ЗАСОЛЕНИЕ И МЕЛИОРАЦИЯ ПОЧВ

SRSTI 68.33.31

DOI: 10.51886/1999-740X_2024_3_33

M.S. Mirdadayev[1]*, A.V. Basmanov[1], N.N. Balgabayev[1], N.N. Khozhanov[1]

AMELIORATIVE IMPROVEMENT OF DEGRADED IRRIGATED LANDS IN THE SOUTH OF KAZAKHSTAN USING CHEMICAL RECLAMATION

[1]Kazakh Scientific Research Institute of Water Economy,

*080003, Taraz, K. Koigeldy str., 12, Kazakhstan, *e-mail: mirdadaev@mail.ru*

Abstract. The article presents studies of energy-efficient use of chemical reclamation on degraded irrigated lands of the Republic of Kazakhstan. According to the research results, it has been revealed that the combined use of certain chemical reclamation technologies provides a favorable salt regime of the soil and obtaining high yields of corn grain with savings of fuel and energy resources. When carrying out chemical melioration on irrigated degraded lands using water-saving irrigation technologies and adding mineral and liquid chemical meliorants: phosphogyp-sum ($CaSO_4 \cdot 2H_2O$)+aqueous ammonia (NH_3+NH_4OH) (phosphogypsum dose 5 t/ ha+aqueous ammonia dose 50 kg/ha, concentration 25%) - in the root zone, a decrease in toxic salts and an increase in non-toxic ones are ensured. This generally leads to an improvement in the condition and productivity of such lands, so the yield of corn grain in this research option exceeded the control option with discrete and drip irrigation, respectively, by 20.7-20.9 c/ha.

Key words: irrigation, melioration, phosphogypsum, ammonia, degraded lands.

INTRODUCTION

According to the United Nations Environment Program, over the entire history of agriculture, as a result of irrational use, about 2 billion hectares of soil were subject to degradation processes, of which due to water erosion - 55.6%, wind-27.9%, chemical (depletion, salinization, pollution) – 12.12%, physical (compaction, flooding) – 4.2% [1].

Currently, when scientific and technological progress is developing in all sectors of the economy, processes of negative influence caused by changes in climatic conditions and land degradation are observed in the agricultural sector. This is, first of all, due to human transformation of the ecosystem and the influence on it of additional technical (anthropogenic) types of energy in its various forms (fertilizers, pesticides, agricultural machinery, new varieties, irrigation, etc.).

To improve the condition of degraded lands, it is necessary to apply various types of reclamation. Agricultural reclamation includes measures to radically improve soil conditions to increase agricultural productivity. This is mainly observed in the form of work to regulate the water-physical properties of soils. But in terms of the scale of work and the volume of impact on the soil in order to improve it, they are superior to chemical methods of impacting the soil. Chemical reclamation is a system of methods of chemical influence on soil to improve its properties and increase yields [2-4].

Chemical land reclamation is divided into salt enrichment andacid regulation [5]. Salt enrichment is a measure to increase the content of essential nutrients in the soil, primarily this is achieved by introducing organic and mineral fertilizers. Acid-regulating measures are measures to create a favorable reaction of the soil environment. This includes liming, gypsuming and acidification.

Klebanovich N.V. [6] provides the main scientific and practical provisions for improving plant nutrition by applying organic, mineral fertilizers and chemical ameliorants. At the same time, special emphasis is placed on the issues of optimizing the reaction of the soil environment and the environmental aspects of the use of chemicals in agriculture.

In general, it can be noted that the chemical reclamation technologies used are quite energy-intensive, and the funds spent on their implementation are economically ineffective [7-10]. However, it is worth considering that on degraded lands without the use of chemical reclamation it is impossible to obtain acceptable yields of cultivated crops. A feature of chemical reclamation is the ability to accelerate the processes of replacing toxic salts in the root zone to ensure the normal development of cultivated crops and optimize the ecological and reclamation state of degraded lands.

In Kazakhstan, irrigated agriculture is the basis of food security, especially in the southern regions of the country, where without irrigation it is impossible to obtain guaranteed crop yields. However, in the process of exploitation of irrigated lands, problems arise of deterioration of soil-reclamation, agrochemical and ecological conditions of soils. To solve these problems, it is necessary to apply various reclamation measures to preserve and reproduce the soil fertility of agricultural lands [11-13]. It should be noted that it is also necessary to take into account the economic aspects of the use of such reclamation measures - so that the funds spent pay off within a short time and ensure the efficiency of agricultural production.

