**Implementing predictive breeding to improve yield under rainfed drought environments in rice : A new hope**

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Abstract

Rice cultivation under rainfed conditions accounts for 33% of total rice area and in which more than half of it is affected by drought. Breeding for drought tolerance in rainfed areas is challenging as the varieties should yield decently enough when the stress occurs but also yield high when adequate rainfall is received. The rates of genetic gains under rainfed conditions in rice has been very low. Although it is understood that drought tolerance is controlled by quantitative inheritance, drought breeding in rice has majorly focused on introgressing one or more yield-under-drought quantitative trait loci (QTL) into high yielding varieties. To overcome these challenges, we have adopted a population improvement approach where rapid recurrent selection is carried out with high yielding elite breeding materials. We identified a set of high yielding breeding lines from multi-location breeding trials under rainfed condition and selected lines with reasonably high frequency of yield-under-drought QTL through marker assisted selection. These selected lines act as a base population from which the crosses are planned to generate the lines for evaluation. Early stage breeding trials are conducted at multiple locations with the national partners directly in the target population of environments (TPE). Breeding values are generated and used to select parents and advancement of lines to late stage testing using genomic prediction models with G x E interaction. Optimal contribution selection methods are used to maintain genetic gain without drastically depleting the genetic variance. The advanced lines are retested in multiple location in the TPE and further characterized and validated under managed stress conditions at the IRRI HQ. This approach will identify next generation breeding lines that will increase yield under rainfed environments.