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CHENOPODIUM ALBUM AS A PERSPECTIVE PLANT FOR SALINE SOIL PHYTOREMEDIATION

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Introduction

Soil salinity is a serious environmental problem and a major factor that decreases agricultural productivity and poses a challenge to the agricultural capacity to sustain an increasingly growing population. Over recent years, the intense raise in soil infertility due to salinization of soil is a consequence of inappropriate irrigation and other anthropogenic operations [2]. On this basis, it is very important to prevent the process of soil salinization, as well as to remediate already saline soils. The present paper discusses the novelty of Chenopodium album in the context of reducing salt stress.

Methodology

Salt tolerance potential and phytodesalination ability of C. album growing in the same salt-affected soil of two different textures (clay and clay loam) over a range of salinity (non-saline (ECe is 0-2 dS/m), slightly salinized (ECe is 2-4 dS/m), moderately salinized (ECe is 4-8 dS/m), highly salinized (ECe is 8-16 dS/m), and extremely heavily salinized (ECe >16 dS/m) of two different rates: extreme1 (ECe is 16-20 dS/m) and extreme2 (ECe is 25-30 dS/m)) [1] were studied and compared.

Results and Discussion

Results demonstrate that C. album has high adaptability and tolerance to extreme salt stress. Morphological and physiological characteristics promoted the stress tolerance of this plant. The studied attributes of growth such as stem diameter, shoot length, fresh and dry masses in the process of salinity increasing altered differently in clay and clay loam soil types.

Table 1. Effect of salinity on content of ions in roots and shoots of plants growing in clay soils (mg/g), n = 5, P < 0.05

Salinity degree	K^+		Na^+		Ca^{2+}		Cl^-		TDS	
	root	shoot	root	shoot	root	shoot	root	shoot	root	shoot
Non	11.80	48.02	1.41	0.13	0.62	1.50	0.46	3.80	21.55	78.46
Slight	9.87	50.18	3.76	0.49	0.64	1.55	0.69	5.73	22.61	84.77
Moderate	7.29	53.27	7.58	0.92	0.65	1.63	1.02	8.38	23.60	90.49
High	4.10	57.73	10.08	4.45	0.65	1.87	1.74	20.47	26.36	110.23
Extreme$_1$	3.55	62.21	12.45	7.83	0.69	2.21	2.20	24.77	33.92	117.13
Extreme$_2$	3.53	68.63	13.33	10.75	0.72	2.37	2.45	27.50	35.64	130.63

Table 2. Effect of salinity on content of ions in roots and shoots of plants growing in clay loam soils (mg/g), n = 5, P < 0.05

Salinity degree	K^+		Na^+		Ca^{2+}		Cl^-		TDS	
	root	shoot	root	shoot	root	shoot	root	shoot	root	shoot
Non	12.42	53.67	1.61	0.04	0.72	1.73	0.47	3.06	22.61	69.24
Slight	7.29	57.18	4.71	0.68	0.78	1.80	0.82	8.87	25.41	75.93
Moderate	4.67	59.43	7.29	1.39	0.82	1.92	1.10	13.23	28.31	84.39
High	4.08	63.80	12.90	4.47	1.56	2.08	1.90	21.97	29.94	101.52
Extreme$_1$	3.19	51.35	13.00	12.67	1.72	1.88	3.96	30.85	32.28	136.00
Extreme$_2$	2.85	50.63	15.50	15.57	1.72	1.83	4.30	33.60	37.54	160.27

In particular, according to investigated growth traits, plants growing in clay soils showed a better adaptation reaction than plants growing in clay loam soils, and an increase in the main part of studied indices was observed until reaching high degree of salinity, after which the plants showed symptoms of stress in all the growth parameters. Under the most favorable soil conditions for the studied plants (clay soil) they did not just avoided dehydration of root and shoot and undergo suppression in various growth traits under saline stress but even considerably enhanced. It is worth noting that, despite the fact that there was an inhibition of some physiological parameters of plants under the salt stress conditions, such as photosynthesis and transpiration rates, the plants retained survivability even if exposed extreme degrees of salinity. Observed intensive accumulation of salt ions by plant further promote the feasibility of C. album for phytodesalination of saline degraded soils basing on the fact that the maintaining of the plant growth and function under long-term NaCl stress is indicative of the tolerance ability.

Conclusions

Obtained results may be the input to give a new comprehension of an alternative phytotechnology for sustainable functioning of saline agriculture and remediation of saline soils by tolerant and abundant biomass yielding plant C. album. However, future research should be carried out to ascertain previously unexplored key traits of C. album and to open up possibilities for enhancing its salinity tolerance and soil desalination potential.

References

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