Genetic analysis of *Lr13* and *Ne2*

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Leaf rust, caused by *Puccinia triticina* Eriks. (*Pt*) is a worldwide disease of wheat (*Triticum aestivum* L.) that can be controlled using leaf rust resistance (Lr) genes. *Lr13* confers race-specific resistance to *Pt* at the adult-plant stage but can also be detected at the seedling stage under certain conditions. While virulence to *Lr13* is common, the combination of *Lr13* and *Lr34* has shown to be effective in providing field resistance. Another interesting feature of *Lr13* is its association with the hybrid necrosis gene *Ne2*. Hybrid necrosis occurs in plants carrying the complementary dominant genes *Ne1* and *Ne2*. When individuals carry both *Ne1* and *Ne2*, leaves begin to die shortly after they have fully elongated (progressive necrosis). In this study we further investigate the relationship between *Lr13* and *Ne2*. A doubled haploid (DH) population (n = 196) was developed from the cross of Thatcher/Thatcher-*Lr13* (a near-isogenic line carrying *Lr13*). DH lines were inoculated with *Pt* race BBBD at the adult-plant stage and the flag leaves were rated for their infection types. Each DH line was also crossed with Kubanka, a durum wheat that carries *Ne1*, and the F_1 progeny were sown and observed for progressive necrosis. Additionally, leaf tissue was collected from each DH line for genetic mapping of *Lr13* and *Ne2* using DNA markers. There were no recombinants between *Lr13* and *Ne2* in the DH population. Genetic mapping placed these genes in a chromosomal location that is consistent with previous genetic maps. Recombinant inbred lines (RILs) were developed from the crosses CSP44/WL711 and VL404/WL711. The RILs were inoculated with *Pt* isolate 104-1,2,3,(6),(7)+Lr24 the seedling stage and were also crossed with the cultivar Spica, a carrier of *Ne1*, to assess the leaf rust resistance and the hybrid necrosis phenotypes. Out of 171 RILs there were no recombinants between *Lr13* and *Ne2*. Seed of Manitou, Egret, Thatcher-*Lr13*, and Avocet R was treated with EMS to generate mutants for *Lr13*. There were eight mutants generated that lost *Lr13* activity and did not appear to carry large chromosome deletions. These mutants were subsequently crossed with Spica. All eight of these mutants also lost *Ne2* activity. Given the co-segregation of leaf rust resistance and hybrid necrosis following at least 500 opportunities for recombination in the above populations and the co-silencing of *Lr13* and *Ne2* in EMS mutants, it appears that *Lr13* and *Ne2* may represent the same locus.