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K. K. Kubenkulov, A. Kh. Naushabayev, N. A. Khokhanbaeva, N. Seitkali

Kazakh national agricultural university, Almaty, Kazakhstan.
E-mail: Nuri.310385@mail.ru

COMPARATIVE INFLUENCE OF PHOSPHOGYPSEUM, ELEMENTAL SULFUR AND SULFURIC ACIDS ON THE COMPOSITION OF THE WATER EXTRACT OF THE SEMI-HYDROMORPHIC SOLONCHAK-SOLONETZ

Abstract. The article showed that effects of phosphogypsum, sulfur and sulfuric acid on salt regime soda-saline solonetzin LLP "Amiran" of district Nura of Talgar region.

Key words: solonchakous, solonetzification, phosphogypsum, elemental sulfur.

Introduction. 704.3 million or 73.87% of the 953.4 million hectares of the earth's saline lands are the soda-derived genesis [1]. The area of soda saline soils in the former USSR is 120 million hectares. Their largest arbor is formed in the forest steppes and steppes of Western Siberia. It also includes the northeastern region of the Republic of Kazakhstan. The considerable territory of sodium saline soils (7.1 million hectares) is located in the Southern and Southeastern regions of our Republic [2]. Their districts in these regions are as follows: Zhambyl - 3383 thousand hectares, Southern Kazakhstan - 1935 thousand hectares, Kyzylorda - 1543.2 thousand hectares, Almaty - 1321 thousand hectares. Obviously, they range from tens of square meters to several hectares, among the most meadow meadow, meadow-gray, meadow-chestnadsoils of the foothill flat. These conditions require the identification of high-efficiency meliorants to improve fertility of soda saline soils and to develop technology for their application.

Research Materials and Methods. The researches were conducted in the farm "Amiran" of Nurain Talgar district of Almaty region. The farmland is bordered with the Zhetygen-Kyraltabay highway in the north, with the Lep River in the east, on the west with the Issyk rivers.

In the spring of 2015, a field of special practice was selected for field research. Particularly semi-hydromorphic dumplings, located in the gray soils of the northern slopes of the meadow.

Field practice is put in saline soils (25.06.15), which is defined as stain on the farm №11. It was widely known [3] by the following scheme:

1. Control
2. Phosphogypsum - 27 t/ha and 27 kg / 15 m^2
3. Elemental sulfur - 5 t/ha and 5
4. Sulfuric acid - 15.4 t/hectare and 15.4%

Experience was conducted with three repetitions. Area of mites (3×5m) 15 m^2. Soil samples were taken from 0-20, 20-40, 40-60 cm depth in all variants before feeding. In the case of phosphogypsum and elemental sulfur field experiments, the soil was grounded at depths below 29 cm and then introduced by discoloration. Size of meliorantswas calculated according to the formula of B. M. Agayev (1966) in0.5 m depth of soil [4].

$$G = 0,086(Na^+ - 0,1E) + [(CO_3^{2-} + HCO_3^-) -1,0] \times H \times ПП;$$

where G – dose of pure gypsum (100% $CaSO_4$ $2H_2O$); Na + – variable sodium content, in mg of 100 g soil; H – thickness of the reclamation layer, cm; PP – soil density, g/cm^3; E – absorption capacity, in mg of 100 g soil; 0,086 – conversion coefficient of calcium into gypsum; (CO_3^{2-} + HCO_3^-) – the content of ions in the filtered water, in mg of 100g soil; 0,1 – the coefficient allowing the conservation of solonetzes in the AUC of 10% exchange sodium.

The phosphogypsum, elemental sulfur and sulfuric acid quantities were found to be increased to 1.10 0.19 and 0.57, respectively, from the determined gypsum.

The phosphogypsum, elemental sulfur and sulfuric acid quantities were found to be increased to 1.10 0.19 and 0.57, respectively, from the determined gypsum.

