

ARSENIC UPTAKE IN TOMATO AND POTATO PLANTS GROWN IN SILT AND SAND SOIL AND IRRIGATED WITH WATER CONTAINING ARSENIC

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Abstract

Arsenic uptake by tomato (*Solanum lycopersicum* L.) and potato (*Solanum tuberosum* L.) plants was studied by cultivating the plants in silt and sand soil and irrigating them with water containing arsenic at concentrations of 0.05 and 0.2 mg As L⁻¹.

Introduction

Aquifers in the Pannonian basin contain naturally occurring arsenic (1-174 µg L⁻¹), and the water from these aquifers is utilized for drinking and irrigation purpose, which affects a million people at levels greater than the recommended 10 µg L⁻¹ WHO standard (Varsanyi et al., 2006). The transfer of arsenic in soil–plant systems represents one of the principal pathways for human exposure to arsenic (Lu et al., 2010). As uptake by vegetables depends on its availability in soil and the ability of the crop to take up and translocate As (Huang et al., 2006).

Experimental

Arsenic uptake by tomato and potato was studied in sand and silt soil by applying irrigation water containing As, mimicking the groundwater As concentration. Arsenic was supplied in the form of sodium arsenate, at concentrations 0.05 and 0.2 mg L⁻¹. Arsenic accumulation in root, shoot, and fruit was analyzed at the fruiting stage. Plants were grown in a pot-soil system in open greenhouse, supplied with Hoagland's nutrient solution and irrigated once a week.

Upon harvest plant samples were thoroughly washed with Milli-Q water and oven dried at 40°C for 48hrs. The dry homogenized samples were digested in a microwave-assisted acidic digestion system using 7 cm³ 67 % nitric acid and 3 cm³ 30 % hydrogen-peroxide. The resultant solutions were diluted with deionized water up to 25 cm³. Concentration of As and certain nutrients (P, K, Mg, Fe, Mn, Cu, Zn) were determined by inductively-coupled plasma mass spectrometer.

Results and discussion

- The As content of the sand and silt soil was 4.32 mg kg⁻¹ and 9.02 mg kg⁻¹, respectively.
- Increase in As concentration of the irrigation water caused an increase in the As accumulation in the plant, and in both plants maximum As concentration was found in the roots and minimum in the fruit.
- Vegetables grown in sandy soil had the maximum As concentration and minimum biomass productivity.

- At 0.05 mg As L⁻¹ potato displayed a positive biomass production in silt soil. At 0.2 mg As L⁻¹ treatment, both plants displayed a negative biomass production in both soil types.
- As accumulation in edible part was higher in potato.
- Arsenic intake for a person consuming 450g (FW) of tomato would be 0.99 µg (sand) and 0.54 µg (silt). In case of potato the As intake would be 2.79 µg (sand) and 1.26 µg (silt).

Conclusion

Considering the FAO-WHO recommended maximum tolerable daily intake limit of 2 µg kg⁻¹ body weight, and the biomass production, both plants grown in irrigation water containing up to 0.2 mg As L⁻¹ are safe for consumption. But considering the biomass production it is advised to cultivate plants at 0.05 mg As L⁻¹ treatment and in silt soil.

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