

NOVEL SOURCES OF RESISTANCES TO LEAF, STRIPE AND STEM RUST IN THE BRAZILIAN WHEAT CULTIVAR TOROPI

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Leaf, stripe and stem rust are a major threat to wheat production worldwide. Deployment of cultivars with effective resistance is the preferred control method, considering its environmental and economical advantages over fungicide management. The effective, multiple rust resistance present in the Brazilian cv. Toropi (Frontana 1971.37/Quaderna//Petiblanco 8), released in 1965, makes it an excellent choice for genetic resistance study. A doubled-haploid population derived from Toropi-6.4 and the cv. Thatcher (168 lines) was phenotyped in Canada (2010 to 2018), New Zealand (2011 and 2012) and in Kenya (2012 and 2018), with a total of eight field trials for leaf rust and nine field trials for stripe rust, both in four locations. The population was phenotyped for stem rust resistance to Ug99 isolate and variants in field trials in Kenya in 2012 and 2018, and in seedling tests in Morden, Canada. Seedling and adult plant reactions to *Puccinia triticina* races BBBB and TBJJ were also scored in the greenhouse. A whole-genome linkage map was constructed using DNA markers from the 90K iSelect array, 227 SSR and 149 KASP markers. The linkage map included 1,223 non-redundant markers and had a total size of 3,126.2 cM. Significant quantitative trait loci (QTL) derived from Toropi-6.4 were identified in multiple environments on chromosomes 1BL for both leaf and stripe rust resistance; 3BS, 4BL, 5AL and 5DS (*Lr78*) for leaf rust resistance; 4BL and 5AL for stripe rust; and 1AL for stem rust resistance. The effect of QTL interaction on LR and YR resistance was evaluated combining the QTL that explained the biggest percentages of phenotypic variance. In most trials, the presence of the Toropi alleles on the 1BL, 5AL and 5DS LR QTL resulted in lower LR severity than any other combination, with a reduction in the severity over 40% when compared with the Thatcher allele in the three QTL. The combination of 1BL and 5AL YR QTL reduced significantly the YR severity in some locations, mainly in New Zealand. No stem rust resistance genes have previously been reported on 1AL, thus this gene, temporarily designated *SrTrp*, is novel. *SrTrp* conditions intermediate (20 MRMS) field resistance to Ug99 isolates. KASP markers have been validated in two different populations of Toropi to confirm the importance of the Toropi QTL to leaf, stripe and stem rust and to aid the incorporation of this resistance into future wheat cultivars.