Contamination of soil with heavy metals and the consequent implications on plant growth

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A series of pot experiments were conducted to study the contamination of soil with some heavy metals and the consequent implications on plant growth to fulfill the purpose of this study. Three surface soil samples (0 — 30 cm) were chosen to represent the sandy, the Nile alluvial and calcareous soils and used for conducting the following experiments. Incubation experiment: It was carried out to study the fate of Cd, Pb and Ni added separately to the studied soils. The treatments were 0, 2.5, 5, 10 and 20 mg kg for Cd in the form of CdSO4; 0, 50, 100, 200 and 400 mg kg -1 for Pb in the form of Pb(NO3)2 and 0, 5, 10, 20 and 40 mg 1(2-I for Ni in the form of NiSO4. The different soils were exposed to soil removal after 0, 7, 14 and 45 days of incubation for extracting the available Cd, Pb and Ni. The results obtained could be summarized as follows:1-Increasing the levels of Cd, Pb or Ni added to the different studied soils was associated with progressive significant increases in their availability.2-Increasing the time of incubation was accombined by gradual decreases in the available contents of Cd, Pb and Ni.3-The linear regression analysis indicated a significant positive correlation between organic matter content in the different studied soils and each of available Cd, Pb and Ni. On the other hand, a negative trend was found between available Cd and each of the soil pH, N, P, K, but this trend was not significant for soil pH in the different studied soils, for N, P & K Nile alluvial soil and for P and K in sandy soil. A significant negative trend was obtained between Pb or Ni and each of soil pH, N,P & K in the different studied soils.814-Multiple regression analysis showed that soil organic matter represented the most important factor affecting the availability of Cd in the different studied soils. The contribution of this soil parameter reached 59, 64 and 38 % for sandy, Nile alluvial and calcareous soils, respectively.5-Also, multiple regression analysis showed the important effect of pH on the availability of Pb in sandy and Nile alluvial soils, and that of N and K in calcareous soil. The contribution of pH reached 39 and 50 % for sandy and Nile alluvial soils, respectively, while in calcareous soil the contributions were 31 % for N and 39 % for K.6-Multiple regression analysis also showed the important effect of pH on the availability of Ni in sandy soil as well as K in Nile alluvial and calcareous soils. The contribution of soil pH reached 37 % in sandy soil, while K was 65 and 57 % in Nile alluvial and calcareous soils, respectively. Greenhouse experiment: It was performed to study the effect of different concentrations of Cd, Pb and Ni on plant growth, with special reference to contents and uptake by redradish and watercress plants. Cd, Pb and Ni were applied to the different studied soils at concentrations of 0, 2.5, 5, 10 and 20 mg Cd kg’ soil; 0, 50, 100, 200 and 400 mg Pb kg’ soil; 0, 5, 10, 20 and 40 mg Ni kg’ soil. The obtained results could be summarized as follows:I- The dry weight of watercress shoots and redradish shoots and roots progressively decreased with increasing concentration of applied Cd up to 20 mg kg’ in all the studied soils.2-The adverse effect of Cd on plant growth was more obvious in roots than that in shoots of redradish plants.3-Redradish plants were more sensitive to Cd than watercress plants.4-The adverse effect of Cd on plant growth was more obvious in sandy soil followed by calcareous soil and Nile alluvial soil.5-Addition of Cd to the different studied soils consistently increased Cd content in both the two plants.6-Most of Cd taken up by redradish plains was retained in the roots, indicating less ability of Cd translocation to the shoots.7-The highest amount of Cd taken up by plants was found in calcareous soil, while the lowest one was found in Nile alluvial soil.8-The content of N, P and K in different organs of watercress and redradish

progressively decreased upon rasing the rates of the added Cd up to 20 mg kg-1 .9-Application of Pb at different rates to all soil under study significantly decreased the dry matter yields of watercress shoots and redradish shoots and roots.10-• The harmful effect of Pb was observed on redradish plants grown in sandy soil rather than those grown in Nile alluvial soil.11-Increasing the rates of Pb to the investigated soils up to 400 mg kg soil was associated with a progressive and significant increase in Pb content in both redradish and watercress.12-Most of Pb taken up by redradish plants was retained in the roots, indicating less Pb translocation to the shoots.13-The highest amount of Pb taken up by plants was found in Nile alluvial soil.14-The contents of N, P and K in watercress shoots and redradish shoots and roots consistently increased upon raising the rates of applied Pb up to 400 mg kg soil.15-The dry weight of watercress shoots and redradish shoots and roots were significantly decreased by increasing concentrations of the applied Ni in the studied soils.16-The adverse effect of Ni on plant growth was much more pronounced in roots of redradish than that in shoots.8317-Application of Ni to different soils generally increased the content of Ni in watercress shoots and redradish shoots and roots.18-The highest amount of Ni taken up by plants was found in sandy soil, whereas that of Nile alluvial soil was lower.19-The content of N, P and K in watercress shoots and redradish shoots and roots consistently decreased upon raising the rates of applied Ni up to 40 mg kg’ soil. Toxicity experiment: It was carried out to study the visual symptoms- of the applied high concentrations of Cd, Pb and Ni individually, which appeared on the plants of redradish and watercress. The concentrations of Cd, Pb and Ni increased stepwise by through the period of experiment and the visible symptoms which appeared on the plants were observed and recorded as follows:I- The toxicity symptoms of Cd in watercress were observed at 60, 100 and 100 mg kg1 soil for sandy, calcareous and Nile alluvial soils, respectively. While, the toxicity symptoms of Cd on redradish plants commenced when the concentrations of Cd reached 40, 40 and 80 mg kg’ soil for sandy, calcareous and Nile alluvial soils, respectively.2-The visual symptoms of Pb toxicity on the leaves of watercress plants were observed at 1200, 2000 and 2000 mg kg’ soil for sandy, calcareous and Nile alluvial soils, while it appeared on redradish plants at 800, 1200 and 1200 mg kg’ soil for sandy, calcareous and Nilealluvial soils, respectively.3-The visual symptoms of Ni toxicity on watercress plants were observed at 160, 200 and 240 mg kg”’ soil for sandy, calcareous and Nile alluvial soils, respectively. However, the symptoms of Ni toxicity on the leaves of redradish plants commenced at 120, 120 and 160 mg kg’ soil for sandy, calcareous and Nile alluvial soils, respectively.