



Antioxidant defense strategies of urban ornamental plants in southern Iran against heavy metals

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ABSTRACT

One of the effective approaches to reduce heavy metals (HMs) contamination is phytoremediation. The concentration of 10 HMs was measured in 10 ornamental plants grown in the city of Bushehr, located in southern Iran. The concentration of HMs was determined by ICP-MS. Some physiological parameters and antioxidant enzymes activity were measured. *Bougainvillea* had greater amount of Zn (61.86 mg/kg D.W.), Cu (45.52 mg/kg D.W.), and Cr (14.71 mg/kg D.W.) than the other HMs. Greatest amount of Co (0.686 mg/kg D.W.), Fe (428.00 mg/kg D.W.), and Ni (6.44 mg/kg D.W.) was obtained in *Conocarpus erectus*. Also, *Clerodendrom inerme* had maximum As (0.0087 mg/kg D.W.) and Sn (2.516 mg/kg D.W.). The POD activity (1.462 and 1.214 U/g F.W./min) was highest in leaves of *C. inerme* and *Ficus elastica* containing the highest concentrations of As, Sn, and Pb, respectively. The SOD activity was high in these two species. Synthesis of osmolytes increased under Co and Sn stresses. The selected plant species followed a defensive strategy (enzymatic or non-enzymatic) against excess of HMs. Overall, shrubs were much more suitable than trees for absorption and accumulation of HMs, and *C. inerme*, *F. elastica*, and *Bougainvillea* are the best plant species for phytoremediation.

KEYWORDS

Antioxidant enzymes; metals pollution; oxidative stress; phytoremediation; plant toxicity

Introduction

Urban green spaces are a part of open spaces often made artificial, particularly dominated with cover plants, grasses, trees, and shrubs. Plants, especially trees and shrubs, can partially reduce the risk of pollutions caused mainly by heavy metals (HMs) and hazardous gases (Delaman and Farahmand 2017; Ghafari et al. 2020). Urban ornamental plants have a prominent role in the mental and physical health of the people, reducing the effects of climate change and urbanization, as well as providing ecosystem services (Orlóci and Fekete 2023). Two very important criteria for choosing suitable ornamental plants for any urban green space are having beauty and reducing environmental pollutants. The use of innovative breeding technologies for the production of ornamental plant varieties with improved properties especially tolerant against urban biotic and abiotic stress has been increased (Kisvarga

et al. 2023). Planting invasive ornamentals and allergenic plants in urban green space should be avoided for various reasons (Yessoufou 2023; Magyar 2023). Also, a paradigm shift is necessary to maintain and design urban green spaces in relation to visually important trees and shrubs (Nádasy, Valánszki, and Sárospataki 2023). The selection of suitable ornamental plants that are adapted to the urban area is the key to success in developing a sustainable green space (Ghafari et al. 2020). The main priorities for choosing plants in urban green spaces with extensive traffic are their ability to reduce environmental pollution without injury, architecture, beauty, performance, adaptation to different soils and climate, growth, cost-effective, being local, resistance to pests and diseases, and ecological and esthetic needs of each city or town (Cameron et al. 2012; Ghafari et al. 2020).

HMs include metals and metalloids with atomic density more than 4 g/cm³ or five times