Germination Characteristics and Metal Tolerance of Atriplex lentiformis and Atriplex canescens Seeds Under Zinc Stress

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There are 500,000 abandoned mine sites in the United States. Mine tailings cause land to remain un-vegetated for decades, characterized by low pH, high salinity, low organic matter, and efflorescent salts. Globally, 12 million tonnes of Zinc tailings are produced (Gill, 2023). Over 23 million people live in tailings danger zones, exposed daily to heavy metal waste (Macklin et al. 2023). Aerosolized tailing soil, when ingested, causes cytotoxicity, abdominal pain, nausea, vomiting, lethargy, and anemia. A cost-effective solution ($10-$35 USD/ton): Phytostabilization and phytoremediation. Using plants native to particular ecosystems, we immobilize heavy metals in plant roots. To test the viability, seed development, and range of phyto-solutions in Semi-arid desert ecosystems, this study focuses on the metal tolerance (MT) of Atriplex spp. during seed germination (the growth phase when plants are the most sensitive to metal stress). Atriplex lentiformis (AL), Atriplex lentiformis mine-site subpopulation (Al-lK), and Atriplex canescens (AC) are southwestern native, halophytic, drought tolerant shrubs. Germination of AL and AC was tested at various Zinc concentrations: 100, 500, 1000, 2000, and 4000 ppm at 25 ºC in perlite and petri dishes. Statistical significance was confirmed using student's T-Tests and two-way ANOVA with Tukey's HSD. These seeds, without chemical pretreatment, soil amendments, show potential as a native colonizing species to barren contaminated land. The highest % seed MT per species: AL, Zn 500 ppm, 98%; AL-lK, Zn 1000 ppm, 79%; AC, Zn 2000 ppm, 89.3%. The highest % seed germination under metal stress: AL 47% (Zn 500 ppm); AL-lK 69.3% (Zn 1000 ppm); AC 48% (Zn 500 ppm) and 28% (Zn 2000 ppm). Exposure to Zinc allowed AL-lK seeds to double MT threshold.