Uptake and distribution of selected heavy metals by sweet potato plant varieties under green house conditions

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The extent to which cadmium, chromium, lead and zinc ions were absorbed and trans-located into roots, stems and leaves of different sweet potato (Ipomea batatas) plant varieties from their respective metal solutions was studied. The five varieties used in this work were UP-A, UP-B, UP-C, UP-D and UP-16. The uptake and distribution of the respective ions depended not only on the type of metal ion but also on the type of sweet potato variety of interest. The levels of cadmium and chromium, obtained in the leaves ranged from 0 to 144.17μg and 2.81 to 100.63μg, respectively. On the other hand, the amount of lead and zinc inthe leaves ranged from 0 to 13.80μg and 1.10 to 58.63μg, respectively. The amount of chromium and cadmium found in the leaves of sweet potato plant varieties was a bit higher than those obtained in the case of lead and zinc. In the case of zinc, the highest amount of metals in the leaves was found in 20ppm zinc solution rather than 50ppm zinc solution. For the other varieties, the highest amount of metal was found in 50ppm metal solutions as expected. Cadmium content obtained from sweet potato plant varieties grown in 10ppm cadmium solution ranged from 653.51 to 771.52 μg/ gram dry weight (gdwt) of the plant tissue while that from 20ppm solution ranged from 920.18 μg to 1032.70 μg/ gdwt. Results of zinc content in the plant varieties grown in 10ppm zinc solution showed the range of 361.38 - 499.79 μg/ gdwt of the plant tissue and 505.44 - 601.67 μg/ gdwt for plants grown in 20ppm zinc solution. However, a lower range of between 308.63 and 370.42 μg/ gdwt was recovered from plants grown in 50ppm zinc solution. Plant varieties grown in lead solutions registered the highest lead content compared to the other metals used for the study. In case of 10ppm lead solution the plants accumulated a range of 7.14 - 108.10 μg/ gdwt lead, while the plants grown in 20ppm lead solution gave a range of 1389.41 - 1962.13 μg gdwt lead. On the other hand, plant varieties in 50ppm solution had lead content of between 2,800 and 3,570 μg/ gdwt of the plant tissue. Moreover, a 10ppm total chromium solution gave a range of 109.23 - 164.64μg/ gdwt, while the plants grown in 20ppm chromium solution had chromium ranging from 159.13 to 240.7μg/ gdwt. Total chromium content of the plants harvested from 50ppm solution ranged from 341.49 to 685.69μg/ gdwt of the plant tissue.

The plants in hydroponics solutions containing cadmium survived for only 14 days, compared with other hydroponics containing other metals (chromium, lead and zinc), which continued to grow for additional days. The amount of each heavy metal in the roots, stem and leaves increased with the increase of ions in the metal solutions. However, the percentage of the metals in each part of the sweet potato plant variety decreased with the increase in metal ions in the hydroponics as expected. The variations in metal ion intake by different sweet potato varieties could not be fully explained.

INTRODUCTION

Sweet potato plants were introduced in East Africa from Latin America by the Portuguese [1, 2]. Since the plants were first introduced in this region, there are currently about 100 varieties in Kenya and similarly related number of varieties in Tanzania and Uganda. In this region, generally, sweet potato vines are commonly grown in well-drained soils. However, one of the objectives of the current research work was to determine whether the sweet potato varieties can grow in pure water and polluted water environment. If this is the case, then there is possibility of the pollutant being distributed in the different parts of the plant. Moreover, during the intake of water by plants various nutrients also end in the plant. For this reason plants can be used for environmental