LEAD TOLERANCE AND THE INTERACTIVE EFFECTS OF LEAD AND IAA ON DIRECT ROOT REGENERATION IN THE SUNFLOWER

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We examined lead toxicity and the interactive effects of Pb and indole-3-acetic acid (IAA) on direct root regeneration from the hypocotyls of sunflower seedlings. Plants were grown in vitro on MS medium supplemented with Pb(NO$_3$)$_2$ or PbCl$_2$ at five different concentrations (5, 10, 20, 40 and 80 mg dm$^{-3}$ Pb$^{+2}$) with or without 1 mg/l IAA. After 12 days of regeneration, the number and length of roots were measured.

In seedlings growing in presence of lead without IAA, the effect of Pb$^{+2}$ ions on the number of roots was similar for both types of salt. 5, 10 and 20 mg dm$^{-3}$ Pb$^{+2}$ significantly increased the root number, while 40 and 80 mg dm$^{-3}$ Pb$^{+2}$ did not change it, compared to the control. As regards the length of the roots, some important differences arose between Pb(NO$_3$)$_2$ and PbCl$_2$. In presence of Pb(NO$_3$)$_2$, for 10, 20, 40 and 80 mg dm$^{-3}$ Pb$^{+2}$, a significant increase in the length of the regenerated roots was observed. At the same concentrations of PbCl$_2$, the length of regenerated roots decreased. For both salts the smallest changes in roots length were visible for 5 mg dm$^{-3}$ Pb$^{+2}$.

The interaction between Pb$^{+2}$ and IAA significantly changed the results obtained for Pb ions. In the two lower concentrations of Pb(NO$_3$)$_2$ and PbCl$_2$, the number of regenerated roots was nearly the same as in the control. However, for 20, 40 and 80 mg dm$^{-3}$ Pb$^{+2}$, the root number was much smaller than in the control and at similar concentrations without IAA. Irrespective of the salt type, the interaction between Pb$^{+2}$ made the roots 2 or 3 times shorter.

The process of sunflower root regeneration seems to be less sensitive to lead than the growth of seedlings or even seed germination. Low concentrations of Pb$^{+2}$ stimulate the regeneration of roots, while higher ones do not change this process. On the other hand, Pb$^{+2}$ could stimulate or block root elongation according to the salt type. The process of root regeneration and elongation in sunflower seedlings is distinctly more sensitive to Pb ions in presence of IAA.