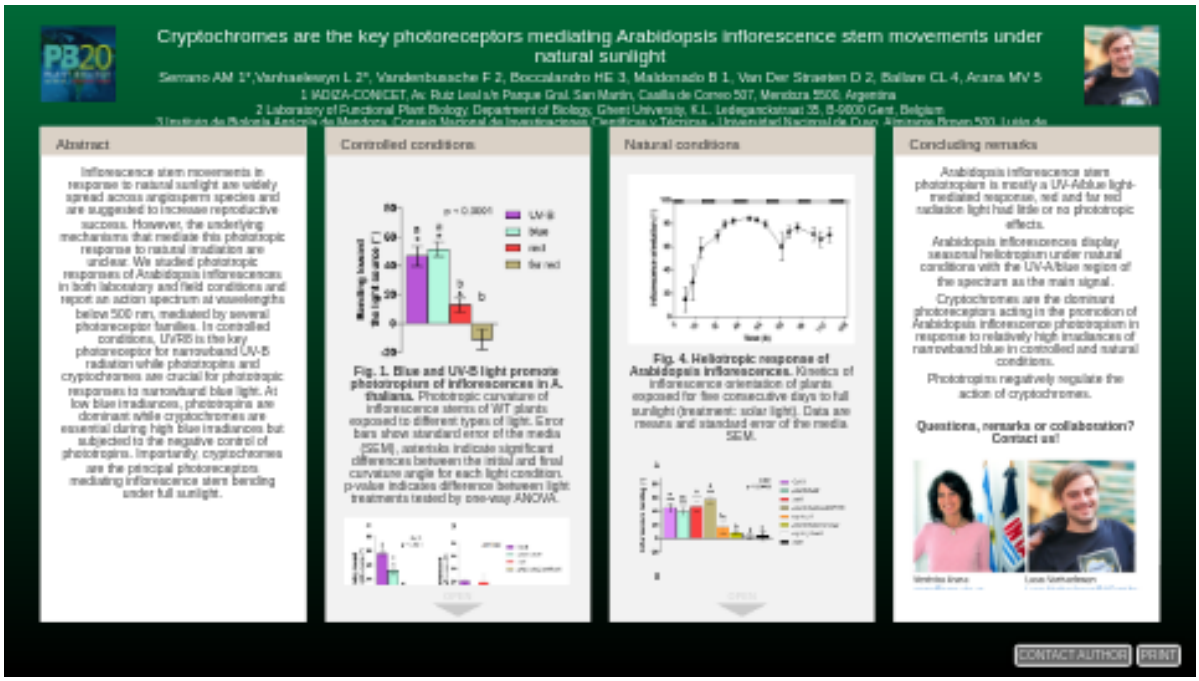
Cryptochromes are the key photoreceptors mediating Arabidopsis inflorescence stem movements under natural sunlight



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ABSTRACT

Inflorescence stem movements in response to natural sunlight are widely spread across angiosperm species and are suggested to increase reproductive success. However, the underlying mechanisms that mediate this phototropic response to natural irradiation are unclear. We studied phototropic responses of Arabidopsis inflorescences in both laboratory and field conditions and report an action spectrum at wavelengths below 500 nm, mediated by several photoreceptor families. In controlled conditions, UVR8 is the key photoreceptor for narrowband UV-B radiation while phototropins and cryptochromes are crucial for phototropic responses to narrowband blue light. At low blue irradiances, phototropins are dominant while cryptochromes are essential during high blue irradiances but subjected to the negative control of phototropins. Importantly, cryptochromes are the principal photoreceptors mediating inflorescence stem bending under full sunlight.

