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Effects of form of nitrogen fertilization on the accumulation of Pb, As, Sc Ge and U in shoots of reed canary grass (Phalaris arundinacea L.)

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Nitrogen (N) fertilization is necessary for growth and development of plants but it may also causes an increased metal uptake by plants due to changes of physiochemical properties of the elements in soil. The research in phytoremediation and phytomining conducted so far has revealed that the effect of nitrogen fertilizers initially depends on the form of application, as N is the only element that can be readily utilized by plants in its cationic (ammonia) or anionic form (nitrate) causing several effects in soil-plant system. However, to our knowledge most of the recent studies only documented an improvement of yield parameters and the uptake of heavy metals by plants as a result of different forms of N-fertilization. Here we report the result of a field experiment were we tried to obtain more information about the effects of form of N-fertilization on uptake of As, Pb, Sc Ge and U in reed canary grass (Phalaris arundinacea L.). In this study, reed canary grass was grown on 15 plots (4 m^2 each) under field conditions on a semi-field lysimer at the off-site soil recycling and remediation center in Hirschfeld (Saxony, Germany). To test the effects of a fertilization with different N-forms on the accumulation, the plots plants received 5 g N / m^2 in three doses as NH4SO4, $Mg(NO_3)2$ or $NH4NO_3$. The geometrical arrangement of plots was randomized and every treatment was fivefold replicated. After a 50 day period of plant growth, the plants were harvested and concentrations of trace metals in the shoots were measured with ICP-MS. As a result of the different N-treatments we found that in plants treated with NH4SO4 concentrations of Pb and As as well as of Sc, Ge and U were significantly increased in plant tissues compared to plants treated with $NH4NO_3$. Furthermore, no significant changes in mineral composition of plants between the $Mg(NO_3)2$ and $NH4NO_3$ treatments could be observed.

Our interpretation of these results is that it might be an effect of the acidification of the rhizosphere due to a release of protons in the rhizosphere by roots of reed canary grass as affected by the uptake of N, predominantly NH4+In other words plants taking up an excess of cations (NH4+) over anions exuded H+ from their roots and thus this might have increased bioavailability of trace metals in the root zone and therefore enhanced uptake by reed canary grass. However, in this preliminary study we did not analyze rhizosphere soil, and thus, further research on this topic is needed.

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