Therefore, the current situation obliges us to find optimal ways to increase the efficiency of functioning of agricultural landscapes, and in this aspect, developing issues of improving the energy efficiency of chemical reclamation can play a significant role.

MATERIALS AND METHODS

Field experiments to study the energy-efficient use of chemical reclamation on degraded lands were carried out at the experimental production site of KazSRIWE on an area of 2 hectares according to the following options:

Option 1. Control:

Option 2. Application of the mineral chemical ameliorant phosphogypsum ($CaSO_4 \cdot 2H_2O$), dose 5 t/ha.

Option 3. Application of liquid chemical ameliorant sulfuric acid (H_2SO_4) concentration 2.5%.

Option 4. Application of liquid chemical ameliorant ammonia aqueous (NH_3+NH_4OH) dose 50 kg/ha, concentration 25%.

Option 5. Combined application of mineral and liquid chemical ameliorant phosphogypsum ($CaSO_4 \cdot 2H_2O$) + aqueous ammonia (NH_3 + NH_4OH), dose of phosphogypsum 5 t/ha + dose of aqueous ammonia 50 kg/ha, concentration 25%.

When setting up experiments, their effectiveness largely depends on the representativeness of the research objects [14]. Consequently, when studying reclamation processes in chemical reclamation, it is necessary to clearly justify the selected research objects and the typicality of soils. Typing research objects is a special case, provided that a specific object is taken as a standard, in relation to which the measure of similarity is determined. Consequently, we have the right to extend the research results and recommendations to irrigation areas that are located in similar soil reclamation zones.

To establish the degree and chemistry of salinization of degraded lands, the dry residue was determined in the water extract of soil samples in a chemical laboratory, i.e. total amount of water-soluble substances, composition of ions - CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-}; Ca^{2+}, Mg^{2+}, Na^++K^+.

The results of water extract make it possible to determine the qualitative composition of salts in the root layer of soil. Calculation of the qualitative composition of salts was carried out according to the method of N.I. Bazilevich, E.I. Pankova [15]. In this case, non-toxic salts include: $Ca(HCO_3)_2$ and $CaSO_4$, toxic salts: Na_2CO_3, $NaHCO_3$, $Mg(HCO_3)_2$, $MgSO_4$, Na_2SO_4, $CaCl_2$, $MgCl_2$, NaCl [16-18]. Based on the results obtained, one or another chemical reclamation technology can be recommended.

Based on the calculated data of the studies, the energy intensity of reclamation measures was determined when using different types of ameliorants and reclamation methods. For an objective assessment, energy intensity indicators were divided into two groups: by type of cost and by reclamation effect [19].

RESULTS AND DISCUSSION

In the southern regions of Kazakhstan on gray soils, where irrigation is accompanied by the replacement of 2-valent calcium with magnesium in the IPC, a significant part (about 25-30%) of irrigated lands acquired the properties of takyrs, which are characterized by compactness and a low rate of water absorption. When watered, they float, and when they dry out, deep cracks form, which leads to a decrease in crop yields and an increase in water consumption per unit of production [19].

The main objectives of the study of the possibility of energy-efficient use of chemical reclamation on degraded lands were:

- study of the process of changing the chemical composition of the soil, aimed at reducing toxic salts at the lowest cost of production means;

- restoration of carbon dioxide-calcium balance in the soil solution ($Ca>HCO_3$);

- optimization of the composition of the soil-absorbing complex (SAC) by saturating root horizons with calcium up to 70-80% of the amount of absorbed bases (with a magnesium-calcium composition);

- reducing the dispersion of the solid phase of soils through the accumulation of organic substances and the transition of hydrophilic colloids, firmly associated with the mineral part of the soil, in the composition of humus;

- accelerating the saturation of calcium in the PPC by improving soil preparation technology and introducing chemical ameliorants.

Soil reclamation characteristics of the experimental plot. In the Asa-Talas River basin there are underdeveloped ordinary sierozems, which are not widespread. This type of soil is formed on thin alluvial-deluvial, poorly sorted formations under highly sparse efermer-wormwood vegetation.

For the experimental site, the mechanical composition and water-physical properties of the root-inhabited soil layer were established: bulk density, water permeability, and the lowest soil moisture capacity (MC). The results showed that the soils of the experimental plot in terms of mechanical composition are medium and heavy loams (table 1).

The data presented show that the agronomically valuable aggregates (more than 0.25 mm) in the root layer of soils of the experimental plot are very low, varying within 0.12-0.30%.

