LEAF RUST RESISTANCE GENES/QTLs IN DURUM WHEAT INVESTIGATED VIA ASSOCIATION MAPPING APPROACHES


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Leaf rust (Puccinia triticina) is a main fungal disease for durum wheat worldwide. Association mapping based on germplasm collections has been recently introduced in crops to validate the effect of genes/QTLs previously discovered with traditional mapping and/or to discover novel valuable allelic variation. In this study, a panel of 200 elite durum wheat accessions (Durum Panel) representative of the genetic variation present in the Mediterranean Basin and in CIMMYT and ICARDA breeding programs were tested for leaf rust response at adult plant and at seedling stage. Field experiments were carried out in artificially inoculated field trials in Italy (Argelato, Bologna) in 2006 and 2007 and in Mexico (Obregon and El Batan) in 2006, 2007 and 2008; infection type (IT) at the seedling stage was evaluated by means of artificial inoculation of 18 single spore P. triticina isolates in greenhouse experiment carried out in Italy, Minnesota, Poland and Israel. The Durum Panel was also profiled with ca. 200 SSRs and ca. 900 DArT markers of known genetic map position (linkage groups and genetic distances determined from a mapping effort using durum wheat recombinant inbred line populations). Moreover, the genetic region on chr. 7BL (deletion bin 0.78-1.00) known to harbour the major gene for leaf rust resistance present in Creso (QLr.ubo-7B.2, Maccaferri et al., 2008, TAG 117: 225-40) and the resistance gene Lr14a identified in cv. Llareta (Herrera-Foessel et al., 2008, Plant Dis 92, 469-473) has been investigated in detail through haplotyping with 16 SSR markers.

Association mapping revealed that the locus present in the 7BL region is the most important source of resistance exploited by breeders to obtain durum materials for the Mediterranean areas. Based on the profiles of four SSRs mapped in the 7BL region and showing the highest association with leaf rust resistance, the haplotypes of Creso and Llareta are most probably identical by descent; further, the Creso/Llareta haplotype is present in a number of resistant accessions from CIMMYT and ICARDA breeding programs.

In a genome-wide association mapping approach, a separate analysis of the accessions not carrying the Creso/Llareta haplotype at the 7BL region and the use of four isolates which overcome the Creso-resistance allowed us to map other regions most probably harbouring useful alleles for leaf rust resistance response.