TWO NOVEL MUTATIONS IN THE PHYTOCHROME SIGNAL TRANSDUCTION PATHWAYS IN ARABIDOPSIS

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By screening suppressor mutants of the hy2 mutation of Arabidopsis thaliana, we have isolated two dominant photomorphogenic mutants, shy1-1D and shy2-1D, for two genetic loci designated as SHY1 and SHY2 (suppressor of hy2 mutation). Both of these nonallelic, extragenic suppressor mutations of hy2 are located on the chromosome 1 of the Arabidopsis genome. Both mutations suppress the elongated hypocotyl phenotype of hy2 by light-independent inhibition of hypocotyl growth as well as by increasing the effectiveness of light inhibition of hypocotyl elongation. Both mutations can also suppress the early flowering phenotype of hy2 and have a distinct pleiotropic effect on leaf development such as upward leaf rolling.

The shy1-1D mutation is partially photomorphogenic in darkness with apical hook opening and reduced hypocotyl elongation. Examination of red/far-red light responses shows that the shy1-1D mutation suppresses the hypocotyl elongation of the hy2 mutation effectively in red light but not effectively in far-red light. Further characterization of shy1-1D and shy1-1Dhy3 double mutants showed that shy1-1D acts as a downstream component of PHYB in the HIR.

The shy2-1D mutant displays highly photomorphogenic characteristics in darkness such as extremely reduced hypocotyl growth, true leaf development, cotyledon expansion, cellular and plastid differentiation, and high-level expression of light inducible genes. In addition, dark-grown shy2-1D mutant seedlings exhibited reduced geotropic response, one of the phytochrome mediated responses. With regard to hypocotyl elongation, however, the shy2-1D mutation is still light sensitive. The shy2-1D suppresses hypocotyl elongation of the hy2 mutation effectively in both red and far-red lights. Interestingly, compared to shy2-1D mutant, shy2-1Dhy2 mutant showed less photomorphogenic phenotypes in the dark, such as elongated hypocotyl, reduced cab gene expression, and elongated internode. Further characterization of shy2-1Dhy3, shy2-1Dfre1-1 double mutants revealed that shy2-1D mutation requires PHYA and PHYB for its full activity in the dark. This result suggests SHY2-1D interacts closely with PHYA and PHYB.

Our data suggest that SHY1 and SHY2 represent a novel class of components involved in the photomorphogenic pathways of Arabidopsis.