Imaging phytohormones during development and environmental responses using FRET biosensors

Annalisa Rizza[1], Wolf B. Frommer[2], and Alexander M Jones[1]
[1]Sainsbury Laboratory, Cambridge University, [2]Carnegie Institution for Science Department of Plant Biology

Plants use phytohormones - a suite of mobile small molecules – as potent regulators that coordinate and adjust development to match their environmental conditions. For example, accumulation of gibberellins (GA) is integral to numerous plant growth processes such as germination, tissue enlargement, and fruit set as well as key developmental transitions such as photomorphogenesis and flowering. It is no surprise, then, that accumulation of GA is tightly regulated in a cell-type and temporally specific manner by a series of biosynthetic, modification, catabolic and transport proteins. However, we currently lack methods for high spatiotemporal resolution measurement of GA in living tissues, and this limitation hampers analysis of cell-specific GA accumulations. Using an accelerated biosensor engineering platform, we have developed genetically- encoded, ratiometric fluorescent biosensors for the high-resolution measurement of GA in living tissues. Fluorescence imaging of the Gibberellin Perception Sensor (GPS) in the nuclei of *Arabidopsis* hypocotyls undergoing photomorphogenesis allows comparison of the timing of GA accumulation vs cell expansion. In addition to tracking endogenous GA accumulations, treatment of GPS plants with exogenous GA reveals that GA accumulation is patterned across tissues and varies with the type of GA applied. Potential mechanisms governing these cellular GA patterns and dynamics will be discussed. In the future, GPS can be used to address fundamental questions regarding how multiple signals integrate to control the hormone patterns and dynamics that, in turn, influence plant developmental and environmental responses.