Identification, Cloning and Characterization of *HvEXPB7* in Root Hairs of Tibetan Wild Barley under Drought Stress

Xiaoyan He, Feibo Wu

College of Agriculture and Biotechnology, Zhejiang University, Hangzhou, China. Corresponding author E-mail: wufeibo@zju.edu.cn

Drought is one of the most severe abiotic factors affecting crop productivity worldwide. The identification of drought tolerant crop germplasm and understanding the underlying tolerance mechanisms is necessary, therefore, to improve the plant adaptation to drought-prone environments. As a single cell type, root hair is an important organ in uptake water and nutrients, and plays an important role in drought tolerance. However, there is a very little information about the genetic and molecular basis of root hair development in monocots in response to drought. Tibetan wild barley is rich in genetic diversity and provides elite genes for crop improvement in such abiotic stress tolerance as drought. In this study, the drought-tolerant Tibetan wild barley XZ5 was used. Based on the genotypic differences of root hair development and root hair transcriptome in response to drought stress, the root hair development-regulated gene, *HvEXPB7* being associated with drought tolerance in XZ5, was isolated and cloned, and the molecular drought-tolerant mechanism in wild barley was studied.

Results

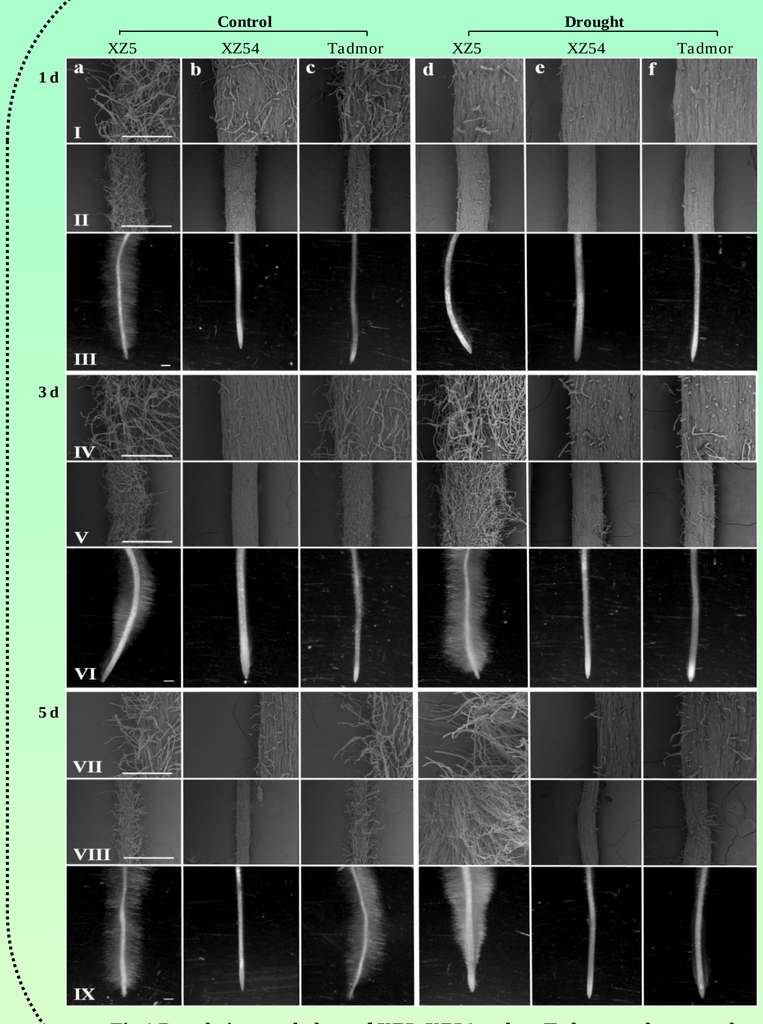

Fig.1 Root hair morphology of XZ5, XZ54 and cv. Tadmor under control (column a, b, c) and drought condition (column d, e, f).

