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Resurgence of Doubled Haploid Breeding: exceeding our expectations in rice improvement

Sanghamitra Samantaray
ICAR-National Rice Research Institute, Cuttack, Odisha, India
Email: smitraray@gmail.com

Abstract:

Considering the rapidly growing population and diminishing cultivation area throughout the world, it is required to develop high yielding rice varieties for which currently traditional breeding is being followed. However, the ability to generate homozygous and homogeneous lines is an important time constraint in plant breeding. Utilization of doubled haploid (DH) technology can substitute the traditional breeding in achieving stable homozygous lines which can be produced in two rather than, five or more generations. Other advantages include reduced costs to produce cultivars, more precise evaluation of phenotypic traits, effective elimination of undesirable genes, and trait fixation in haploids using marker-assisted selection, leading to effective use of molecular markers and more efficient combination of traits. Because the success of breeding programs depends on the genetic gain per unit time, the use of DH technology plays a major role in the breeding of the self-pollinated cereal species including rice.

Though the generation of efficient DH technology in rice can be utilized to accelerate plant breeding programs, the anther culture-based rice doubled haploid generation does not fulfill the demand of the breeders as it requires expertise along with variability in responses of different genotypes under in vitro culture in indica rice. Therefore, a novel approach like seed-based haploid induction technology could be adopted, allowing routine germplasm-independent doubled haploid line production. Knock-out of OsMATL gene in rice has generated immense hope to develop such technology. Developing a Haploid Inducer (HI) line exploiting CRISPR/cas9 genome editing technology in different genetic background will enable us to compare the haploid induction frequency in different backgrounds and find a suitable system for DH production in rice. This research may mobilize rice breeding into a new era.