

Impact of Nanotechnology on Sodic Soils and Sorghum Crop Growth

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Introduction:

Sodic soils are characterized by having a high pH (>8.5) and an amount of exchangeable sodium (ESP >15) sufficient to adversely affect both sorghum crops and soil structure. Excess Na in the cation-exchange complex causes clay particles to disperse, and as a result, these soils exhibit high compaction, low aggregate stability, and reduced water infiltration. These conditions create a poor rooting environment and limited nutrient availability, negatively impacting soil biological activity and plant growth. One of the tools to mitigate this effect is the application of a calcium (Ca) source capable of displacing Na from the cation exchange complex (CEC).

Objective:

To evaluate the effect of adding gypsum nanoparticles (GNP) to sorghum grown in sodic soils..

Methodology:

Seedlings of the sorghum hybrid Silero INTA PEMAN, pre-germinated for 5 days, were transplanted into 450 cm³ pots and maintained under controlled greenhouse conditions using alkaline (pH 9.4) and neutral (pH 6.5) substrates. A group of pots received 10 µL/pot of GNP. The remaining group was considered the control (C). Twenty days after transplanting (dat), the following plant variables were evaluated: aerial fresh weight (AFW), maximum photochemical efficiency (Fv/Fm), and total mycorrhization (M). In the soil, the following were assessed: total fungal count (TF), Na and Ca in the cation exchange complex (CEC), and Na content in the leachate at the end of the experiment, extracted from the final irrigation (200 cm³ of deionized water per pot).

Results:

Application of GNP increased AFW, with statistically significant differences in plants grown under both soil conditions. In the alkaline substrate, Fv/Fm increased significantly with the addition of GNP. In the neutral substrate, application tended to improve mycorrhizal interaction (Table 1). Total fungal count increased under both soil conditions with the GNP treatment, with statistically significant differences compared to the control (Table 1). In the CEC, Na content tended to decrease while Ca increased with GNP application under alkaline conditions. This correlated with what was observed in the final leachate, where Na tended to increase (Table 1).

Table 1. Statistical analysis of plant and soil variables evaluated between treatments for each soil condition (neutral and alkaline pH).

	Treatment	PLANT				SOIL		
		AFW	Fv/Fm	M	TFC	Na (CEC)	Ca (CEC)	Na (leachate solution)
		g		%	CFU/g	ppm	ppm	nmol/mL
pH 6.5	S+Ca	0,23 b	0,80 b	4,9	4,38·104 a	71,00 a	1072,00 b	3,48 a
	T	0,16 a	0,80 b	0,3	1,78·104 b	77,00 a	1071,00 b	1,66 a
pH 9.4	S+Ca	0,20 b	0,78 b	0	5,84·104 a	275,00 b	902,25 a	87,25 b
	T	0,13 a	0,61 a	0,6	1,94·104 b	290,00 b	848,67 a	68,38 b

Plantas creciendo a pH 9.4



T

S+Ca

Means followed by different letters are significantly different ($p < 0,05$) among treatments within each soil condition (neutral and alkaline pH).

Conclusion::

The use of this technology is a valuable tool to improve soil quality and, consequently, increase the aerial fresh weight (AFW) of sorghum grown in marginal areas with high soil sodium levels.



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