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**Lead author is a graduate student.*

The World of Rust Resistance Breeding

Lead author is a graduate student.

Seed Delivery and Adoption

**Lead author is a graduate student.*

Phenotypic variation in leaf rust response in Mexican durum wheat landraces collected in Oaxaca

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Introduced to Mexico by the Spaniards around the beginning of 16th century both bread wheat and durum were cultivated mainly in the central plateau under rainfed conditions. Over 10,000 Mexican landraces were collected during 1992 to 1994, and curated and preserved at CIMMYT and INIFAP germplasm banks. Some collections were identified as durum. Our aim was to identify new diversity for resistance to race BBGBNG of the leaf rust fungus, and its derivatives, because of the susceptibility of over 90% of semidwarf durum varieties and improved durum germplasm to this race group that was introduced into Mexico in 2001. We evaluated 307 durum landraces collected in Oaxaca at the seedling stage in a greenhouse with races BBBBNG, BBBBNJ, BBGBNC, BCGBNC, BBGBPC and CBGBPC, and in field trials with races BBGBNC and BBGBPC. About 10% of accessions displayed hypersensitive responses at the seedling stage and the remaining 90% were susceptible. Over 60% of seedling susceptible accessions displayed different levels of adult plant response in field trials with final disease severities ranging from immunity to 30% and most lines displaying compatible host reactions. This group is considered to be more valuable as potentially new sources of adult plant or slow rusting resistance. Although accessions displaying 40 to 50% rust severities may not have immediate value in breeding, genotypes with higher levels of resistance can be developed by intercrossing them provided they possess diverse slow rusting resistance genes. All accessions were tall and classified as late to very late, a typical characteristic of durum landraces. Mapping of slow rusting resistance in selected accessions is underway.

Mapping of stripe rust resistance gene *Yr56* in durum wheat cultivar Wollaroi

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Stripe rust resistant Australian durum cv. Wollaroi AUS91465 was crossed with the susceptible genotype Bansi. A Wollaroi/Bansi F8 RIL population was tested for variation in stripe rust response under field conditions for three years and a DArT map was generated. Composite interval mapping (CIM) detected three consistent quantitative trait loci (QTL) in chromosomes 2A, 3B and 5B. These QTL, named *QYr.sun-2A, QYr.sun-3B* and *QYr.sun-5B*, explained on average 9.3, 26.7 and 8.7 % of the variation in stripe rust response, respectively. Wollaroi produced infection type (IT) 23N at the 4^{th} leaf stage under greenhouse conditions. The RIL population was tested at the 4^{th} leaf stage with *Pst* pathotype 150 E16A+. Monogenic segregation for stripe rust response was observed. The resistance gene was temporarily named *YrWol*. Phenotypic data were converted into genotypes and incorporated in the Wollaroi/Bansi genetic map. *YrWol* was flanked by DArT markers *wpt4197* (distally) and *wpt9104* (proximally) in chromosome 2AS. In a revised CIM analysis *QYr.sun-2A* peaked at *YrWol*. DArT clones were converted to sequence tagged site (STS) markers which were named *sun167* (*wpt4197*) and *sun168* (*wpt9104*). Lines carrying *YrWol*/*QYr.sun-2A* singly produced 40 to 50% severities. Since no other stripe rust resistance gene was located in chromosome 2AS, *YrWol* was formally named *Yr56*.

Leaf rust reactions of a *Triticum durum* germplasm collection

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Leaf rust is increasingly becoming a significant disease of durum since the detection of *Pt* race BBG/BN in Mexico in 2001. Many durum cultivars are susceptible to this race. A similar race, BBGQ, is present in California and its potential to spread to the major durum-producing areas of the U.S. northern Great Plains is a major concern. The objective of this project is to identify effective sources of resistance that can be utilized in durum to reduce the risk of yield losses due to leaf rust. A total of 497 durum accessions from the USDA-ARS National Small Grain Collection were evaluated for reaction to race BBGQ at the seedling stage. A subset of these accessions was evaluated at the adult plant stage at two locations in Mexico. Both, association mapping and biparental populations are being used to map resistance loci. The collection was screened for the presence of *Lr14a*, *Lr46*, and *Lr23* using molecular markers. Thirty two (6.4%) genotypes from 22 countries were resistant to BBGQ at the seedling stage; 19 of these were resistant at the adult stage in Mexico. Association mapping based on reaction to race BBGQ and 5,490 SNP markers revealed loci on chromosomes 2AS and 2BL that were significantly associated with resistance. For further validation 16 biparental hybrid populations were developed. Eleven of the resistant parents used in developing these populations were also resistant in Mexico. Marker screening revealed that *Lr14a* was present in only two resistant accessions from Argentina (PI 324928 and PI 383915); *Lr23* was postulated in 36% of accessions, and *Lr46* was not detected.

