0.25	1.413
20-50	0.011	0.036	0.83	0.17	0.032	0.0 32	1.111
50-100	0.012	0.058	1.68	0.35	0.041	0.18	2.321
100-150	0.012	0.064	1.25	0.015	0.021	0.19	1.552
0-100	0.00 7	0.2 4 8	1, 6 5	0, 4 7	0.0 25	0, 2 8	2.68
0-150	0.012	0.065	0.70	0.36	0.020	0.30	1.457

The soil samples presented in Tables 1-2 have 3-4 points based on the classification of salinity level and are characteristic of moderately and strongly saline soils [9] .

Before the planting of licorice, the concentration of water-soluble salts in the 0-50 cm layer of the soil was 1.462 % and chlorine (Cl') anions was 0.092 %. According to the analyzes, after the cultivation of licorice on moderately saline soils , during the first vegetation period, the concentration of water-soluble salts in the soil composition decreased by 0.1 77% in the 0-50 cm layer and chlorine (Cl') anions by 0.025%. When 3 types of licorice were planted on moderately saline soils for two years, the amount of salts in the soil changed in different concentrations and the amount of salts decreased significantly.

G.tipica: reduced the salinity of moderately saline soils by 95%. We observed that the chloride

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(Cl`) anion, which is especially harmful to plant growth in the soil, decreased by 0.142% - 0.12% in the 0-10th layer, by 0.041-0.002% in the 20-30th layer, and by 0.061-0.007% in the 0-50th layer.

G.aspera reduced the salinity of moderately saline soils by 82%. Chlorine (Cl`) anion decreased to 0.142% - 0.111% in the 0-10 layer, to 0.041-0.020% in the 20-30 layer; to 0.061-0.032% in the 0-50 layer. G.glandulifera reduced the salinity of moderately saline soils by 80%. Chlorine (Cl`) anion decreased to 0.142% - 0.116% in the 0-10 layer, to 0.041-0.032% in the 20-30 layer; to 0.061-0.036% in the 0-50 layer.

After the results of the laboratory analysis, we determined the quantitative dependence of anions and cations in moderately and highly saline soils in the study of the salinity tolerance of sweet potato.

This is the case for G. tipica, which has a salt reduction capacity of 95% in moderately saline soils, and G. glandulifera, which has a salt reduction capacity of 78% in highly saline soils.

One of the main tasks of correlation analysis is to determine the influence of these factor indicators on the resulting indicator. Data is collected on the factor (x) and the resulting indicator (y) under study.

To analytically express the relationship between X and U, a mathematical (linear or curvilinear) equation is selected. The correct choice of the equation is very important. Because the subsequent solution of the problem and the result of the calculations depend on the correct choice of this equation. The justification of the relationship equation is carried out using parallel series comparisons, data grouping, and line graphs. We use a linear equation to express the pairwise relationship between anions and cations in moderately and strongly saline soils.

