

Registration of 'Okfield' Wheat

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'Okfield' (Reg. No. CV-1019, PI 643087) is a hard red winter (HRW) wheat (*Triticum aestivum* L.) cultivar developed and released cooperatively by the Oklahoma Agricultural Experiment Station (AES) and the USDA-ARS in 2005. It is recommended for dryland wheat production using either grain-only or dual-purpose management systems in the west-central Great Plains. Reasons for its release include tolerance to imazamox herbicide, improved winter dormancy retention relative to other imazamox-tolerant cultivars, and good stay-green capacity of the flag leaf.

Okfield resulted from a single cross between an imazamox-tolerant BC₃F₂ plant with the pedigree TXGH12588-120*4/FS4, and the HRW experimental line HBZ374C, eventually released as '2174' by the Oklahoma AES and the USDA-ARS in 1997. 2174 has the pedigree IL71-5662//PL145' (PI 600840)//'2165'. TXGH12588-120 is a nonreleased sister line of the HRW wheat cultivar 'TAM 110' (Lazar et al., 1997), and FS4 was derived by sodium azide-induced mutagenesis of the cultivar Fidel. The BC₃F₂ population was provided by American Cyanamid Company. Ownership of the gene mutation was subsequently transferred to BASF Corporation.

The F₁ plant generation was produced in the greenhouse in 1998, and the F₂ generation was advanced at Stillwater, OK, the following year. Single heads were collected from plants that survived 36 g ai ha⁻¹ imazamox in February 1999. Okfield is derived from a single F_{2:3} head row selected at Stillwater in 2000 on the basis of tolerance to 36 g ai ha⁻¹ imazamox, plant and head type, maturity, kernel size, and field-sprouting tolerance. The F_{2:4} head row progeny was evaluated in an augmented experimental design in 2001 at Stillwater and Lahoma, OK, and treated with

18 g ai ha⁻¹ imazamox in March. Comparisons were made to nontreated check plots of 2174 for tillering capacity, fertile spike density, grain yield, kernel size, grain volume weight, hardness index, and wheat protein content.

After compositing the seed from a single field plot at Stillwater in 2001, Okfield was tested as OK02909C in replicated breeder trials from 2002 through 2004 representing 49 site-years in Oklahoma, Kansas, and Colorado. Bulk seed increases occurred in Stillwater each year with a March application of 18 g ai ha⁻¹ imazamox. Further testing was provided in the USDA-ARS Regional Germplasm Observation Nursery (RGON, entry 47) and BASF-sponsored qualification trials conducted during the 2003–2004 crop season. Okfield was included in the Oklahoma State University Wheat Variety Trials (OWVT) beginning in 2004. End-use quality was examined in 2004 by the USDA-ARS Hard Winter Wheat Quality Laboratory (Manhattan, KS), ConAgra, Inc. (Omaha, NE), and the Hard Winter Wheat Milling and Baking Evaluation Program sponsored by the Wheat Quality Council. Breeder seed was produced in Yuma, AZ, in 2004. Okfield is an F₂-derived line currently in the F₁₀ generation (2006–2007 crop season).

Okfield is a moderately tall, semidwarf wheat with intermediate maturity based on arrival to first-hollow-stem (FHS) stage and heading date. Averaged across 3 yr (2004–2006), it reached the FHS stage in central Oklahoma 7 and 10 d later than 'AP502CL' and 'Jagger' (Sears et al., 1997) and 5 d earlier than the late FHS-stage cultivar 2174. The genetic range in FHS date among current cultivars is typically defined by Jagger and 2174 (Edwards, unpublished data, 2007). Arrival at FHS stage also is highly consistent for Okfield, with a range of 4 d across years (same as 2174), compared with a range of 14 d for Jagger. Heading date for Okfield is 4 d later than AP502CL, a relatively early-heading cultivar, and 2 d earlier than the intermediate cultivar 2174. Okfield exhibits high-temperature (35°C ambient temperature) sensitivity during germination, similar to 2174 and 'Ok102' (PI 632635), another descendent of 2174. Its vegetative canopy during the fall is semi-erect to erect and similar to 2174 but more erect than Jagger. Plant height of Okfield in Oklahoma is 85 cm, 7 cm taller than AP502CL. Based only on environments with moderate to severe lodging, Okfield had a mean rating of 2.1 (scale of 1 = tolerant to 5 = susceptible, *n* = 7 observations), compared with 2.7 for AP502CL; in contrast, 2174 is highly resistant to lodging and rarely receives a rating other than 1.

Based on field observations in Oklahoma, Okfield is susceptible to *Wheat soilborne mosaic virus* and *Wheat spindle streak mosaic virus* but shows an intermediate reaction to *Barley yellow dwarf virus* similar to 2174. Based on natural field infection and

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observations of adult plants across Oklahoma through 2006, it showed a moderately susceptible reaction to leaf rust, caused by *Puccinia triticina* Eriks. and an intermediate reaction to stripe rust caused by *P. striiformis* Westendorp. f. sp. *tritici*. Based on a scale of 0 (resistant) to 4 (highly susceptible) during the stripe rust epidemic in 2005, Okfield had a mean rating of 1.3 across seven Oklahoma sites, compared with mean ratings of 2.7 for AP502CL and 2.8 for the susceptible check, Ok102. In the seedling stage, Okfield is moderately susceptible to wheat stem rust caused by *P. graminis* f. sp. *tritici* (composite of races RCRS, TTTT, QFCS, QCCJ, and others; Y. Jin, personal communication, 2004). Based on limited greenhouse observations in Oklahoma, Okfield is moderately susceptible to septoria leaf blotch (*Septoria tritici* Roberge in Desmaz.). Its reaction to tan spot [*Pyrenophora tritici-repentis* (Died.) Drechs.] in greenhouse tests has been inconsistent and thus is inconclusive. Based on greenhouse and field observations, its reaction to powdery mildew (*Blumeria graminis* f. sp. *tritici*) has ranged from intermediate to resistant.

