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IN BRIEF

Cryptochromes and Seed Dormancy: The Molecular Mechanism of Blue Light Inhibition of Grain Germination

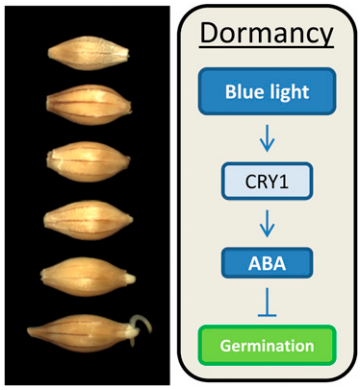
In the wild, seed dormancy promotes fitness by preventing germination before conditions are optimal for plant growth. During crop domestication, however, seed dormancy was selected against to ensure uniform germination upon sowing. Despite this, too little dormancy can be problematic, especially in cereal crops where it causes yield losses due to preharvest germination. Seed dormancy has long been known to be antagonistically regulated by abscisic acid (ABA) and gibberellic acid, and recent efforts have elucidated some of the molecular underpinnings of dormancy initiation and release (reviewed in Graeber et al., 2012).

Phytochrome photoreceptors are involved in seed dormancy in *Arabidopsis thaliana* (Shi et al., 2013), whereas wild grasses such as *Brachypodium distachyon* exhibit blue light (BL) effects on germination as well as red/far-red light responsiveness likely mediated by phytochromes (Barrero et al., 2012). In domesticated cereals, there is no clear evidence of red/far-red light involvement, but BL inhibits germination of dormant grain. New work from **Barrero et al. (1094–1104)** reveals that this inhibition requires the CRYPTOCHROME1 (CRY1) photoreceptor in barley (*Hordeum vulgare*).

Barrero et al. used RNA interference (RNAi) in barley to downregulate *CRY1* (both *a* and *b* transcripts) and *CRY2*. The germination behavior of the resulting lines suggested that the *CRY1a/b* gene products mediate the promotion of dormancy by BL and that CRY2 is not important in this process. Correspondingly, genes normally induced by BL during dormancy were no longer as responsive to BL in *CRY1a/b* RNAi grain.

In barley, the inhibition of germination by BL coincides with induction of the ABA biosynthetic gene *9-cis-epoxycarotenoid dioxygenase* (*NCED1*) and increased ABA content in response to BL exposure (Gubler et al., 2008). In *CRY1a/b* RNAi grain, expression of *NCED1* was no longer induced by BL late in germination; furthermore, an ABA catabolic gene was slightly upregulated early during germination in BL. Consistent with this, the ABA content declined faster in the *CRY1a/b* RNAi line than in its null sibling when germinating in BL.

This report demonstrates that CRY1 mediates the effects of BL on grain dormancy in barley, including the inhibition of germination caused by higher levels of ABA in dormant grain (see figure). These findings should facilitate efforts to optimize seed dormancy in crop plants and, intriguingly, reveal that the effects of light on dormancy converge at *NCED* genes in both dicots and monocots, even though different light qualities and different photoreceptors are involved.



Cryptochrome mediates BL promotion of grain dormancy. Left: Barley grain at different stages of germination (*photo credit: Rosemary White, CSIRO Plant Industry*). Right: In dormant barley grain, BL enhances the ABA content to inhibit germination. (*Adapted from Barrero et al. [2014], Figure 8.*)

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