A method of saving water when washing highly saline soils in the conditions of Uzbekistan

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Abstract. Laboratory and field experiments established an increase in salt leaching by spraying the soil inside the checks with the Biosolvent preparation diluted with water 1:10. before supplying water for flushing. There was an increase in the leaching of ions and salts in the soil layer 0-70 cm: chlorine-ion - by 42% and the total amount of salts by 38%. It was found that with a high degree of soil salinity, water savings for its desalination is 3000 m^3/ha.

Keywords*: saline soils, ion leaching, Biosolvent preparation, washing, leaching rate, water saving.*

Introduction

About half of the irrigated lands in the Republic of Uzbekistan are subject to seasonal salinization and about 20% require soil leaching in the winter-spring period. Usually, saline lands are flushed according to checks, for this preparatory work is performed (leveling the surface of the field, cleaning the drainage, making rollers and temporary earthen channels for supplying water, etc.). In addition to labor costs, land leaching requires large volumes of water. The leaching rates for moderately saline lands are 4000-5000 m^3/ha, and for highly saline lands - more than 6000 m^3/ha. Water resources in Uzbekistan are limited, and therefore, increasing the efficiency of leaching is urgent. Reducing the amount of water spent on flushing will allow them to be stored in reservoirs and used during the growing season.

The purpose and objectives of the study

The aim of the study is to search for methods and technologies to improve the efficiency of leaching of saline lands, ensuring water savings.

Tasks for achieving the goal: 1. Conducting a study to study the leaching capacity of the Biosolvent preparation, developed at the Institute of Bioorganic Chemistry, ASRUz. 2.Quantitative and qualitative assessment of the leaching capacity of the preparation, according to the data on changes in the ionic composition of the soil. 3 Establishing indicators of soil leaching and water saving when using Biosolvent for washing.

Materials and methods

The studies were carried out in the field at an experimental site located in the Syrdarya region of Uzbekistan (figure 1) [1,2,3].

The soils are homogeneous in texture, light loamy, with rare interlayers of sandy loam, average soil salinity for the site according to ECe in a layer of 0-100 cm, up to 18 dS/m. The experiments were performed in triplicate according to generally accepted methods. Soil analyzes before and after leaching were carried out by the method of full water extraction; statistical processing of the data was carried out according to the Student's method.

Figure 1 - Location of the Syrdarya region on the territory of Uzbekistan and the location of the experimental sites

Flushing at a rate of 2000 m^3/ha, carried out on checks of 25x25m^2, in the following options: "control", - normal flushing and "experiment", - washing with spraying the soil inside the check with Biosolvent diluted in a ratio of 1:10. Water was supplied to each check separately; water accounting was carried out with the help of the Chipoletti spillway. The efficiency of leaching was assessed by comparing the data of laboratory analyzes of the ionic composition of the soil "before" and "after" leaching.

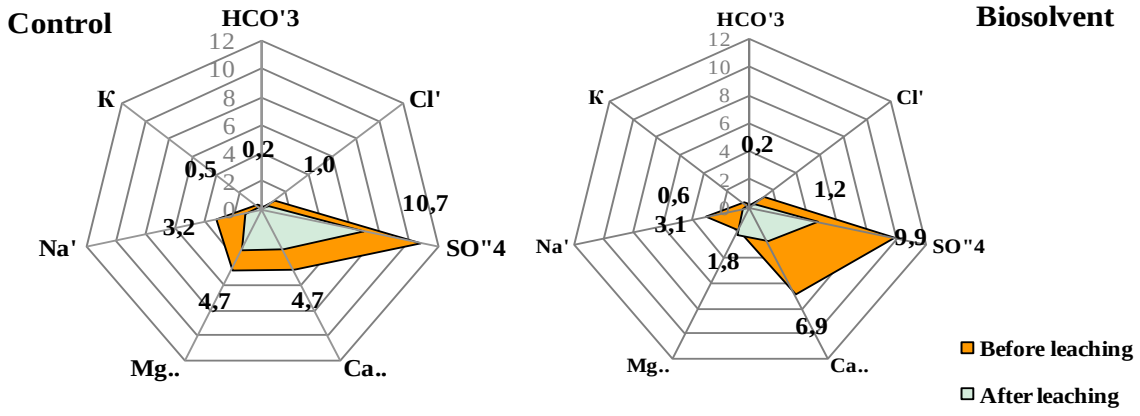
The consumption of water for desalination of soils from a high degree of salinity to the level of non-saline, was determined by a calculation method (according to experimental data on soil leaching by a dense residue).

