

Major and Trace Metal uptake from soil and water by common garden vegetables.

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High concentrations of heavy metals and metalloids in soils, irrigation water, and plants represent a potential risk to food safety and human health. This study aims to investigate the uptake of major and trace metals from soils to common garden vegetables irrigated with secondary water over a period of 12 weeks during the growing season in Utah. All soil and vegetable samples were processed in nitric acid utilizing MARS 6 digestive microwave procedures. All liquid samples were analyzed in ICP-MS. Water used in the study contains significant concentrations of heavy metals including arsenic, mercury, cadmium, lead, manganese and uranium. Water samples contain typical concentrations of major ions (Ca-average 103 mg/L), Mg (35 mg/L), K (8.1 mg/L), and Na (96 mg/L). Most common trace elements included titanium, zinc, manganese and copper. This unique composition is related to local lithological sources which contain elevated concentrations of these elements. Soil samples were collected in four different locations. All collected samples include high concentrations of iron, aluminum, manganese, boron, and strontium. Elevated concentrations of lead, barium, zircon, silver and gallium are also present. Concentration of uranium exceeded 10 $\mu\text{g/L}$. In the vegetable samples, kale tends to accumulate elements common in the used water: calcium, titanium, and barium. Carrots notably accumulate sodium from water. Potassium concentrations in most vegetables remain relatively stable and correlate better with soil potassium concentrations. Tomatoes showed the lowest concentration of potassium which overall increased with time. Beans accumulate lead, molybdenum, and copper which are correlated with higher soil concentrations. Additional elements which readily were transferred from soils to plants were: zircon, mercury, titanium, and bismuth. The study includes time trend analysis of uptake of major and minor metals from water and from soil.