

Review Article

WATER SAVING TECHNOLOGY FOR LEACHING SALINITY OF IRRIGATED LANDS: A CASE STUDY FROM BUKHARA REGION OF UZBEKISTAN

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Abstract

Today the water resources have a strategic impact in Bukhara region of Uzbekistan and about 95% of agricultural products produced in irrigated areas of the region. Conservation and efficient use of water resources is imperative. The goal of this research is to provide farmers scientific and practical recommendations on enhancing the soil leaching efficiency and improving the ameliorative condition of arable lands by using Biosolvent chemical compound during the soil leaching. Salts in the composition of the soil, especially soluble, have a serious impact on the development of crops, can dramatically reduce their yield.

As a result of the analysis, the degree of soil salinity was determined: the soil is moderately saline, refers to chloride-sulfate salinization. When, soil leaching is carried out by Biosolvent chemical compound at the medium salted soils in Kagan district of Bukhara, the process of salt dissolution in soils accelerated and consumption of water used for soil leaching was saved up to 30% due to the enhancing the soil leaching efficiency.

Keywords: Biosolvent chemical compound; degree of salinity; soil leaching; seasonal leaching norm; period of leaching; chloral ion; water saving; ameliorative conditions.

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INTRODUCTION

Salts in the composition of the soil, especially soluble, have a serious impact on the development of crops, it can dramatically reduce their yield [1,2]. The salts are white, chemically neutral, and include chlorides, sulfates, carbonates and sometimes nitrates of calcium, magnesium, sodium and potassium [3]. Salinity is a soil and water quality concern, especially in arid and semiarid areas where water demand is increasing day by day for irrigation and agriculture. Arid and semiarid areas are the regions where there are insufficient rain to leach salts and excess sodium ions out of the lithosphere. Most of saline soils contain calcites and calcium salts of extremely low solubility (Qadir et al., 2002) [4].

In the view of several scientists, salt-affected soils may inhibit seed germination, retard plant growth, and cause irrigation difficulties. Salty soils cannot be reclaimed by chemical amendments, conditioners or fertilizers. Salty soils are often reclaimed by leaching salts from the plant root zone [3].

There are numerous sources of soil salinity. In the view of some authors, Soil salinity is a measure of the minerals and salts that can be dissolved in water. Salt-affected soils occupy, on a global basis, 952.2 million ha of land. These soils constitute nearly 7% of the total land area or nearly 33% of the potential agricultural land area of the world (Gupta and Abrol, 1990) [5].

Several scientists made researches on determining the level of soil leaching, and suggested a number of formulas to determine the level of soil leaching [6]. In research salinity was determined by the formula by V.Volobuyev and the method of soil leaching was carried out on this basis.

Before soil leaching, the soil should be cleaned from the cotton stalks, land leveling, drainage, flat slope must be provided. In the field, the soil leaching is carried out by polling. In the 1980's in Mirzachul, the soil salinity was leached by shallow and deep furrows [7].

Another researcher has developed recommendations on how to apply sampling measures to soil degradation and to perform saline cleaning. The recommendations are reflected in the table below [8]. Researchers have studied that cotton yield is dependent on land salinity [9]. Mineralized water can also be used for soil leaching. Salinity leaching process may be done by mineral water as well. A number of researches have been conducted in "Soil research and salinity leaching" laboratory of the Central Asian Research Institute of Irrigation. Research showed that soil leaching can be provided when mineralization in studies of weak salinity is 3.0-6.0 g/l; average salinity - 5.0-7.5 g/l; in the case of heavy salinity it is possible to provide 7.2-10.0 g/l and saline soaking up to 15.0-16.0 g/l in very strong saline [8].

The lush soils areas of Uzbekistan have natural and secondary features of salinity. According to the several researchers' ideas there are three main sources of land salinity in the Republic:

- Salt content of irrigation water;
- The initial amount of salts present in the soil;
- Saturation of pressured groundwater and aeration zone with mineralized water [9].

From the background of scientists, it is clear that, Salt regime implies the history of salt composition and migration in value ecosystem soils. It consists in unwashed salts, particularly by impulverization, dissolving of salts that are in crystalline state, and vice versa in precipitation of salts from solutions, consumption of salts from solutions by plants and partially by soil organisms, their return with abatement, cyclic vertical migrations of salts, carry-over of salts into illuvial horizons during soil formation, carry-over of salts from the system with surface and ground waters, as well as by expulverization. Salt regime can be broken by environmental pollution [10].

Salt regime implies the history of salt composition and migration of salts in soils and water bodies. It is one of the most important environmental factors. It can be broken by erosion of

banks, salinity and over wetting of soils, pollution of environment, etc. [11].

Salt regime of soil implies change in the inter-irrigation, annual or many-year cycle of salt content and its qualitative composition in soil. Salt regime of soil is as a rule heavily dependent on irrigation and natural water regime; it (water-salt regime) is usually studied simultaneously [12].