CONTROLLED CONDITIONS

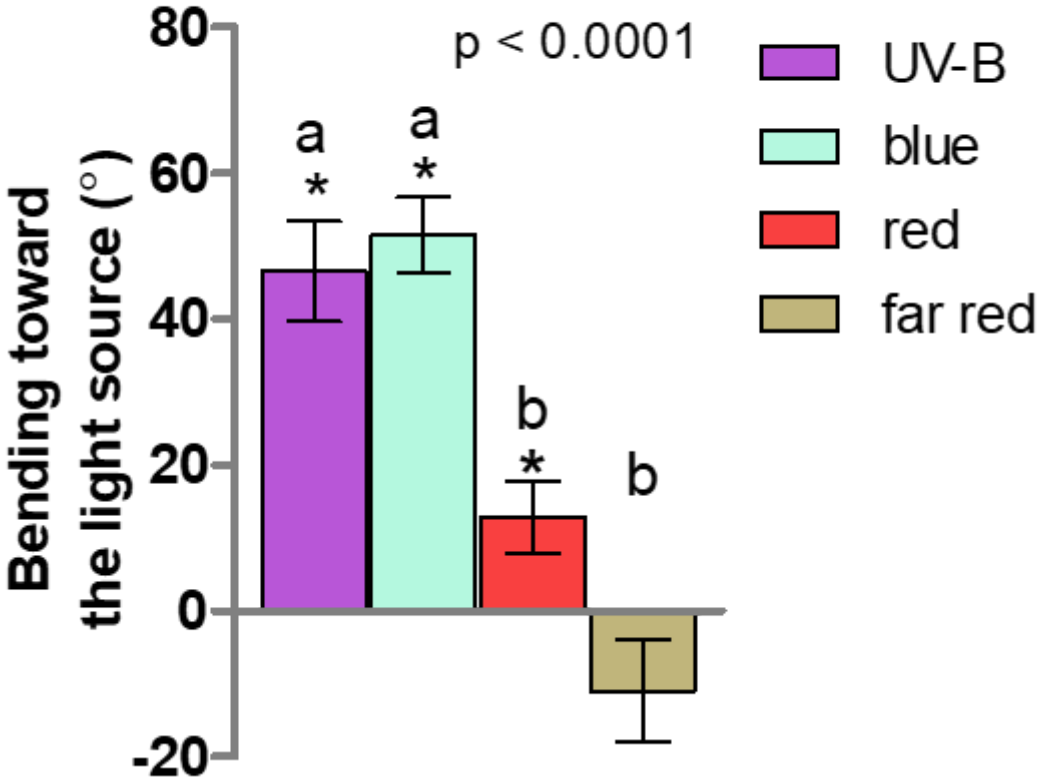

Fig. 1. Blue and UV-B light promote phototropism of inflorescences in A. thaliana. Phototropic curvature of inflorescence stems of WT plants exposed to different types of light. Error bars show standard error of the media (SEM), asterisks indicate significant differences between the initial and final curvature angle for each light condition. p-value indicates difference between light treatments tested by one-way ANOVA.

