

5-SUMMARY

This study aimed at evaluating the influence of sewage sludge (as an organic amendment) and the commonly used gypsum (as an inorganic amendment) on distribution and transport of some trace elements (Fe, Mn, Cu and Zn), cations (Ca, Mg, Na, and K) and anions in saline sodic soils through period of continuous leaching of these soils.

To fulfill the purposes of this study, three surface soil samples differing 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, soil samples were mixed with either sewage sludge (at rates of 3 % and 6%) or gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at rates of 100 % or 200 % of the gypsum requirements. The soils were packed uniformly in columns of PVC. A constant head of water was kept above the soil surface throughout the period of the experiment. Leachate was collected in 200ml 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 and available trace elements (Fe, Mn, Cu and Zn).

A fractionation experiment was conducted to find out the distribution of Fe, Mn, Cu and Zn among the different soil components.

In this experiment, fractions of the studied trace elements were extracted using a modified version of sequential fractionation scheme proposed by **Mc Laren and Crawford(1973)**.

The obtained results could be summarized in the following:

1-Percentages of total cations (Ca,Mg, Na and K) remained in the different segments of the investigated soils were reduced markedly due to continuous leaching.

Application of sludge or gypsum enhanced transportation of Na and 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 soils received sludge or gypsum were, in most cases, higher than the corresponding values of the soils received distilled water only.

2-A very limited 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 decrease depthwise. In all the investigated soils, total as well as available Mn did not show a certain pattern of distribution with depth.

Total and AB-DTPA-extractable Ca were almost constant within the different depths of each studied soil.

Total Zn as well as AB-DTPA extractable Zn followed patterns of distribution differed from a soil to another.

The effect of sludge or gypsum on distribution of the above mentioned trace elements in the different segments of the amended soils seemed dependent on type of the applied amendment and its rate of application.

Briefly, application of sewage sludge or gypsum seemed to improve physical properties of the investigated soils and thus maximized the effect of leaching on transport of trace metals in the studied soils.

3-The leaching process resulted in decrease in EC values of the leached soil reflected on EC values of the leachate fractions, the effect was highest in the second leachate fraction where a sharp decrease occurred. Also, the time required to receive this leachate fraction seemed to be obviously decreased.

The pH values of the different leachate fractions fluctuated slightly about neutrality. Number of the leachate fraction did not show a marked effect on values of leachate pH.

Ca, Mg, Na and K concentrations were highest in the first leachate fraction and tended to decrease thereafter to almost constant values.

The above mentioned trends characterized the soils leached with water only as well as the soils leached and received sewage sludge or gypsum simultaneously.

Concentrations of the soluble trace elements i.e. Fe, Mn, Cu and Zn in the leachate fractions were variable and dependent on number of leachate fraction, type of soil amendment and characteristics of the concerned soils.

4-Fractionation of iron revealed that Fe was distributed among the different soil components in the following descending order :

Residual Fe > occluded Fe > organically bound Fe > inorganically bound Fe > soluble +exchangeable Fe.

This pattern of Fe distribution was noticed in the soils reclaimed by leaching only as well as in those leached and amended with sewage sludge or gypsum at any of their application rate.

Manganese fractions were found to be arranged in different orders according to soil type and soil treatment

The main pattern of Mn distribution was:

Residual Mn > occluded Mn > inorganically bound Mn > organically bound Mn > soluble + exchangeable Mn.

This pattern of Mn distribution among the different soil components characterized soils of Abo-Soltan and El-Kassasen whether they were leached with water only or received sewage sludge also at any rate of its application. Mn followed the same pattern of distribution in El-Kassasen soil that was leached and received gypsum simultaneously. However, some other patterns were detected such as

a-Occluded Mn > Residual Mn > inorganically bound Mn > organically bound Mn > soluble + exchangeable Mn .

b- inorganically bound Mn > occluded Mn > organically bound Mn > residual Mn > soluble + exchangeable Mn .

Variations in characteristics of the investigated soils and type of the used amendment may account for such findings.

Copper fractions were found in the following order:

Occluded Cu > residual Cu > organically bound Cu > inorganically bound Cu > soluble + exchangeable Cu .

Zinc fractions followed mainly the order:

Residual Zn > occluded Zn > organically bound Zn > inorganically bound 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 > inorganically bound Zn > soluble + exchangeable, Zn.

The different distribution patterns of Zn seemed dependent on soil characteristics , amendment type and rate of application.