LEAD EFFECTS UPON THE GERMINATION AND DEVELOPMENT OF *MENTHA PIPERITA* L. SEEDLINGS

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Abstract. Aromatic and medicinal plants have a demonstrated ability to accumulate heavy metals, thus they appear to be a good choice for phytoremediation since these species are mainly grown for secondary products (essential oils). The aim of this study is to investigate the tolerance of lead in *Mentha piperita* L. using seed germination and seedling growth bioassays.

Keywords: medicinal plant, *Mentha piperita* L., lead, seed germination.

Rezumat. Efectele plumbului asupra germinaţiei şi dezvoltării plantulelor de *Mentha piperita* L. Plantele medicinale şi aromatice deţin abilitatea de a acumula metale grele şi astfel reprezintă o bună alegere în fitoremediere deoarece aceste specii sunt cultivate în special pentru produşii lor secundari (uleiuri esenţiale). Scopul acestui studiu este de a investiga toleranţa speciei *Mentha piperita* L. faţă de plumb utilizând metode de testare a germinaţiei seminţelor şi de creştere a plantulelor.

Cuvinte cheie: plantă medicinală, *Mentha piperita* L., plumb, germinaţia seminţelor.

INTRODUCTION

Medicinal and aromatic plants are beginning to be more and more considered as good choices for phytoremediation since these species are mainly grown for secondary products known as essential oils, eliminating the threat of contamination of the food chain with heavy metals. Heavy metals such as lead are naturally present in the environment and their presence has gradually been increasing with the development of industrialization and in consequence of pollution.

It has been demonstrated that aromatic and medicinal plants have the ability to accumulate heavy metals (SCHNEIDER & MARQUARD, 1996) but these metals do not appear in their essential oils (SCORA & CHANG, 1997; ZHELJIAZKOV & NIELSEN, 1996) and do not affect their composition and properties.

The aim of this study is to test the medicinal species *Mentha piperita* L. for heavy metal tolerance, lead in this case, by testing the germination ability of seeds and the ability of their seedlings to develop in a heavy metal contaminated environment.

MATERIAL AND METHODS

The material for our research is represented by seeds of *Mentha piperita* L. that were immersed for 3 h in distilled water (control) and lead nitrate treatment solution of different concentrations (experimental variants: V1- 100 mg/l, V2 - 300 mg/l and V3 – 500 mg/l). The selected concentrations of lead solutions were applied starting with the critical concentration of lead in soil (100 mg/l).

A number of 10 seeds for each variant (treated with lead nitrate) and for control (immersed only in distilled water), were placed on filter paper in Petri dishes and kept at room temperature. Distilled water has periodically been added in each Petri dish to keep all the seeds hydrated and to help them germinate properly. Root and hypocotyl length of geminated seeds was measured after 21 days. The experiment has been repeated 3 times.

The obtained data was statistical analyzed using Anova test (Microsoft Excel). Significant differences were defined at a 0.05 level. The seed germination bioassay has been evaluated according to TAM & TIQUIA (1994); relative seed germination (%), relative root elongation (%) and germination index (GI) were calculated for each experimental variant.

RESULTS AND DISCUSSIONS

Lead influenced the germination of *Mentha piperita* L. seeds reducing it*,* the percentages of germination being 90% in V1, 93.33% in V2 and 73.33% in V3, as compared to the control sample (Fig. 1). Lead solutions reduced relative root elongation in the investigated species and also reduced relative hypocotyl elongation (Figs. 2, 3).

The analyzed seeds presented germination indexes (GI) under the value of 100% for all tested lead solutions (Fig. 4). The germination index proved to be a sensitive index indicating, when greater than 80%, the disappearance of phytotoxicity of the substrate (TIQUIA et al., 1996). The germination indexes obtained for the three tested lead solutions were 59.49%, 40.9%, and 29.19% respectively.

All tested lead solutions had inhibitory effect concerning root and hypocotyl length of seedlings of the studied *Mentha piperita* L.*,* as compared to the control sample (Figs. 5, 6). These results are statistically significant (Anova Single Factor, F>F crit.). Root growth has been proven to be an indicator of metal tolerance in plants (WILKINS, 1978), roots being responsible for absorption and accumulation of metals. Thus, metal concentration affects the roots more than the aerial parts of the plant (ONCEL et al., 2000).

