SHADE ADAPTATION

Fight or flight

Plant Cell http://doi.org/dbn7 (2019).

Credit: Nigel Cattlin / Alamy Stock Photo

As every photographer knows, natural light on Earth can be beautifully diverse, despite coming mostly from one source. Alternating between bright and cloudy days, dawn and sunset, full sun and shade, light can vary quantitatively and qualitatively. Its energy is necessary for plant photosynthesis, but light can also be a stress or a developmental signal in specific situations. Plants have evolved a complex network of photosensors to perceive light conditions and adapt during processes such as germination, phototropism or flowering. In a recent study, a team led by Jaime Martinez Garcia in Barcelona used the contrasting responses to shade of phylogenically related plants to investigate the molecular mechanisms controlling this behaviour.

When confronted with shade coming from the canopy or neighbouring plants, *Arabidopsis thaliana* seedlings try to escape it by elongating their hypocotyl. It is called the shade avoidance syndrome and has become the canonical response in our *Arabidopsis*-centric research world. On the other hand, the small related crucifer *Cardamine hirsuta* does not elongate but adapts its metabolism to tolerate these conditions. *C. hirsuta*, known for its compound leaves and explosive seed shattering, has been recently established as a new model, complete with genetic and functional tools, to go beyond *Arabidopsis* and allow comparative studies between related species; for example, to understand the evolution of leaf morphologies.

A forward genetic screen in *C. hirsuta* led to the isolation of mutants that, unlike the wild type, elongate in response to shade, just like *Arabidopsis*. The mutations are in the *phytochrome A* (*phyA*) gene, which indicates that *phyA* activity suppresses hypocotyl elongation in response to various degrees of shade. The phyA proteins from both plants are not fully interchangeable, as the one from *C. hirsuta* is more intrinsically active and has a broader range of shade response than its counterpart in *Arabidopsis*.

Future research will be needed to link the *phyA* differences between both species to specific amino acid changes, and to assess the role of *phyB* and other components in this response. This study nevertheless illustrates the power of comparative research, in this case to show that variation of phytochrome activity can be an evolutionary adaptation to light diversity and so, new environments.

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Published online: 8 October 2019
https://doi.org/10.1038/s41477-019-0533-6