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The impact of new technology on the biological activity of saline soils and the yield of rice

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Introduction

Kazakhstan has 35.8 million hectares of saline soils or 16.6% of the total area of agricultural land. Saline soils cover 2.4 million hectares of arable land, 0.16 million of which are in the Kyzylorda region [1]. As is known, 88% of the republic's rice crops are located on the territory of the Kyzylorda region, where every third resident is involved in the rice industry in some way. The degree of mineralization and qualitative content of groundwater are differentiable as a result of vertical water and salt exchange in rice soils. Hydrocarbonate-sulfate-sodium waters form beneath riverbeds with concentrations of up to 1 g/l; hydrocarbonate-chloride-sulfate-sodium waters form beneath interchannel depressions with dense residues of up to 3 g/l; and chloride-sulfate-sodium waters form beneath flat ridges with dense residues of 3 to 7 g/l. During the spring-summer period, alluvial-meadow soils become saline from the surface. According to the type of salinity, the soils of this region are chloride-sulfate, with a large predominance of sulfates. The main part of the salt reserve is concentrated in crusty-puffy solonchaks of flat watershed ridges [2].

Table 1 - Area of saline soils by region (ha) [1]

Region	Size (hectares)
Akmola region	0.6 mln.
Turkestan	0.12 mln
Almaty	0.15 mln.(0.06 mln. hectares of irrigated land),
Zhambyl region	0.18 mln
Kyzylorda	0.16 mln.

Methodology

In the Shieli district of the Kyzylorda region, the Tonkerys peasant farm is located, based on the level of salinity of 20 hectares of soil of which we have chosen to introduce the "NTOZ-2" technology - a new technology for the development of highly saline and alkaline soils. This technology is designed to increase the fertility of saline soils, as well as the productivity of rice crops. The method consists in plowing chopped straw up to 3 t/ha and pre-treating rice seeds special plants with a 40% PFCM solution for 1 hour.

Results and Discussion

Results. After the application of the technology, 6.1% of the farm's 20 hectares of land fell into the category of non-saline soils, the area of slightly saline soils increased, while the area of medium and highly saline soils reduced. Sowing rice according to the "New Technology for the Development of Salt Soils (NTOZ-2)" stimulated plant growth and had a positive effect on the biological activity of rice soils in varying degrees of saline soils, the intensity of soil respiration increased, in strongly saline soils it is lower than in medium and slightly saline ones. The release of CO2, as the end product of microbial metabolism, is closely related to the development of plants, and in soils without rice it is less, there is a high number of aerobic and anaerobic nitrogen fixers. NTOZ-2 stimulated the development of denitrifying bacteria, and the potential activity of denitrification of rice soils increased sharply. The Tonkerys farm's yield of rice per 20 hectares improved by 28.7%, demonstrating the efficiency of the NTOZ-2 technology. This is also supported by the economic efficiency calculation, which found that the introduction of technology resulted in a net profit of 57,430 tenge/ha.

Discussion. The use of a new technology for the development of saline soils "NTOZ-2" on the lands of the farm "Tonkerys - K" made a profit and reduced the degree of soil salinity. The use of this technology in subsequent years will lead to a further decrease in soil salinity and can be replicated in other rice-growing farms in the region.

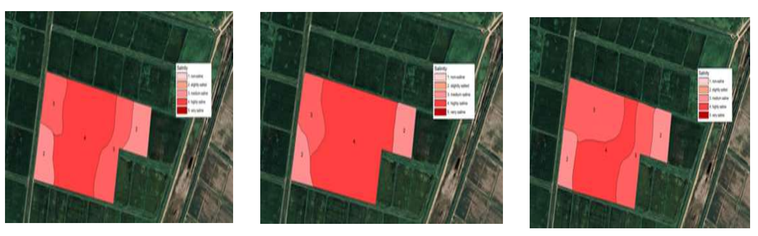

Figure 1 – Salinity map of 0–20, 20–50, and 50–100 cm of «Tonkeris» farm soil layer in Shieli district of Kyzylorda region.

Figure 2 - Map of salinity of 0-20, 20-50 and 50-100 cm of the soil layer of the farm "Tonkeris" of the Shieli district of the Kyzylorda region at the end, after harvesting (post-monitoring, autumn 2020)

Table 2 - The impact of the application of technology in the fields of PF "Tonkerys" on the yield of rice

Repetitions	control, c/ha	Technology, c/ha	yield increase, c/ha	yield increase, %
I	36,0	46,5	10,5	29,2
II	37,0	48,2	11,2	30,3
III	35,6	45,1	9,5	26,7
Average	36,2	46,6	10,4	28,7

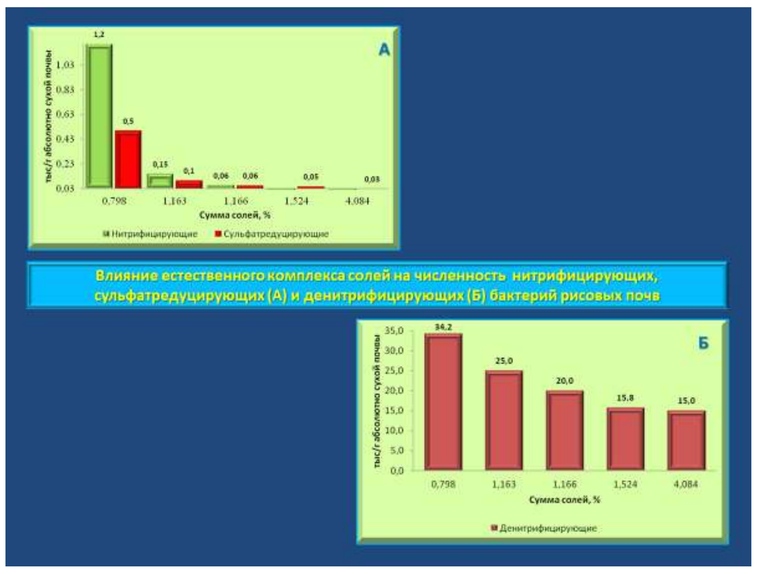

Figure 3–Influence of salinity on the number of nitrifying, sulfate-reducing (A) and denitrifying (B) bacteria in rice soils

Table 3 - Change in the degree of soil salinity of the farm "Tonkerys" at application of NTOS-2 technology

The degree of soil y in The degree of soil salinity in the layer 0-20 cmeer 0-20 cm	Spring		Autumn	
	hectares	%	hectares	%
non-saline soil	0	0	1,22	6,10
Slightly saline soil	3,84	19,20	5,98	29,90
Medium saline soil	6,12	30,60	4,38	21,90
Highly saline soil	10,04	50,20	8,42	42,10
Total:	20	100	20	100

Conclusions

The application of the technology reduced soil salinization increased their biological activity and gave an increase in rice yield and

References

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Acknowledgements

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