Reclamation Of Saline And Gypsed Hungry Steppe Soils Using Deep Loosening And Chemical Biological Preparations

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Abstract: The effect of deep loosening in the early spring and soil treatment with Biosolvent was studied in this research paper. During irrigation, on the physical properties of gypsum soils and the desalination processes in them. The studies were carried out in the Syrdarya region of Uzbekistan in 3 experimental plots under cotton. Objects of research - saline, compacted, gypsum-bearing soils. Field and phenological observations, soil analyzes were carried out according to generally accepted methods. It was revealed that loosening the soil to a depth of 70 cm contributes to: a decrease in bulk density by 4–9%, respectively, porosity, and also to an increase in water permeability by 3–14 times. This led to an increase in irrigation rates by 350 m^3 / ha, with a washing fraction of 9%. Along with a decrease in soil density, this contributed to an increase in cotton yield - 4.6 c/ha. Due to the rupture of capillaries in the soil when loosening, the accumulation of chlorine salts from spring to autumn, in a soil layer of 0-60 cm, decreased by 1.8 times, and with conventional plowing of the soil - increased by 2.4 times. When loosening gypsum soils to a depth of 70 cm, the bulk soil mass decreased from 1.60 g/cm^3 to 1.20-1.36 g/cm^3. When spraying heavily salted loose soil with Biosolvent before watering the cotton, the leaching of the toxic chlorine ion by irrigation reached 90%. The combination of deep loosening of the soil with the Biosolvent preparation is recommended for land reclamation of the Hungry Steppe lands.

Index Terms: Biosolvent preparation, bulk, density, deep loosening, water permeability, saline soils, salt leaching.

1. INTRODUCTION

Due to the importance of sustainable agricultural production, ensuring food security for the population of countries, their economic and political stability, the issue of increasing soil productivity, including land reclamation, is the most important. Soil degradation brings humanity great economic damage and threats. In different countries, various forms of soil degradation are observed, which determine the types of land reclamation. In an arid climate, there is a proliferation of gypsum, compacted soils, which are often saline. The combination of compaction, salinity, and gypsum inclusions proper in soils has a negative impact on their productivity: crop yields are reduced. During their development of such lands, their washing was difficult, special techniques were required that destroy the hard layers of gypsum, increase the permeability and leaching of salts - salt recovery and the introduction of various ameliorants that improve their chemical properties. During the period of mass development of new lands (70-80s of the 20th century), such lands were called - hardly reclaimed. According to published data, the area of difficultly reclaimed highly saline lands in Uzbekistan is approximately 200.2 thousand ha [1].

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Territorial in Uzbekistan, difficultly reclaimed soils, including gypsum-bearing soils, are common in several regions: in the Syr Darya, Jizzakh, Navoi, Surkhandarya and Ferghana regions. The spread of soil salinization in Uzbekistan is of genetic and anthropogenic origin. It is mainly observed in the flat part of the territory and has a seasonal character: the accumulation of salts in the fields from spring to autumn and then washing in the winter - spring period. According to the Ministry of Water Resources of the Republic as of 01.01.2019, the area of saline land is about 2 million hectares, or 45% of the irrigated land, and the area with medium and strong salinity, respectively 12% and 2% of the irrigated territory. The territory of the Syrdarya region of Uzbekistan (Figure 1), called the Hungry Steppe, is still experiencing problems with land productivity, which, inter alia, is associated with two of the above reasons: plastering and soil salinity. The reasons for the repeated degradation of some of these lands, from the moment of their development to date, are that in the last 15–20 years some territories were not adequately provided with water and drained, insufficient attention was paid to their flushing and agricultural management. Recently, attention has been paid to the problem of abandoned lands that have gone out of agricultural circulation in Uzbekistan. The decree of the President of the Republic of Uzbekistan dated June 17, 2019 stipulates “a set of measures to increase soil fertility by preventing and significantly reducing the degradation of agricultural land, including: studying and eliminating the reasons for lowering the soil bonitet score; the use of saline irrigated land for sowing salt tolerant crops; widespread adoption of modern technologies to prevent degradation. Implementation of technologies for the efficient use of soil in agriculture, including minimizing the use of inorganic fertilizers and pesticides, widespread use of available stocks, etc. ” The authors conducted a retrospective analysis of scientific research on land reclamation methods recommended for the development of hardly reclaimed lands until 1990. [1-7] To restore difficultly reclaimed lands in the past, capital leaching of lands was used, with the addition of large doses of manure or lignin (up to 40 t / ha) against the background of deep

