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'GAIN-OF-FUNCTION' MUTANTS FOR GENE DISCOVERY AND FUNCTIONAL GENOMICS FOR MULTIPLE STRESS TOLERANCE IN RICE

Mutation breeding is a traditional approach to generate crop plants with increased tolerance to abiotic stresses. Oryza sativa L. cv IR64 is high yielding rice with incomplete tolerance to critical abiotic stresses, such as extreme temperatures, high salinity, and drought. In the present study, we have generated a population of IR64 mutants by using gamma radiation. Over 4,000 independent M3 lines were screened at the seedling level for improved tolerance to high temperature and salinity stress using hydroponics. The preliminary phenotyping led to the identification of mutant lines which showed a robust phenotype to stress. Apart from this, the selected mutant lines also showed higher tolerance over wild-type plants to both the stress at the flowering stage regarding their growth and yield parameters, including plant height, tiller number, grain weight, harvest index, etc. Further, molecular analysis revealed that several stress-related proteins show higher constitutive levels of HSPs and various anti-oxidative enzymes in the mutant lines as compared to wt and under stress conditions. Proteome analysis using 2-D-DIGE approach, revealed some of the critical stress proteins to be accumulating at higher levels in mutants. These findings suggest that the transcription circuits and ROS scavenging machinery may be working more efficiently in these mutants. Whole genome sequence analysis revealed the 'hot-spots' contributing to the observed phenotypes. Using the tools of functional genomics, a set of the 'candidate genes' identified from the present work have also been validated. Similarly, GC-MS based metabolite profiling of these mutants has also revealed insight into to the tolerance pathways contributing to the phenotype. The present study opens new vistas to use mutation breeding as a potential tool for tailoring multiple stress tolerance in rice which can accelerate the breeding programmes focussing towards the improvement of tolerance towards abiotic stresses.

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