Results

The results of field studies of leaching of saline soils using Biosolvent are shown in Figures 2 and 3 and in table 1.

Under the influence of leaching, the ionic composition of the soil changed as follows:

- the content of HCO_3, and when washing with Biosolvent - decreases (horizons 0-30 cm), or increases to a lesser extent, and in the control after washing with ordinary water, it slightly increases.
- the chlorine ion is washed out very well, in the control in the layer 0-70 cm -17.7% of the initial content was taken out, and in the variant with Biosolvent 59.6%, the difference between the variants was 41.9%.
- the effect of Biosolvent is also noticeable when sulphates are washed out, which in the 0-70 cm layer was: 21.8% in the control and 35.2% in the variant with the preparation (difference -13.4%);
- washing out the calcium ion from the 0-70 cm layer, in the control was -32.5%, and in the experiment - 60.5% (the difference was 28%);
- the content of magnesium, in the 0-70 cm layer, in the control decreased by 2.9%, and in the experiment, increased by -74.7%, which can be explained by an increase in the dissolution of magnesium by the Biosolvent;
- there was also an increase in the washout of sodium ion in the soil layer 0-70 cm: in the control it, washed out, was -36.6%, and in the experiment with the preparation: -56.3%



(difference -19.7%).

Figure 2 Comparison of the leaching of ions from the soil in the variants of the experiment

