The Dose-Dependent Beneficial and Toxic Effects of Al on Switchgrass.

Switchgrass (Panicum virgatum L.) is a perennial herbaceous bioenergy crop. This project aims to provide basic knowledge for growing switchgrass on marginal lands, including those with acidic soils. Switchgrass 'Alamos' tiller buds were collected from mature plants. Seedlings with emerging root-tips were transplanted to basic Magnavaca's nutrient solution (pH 4.0) supplemented with $AlCl_3$ at 0, 200 μM, 500 μM, 1 mM, 2 mM, 4 mM, 8 mM, and 10 mM. Leaf photosynthesis, plant height, and root length were recorded. Results indicated that the supplement of 200 μM-1 mM $AlCl_3$ promotes forming a larger root system than the 0 μM control. Further increases in Al concentration began showing phytotoxicity until root growth was completely inhibited by the 8-10 mM $AlCl_3$ treatments. The ICP-MS mineral analysis of basal 1-cm root tip sections and leaf tissues confirmed significantly high Al contents in the 8-10 mM treated plants. To examine the anatomical features associated with the beneficial and toxic effects from Al, a library of images was constructed for the root-tips grown under each of the Al treatment concentrations. The fresh frozen root tips were cut longitudinally into 10 μm thin-sections, each representing a single layer of cells on the horizontal orientation across the cylindrical root-tip. Cell patterning in the quiescent center, the apical meristem region, the epidermal layers, and root caps were all affected. These cells have been selected for proteomics analysis to reconstruct the regulatory network for cell ontogeny under the influences of Al3+ ions in the closed root-tips in switchgrass.