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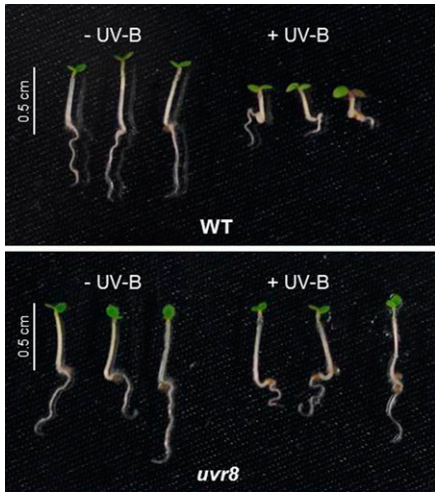
IN BRIEF

How ELONGATED HYPOCOTYL5 Helps Protect Plants from UV-B Rays

Most of us do what we can to avoid the DNA-damaging effects of UV-B rays. While plants can't slap on sunscreen, put on a nice hat, or move to a shady spot, they too have ways to protect themselves from (and acclimate to) damaging UV-B radiation. For example, plants undergo UV-B-dependent photomorphogenic changes (see figure), including reduced hypocotyl and leaf expansion, increased stomatal closure, and the production of UV-absorbing compounds such as flavonoids. In *Arabidopsis thaliana*, UV-B-induced responses are mediated by the photoreceptor UV RESISTANCE LOCUS8 (UVR8) (Rizzini et al., 2011), which lacks the usual prosthetic light-sensing chromophore, instead relying on specific intrinsic tryptophans for light detection (Jenkins, 2014). Upon sensing UV-B light, the homodimeric UVR8 rapidly switches to its active, monomeric form, which interacts with the E3 ubiquitin ligase CONSTITUTIVELY PHOTOMORPHOGENIC1 (COP1), a well-known repressor of photomorphogenesis. Downstream of UVR8 and COP1, the bZIP transcription factor ELONGATED HYPOCOTYL5 (HY5) and its homolog HYH mediate most UV-B-induced changes in gene expression. While uncomplexed COP1 targets HY5 for ubiquitination, HY5 induces *COP1* expression by binding to a specific UV-B-responsive element in its promoter, and UVR8-COP1 somehow stabilizes HY5 (Huang et al., 2012). However, it is not known how *HY5* expression is induced by UV-B exposure. In addition, while HY5 potentially interacts with thousands of target genes, it is unclear how HY5 associates with chromatin in response to UV-B light exposure.

A recent study by **Binkert et al. (2014)** has brought us much closer to elucidating the role of HY5 in the UV-B response. First, chromatin immunoprecipitation (ChIP) experiments using anti-HY5 antibodies demonstrated that UV-B treatment affects the association of HY5 with its target genes. Next, HY5 ChIP analysis of a *uvr8* null mutant revealed that the UV-B-enhanced association of HY5 with its target promoters is regulated by UVR8. Conversely, the authors observed a reduced UV-B-specific response in plants overexpressing REPRESSOR OF UV-B PHOTOMORPHOGENESIS2, a negative regulator of UVR8. They also found that HY5 associates with the promoters of various UV-B-regulated genes but not with that of the constitutively expressed *UVR8*. Importantly, one of these UV-B-regulated genes is *HY5* itself; ChIP analysis revealed that both HY5 and HYH specifically bind to the *HY5* promoter. In fact, transgenic seedlings expressing the *ProHY5:LUCIFERASE* (*LUC*) reporter construct exhibited increased luminescence in response to UV-B irradiation in the *hy5*, *hyh*, and wild-type backgrounds, while *ProHY5:LUC* induction was nearly absent in the *hy5 hyh* double mutant background and completely absent in *uvr8* knockout mutants, demonstrating that HY5 and HYH act redundantly to regulate UV-B-induced transcription of *HY5*. A similar assay using truncated and mutated *HY5* promoters uncovered a T/G-box in the *HY5* promoter that's required for its UV-B responsiveness. The binding of this promoter region by HY5 and HYH was confirmed by electrophoretic mobility shift assays. Therefore, HY5 and HYH bind to the T/G-box of the *HY5* promoter, thus playing a crucial role in the UV-B-induced regulation of *HY5*, which in turn mediates UV-B responses.



UV-B-induced photomorphogenesis. Wild-type (WT) and *uvr8* mutant *Arabidopsis* seedlings grown for 4 d in the absence or presence of UV-B light. (*Figure courtesy of M. Binkert*.)

It remains to be determined how UV-B light enhances the binding of HY5 and HYH to the T/G-boxes in the promoters of their many target genes. Moreover, additional transcription factors that regulate UV-B-induced *HY5* expression remain to be identified. Nonetheless, this pivotal study sheds light on the role played by HY5 to help plants cope with excess UV-B rays—sunscreen not required.

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REFERENCES

Binkert, M., Kozma-Bognár, L., Terecskei, K., De Veylder, L., Nagy, F., and Ulm, R. (2014). UV-B-responsive association of the *Arabidopsis* bZIP transcription factor ELONGATED HYPOCOTYL5 with target genes, including its own promoter. Plant Cell **26:** 4200–4213.

Huang, X., Ouyang, X., Yang, P., Lau, O.S., Li, G., Li, J., Chen, H., and Deng, X.W. (2012). Arabidopsis FHY3 and HY5 positively mediate induction of COP1 transcription in response to photomorphogenic UV-B light. Plant Cell **24:** 4590–4606.

Jenkins, G.I. (2014). The UV-B photoreceptor UVR8: from structure to physiology. Plant Cell **26:** 21–37.

Rizzini, L., Favory, J.J., Cloix, C., Faggionato, D., O'Hara, A., Kaiserli, E., Baumeister, R., Schäfer, E., Nagy, F., Jenkins, G.I., and Ulm, R. (2011). Perception of UV-B by the Arabidopsis UVR8 protein. Science **332:** 103–106.

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