loosening of the soil (up to 1 m) [2, 3]. In particular, it was proposed to increase the drainage of the territory by temporary drainage [1]. In some cases, guzapaya (crushed dry cotton stalks with empty boxes) and chemicals were used (complex polymer fertilizers - CPF) [3]. Currently, many lands that were previously developed have again become unusable and require re-development. They partially preserved the irrigation and drainage infrastructure, which requires restoration. The restoration of land and its fertility requires a set of measures, both hydraulic and agricultural. In modern conditions, the use of the whole complex of the above measures does not seem rational, due to the high cost of water for capital washing (more than 10 thousand m3 / ha), high doses of organic additives to the soil, transportation costs for the delivery of organic additives and lack of production CPF. Also requires large costs and restoration of drainage. The purpose of the experiments described in this article is to find ways to restore the productivity of difficultly reclaimed lands, improve their water-physical properties, maintain a favorable salt regime, using both known and modern land reclamation methods. The authors reviewed the results of their own studies on the effectiveness of deep loosening of soil in early spring, as well as on the effect on the saline and gypsum soils of the Biosolvent preparation (analogue of the Spersal preparation), which enhances the leaching of salts from the soil.

2 METHODS OF RESEARCH

2.1 Location of experimental plots and experimental procedure

Study the reclamation efficiency of deep early spring soil loosening (and its effect on the change in physical and water-physical properties) and the Biosolvent desolenizer preparation (and its effect on changing the degree of salinization and chemical composition of soils), studies were conducted. Deep loosening of the soil was investigated in the Sardoba region, the Biosolvent preparation in the Mirzaabad region, and loosening experiments, with subsequent use of the Biosolvent, were carried out in the Havast region (table 1).

***Fig.1**. Location of the Syrdarya region of Uzbekistan and sites*

The studies are field work, laboratory analysis of soils, and field observations in the fields under cotton. Field studies and laboratory analysis of the soil were carried out according to generally accepted methods. Research included:

I. The laying of soil sections, with the determination of volumetric mass and water permeability of the soil "before" and "after" loosening;
II. Bookmark control points of soil salinity (salt and gypsum content in the soil), take and laboratory analysis of soil samples for periods: "before" and "after" leaching; "Before" and "after" vegetative irrigation of cotton.
III. Rinsing saline soils on checks with a size of 20 x 20 m, with measuring the water supply by the Chipoletti spillway in the following variants: control - conventional soil preparation, experience with preliminary spraying of the soil with 10% Biosolvent solution.
IV. Irrigation of saline soils along the furrows of 20 x 20 m, in the options: control - regular watering; experience - watering with preliminary spraying the soil of furrows with a 10% solution of Biosolvent.

Volumetric mass was determined in soil sections, using the cutting ring method before and after loosening. Water permeability was determined by the double ring method, also before and after loosening. The remaining indicators were monitored by monitoring points, which were laid in the experimental plots using the envelope method for each experiment. Soil sampling was carried out at these points by the method of manual drilling (most often at horizons of 0-30, 30-70, 70-100 cm) according to observation periods. In the soil samples, the degree of salinization of the soil according to the EU, or the full chemical composition by the method of water extraction was determined. Phenological observations of the growth and development of cotton were carried out according to the method All-Union SciRCI.

***Table 1**.Experiments on deep cultivation, including with the use of Biosolvent*

Place of experiments	Soil characteristics	Description of experience	Options	Note
Sardoba district, experimental farm of SRIIWP (G.Gulyam), 5. U49	Gray-earth meadow, light loam (Loam), homogeneous 4,6 9,0 dS/m	Soil loosening in March, monitoring changes in bulk density, moisture, and soil salinity	Control plowing without loosening	[8]
			Experience - loosening 70 cm deep + plowing.	
Sardoba district, experimental farm of SRIIWP 5.	EC=2,0-10,0 dS/m	Also		[9]
Sardoba district, Uzakov Farm	Gray-earth meadow, sandy loam (Sandy Loam) gypsum soils ES= 4,5 - 14,9 dS/m	Also	Control - plowing without loosening Experience - loosening to depth: 40,60,80 cm	[10]
Mirzaabad district, WUA “Yangiabad” 5.	Serozem-meadow, light and medium loam (Loam), Salinization 2,5-18,0 dS/m	Winter leaching of saline soil according to checks	Control - the usual washing of the soil according to checks; Experience - flushing according to	[11,12]

