Compensation syndrome: An emerging evidence of coordination between cell proliferation and expansion in organ-size control

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One of the most prominent differences between species is their body and organ size, which depends largely on the number and size of cells. Thus, the number and size of cells must be tightly regulated during organ formation. In *Arabidopsis thaliana*, decrease in the number of cells in leaf blade triggers significant cell enlargement, therefore results in a mild decrease in leaf area. This phenomenon that we named compensation (Tsukaya, 1998, 2002) signifies that cell proliferation and expansion are inter-linked during organogenesis. Therefore, compensation-exhibiting mutants represent a powerful tool to understand the basic machinery of organ-size regulation. We have screened and identified over two hundreds of mutants of *Arabidopsis thaliana* that have a defect in either leaf size or shape and classified them based on their cell number and size (Horiguchi et al., 2006a, b). Among them, we identified six new compensation-exhibiting mutants, namely *fugu1-fugu5* and *erecta*, and analyzed them together with *an3* and *KRP2* overexpressor. How and when is compensation induced? Our time course analysis of cell proliferation and expansion during leaf development revealed that compensated cell enlargement is exclusively induced postmitotically, either by increased expansion activity or extended expansion period. Moreover, we found that compensation occurs in leaves, petals, cotyledons but not in roots, despite significantly decreased cell number. Therefore, compensation is likely to be specific to organs with determinate growth. On the other hand, to genetically dissect the cell-expansion system that mediates compensated cell enlargement, we used 10 *extra-small sisters* (*xs*) mutants, which have decreased cell size but normal cell number, and *an3* as a representative of compensation-exhibiting mutants. Palisade tissue cells in *xs an3* double mutants, examined so far, revealed that *xs* could be classified into three functional classes: upstream, downstream or parallel to the target process of *an3*-mediated compensation. Taken together, our results suggest that a part of the cell expansion network, also required for normal leaf expansion, is hyperactivated during compensation.