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PLANT DEVELOPMENT

A new take on flower arranging

Over the past few years, data have steadily been emerging that indicate that Johann Wolfgang Goethe might have been right when — in 1790 — he proposed that flowers are modified leaves. The notion now receives further support from a paper by Martin Yanofsky and his colleagues, who have been examining the function of the four SEPALLATA (SEP) proteins during flower development. The authors have found that the more SEP genes they inactivate, the more like leaves the flower organs become.

Several years ago, the Yanofsky laboratory found that in *Arabidopsis thaliana* SEP1, SEP2 and SEP3 are all required for the proper formation of petals, stamens and carpels. Without these proteins, the three organs develop into sepals, the green structures that normally form on the outside of the flower. However, although *sep1 sep2 sep3* triple mutants produce proper sepals, Yanofsky *et al.* predicted that the three SEP proteins might nonetheless be involved in the formation of sepals themselves, and that another redundant gene must be masking their roles in sepal development. *SEP4* was a good candidate for this gene because its sequence and RNA-expression pattern is similar to those of the other SEP genes.

To investigate the role of *SEP4* during flower development, the researchers generated a *sep4* mutant plant and found that it was indistinguishable from the wild-type. When they went on to make *sep1 sep2 sep3 sep4* quadruple mutant plants, all of the flower organs — including the sepals — became leaf-like. These profound changes were most striking on the inner (adaxial) surfaces of the organs; rather than consisting of elongated rectangular cells, the adaxial surface consisted of irregular puzzle-shaped cells typical of those found on leaves.

Is *SEP4* needed for petal, stamen and carpel identity, as well as for sepal formation? The authors tested multiple *sep1 sep2 sep3 sep4* mutants in several combinations and concluded that all four SEP genes are important for the development of the four whorls of flower organs. Furthermore, each of these genes contributes in a redundant and additive manner, although different SEP genes contribute disproportionately to organ development.

To complete the story, the researchers asked what happens when *SEP4* is overexpressed. They found that the normally indeterminate inflorescence meristems — those meristems that are usually 'saved' for the continuous production of flowers — produced terminal flowers early on, showing that SEP4 promotes the floral fate of meristems. SEP proteins are thought to have been involved in plant reproduction for over 140 million years, so these findings have implications not just for our understanding of *A. thaliana* development but perhaps for all of the angiosperms, placing SEP genes firmly at the center of flower development.

Jenny Bangham

References and links

ORIGINAL RESEARCH PAPER Ditta, G. *et al.* The *SEP4* gene of *Arabidopsis thaliana* functions in floral organ and meristem identity. *Curr. Biol.* **14**, 1935–1940 (2004)

WEB SITE
Martin Yanofsky's laboratory: http://www-biology.ucsd.edu/labs/yanofsky/home.html

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