			checks with preliminary soil treatment with 10% Biosolvent solution	
		Furrow irrigation of cotton on saline soils, increased salt leaching during irrigation	Control - conventional furrow irrigation of cotton; Experience - watering with preliminary soil treatment with 10% Biosolvent solution	[13]
Khavast district, cluster “BEK”, 5 .	Medium and heavily gypsum (in the layer 39-70 cm 31.5% gypsum. In the remaining horizons - 10%. Light loam with interlayers of sand and sandy loam. (Loam, Silty and Sandy loam)	Loosening of the soil in March + soil treatment with 10% Biosolvent solution before watering cotton	Soil salinity level 1.Medium EC= 7,5 dS/m; 2. Very strong EC= 28 dS/m;	[14]

When studying the amelioration efficiency of the “Biosolvent” and other preparations, three phases of research were passed: laboratory washings on columns, studies on vegetative vessels and then in field conditions [12]. According to the established laboratory studies of effective concentrations of "Biosolvent" - 10% solution, this drug was used in field experiments by spraying the soil before water supply (in checks, - when washing and in furrows, - before watering cotton).

3 RESULTS AND DISCUSSION

3.1 Assessment of the Influence of Deep Loosening on Water-Physical Properties, Soil Salinity and Cotton Harvest

The effect of deep loosening on the bulk density of soils is shown in Table 2. It follows from the table that for the conditions of homogeneous non-gypsum soils, the bulk soil mass in the loose layer decreased by an average of 0.10 g / cm^3 (6.4%) from the initial one. On the gypsum-bearing soils of the experimental plot of the "Bek" cluster, under the influence of deep loosening, the maximum decrease in volumetric mass was noted. On average, for a layer of 0-70 cm, it decreased from 1.64 g / cm^3 to 1.26 g / cm^3, or by 23% (Table 2, Fig. 2).

Table 2*.Generalized data on the effect of deep loosening on the change in bulk density and other soil properties, averaged for the loose layer*

№ experience	Location research	Characteristics of soils	Depth loosening, cm	Bulk weight soil, g/cm^3			Difference
				Before loosening	After loosening	g/cm^3	%
1	Sardoba district, RIIWP experimental farm, U49 pit.2	Serozem-meadow, light loam homogeneous	70	1,47	1,38	-0,09	6,1
2	Sardoba district, RIIWP experimental farm, U-50, pit.1		70	1,53	1,34	-0,19	12,4
3	Sardoba district, Uzakov Farm		40	1,43	1,34	-0,09	6,3
			60	1,45	1,38	-0,07	4,8
			80	1,46	1,39	-0,07	4,8
	The average			1,47	1,37	0,10	6,9
	Minimum			1,43	1,34	0,07	4,8
	Maximum			1,53	1,39	0,19	12,4
4	Khavast, district, "BEK" Claster	Medium and heavily gypsum (in the layer 39-70 cm), light loam	70	1,64	1,26	-0,38	23

Reducing the bulk of the soil is an important indicator for increasing its productivity. A soil density value of more than 1.6 g / cm3 is considered insurmountable for the roots of some plants. According to the criteria of the methodology for assessing soils of the Research Institute of Soil Science of Agrochemistry of the Republic of Uzbekistan (RISSA of the Republic of Uzbekistan) [15], with a bulk density of 1.4 g / cm^3, yield losses are 10 -15%; at 1.5 g / cm^3 - 20-30%; at 1.6 g / cm^3 - 30-50%, and at> 1.6 g / cm^3 40-60%.