Improving the efficiency of soil leaching by Biosolvent Chemical compound (BChC): The effect of the composition based on the water-soluble polymer on the salt content in the soil salts

A number of Bioorganic Chemistry Institute named after academician O. S. Sodikov under Academy of Sciences of the Republic of Uzbekistan researchers have studied the effect of composition on the basis of water-soluble polymer to salts in saline soil and have come to the following conclusions [13]:

As you know, due to soil salinity and erosion, plants stop growing and developing, causing corrosion of buildings, roads, bridges and hydraulic structures. Chemical melioration is a main reclamation process where sodium and magnesium are replaced by calcium, soil alkalinity decreases, the soil natural structure is restored, increases grain content and improves properties. For this purpose, ameliorative compounds and calcium-rich industrial wastes such as dolomite, gypsum, phosphogypsum, calcium chloride, local fertilizers, etc. are used [13].

Surfactants are also of great importance in improving the physical, chemical and biological properties of saline soils, they are examples of polymeric ion exchangers. Surfactants disintegrate the gypsum and carbonates, neutralize salts, accelerate the melting process and improve soil structure [13].

A polymer composition with the following properties is selected for the removal of soluble and hard soluble salts from saline soils: a functional group containing an acidic ion exchange, which is well dissolved in water, the functional properties of these functional groups are organic, it should be able to maintain the bioorganic surfactant, as far as possible, in the lower molecular weight [13].

Based on these requirements, the polymaleic acid polymer composition of average molecular weight 2000 was obtained based on maleic acid homopolymer and the biocomposition of the resulting soil is water soluble in salts, mainly affected by sodium chloride and sodium sulphate, which is most harmful to plants, in addition, the soil has a low hydraulic conductivity and pH factor was high and saline soils were inspected in the Mirzaabad district of Syrdarya region. For the experiment, the composition is selected, which complies with the requirements of soil elements, biologically acceptable, biodegradable and vegetable cultivation. In experiments, the polyeneal type sodium and ethanolamine salts of surfactants, polymaleic acid compositions were used [13].

When saline soil is leached with water and polymer composition and the soil composition is detected by aqueous solution, it was observed that the total dry residue decreased by 1.4 times in the saline soil, which leached with polymer composition compared with the saline soap leached with water. The polymer composition was detected in all soil samples Cl^- 1.3 times and CO_3^{2-} ions of 1.4 times more water than water. In addition, saline soils have been detected by 1.7 times in the ions of Ca^{2+} and K^+ , the Mg^{2+} ion is 1.6 times, the Na^+ 1.1 times [13].

Saline soil samples were leached with the composition and 71 mg/l of Ca_3^{2-} ion was detected in the aqueous solution by titration. This means that when the polymer composition

solution passes through the soil, the acidic environment at the expense of carboxyl groups in the soil and the turbid carbonate salts turn into soluble hydrocarbonate salts. Even in experimental field experiments, when saline soil was leached, the soluble solids in the soil were rinsed 1.5 times more than leached with water only [13].

Polymer composition studies in Syrdarya region

A few scientists of Bioorganic Chemistry Institute named after academician O. S. Sodikov under Academy of Sciences of the Republic of Uzbekistan studied polymer composition on salts in saline soils of Syrdarya region [14].

As a result of soil salinization, erosion and lack of water supply, crop yields in irrigated lands are poor and weak. For instance, in the un-saline lands, the cotton and wheat yields are 40-50 ts/ha, and in saline soils it does not exceed 15-20 ts/ha. This is an important problem in increasing the efficiency of irrigation, increasing their fertility, getting high quality, cheap products guaranteed per hectare. Based on the above, salinization, erosion and all natural and anthropogenic harmful effects will be eliminated. In this regard, chemical melioration is one of the most important methods for washing water-soluble salts in the soil [14].

Surfactants play an important role in improving the physical, chemical and biological properties of saline soils. Examples of chemical meliorants are polymeric ion exchangers. Surfactants destroy gypsum and carbonates, neutralize salts, accelerate the melting process and improve soil composition. Research was conducted on obtaining a polymer composition capable of effectively washing saline soils that can increase productivity of agricultural crops on the basis of local raw materials [14].

Saline soils contain mainly 12 different salts, of which 8 species; soda, sodium chloride, magnesium chloride, calcium chloride, sodium sulfate are the most harmful for plants [14].

Studies have shown that saline soils of Uzbekistan's Syrdarya region are damaged by water soluble salts, mainly sodium chloride and sodium sulphate; in addition, the soil has a low hydraulic conductivity, high pH factor and saline soil structure.

Syrdarya soils have been found to be higher than ions of CO_3^{2-} and Ca^{2+} in comparison with other types of ions [14].

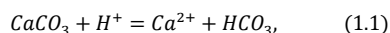
Initial soil analyzes and saline soil reclamation theories show that the following molecular weight polymer composition is required for washing soluble and hard soluble salts: the functional group containing acidic ion exchange, which has good solubility in water, the specificity of these functional groups, the organic base, the lower molecular weight possible, and biodegradable surfactants. Taking into consideration these requirements, the acid polymer composition of the polymer with molecular weight 2000, based on maleic acid homopolymer, was obtained. The composition of this structure includes the composition of soil, which complies with the requirements of soil elements such as biomass, biodiversity and plant cultivation. Taken samples content is shown in Table 1 [14].

