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A dominant negative OsKAT2 mutant delays light-induced stomatal opening and improves drought tolerance without yield penalty in rice

Jin-Ae Kim, Seok-Jun Moon, Yongsang Lee, Myung Ki Min, In sun Yoon, Taek-Ryoun Kwon and Beom-Gi Kim*

Gene Engineering Division, National Institute of Agricultural Sciences, Rural Development Administration, Jeonju, South Korea.

Abstract

Stomata are the main gateways for water and air transport between leaves and the environment. Inward-rectifying potassium channels regulate photo-induced stomatal opening. Rice contains three inward rectifying shaker-like potassium channel proteins, OsKAT1, OsKAT2 and OsKAT3. Among these, only *OsKAT2* is specifically expressed in guard cells. Here, we investigated the functions of OsKAT2 in stomatal regulation using three dominant negative mutant proteins, OsKAT2(T235R), OsKAT2(T285A) and OsKAT2(T285D), which are altered in amino acids in the channel pore and at a phosphorylation site. Yeast complementation and patch clamp assays showed that all three mutant proteins lost channel activity. However, among plants overexpressing these mutant proteins, only plants overexpressing OsKAT2(T235R) showed significantly less water loss than the control. Moreover, overexpression of this mutant protein led to delayed photo-induced stomatal opening and increased drought tolerance. Our results indicate that OsKAT2 is an inward-rectifying shaker-like potassium channel that mainly functions in stomatal opening. Interestingly, overexpression of OsKAT2(T235R) did not cause serious defects in growth or yield in rice, suggesting that OsKAT2 is a potential target for engineering plants with improved drought tolerance without yield penalty.

Keywords: rice, ABA, OsKAT2, stomatal opening, guard cell

Corresponding author*

Beom-Gi Kim

Address: 166, Nongsaengmyeong-ro, Iseo-myeon, Wanju-gun, Jeollabuk-do 55365, Republic of Korea

Tel and Fax: 82-63-238-4662, 82-63-238-4654

E-mail: bgkimpeace@gmail.com