In the experimental plot that was washed out with sulfuric acid in 2800m^3 of salt in the soothed salts formed during sulfuric acid interactions during the second decade of July (July 17). Samples of soil samples were obtained from 0-20, 20-40 and 40-60 cm in 13 days after rinsing sulfuric acid (30.07.2015) and all other options (07.11.2017). During this period, the amount of moisture required for the normal movement of the processes occurring in the soil with the presence of microorganisms.

The plot area (3×5) 15 m^2 replication of the experiment is 3-fold. Correction of ameliorants into the soil was carried out by plowing to a depth of 29 cm, followed by disking. Samples of soils were selected in the spring before introduction of ameliorants (26.06.2015), in the autumn after 4.5 month incubation of meliorants (07.11.2015), in spring and summer next year before (26.03.2016) after (28.04.2016) washing. The depth of sampling of samples is 0-20, 20-40 and 40-60 cm. They determined the composition of the ions of aqueous extract [7], obtained by filtering the suspension with a soil to water ratio of 1: 5. The field experiment was conducted according to the generally accepted method [8-9].

In the third decade of July (31.07.2015), the variety of barly “Arna” (sowing capacity of 150 kg/hectare) and and) the variety of alfalfa "Semirechinskaya" (sowing capacity of 15 kg/hectare) were sown in the plots that was rinsed with sulfuric acid. Ammophos (240 kg/ha) was used to increase soil fertility.

In the spring of the next year, soil samples were taken before and after rinsing the plots which were treated by phosphogypsum and elemental sulfur.

Soil samples were collected from the depths 0-20, 20-40 and 40-60 cm in all three years (2015-2017) year by year seasons (spring, summer and autumn). The soil sample of the soil samples obtained from the laboratory was determined by the content of ions, salts and hydrogen concentrations (pH values).

Results and discussion. It is well-known that the liquid phase of the soils is considered to be the most unstable part of the soils, not only in the seasons, but also within a day.

This peculiarity of the soils' liquid phase allows the soil course to be oriented and characterized and evaluated and managed. The method of analysis of the composition of water filtrate adopted in the CIS countries is used for studying soil condition (ionic content, concentration and pH). But its details do not fully match the true soil solution. Nevertheless, this method allows us to see changes in soil solutions, which are made from natural processes (seasonal fluctuations of humidity and temperature fluctuations) and artificial fertilizers (fertilizers, melioration, soil treatment, irrigation, rinse, etc.). They are in our soil condition.

From the data analysis water filtrate in the soil, it is possible to see that the initial level of ionic content of the test is saline (0.5-0.7% of salts) and their salts are sodium-sulphate.

The negative effects of soluble salts in plants are due to the interaction of several factors.

Typically, high osmotic pressure of the soil solution plays a major role. It is caused by a high amount of dissolved salts which worsens moisture absorption of plants from the soil. Therefore, in conditions of the same moisture of soil, plants are less likely to have a moisture shortage than saline soils.

Some of the factors that prevent normal growth of plants are the unique effects of ions Cl^-, SO_4, HCO_3^-, Na^+, Ca^{2+}, Mg^{2+} in soil solubility, some of which have high concentrations of necrosis (Cl^-), some of which transpiration process (Na^+ and Cl^-) and plants Mg^{2+} and K^+ (Ca^{2+}-дан) and Ca^{2+} and Mg^{2+} (Na^+).

The third factor causing the adverse effects of the salts of light-soluble plants is a sharp deterioration of the physical properties of the soils in the presence of clastic soil in presence of a significant amount of Na + 5% of the accumulated cations. its water and air volatility also deteriorate.

The fourth factor that adversely affects the root system of plants is the effect of high alkalinity of the soil solution, especially the young roots hairs.

There are all of the above-mentioned factors, which have a negative impact on the growth and development of plants in our test plot. Among them are the most severe dehydration and high alkalinity observed in sodium saline. Sodium salinity of the plot is characterized by the presence of all test variants in the test variants higher than its toxicity (0.8 mg/l in soil) in table 1.