Analysis of the mechanical composition of fractions along the depth of the root-inhabited soil layer shows that in the 20-40 cm layer the fractions related to physical clay increase sharply, amounting to 58.9%. An increase in the content of clay fractions indicates a deterioration in the physical properties of soils in this horizon.

Table 1 - Mechanical composition of soils in the experimental plot (%)

Place and date of selection	Selection horizon, cm	Fraction sizes, mm						Variety according to granulometric composition
		1-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	less 0,001	
		Physical sand		Dust		Physical clay		
T-1, 12.01. 2023 y.	0-20	0,30	13,94	47,28	8,96	12,88	16,64	38,48 mediumloam
	20-40	0,21	12,43	48,08	10,52	11,64	17,12	39,28 mediumloam
	40-60	0,14	11,38	47,20	7,44	15,76	18,08	41,28 heavyloam
	60-80	0,12	11,92	47,08	6,72	16,32	17,84	40,88 heavyloam
	80-100	0,13	12,27	44,96	7,04	16,72	18,88	42,64 heavyloam

The main indicators of the water-physical properties of the soil are volumetric mass and the lowest moisture capacity (MC); without their determination, it is impossible to establish irrigation norms and irrigation dates. From table 3 it follows that the volumetric mass of the soil in the 0-40 cm layer is 1.38 t/m^3, for the design layer (0-60 cm) it is 1.42 t/m^3. Determined by MC, which in the calculated soil layer was within 17.1% of the soil mass.

The results of agrochemical soil analyzes show, that the humus content in the 0-60 cm layer ranges from 0.73 to 2.80%, which indicates a low content of mobile forms of nitrogen - 2.9-4.585 mg/100 g, phosphorus - 5.44-12.86 mg/100 g, potassium -10.2-48.2 mg/100 g of soil (table 2).

Table 2 - Content of humus and mobile forms

Place and date of selection	Selection horizon, cm	Humus, %	Mobile forms, mg/100 g soil		
			NO_3	P_2O_5	K_20
T-1, 15.03.2023 y.	0-20	2,80	4,065	12,86	48,2
	20-40	1,61	4,065	8,42	27,3
	40-60	0,73	3,68	5,82	21,2
T-2, 15.03.2023 y.	0-20	1,55	3,81	7,62	39,4
	20-40	1,28	4,585	5,69	20,6
	40-60	0,83	3,68	5,44	10,2
T-3, 15.03.2023 y.	0-20	1,17	3,03	7,36	34,2
	20-40	0,96	3,55	5,82	28,1
	40-60	0,75	2,9	5,44	18,9

The type of soil salinization depending on the ratio of anions and cations in the water extract is confirmed by the sum of cations in the SAC. Mg^2+ and Na+ cations predominate, which is accompanied by the formation of large amounts of toxic salts. The percentage of absorbed Mg^2+ bases ranges from 35.8-45.4% for the horizon 0-60 cm (table 3).

Table 3 - Absorbed bases of soil samples

Place and date of selection	Selection horizon, cm	Absorbed bases, mEq/100 g				in % of the amount of SAC		
		Ca^{2+}	Mg^{2+}	$Na^{+}+K^{+}$	$\Sigma_{погл.\ осн.}$	Ca^{2+}	Mg^{2+}	$Na^{+}+K^{+}$
T-1, 23.03.2023 y.	0-20	4,5	4,5	3,004	12,00	37,5	37,5	25,0
	20-40	4,0	5,5	3,0	12,50	32,0	44,0	24,0
	40-60	3,0	3,5	3,290	9,79	30,6	35,8	33,6
T-2, 23.03.2023 y.	0-20	3,5	4,0	3,030	10,53	33,2	38,0	28,8
	20-40	3,0	5,0	3,023	11,02	27,2	45,4	27,4
	40-60	2,5	5,0	3,025	10,53	23,8	47,5	28,7
T-3, 23.03.2023 y.	0-20	4,0	4,5	3,104	11,60	34,5	38,8	26,7
	20-40	3,0	5,0	3,029	11,03	27,2	45,3	27,5
	40-60	3,0	4,0	3,035	10,04	29,9	39,9	30,2

In second place is the Na+ cation, which forms toxic sulfate salts, which are distributed evenly throughout the entire soil profile (24.0-33.6%). At the same time, the percentage of Ca2+ cation remains quite low.