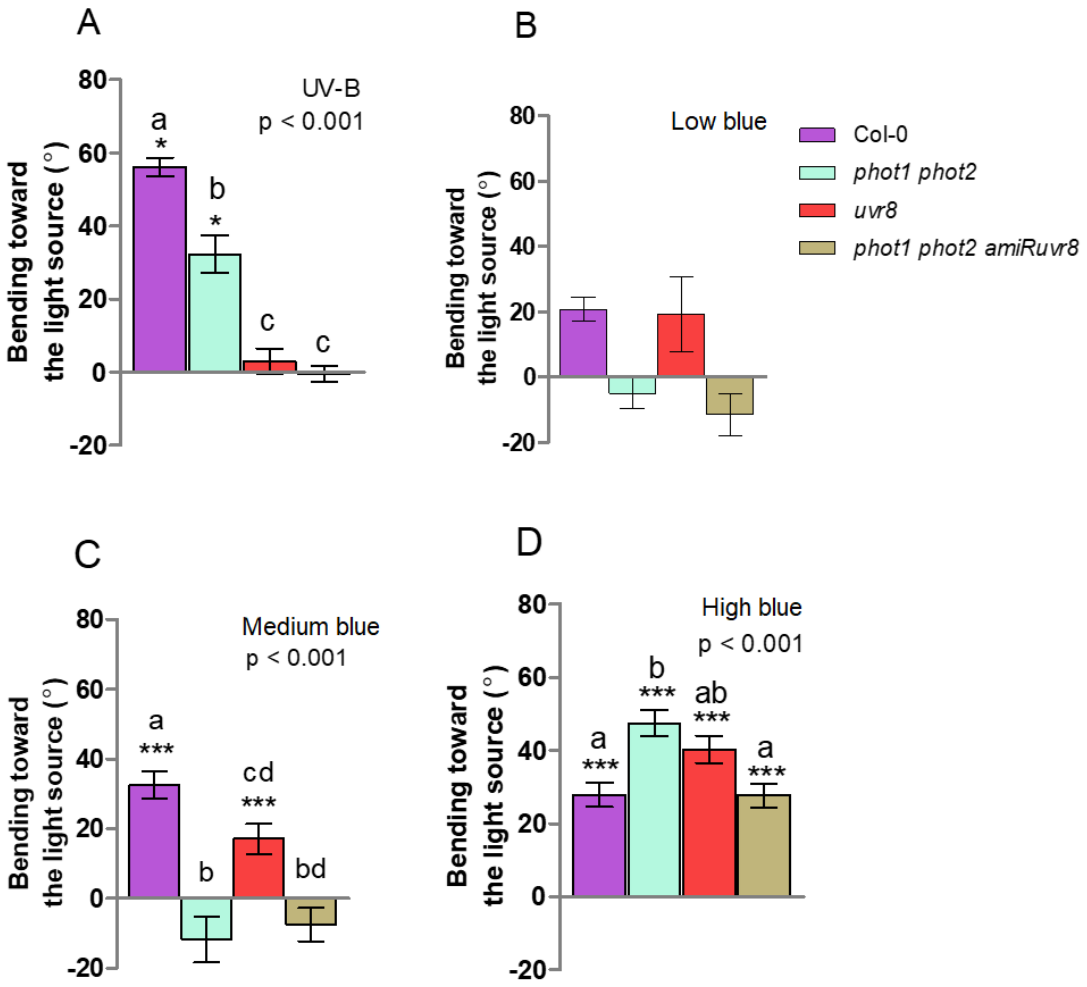

Fig. 2. UVR8 and phototropins steer phototropism toward blue and UV-B light. Phototropic curvature of inflorescence stems of wild type (Col-0), *phot1 phot2, uvr8, phot1 phot2 amiRUVR8* in response to UV-B (A) and different irradiances of blue light; low (B), medium (C) and high (D). Error bars show SEM, asterisks indicate significant differences between the initial and final curvature angle for each light condition and genotype.

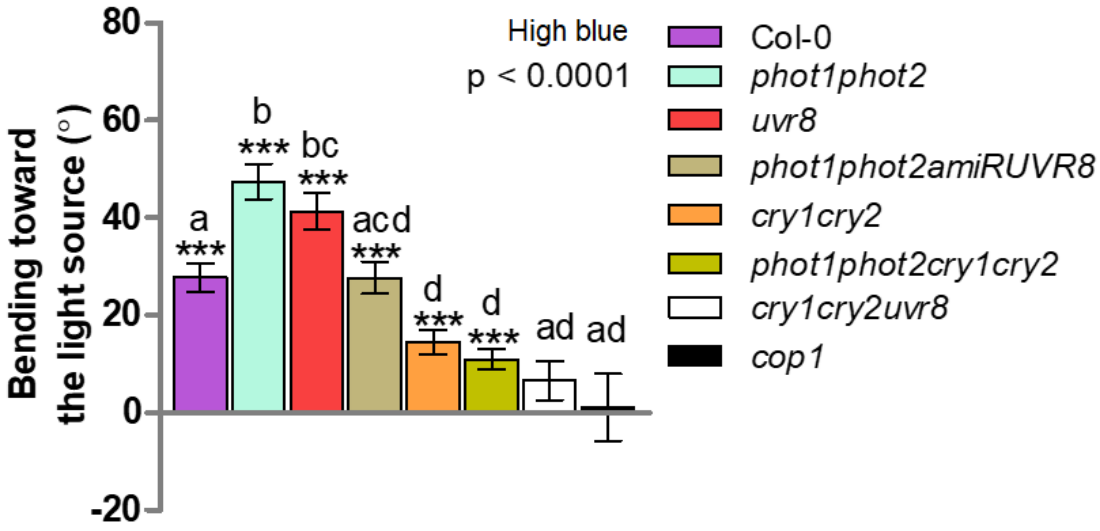

Fig. 3. Cryptochromes steer bending of inflorescence stems toward high irradiances of blue light. Phototropic curvature of inflorescence stems of wild type (Col-0) *phot1 phot2, uvr8, phot1 phot2 amiRUVR8, cry1 cry2, phot1 phot2 cry1 cry2 and cry1 cry2 uvr8* in response