Table 1 – Ionic composition and salts of filteratewater before treatment with elemental sulfur and sulfuric acid phosphogypsum for half-hydromorphic acid, (mg/equiv) /% (25.06.2015)

Variant	Depth of sample, cm	Total HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	$Na^+ + K^+$	Total salt, %	pH
Phospho-gypsum	0-20	1,12	–	0,75	8,63	4,25	2,88	3,37	0,777	8,2
		0,068		0,026	0,410	0,085	0,034	0,077		
	20-40	1,56	–	0,70	4,25	1,75	1,38	3,69	0,454	8,1
		0,095		0,024	0,200	0,035	0,016	0,084		
	40-60	1,64	0,48	0,60	4,13	2,25	1,50	3,10	0,459	8,6
		0,100	0,014	0,021	0,190	0,045	0,018	0,071		
Elemental sulfur	0-20	1,48	No	0,65	7,75	4,00	2,88	2,75	0,659	8,2
		0,090		0,022	0,370	0,080	0,034	0,063		
	20-40	1,92	–	0,75	5,38	2,50	1,75	2,29	0,516	8,2
		0,117		0,026	0,250	0,050	0,021	0,052		
	40-60	2,32	0,60	0,75	4,38	2,00	1,25	4,80	0,560	8,8
		0,141	0,018	0,026	0,210	0,040	0,015	0,110		
Sulfuric acid	0-20	1,56	–	0,75	6,00	2,50	2,00	3,81	0,692	8,1
		0,095		0,026	0,280	0,050	0,024	0,087		
	20-40	1,84	0,30	0,65	4,63	2,00	1,25	4,07	0,513	8,5
		0,112	0,009	0,022	0,220	0,04	0,015	0,093		
	40-60	2,56	0,24	0,70	5,00	2,50	1,50	4,38	0,595	8,8
		0,156	0,007	0,024	0,240	0,050	0,018	0,100		

High concentrations of sodium are due to the significant salinization of soil.

Thus, the initial soil moisturization of phosphogypsum with sulfur and sulfuric acid is characterized by the bicarbonate ion along the entire soil surface, the alkalinity provided by the normal carbonate in the lower part and the high amount of sulfate ions. In the case of Sa2+, Mg2 + and Na +, soil salts are substantially toxic NaHCO3, Na2SO4, and MgSO4.

The composition of the filtrate water of soil samples collected in the spring of 2017 to determine the direction and intensity of reclamation efficiencies of themeliorates given to the soils of the test variants has been identified. After two years of chemical and phytomelioration treatments, all the variants of the salts on the soils decreased and became slightly salted than strong, moderately salinized (table 2).

Table 2 – Reclamation Effect of Lucerne Cultivation after Partial Hydromorphic Dissolving, Phosphogypsum, Elemental Sulfur and Sulfuric Acid (mg/eq)/% (26.04.2017)

Variant	Depth of sample, cm	Сілтілік		Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	$Na^+ + K^+$	Тұздар жиын-тығы, %	pH
		жалпы HCO_3^-	CO_3^{2-} тен							
Phospho-gypsum	0-20	1,88	0,56	0,40	1,25	0,80	0,30	2,15	0,274	7,8
		0,114	0,017	0,014	0,059	0,016	0,004	0,049		
	20-40	1,20	0,56	0,40	1,25	0,65	0,45	2,01	0,244	7,7
		0,073	0,017	0,014	0,059	0,013	0,008	0,046		
Elemental sulfur	0-20	1,58	Іздері	0,45	1,12	0,55	0,35	2,05	0,243	7,6
		0,095		0,023	0,054	0,016	0,006	0,047		
	20-40	1,42	Іздері	0,30	0,87	0,80	0,50	0,79	0,160	7,5
		0,086		0,011	0,062	0,016	0,006	0,028		
Sulfuric acid	0-20	0,96	Іздері	0,30	0,90	0,70	0,40	1,06	0,156	7,5
		0,058		0,011	0,043	0,014	0,005	0,025		
	20-40	0,84	Іздері	0,30	1,57	0,60	0,30	1,81	0,195	7,4
		0,051		0,010	0,075	0,012	0,004	0,042		