Analysis of the ionic composition of salts shows that the dominant ion in the root zone of the experimental plot is HCO_3 (Table 4). In the 0-60 cm layer, the hydrocarbonate content is 0.059-0.060% of the dry soil mass (dsm) or 37-38% of the total salts. The chlorine content does not exceed the toxicity threshold and in the root zone is 0.013-0.023% of the msm. Among the cations, Ca^{2+} is predominant, the content of which in the 0-60 cm layer is 0.009-0.012%. The reserves of toxic cations Na^{+} and Mg^{+} are 0.028-0.035% and 0.006-0.008%, respectively. Analysis of the qualitative composition of salts shows that in the root zone of soils the dominant salts are non-toxic hydrocarbonates $Ca(HCO_3)_2$ - for the horizon 0-60-layer 20.01-23.19% of the total salts and in some horizons toxic - $NaHCO_3$ - 23.4-28.2%. Toxic salts are represented by sodium hydrocarbonate, magnesium and sodium sulfates, as well as sodium chloride. The total content of toxic salts is more than 70% of their total amount.

Thus, the soil cover of the experimental site is represented by irrigated gray soils, according to the degree of salinity they belong to highly saline magnesian soils. The humus horizon is low-power (0-20 cm), the content of mobile forms of nutrients (NO_3, P_2O_5) in the root layer is low.

According to the classification of soils according to the degree of salinity, depending on the chemistry of salinity, the gray-earth soils of the experimental site belong to sulfate-chloride-carbonate slightly saline soils.

The research results show that in the root-inhabited layer of gray-earth soils of the experimental site, the effect of reclamation measures was shown by the following rates of ecological reclamation processes:

In the upper horizons, with the introduction of mineral chemical meliorant phosphogypsum ($CaSO_4 \cdot 2H_2O$), the dose of 5 t/ha in the qualitative composition of salts, the upper horizons increases $CaSO_4$ compared with the initial one. The amount of non-toxic salts increases over all horizons, relative to the initial composition of the salt quality.

In the variant with the introduction of a liquid c chemical meliorant of sulfuric acid (H_2SO_4), the concentration of 2.5% in the root layer is dominated by sodium sulfates – Na_2SO_4. Their content in the 0-60 cm layer is 0.241% of the mass of dry soil or 25.9% of the amount of salts. In the underlying horizons of soils, there is an increase in their content. Therefore, in general, in the upper meter layer, their content is 0.287% of the mass of dry soil, or 34.2% of the amount of salts. When considering the qualitative composition of salts, it was found that there are no sodium bicarbonates in the soil, which were noted in the control variant.

In the variant with the introduction of a liquid chemical - ammonia aqueous (NH_3 + NH_4OH) dose of 50 kg/ha, a concentration of 25% in the root layer of toxic salts dominated by magnesium sulfates – $MgSO_4$. In the underlying horizons of soils, there is an increase in their content. Therefore, in general, in the upper 0-60 cm layer, their content is 0.036% of the mass of dry soil, or 24.0% of the amount of salts. When considering the qualitative composition of salts, it was found that there are no sodium bicarbonates in the soil, which were noted in the control variant.

With the combined application of mineral and liquid chemical meliorants: phosphogypsum ($CaSO_4 \cdot 2H_2O$)+aqueous ammonia (NH_3+NH_4OH), the dose of phosphogypsum is 5 t/ha+the dose of aqueous ammonia is 50 kg/ha, the concentration of 25% is in the root layer, magnesium sulfates – $MgSO_4$ also dominate from toxic salts. in the upper 0-60 cm layer, their content is 0.037% of the mass of dry soil, or 24.4% of the amount of salts. When considering the qualitative composition of salts, it was found that sodium bicarbonates are present in the soil, but in small doses in relation to the control variant. It should also be noted in this variant, the amount of non-toxic salts reaches up to 70% of the total of all salts.

According to the results of the research, it was found that the variant, including the combined introduction of liquid and mineral chemical meliorants: aqueous ammonia (NH_3+NH_4OH)+phosphogypsum ($CaSO_4 \cdot 2H_2O$), in the ratio of doses - aqueous ammonia 50 kg/ha, with a concentration of 25%+phosphogypsum of at least 5 t/ha, compared with other variants, proved to be more effective.