Table 1. Polyanion type surfactants composition content

№	Content of the composition %				
	Surfactants sodium salts	Surfactants salts	Triethanolamine	Polymalein Acid (PMA)	H ₂ O
1	13.3	-		23.3	63.4
2	10.3	-		27.7	66.4
3	-	10.0		30.0	60.0
4	-	10.3		27.7	66.4
5	-	5.7		27.7	66.6

Surfactants, Polymalein Acid (PMA), Triethanolamine (TEA). It was observed when saline soil was leached with water and polymer composition and the soil content was determined by aqueous sorption, the total dry residue decreased by 1.4 times in saline soils, which leached with polymer composition, compared with saline soap. It was determined that the polymer composition of the soil samples Cl^- and CO_3^{2-} ions and water to wash more than 1.1 times. In addition, the salt content in the soil Ca^{2+} and K^+ ions, 1.5 times, 1.8 times Mg^{2+} ions, Na^+ ions 1.12 times to wash identified [14].

Saline soil samples were leached with composition and chemically tested by titration; 68 mg/L of CO_3^{2-} ion has been found. Thus, when the composition was leached, the solubility of water-insoluble salts of $CaCO_3$ and $MgCO_3$ also increased. This is because the amount of these salts does not change with only water. The polymer composites solution exhibits an acidic atmosphere at the expense of carboxyl groups. When it passes through the soil, it transforms melting salts into soluble hydrocarbon salts:



It also proves a significant increase in hydro-carbonate ions in soil content after the compositional washing of it. Field experiments have shown that, when salinized with saline soil,

heavy soluble salts in soil have been detected more than 1.5 times more than leached with water [14].

Rational use of land and water resources is ensured by modern methods of irrigation, i.e. through drip, flexible pipes, and widespread use of film-based irrigation methods. In addition to the introduction of modern irrigation methods, the development of biological, agro-organic and chemical reclamation is of great importance. The article describes the importance of polyanion polymers (chemical melioration element) when washing saline soils [15].

As a result of the study, a polymer (polyanion) molecular mass of about 2000 to about 500 daltons was synthesized, which ensures light and rapid dissolution in the water. There was also no adverse effect on the soil, the plant [15].

The experiments on the administration of the biosolvent composition showed the following results in laboratory conditions [15]:

- When washing anions in soil, the effectiveness of the composition due to water is 2.23 times higher;
- When washing cations in soil, the effectiveness of the composition due to water exceeds 2.2 times;
- When leaching by composition, the soil's water-solubility capacity is 1.5 times higher than that of water (Table 2)

Table 2. The effect of the composition on the total porosity (water permeability) of the soil relative to water

№	Experiment	The soil's hygroscopic moisture, %	Volumetric mass of soil, g/cbcm	Relative density, g/cbcm	The general porosity of the soil, %
1	Before leaching with water	1.18	1.33	2.58	48.45
2	After leaching with water	1.138	1.2	2.62	54.20
3	Before leaching with composition	1.178	1.44	2.64	45.45
4	After leaching with composition	1.165	1.12	3.34	66.5

The BCC was originally tested on the fields of "Sayhun Javohirbek Shahriyor" farm in Sayhunobod district of Syrdarya region and "Chilboy" farm in the Oq oltin district of Syrdarya region. Later, these experiments were conducted by "Ilyos Mallaev" in Goziobod district of Syrdarya region and "Muhammad Choruqiy" district of Bukhara region. It also gave good results [15].

It enhances the solubility of salts in the soil based on the BChC. Salts are removed from the agro-irrigation horizons, improving the water-physical properties of the soil, which in turn promotes the growth of the seed, reduces the risk of stroke. It can be used in any irrigation method: flood irrigation, ridge irrigation, drip irrigation, micro spray irrigation and sprinkler irrigation. The drug can be leached with saline, damp cloth or used at any time of year. In short, the obtained polymer is effective and harmless to the plant, and also improves soil structure [15].

UZBEKISTAN'S IRRIGATION REFORMS

Article 55 of the Constitution of the Republic of Uzbekistan states: "Land, land resources, water, flora and fauna and other natural resources are national wealth, they should be rationally used and protected by the state" [16].

Water is one of the key factors of the socioeconomic well-being of the Central Asian states and the preservation of the environment. The shortage of water resources, as it has been observed in all Central Asian countries, also has a significant impact on our country. Because of Uzbekistan has a high demand for water to meet the socio-economic and environmental needs of its growing population and natural ecosystems, and ensure sustainable development.

Today, soil salinity is one of the major factors that adversely affect agricultural and environmental protection. About 2 million hectares of irrigated land in the country, or about 46.6% of the total area of irrigated and saline soils, Aral Sea drainage, uncontrolled use of land, water resources, global climate change, and other factors show their impact. One of the main reasons for soil salinity is the fact that the water used in agriculture is largely eroded from irrigation branches during vegetation, excessive irrigation water use, because of the increase in the level of groundwater, permanent groundwater contamination is continuously evaporating over the course of the year [17].

In order to regulate water relations, the Law of the Republic of Uzbekistan "On water and water use" was adopted on May 6, 1993. The main objectives of this Law are to ensure the rational

use of water for the needs of the population and industries, protect the water from contamination, pollution and depletion, prevention and elimination of harmful effects of waters, improvement of water objects' condition, as well as the protection of rights and legitimate interests of enterprises, institutions, organizations, farmers, peasant farms and citizens in the field of water relations [18].

For the purpose of implementation of the Law of the Republic of Uzbekistan "On Water and Water" and for the rational use of water resources, the Regulation "On the order of water use and consumption in the Republic of Uzbekistan" was approved. The present Regulation highlights the importance of rational use and protection of water in all sectors of the economy, as well as observance of the established limits of water withdrawals by all users of water and water users, strengthening of control over the accounting and reporting in the prescribed manner [19].