to high fluence rate unilateral blue light. Error bars show SEM, asterisks indicate significant differences between the initial and final curvature angle for each light condition and genotype. p-value indicates difference between genotypes tested by one-way ANOVA.

NATURAL CONDITIONS

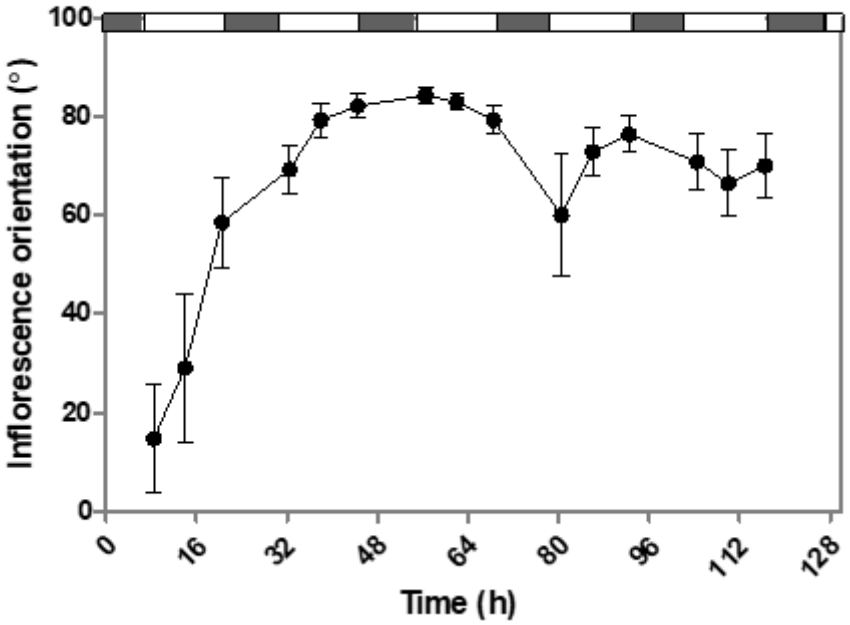

Fig. 4. Heliotropic response of Arabidopsis inflorescences. Kinetics of inflorescence orientation of plants exposed for five consecutive days to full sunlight (treatment: solar light). Data are means and standard error of the media SEM.