Table 4 - Ionic composition of soil samples from the experimental plot

Place of selection	Selection horizon, cm	Anions, $\frac{\%}{mg-eq}100g$				Cations, $\frac{\%}{mg-eq}100g$			$\Sigma_{сол.}$, %	pH
		CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^++K^+		
Experimental plot T-1	0-20	absent	0,068 1,12	0,012 0,36	0,031 0,64	0,008 0,4	0,007 0,4	0,025 1,12	0,151	7,75
	20-40		0,056 0,92	0,014 0,4	0,048 1,0	0,008 0,4	0,007 0,6	0,030 1,32	0,163	7,78
	40-60		0,058 0,96	0,014 0,4	0,048 1,0	0,012 0,6	0,004 0,4	0,031 1,36	0,167	7,70
	0-60		0,060 1,0	0,013 0,38	0,042 0,88	0,009 0,46	0,006 0,46	0,028 1,26	0,160	7,74
Experimental plot T-2	0-20	absent	0,056 0,92	0,021 0,60	0,057 1,2	0,008 0,4	0,009 0,8	0,035 1,52	0,186	7,80
	20-40		0,053 0,88	0,024 0,68	0,053 1,12	0,012 0,6	0,007 0,6	0,035 1,48	0,184	7,82
	40-60		0,070 1,16	0,024 0,68	0,044 0,92	0,008 0,4	0,009 0,8	0,036 1,56	0,134	7,80
	0-60		0,059 0,98	0,023 0,65	0,051 1,08	0,009 0,46	0,008 0,6	0,035 1,52	0,168	7,80

The technology of applying chemical meliorants (before or after plowing, leveling the soil surface) is carried out according to the technological scheme in the following sequence:

The 1st operation is the selection and chemical analysis of reclaimed soil before the introduction of chemical meliorants;

The 2nd operation is the introduction of chemical meliorants in one step (trace) of the movement of the agricultural unit across the field, in sequence - liquid ammonia and / or ammonia water are sprayed and at the same time the treated soil is covered with phosphogypsum at the temperature of the soil - no higher than 10^0C and air – no higher than 15^0C for a joint prolonged and fugitive action;

The 3rd operation is the selection and chemical analysis of reclaimed soil of the aftereffect of chemical meliorants.

Simultaneous application of liquid and mineral bulk meliorants reduces the need for vehicles, increases productivity and reduces the cost of their application, and also increases soil fertility due to uniform and accurate distribution of meliorants across the field and low-tonnage load on the soil horizon. Based on the calculated characteristics, the proposed method increases the mobilization of residual and mobile phosphorus, increasing its content in the soil and increasing crop yields.

The mechanism of the chemical reaction of the use of chemical meliorants in the soil follows the following scheme:

$$2NH_4OH + (CaSO_4 \cdot 2H_2O) + CO_2[soil] \rightarrow (NH_4)_2SO_4 + CaCO_3\downarrow + 3H_2O \quad (1)$$

When applied simultaneously, aqueous ammonia combines with phosphogypsum, as a result of a chemical reaction, an inorganic fertilizer is formed - ammonium sulfate $(NH_4)2SO_4$ and calcium carbonate. The ammonium form, unlike nitrate nitrogen, has a prolonged effect. Calculation of the rate of application of each meliorant is established by chemical analysis of the soil.

The rest of the phosphogypsum, which does not participate in the chemical reaction, acts as a calcium-containing meliorant in the soil-absorbing complex according to the following scheme:

$$\left\{\begin{array}{l}[SAC]\ 2Na^+ + CaSO_4 \rightarrow [SAC]\ Ca^{2+} + Na_2SO_4, \\ [SAC]\ Mg^{2+} + CaSO_4 \rightarrow [SAC]\ Ca^{2+} + MgSO_4\end{array}\right\} \quad (2)$$

The reaction product is sodium and magnesium sulfate – easily soluble and easily washed out of the soil salts, which also contribute to the coagulation of soil colloids. In the case of the presence of normal soda in the soil solution, its elimination is also observed:

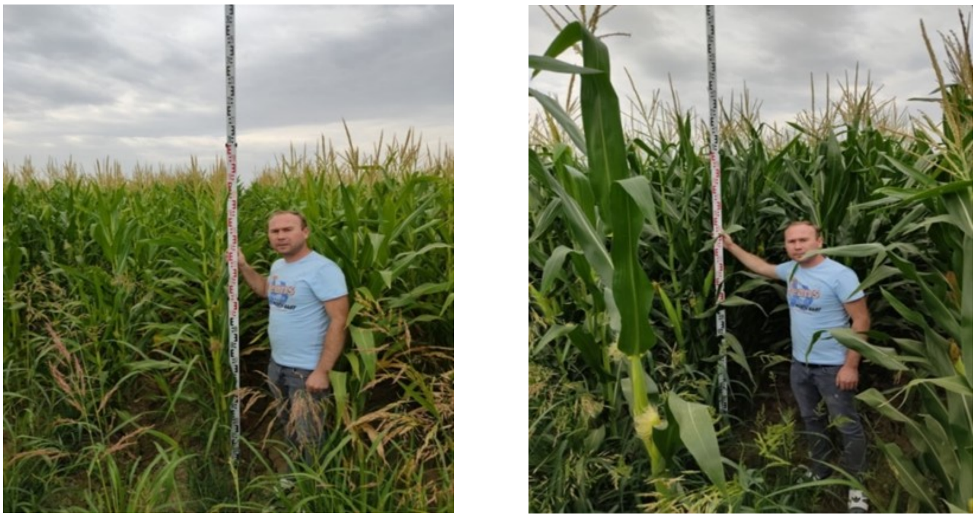
$$Na_2CO_3 + CaSO_4 \rightarrow CaCO_3\downarrow + Na_2SO_4 \quad (3)$$

