Cytokinin: Beyond Two Component Signaling

Christian Burr[1], Carly Sacks[1], Tracy Raines[1], Masha Yamburenko[2], G. Eric Schaller[2], and Joseph Kieber[1]
[1]Department of Biology, University of North Carolina, [2]Department of Biological Sciences, Dartmouth College

Cytokinins are N^6-substituted adenine derivatives that have been implicated a wide variety of plant growth and development processes. A basic framework for cytokinin signal transduction has emerged that is similar to two-component phosphorelays, which rely on the transfer of phosphates between alternating histidine and aspartic acid residues. Cytokinins are perceived by a family of histidine kinase receptors (AHKs), which, following binding of cytokinin, transfer a phosphoryl group to the histidine phosphotransfer proteins (AHPs), which in turn donate the phosphate to the response regulators proteins (ARRs) thereby regulating their activity. The ARRs fall into two groups, the type-A and type-B ARRs, which act as negative and positive elements in cytokinin signaling respectively. Two-component elements are partially functionally redundant in mediating the response to cytokinin and in various roles in regulating plant growth and development.

We are characterizing the mechanism underlying cytokinin perception and signaling in both Arabidopsis and rice, and are exploring how this two-component signaling pathway modulates the many processes regulated by cytokinin. We have examined the cytokinin- regulated transcriptional network, including extensive characterization of the cytokinin-regulated transcriptome and binding of the type-B ARRs to their genomic targets. We have characterized the role of several of these outputs in cytokinin function, focusing on transcription factors. In the monocot rice, we find that cytokinin has a much more extensive effect on the transcriptome as compared to Arabidopsis. Using CRISPR/Cas9 technology, we are isolating loss-of-function alleles of various two-component elements and are determining the effect of their disruption on rice growth and development.