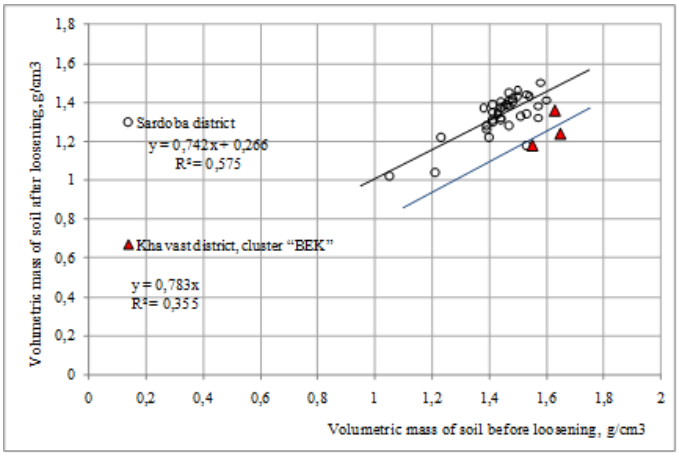

Fig.2*. Changes in the bulk density of the soil under the influence of loosening under various conditions (the initial data were taken for soil layers of 10 cm)*

An important indicator of the land reclamation state is also soil permeability. Under the influence of deep loosening on the virgin land plot of the experimental farm of G. Gulyam, there was an increase in soil permeability from 2.8 to 12-14 times. This phenomenon increases the efficiency of soil leaching

from salts, and at the same time leads to an increase in irrigation rates during irrigation. Studies [10] have established the reclamation efficiency of early spring loosening, and during the growing season, a leaching irrigation regime is created, and the soils do not become saline by autumn. This is also confirmed by the data on seasonal changes in soil salinity in terms of chlorine - ion at the U-49 site (Fig. 3). In the control (without loosening), from spring to autumn, the average content of chlorine - ion in the layer 0-75 cm, increased 2.4 times (from 0.035% to 0.081% by weight). In this case, in the variant with loosening, it decreased by 1.8 times (from 0.048 to 0.027% by weight). Usually, moisture, rising up the thin capillaries and evaporating, transports salts from groundwater to the root zone of plants. When loosening in the soil, the capillaries break, and the accumulation of salts in the loosened layer does not occur. Experimental data confirm this. On the U-50 site, a year and a half after deep loosening of the soils, the content of chlorine ion in the 0-70 cm soil layer was 2 times less than in the control, and in the 0 - 30 cm layer, by 2.9 times (table3) [8].

***Table 3**. Change in the content of chlorine ion in the meter layer of soils of the experimental site for a year and a half (Sardobinsky district, farm named after G. Gulyam, U - 50)*

Horizon, cm	Chlorine - ion content,% by weight						Ratio Control Experience on the 18.09.96
	Control - without loosening			Experience - with loosening			
	5.04.95	18.09.96	Change, % to ref.	5.04.95	18.09.96	Change,% to ref.	
0 – 30	0,021	0,043	105	0,051	0,015	-71	2,9
30 – 70	0,024	0,018	-25	0,043	0,017	-60	1,1
70 - 100	0,025	0,013	-48	0,041	0,022	-46	0,6
0-70	0,023	0,031	40,0	0,047	0,016	-65,5	2,0

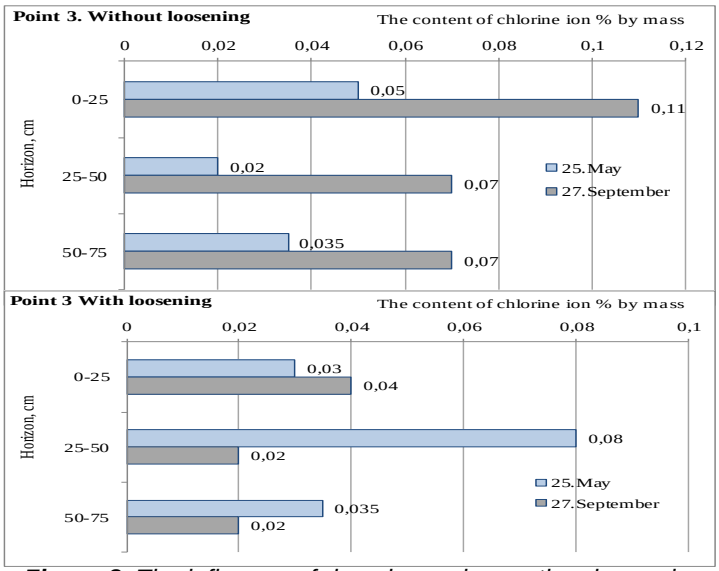

***Figure 3**. The influence of deep loosening on the change in the salt profile of the soil from spring to autumn (Sardobinsky district, farm named after G. Gulyam U-49 1994)*

