



# Haplotypes of *qGL3* and their roles in grain size regulation with *GS3* alleles in rice

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**ABSTRACT.** Grain size is an important trait that directly influences rice yield. The *qGL3* and *GS3* genes are two putative regulators that play a role in grain size determination. A single rare nucleotide substitution (C→A) at position 1092 in exon 10 of *qGL3* might be responsible for variations in grain size. However, little is known about the haplotype variations of *qGL3* and their interactions with *GS3* during the regulation of grain length and grain weight. In this study, *qGL3* haplotype variations were examined in 61 *Indica* varieties, and the effects of *qGL3* and *GS3* on grain trait variation in 110 lines were evaluated. Six *qGL3* haplotypes were identified, and *qGL3*-2 was a major haplotype in *Indica* varieties. Moreover, *qGL3*-6, a reported key single nucleotide polymorphism, was validated. Our results showed that the mutants *qgl3* and *gs3* (loss-of-function mutation types of *qGL3* and *GS3*, respectively) had significant effects on grain length and grain weight. However, no significant effects associated with differences in the regulation of grain thickness were observed. The genetic effects of *qgl3* on grain phenotypes were stronger than those of *gs3*. In addition to increased grain length, *qgl3* had an evident role in grain width increases. In contrast, *gs3*

played an opposite role in grain width regulation. These results provided novel insights into grain size control and the functions of *qg13* and *gs3* in rice yield improvement.

**Key words:** Rice; Haplotype; Grain size; *qGL3*; *GS3*