Genetics of Grain Arsenic Content in Two Advanced Rice Breeding Populations

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ABSTRACT

Arsenic species have a well documented toxic effect in humans. Growing rice that meets international standards for total (tAS) and inorganic arsenic (iAs) is key for human food innocuity and access of rice production to international markets. An important proportion of the variation in both tAs and iAs in rice grain is due to genetic factors. Breeding for low As content requires assessing the genetic diversity and developing suitable selection strategies for this trait. Standard laboratory methods for quantification of tAs and iAs in rice grain are expensive and low-throughput, thus are not suited for selection in breeding. This work presents the first evaluation of the genetic variability of grain tAs and iAs content in Uruguayan rice germplasm, and a genome-wide association study of grain tAs content to assess the usefulness of marker assisted selection. Two populations (150 indica and 150 tropical japonica) were genotyped-by-sequencing and their grain tAs content measured by Graphite Furnace Atomic Absorption Spectrometry. A subset of 32 genotypes representing the genotypic diversity of both populations was assayed for grain iAs and tAs content with High Pressure Liquid Chromatography-Inductively Coupled Plasma Mass Spectrometry. A significant genotypic effect was found, enabling the selection of advanced lines with low grain tAs and iAs content. For tAs, six QTL were found in the indica population, and other different 8 QTL in the tropical japonica population explaining 48% of the phenotypic variance, respectively. Content of tAs and iAs in the grain were significantly correlated (0.3, $p<0.01$) in the 32 genotypes subset. These results suggest the feasibility of MAS in breeding for low grain As content in Uruguayan rice germplasm.

Key words: association mapping, food innocuity, *Oryza sativa*, arsenic.