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ORIGINAL ARTICLE

Identification of novel QTLs for late leaf spot resistance and validation of a major rust QTL in peanut (*Arachis hypogaea* L.)

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Abstract

Co-occurrence of two devastating foliar-fungal diseases of peanut, viz., late leaf spot (LLS), and rust may cause heavy yield loss besides adversely affecting the quality of kernel and fodder. This study reports the mapping of seven novel stress-related candidate EST-SSRs in a region having major QTLs for LLS and rust diseases using an F_2 mapping population (GJG17 × GPBD4) consisting of 328 individuals. The parental polymorphism using 1311 SSRs revealed 84 SSRs (6.4%) as polymorphic and of these 70 SSRs could be mapped on 14 linkage groups (LG). QTL analysis has identified a common QTL (LLS_{QTL1}/$Rust_{QTL}$) for LLS and rust diseases in the map interval of 1.41 cM on A03 chromosome, explaining 47.45% and 70.52% phenotypic variations, respectively. Another major QTL for LLS (LLS_{QTL1}), explaining a 29.06% phenotypic variation was also found on LG_A03. A major rust QTL has been validated which was found harboring R-gene and resistance-related genes having a role in inducing hypersensitive response (HR). Further, 23 linked SSRs including seven novel EST-SSRs were also validated in 177 diverse Indian groundnut genotypes. Twelve genotypes resistant to both LLS and rust were found carrying the common (rust and LLS) QTL region, LLS QTL region, and surrounding regions. These identified and validated candidate EST-SSR markers would be of great use for the peanut breeding groups working for the improvement of foliar-fungal disease resistance.

Keywords Expressed sequence tag · Foliar-fungal disease · Groundnut · LLS · QTL mapping

Introduction

Globally, peanut (*Arachis hypogaea* L.) is one of the most important oilseed crops, having multiple economic uses like vegetable oil, confectionery, and feed (Nawade et al. 2019; Bhalani et al. 2019). It is widely cultivated as a grain-legume in Asia, Africa, and America, especially in the arid and semi-arid regions (Nawade et al. 2018). Besides the rich source of oil (40–60%), protein (25–30%), and carbohydrate (10–20%), it also contains various cardio-protective and anti-carcinogenic compounds (Aggarwal et al. 2004; Ko et al. 2017; Pandey et al. 2012). Globally, the peanut is cultivated in 28.52 Mha with 45.95 Mt of yield (FAOSTAT 2018). Though, India is the second-largest peanut producer (6.70 Mt), but its productivity is very low (1.36 t/ha), when equated with other major producers like China (3.75 t/ha) and USA (4.47 t/ha) (FAOSTAT 2018).

Among biotic constraints, rust, leaf spots, stem rot, and collar rot are the major ones restricting the optimum expression of yield potential (Varshney et al. 2014; Dodia et al. 2019; Bosamia et al. 2020). Late leaf spot [*Phaseoisariopsis personata* (Berk. and Curt) Deighton] and rust (*Puccinia arachidis* Speg) are the two most prevalent and devastating foliar-fungal disease of peanut which mostly occur together and may result in yield loss to the tune of 50–70%

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