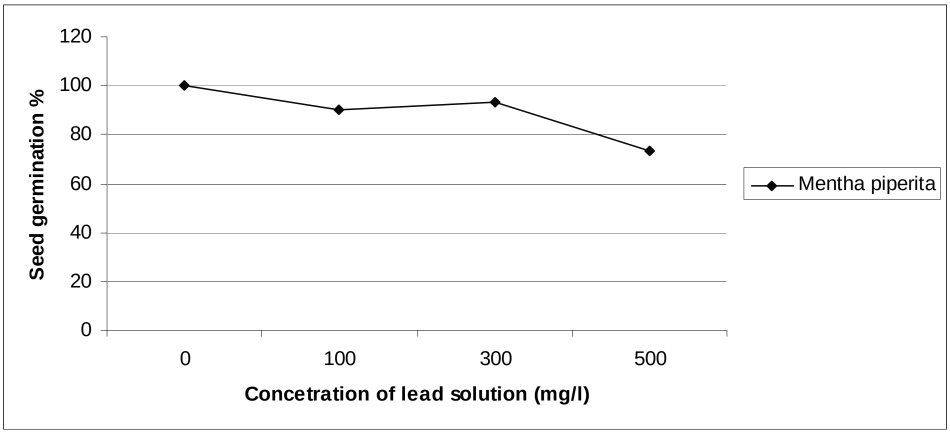

Figure 1. Percentage of seed germination in *Mentha piperita* L. for different concentrations of lead solution.
Figura 1. Procentajul de germinație la *Mentha piperita* L. pentru diferite concentrații de soluții cu săruri de plumb.

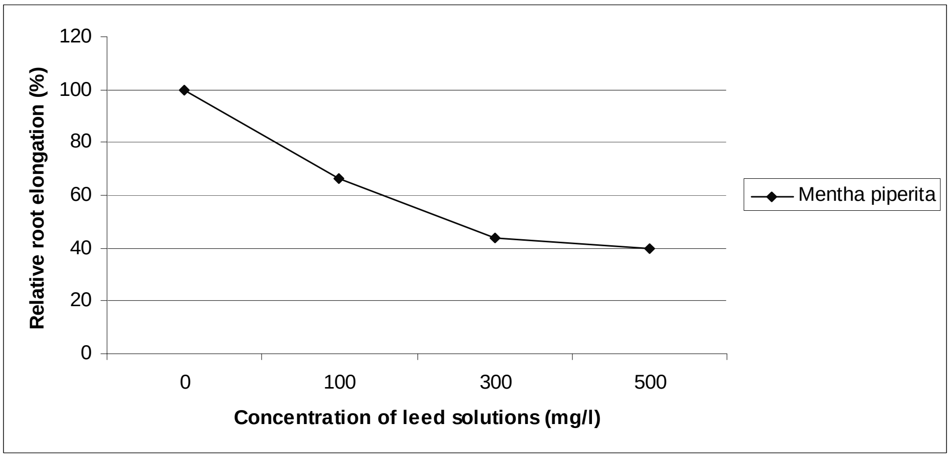

Figure 2. Relative root elongation in *Mentha piperita* L. for different concentrations of lead solutions.
Figura 2. Lungimea relativă a rădăcinii la *Mentha piperita* L. pentru diferite concentrații de soluții cu săruri de plumb.

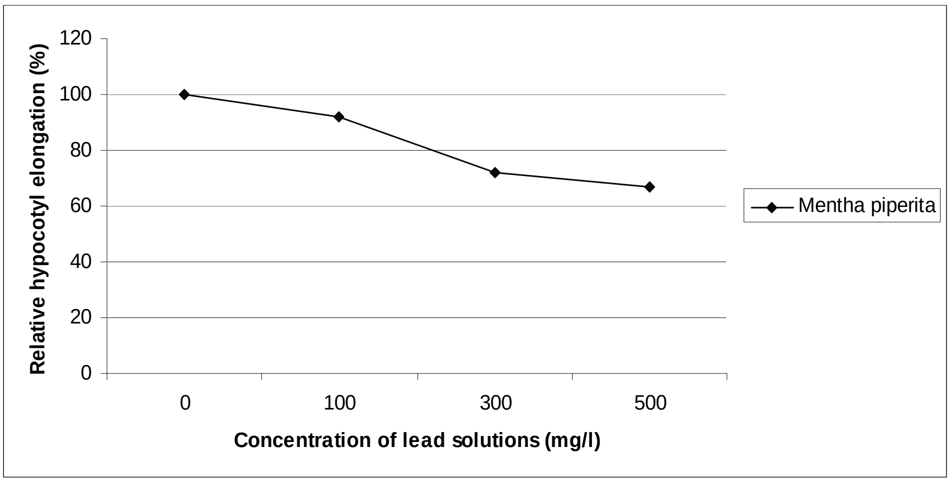

Figure 3. Relative hypocotyl elongation in *Mentha piperita* L. for different concentrations of lead solution.
Figura 3. Lungimea relativă a hipocotilului la *Mentha piperita* L. pentru diferite concentrații de soluții cu săruri de plumb.

