Metals/Metalloids

Title	Engineering plants for heavy metal stress tolerance
Author Name	Wasia Wani, Khalid Z. Masoodi, Abbu Zaid, Shabir H. Wani, Farheena Shah, Vijay Singh Meena, Shafiq A. Wani, Kareem A. Mosa
Journal Name	Rendiconti Lincei. Scienze Fisiche e Naturali
Year	2018
Volume and Issue	Volume 29,3
Pages	Pages 709-723
Abstracts	We here assess the biodiversity of the *rhizosphere* microbial communities of metal-tolerant plant species *Arabidopsis arenosa*, *Arabidopsis halleri*, *Deschampsia caespitosa*, and *Silene vulgaris* when growing on various heavy metal polluted sites. Our broad-spectrum analyses included counts for total and metal-tolerant culturable bacteria, assessments of microbial community structure by phospholipid fatty acid (PLFA) profiling and community-level analysis based on BIOLOG-CLPP to indicate functional diversity. The genetic-biochemical diversity was also measured by denaturing gradient gel electrophoresis (PCR-DGGE) and *metabolomic* analysis (HPLC-MS). Different *rhizospheres* showed distinctive profiles of microbial traits, which also differed significantly from bulk soil, indicating an influence from sampling site as well as plant species. However, total bacterial counts and PCR-DGGE profiles were most affected by the plants, whereas sampling site-connected variability was predominant for the PLFA profiles and an interaction of both factors for BIOLOG-CLPP. Correlations were also observed between pH, total and *bioavailable* Cd or Zn and measured microbial traits. Thus, both plant species and heavy-metals were shown to be major determinants of microbial community structure and function.
Keywords	Heavy metal stress tolerance; Metabolic engineering; Physiological and cellular changes ; Transgenics; Crop improvement

Title	**Heavy metals and metalloids: Sources, risks and strategies to reduce their accumulation in horticultural crops**
Author Name	Menahem Edelstein & Meni Ben-Hur
Journal Name	Scientia Horticulturae
Year	2018
Volume and Issue	234
Page	431-444
Abstracts	Food production in areas contaminated with heavy metals is associated with health risks because of their adverse effects on food safety and marketability, and on crop growth and yield quality. The present review focuses on sources and risks of heavy metals, mainly in cultivated fields in various regions, and strategies to reduce their accumulation in horticultural crops. The following heavy metals are discussed: arsenic (As), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), strontium (Sr), tin (Sn), titanium (Ti), vanadium (V) and zinc (Zn). Heavy metal sources in the environment can originate from natural and anthropogenic activities. Their main natural enrichment in soils stems from parent-material weathering. However, in coastal areas, precipitation of sea spray may enrich soil with B. In contrast, the main anthropogenic sources of heavy metals in cultivated areas are irrigation with treated sewage water, application of residual *biosolids*, and atmospheric pollution. Plants absorb heavy metals predominantly through roots and, to a lesser extent, through leaves. Leaf uptake can occur through the *stomata, cuticular cracks, ectodesmata,* and *aqueous pores*. Heavy metal uptake may lead to their accumulation in vegetables and fruit trees, and their consequent introduction into the food chain, which is recognized as one of the major pathways for human exposure to them. This exposure can result in retardation, several types of cancer, kidney damage, endocrine disruption, and immunological and neurological effects. High concentrations of heavy metals can also affect the growth and yield of many crops: Zn and Cd decrease plant metabolic activity and induce oxidative damage; Cu generates oxidative stress and reactive oxygen species; Hg can induce visible injury and physiological disorders; Cr affects photosynthesis in terms of CO2 fixation, electron transport, *photophosphorylation* and enzyme activities; Pb induces plant abnormal morphology; Ni spoils the nutrient balance, resulting in disorders of cell membrane functions; Fe causes free radical production that irreversibly impairs cell structure and damages membranes, DNA and proteins; As causes leaf necrosis and wilting, followed by root discoloration and retardation of shoot growth. Therefore, international organizations, such as the US EPA and EU bodies, are working on regulating the maximum allowable levels of food pollutants. A number of direct (*mycorrhiza*, transgenic plants and grafting) approaches can be deployed to overcome problems of heavy metal contamination in horticulture.
Keywords	Contamination; Fruits; Health risks; Heavy metals; Pollution; Vegetables; Wastewater

