Breeding by Design: a Novel Marker-Assisted Selection (MAS) Approach for Crop Improvement

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ABSTRACT

Crop Improvement involves both changing the genetic information in plants to produce superior varieties and development of improved production technology. Development of improved varieties using markers is a stable method of crop improvement. With the increasing knowledge of genomes, molecular markers have been assisting phenotypic data for genetic characterization studies. Molecular markers reflect genetic polymorphisms at the DNA level, which are related to different phenotypes. On one hand, they facilitate the choice for the elite parental lines to be used in cross breeding and on the other hand, the decision on which offspring to continue breeding with or to choose for multiplication. In Marker-Assisted Selection (MAS), allele of a DNA marker is determined; the plants that possess particular genes/ Quantative Trait Loci(QTLs)are identified on the basis of genotype rather than phenotype. Molecular markers serve as reference points to location of other genes when genetic maps become available. The knowledge of the map positions of all loci of agronomic interest, allelic variation at those loci, their contribution to phenotype enables the breeder to design superior genotypes 'in silico' using 'Breeding by design' approach. The selection based on DNA markers permits a more effective breeding design as the positions of all loci of importance are mapped precisely and recombination events can be accurately selected using flanking markers. Molecular breeding, thus, increases genetic gain per crop cycle, speeding up the delivery of improved crop varieties to farmers. With the recent advances in marker technology, including high throughput genotyping techniques and integrated breeding (combining traditional breeding with molecular breeding tools) is anticipated for increasing crop production and meeting the projected food demands.

Keywords: Molecular markers, marker-assisted selection,QTL, molecular breeding