

Root Growth under Drought --- Role of Cell Wall Localized Reactive Oxygen Species

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Drought is the most important cause of crop failure in Missouri and limits crop production in large parts of the US and the world. The root system is critical to plant adaption and crop productivity in drought-prone environments. Some types of roots have the ability to maintain elongation under severe water deficit levels which completely inhibit shoot growth. Previous work on maize primary root growth under water deficit conditions showed that cell elongation is maintained in the apical region of the growth zone but progressively inhibited further from the apex. In association with these growth responses, cell wall extensibility is enhanced in the apical region but decreased in the basal region of the root growth zone. Cell wall proteomic analyses were conducted to identify proteins important for wall extensibility and elongation (Zhu *et al.* 2007, *Plant Physiol.* 145: 1533-48). The results revealed predominantly region-specific changes in protein profiles between well-watered and water-stressed roots. Several cell wall proteins related to reactive oxygen species (ROS) generation showed an increased abundance in the apical region of water-stressed roots, prominent among them being putative oxalate oxidases, which result in hydrogen peroxide generation. An increase in cell wall localized ROS in the apical region of water-stressed roots was confirmed by *in-situ* imaging. ROS could have cell wall loosening or tightening effects and these effects could be region specific. To understand the role of oxalate oxidase/cell wall localized ROS in root elongation, we are studying a transgenic maize line constitutively expressing a wheat *oxalate oxidase* gene (Ramputh *et al.* 2002, *Plant Sci.* 162: 431-440). The results show differential effects on growth and growth-related processes in well-watered and water-stressed roots. Experiments to determine the mechanisms of root growth regulation by oxalate oxidase/cell wall-localized ROS are in progress. This information could be used to develop plants that produce appropriate amounts of ROS to enhance root growth under water deficit conditions. The results may also be applicable to understanding and manipulating plant growth responses to other environmental challenges.