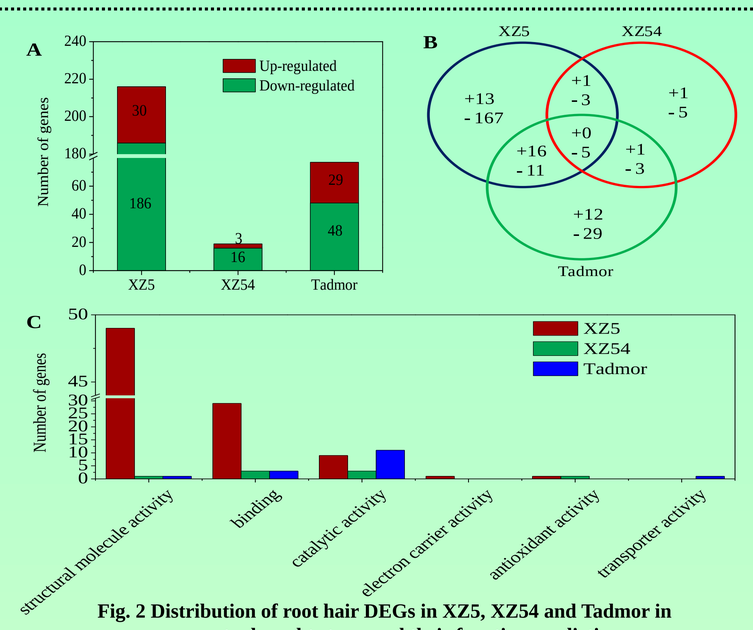

Fig. 2 Distribution of root hair DEGs in XZ5, XZ54 and Tadmor in response to drought stress and their function prediction.

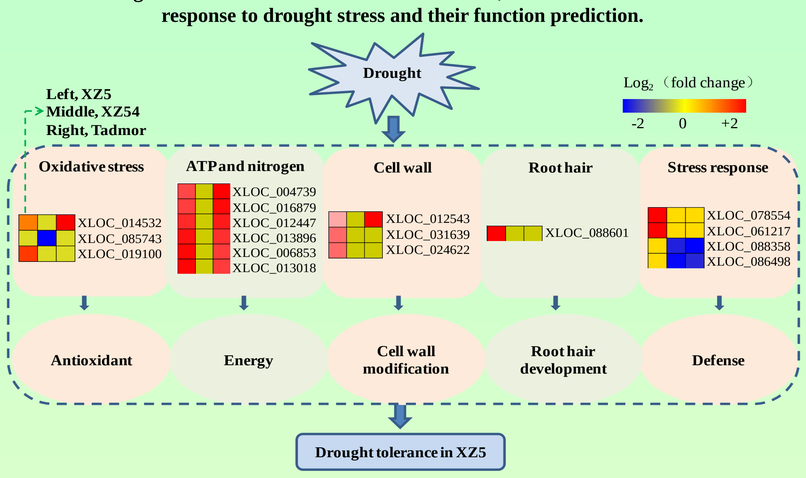

Fig. 3 A predicted root hair DEGs based drought tolerance associated model in Tibetan wild barley XZ5 in response and adaptation to drought stress.

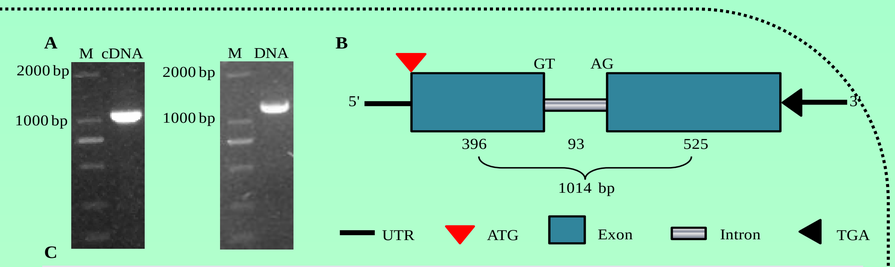

Fig. 4 Gene cloning of *HvEXPB7* in XZ5.

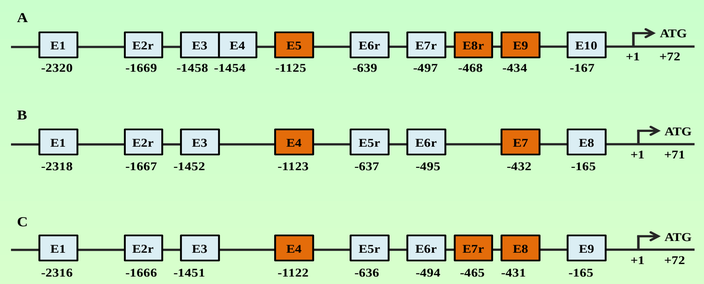

Fig.5 Relative positions of RHEs in the *HvEXPB7* promoter regions of XZ5, XZ54 and Tadmor.

