Distribution and transport of trace elements and some cations and anions in soils treated with various amendments

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This study aimed at evaluting the influence of sewage sludge (as anorganic amendment) and the commonly used gypsum (as an inorganicamendment) on distribution and transport of some trace elements (Fe,Mn, Cu and Zn), cations (Ca, Mg, Na, and K) and anions in saline sodicsoils throught period of continuous leaching of these soils.To fulfill the purposes of this study, three surface soil samplesdiffering in their contents of salts, exchangeable Na percentages (ESP),texture and cation exchange capacities were collected from three different.localities . A column experiment, was conducted. In this experiment, soilsamples were mixed with either sewage sludge (at rates of 3 % and 6%)or gypsum (CaS04.2H20) at rates of 100 % or 200 ~Ioof the gypsumrequirements. The soils were packed uniformly in columns of PVC. Aconstant head of water was kept above the soil surface throughout theperiod of the experiment. Leachate was collected in 200mI fractions.Period of collecting each leachate fraction was :recorded. Also, soluble, cations and anions as well as soluble (leached) trace elements (Fe, Mn,Cu, and Zn) of each leachate fraction were determined. At and of leaching, each soil column was cut into 4 segments, each of them was analysed for total Ca, Mg, Na and K as well as total andavailable trace elements(Fe, Mn , Cu and Zn).A fractionation experiment was conducted to find out thedistribution of Fe, Mn , Cu and Zn among the different soil components.In this experiment, fractions of the studied trace elements were extractedusing a modified version of sequential fractionation scheme proposed byMe Laren and Crawford(1973).The obtained results could be summarized in the following:I-Percentages of total cations (Ca,Mg, Na and K) remained in thedifferent segments of the investigated soils were reduced markedly dueto continuous leaching.Application of sludge or gypsum enhanced transportation ofNaand K from the surface layers to the layers below. On the other hand,percentages of Ca and Mg remained in the different segments of the soilsreceived sludge or gypsum were, in most cases, higher than thecorresponding values of the soils received distilled water only.2-A very limted transport of total Fe occurred within the soil columns,being more obvious in the few surface centimeters. Available Fe was,generally, highest in the surface layer and tended to decreasedepthwise. In all the investigated soils ~total as well as available Mndid not show a certain pattern of distribution with depth.Total and AB-DTPA-extractable Ca were almost constant withinthe different depths of each.studied soil.Total Zn as well as AB-DTPA extractable Zn followed patterns ofdistribution differed from a soil to another.The effect of suldge or gypsum on distribution of the abovementioned trace elements in the different segments of the amended soilsseemed dependent on type of the applied amendment and its rate ofapplication.Briefly, application of sewage sludge or gypsum seemed toimprove physical properties of the investigated soils and thus maximizedthe effect of leaching on transport of trace metals in the studied soils.3-The leaching process resulted in decrease in E¢ values of the leachedsoil reflected on EC values of the leachate fractions , the effect washighest in the second leachate fraction w~ere a sharp decreaseoccurred. Also, the time required to receive this leachate fractionseemed to be obviosly decreased.The pH values of the different leachate fractions fluctuated slightlyabout neturality. Number of the leachate fraction did not show a markedeffect on values of leachate pH.Ca,Mg, Na and K concentrations were highest in the first leachatefraction and tended to

decrease thereafter to almost;constant values.The above mentioned trends characterized the soils leached withwater only as well as the soils leached and received sewage sludge orgypsum simulatneously.Concentrations of the soluble trace elements i.e. Fe, Mn, Cu andZn in the leachate fractions were variable and dependent on number ofleachate fraction, type of soil amendment and characteristics of theconcerned soils.4-Fractionation of iron revealed that Fe was distributed among thedifferent soil components in the following descending order :Residual Fe> occluded Fe > organically bound F~> inorganically boundFe > soluble +exchangeable Fe.This pattern of Fe distribution was noticed in the soils reclaimed by ,leaching only as well as in those leached ard amended with sewagesludge or gypsum at any of their application rate,Manganese fractions were found to be arranged in different ordersaccording to soil type and soil treatmentThe main pattern ofMn distribution was:Residual Mn > occluded Mn > inorganically bound Mn > organicallybound Mn > soluble +exchangeable Mn.This pattern of Mn distribution among the different soilcomponents characterized soils of Abo-Soltan and El-Kassasen whetherthey were leached with water only or received sewage sludge also at anyrate of its application. Mn followed the same pattern of distribution in El-Kassasen soil that was leached and received gypsum similtaneously.However, some other patterns were detected such asa-Occluded Mn > Residual Mn > inorganically bound Mn > organicallybound Mn > soluble + exchangeable Mn .b- inorganically bound Mn > occluded Mn :> organically bound Mn >residual Mn > soluble + exchangeable Mn Variations in characterestics of the investigated soils and type of the usedamendment may account for such findings.Copper fractions were found in the following order :Occluded Cu > residual Cu > organically bound Cu > inorganicallybound Cu > soluble + exchangeable Cu .Zinc fractions followed mainly the order : Residual Zn > occlouded Zn > organically bound Zn > inorganicallybound Zn> soluble + exchangeable Zn .However, the following orders were also detected : Residual Zn > organically bound Zn > inorganically bound Zn>Occluded Zn > soluble + exchangeable Zn Residual Zn > organically . bound Zn > occluded Zn > inorganicallybound Zn> soluble + exchangeable, Zn.The different distribution patterens of Zn seemed dependent on soilcharacteristics , amendment type and rate of application .