

A LATERAL ROOT WAY TO BE CALL(O)US

Roots can be “callous”; their regenerative programs don’t require the stem cell niche.

Arabidopsis thaliana mutants with defects in the *PLT-SHR-SCR* gene network fail to regenerate the QC following ablation, demonstrating that these genes are essential to rebuilding the niche (Xu et al. 2006). Surprisingly, despite the lack of the QC in this condition, the root tip can still regenerate following its own excision (Sena et al. 2009). This is regeneration without a functional meristematic niche! This phenomenon speaks to the competence of the cells surrounding the injury to fuel organ regeneration. As mentioned in Section 24.3, “partially differentiated cells” are competent to respond to the injury by re-entering the cell cycle and either dedifferentiating or transdifferentiating into the missing cells and tissues for complete regeneration. For instance, xylem pole-specific pericycle cells have been demonstrated to exhibit extreme cellular plasticity, particularly for the initiation of lateral root formation, as well as for the development of callus and shoot cell identities (Malamy and Benfey 1997; De Smet et al. 2006; Sugimoto et al. 2010; Kareem et al. 2015, 2016a,b).

More recent genetic analysis has started to suggest a modest distinction between embryonic and regenerative developmental programs in plants (Kareem et al. 2016a,b). Embryogenesis occurs normally in the *A. thaliana aberrant lateral root formation 4 (alf4)* mutant and in a triple *plt* mutant, but both mutants fail to form totipotent callus or to properly regenerate organs (Celenza et al. 1995; Prasad et al. 2011; Kareem et al. 2015). Thus, during plant regeneration, the callus may not be reverting to a true undifferentiated embryonic state, but rather transitioning to something more like a lateral root primordium identity (Sugimoto et al. 2010).

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