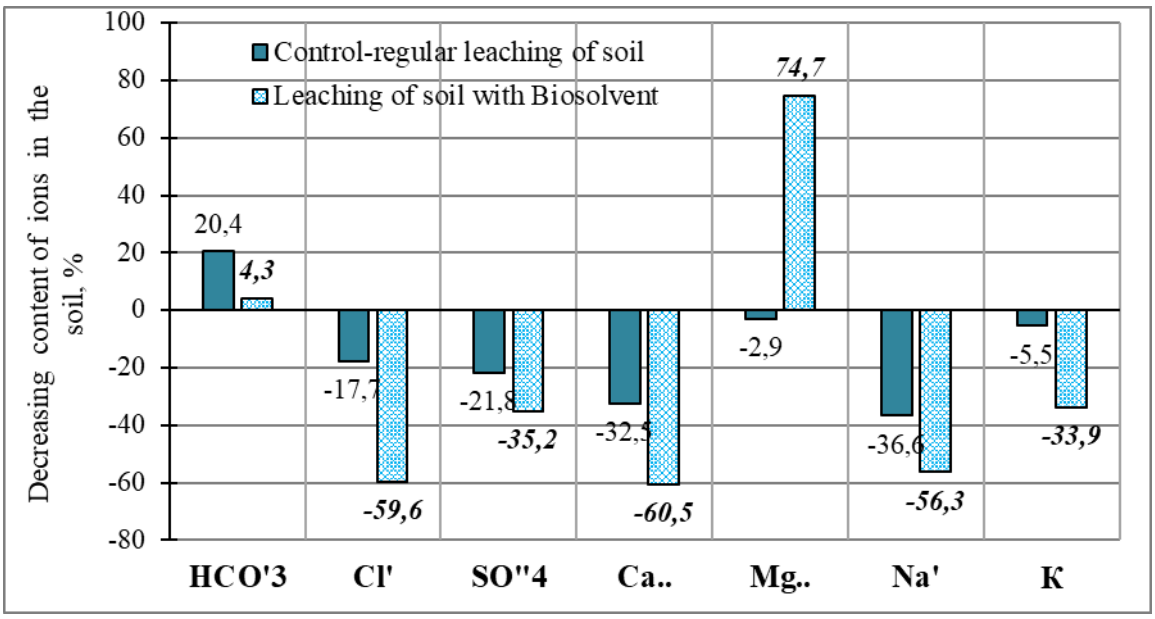


Figure 2 Influence of processing checks with Biosolvent on the efficiency of leaching of individual ions during washing (layer 0-70 cm)

Table 1. Indexes of efficiency of salt leaching and calculated norms of water for strong saline soils in options of field research

Indexes	Options of field research		Differences (B-C)		Changing, times (B/C)
	Control (C)	Biosolvent (B)	Absolute value	%%	
Before leaching (TDS,%)	0,812	0,842			
After leaching (TDS,%)	0,644	0,499			
Changing (TDS,%)	0,168	0,343	0,175	104	More, than 2,0
Unit costs of water for decreasing of TDS to 0,1 %	1190	583	607	51	Less, than 2,0
Soil leaching, coefficient, α	1,99	0,88	-1,11	-56	Less, than 2,3
Calculated norm of leaching for strong saline soils, m^3/ha	8549	5298	-3251	-38	Less, than 1,6

To clarify the values (volumes) of possible water savings during leaching with the use of Biosolvent, indicators of soil leaching were determined, based on actual data on soil desalinization by conventional leaching and with Biosolvent in field conditions. The calculations were carried out according to the formula of V.R. Volobuev:

$$\mathbf{M_{LE} = 10000\ \alpha\ lg(Sin/Sadd)}$$

where:

M_{LE} – leaching rate, m^3/ha;

Sin – salt content in the soil layer in need of washing, in% of the soil mass;

Sadd – permissible salt content in this layer, in% of the soil mass;

α – soil leaching coefficient, established according to the data of pilot production flushing.

The required leaching rates for highly saline soils, in the considered leaching options, are calculated using the same formula and the soil leaching coefficient indices established experimentally.

Conclusion

Experimental data have shown that the use of the Biosolvent preparation during flushing increases its efficiency in comparison with conventional technology and helps to save water by increasing the leaching of salts. The specific and total consumption of water for flushing is reduced. With conventional leaching, to reduce salinity (according to TDS) by 0.1%, 1190 m^3/ha is required, and when using Biosolvent - 583 m^3/ha, that is, almost half as much. Net leaching rates, calculated from the actual soil leaching coefficient α, for desalination of highly saline soils to the level of non-saline ones, with the use of Biosolvent less by 3000 m^3/ha (by 38%).

References

1. Yulia Shirokova, Gauharay Paluashova, Farhod Sadiev. Results of Testing the Leaching Ability of the Biosolvent Preparation on Salted Soils of the Middle Current of the Syrdarya River. // Research Article. Advances in Agriculture, Horticulture and Entomology, AAHE-128. Volume 2020, Issue 04. ISSN 2690-1900. www.kosmospublishers.com contact@kosmospublishers.com DOI: 10.37722/AAHAE.202042.
2. Farhad Fatullaevich Sadiev, Yulia Illarionovna Shirokova, Gaukharai Kalbaevna Paluashova. Investigation of the reclamation effect of the "Biosolvent" preparation on saline soils during leaching and irrigation. // Scientific journal of the Russian Research Institute of Melioration Problems. 2021. V. 11, № 1. P. 24–46. doi: 10.31774/2222-1816-2021-11-1-24-46.
3. Sadiev Farkhod, Shirokova Yulia, Paluashova Gauharai. A method for enhancing the leaching of salts from the soil during leaching and irrigation using the domestic preparation Biosolvent. // J. AGRO ILM. № 1.[57], 2021. P.59-60.