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CELL-WALL INVERTASES, HEXOKINASES AND SUGAR TRANSPORTERS IN RICE

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In order to understand sucrose metabolism in rice, we isolated 20 cDNA clones encoding cell-wall invertases (OsCIN), hexokinases (OsHXK) and sugar transporters (OsSTP) from a search of rice sequence databases. We analyzed gene structure, chromosomal localization, evolutionary relationships, enzyme activity, temporal and spatial expression patterns, and examined responses to the treatment of sugars such as sucrose, glucose and fructose. The analysis of gene expression revealed that these are expressed in unique patterns in various organs. This suggests that the gene families play diverse roles involving the regulation of metabolism, growth, development, and stress responses. Interestingly, the expression of three genes, OsCIN3, OsHXK3and OsSTP3, were pollen-specific. Sugars induced the accumulation of several genes in excised leaves and immature seeds, while the gene expression of OsCIN5 and OsHXK7 wassignificantly down-regulated. The transcript analysis of in developing seeds indicated that the genes play an important role involving sucrose partitioning to the embryo and endosperm. The biochemical analysis of OsCIN proteins expressed in E coli demonstrated that the proteins catalyze the hydrolysis of sucrose into glucose and fructose. Genetic complementation experiments in yeast mutants supported that the cloned genes of OsHXKs and OsSTPs function as hexokinase and sugar transporter, respectively. We have isolated null mutants for five genes, OsCIN3, OsCIN4, OsHXK4, OsHXK7, and OsHXK8, from T-DNA and Tos17 mutant populations. The loss-of-function of OsHXK4 caused growth defect, early senescence and dwarfism.