Engineering Phytochromes for Turfgrass Biotechnology

Jeong-Il Kim, Yun-Jeong Han, Kyung-Moon Kim, Hyo-Yeon Lee[1], and Pill-Soon Song*
Kumho Life & Environmental Science Laboratory, Gwangju 500-712, Korea.
[1]*Dept. of Horticultural Life Science, Cheju National University,Korea*

Objectives

For the development of shade-tolerant and super-healthy transgenic plants, the objectives are to produce hyperactive and shade-perceptive phytochromes, and to examine their potentials for biotechnological applications using transgenic turfgrass and other plants.

Materials and Methods

1. Plant materials : *Arabidopsis*, turfgrass and cassava
2. Methods: Site-specific mutagenesis, *in vitro* protein-protein interaction assay, protein phosphorylation assay, embryogenic callus-derived turfgrass transformation, cassava transformation using barmbardment etc.

Results and Discussion

Phytochromes are molecular light switches that regulate various aspects of plant growth and development such as the suppression of shade avoidance. For an efficient biotechnological application of phytochromes, it is necessary to increase the phytochrome activity in plants. For example, higher expression levels of phytochromes or the generation of hyperactive phytochromes would be an effective means to increase the phytochrome activity in plants. Based on our recent results of the phytochrome signaling studies that phytochrome phosphorylation is a signal attenuating mechanism, we generated hyperactive phytochrome mutants, and their potentials for the biotechnological applications were examined by transforming them into turfgrass and cassava. The transgenic turfgrass of the hyperactive phytochrome showed greener and compact phenotypes, and had more tillers. The transgenic cassava of the hyperactive phytochrome were greener and had reduced internodes. As a photobiologicl alternative, wavelength-shifted mutant phytochromes, especially red-shifted, can also be very efficient for the suppression of shade avoidance, because these mutants can recognize shade light efficiently and generate phytochrome signaling, i.e., shade tolerance, even in the shade. The red-shifted phytochrome mutants were generated by site-specific mutagenesis in the chromophore-binding pocket, and the shade tolerance of the transgenic *Arabidopsis* with the red-shifted phytochromes were examined. Results showed that 8 nm red-shifted mutants had 2.5 times higher shade tolerance than non-transgenic plants, while 8 nm blue-shifted mutants showed shade-sensitive phenotypes. The generation and characterization of phytochrome mutants will be presented and their potentials for the biotechnological applications will be discussed further.

---

*Corresponding author: Pill-Soon Song, TEL: 062-971-2263; E-mail: pssong@kkpc.com

** This research is supported by Korea Kumho Petrochemical Co., Ltd, and in part by grants from the BioGreen 21 program of RDA (to P.-S.S.) and the KOSEF/MOST to the Environmental Biotechnology National Core Research Center (NCRC) (to J.-I. Kim and P.-S.S; grant #R15-2003-012-01003-0).