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YR15 GENE (*WTK1*) ENCODES TWO KINASE-LIKE PROTEIN DOMAINS AND CONFERS BROAD-SPECTRUM RESISTANCE TO STRIPE RUST

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New *Pst* races documented within the last two decades have caused severe yield losses worldwide. Genetic bottlenecks associated with wheat polyploidization, domestication and initial selection in agroecosystems decreased wheat genetic diversity and increased its vulnerability to biotic and abiotic stresses. Wild emmer wheat (*Triticum turgidum* ssp. *dicoccoides*, WEW), the tetraploid progenitor of common wheat, has valuable residual adaptive diversity in response to diseases, including stripe rust. *Yr15*, a dominant WEW gene located on chromosome 1BS, confers broad-spectrum resistance to stripe rust. *Yr15* was incorporated into wheat cultivars and lines in research and breeding programs around the globe. Comparative genomics, chromosome walking, BAC libraries, whole genome assemblies, EMS mutagenesis and transgenic approaches enabled us to clone *Yr15* and validate its function. The Yr15 protein, designated here as Wheat Tandem Kinase 1 (WTK1), has a novel structure for R-genes in wheat with putative kinase-pseudokinase domains that are both essential for resistance. Microscopic observations of fungal development and accumulation of biomass suggest that the hypersensitive response plays a central role in the resistance mechanism. Non-functional alleles of *Yr15* (*wtk1*) in *T. dicoccoides*, *T. durum* and *T. aestivum* differ from the functional allele of WEW G25 (*Wtk1*) by indels, creating truncated proteins. We designed diagnostic markers that differentiate between *Wtk1* and *wtk1* alleles of *Yr15*. Among 545 cultivated wheat and breeding material, including durum and common wheat accessions, only *Yr15* introgression lines contained the functional allele, whereas all others contained non-functional alleles. These results suggest that *Yr15* has the potential to improve stripe rust resistance in a wide range of tetraploid and hexaploid wheat germplasm. The absence of the functional *Yr15* in tested wheat varieties highlights the value of WEW germplasm as a reservoir of resistance genes for wheat.

ABSTRACT