Complex measures have been undertaken to strengthen the material and technical basis of the farms, allowing them to increase the efficiency and profitability of the farm, and to streamline their land use through more rational use of land, water and material and technical resources. A modern production and market infrastructure is being created in rural areas, providing all necessary services to farmers [20].

The economy of water resources and their rational use are a requirement of this time. More than 90% of the annual water resources used in Uzbekistan are used for irrigation. About 75% of these are used for irrigation of agricultural crops during the vegetation. In addition to vegetation, i.e. during the non-vegetation period, it is used to moisturize the winter crops and to leach saline soils.

In the third priority of the ACTIONS STRATEGY the five priorities of development of the Republic of Uzbekistan for 2017-2021 that is, "Priority direction of economic development and liberalization" the following priorities are identified for the modernization and accelerated development of agriculture [21]:

- deepening of structural changes and continuous development of agricultural production, further strengthening of food security of the country, expansion of ecologically clean products, considerable increase of export potential of the agrarian sector;
- to reduce area for cotton and grain, further optimization of sown areas, placement of potatoes, vegetables, food, oilseed crops, as well as new intensive gardens and vineyards in vacated land;
- expansion of research works on creation and introduction of new types of selection of agricultural crops and creation of new types of animal species adapted to local climatic and ecological conditions with high productivity, disease and pest resistance;
- creation of favorable conditions for stimulation and development of multi-profile farms engaged in production, processing, storage, sale, construction and rendering of agricultural products, first of all agricultural products;
- implementation of investment projects for the construction, reconstruction and modernization of new processing plants equipped with the latest high-tech equipment for the processing of agricultural products, semi-finished products and finished food products, as well as packaging products;

- further development of infrastructure for storage, transportation and sale of agricultural products, agrochemical, financial and other modern market services;
- improvement of reclamation status of irrigated lands, development of branches of meliorative and irrigation facilities, introduction of intensive methods of agricultural production, first of all, introduction of savvy agricultural and resource technologies, use of high-productive agricultural machinery;

take a systematic approach to global climate change and the Aral Sea drainage to mitigate the adverse effects of agricultural development and the lives of the population [21];

A number of works have been done to improve the reclamation status of irrigated lands in our country. In particular, in accordance with the Decree of the President of the Republic of Uzbekistan "On measures to radically improve the system of land reclamation improvement" from October 29, 2007 of PD-3932 In 2007, the Fund for Reclamation of Irrigated Land was established and the State Program on Ameliorative Improvement of Irrigated Lands for 2008-2012 was adopted. Also state-owned leasing company "Uzmeliomashleasing" and 49 state unitary enterprises specializing in land reclamation and other water management activities were established [22].

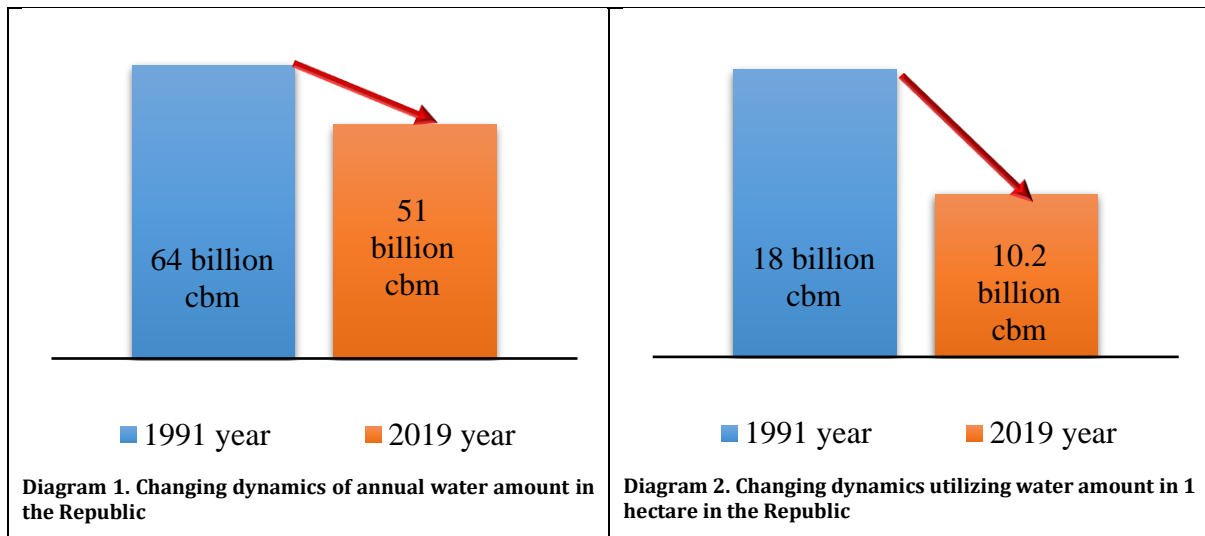
Within the framework of the Fund for Reclamation of Irrigated Land, 1 mln. Reclamation status of more than 200 000 hectares of irrigated lands has been improved. In the regions where meliorative measures have been carried out, the average yield increased from 2-3 centners of cotton, from 3-4 centners to grain.