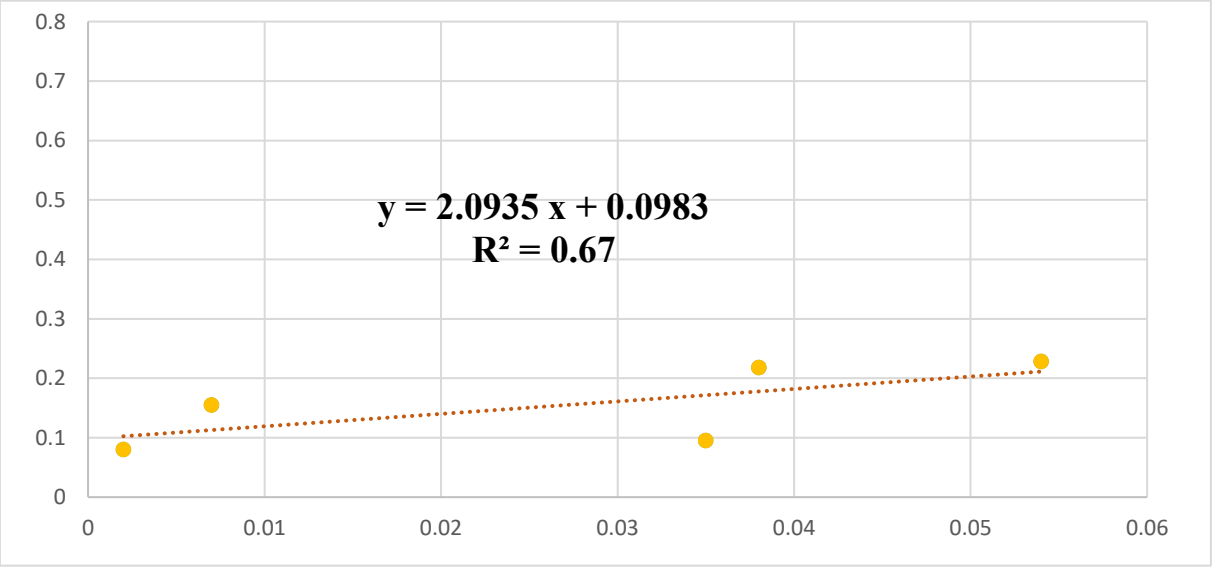

Figure 1. Correlation between chlorine (Cl`) anion and calcium (Ca``) cation in moderately saline soils planted with G.tipica.

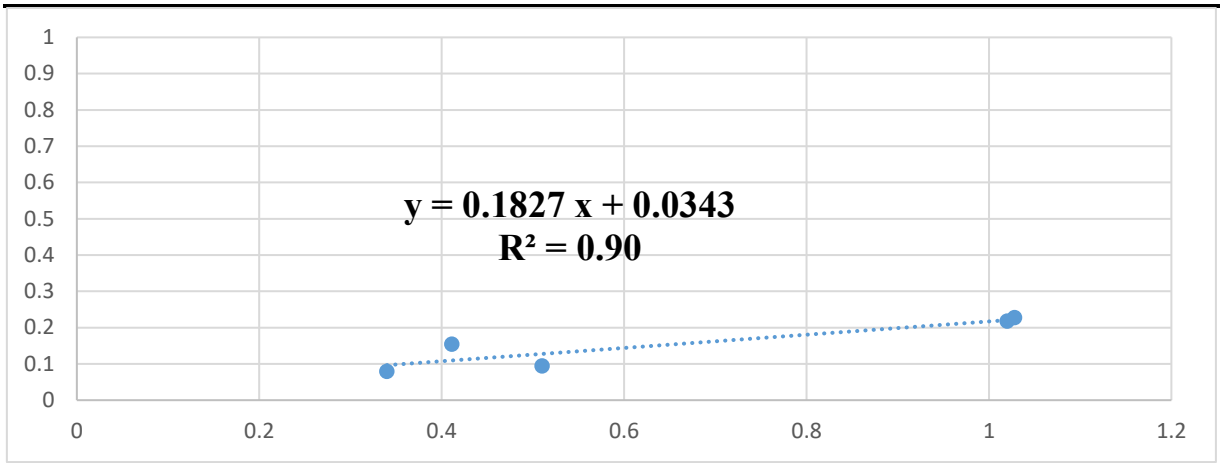

Figure 2. Cross-correlation of chloride (SO4``) anion and calcium (Sa``) cation in medium salinity soils planted with G. typica