Size of hydrocarbons ion; As a rule, the depth increases to 40-60 cm at 100 g soil and has reached 2 mg or more. It should be noted that at this depth only normal carbonates are present, the maximum concentration of which (more than 0.03 mg/eq) is more than 10 times, so the lower layer is slightly alkaline (pH 7.6-8.2). The amount and distribution of chlorine ions along the surface of the soils is the same for all experimental variants (0.60-0.75 mg/eq. In 100 g soil) and twice as high as toxicity (0.35 mg/eq). They say that there is no swelling of the soil in the form of soil and water. The concentration of sulphate ions in anions differs from the maximum (7-8 mg/eq. in 100 g soil), which is 4 times higher than the toxic concentration (1.7 mg/min). They decrease as deep as the control varies (up to 4-5 mg/dl). Anion composition test site shows that the soil is soda-sulphate salinity type.

The cationic content of the aqueous filter is characterized by a considerably lower amount of calcium and sodium than the elevated and upper layer and lower layers. This is due to the carbonaceousness of the soil, the magnesium content of the cation content is significantly (25-30%). This affects the soil for magnesium oxidation.

After the phosphogypsum discovery, the volume of hydrocarbonate ion that detects the total alkalinity has increased even at a depth of 0-20 cm at 100 g of soil from 1.12 to 1.88 mg/dl and less than 20-25 cm below it. Elementary sulfur variants show the same pattern. Depending on the positive effects of sulfuric acid, the concentration of bicarbonate ions in the depths of 0-20 and 20-40 cm decreases from 1.7 to 0.9 mg/Eq in soil approximately 100g. However, the concentration of this ion does not exceed 0.8 mg/l in soil 100 g of its toxicity, but only sulfuric acid is close to its boundaries.

The meliorative work carried out has also changed the concentration of normal carbonates. Initially, the CO2-ion, which had no variants at 0-20 and 20-40 cm depth, after two years, its size and control of the phosphogypsum were significantly higher (0.03 mg/equivalence). And sulfur and sulfuric acid has the same traces in its variants. Hence, these meliorants have constrained the formation and growth of normal carbonate in the soil. The experimental variants are likely to cause rinsing of soil and reduce the amount of precipitated chlorine ions. Its concentration approximates to the toxicity limit (0.35 mg/min 100g soil) on all options.

The concentration of sulfate ions in the test sample was highest in the control version (8.50 mg/eq. In the average 100g soil level). Such amount of meliorants is stored at depths of 0-20 cm above the given variants. But as the deeper it goes deeper, the amount of the ion has dropped almost twice. The results of the two-year reclamation processes in the soil have been reduced and equalized (~ 1 mg-Eqv in the 100g soil average from 5.00 mg to 1.00 mg/Eq) in SO_2-Ion concentrations in the spring of 2017). The reduction of sulfate ions in the soil solution can be due to the oxidation of sulfur and its intensive use of the alfalfa plant. Two years later, the reduction of its size and the appearance of normal carbonates have led to the transition of soda-sulphate saline chemistry to sulfate-soda.

