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# REGULATORY NETWORKS FOR SHADE AVOIDANCE RESPONSE

RUBERTI I.*, CARABELLI M.*, POSSENTI M.**, SESSA G.*, CIOLFI A.*,**, SASSI M.*, MORELLI G.**

*) Institute of Molecular Biology and Pathology, National Research Council, Rome (Italy)
**) National Research Institute for Food and Nutrition, Rome (Italy)

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The shade avoidance response is a strategy of major adaptive significance to plants in natural communities. It is highly widespread in the angiosperms, and depends on the ability of the plant to perceive the presence of neighbors. Within vegetation, the ratio of red to far-red (R/FR) is lowered by the absorption of R light by photosynthetic pigments. This light quality change is perceived through the phytochrome system as an unambiguous signal of the proximity of neighbors. Upon sensing a low R/FR ratio, a shade-avoiding plant reacts very rapidly and enhances elongation growth even before it is directly shaded. If the plant succeeds in the attempt to overgrow its neighbors and the photosynthetic organs perceive daylight again, the shade avoidance response is rapidly reverted through phytochrome photoconversion. Consistent with the rapidity of plant response to low R/FR and its reversibility upon perception of high R/FR, changes in gene expression are rapid and reversible. The transcript level of the Arabidopsis HD-Zip *ATHB2* and bHLH *PIL1* transcription factor genes, functionally implicated in shade avoidance response, increases within a few minutes of low R/FR exposure. Significantly, *ATHB2* and *PIL1* transcript levels fall very rapidly after transfer from low to high R/FR. Low R/FR also provokes a rapid induction of the Arabidopsis *HFR1/SICS1* gene, a negative controller of the shade avoidance response, ensuring that an exaggerated reaction does not occur when the plant is unsuccessful in escaping canopy shade. In this unfavorable environmental condition, HFR1/SICS1 is likely to play a fundamental role in the acclimation of the plant, and by delaying flowering, to ensure a better seed production needed for long term survival.

Recent work revealed that the same low R/FR signal that induces hypocotyl elongation also triggers a rapid arrest of leaf primordium growth ensuring that plant resources are redirected into extension growth. The growth arrest induced by low R/FR depends on auxin-induced cytokinin breakdown in incipient vein cells of developing primordia, thus demonstrating the existence of a previously unrecognized regulatory circuit underlying plant response to canopy shade.