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## Registration of 'Bond CL' Wheat

'Bond CL' (Reg. no. CV-979, PI 639924) hard red winter wheat (*Triticum aestivum* L.) was developed by the Colorado Agricultural Experiment Station and released to seed producers in August 2004. Bond CL was released based on its resistance to the original North American biotype, designated as "Biotype 1" (D.R. Porter, personal communication, 2004), of the Russian wheat aphid [*Diuraphis noxia* (Mordvilko)], its tolerance to imazamox {2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid} herbicide, its adaptation to dryland production in eastern Colorado and the west-central Great Plains, and improved bread baking quality relative to available imazamox-tolerant cultivars.

Bond CL is a doubled-haploid line developed using the wheat × maize (*Zea mays* L.) hybridization method (Laurie and Bennett, 1988) from the cross 'Yumar'//TXGH12588–120*4/FS2 made in 1997. Yumar (PI 605388) is a hard red winter wheat cultivar released by Colorado State University in 1997 (Quick et al., 2001) and TXGH12588–120 is an unreleased sister selection of the hard red winter wheat cultivar TAM 110 (PI 595757). The wheat germplasm line FS2 was developed by BASF Corporation (formerly American Cyanamid) using sodium azide–induced mutagenesis of the French wheat cultivar Fidel to obtain tolerance to the imidazolinone class of herbicides (Newhouse et al., 1992). Doubled haploids were generated in the $F_1$ generation of the cross between Yumar and an imazamox-tolerant $BC_3F_2$ plant with the pedigree TXGH12588–120*4/FS2.

Doubled haploids were produced in the greenhouse and growth chambers at Fort Collins, CO. Vernalized seeds from the $F_1$ were planted in the greenhouse during the winter of 1997–1998. Wheat florets were emasculated approximately 2 to 3 d before application of fresh maize pollen using a small brush. One day after pollination, spikes were sprayed and injected with a solution containing 25 mg $kg^{-1}$ 2,4-dichlorophenoxyacetic acid (2,4-D) and 75 mg $kg^{-1}$ gibberellic acid ($GA_3$) (Giura, 1997). Immature embryos were excised from fertilized seeds 12 to 14 d after pollination and placed on modified Gamborg's B5 medium in culture tubes in a growth chamber. Seedlings of regenerated haploid plants were transplanted to soil pots and vernalized for 8 wk at 2°C. After vernalization, when two to three tillers had developed on each plant, regenerated haploid plants were treated with a 0.1% colchicine solution for chromosome doubling. Seeds harvested from the doubled haploid plants were increased in the greenhouse during the spring of 1999 and then in the field at Fort Collins, as plant rows during 1999–2000. During the winter of 1999–2000, remnant seed samples from the greenhouse increase were evaluated for resistance to Russian wheat aphid Biotype 1 in standard greenhouse screening tests (Nkongolo et al., 1989) and for herbicide tolerance by germinating 20 seeds in petri dishes in the presence of an aqueous solution (50 μL $L^{-1}$) of imazamox herbicide. Bond CL was selected from the plant rows grown in 2000 at Fort Collins and was given the experimental number CO00D007. Bulk seed increases of Bond CL were grown in 2001 at Fort Collins, concurrent with replicated yield trials in eastern Colorado. Following treatment of the seed increases with imazamox herbicide (44.8 g a.i. $ha^{-1}$) in the fall of 2000, single spikes were selected at random for further seed increase in 2002. Seed increase of Bond CL was done by treating 405 headrows with imazamox herbicide (44.8 g a.i. $ha^{-1}$) in Yuma, AZ, in 2002 and compositing the seed from the rows. Breeder seed was produced in 2003 in Yuma.

Bond CL is a medium-early maturing, semidwarf hard red winter wheat. Average heading date of Bond CL is about 1.8 d later than 'Above' (Haley et al., 2003) and about 2.2 d earlier than Yumar. Plant height of Bond CL is medium-tall, about 4.6 cm taller than Above and about 3.5 cm taller than Yumar. Coleoptile length of Bond CL (78.5 mm, $n = 6$ observations) is shorter than Above (86.5 mm), but longer than Yumar (62.9 mm). Shattering tolerance of Bond CL is good (3.6 score, 1 = no shatter to 9 = severe shatter, $n = 3$ observations), slightly better than Above (4.3 score) and Yumar (4.8 score). On the basis of field evaluations under natural infection in Colorado and cooperative evaluations through the USDA Regional Testing Program, Bond CL is moderately susceptible to stem rust (caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn.; composite of races QFCS, QTHJ, RCRS, TPMK, and TTTT), moderately susceptible to leaf rust (caused by *Puccinia triticina* Eriks.; composite of races MLRT, MFBP, TKBP, TDGT, and KBQT), moderately susceptible to stripe rust (caused by *Puccinia striiformis* f. sp. *tritici* Westend.; natural field infection), and moderately susceptible to *Wheat streak mosaic virus*. In greenhouse seedling screening tests, Bond CL is resistant to greenbug [*Schizaphis graminum* (Rondani)] biotype E, and susceptible to the Great Plains biotype of Hessian fly [*Mayetiola destructor* (Say)]. Resistance to Russian wheat aphid Biotype 1 in Bond CL is conditioned by the *Dn4* resistance gene from the Yumar parent. Average Russian wheat aphid resistance scores for Bond CL (1.8 score, 1 = very resistant to 5 = very susceptible, $n = 11$ observations) in standard greenhouse seedling screenings tests are slightly better than Yumar (2.2 score).

