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PHYTOCHROMES FOR BIOTECHNOLOGICAL APPLICATIONS

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Phytochromes are molecular light switches that regulate various aspects of plant growth and development. They are plant red/far-red photoreceptors that exist as dimeric photochromic proteins with covalently linked tetrapyrrole chromophore phytochromobilin. They exist in two photo-interconvertible species, red-light absorbing Pr and far-red-light absorbing Pfr forms. The Pfr form is considered the active form of phytochrome because of the promotive effect of red-light on most physiological responses. Since phytochromes involve positively in many processes of plant growth and development such as shade avoidance, they could be used for the biotechnological applications. An example of the application is the suppression of shade avoidance in plants. Because the shade avoidance induces a rapid and dramatic increase in the extension growth of stems and petioles at the expense of leaf growth, storage organ production, and reproductive development, the suppression of shade avoidance can improve plant's growth and productivity. For the efficient biotechnological application of phytochromes, it is necessary to increase the phytochrome activity in plants. For example, higher expression level of phytochromes or the generation of hyperactive phytochromes would be the ways to increase the phytochrome activity in plants. Based on recent results of the phytochrome signaling that phytochrome phosphorylation is an inhibitory mechanism in its signaling, we generated hyperactive phytochrome mutants for possible biotechnological application. As another way, wavelength-shifted mutant phytochromes, especially red-shifted, can also be very efficient for the suppression of shade avoidance, because these mutants can recognize light efficiently and generate phytochrome signaling even in the shade. In the presentation, the generation and characterization of phytochrome mutants will be presented and their potential for the biotechnological applications will be discussed.