

Ethylene-Induced Redox Signaling Drives Root Development in Arabidopsis

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In *Arabidopsis thaliana*, the gaseous plant hormone ethylene promotes root hair formation through localized increases in reactive oxygen species (ROS). Treatment with ethylene or its precursor, ACC, results in elevated ROS in epidermal cells prior to root hair initiation, as detected with the hydrogen peroxide selective fluorescent dye, Peroxy Orange 1 (PO1). Ethylene-induced ROS and root hair formation are both lost in an *rbohC* mutant, and in roots treated with the pan-NADPH oxidase inhibitor VAS2870. Upon ACC treatment we see a significant increase in transcript abundance for RBOHC along with increased superoxide production in root tissue, measured by an in vitro nitroblue tetrazolium RBOH enzyme activity assay. We found that ethylene also delays gravitropism following reorientation of seedlings relative to the gravity vector, and we are asking whether this is due to changes in ROS accumulation across a root tip reoriented relative to gravity. Interestingly, inhibition of RBOH enzymes with VAS2870 completely disrupts gravitropism. Ongoing experiments are investigating which step of the root gravitropic response is affected by the inhibition of RBOH activity. These include confocal microscopy to detect H₂O₂ accumulation with PO1 and auxin redistribution with genetically encoded auxin reporters. We are also examining oxidation of cysteine residues in proteins as a post-translational modification that can alter protein structure and activity. Using redox proteomics, we have identified targets of protein oxidation involved in root hair growth and root gravitropism, and are working to uncover the effects of this oxidative modification on enzyme activity. We are currently working to identify proteins that display differential oxidation following ethylene treatment. This research demonstrates the role of ethylene-induced ROS production by RBOH enzymes in root hair growth and gravitropism, with a particular interest in oxidative modification of proteins as a mechanism of developmental regulation.