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Trace elements contents within an agricultural field receiving long-term farmyard manure

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The natural occurrence of trace elements in soils depends mainly on its parent material and other soil-forming factors. Anthropogenic additions (farmyard manure, biosolids, atmospheric deposition, etc.) may significantly increase trace element concentration. Thus, soil trace element levels vary following landscape and agricultural systems, as a result of interaction between natural factors and human activity. Consequently, the relationship between the soil and its parent material is quite conspicuous in natural soils with lowest anthropogenic inputs, but becomes less expressive in agricultural soils affected by fertilization practices. Accumulation of trace metals in the topsoil could result in mobilization and release into water bodies and incorporation into the food chain. Because of these concerns, not only N and P, but also trace element contents in soils amended with dairy manure have been widely investigated. Farmyard manures are known as important sources of Zn and Cu and may contribute, to a lesser extent, to accumulate Cd, Pb, Ni, Cr and Mn in soils. Research has focused on comparisons of trace elements between fields, whereas, assessment of within field variability has been not frequent. Thus, the purpose of this study was to assess the variability of trace element concentrations in the topsoil of an agricultural field with a long-term history of animal manure application. The study field, 6 ha in surface, was located at Castro de Ribeira de Lea, Lugo province, Spain, 7º 29´ 47´´ W longitude. 43º 09´49´´ N latitude. Mean yearly temperature and rainfall are 11.2 ºC and 930 mm, respectively. The soil, classified as a gleyic Cambisol, was developed on Quaternary sandy sediments underlying by Tertiary clayey sediments. Forty soil samples were taken at the 0-30 cm depth. Trace elements were extracted by nitric acid combined with microwave digestion, following the USEPA method 3051 and determined by ICP-MS. Data analysis included comparison with background levels in forest land an principal component analysis to ascertain sources of variability. Previous results showed the very much overload with P, as a result of the intensive rates of manure applied. Mean trace element concentrations (mg kg^{-1}) and coefficients of variation were as follows: Ba = 38.9 and 11.0%; Cd = 0.15 and 49.7 %; Co = 1.36 and 23.2 %; Cr = 15.9 and 6.7 %; Cu = 2.95 and 59 %; Hg = 0.134 and 91.1 %; Mn = 59.5 and 56.4 %; Ni = 6.80 and 5.9 %; Pb = 21.1 and 14 %; Ti = 35.1 and 12.3 %; V = 20.1 and 1.1 % and Zn 15.3 and 56.1 %. To assess our results it should be taken into account that trace elements released by HNO_3 is 1.5 to 5 times less than total trace element content. On the other hand, background total trace element contents in the soils of the studied region are low or very low, because of the sandy nature of the parent material and the scarcity of metal-bearing minerals. So, the mean concentrations (and even the maximum values) of heavy metals that may impact on soil fertility (Zn, Cu, Cd, Hg, Cr, Ni, Pb) were still far below limits that could be of concern with regard to plant toxicity. This notwithstanding, accumulation of Cu and Zn within this experimental field was clearly shown. Results also suggest minor inputs of other trace elements by human activity. Site-specific variability of trace elements extracted by USEPA method was also assessed by geostatistical analysis, allowing knowledge of spots where maximal concentrations occurred. It was concluded that accumulation of Zn and Cu on this field is not a problem in the short term; however, it becomes important to assess trace metal content over time in order to avoid accumulation