Abstract

Abiotic stresses can significantly reduce crop yields. Studies of the harmful effects of heavy metals on crops have attracted much attention. Manganese (Mn) is one of the essential elements for plant growth that is involved in metabolic processes such as photosynthesis and also acts as cofactors in several enzymes. However, excess Mn is toxic to plants, which can alter metabolic processes with oxidative damage and nutrient imbalances. Barley is one of the most important crops, with a wide range of uses from human food to animal feed; it could be considered a good genetic model for the Triticeae among the cereals, to study plant response to adverse environmental conditions. Therefore, GWAS analysis was conducted to identify molecular markers associated with thirty-three phenological, morphological and physiological traits in 148 spring barley genotypes using 407 SSR and AFLP markers. The resultant data were analyzed as alpha-lattice design with two replications in two conditions (normal and Mn stress). In the phenotypic evaluation, the results of combined analysis of variance showed that there were significant differences between all genotypes and two experimental conditions. Association analysis between the markers and phenotypic traits was performed with a mixed linear model (MLM with K+Q) using the TASSEL$_{v3}$ software. In this study, many significant markers were identified for studied traits under both normal and stress conditions. A stable significant marker was detected on chromosome 5H (E42M32-250) for number of grains per main spike under stress condition. The E35M55-302 marker (55.76 cM) on chromosome 4H was associated with thousand grain weight, grain yield, biomass yield and ascorbate peroxidase activity in stress condition. Common genetic locations for these traits are probably due to pleiotropic effects or genetic linkage. Co-location of QTLs can provide a clear understanding of the genetic basis of traits, especially grain yield and its components.

Keywords: Barley, Linkage Disequilibrium, Mixed Linear Model, Manganese, Association Mapping

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