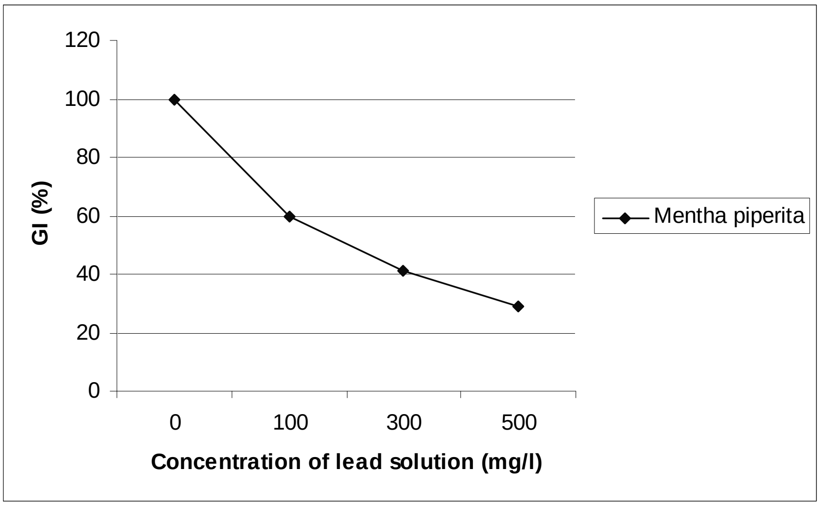

Figure 4. Germination index (GI) in *Mentha piperita* L. for different concentrations of lead solution.
Figura 4. Index de germinaţie (GI) la *Mentha piperita* L. pentru diferite concentraţii de soluţii cu săruri de plumb.

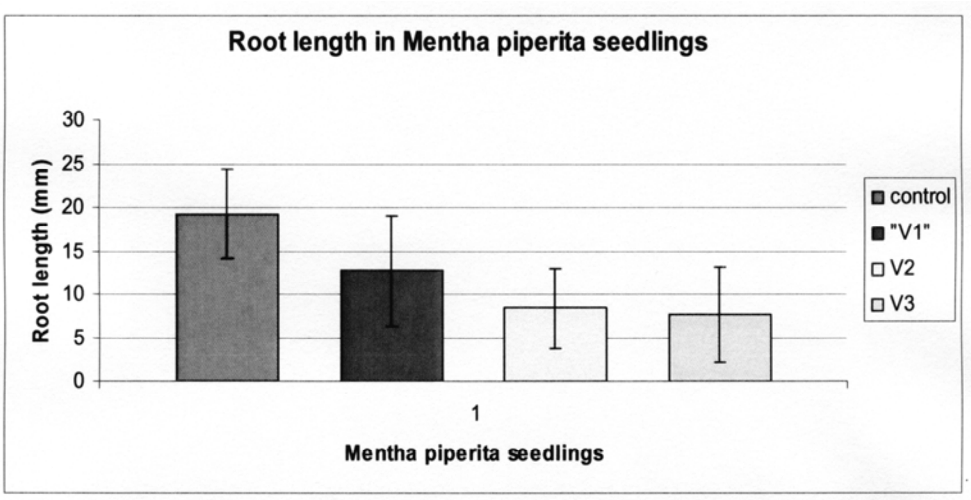

Figure 5. Root length of *Mentha piperita* L. seedlings for different concentrations of lead solutions (±s.d., n=15).
Figura 5. Lungimea rădăcinii la plantele de *Mentha piperita* L. la diferite concentraţii de soluţii cu săruri de plumb (±s.d., n=15).

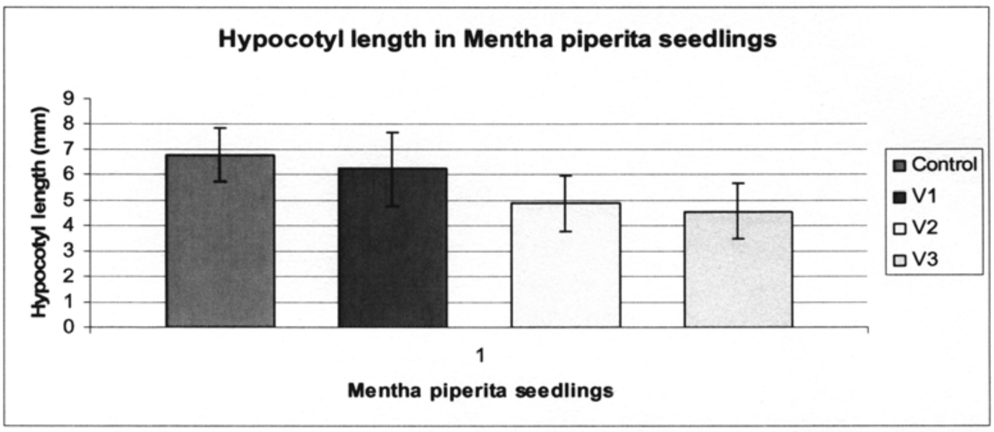

Figure 6. Hypocotyl length of *Mentha piperita* L. seedlings for different concentrations of lead solutions (±s.d., n=15).
Figura 6. Lungimea hipocotilului la *Mentha piperita* L. la diferite concentraţii de soluţii cu săruri de plumb (±s.d., n=15).

CONCLUSIONS

The results from the conducted study indicate that nitrate lead solutions of 100 mg/l and 500 mg/l inhibit seed germination in *Mentha piperita* L., noticing a slight stimulation of seed germination in 300 mg/l concentration variant of nitrate lead, compared to the other two tested variants. Considering root growth and relative root elongation, results from the present study suggest that *Mentha piperita* L. could not be successfully used for phytoremediation of soil contaminated with lead, but considering seed germination, this species could be an important candidate for phytoremediation of lead contaminated soils.

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