

CONSTITUTIVELY ELEVATED SALICYLIC ACID PROVOKES OXIDATIVE RESPONSE IN TRANSGENIC POPULUS VIA METABOLIC AND TRANSCRIPTIONAL REPROGRAMMING

C-J Tsai

Warnell School of Forestry and Natural Resources, and Department of Genetics, University of Georgia, Athens, GA

The phytohormone salicylic acid (SA) regulates many aspects of plant growth and adaptation. Exogenous applications of SA have long been shown to improve oxidative stress tolerance of several crop species. However, an *in planta* assessment of elevated SA effects on oxidative stress responses has been lacking, in part because constitutive overproduction of SA in transgenic or mutant *Arabidopsis* leads to severe growth retardation. We show that transgenic *Populus* can over-accumulate, by three orders of magnitude, SA and SA-conjugates without negative growth consequences. This has allowed a comprehensive characterization of constitutive SA overproduction in *populus* using a functional genomics approach. In the absence of oxidative stress, high-SA poplars exhibited a constitutively altered oxidative state, with transcriptional and metabolic responses resembling those of heat-stressed wild-type plants. Network analysis identified several metabolites and genes with strong SA-dependent regulation that have not been reported previously. Of particular interest were the increased expression as well as increased network connectivity of nucleoredoxins in SA-overproducing poplars. In contrast, orthologs of well-known *Arabidopsis* SA signaling components NPR1 and thioredoxins were absent in the reconstructed gene network of high-SA poplars. Together, the physiological, molecular and metabolite data reveal a sustained oxidative response in SA-hyperaccumulating *Populus* that is growth-compatible. This work advances previous studies reporting SA-homeostatic differences between *Arabidopsis* and *Populus*, and provides experimental evidence that components of the SA- and/or redox-mediated signaling pathway differ as well. The SA response in *Populus* involved a reprogramming of carbon uptake and partitioning during stress that is compatible with constitutive chemical defense and sustained growth, contrasting with the SA response in *Arabidopsis* which is transient and compromises growth if sustained.