In greenhouse seedling tests, Okfield showed a heterogeneous reaction (50% resistant: 50% susceptible) to biotypes E and I greenbug (*Schizaphis graminum* Rondani), which confirms the presence of *Gb3*. It is susceptible to Biotypes 1 and 2 of Russian wheat aphid, *Diuraphis noxia* (Mordvilko). Seedling reaction to a Kansas population of Hessian fly (*Mayetiola destructor*) is heterogeneous (M. Chen, personal communication, 2006).

Green-leaf retention, or stay-green, is a pronounced characteristic of Okfield. Based on replicated ratings across six environments challenged by either leaf rust or stripe rust during the mid-grain filling period, stay-green rating on a scale of 1 (green canopy) to 9 (senesced canopy) according to Martin et al. (2003), averaged 4.6 for Okfield and 8.3 for AP502CL ($P < 0.05$). Although Okfield may show a nonresistant reaction type to these diseases, it maintains a greater area of nonchlorotic tissue on the flag leaf even during periods of severe infection.

Flag leaves of Okfield at the boot stage are blue-green, recurved, twisted, and waxy. Spikes are white-chaffed, awned, oblong, middense, and recurved at harvest-maturity. Kernels are red, hard-textured, ovate, and they have a midwide, middeep crease, rounded cheeks, and large germ.

Okfield was tested in the OWVT in 2005 and 2006, along with 2174 and AP502CL. With the severe infection of stripe rust in 2005, mean yields were 2510 (Okfield), 2520 (AP502CL), and 2370 kg ha⁻¹ (2174) (LSD = 180 kg ha⁻¹, $n = 13$ environments, $P < 0.05$). With severe, season-long drought stress in 2006, mean grain yields were 2070 (Okfield), 2120 (AP502CL), and 1910 kg ha⁻¹ (2174) (LSD = 130 kg ha⁻¹, $n = 16$ environments, $P < 0.05$). Hence, in these trials, Okfield and AP502CL had similar yields, but both exceeded the yield of 2174. Okfield and AP502CL also shared similar grain volume weight, but both were lower than 2174. In 2005 these values were 74.7 (Okfield), 73.1 (AP502CL), and 76.1 kg hL⁻¹ (2174) (LSD = 0.6 kg hL⁻¹, $n = 13$ environments, $P < 0.05$). In 2006 grain volume weight averaged 78.4 (Okfield), 77.1 (AP502CL), and 79.6 kg hL⁻¹ (2174) (LSD = 0.6 kg hL⁻¹, $n = 16$ environments, $P < 0.05$).

The below-average grain volume weight of Okfield is coupled with above-average kernel size. Across 15 site-years in Oklahoma from 2002 to 2004, Okfield averaged 30.0 mg kernel weight based on the single-kernel characterization system (SKCS), and 2.40 mm SKCS-kernel diameter. Corresponding values for AP502CL were 30.4 mg kernel weight and 2.28 mm kernel diameter.

Based on evaluation of multilocation ($n = 6$) composite grain samples from two crop seasons (2004 and 2005) by the USDA-ARS Hard Winter Wheat Quality Laboratory, Okfield averaged 635 g kg⁻¹ in Quadrumat Senior flour yield (C.W. Brabender Instruments, South Hackensack, NJ) across years, with a flour ash content of 39 g kg⁻¹. The check cultivar OK Bullet, noted for exceptional milling and baking quality (Carver et al., 2006), produced values of 675 g kg⁻¹ and 31 g kg⁻¹ for flour yield and flour ash, respectively. With multienvironment comparisons to other cultivars, Okfield typically has a significantly lower ($P < 0.05$) flour yield by approximately two to three percentage points. Wheat and flour protein (140 g kg⁻¹ moisture basis) averaged 123 g kg⁻¹ and 109 g kg⁻¹, respectively, for Okfield, compared with 131 kg⁻¹ and 117 kg⁻¹ for OK Bullet.

Straight-dough baking quality of Okfield is acceptable but not exceptional. From the same samples mentioned above, Okfield averaged 596 g kg⁻¹ bake absorption, mixing tolerance score of 2.0 on a scale of 0 (poor) to 6 (good), 3.2 min bake mixing time, 867 cm³ loaf volume, 75 loaf-volume regression score, and 2.1 for crumb-grain score on a scale of 0 (poor) to 6 (good). Corresponding values for OK Bullet were 632 g kg⁻¹ bake absorption, 4.0 mixing tolerance score, 5.2 min bake mixing time, 857 cm³ loaf volume, 64 loaf-volume regression score, and 4.0 crumb-grain score. Weaknesses identified by the Hard Winter Wheat Quality Council were open crumb grain and yellow crumb color. High-molecular-weight glutenin subunits that are present in Okfield at the *Glu-A1*, *Glu-B1*, and *Glu-D1* loci are, respectively, 2*, 6*+8*, and 2+12/3+12 (Shan et al., 2007).

U.S. Plant Variety Protection for Okfield has been filed (PVP application no. 200600227). All seed requests should be sent to the corresponding author during the period of Protection by the Plant Variety Protection Certificate. Seed of this release is deposited in the National Plant Germplasm System, where it will be available after the expiry of the Plant Variety Protection for research purposes, including development and commercialization of new cultivars. It is requested that appropriate recognition be made if this cultivar contributes to the development of new germplasm or cultivars.

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