Title: From genomics to cellular dynamics: ABA and calcium signaling in guard cells

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Abstract:
The phytohormone abscisic acid (ABA) regulates diverse cellular processes including modulation of seed dormancy, seed maturation, stomatal movements, gene expression, and vegetative growth during plant development. Reactive oxygen species (ROS) and the gas nitric oxide (NO) are short-lived molecules and act as as second messengers to mediate ABA signaling in stomatal guard cells. Previously, we showed that two NADPH oxidases AtrbohD and AtrbohF are responsible for ABA-triggered ROS production and act as positive regulators of guard cell ABA signaling. Recently, we have identified two MAP kinase genes, MPK9 and MPK12, that are highly and preferentially expressed in guard cells and act downstream of ROS to positively regulate ABA- and calcium-activation of anion channels and ABA-induced stomatal closure. Our preliminary results indicate that MPK9 an MPK12 are regulated by redox. Other novel molecular components of ABA signaling will be discussed.

Plasma membrane Ca^{2+} channels are an essential component of cellular activities. However, the molecular identity of plasma membrane Ca^{2+} channels in plant cells remains elusive. Using Ca^{2+} imaging-based expression assays and patch clamp analysis in HEK293 cells, we systematically tested ion channel activity of seven Arabidopsis glutamate receptor homolog genes (AtGLRs) that have been proposed to function as calcium channels. We demonstrate that two AtGLRs form heteromeric Ca^{2+}-permeable cation channels in the plasma membrane. We provide direct functional and genetic evidence that AtGLR-formed ion channels mediate calcium influx across the plasma membrane, regulate basal cytosolic calcium levels, and control calcium-mediated signaling and physiological processes. Further progress will be discussed.