In order to improve reclamation status of irrigated lands, to improve irrigation and reclamation branches, to ensure efficient use of water resources and increase productivity of irrigated lands, the Resolution of the President of the Republic of Uzbekistan "On Measures for Further Improvement of Ameliorative Status of Irrigated Lands and Efficient Use of Water Resources for 2013-2017" dated April 19, 2013 [23].

According to this resolution, the introduction of irrigation methods with 25,000 hectares of drip irrigation system, 45,600 hectares of landfill irrigation and 34,000 hectares of landslide flexible pipes will be introduced in 2013-2017 [23].

In Uzbekistan, irrigated agriculture plays an important role in human activities. Irrigation is the basis of the agro-industrial complex, which is the basis of food security in the dry climatic conditions, the basis of the well-being of the rural population, the protection of land and its productivity, and the rapid pace of development [9].

Today the water resources have a strategic impact in Bukhara region of Uzbekistan and about 95% of agricultural products produced in irrigated areas of the region. Conservation and efficient use of water resources is imperative [24]. As a result of the state policy in the field of rational use of water resources in Uzbekistan, the total amount of used water is 64 billion cubic meters annually compared to the average of 51 billion cubic meters diminished as in the 1991s (diagram 1). If we used water from 1 hectare irrigated area in the 1991th years to 18.0 thousand cbm/ha, today it is 10.2 thousand cbm/ha (diagram 2).



Picture 1. The map of Bukhara oasis [25].

MATERIALS AND METHODS

System and method of experiments on the soil leaching process through BChC

There are 274612 irrigated land in Bukhara region, which 38903 hectare (14.2) is not saline, another 235709 hectare of land (85.8 %) is saline. Distribution of Bukhara region saline degrees are reflected in the following 3 diagram.

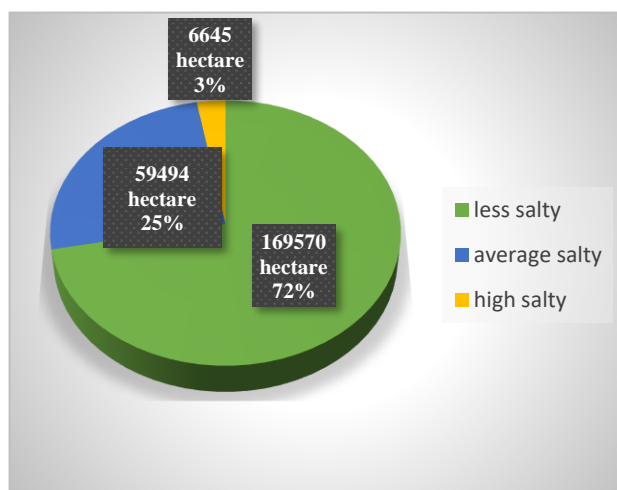


Diagram 3. Distribution of saline degrees of Bukhara region's saline land.

Salt leaching physical lands in Bukhara region consists of 180.6 thousand hectares, 1430 mln cbm hectares are utilized annually in salt leaching .

The research was carried out on the irrigated fields of the educational-scientific center of the Bukhara branch of Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, located in the Khodzha Yakshaba rural citizens'

residence, Kagan district, Bukhara region during the 2017-2019 years. The educational-research center specializes in cotton, grain and gardening, and collector-hub branches are built in the center. There is a 4.7 km open-air drainage within the training center and the irrigation branch has engineering capability. For irrigation purposes, water is supplied to the fields by horns and bullets, and is irrigated by spruce. The soil of the farm is weak and moderately saline.

Field experiments were conducted to study the growth and development of Bukhara-6 varieties of cotton in conditions of grass-alluvial soils, the largest area of irrigated lands of the region (87.7%) and deep water depth of 1.5-2.0 m.

Scientific-research works were carried out in the following systems for salinization:

Soil leaching were carried out in the area of VI-hydromodul district of Kagan district of Bukhara region by methodology of

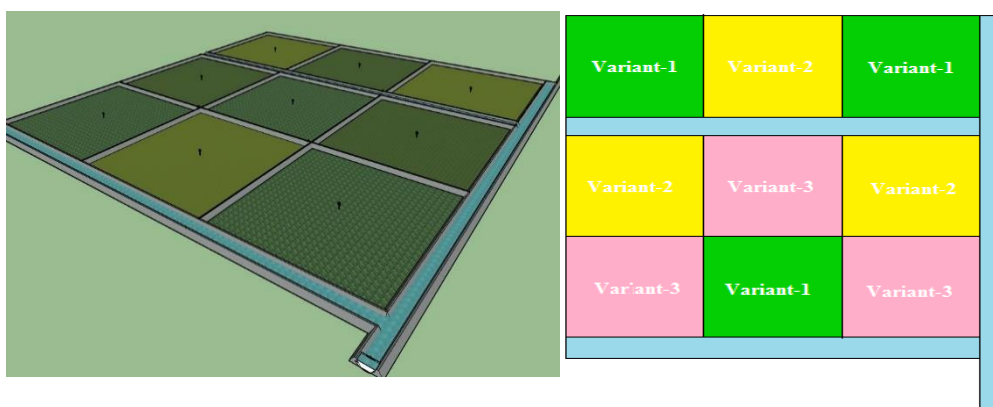
Irrigation and Water Problems Scientific Research Institute and Cotton Research Institute of Uzbekistan

Experiments were 3 options and 3 repetitions of divisions – 0.0625 hectares. In the first variant of the researches, soil leaching based on recommended salt solution according to V.R. Volobuev's recommendation. In the second option of experiments soil leaching was carried out through biosolvent chemical compound at the Institute of Bioorganic Chemistry named after academician O. S. Sodikov of the Academy of Sciences of the Republic of Uzbekistan and determined that the salinity was less than 30%. In last variant number 3, traditional methods of salinization were performed in the farm, and the results of the experiments were compared.

