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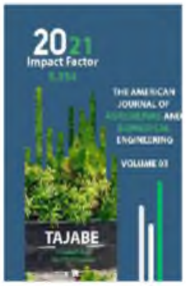


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# Optimization Of Plant Development In Case Of Soil Salinization

**Vitaly Igorevich Savich**
Doctor Of Agricultural Sciences, Professor Department Of Soil Science, Geology And Landscape Science Rsau-Moscow Agricultural Academy Named After K.A. Timiryazeva, Uzbekistan

**Hafiza Tuymurodovna Artikova**
Candidate Of Biological Sciences, Associate Professor Department Of Soil Science, Bukhara State University (Uzbekistan)

**Shavkatullo Shukurovich Nafetdinov**
Candidate Of Biological Sciences, Associate Professor Department Of Soil Science, Bukhara State University (Uzbekistan)

**Khilola Hamroevna Salimova**
Lecturer Department Of Soil Science, Bukhara State University (Uzbekistan)

## ABSTRACT

This article discusses the improvement of the development of biotests in saline soils with the addition of zeolite, phosphogypsum, organic fertilizers. The development of biotests on seawater with a concentration of 1-10 g / l improved when humates, $KNO_3$, and water extracts from crop residues were added to the water. A decrease in the salinity of the upper soil layer is shown when an interlayer with large pores from high moor peat is created at a depth of 25 cm.

## KEYWORDS

Salinization of soils, reclamation of waters, soils, geochemical barriers, saline brown semi-desert soils.

## INTRODUCTION

Comparative dynamics of soils light chestnut saline soils, red sulfate soils, saline brown semidesert soils, saline soils of Asian countries.The study methodology consisted of assessing soil properties by conventional methods, assessing soil salinity [4]. In model experiments, the development of biotests was assessed when zeolite, phosphogypsum [4], and organic fertilizers [9] were introduced into the soil. The effect on the development of biotests of adding 5-10 g / l of stimulants, N, P, K to sea water was studied [8, 9].

In field conditions, the effect of watering soils with a mixture of sea, rain and river water on the yield of rice on acidic sulphate soils was assessed [8].

## THE MAIN FINDINGS AND RESULTS

An increase in the yield of agricultural crops on saline soils is of great economic importance. However, for different types of salinity, individual groups of soils, recommendations for optimizing the situation have not been developed. They vary depending on the hydrothermal conditions of the territory and differ for individual crops grown. The transformation processes of the salt regime in the soil-plant system have been insufficiently studied. The nature and degree of soil salinity, as a rule, change in time and space [8].

The permissible indicators of soil salinity differ for different components of the landscape: soils, plants, water environment. They depend on the hydrothermal conditions of the territory and change for individual geomorphological territories, microrelief in seasonal and long-term dynamics. The salt composition of soil solutions regularly changes depending on humidity and temperature, the content of carbon dioxide, oxygen, methane in soil solutions, their pH and Eh environment, complexing ability.

The maximum permissible salt concentration depends on the mineralogical and granulometric composition of soils and soil fertility. The content of salts in soil solutions is determined by the effective product of the solubility of their precipitation, the processes of ion exchange and complexation and does not fully characterize their content in the solid phase of soils. For a more correct assessment of soil salinity, it is necessary to determine the kinetics of their transition from soil to solution, the depositing ability in relation to them, the content of positively and negatively charged complex compounds, associates.

Agroecological assessment of soil salinization is characterized by additional processes and regimes occurring in landscape components.

The experiments have shown the presence of salt components in the form of complexes, associates, precipitates, absorbed by the solid phase by the type of ion exchange. Depending on humidity, temperature, $pCO_2$, composition of migrating (ascending, descending and lateral flows) soil solutions, there is constant competition between the transition of some cations and anions from one state to another, as well as competing complexation, sedimentation, and competing processes of ion exchange in soils and in metabolic processes of plants and microflora [6, 7, 9, 11].

The presented work proposes new methods for regulating the combination of properties of saline soils, the promising use of which has been confirmed in our studies [4, 7, 8, 9].

1. Experiments have shown the feasibility of optimizing the soil-plant system on saline soils using zeolite.

According to literature data, when zeolite was introduced into the soils of the arid zone at a dose of 10 t / ha, the moisture in the arable layer increased 2 times, which corresponded to an increase in wheat yield [10].

The influence of zeolite introduced into soils of different particle size distribution on the development of wheat seedlings and the moisture content of soil wilting, according to model experiments, is shown in the following table.

**Table 1**

**The effect of zeolite introduced into soils on the moisture content of wilting soils and the length of wheat seedlings (cm)**

| Granulometric composition of soils | Option | |
|---|---|---|
| | the control | + zeolite |
| light loam | 8,5±0,7 | 12,9±1,0 |
| heavy loam | 11.5±1,1 | 15,0±1,7 |

As can be seen from the data presented, the introduction of zeolite into the soil improved the development of seedlings. To a greater extent, this is observed for soils with a lighter granulometric composition. At the same time, the moisture content of soils of light granulometric composition increased from 2.6 ± 0.4 to 3.9 ± 0.6 and on soils with a heavy granulometric composition - from 3.2 ± 0.2 to 5.2 ± 0.7.

The introduction of zeolite into soils increased the pH of the medium, and, therefore, reduced the value of Eh mv according to CSE in chernozems with a light particle size distribution from 187.7 ± 8.7 to 143.7 ± 33.1, and in chernozems with a heavy granulometric composition - from 199, 2 up to 186.7 mV by HSE. The addition of stimulants to the zeolite increased the length of wheat seedlings by 4 times.