The dose of phosphogypsum application is determined by the chemical analysis of the reclaimed soil, i.e. the content of exchangeable sodium (Na^+) and (or) magnesium (Mg^{2+}) in the soil-absorbing complex (SAC) of the soil, which must be replaced with calcium.

The optimal time for reclamation work on the introduction of chemical meliorants is the autumn–winter period for plowing, or in the spring period before sowing. After application on non-irrigated areas, it is necessary to carry out snow retention measures. It is advisable to introduce aqueous ammonia into sufficiently moist soil to reduce fugitive losses.

The study revealed that the studied chemical meliorants had a beneficial effect on the development of plants in the phases of growth, germination, germination energy, biomass, in addition, the biological activity of nitrifying bacteria increases markedly, due to the acceleration of the processes of microbiological transformation of ammonium salts into nitrates, which are the main form of nitrogen nutrition for agricultural crops.

According to phenological measurements, the height of cultivated corn was: in the control variant - 190-200 cm, in the variants with the introduction of chemical ameliorants - 230-240 cm (figure 1).



a) b)

Figure 1 - Phenological observations of the growth and development of corn (a - control variant, b - application of chemical meliorants)

In addition, the effectiveness of this option is confirmed by calculations of the costs of fuel and energy resources during reclamation activities on the pilot site. It follows from this that the total energy costs for machinery and equipment according to the research options range from 16.20 to 18.44%, the total costs of working capital account for 79.86% to 81.99% of the total energy costs for the cultivation of agricultural crops. Total labor costs range from 1.70% to 2.20%.

The data shows that in the irrigated regions of the south of Kazakhstan, up to 80% of the costs are spent on total costs, i.e. on the purchase of seeds, fertilizers, chemical meliorants and pesticides, fuel and energy costs.

The research results show (table 4) that with option 5, compared with the control option, the yield of corn per grain is 20.9 c/ha higher. In other studied variants, it was 5.0 c/ha; 9.2 c/ha; 11.4 c/ha, respectively.

Table 4 - Corn yield per grain, c/ha (2023 y)

Options for chemical meliorant	Yield by repetition			Sum, V	Medium
	1	2	3		
1	105,3	110,9	99,7	315,9	105,3
2	112,4	111,5	107,0	330,9	110,3
3	119,2	114,3	110,0	343,5	114,5
4	122,5	115,2	112,4	350,1	116,7
5	126,1	126,4	126,1	378,6	126,2

Mathematical statistical processing of the results of the field experiment by the method of variance analysis showed that the smallest significant difference is 0.95 = 6.3 c/ha, so the results of 2nd variant are within the error of the experiment and they can be neglected.

CONCLUSION

The results of studies on the use of various chemical reclamation technologies have shown that the technology variant gives the greatest efficiency - "combined application of mineral and liquid chemmeliorant phosphogypsum ($CaSO_4 \cdot 2H_2O$)+ aqueous ammonia (NH_3+ NH_4OH), a dose of phosphogypsum 5 t/ha+a dose of aqueous ammonia 50 kg/ha, concentration 25%". When applied simultaneously, aqueous ammonia is completely combined with some part of phosphogypsum, resulting in an inorganic fertilizer - ammonium sulfate (NH_4)2SO_4 and calcium carbonate. The ammonium form, unlike nitrate nitrogen, has a prolonged effect.

This article reflects the direction of work and was prepared within the framework of the implementation of the research work of the IRN AP23490147 "Development of technology for intensive melioration improvement of degraded irrigated lands using highly effective organomineral compost-ameliorant" under grant funding for scientific and (or) scientific and technical projects for 2024-2026 (customer - the Ministry of Science and Higher Education of the Republic of Kazakhstan).

REFERENCES

1. Report of the Governing Council / Global Ministerial Environment Forum of the United Nations Environment Programme on its 1st universal session. (2014) - 2013. - T. 99 - P. 190.

