Elevated Vitamin C Enhances Growth, Stress Tolerance, and Phytoremediation Potential in Arabidopsis

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Background and objective: Ascorbate (AsA, vitamin C) is a key antioxidant and enzyme cofactor in animals and plants, and a modulator of plant development and senescence. Our group has previously engineered elevated AsA levels in Arabidopsis by over-expressing *myo*-inositol oxygenase ($MIOX_4$) and L-gulono-1,4-lactone oxidase (GLOase), enzymes involved in the inositol pathway to AsA. The objective of this study was to study the stress tolerance and growth of these high AsA lines.
Methods: $MIOX_4$ and GLOase over-expressers were grown and challenged with various types of abiotics and chemical stresses and their growth and performance was compared to the one of wild type controls.
Results: $MIOX_4$ or GLOase lines containing higher AsA content (2 to 3-fold), were more tolerant to salt, cold, heat, high light, and methyl viologen compared to controls. They also displayed enhanced growth of both aerial and underground tissues. In addition, these lines exhibited tolerance to common environmental pollutants such as trichloroethylene, a chlorinated hydrocarbon, and pyrene, a model polycyclic aromatic hydrocarbon.
Discussion and conclusions: These broad stress-tolerance responses are most likely due to the ability of AsA to detoxify reactive oxygen species. Engineering crops to have elevated vitamin C may lead to increased biomass, stress tolerance, and enhanced phytoremediation capabilities.

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