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qVDT11, a major QTL related to stable tiller formation of rice under drought stress conditions

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Abstract

Drought is the most serious abiotic stress limiting rice production. However, little progress has been made in the genetic analysis of drought tolerance, because it is a complex trait controlled by a number of genes and affected by various environmental factors. In here, we screened 218 rice genetic resources for drought tolerance at vegetative stage and selected 32 highly drought tolerant varieties in greenhouse. Under rain-fed conditions, Grain yield of Nagdong was decreased by 53.3% from 517 kg/10a to 241 kg/10a when compare to irrigation condition. By comparison, grain yield of Samgang was decreased by 23.6% from 550 kg/10a to 420 kg/10a. The variety Samgang exhibited strong drought tolerance and stable yield in rain-fed conditions and was selected for further study. To identify QTLs for drought tolerance, we examined visual drought tolerance (VDT) and relative water content (RWC) using a doubled haploid (DH) population consisted of 101 lines derived from a cross between Samgang (a drought tolerance variety) and Nagdong (a drought sensitive variety). Three QTLs for VDT were located on chromosomes 2, 6, and 11, respectively, and explained 41.8% of the total phenotypic variance. *qVDT2*, flanked by markers RM324 and S2016, explained 8.8% of the phenotypic variance with LOD score of 3.3 and an additive effect of −0.6. *qVDT6* was flanked by S6022 and S6023 and explained 12.7% of the phenotypic variance with LOD score of 5.0 and an additive effect of −0.7. *qVDT11*, flanked by markers RM26765 and RM287, explained 19.9% of the phenotypic variance with LOD score of 7.1 and an additive effect of −1.0. *qRWC11* was the only QTL for RWC to be identified; it was in the same locus as qVDT11. *qRWC11* explained 19.6% of the phenotypic variance, with a LOD score of 4.0 and an additive effect of 9.7. To determine QTL effects on drought tolerance in rain-fed paddy conditions, seven DH lines were selected according to the number of QTLs they contained. Of the drought tolerance associated QTLs, *qVDT2* and *qVDT6* did not affect tiller formation, but *qVDT11*increased tiller number. Tiller formation was most stable when *qVDT2* and *qVDT11* were combined. DH lines with both of these drought tolerance associated QTLs exhibited the most stable tiller formation. These results suggest that *qVDT11* is important for drought tolerance and stable tiller formation under drought stress condition in field.

Keywords: rice, drought stress, QTL, vegetative growth stage

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