THE RESPONSE AND TOLERANCE MECHANISMS OF LETTUCE (*LACTUCA SATIVA* L.) EXPOSED TO INCREASED CONCENTRATIONS OF MANGANESE IN AQUATIC CULTURES

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INTRODUCTION

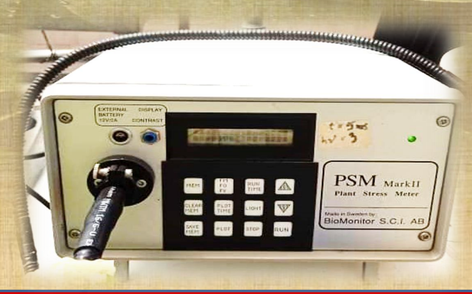
Mn is a microelement that has an important metabolic role within different plant cell compartments. The essential amount of Mn in plants should be in the range of 20-40 mg Mn / kg of dry weight for its various functions. Mn is an essential cofactor for the oxygen complex evolving complex of the photosynthetic machinery, catalyzing the water-splitting reaction in photosystem II. Manganese is involved in chlorophyll biosynthesis and is therefore very important for the photosynthesis process, as it plays a key role in electron transport in this process. Due to different degrees of valence, Mn is a regulator of many oxido-reduction processes. It is part of manny enzymes and is involved in protein synthesis. In addition, it has a significant impact on building resistance to abiotic and biotic stresses, which is important for this experiment.

METHOD / DESIGN

The plants used for this experiment were grown by the method of static water cultures with aeration, using Hoagladn 's 100% solution.

After 40 days of growth, the plants were exposed to Mn treatment.

For seven days, the control plants were grown on a pure nutrient solution, whereas half of plants where placed on tenfold higher concentrations of manganese in a nutrient solution. After sampling, the parameters of photosynthesis and water regime were measured, as well as the measurement of enzyme activity and biochemical indicators.



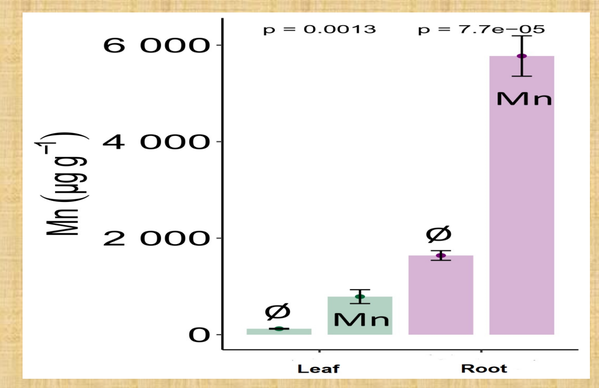
RESULTS & DISCUSSION

Conducted analyzes showed that the treatment of Mn did not significantly affect the intensity of photosynthesis, indicating to stable bioproduction in spite of Mn treatment. Mn treatment had significantly reduced stomatal water conduction, although the transpiration rate was not affected accordingly.

Column1	sod	gst	apx	gpx	cat	Proteins	proline	ppo	gsh	tbars	idh	mdh	SCcO
	U/mg protein	U/mg protein	U/mg protein	U/mg protein	U/mg protein	mg/g FW	mg/g FW	U/mg protein	µmol/mg protein	nmol MDA/g FW	U/mg protein	U/mg protein	U/mg protein
Control	3.58	2558.24	11.29	1.15	3.85	2.55	2.29	0.05	64.36	38.68	20.89	13.62	2.28
Mn	3.40	2263.91	13.73	1.00	**0,41** *	2.42	**6,61** *	0.03	59.56	45.68	**35,91** *	**61,40** *	1.71

*value is significantly different comperd to control ($p<0.05$) according to t-test

*SOD - super- oxide dismutase; GST-glutathione-S-transferase; APX-ascirbate peroxidase; GPX-guaicol peroxidase ; CAT-catalase ; L-proline- proteins ; PPO-polyphenols oxidase ; GSH-glutathione ; TBARS-thiobarbituric acid-reactive substances ; PROLINE- L-proline ; IDH-NAD isocitrate dehydrogenase ; MDH-NADH malate dehydrogenase ; SScO-succinate cytochrome – C oxidase.



*Mn accumulation in leaves and roots of controle and Mn treated plants.

CONCLUSIONS

- The results of the analysis lead to the conclusion that *Lactuca sativa* L. is a good candidate species for phytoextraction at moderate Mn load.
- The application of tenfold elevated Mn treatment to plants led to minimal and very moderate stress, while at same time sustaining balanced bioproduction as an important factor for successful phytoremediation trials.

Respectively, intrinsic water use efficiency was elevated under the influence of Mn treatment. These results lead to the conclusion that Mn to some extent affected the function of the stomatal apparatus. From the examined stress indicators, it was determined that only the concentration of proline increased, which is an indication for increased metabolic acclimatization of plants to Mn exposure. Since Mn did not affect the concentration of glutathione and thiobarbituric acid-reactive substances, it implies that the stress was relatively moderate and successfully managed by the treated plants. Mn treatment of *Lactuca sativa L.* plants did not significantly affect the activities of antioxidant enzymes except for the decrease in catalase activity. This indicates that the antioxidant system of cells was not under intense oxidative pressure coming from the treatment. Respiration enzymes where also not affected. Treatment of plants with Mn proved that the accumulation of this element was significantly higher in treated plants (788,1 µg/g in leaves and 5775,2 µg/g in roots), compared to the control (122, 6 µg/g in leaves and 1641,0 µg/g in roots). The accumulation was significantly higher in the roots of plants than in the leaves.