Registration of Five Wheat Isogenic Lines for Leaf Rust and Stripe Rust Resistance Genes

We report here the release of four germplasm lines of hard red spring (HRS) wheat (T. aestivum L.) [Yecora Rojo Yr36–Gpc-B1 (Reg. no. GP-793, PI 638740), Yecora Rojo Lr47 (Reg. no. GP-791, PI 638738), Kern Lr47 (Reg. no. GP-792, PI 638739), and Anza Lr37/Yr17/Sr38 (Reg. no. GP-795, PI 638742)] and one durum wheat (T. turgidum L.) [UC1113 Yr36–Gpc-B1 (Reg. no. GP-794, PI 638741), isogenic for leaf rust (Puccinia triticina) resistance gene Lr47, stripe rust (P. striiformis), and stem rust (P. graminis) to their recurrent parents. The isogenic lines are expected to be more than 99% identical to their recurrent parents.

Isogenic Lines for Stripe Rust Resistance Gene Yr36 and Grain Protein Content Gene Gpc-B1

Chromosome 6B from T. turgidum ssp. dicoccoides (Körn.) Thell. accession ‘FA15–3’ from Israel (DIC hereafter) carries a gene that significantly increases grain protein content (Cantrell and Joppa, 1991). This gene was initially mapped as a quantitative trait locus within a 30-cM region of the short arm of chromosome 6BS using Recombinant Substitution Lines (RSLs) of the DIC 6B chromosome in the genetic background of Langdon (Joppa et al., 1997). The same DIC chromosome segment was found in the hexaploid wheat variety ‘Glupro’ (‘Columbus’/T. turgidum var. dicoccoides’/Len’) (Khan et al., 2000; Mesfin et al., 1999). The gene responsible for the differences in grain protein content was mapped as a single locus designated Gpc-B1 proximal to the Nuclear Organizer Region (Olmos et al., 2003; Distelfeld et al., 2004).

During field evaluations of the RSLs at University of California (UC) at Davis (Olmos et al., 2003), we observed that the lines with the DIC segment were more resistant to stripe rust than the lines with the Langdon segment. Two RSLs with the DIC 6BS region and two with the Langdon region were evaluated under controlled conditions at Washington State University. At the seedling stage, all lines were susceptible to the 15 different stripe rust races tested (including the new races PST100 and PST101), but when the same lines were evaluated at the adult plant stage under a high-temperature environment, some of the plants carrying the DIC segment showed purple stems in some plants. The two pairs of isogenic lines were compared in field trials at Madera, CA, and Davis, CA, in 2004 under severe stripe rust infection pressure using a split plot design with two replications and large plots (1.2 by 4.0 m in Davis and 1.5 by 4.0 m in Madera). Lines with and without Yr36–Gpc-B1 showed no significant differences in height and heading time for both the tetraploid and hexaploid pairs of isogenic lines.

The UC1113 Yr36–Gpc-B1 line showed a significant reduction in stripe rust infections (from 87 to 51% severity, Davis P = 0.20, Madera P = 0.0009), higher yields (average increase of 970 kg ha⁻¹, Davis P = 0.05, Madera P = 0.02), and an average increase of 850 g protein per 100 kg of grain relative to the isogenic line without the DIC 6BS chromosome segment (from 13.2 to 14.1% protein content, Davis P = 0.03, Madera P = 0.0007). Test weights of the lines with the Yr36–Gpc-B1 genes (79.3 ± 0.5 kg hL⁻¹) and without these genes (78.8 ± 0.9 kg hL⁻¹) were not significantly different in this experiment.

The UC1113 Yr36–Gpc-B1 line showed a significant reduction in stripe rust severity (from 36 to 2% severity, Davis P = 0.03, Madera P = 0.006), slightly higher yields (average increase of 242 kg ha⁻¹, although not significant in both locations), and an average increase of 1100 g protein per 100 kg of grain relative to the isogenic line without the DIC 6BS chromosome segment (from 13.5 to 14.5% protein content, Davis P = 0.006, Madera P < 0.0001). Test weights of the lines with the Yr36–Gpc-B1 genes (80.1 ± 0.5 kg hL⁻¹) and without these genes (81.0 ± 0.5 kg hL⁻¹) were not significantly different in this experiment.

Isogenic Lines for Leaf Rust Resistance Gene Lr47

The interstitial translocation line TTAS-7S#1–7AS-7AL carrying Lr47 from T. speltoides (Tausch) Gren. was originally transferred to bread wheat by irradiating hybrid seed (CI15092/T. speltoides/Fletcher/35°/Centurk) with fast neutrons (Wells et al., 1982). Interstitial segments of chromosome 7S#1 were transferred to chromosome 7A of hexaploid wheat using the phi1 mutation that promotes homoeologous recombination (Łukaszewski 1995). The interstitial translocations were backcrossed three times into hard white spring variety ‘Pavon 76’ (PI 519847) and plants homozygous for the interstitial translocation were released as germplasm PI 603918 (Łukaszewski et al., 2000). The BC1F3 seeds of the homoeologous lines were deposited at the National Small Grains Collection (NSGC) as Yecora Rojo Lr47 and Kern Lr47. The two pairs of isogenic lines were compared in field trials at Kings, CA, in 2003 and Kings and UC Davis, CA, in 2004 using a split plot design with four replications [plot size (1.2 by 4.0 m in Davis and 1.5 by 4.0 m in Kings)]. Isogenic lines with and without the gene showed similar agronomic characteristics including height and heading time. Depending on the environment, some of the plants carrying the Lr47 chromosome segment showed purple stems in some plants.

No significant differences in yield between isogenic lines with and without the Lr47 gene were detected at Kings.