Searching for resistance to rusts in durum wheat genetic resources

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Early identification of valuable traits in wheat genetic resources, such as resistance to rusts, is of equal importance to the process of transferring these traits into improved cultivars. However, the lack of comprehensive evaluation of genetic resources has been an ongoing barrier to their efficient use in wheat improvement. The objective of this study is to address the hindered evaluation of genetic resources *vis a vis* sources of disease and insect resistance, but particularly to rusts, in durum wheat genetic resources. The approach is to search for patterns of relationship between a particular trait and geo-physical and climatic data of the areas from which those traits were originally sampled. If a dependency can be detected it can be used to target more intensive evaluation of accessions that otherwise might be overlooked. The study discusses the approach and the results in relation to identification of accessions available in the genebanks as well as the areas with the highest probability of yielding accessions with potential resistance to one or more of the rusts.

Responses of some Turkish durum wheat genotypes to stem rust and stripe rust

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Wheat is the staple crop of agriculture in Turkey, the second largest pasta manufacturer in the world after Italy. Stem rust and stripe (yellow) rust are the most important diseases limiting wheat production in Turkey. Eighty Turkish durum wheat genotypes developed by the Central Research Institute for Field Crops (CRIFC) and currently in advanced yield trials were evaluated for adult plant response to local *Pgt* and *Pst* races. Evaluations were carried out at the facilities of CRIFC at İkizce and Yenimahalle in Ankara in 2012. Although weather conditions after inoculation were not favorable, disease development was enhanced with irrigation. Stem rust and stripe rust responses on each entry were scored twice using the modified Cobb scale when the susceptible check Little Club had reached 80S severity. Coefficients of infections (CI) were calculated and values below 20 were considered to be resistant. Forty one (51%) genotypes were resistant to stem rust (avirulent on seedlings with *Sr24, Sr26, Sr27* and *Sr31*) and 61 (81%) were resistant to stripe rust (virulent on seedlings of Lee, Heines Kolben, Heines Peko, Kalyansona, Sonalika, Federation*4/ Kavkaz and Avocet S); and 32 (40%) genotypes were resistant to both stem rust and stripe rust. This work enabled the identification of candidate lines resistant to stem rust and stripe rust.

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New sources of resistance to stem rust and leaf rust in durum wheat in India

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Stem rust and leaf rust are the major biotic stresses affecting durum wheat in India. Field responses of durum genotypes in advanced varietal trials in inoculated multi-location field nurseries during 2006-2013 were determined in order to identify sources of resistance. Genotypes showing maximum co-efficients of infection of 10.0 for a minimum two years were classified as 'resistant'. Four genotypes, HI 8682, HI 8722, HI 8731 and HI 8739, were resistant to mixtures of important *Pgt* pathotypes. In isolated single pathotype nurseries all four genotypes were resistant to the most prevalent bread wheat-virulent pathotype 40A (62G29), whereas HI 8731 and HI 8739 was resistant only to 117-6 (37G19), the most common one on durum in India. Stem rust resistance genes *Sr11+* (HI 8682), *Sr2+* (HI 8722), *Sr2+9e+13+* (HI 8739) were postulated in these genotypes. HI 8663 showed resistance to many *Pt* pathotypes, including 77-5 (121R63-1) and 104-2 (21R55), the most prevalent ones. *Lr23+* was postulated in this genotype. It is evident that these genotypes carry genes additional to those listed above. These unknown resistance genes could serve as sources of stable resistance in durum.