Experiments in this field are carried out in 3 variants, 1 fertilizer norm, 1 grade and the width of the fracture row is 90 cm.

Table 3. Scheme of field experiments

Variants, number	Technology of soil leaching	Amount of soil leaching
1	soil leaching based on recommended salt solution	determination of saline detection by V.R.Volobuev formula
2	soil leaching technology by using BChC method	30% less water used than determination of saline detection by V.R.Volobuev formula
3 (control)	traditional method	the principle of soil leaching used in practice



Scheme 1. The layout of the experimental plots on the experimental site [1,2].

Agrophysical studies:

Determination of the morphological structure of the soil's genetic layers (on soil slices during the commencement of research).

Determination of mechanical composition of soils. It was discovered at the beginning of the research on the method of N. A. Kachinsky.

The weight of the soil was determined by a steel cylinder with a height of 10 cm in the soil layers from 10 cm to 100 cm at the beginning and at the end of the vegetation period.

The water permeability of the soil was determined by the Nesterov method for 6 hours at the beginning and at the end of the vegetation period, for internal and external cylindrical rings.

The limited soil density of the soil (LSDS) was determined by the Rozov method in the beginning of the research, by filling a layer of 2x2 m² with 20-30 cm of water thickness.

Determination of the dynamics of the level of the groundwater.

To do this, two observation wells were installed. Monitoring activities were conducted during the academic year on the 10, 20, 30 days of each month.

Determination of mineralization levels of the groundwater.

Samples were taken from all observation wells on the 10th day of month and dry residue was detected.

Agrochemical Research:

Humus, grape nitrogen, phosphorus and potassium in the soil were found at 0-30, 30-50 cm layers at the beginning of the study.

The active nitrogen (nitrate and ammonia), phosphorus and potassium in the soil have been found at the beginning of the vegetation on the 0-30, 30-50 cm layers in all options of 2 and 3 repetitions. This is the amount of humus in the soil determined by I. V. Tyurin's method, general nitrogen, phosphorus by L. P. Gritsenko's method and the method of M. M. Maltseva, mobile phosphorus by means of B. M. Machigin's method, the potassium metabolite is converted to P. V. Protasov's method.

Determination of soil salt regime

At the beginning of the study, soil samples were taken before and after the saline and after the saline and at the end of the plant cycle on each field and option. Samples were taken at a depth of 20 cm from the depth to the groundwater volume and the dry residue and chlorine ion were determined. In addition,

in each option, the degree of washing of chlorine - ion was detected in soil leaching (at a depth of 1 m). Also, the level of salinity of all samples collected by the electro conductor meter was determined.

RESULTS AND DISCUSSION

The soil leaching was carried out in this field to continue experiments after the stacking of the stems. In order to conduct experiments on saline soil, the soil temperature, moisture, salinity and salinity level, dry residue were measured by using Environmental-Device-Technology (Umwelt-Geräte-Technik GmbH) UMP-1 soil measurement device with 7 points in field conditions, soil samples on 0-100 cm layer, and analysis for soil leaching area selected. For the purpose of determining soil leaching standards in the field of experiments, the above indicators were determined in laboratory and field conditions.

Purpose of work - the purpose of this research is to achieve high efficiency through the introduction of modern technologies to improve saline care in farms operating in saline soils by reducing soil leaching norms and terms.

Soil leaching with the Biosolvent Chemical Compound (BChC)

Leaching rate means the quantity of water to be supplied to the field for removal of excess water-soluble salts that are harmful for cultivated plants from soil. Leaching rate is determined experimentally or calculated by using relevant formulas [12].

In order to perform saline cleaning in the field of experiments, the amount of saline detection was determined by the end of the vegetation, depending on the chlorine-ion content of the soil and the mechanical composition of the soil. During the study of the method of salinization the saline detection parameters for each option were determined, depending on the amount of salts

contained in soil, soil salinity and mechanical composition of the soil and the specific natural and climatic characteristics of the area. Calculation of the rate of salinity is based on the water-physical properties of the soil and the amount of salts in the soil for a one-meter soil layer calculated according to V. R. Volobuev's formula:

$$N = 10000 \cdot \lg \left[\frac{S_i}{S_{adm}} \right]^\alpha, \quad \text{cbm/ha} \quad (1.2)$$

where α is the free salt yield factor, S_i , S_{adm} – amount of salts in the soil before leaching and allowed amount, in% of weight.

