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# An integrase toolbox to record gene-expression during plant development

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## Abstract

Synthetic circuits that record in vivo signaling events are providing insights into the coordination of dynamic, multicellular behaviors in animal development. We are transferring this technology to plants using orthogonal serine integrases to mediate site-specific and irreversible DNA recombination visualized by switching between fluorescent reporters. When combined with lateral root-specific promoters, integrases can mark cells that express developmentally relevant genes and all descendants of these cells. We have also developed a suite of methods to tune the threshold for integrase switching, including: RNA/protein degradation tags, a nuclear localization signal, and a split-intein system. These tools improved the robustness of integrase-mediated switching with different promoters and the stability of switching behavior over multiple generations. We are currently building history-dependent circuits that can decode the order of expression of developmentally-regulated genes in each lateral root cell. In the future, this approach could be applied to studying development in many contexts across diverse organisms.

**Keywords:** integrase, plant development, logic circuit, *A. thaliana*, lateral root

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