RESEARCH HIGHLIGHTS

PLANT DEVELOPMENT

A time and a place for flowers

For reproductive success, all the plants of any one species need to ensure that they flower at the same time. New research sheds light on the mechanisms that control this process. It shows how the temporal signal that is a response to the correct time for flowering is interpreted spatially to position flower development at the shoot apex.

In *Arabidopsis thaliana* the time of year is sensed through the accumulation of the nuclear protein CONSTANS (CO) in the leaf when daylight hours are long. *FLOWERING LOCUS T* (*FT*) is the primary target of CO in the leaf, but this signal somehow needs to reach the site of flower development. Huang *et al.* show that the mRNA of *FT* is transported through the phloem to the shoot apex, where it is translated into protein.

How does FT then trigger the pathways that lead to flower development? And how is it localized to the shoot apex? Using independent approaches, Abe *et al.* and Wigge *et al.* identified the bZIP (basic region leucine zipper) transcription factor, FD, as the partner of FT in the induction of flower development. Whereas FD is expressed constitutively in the shoot apex, the non-localized *FT* transcripts are only expressed when daylight hours indicate the correct time for flowering. Therefore, the interaction between the two proteins represents the integration of the spatial and temporal signals for flower development.

Abe *et al.* provide evidence for the presence of FT and FD in the nucleus, and on the basis of genetic and biochemical evidence both groups suggest that the proteins form a transcriptional complex. Wigge *et al.* show that the floral meristem identity gene, *APETALA 1* (*AP1*), a crucial early factor in flower development, is a direct target of this complex.

The combined data nicely demonstrates how the temporal signal, which is generated in the leaves, is combined with the spatial one. However many questions remain, such as how the response is fine-tuned so that the expression of *AP1* is restricted to part of the shoot apex, whereas *FD* is expressed in most of it. And whether this mechanism is conserved in other plants.

Patrick Goymer

References and links

ORIGINAL RESEARCH PAPERS Huang, T. *et al*. The mRNA of the *Arabidopsis* gene *FT* moves from leaf to shoot apex and induces flowering. *Science* 11 August 2005 (doi:10.1126/science.1117768) | Abe, M. *et al*. FD, a bZIP protein mediating signals from the floral pathway integrator FT at the shoot apex. *Science* **309**, 1052–1056 (2005) | Wigge, P. A. *et al*. Integration of spatial and temporal information during floral induction in *Arabidopsis*. *Science* **309**, 1056–1059 (2005)
FURTHER READING Krizek, B. A. & Fletcher, J. C. Molecular mechanisms of flower development: an armchair guide. *Nature Rev. Genet*. **6**, 688–698 (2005)