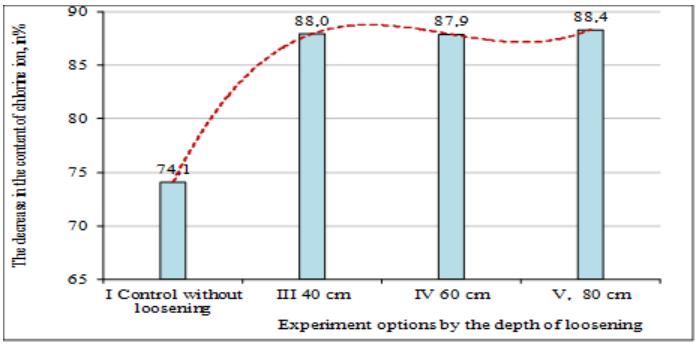

Figure 4. Decrease in soil salinity for chlorine - ion against the background of deep loosening,according to [10], Syrdarya region, GWL> 2 m; in the third year after loosening

Due to a decrease in the volumetric mass (and, accordingly, an increase in soil porosity), an increase in soil water permeability, in the first year after loosening, during irrigation, inevitably occurs an increase in irrigation rates and an adjustment of the irrigation regime for cotton. According to the results of observations of irrigation of cotton, in the variants after loosening, an increase in irrigation rates was revealed, compared with non-loose soil (from 65 to 980 m^3 / ha, table 4). In addition, in the experience of households. them. Uzakov revealed the advantage of the option of loosening to a depth of 60 cm, which provided an increase in yield of 4.6 c/ha (28%). At the same time, in comparison with the control, the unit costs of water decreased by 15%. When the soil was loosened to a depth of 80 cm, the yield increase was less - 1.5 c/ha, and the specific water consumption was more by 14%. Thus, when comparing the costs of water and the yield obtained, it was revealed that, in conditions of homogeneous gray-earth-meadow soils, a loosening depth of 60 cm is quite sufficient.

***Table 4**. Influence of deep loosening and leveling of the field on the consumption of irrigation water and the yield of cotton (according to the experiments of the Syrdarya region, Sardobin district, farm named after Uzakov [8], 1989-1991)*

Deep loosening option	Irrigation rate, m^3 / ha	Change		Yield, c / ha	Difference by rel. to control		Specific water consumption, m^3 / c	Difference by rel. to control	
		m^3/ga	%		c/ga	%		m^3/c	%
Control - conventional plowing	3960	0		16,5			240		

Plowing28 -30 cm deep,	3800	-160	-4	18,8	,3	3,9	202	-38	-16
Loosening to a depth of 40 cm, grading	4025	65	1,6	20,2	,7	2,4	199	-41	-17
The same, 60 cm	4310	350	8,8	21,1	,6	7,9	204	-36	-15
The same, 80 cm	4940	980	4,7	18	,5	,1	274	34	14

From the data in the table, it follows that the increase in irrigation rates after soil loosening is not negative, since additional water consumption is compensated by: an increase in yield (Table 4), and a decrease in soil salinity due to the leaching irrigation regime (Figures 3 and 4). The increase in yield occurs due to the creation of favorable conditions for the cotton root system. Experimental data show that under the conditions of the year-round use of lands for cotton and grain crops practiced in Uzbekistan, early spring loosening of soils (and plantation plowing) are the best ways to regulate the salt regime of the soil, by increasing water supply by 5-10% during the growing season and moisture recharge watering (water charging irrigation).

