Abstract

Soil water stress (SWS) is one of the major environmental stress factors that limit the rice yield. Exploitation of valuable genetic resources of wild rice progenitors for "mining" of novel and/or existing alleles as well as promoters for SWS tolerance traits is the new paradigm for producing farmer-friendly stress tolerant crops. Gene(s) encoding late embryogenesis abundant (LEA) proteins constitute an important gene family involved in protecting plants during desiccation and hence, *Wsi18*, a group 3 *LEA* gene, was selected as prospective candidate for such "allele mining" in this study. A number of genetically divergent modern rice cultivars and its ecologically distinct wild progenitors were studied for their differential response towards SWS. The wild rice genotype, *Oryza nivara*, showed relatively enhanced tolerance to SWS, whereas the cultivated crop *IR20* was found to cope inefficiently with the stress conditions at the phenotypic level. A comparative expression profiling of *Wsi18,* performed by means of quantitative real time PCR analysis, revealed differential response under SWS conditions across different rice genotypes. *In-silico* analysis showed the presence of additional *cis*-elements in the *Wsi18* promoter from *O. nivara* in comparison to similar promoter from *IR20.* When the reporter *gusA* gene was placed under the control of three different versions of *Wsi18* promoters, namely *OnWsi18, IR20-Wsi18* and *deleted-OnWsi18* promoters, the transgenic rice plants carrying the *OnWsi18* promoter showed higher expression of *β*-glucuronidase under SWS conditions unravelling its strong stress-inducible nature among them. Transgenic expression of *OnWsi18* gene in elite cultivar *IR20*, under the control of the SWS-inducible *OnWsi18* promoter, resulted in enhanced SWS tolerance with relatively higher survival rates, water content and yield. Cell membrane stability index, proline and soluble sugar content also increased in transgenic rice plants, indicating the role of *OnWsi18* gene in maintaining normal metabolic functions and cellular activities under SWS. All these results demonstrate the successful deployment of complete genetic locus of *Wsi18* from a wild genotype to an elite cultivar for the generation of SWS tolerant rice plants with improved yield characteristics. Thus, this study is expected to contribute to the development of molecular strategies to generate relatively high-yielding and SWS-tolerant crop plants.

Keywords: Soil water stress, late embryogenesis abundant protein, wild genotype, elite cultivar, *gusA*, reporter assay, relatively tolerant, transgenic plants, inducible expression, improved yield.