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Molecular Diversity in Photoperiodic Flowering between Rice and *Arabidopsis*

Takeshi Izawa

National Institute of Agrobiological Sciences, Tsukuba, Japan

Two evolutionarily distant plant species, rice, a short-day plant, and *Arabidopsis thaliana*, a long-day plant, share a conserved genetic network controlling photoperiodic flowering. The orthologous floral regulators — rice *Heading date 1* (*Hd1*) and *Arabidopsis CONSTANS* (*CO*) — integrate circadian clock and external light signals into mRNA expression of the *FLOWERING LOCUS T* (*FT*) group floral inducers. The circadian clocks regulate *Hd1/CO* mRNA expression mainly during the subjective night. In rice, *Hd1* inhibits floral transition by suppressing *FT-like* genes on long days, possibly interacting with Pfr phytochromes produced during the daytime. On short days, the longer duration of darkness results in alteration of *Hd1* function from a suppressor to an activator of *FT-like* genes at dawn. Therefore, *Hd1* promotes flowering only on short-days. In *Arabidopsis*, long days cause *CO* mRNA expression at dusk through the interaction between light signal transduction and circadian clocks. Blue or far-red light signaling further makes the *CO* protein an activator of *FT* at dusk on long-days. Thus, the regulation of *FT* group genes by *Hd1/CO* plays a central role in photoperiodic flowering. We here performed transient assays to examine *FT* (and its orthologs) gene expression by *Hd1/CO* using rice protoplasts and *Arabidopsis* seedlings reciprocally. The results suggest that the difference in *FT/FT*-like gene promoter sequences is a key to determine the photoperiodic responses in these plants. Responsible cis-elements are being searched. In addition, we have recently cloned *Early heading date 1* (*Ehd1*) gene of rice, which confers SD promotion of flowering in the absence of a functional allele of *Hd1* and encodes a B-type response regulator that might not have an ortholog in *Arabidopsis*. *Ehd1* promotes flowering by inducing *FT-like* gene expression only under short-day conditions. Therefore, a novel two-component signaling cascade is integrated into the conserved pathway in the photoperiodic control of flowering in rice.