2. Anoshko V.S. Geographical foundations of land reclamation. Minsk, (1974), 175 p.

3. Faizov K.Sh., Urazaliev R.A., Iorgansky A.I. Pochvi Respublici Kazakhstan. – Almaty, 2007. – 328 s.

4. Summary analytical report on the acquisition and use of land of the Republic of Kazakhstan for 2019// Land Resources Management Committee of the Ministry of Agriculture of the Republic of Kazakhstan. – Nur-Sultan, 2020. - 254 p.

5. Baishanova A.E., Kedelbaev B.Sh. Problems of soil degradation, analysis of the current state of fertility of irrigated soils of the Republic of Kazakhstan// Cientific review Biological sciences. - 2016. - № 2. - P. 5-13.

6. Klebanovich N.V. Fundamentals of chemical soil reclamation: a course of lectures for students of the Faculty of Geography / Klebanovich N.V. – Minsk, 2005. – 100 p.

7. Mirdadayev, M., Basmanov, A., Balgabayev,N., Amanbayeva, B., Duisenkhan, A. Research of hydrogeological conditions and energy arameters of zonal irrigated soils when optimizing energy-efficient reclamation technologies in the Republic of Kazakhstan. News of the NAS of the R.K., Series of Geology and Techn. Sci. Vol. 5. - 2022. - P. 128-142.

8. Vyshpolsky, F; Mukhamedjanov, K; Bekbaev, U; Ibatullin, S; Yuldashev, T; Noble, AD; Mirzabaev, A; Aw-Hassan, A; Qadir, M. Optimizing the rate and timing of phosphogypsum application to magnesium-affected soils for crop yield and water productivity enhancement// Agricultural Water Management, 2010. -№97(9), -P.1277–1286.

9. Vyshpolsky F.F., Mukhamedzhanov H.V. Technology of water conservation and management of soil reclamation processes during irrigation. – Taraz, 2005. – 162 p.

10. Mueller, L.; Suleimenov, M.; Karimov, A.; Qadir, M.; Saparov, A.; Balgabayev, N.; Helming, K.; Lischeid, G .Land and water resources of Central Asia, their utilisation and ecological status// Novel Measurement and Assessment Tools for Monitoring and Management of Land and Water Resources in Agricultural Landscapes of Central Asia; Springer: BerlinHeidelberg, Germany, 2014. - P. 3–59.

11. Balgabaev N., Kalashnikov A., Tskhay M., Abashev M., Bekmukhamedov N. Data support for satellite monitoring of melioration state of irrigated lands in South Kazakhstan region// Journal of Advanced Research in Dynamical and Control Systems. - 2020. - № 12(5). - P. 357–369.

12. S.U. Laiskhanov, A.Otarov, I.Y. Savin, S.I. Tanirbergenov, Zh.U. Mamutov, S.N. Duisekov, A. Zhogolev. Dynamics of Soil Salinity in Irrigation Areas in South Kazakhstan// Pol. J. Environ. Stud. 2016; 25(6). - P. 2469–2475.

13. Laboratory Manual for soil and plant analyses// ICARDA Regional Office for Central Asia. – Tashkent, 2002. – 122 p.

14. Yudin F.A. Methods of agrochemical research – M.: Kolos, 1988. - 366 p.

15. Bazilevich N.I., Pankova E.N. Experience of soil classification by salinization// Soil science. – 1968. - № 11. – P. 3-16.

16. Kuzmenko O.V. Methodological features of the substantiation of directions and evaluation of the effectiveness of innovative development of crop production// International Technical and Economic Journal. – 2012. – № 4. – P. 18-24.

17. Vafina E.F., Sutygin P.F. Energy assessment of the effectiveness of techniques of technology of cultivation of field crops. Study guide.- Izhevsk: Izhevsk State Agricultural Academy, 2016. - 62s.

18. Saparov A.S., Raizov K.Sh., Mamutov Zh.U. On soil dehumification// Dokladi NAN RK. - 2006. - № 3. - S. 52-55.

19. Zhaparkulova E.D., Amanbayeva B.Sh., Dzaisambekova R.A., Mirdadayev M.S., Mosiej J. (2021) Geological structure of soils and methods of water resources management of the Asa River// News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. - 2021. - Vol. 4. - № 448. - P. 131-138.