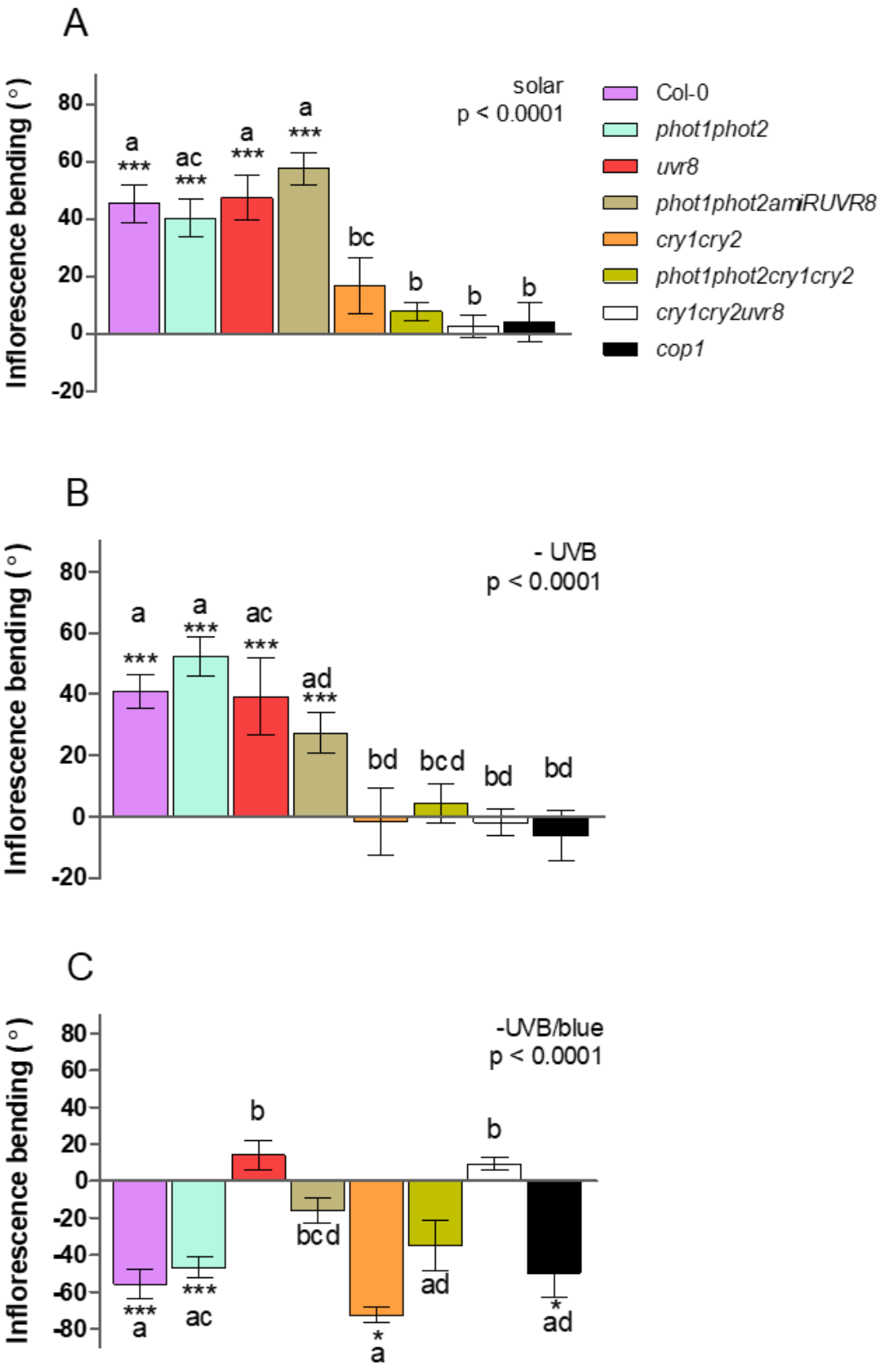

Fig. 5. Solar wavelengths in the region of UV/Blue light promote inflorescence heliotropism in Arabidopsis, and cryptochromes are the main photoreceptors for the promotion of inflorescence bending under full sunlight. Inflorescence bending of wild type (Col-0), *uvr8-6, phot1-5 phot2-1, phot1-5 phot2-1 amiRUVR8, cry1-104 cry2-1, cry1-104 cry2-1 phot1-5 phot2-1 and cry1-104 cry2-1 uvr8-6* in response to full sunlight (solar), solar light > 315 nm (solar - UVB), and solar light > 500 nm (solar – UV/Blue). Error bars show SEM , asterisks indicate significant differences between the initial and final curvature angle for each light condition and genotype. p-values indicate difference among genotypes tested into each light treatment by one-way ANOVA.

CONCLUDING REMARKS

Arabidopsis inflorescence stem phototropism is mostly a UV-A/blue light-mediated response, red and far red radiation light had little or no phototropic effects.

Arabidopsis inflorescences display seasonal heliotropism under natural conditions with the UV-A/blue region of the spectrum as the main signal.

Cryptochromes are the dominant photoreceptors acting in the promotion of Arabidopsis inflorescence phototropism in response to relatively high irradiances of narrowband blue in controlled and natural conditions.

Phototropins negatively regulate the action of cryptochromes.

Questions, remarks or collaboration? Contact us!

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