As a result of soil analyzes, the level of salinity of soils is considered to be saline, the type of chloride-sulfate salinity [6]. In the field scientific researches on soil leaching was twice carried out in January. The highest level of soil leaching in the test field was recorded in the experimental option of traditional field-controlled control; seasonal saline dumping option was 4620 cbm/ha, with soil leaching carried out twice during the season. In option 2, which performs soil leaching using Biosolvent chemical compound which is produced by the scientists of the Institute of Bioorganic Chemistry named after academician O. S. Sodikov of the Academy of Sciences of the Republic of Uzbekistan, according to their recommendation, is calculated at a rate of 8-10 liters per 1 ha, for each option is sprinkled, which is 30% less water was consumed than the saline detection rate calculated by the V. R. Volobuev formula and the salinity was 2906 cbm/ha, with soil leaching done only 1 time. Option 1 is calculated using the formula of V. R. Volobuev, taking into account the salt content of the chlorine salts in the soil. In this option the seasonal leaching rate was 4151 cbm/ha during the entire season, soil leached twice.

Table 4. Amount of soil leaching in experimental field.(average over years of research)

Variants	Indicators	Irrigations, cbm/ha		Seasonal soil leaching amount, cbm/ha
		1-soil leaching	2-soil leaching	
1-variant	Period of soil leaching	11.01.	30.01	4151
	Interval of soil leaching, day		19	
	Amount of soil leaching, cbm/ha	2134	2017	
2-variant	Period of soil leaching	11.01.		2906
	Interval of soil leaching, day			
	Amount of soil leaching, cbm/ha	2910		
3-variant	Period of soil leaching	11.01.	31.01	4620
	Interval of soil leaching, day		20	
	Amount of soil leaching, cbm/ha	2539	2081	

The dynamics of salts in the soil before and after washing are given in the table. 6.

During the researches, soil leaching activities lasted from the first decade of January to the last ten days of January and the period between soil leaching was 19 days. Table 4 illustrates the highest water consumption was consumed in the traditional way, used for soil leaching in agricultural conditions, with a biosolvent concentration ratio of up to 30% determined by the

chemical compound, and 1714 cbm/ha have been consumed compared to option 2. During the experiments, the least amount of water consumed for saline was option 2, the seasonal salinity was 2906 cbm/ha, or by 37% compared to option 3, and by 30% in option 1, the efficiency of soil leaching has increased.



Picture 2. The process of mixing BChC with water and sowing BChC by variants



Picture 3. Water flow measurement with using Chipoletti-75 water droplet

Picture 4. Soil leaching process

Influence of the BChC on the salts present in the experimental field

As noted above, the soils of the test field are irrigated, grassy alluvial soils. Due to the fact that the mineralization of the waste water is 1.0-3.0 g/l and depth is at a depth of 1.5-2.0 m, the salinity of the soils at the end of the vegetation period will increase.

That is why in the area of the farm every year in the winter and spring, salinization is carried out. At the time of cultivation, the soil is formed on the rootstock of the plant and the optimum salt level for the production of cotton seeds. In the field of experiments, the soil samples were collected prior to and after saline soils, and the soil samples were taken from each variant and the amount of Cl and dry residues in the soil was determined (in% of soil dry weight). Table 5 shows that, in the first option, the amount of Cl in the carrier layer (0-30 cm) before the leaching process was 0.027 %, the dry residue in the soil was 0.406 %. The amount of chlorine in the 0-100 cm layer of soil corresponds to Cl - 0.025 % and dry matter residues equal to 0.376 %. The classification of salts in soils is approximated to the category of average saline soils.

At the end of the soil leaching it was determined that all the salts in the soil were diminished, but in the control version only their quantity was higher than the other options. If we analyze the amount of Chlorine (Cl) in the soil, during the research, the chemical composition of biosolvent is sown in the soil, saline leached in the first option, the chlorine content in the soil (0-30 cm) layer decreased from 0.025 % to 0.008 %, if the amount of chlorine decreased to 0.018 % relative to the result of the soil leaching (30-50 cm) it was found that the amount of chlorine in the soil decreased from 0.025 % to 0.008 % after the soil leaching in the 0-100 cm layer. The amount of dry residue decreased by 0.194 % to 0.212 % after the saline washing process, compared with the saline wash season. During the

observations, the amount of dry residue in the 0-100 cm layer was equal initially 0.376 %, down to 0.172 % at the end of the seasonal leaching and amounted to 0.204%. In the second option, which soil was leached through Biosolvent Chemical Compound, the soil salinity was 3.15 in chlorine ion and 1.79 by dry residue. This indicates that it was 0.39-0.18 more than 1st variant, and 0.78-0.21 more than variant 3.

On the basis of the 1st option of the study, i.e., the amount of salts in soil, using V.R. Volobuev's formula, the saline wash norms is calculated, the amount of chlorine in the soil (0-30 cm) layer of the soil in the field of soil leaching was initially equal to 0.027 %, 0.026 % of the surface of the undercoat (30-50 cm) layer and 0.025 % of the chlorine content in the 0-100 cm layer, after saline washing, the amount of chlorine in the soil was 0.010 % in the road surface, 0.009 % in the submerged layer and 0.009 % in chlorine content in the 0-100 cm layer, which was higher than 0.001 % in chlorine content in the soil compared to saline leached using Biosolvent Chemical Compound. When analyzing the amount of dry matter residues in the soil, it is possible to observe that in the beginning the soil was 0.406 % in the 0-30 cm layer and 0.376 % in the 0-100 cm layer, 0.240 % in the carrier layer and 0.225 % in the 0-100 cm layer. In variant 1, the seasonal salt absorption coefficient was 2.76 at chlorine ion and 1.61 by dry residue.

