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Mapping of a Major QTL, *qHD6-SD* Responsible for Days to Heading Under Natural Short Day Condition to Develop Rice Varieties Adaptable to Tropical Regions

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[Introduction]

In tropics (Southeast Asian countries), indica rice is more common than japonica. The japonica rice is mainly cultivating in temperate regions including Korea, Japan, and China (northeast regions) due to its inferior adaptation in tropical areas. To develop tropically adapted high yielding japonica rice, breeders should overcome the challenges including extremely early flowering, low biomass accumulation, and inferior panicle traits.

[Materials and Methods]

One hundred eighty RILs (F_{2:9}) were developed from a cross between Ilpum, a popular South Korean japonica variety, and Zenith, an indica variety. The population was developed in the experimental fields of the National Institute of Crop Science in Milyang, Korea. Ilpum, Zenith and RILs were established in the National Institute of Crop Science (NICS), Republic of Korea in 2018 and in the International Rice Research Institute (IRRI) headquarters, Philippines in the 2021 Dry Season. Appropriate field practices and management was employed according to the standard cultivation method of NICS and IRRI.

[Results and Discussions]

We identified two major QTLs, *qHD6-SD* and *qHD6-LD*, conferring days to heading under short day (SD) and long day (LD) conditions, respectively. Finer mapping revealed that both *qHD6-SD* and *qHD6-LD* located in the similar 98 kb region harbors *Hdl* gene. Days to heading in the RILs harboring Zenith allele type of *qHD6-SD* under SD significantly longer than those of harboring Ilpum allele type. On the contrary, days to heading in the RILs harboring Zenith allele type of *qHD6-SD* under LD was significantly shorter than those of harboring Ilpum allele type. This bi-functionality of *qHD6-SD* upon heading strongly support that both *qHD6-SD* and *qHD6-LD* might be the *Hdl* gene. Our findings further support that functional allele type of *Hdl* gene delays long-day heading and promotes extremely early short-day heading. Therefore, a non-functional *Hdl* type is critical to tropical adaptation of japonica rice since it delays days to heading, which is essential to attain prolonged vegetative state in order to achieve optimum biomass, increased spikelet number and grain filling capacity.

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