Toxic and signaling effects induced by Ni^{2+} and complexes of Ni^{2+} with histidine in roots of higher plants

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In response to excess nickel content in the soil, many plants synthesize and excrete histidine (His), which binds Ni^{2+} and forms complexes. In the present work, the hypothesis was tested according to which the formation of Ni-histidine complexes causes activation of the redox- and Ca^{2+}-signaling systems, contributing to the recognition of Ni^{2+} excess in the environment. *Arabidopsis thaliana* L. Heynh. root growth inhibition was observed beginning from 3 to 30 µM Ni^{2+} depending on cultivation method (sterile gel systems or hydroponics), plant development stage, and treatment techniques (germination or medium exchange). The addition of Ni^{2+} with His at a ratio of 1:2 had a protective effect against the toxic effects of Ni^{2+}. His stimulated the accumulation of nickel in the roots, but inhibited the translocation of this metal into the aboveground organs. Using EPR spectroscopy, it was shown that the treatment with 0.01-3 mM Ni^{2+} did not cause the formation of hydroxyl radicals ($HO^{\bullet}$) under standard conditions, in the presence of 1 mM of L-ascorbate and 1 mM of H_2O_2. At the same time, the introduction of nickel together with His induced the synthesis of $HO^{\bullet}$. Similar effects were found when registering ROS using fluorescent ROS-sensitive probes. ROS synthesis under Ni^{2+}-His_2 treatment was inhibited by dimethyl sulfoxide (free radical scavenger), suggesting that it was related to hydroxyl radacals. In aequorin-transformed plants, the addition of 0.01-3 mM Ni^{2+} did not cause changes in the level of cytosolic Ca^{2+} ($[Ca^{2+}]_{cyt.}$), but a significant Ca^{2+} signal was generated after addition of Ni^{2+}-His_2. Hypothetically, in the presence of His, nickel formed ROS-generating complexes causing redox-dependent activation of Ca^{2+}-permeable cation channels and a transient increase in $[Ca^{2+}]_{cyt.}$.The work also revealed expression of genes responsible for the processes of signal transduction, DNA repair, and antioxidant protection to be stimulated in the presence of Ni^{2+}, but not in the presence of Ni^{2+}-His_2. Experiments with agricultural species showed high sensitivity to nickel of wheat and sunflower and low sensitivity of pea plants (pea growth was observed until 10 mM Ni^{2+} in the medium).

Приживаемость микроклональных растений разных видов лип на этапе адаптации

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Липа – одно из наиболее распространенных деревьев в городских насаждениях. Ведение селекционной работы, сохранение ценных генотипов и производство качественного посадочного материала определяют перспективность разработки и внедрения биотехнологических методов размножения древесных растений, включая представителей *Tilia spp***.** Изучена приживаемость микроклональных растений *Tilia cordata* Mill. и *Tilia platyphyllos* Scop. на этапе адаптации, укоренение которых проводилось на шести вариантах питательных сред различного минерального и гормонального состава. Наибольшая приживаемость для обоих видов отмечена у растений, ризогенез которых осуществлялся на питательной среде состава ½ MS, 0,3 мг/л НУК, 10 г/л сахарозы (*T. cordata* – 74,29%, *T. platyphyllos* – 90,00%) и ½ MS без