Abstract

Increasing the yield potential of rice (*Oryza sativa*), the major staple food crop of the world is a challenging area of research. Modification of the plant architecture and grain size has a direct impact on yield improvement as well as customer preference, particularly in case of aromatic rice cultivars. In order to address these two important aspects, molecular characterizations of the rice gibberellic acid (GA) insensitive (*OsGAI*) gene and the major gene, grain size 3 (*OsGS3*), involved in determining the grain size in rice, have been carried out in the present study. The wild-type GAI (a 'DELLA' family protein) restrains the expression of other genes associated with GA-induced growth processes through acting as a nuclear-localized GA-signaling repressor. In this study, the effects of transgenic expression of the rice wild-type *OsGAI* gene in a local aromatic *indica* rice cultivar Badshabhog and a heterologous plant system (tobacco) have been investigated. The transgenic lines of rice and tobacco were found to have significantly reduced plant height, decreased seed α-amylase activity, reduced early seedling growth, higher level of anthocyanin pigmentation and reduced stem cell wall lignifications. Leaf chlorophyll content was observed to be increased in case of transgenic rice but decreased in transgenic tobacco lines. The reduced lignification in transgenic tobacco lines was noticed to be reversible upon exogenous GA application and correlated to the hypersensitivity towards oxidative stress induced by exogenous application of ammonium persulfate. Through a parallel investigation, the reason behind the small grain size of the Badshabhog cultivar was investigated in the light of allelic variations of the *OsGS3* gene. It was found that the 5^{th} exon of the *OsGS3* allele present in the Badshabhog genome contains a large genomic deletion resulting in a truncated OsGS3 protein in this cultivar. From the established inter-domain interaction of the OsGS3 protein, this new allelic version of *OsGS3* could explain the small grain size in Badshabhog. Thus, the present study not only advances our understanding on OsGAI-mediated regulation of several traits in rice and tobacco plant systems, but also documents a new allelic version of the *OsGS3* gene present in the aromatic *indica* rice cultivar Badshabhog.

Keywords

α-amylase activity, Anthocyanin content, Chlorophyll content, Gibberellic acid insensitive gene, Grain size 3 gene, Lignification, Plant architecture, Transgenesis.