Analysis of Post-Translational Modifications of the Blue Light Photoreceptor, phot1, by the $CRL3^{NPH3}$ Ubiquitin Ligase Complex

Diana Roberts

Dr. Emmanuel Liscum, Dissertation Supervisor

Abstract

Plants are sessile by nature; because of this they have evolved many strategies to cope with the diverse environmental stimuli they encounter in nature. One such strategy is the phototropic response by which plants reorient the aerial organs toward and roots away from directional blue light. The blue light response can be broken down into three general steps: perception of light, signal leading to the lateral redistribution of auxin, and initiation of a differential growth response (resulting in phototropic curvature).

Loss-of-function genetic screens have identified several key proteins involved in phototropic signal-response, including the primary photoreceptors, phototropins 1 and 2 (phot1 and phot2), and a BTB protein, NPH3. Recent studies in our laboratory have shown that NPH3, a phot1 interacting protein, can also interact with Cullin 3 (Cul3) as a substrate adapter in a Cul3-based E3 ubiquitin ligase designated $CRL3^{NPH3}$. We have shown that the CRL^{NPH3} complex is necessary for the mono/multi- and polyubiquitination of phot1 under high fluence rate conditions in addition to the mono/multiubiquitination of phot1 under low fluence rate conditions. Preliminary evidence suggested that mono/multiubiquitination of phot1 is necessary for BL dependant receptor internalization which appears to be critical to phot1 mediated signal transduction. Interestingly, the photoreceptor is internalized in the absence of monoubiquitination signal, but recent evidence suggests that the mono/multiubiquitination signal is responsible for targeting the photoreceptor and is necessary for phototropism. We propose that phot-dependent phototropism is modulated in large part through the ubiquitination of phot1 by $CRL3^{NPH3}$ and the subsequent internalization of phot1. We are currently working to elucidate the role of mono/multiubiquitination in phot1 internalization and receptor function. These ubiquitination responses represent the blue light-induced signal transduction events occurring prior to (and presumably required for) auxin redistribution, auxin-dependent changes in transcription, and development of differential growth.