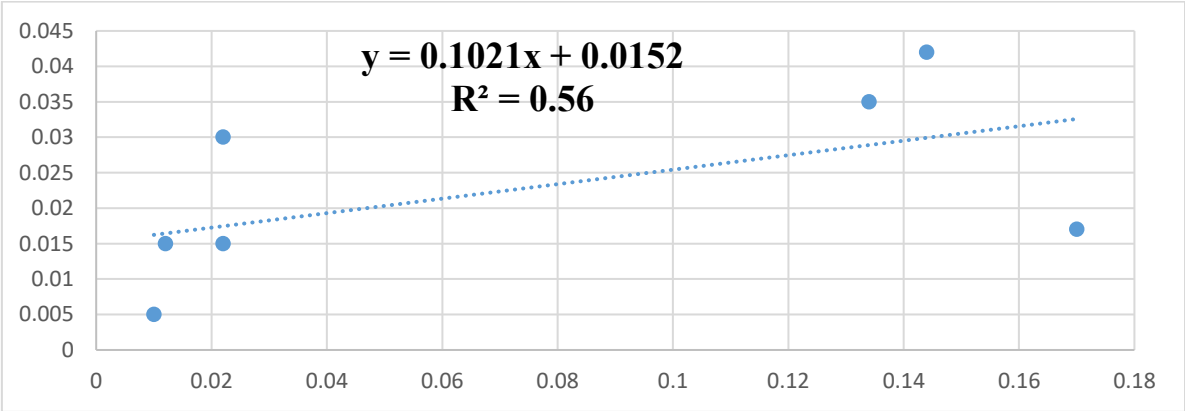

Figure 3. G. *glandulifera* Correlation between chlorine (Cl) anion and calcium (Ca) cation in highly saline soils planted with

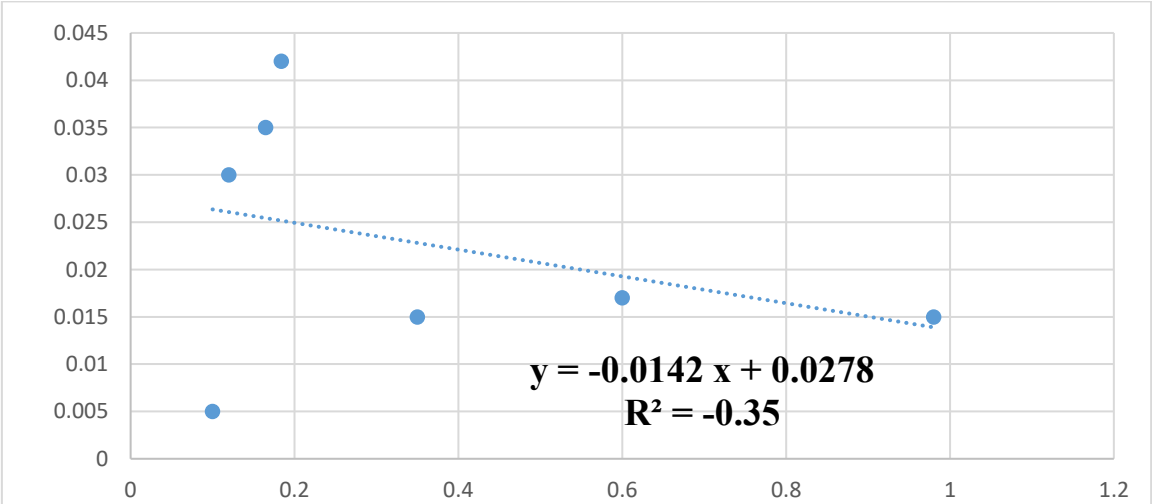

Figure 3. Correlation between chlorine (SO4``) anion and calcium (Ca``) cation in highly saline soils planted with G. glandulifera

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From the above correlation statistics, it can be seen that the resulting indicator of the relationship between salts in moderately saline soils, i.e. R^2, was expressed as 0.90-0.67 (Figures 1-2).
In highly saline soils, the resulting statistical correlation, i.e. R^2: 0.56- -0.37, i.e. here the indicators of these salts are inversely proportional (graphs 3-4).

Conclusion

According to the results of the research , the biomeliorative properties of the licorice plant appear in the 2nd vegetation period. In studying the salt tolerance of the licorice plant, after the results of laboratory analysis, the quantitative relationship of anions and cations in moderately and strongly saline soils was determined by the correlation method . That is, in moderately and strongly saline soils, the correlation between the chlorine (Cl`) anion and the calcium (Ca``) cation, and the (SO4``) anion and the (Ca``) cation was determined . In this case, up to 91 % of the result was achieved in moderately saline soils .
Many lands of our country are in need of melioration measures. In scientific studies, it was determined to improve the condition of these lands through the use of licorice plants in the biomelioration method. As the roots spread vertically and horizontally under the ground, it ensured that salinity in the soil does not reach the surface layer.
Enriches the soil with humus and improves soil aeration. Reduces salinity in highly saline soils to 2.0-2.2.5% . Protects the soil from wind erosion.

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