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Proteome analysis in Arabidopsis reveals shoot- and root- specific targets of cytokinin action and differential regulation of hormonal homeostasis

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Abstract

The plant hormones cytokinins (CKs) regulate multiple developmental and physiological processes in Arabidopsis thaliana. Responses to CKs vary in different organs and tissues, e.g., the response to CKs has been shown to be opposite in shoot and root samples. However, the tissue-specific targets of CKs and the mechanisms underlying such specificity remain largely unclear. Here, we show that the Arabidopsis proteome responds with strong tissue- and time-specificity to aromatic CK 6-benzylaminopurine (BAP) and that fast posttranscriptional and/or posttranslational regulation of protein abundance is involved in the contrasting shoot and root proteome response to BAP. We demonstrate that BAP predominantly regulates proteins involved in carbohydrate and energy metabolism in the shoot as well as protein synthesis and destination in the root. Furthermore, we found that BAP treatment affects endogenous hormonal homeostasis, again with strong tissue specificity. In the shoot, BAP upregulates the abundance of proteins involved in abscisic acid (ABA) biosynthesis and the ABA response, whereas in the root, BAP rapidly and strongly upregulates the majority of proteins in the ethylene biosynthetic pathway. This was further corroborated by direct measurements of hormone metabolites showing that BAP increases ABA levels in the shoot and 1-aminocyclopropane-1-carboxylic acid, the rate-limiting precursor of ethylene biosynthesis, in the root. In support of the physiological importance of these findings, we identified the role of proteins mediating BAP-induced ethylene production, ATMS1 and ACO2, in the early root growth response to BAP.

References

Žd'árská, M., et al. (2013). Proteome analysis in Arabidopsis reveals shoot-and root-specific targets of cytokinin action and differential regulation of hormonal homeostasis. *Plant physiology*, *161*(2), 918-930.