

Boosting INIA's Rice Breeding Program with Molecular and Quantitative Genetics Approaches

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ABSTRACT

As a major rice exporter, Uruguay must maximize its competitiveness with higher yield, quality and innocuity, and lower inputs, in an increasingly instable environment. To timely meet these needs, INIA's public rice breeding program (IRBP) is optimizing its cultivar development pipeline by incorporating molecular and quantitative genetics approaches that will enable to increase the selection accuracy and intensity, and to shorten the breeding cycle. Different strategies are applied depending on the complexity of the target trait in the breeding germplasm: 1) molecular assisted selection (MAS) for screening and introgression of valuable alleles for oligogenic traits, for increasing selection intensity and reducing population size for field trials; 2) genome-wide association studies (GWAS) for traits with unknown genetic architecture in our germplasm; and 3) mixed models integrating pedigree, genomic, and weather data for prediction complex traits under favorable and unfavorable environments for increasing selection accuracy. For MAS, SNP markers have been validated and applied for blast resistance, herbicide tolerance, amylose content and fragrance. GWAS were performed in indica and tropical japonica advanced breeding germplasm for arsenic grain content, tolerance to low temperature at vegetative and reproductive stages, and quantitative blast resistance. Several new and known QTL were discovered in the IRBP germplasm, and the usefulness of MAS for these traits was assessed. Finally, prediction of breeding value for yield is being implemented combining historic phenotypic and pedigree records with environmental data. First analyses of multi-year and multi-location analyses are showing promising results for increasing selection accuracy and characterizing genotype by environment interactions. Combined, these molecular and quantitative approaches are contributing to optimize the IRBP, and will accelerate the delivery of best cultivars for Uruguayan rice farmers.

Key words: breeding, MAS, GWAS, genomic selection.