No. 1016

Development of Salt/Drought-Tolerant Crops by enhancing Raffinose-Related Oligosaccharide Synthesis

Mari Iwaya-Inoue, Takashi Yuasa

Faculty of Agriculture, Kyushu University

Summary

Salt stress and related drought stress on crops result in severe yield losses through growth retardation and irreversible damage. Recent studies indicated that raffinose-related oligosaccharides such as galactinol, *myo*-inositol and stachyose are synthesized in response to various stresses, salt stress and drought in higher plants and that the oligosaccharides play important roles in protection of proteins and biomembranes as osmolytes and antioxidants. In *Arabidopsis*, a galactinol synthase (*AtGolS1*) gene is expressed in seed and multiple *GolSs* are differentially regulated in plant under drought, salt stress and chilling. By searching for tomato EST coding GolS homologs in MiBASE (Kazusa DNA Institute), we isolated a novel tomato (*Solanum lycopersicum* L. cv. Micro-Tom) *GolS* full length cDNA (DDBJ accession number, AB486014) designated *SlGolS2* based on partial sequences of *GolS* homologs in MiBASE. *SlGolS2* was transiently induced in response to salt and heat stresses. The predicted protein of SlGolS2 has high similarlity to AtGolS1 (75% in amino acid identity) rather than LeGolS1 (61%). Furthermore, in signaling of salt stress in *Arabidopsis*, inducer of *CBF* expression 1 (ICE1) has been identified as the master regulator inducing dehydration responsive element binding protein / C-repeat binding factor (DREB/CBF)-type transcriptional factors. To examine whether tomato ICE homologs function in osmotic treatment via regulation of tomato *DREB/CBF* homologs in response to salt stress, profiles of ICE-related polypeptides in tomato were assessed by immunoblot with an antibody which was raised against a polypeptide epitope containing an ICE-specific motif. Salt stress on tomato plants induced an ICE-related protein with molecular masses of approximately 55 kDa indicating that the size is consistent with that predicted for tomato ICE1.

Furthermore, H_2O_2 pre-spraying to soybean (*Glycine max*) leaves exposed to drought stress immediately caused an increase in the mRNA levels of D-*myo*-inositol 3-phosphate synthase 2 (*GmMIPS2*) and *GmGolS*. In addition, H_2O_2-presprayed soybean plant was more drought tolerant than DW-presprayed one. The levels of *myo*-inositol and galactinol were higher in H_2O_2-pretreated leaves than in DW-pretreated leaves. These results indicated that H_2O_2 spraying enabled the soybean plants to avoid drought stress through the maintenance of leaf water content, and that this water retention was caused by the promotion of oligosaccharide biosynthesis rather than by rapid stomatal closure.