Cloning and characterization of up-regulated \textit{HbSINA4} gene induced by drought stress in Tibetan hulless barley

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\textbf{ABSTRACT.} Hulless barley is an important crop cereal in Tibetan, China. Drought is a major abiotic stress in barley production. In this study, we cloned the drought-related \textit{HbSINA4} gene from the variety ‘Himalaya 10’ and analyzed its expression patterns under different drought and rehydration conditions. The cDNA of \textit{HbSINA4} was 1052 bp long, including an open reading frame of 771 bp that encoded a protein of 256 amino acids. The molecular weight of HbSINA4 protein was predicted to be 29.53 kDa and the theoretical pI was 8.32. Bioinformatic analysis showed that the \textit{HbSINA4} gene contained a protein kinase domain profile family signature motif, with high similarity to that of \textit{Oryza sativa} and \textit{Brachypodium distachyon}. Real-time polymerase chain reaction (PCR) assays revealed that gene
expression declined rapidly with increasing drought stress; in contrast, its expression increased after rehydration treatment. Therefore, the \textit{HbSINA4} gene responds to the drought stress and plays an important role in barely drought resistance. Furthermore, our results provide information which may be useful in other temperate crop studies and in aiding resistance to drought.

\textbf{Key words:} Barley; Drought stress; Gene cloning; Gene expression; \textit{HbSINA4}; \textit{Hordeum vulgare}