According to the data obtained, in a long-term model experiment lasting 27 days in the control variant, the biomass of raw winter wheat plants was 0.5 g, length 12.8 cm, leaf area 44.5 $cm^2$; when applying zeolite at the rate of 1 t / ha - biomass 0.9 g, length 20.6 cm, leaf area 77.4 $cm^2$ [4].

Stepanova L.P. et al. showed a positive effect of zeolite introduced into soils on soil structure, moisture capacity, soil density; the best options were noted when zeolite was applied together with organic fertilizers up to 25 t / ha [10].

Saline soils are often alkaline. According to G.M. Barantseva, N.P. Panov [4], simultaneous plastering and acidification of them allows to increase the yield of grain crops in irrigated conditions by 80-115%. In non-irrigated areas - by 20-50%, in this case, gypsum plastering at a dose of 6.5 t / ha (calculated according to the coagulation threshold) and acidification at a dose of 7 t / ha (half dose for exchangeable sodium) are recommended.

According to our data, the introduction of phosphogypsum increased the activity of chloroplasts in the leaves, the content of chlorophyll “a” in them from 179.2 to 199.4 mg / $m^2$ and chlorophyll “b” - from 89.0 to 103.1 mg / $m^2$. At the same time, the emission of $CO_2$ by leaves also increased from 31.5 mg / $m^2$ per hour to 51.8 mg / $m^2$ per hour.

2. According to our data, the introduction of organic composts into soils increases the moisture capacity of soils, lowers the density of soils, and significantly increases the buffer capacity of soils in the acid-base and redox ranges. At the same time, the amount of free radicals increases, which stimulates the capacity of soils [9].

3. Saline soils contain microorganisms in significant quantities. Thus, in streptomycete complexes of brown desert-steppe and gray-brown alkaline soils of the desert steppes of Mongolia, gamophilic alkalophilic and haloalkalophilic streptomycetes were found, preferring for growth a medium with 5% salt concentration and pH = 8-9 [3].

M.E. Kotenko it was shown that in saline soils the growth rate of microbial communities increased to pH = 7.7; Na - up to 0.8 mmol / 100 g of soil, Cl - up to 0.4 mmol / 100 g, solid residue - up to 0.12%. Obviously, the maximum permissible levels of these indicators will differ for soils, microorganisms and plants [2, 8].

4. An increased content of salts in soils leads to a decrease in soil fertility and to oppression of plants. However, salts are necessary for the normal development of living organisms: people, animals, plants. In arid climates, they retain water in biological objects. Therefore, foliar feeding of plants with NaCl increases their resistance to drought.

At the same time, according to the law on partial replacement of plant life factors [1, 5], optimization of the nutrient regime, increasing the concentration of CO2 in the air, feeding plants with stimulants, organic compounds containing energy, can increase the resistance of crops to soil salinity [1].

According to our data, the development of plants on saline soils can be improved by adding organic ligands, complexones, humates, biophilic elements to soil solutions. Also, when we germinated biotest (watercress) seedlings in the water of the Dead Sea with a salt concentration of 1 g / l, 5 seeds germinated, the size of the roots was 5.1 ± 1.9 cm, when humate was added to the solution at a concentration of $10^{-6}$ m / l. l the size of the roots was 19.5 ± 13.0 cm, 9 seeds germinated. When germinating seeds in the water of the Dead Sea with a salt concentration of 5 g / l, the size of the roots was 4.5 ± 1.0 cm, and when humate was added to the solution of $10^{-6}$ m / l and NPK - $10^{-2}$ m / l, the size of the roots was 5.8 ± 0.4 cm.

5. According to the studies carried out, the optimization of the development of plants on saline soils is achieved by creating an interlayer with large pores at a depth of 20-25 cm. It is created from coarse-grained zeolite, peat, when structure-forming agents are added to this depth, etc. The interlayer prevents the capillary rise of salts to the surface. Compaction of the root layer of soils, on the contrary, causes the movement of water to this zone [4]. With a chlorine content of 18 mEq / 100 g at a depth of 50-60 cm, its content in the 0-10 cm layer was 7 mEq / 100 g in the control,

and 0 mEq / 100 g in the presence of an interlayer

6. To a large extent, the optimization of plant development on saline soils can be achieved by enriching the soil with nutrients. Thus, on saline soils of Vietnam, during the development of seedlings in a model experiment in a layer of 30-60 cm, the activity of leaf photosynthesis in the control was 1.9 ± 0.2 mmol / $m^2$ per second, and with the introduction of $KNO_3$ - 4.4 ± 0.3.

7. Irrigation of soils with a mixture of waters of a given composition also leads to the optimization of soil properties and to an increase in the biological productivity of lands. So, in the field, watering saline acidic sulphate soils with a mixture of river, rain and sea water made it possible to significantly optimize the properties of soils and get a rice yield of 70 kg / ha [8].

## CONCLUSIONS

According to our data, to improve the properties of saline soils, it is advisable to use optimization of the properties, processes and regimes of soils, microorganisms and plants.

The experiments have shown the promise of improving the state of the soil-plant system during soil salinity through the use of zeolite, organic fertilizers, tape fertilization, irrigation water reclamation, through the use of water mixtures of a given composition, their enrichment with microelements due to their anodic dissolution, enrichment with humates, complexones and stimulants.

According to the data obtained, the interruption of the capillary rise of saline waters to the surface is achieved by creating an interlayer with large capillaries (peat, structured zeolite, etc.) at a depth of 20-25 cm and creating a more compacted interlayer near the plants that sucks water from the surrounding layers.

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