Bond CL was tested at 14 trial locations of the Colorado Dryland Uniform Variety Performance Trial (UVPT) during 2002 (three locations), 2003 (six locations), and 2004 (five locations). Grain yields of Bond CL (3205 kg $ha^{-1}$) were slightly lower than Above (3252 kg $ha^{-1}$) and greater than 'AP502 CL' (3044 kg $ha^{-1}$; Lazar et al., 2003), the only two cultivars in the trials with tolerance to imazamox. Compared with Russian wheat aphid resistant cultivars in the trials, Bond CL had higher grain yield than 'Ankor' (3138 kg $ha^{-1}$; PI 632275), 'Stanton' (3104 kg $ha^{-1}$; PI 617033), 'Prairie Red' (3097 kg $ha^{-1}$; PI 605390), and Yumar (3064 kg $ha^{-1}$). Average test weight for Bond CL (737 g $L^{-1}$) in these trials was less than Stanton (761 g $L^{-1}$); Yumar (754 g $L^{-1}$); Above, Ankor, and Prairie Red (749 g $L^{-1}$); and AP502 CL (743 g $L^{-1}$). Bond CL was tested at two trial locations of the Colorado Irrigated Variety Performance Trial (IVPT) in 2004. In these trials, Bond CL (7583 kg $ha^{-1}$) had lower grain yield than 'Yuma' (7701 kg $ha^{-1}$; PI 559720) and higher grain yield than Ankor (7318 kg $ha^{-1}$) and Prairie Red (7228 kg $ha^{-1}$). The lodging score of Bond CL in these trials was average (4.0 score, 1 = erect to 9 = flat scale, $n = 3$ observations), greater than Yuma (1.7 score) and Prairie Red (2.0 score) and lower than Ankor (5.0 score). Bond CL was tested in the 2004 Southern Regional Performance Nursery (SRPN). Across nine locations in the High Plains region, Bond CL was the 16th highest yielding entry in the trial (3240 kg $ha^{-1}$; 50 total entries).

Milling and bread baking characteristics of Bond CL were determined from multilocation composite grain samples from the Colorado UVPT in 2001 and 2002. The imazamox tolerant cultivar Above was used a check in these evaluations. Values for milling-related variables of Bond CL were generally inferior to Above. Bond CL (719 g $L^{-1}$) had lower grain volume weight than Above (735 g $L^{-1}$); lower Single Kernel Characterization System (SKCS) kernel weight (23.5 mg $kernel^{-1}$) than Above (27.9 mg $kernel^{-1}$); lower SKCS kernel diameter (1.89 mm) than Above (2.16 mm); lower SKCS kernel hardness index (78.3 score) than Above (80.4 score); lower flour ash (4.2 g $kg^{-1}$) than Above (4.3 g $kg^{-1}$); and lower Quadromat Senior flour extraction (653 g $kg^{-1}$) than Above

(669 g $kg^{-1}$). Values for baking-related variables of Bond CL were generally superior to Above. Bond CL had similar grain protein content (122 g $kg^{-1}$) as Above (123 g $kg^{-1}$); higher (623 g $kg^{-1}$) mixograph water absorption than Above (618 g $kg^{-1}$); higher (4.0 score; 0 = unacceptable to 6 = excellent scale) mixograph tolerance score than Above (1.0 score); longer (3.6 min) mixograph mixing time than Above (2.7 min); higher (615 g $kg^{-1}$) bake water absorption than Above (605 g $kg^{-1}$); longer (4.8 min) bake mixing time than Above (3.0 min); smaller (0.915 L) pup loaf volume than Above (0.930 L); and higher (4.4 score; 0 = unacceptable to 6 = excellent scale) pup loaf crumb grain score than Above (2.8 score).

Bond CL contains a patented herbicide tolerance trait owned by BASF Corp. that confers tolerance to imidazolinone herbicides, such as imazamox. Any use of Bond CL requires a Material Transfer Agreement (for research use only) or a Commercial License to the trait, as well as permission from the originator. Contact the corresponding author for all seed requests. The corresponding author will forward the request for seed to BASF Corporation. No seed will be distributed without written permission from both BASF and the Colorado State University for 20 yr from the date of release by Colorado State University (2004), at which time seed will also be available from the NPGS.

The Colorado Agricultural Experiment Station will maintain Breeder seed of Bond CL. Multiplication and distribution rights of other classes of seed have been transferred from the Colorado Agricultural Experiment Station to the Colorado Wheat Research Foundation, 7100 S. Clinton St. Suite 120, Centennial, CO 80112. Bond CL has been submitted for U.S. Plant Variety Protection under Public Law 91–577 with the certification only option.

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