The initial amount of calcium ions in the cations ranges from 1.75 to 5.00 mg/eq in soil in 100 g of variants. Two years later, its weight decreased to 0.76 mg/l in the average 100g soil. In 2015, the magnesium ion content in the water filtrate is approximately 1 unit, with a depth of 0-20 cm at 100 g soil, between 2,00-2,88 mg. After reclamation, the concentration of the soil was significantly reduced and reached ~ 0.45 mg/dl in 100g of soil on all variants. It is possible to see that the sodium ion has diminished in the soil solution even after the melioration. The phosphogypes have been reduced by 1.5 times, in the variant of sulfur - by 1.1 times and in sulfuric acid by 2.5 times. Thus, the reduction of the ions in the aqueous filtrate of the soil, led to a decrease in salts, with the exception of alkaline ions, leading to a gradual transition from medium-salt to slightly salinized (uncontrolled). However, the increase in alkaline ions (HCO3-CO32-) concentrations has been slightly less alkaline than the neutrals in the test site. It is easy to see that the reclamation of sulfuric acid is the highest in ameliorated soil. It can be traced in all the water filters of the soil. Thus, semi-hydromorphous soda saline molluscs with open-gray soils have been reduced to two-year chemical (phosphogypsum, sulfuric acid, sulfuric acid) and phyto-meliorative (cucumber) salts, reducing the content of normal salts and increasing the share of alkaline salts.

Conclusion. The field studies revealed the relative effects of phosphogypsum, elemental sulfur and sulfuric acid on the saline solids of semi-hydromorphic soda saline solids located in the open gray soils of the IliAlatau plateau of the IliAlatau, and the meliorative effect of sulfuric acid was very high among the reclaimed mud.

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К. К. Кубенкулов, А. Х. Наушабаев, Н. А. Хоханбаева, Н. Сейткали

Қазақ ұлттық аграрлық унивеситеті, Алматы, Қазақстан

ЖАРТЫЛАЙ ГИДРОМОРФТЫ СОДАЛЫ СОРТАҢ-КЕБІРДІҢ СУ СҮЗІНДІСІ ҚҰРАМЫНА ФОСФОГИПС, ЭЛЕМЕНТАРЛЫ КҮКІРТ ЖӘНЕ КҮКІРТ ҚЫШҚЫЛЫНЫҢ САЛЫСТЫРМАЛЫ ӘСЕРІ

Аннотация. Мақалада Талғар ауданы Нұра ауылдық окургының «Амиран» ЖШС территориясында суарылмалы содалы сортаңданған кебірдің тұз құбылымына фосфогипс, күкірт және күкірт қышқылының әсерлері қарастырылған.

Түйін сөздер: сортаңданған, кебірленген, фосфогипс, элементарлы күкірт.

К. К. Кубенкулов, А. Х. Наушабаев, Н. А. Хоханбаева, Н. Сейткали

Казахский национальный аграрный университет, Алматы, Казахстан

СРАВНИТЕЛЬНАЯ ЭФФЕКТИВНОСТЬ ФОСФОГИПСА, ЭЛЕМЕНТАРНОЙ СЕРЫ И СЕРНОЙ КИСЛОТЫ НА СОСТАВ ВОДНОЙ ВЫТЯЖКИ ПОЛУГИДРОМОРФНЫХ СОДОВЫХ СОЛОНЧАКОВ – СОЛОНЦОВ

Аннотация. В статье рассмотрены влияние фосфогипса, элементарной серы и серной кислоты на солевой режим орошаемых содово-засоленных солонцов ТОО Амиран Нуринского сельского округа Талгарского района.

Ключевые слова: засоление, осолонцевание, фосфогипс, элементарная сера.

Information about authors:

Kubenkulov Kanaybek Kubenkulovich – candidate of Agricultural Sciences, Associate Professor of the Department of Soil Science and Agrochemistry of the Kazakh National Agrarian University, Almaty, e-mail: Kkubenkulov@mail.ru.

Naushabaev Askhat Khamitovich – doctor PhD, associate professor of the department "Soil Science and Agrochemistry", Kazakh National Agrarian University, Almaty, e-mail: tatan-askhat@mail.ru

Hohanbaeva Nurzhamal Aybatillaevna – PhD doctoral student of the department "Soil Science and Agrochemistry", Kazakh National Agrarian University, Almaty, e-mail: nuri.310385@mail.ru

Seitkali Nurzihan – Doctor PhD of the department "Soil Science and Agrochemistry", Kazakh National Agrarian University, Almaty, e-mail: Nurzi.seitkali@mail.ru

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