Geophysical Research Abstracts
Vol. 16, EGU2014-436, 2014
EGU General Assembly 2014

Efficiency of single extraction schemes in highlighting the impact of changes in land use of contaminated agricultural soils on their trace metal availability

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Presently changes in the land use of contaminated and marginal agricultural lands from conventional annual food crops to perennial non-food bionergy crops are being encouraged globally. This is being done to avoid food chain contamination with metal and organic contaminants and to meet world energy needs without disturbing normal fertile agricultural lands. Changes in land use from the annual cropping systems to the perennial cropping systems are known to modify organic matter quality and quantity in case of non contaminated soils. In the case of contaminated soils such changes are susceptible to alter trace metal availabilities but studies reporting such changes are scarce. Different single extraction protocols are used to assess the trace element availability in soils. The efficiency of these extractants depends upon soil conditions and may vary case to case. The objective of the present work was to assess the changes in trace metal availability of contaminated soils when annual crops system is replaced by a perennial crop system using different single extraction protocols.

A strategy of studying Cd and Zn availabilities of two sites differing in the soil texture and origin of pollution was adopted i.e. the site of Metaleurop (North of France) and the site of Pierrelaye (Paris Region). They differed in the degree of metal pollution (for Cu, Pb, Cd and Zn) and in the quantity and nature of organic matter (different C/N values). The samples used for this study involved the soils under annual crops and the perennial crop i.e. miscanthus. We investigated the trace metal availabilities of the soils using different single extraction protocols involving chemical metal extractions with EDTA, DTPA and NH_4NO_3 at equilibrium and kinetic EDTA extractions.

The results for the soil under miscanthus compared to annual crop soil showed that single extraction schemes using chelating agents like EDTA and DTPA, however, failed to show if the metal availability can be impacted by land use. The differences in metal availability in the soils under miscanthus and annual crops were highlighted by the weaker extractant NH_4NO_3 and by kinetic extractions using EDTA. For the Metaleurop site, a trend of decrease in Cd and Zn availability in the soil under perennial miscanthus crop compared to the soil under annual crop was observed. For the organic matter rich sandy soils of Pierrelaye labile Zn increased while Cd was decreased. These results showed little impact on trace metal availabilities at the earlier stage of changes in land use (3 years after conversion). However, on longer terms, the impact can be more remarkable. The study also highlighted the efficacy of the use of combination of metal availability assessment approaches instead of relying on single approaches. In addition the type of changes being occurred in metal availability can be predicted using combined extraction approaches because the mechanisms behind each extraction scheme and their target metal pools being different.