In the 3-control variant of researches, the amount of chlorine in the soil content in the field of soil leaching was 0.012 % in salt water, 0.010 % in the undercoat and 0.011 % in the 0-100 cm chloride layer. The amount of dry residue in the soil decreased to 0.159 %, 0.247 %, compared to the initial yield in the 0-100 layer, decreased 0.146 % and equal to 0.230 %. The seasonal decomposition coefficient was 2.37 in chlorine ion and 1.58 on dry residue.

Table 5. Impact of soil leaching on soil salinity(average over years of research)

Soil layer, cm	Before leaching		After leaching		Desalination ratio	
	chlorine	dry residue	chlorine	dry residue	chlorine	dry residue
1-variant						
0-30	0.027	0.406	0.010	0.240	2.79	1.69
30-50	0.026	0.351	0.009	0.215	3.00	1.63
50-100	0.025	0.305	0.011	0.221	2.31	1.38
0-50	0.027	0.378	0.009	0.228	3.00	1.66
0-100	0.025	0.376	0.009	0.225	2.68	1.67
2-variant						
0-30	0.027	0.406	0.008	0.212	3.24	1.92
30-50	0.026	0.351	0.008	0.189	3.25	1.85
50-100	0.025	0.305	0.009	0.203	2.74	1.50
0-50	0.027	0.378	0.008	0.205	3.38	1.85
0-100	0.025	0.376	0.008	0.204	3.13	1.84
3-variant						
0-30	0.027	0.406	0.012	0.247	2.31	1.65
30-50	0.026	0.351	0.010	0.214	2.52	1.64
50-100	0.025	0.305	0.012	0.229	2.11	1.33
0-50	0.027	0.378	0.011	0.231	2.53	1.64
0-100	0.025	0.376	0.011	0.230	2.38	1.64

Note: The seasonal salinity collecting coefficient was calculated by 0-100 cm according to soil layer.



Picture 5. The process of conducting soil analysis through UMP-1 measurement device

In summary, we can say that after soil leaching, the amount of salts in the field of experimental field varied in comparison with the state of the experiment. These changes can be attributed to the fact that the amount of salts in the soil can be determined by the scientifically-based salt-based formulas recommended by scientists. In the case of soil leaching through BChC, the chemical compound has a positive impact on the salinity of the soil in the process of melting and achieving high efficiency, while less than 30% of the saline detection rate has been achieved.

Saving river water in soil leaching through the BChC

In the field of scientific researches salinization was twice carried out in January. The highest level of soil leaching in the field of experiments (Table 4) was recorded in the traditional method of control of the experimental field, with the option of seasonal soil leaching up to 4620 cbm/ha, and twice for soil leaching during the season. In the 2 option, which was done with soil leaching through BChC, was sated in accordance with the recommendation of the by the scientists of the Institute of Bioorganic Chemistry named after academician O. S. Sodikov of the Academy of Sciences of the Republic of Uzbekistan, 30% less water was consumed compared to the saline detection rate

calculated by the Volobuev's formula, i.e. the salinity was 2906 cbm/ha, with soil leaching done only 1 time. In option 1, taking into account the amount of salt of chlorine salts in the soil, it was calculated using the V. R. Volobuev's formula. In this option, the salinity was 4151 cbm/ha, and salinization was carried out twice during the entire season.

We calculate the saved water as a result of the saline washings that have been sprinkled with BChC:

Data used for analysis

It is clear from Table 4, that the lowest amount of water used in soil leaching $M_{BChC}=2906\text{cbm/ha}$,

The amount of water consumed more than the BChC used in soil leaching $M_V=4151\text{cbm/ha}$,

the highest amount of water used $M_C=4620\text{cbm/ha}$,

where: M_{BChC} - seasonal salinity, cbm/ha, when using BChC;

M_V - estimate of salinity, calculated by the formula of V.R.Volobuev, cbm/ha;

M_C - seasonal salinity, cbm/ha control option;

$$M_{E1} = \frac{(M_V - M_{BChC})}{M_C} \cdot 100, \%$$

$$M_{E1} = \frac{(4151 - 2906)}{4151} \cdot 100\% = 30\%;$$

$$M_{E2} = \frac{(M_V - M_{BChC})}{M_C} \cdot 100, \%$$

$$M_{E1} = \frac{(4620 - 2906)}{4620} \cdot 100\% = 37\%;$$

where: M_{E1} - water saved by 1 hectare compared to M_V ,%;

M_{E2} - water saved by 1 hectare compared to M_C ,%;

In summary, the saline washing, which has been sprinkled with BChC, has yielded considerable results in saving water resources.

- 1) The amount of water resources per 1 hectare saved up to 30% compared to the amount of saline detection calculated using the Volobuev's formula in the BChC used in saline washing;
- 2) The amount of water resources per 1 hectare has been saved to 37% compared to the seasonal leaching rate of the control option with option, leaching through BChC.

CONCLUSIONS

On meadow-alluvial, on the mechanical composition of medium loamy, medium-saline soils of the Bukhara region, leaching irrigation using the chemical compound Biosolvent at the rate of 8.0 l/ha ensures high efficiency of washing water. When using the chemical preparation Biosolvent, despite a decrease in the required norm of washing rate by 30%, the best conditions for washing out water-soluble salts are achieved and the desalination coefficient in the 0-100 cm layer will be 1.84 (dry residue) and 3.13 (chlorine ion).

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