ТҮЙІН

М.С. Мирдадаев[1]*, А.В. Басманов[1], Н.Н. Балғабаев[1], Н.Н. Қожанов[1]

ХИМИЯЛЫҚ МЕЛИОРАЦИЯМЕН ҚАЗАҚСТАННЫҢ ОҢТҮСТІГІНДЕГІ ТОЗҒАН СУАРМАЛЫ ЖЕРЛЕРДІ МЕЛИОРАЦИЯЛЫҚ ЖАҚСАРТУ

[1]Қазақ Су шаруашылығы ғылыми-зерттеу институты,

*080003, Тараз, Қойгелді көшесі 12, Қазақстан, *e-mail: mirdadaev@mail.ru*

Мақалада Қазақстан Республикасының тозған суармалы жерлерінде химиялық мелиорацияны энергия тиімді пайдалану бойынша зерттеулер келтірілген. Зерттеу нәтижелері бойынша химиялық мелиорацияның белгілі бір технологияларын кешенді қолдану топырақтың қолайлы тұзды режимін және отын-энергетикалық ресурстарды үнемдей отырып, жүгері дәнінің жоғары өнімділігін қамтамасыз ететіндігі анықталды. Суды үнемдейтін суару технологияларын қолдана отырып және минералды және сұйық химиялық мелиоранттарды енгізе отырып, суармалы деградацияланған жерлерде химиялық мелиорация жүргізу кезінде: фосфогипс ($CaSO_4 \cdot 2H_2O$)+сулы аммиак (NH_3+NH_4OH) (фосфогипс дозасы 5 т/га+сулы аммиак дозасы 50 кг/га, концентрациясы 25%) - тамырдағы қабат улы заттардың азаюымен қамтамасыз етіледі тұздар және уытты емес заттардың көбеюі. Бұл тұтастай алғанда осындай жерлердің жағдайы мен өнімділігінің жақсаруына әкеледі, сондықтан зерттеудің осы нұсқасындағы жүгері дәнінің өнімділігі дискретті және тамшылатып суарумен бақылау нұсқасынан сәйкесінше 20,7-20,9 ц/га асып түсті.

Түйінді сөздер: суару, мелиорация, фосфогипс, аммиак, деградацияланған жерлер.

РЕЗЮМЕ

М.С. Мирдадаев[1]*, А.В. Басманов[1], Н.Н. Балгабаев[1], Н.Н. Хожанов[1]

МЕЛИОРАТИВНОЕ УЛУЧШЕНИЕ ДЕГРАДИРОВАННЫХ ОРОШАЕМЫХ ЗЕМЕЛЬ НА ЮГЕ КАЗАХСТАНА С ИСПОЛЬЗОВАНИЕМ ХИМИЧЕСКОЙ МЕЛИОРАЦИИ

*[1]Казахский научно-исследовательский институт водного хозяйства, 080003, Тараз, ул. Койгельды 12, Казахстан, *e-mail: mirdadaev@mail.ru*

В статье представлены исследования энергоэффективного использования химической мелиорации на деградированных орошаемых землях Республики Казахстан. По результатам исследований выявлено, что комплексное применение определенных технологий химической мелиорации обеспечивает благоприятный солевой режим почвы и получение высоких урожаев зерна кукурузы при экономии топливно-энергетических ресурсов. При проведении химической мелиорации на орошаемых деградированных землях с применением водосберегающих технологий полива, внесением минеральных и жидких химических мелиорантов: фосфогипс ($CaSO_4 \cdot 2H_2O$)+водный аммиак (NH_3+NH_4OH) (доза фосфогипса 5 т/га+водный аммиак доза 50 кг/га, концентрация 25%) - в корнеобитаемом слое обеспечивается снижение токсичных солей и увеличение нетоксичных. Это в целом приводит к улучшению состояния и продуктивности таких земель, так урожайность зерна кукурузы в данном варианте исследований превысила контрольный вариант с дискретным и капельным орошением соответственно на 20,7-20,9 ц/га.

Ключевые слова: орошение, мелиорация, фосфогипс, аммиак, деградированные земли.

INFORMATION ABOUT AUTHORS

1. Mirdadayev Mirobit Salimovich - leading researcher of the department of "Melioration, ecology and water supply", Candidate of Technical Sciences,
e-mail: mirdadaev@mail.ru

2. Basmanov Aleksandr Viktorovich - senior researcher of the department of "Melioration, ecology and water supply", Master of Agricultural Sciences,
e-mail: a.basmanov@mail.ru.

3. Balgabayev Nurlan Nurmakhanovich - General Director, Doctor of Agricultural Sciences, e-mail: balgabayev@mail.ru.

4. Khozhanov Nietbay Nurzhanovich - senior researcher of the department of "Melioration, ecology and water supply", Candidate of Agricultural Sciences,
e-mail: khozhanov55@mail.ru