3.2 About the use of the “Biosolvent” preparation as a soil desalination agent

The Biosolvent preparation was created as an ameliorant-desolenizer of the soil at the Institute of Bioorganic Chemistry of the Academy of Sciences of Uzbekistan (author I. Khudoinazarov), and is an analogue of the Swiss preparation Spersal. Both drugs have an acidic environment, and contribute to increased salt leaching. The results of the study of the Biosolvent preparation by the authors of this article to increase the efficiency of land leaching and for soil desalinization during the growing season were published in the sources [11-13]. Field studies have established that when spraying the soil surface in checks with the Biosolvent preparation of lands saline up to 8.5 dS / m, washing washed out a greater amount of harmful ions: chlorine by 35 ... 42%; sulfates by 13 ... 16%; calcium by 21 ... 28%; sodium by 21 ... 23% in comparison with conventional flushing. No negative effect of the drug on the content of nutrients in the soil was found. When using the Biosolvent in the form of treating the furrow surface with a 10% solution before irrigation, a more significant decrease in the content of harmful salts was also established than with conventional irrigation. With the initial soil salinity of 6.7 dS / m from the 0-70 cm layer, 18 - 23% more salts were washed out along the treated furrows; and ions Cl '; SO "4 and Ca, respectively, by 17; 18 and 14%. The content of toxic ions of magnesium and sodium, during normal irrigation, increased by 23 and 14%, respectively, and in the variant with soil treatment with Biosolvent - decreased by 27, 25% The effect of leaching of salts from the soil achieved after the first watering of cotton remained until the end of the growing season.As a result of the improvement of conditions in the root zone of cotton, an increase in yield of 7.5 c / ha was obtained [13].

3.2 Experience with a combination of deep loosening and Biosolvent

On gypsum-bearing soils of the Khavast district of the Syrdarya region (cluster "Bek"), studies were carried out to quantitatively assess the reclamation efficiency of deep early spring loosening of soils, in combination:

- with land leaching at low rates;
- with the use of "Biosolvent" before watering cotton.

An example for the restoration of hard-to-reclaim lands, in modern conditions, can be the measures applied to the compacted and saline soils of the Bek cluster. Loosening to a depth of 70 cm made it possible to reduce the bulk soil mass from 1.65 g / cm3 to 1.18 -1.36 g / cm3, this alone potentially contributes to an increase in cotton yield up to 50%. Against the background of deep loosening of the soil, the efficiency of spring land leaching has significantly increased. With extremely high soil salinity in the "Bek" cluster, leaching on the background of deep loosening with a total water supply of 4000 m3 / ha (2000 m3 / ha irrigation + 2000 m3 / ha precipitation), reduced the area of extremely saline lands in the 70 cm layer by 50 %. At some points, the soil was desalinated up to 80% of the initial salt content. Thus, the carried out loosening to a depth of 70 cm, instead of water and labor-intensive capital leaching, makes it possible to carry out the usual winter-spring leaching of these lands. When carrying out vegetative irrigation of cotton, a leaching irrigation regime is created against the background of loosening, contributing to further desalination of the soil. The use of a 10% solution of the “BIOSOLVENT” preparation on the site of the Beck cluster, by spraying the soil of the furrows before vegetative irrigation, showed that, with a high degree of soil salinity, by the background of loosening, this promotes intensive desalinization of the soil to a depth of 70 cm. At the same time, only in one watering, the total amount of salts is halved, and the amount of chlorine - ion is reduced by 90% (table 5).

***Table 5**. Comparison of changes in soil salinity under the influence of the Biosolvent preparation when processing furrows before watering cotton*

Point code,		B-1 T. 1			B-3 T.3		
Horizon, cm		0-30	30-70	70-100	0-30	30-70	70-100
ECe, dS/m	Before watering	8,1	7	7,5	32,8	28,4	22,1
	After watering	5,7	8,9	10,4	23,5	7,2	28,5
	Difference	-2,4	1,9	2,9	-9,3	-21,2	6,4
	% to the original	-30	27	38	-28	-75	29
	Change, to ref., Number of times	1,4	0,8	0,7	1,4	3,9	0,8
Cl⁻,%	Before watering	0,065	0,055	0,065	0,645	0,655	0,425
	After watering	0,035	0,075	0,135	0,45	0,05	0,63
	Difference	-0,030	0,02	0,07	-0,195	-0,605	0,205
	% to ref.	-46	36	108	-30	-92	48

Point code,		B-1 T. 1			B-3 T.3		
Horizon, cm		0-30	30-70	70-100	0-30	30-70	70-100
	Change, to ref., Number of times	1,9	0,7	0,5	1,4	13,1	0,7
Mg%.	Before watering	0,036	0,03	0,042	0,12	0,081	0,078
	After watering	0,027	0,042	0,057	0,072	0,042	0,117
	Difference	-0,009	0,012	0,015	-0,048	-0,039	0,039
	% to ref.	-25	40	36	-40	-48	50
	Change, to ref., Number of times	1,3	0,7	0,7	1,7	1,9	0,7

