A cellular basis for decision-making in Arabidopsis seeds

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The decision to terminate dormancy in Arabidopsis is mediated through the antagonistic interactions between the hormones gibberellic acid (GA) and abscisic acid (ABA). The mechanistic basis of the crosstalk between these hormones, and how these interactions constitute a developmental fate switch remains poorly understood. The address this, we captured the observed interactions between these hormones at a metabolic level using mathematical modeling. The output of these equations accurately recapitulates a range of observed developmental dynamics, and predicts diverse mutant phenotypes. The cellular locations where these metabolic and response events take place within dormant embryos were identified using reporter constructs with 3D digital single cell analysis. The sites of each ABA and GA response were found to be non-cell autonomous, while the cellular distribution of hormone metabolic enzymes (synthesis and degradation) overlap with these response centres. This suggests that the GA/ABA crosstalk in seeds is mediated by the intracellular transport of hormones between spatially distinct response centres. Extension of the mathematical model to the multicellular context of the embryo supports a role for hormone transport rates in both the establishment of bi-stability, and setting the threshold of the developmental fate switch in seeds. Cellular compartmentalization of decision-making networks therefore plays a key role in the regulation of developmental fate switching in seeds.