Title	**Toxicity and detoxification of heavy metals during plant growth and metabolism**
Author Name	Sonali Dubey, Manju Shri, Anubhuti Gupta, Vibha Rani & Debasis Chakrabarty
Journal Name	Environmental Chemistry Letters
Year	2018
Pages	Pages 01-24
Abstracts	Pollution of plants by heavy metals is a critical health issue because metals can be transmitted to animals and humans. Heavy metal exposure induces an oxidative stress in plant, resulting in cellular damage and altered cellular ionic homeostasis. As a consequence, plants start detoxification mechanisms. Here, we review heavy metal toxicity and impact. We discuss *metabolism* and *detoxification* strategies of heavy metals and metalloid, with emphasis on the use of *transcriptomics, metabolomics*, and proteomics. A section highlights *microRNA (miRNA)* as critical regulators of heavy metal stress in plants. We also present bioremediation and *phytoremediation* methods to remove metals.
Keywords	Heavy metal; Toxicity; Plants; Oxidative stress; Tolerance; Detoxification; Defense mechanism; microRNAs; Phytoremediation

Title	**Potential health risk assessment of potato (Solanum tuberosum L.) grown on metal contaminated soils in the central zone of Punjab, Pakistan**
Author Name	Yishu Peng, Ruidong Yang, Tao Jin, Jun Chen & Jian Zhang
Journal Name	Food and Chemical Toxicology
Year	2017
Volume and Issue	120
Pages	328-339
Abstracts	We investigated potentially toxic metal *(loid)*s (arsenic, As; cadmium, Cd; chromium, Cr; copper, Cu; mercury, Hg; lead, Pb; selenium, Se; and zinc, Zn) in agricultural samples (i.e., *Solanum tuberosum* L. tubers (potatoes) and their planting media) in the indigenous zinc smelting area of *northwestern Guizhou* Province, China. Based on the pollution index values for As, Cd, Pb and Zn, the order of the samples was as follow: slag > planting soil with slag > planting soil without slag, and the order of the samples in terms of the *bioconcentration* factor was the opposite. Cr, Cu and Hg were present in the planting soil with and without slag at slight pollution levels, and the other potentially toxic metal (*loid*)s had different degrees of contamination. Additionally, the potentially toxic metal (*loid*) contents in potato were under their limit values except for Cd (all samples) and Pb and Se (some samples). All *bioconcentration* factors for potatoes were below 0.5, and no health risk index value for potatoes was higher than 0.1. Therefore, although no significant health risk associated with potentially toxic metal (*loid*)s via consuming potato exists for either adult men or women in the research area, the Cd concentration in this crop should be monitored.
Keywords	Potentially toxic metal(loid); sIndigenous zinc smelting; Solanum tuberosum L.; Enrichment factor; Bioconcentration factor; Health risk index

Title	**Field accumulation risks of heavy metals in soil and vegetable crop irrigated with sewage water in western region of Saudi Arabia**
Author Name	Khaled S.Balkhair, Muhammad Aqeel Ashrafc
Journal Name	Saudi Journal of Biological Sciences
Year	2016
Volume and Issue	23,1
Pages	S32-S44
Abstracts	Wastewater irrigated fields can cause potential contamination with heavy metals to soil and groundwater, thus pose a threat to human beings . The current study was designed to investigate the potential human health risks associated with the consumption of okra vegetable crop contaminated with toxic heavy metals. The crop was grown on a soil irrigated with treated wastewater in the western region of Saudi Arabia during 2010 and 2011. The monitored heavy metals included Cd, Cr, Cu, Pb and Zn for their bioaccumulation factors to provide baseline data regarding environmental safety and the suitability of sewage irrigation in the future. The pollution load index (PLI), enrichment factor (EF) and contamination factor (CF) of these metals were calculated. The pollution load index of the studied soils indicated their level of metal contamination. The concentrations of Ni, Pb, Cd and Cr in the edible portions were above the safe limit in 90%, 28%, 83% and 63% of the samples, respectively. The heavy metals in the edible portions were as follows: Cr > Zn > Ni > Cd > Mn > Pb > Cu > Fe. The Health Risk Index (HRI) was >1 indicating a potential health risk. The EF values designated an enhanced bio-contamination compared to other reports from Saudi Arabia and other countries around the world. The results indicated a potential pathway of human exposure to slow poisoning by heavy metals due to the indirect utilization of vegetables grown on heavy metal-contaminated soil that was irrigated by contaminated water sources. The okra tested was not safe for human use, especially for direct consumption by human beings. The irrigation source was identified as the source of the soil pollution in this study.
Keywords	Health risk; Heavy metals; Sewage water; Metal transfer index; Soil