From table 5 it follows that the amount of soluble salts leached by irrigation (including chlorine and magnesium ions) depends on their initial content in the soil. Under the influence of cotton irrigation with preliminary spraying of the soil with 10% Biosolvent solution, the EC of the soil decreased: at point B1 up to 30% or 1.4 times, and at the extremely saline point B 3 (second horizon) - by 75%, or 3, 9 times (Table 5). A similar picture was observed for chlorine ion. Its content in the soil decreased: by 46% (1.9 times) - at point B1 and by 92% or 13.1 times - at point B 3. The magnesium content changed in the same way: at point B1 it decreased by 25 %, and at point B 3 - by 40%.Thus, the early spring loosening of the soil allows, instead of capital leaching of highly saline lands, with water consumption of more than 6000-8000 m3 / ha and more, to carry out the usual winter-spring leaching. In the future, it is recommended to gradually reduce soil salinity by vegetative irrigation, using the Biosolvent preparation.

4 CONCLUSION

By analyzing the literature and the results of the authors' own research, a high efficiency of deep loosening of soils has been established. Deep loosening of compacted soils subject to salinity has a complex reclamation effect on the soil. Based on the analysis of the authors' own data on deep loosening of soils, on homogeneous soils in the Syrdarya region, quantitative indicators of its influence were established. The bulk density of the soil is reduced by 5 ... 12% (with a corresponding increase in porosity); increase in soil permeability by 3 ... 14 times; increase in irrigation rates up to 350 m3 / ha (leaching irrigation regime 9%); an increase in cotton yield by 4.6 c / ha (28%); a decrease in seasonal soil salinity (from spring to autumn) in an ordinary field, the chlorine ion content increased 2.4 times, and against the background of deep loosening, it decreased 1.8 times. By reducing the density, increasing the aeration of the water permeability of the soil and breaking the soil capillaries:

- a flush irrigation regime is created - salts are washed out from the root zone;
- soil aeration increases;
- the development of the root system improves and the yield of cotton increases;
- evaporation from the soil decreases, restoration of salinity after irrigation and from spring to autumn decreases.

Based on the studies carried out in the Mirzaabad region, the Biosolvent preparation is recommended as an ameliorant for saline soils, by treating the soil before washing and vegetative irrigation with 10% solution. The cost of the drug is 10 liters per 1 hectare, when washing and 5 liters per 1 hectare, during vegetative irrigation. The drug is more effective at a high degree of soil salinity and has no negative effect on soil properties, nutrients and soil microflora. Due to the more intensive leaching of salts when using Biosolvent for leaching, soil desalination in the field is achieved with less water consumption: about 25 -30% than with conventional leaching. Calculations show that water saving, with an average degree of soil salinity (the rate of leaching is 4.0-4.5 thousand m3 / ha), will be 1.0-1.5 thousand m3 / ha, and with a high degree of salinity (leaching rate 6 thousand m3 / ha), savings - up to 2.0 thousand m3 / ha. During pre-irrigation treatment of the surface of irrigation furrows with a Biosolvent solution, the leaching of toxic ions of chlorine and magnesium from the root layer of the soil also increases by 23-27%. Thus, the use of Biosolvent to increase the efficiency of salt leaching during leaching and irrigation gives farmers a chance to save scarce water and get a larger cotton crop.

The experience of previous studies on reclamation of hard-to-reclaim gypsum soils, as well as studies carried out in the Beck cluster, with a soil salinity level of more than 25 dS/m, have shown the expediency of using combined reclamation techniques. When loosening gypsum soils to a depth of 70 cm, the bulk density decreased from 1.64 to 1.26 g/cm3, which made it possible, instead of water and labor-intensive capital leaching, to carry out the usual winter-spring leaching, and soil treatment with Biosolvent before vegetative irrigation significantly increased leaching of toxic salts. At present, it is not possible to leach the soil with large volumes of water for cotton on large areas: both because of the difficulties with the availability and delivery of manure, lignin (which improve leaching), and due to the lack of water. The use of the Biosolvent preparation is an alternative solution to the introduction of other ameliorants that accelerate washing. Deep loosening in early spring, washing with the use of the Biosolvent preparation, as well as its application during the growing season of cotton, will allow you to get an increase in cotton yield: from deep loosening of 3-4 c / ha, from the use of preparations 7-10 c/ha.

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