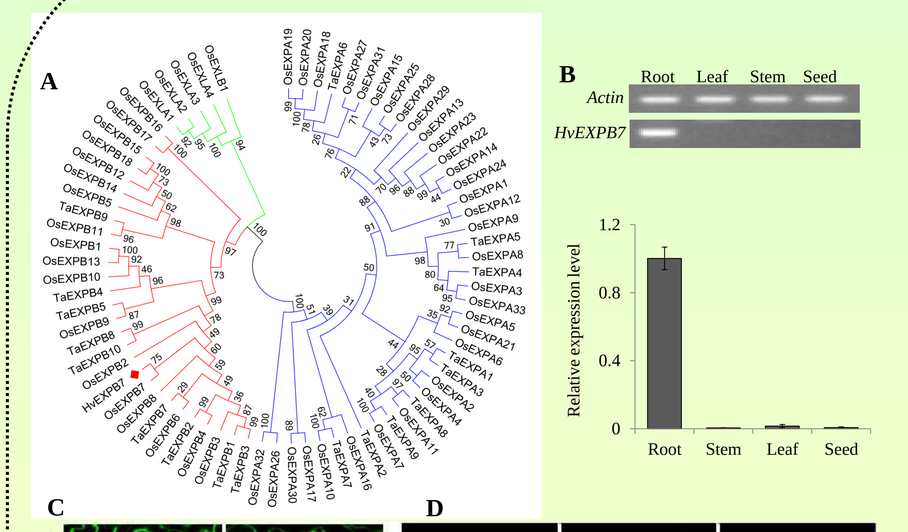

Fig. 6 Phylogenetic tree, tissue expression pattern and subcellular localization of *HvEXPB7*.

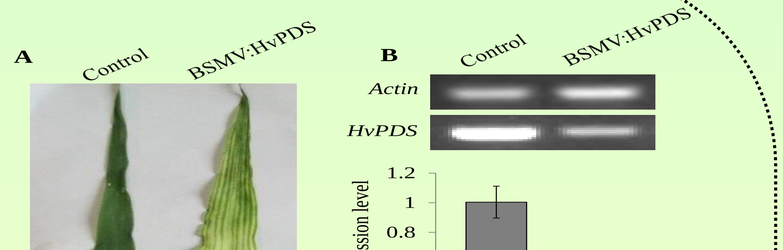

Fig. 7 Silencing of the phytoene desaturase (*PDS*) gene in wild barley XZ5 using BSMV-VIGS.

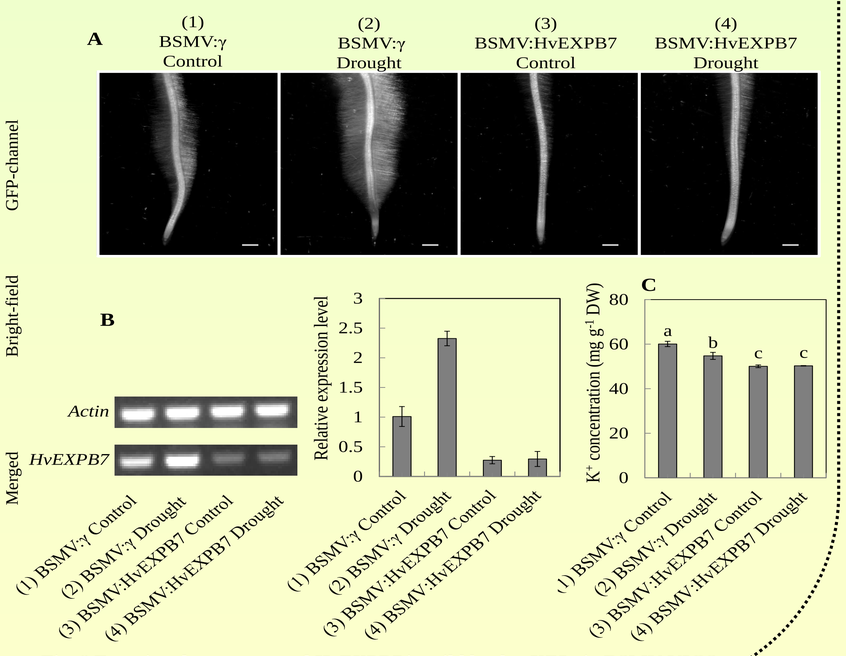

Fig. 8 Functional assessment of *HvEXPB7* in wild barley XZ5 via BSMV-VIGS.

Conclusion

The drought-tolerant Tibetan wild barley XZ5 has significantly well-developed root hairs compared to XZ54 and cv. Tadmor under drought stress; Thirty-six drought-tolerance-related DEGs are identified, and the full length sequence of a novel β-expansin gene named *HvEXPB7* is cloned; The *HvEXPB7* sequence from XZ5 has abundant genetic diversity compared to *cv.* Tadmor; BSMV-VIGS is successfully carried out on wild barley; *HvEXPB7* expression plays an important role in root hair development under drought stress. These results, to a degree, illustrate the drought tolerance mechanism of XZ5 and its differences from *cv.* Tadmor, and *HvEXPB7* could be applied in biotechnology to improve drought tolerance *via* root hair growth in barley.

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