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CULTIVAR DESCRIPTION

CDC Precision durum wheat

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Abstract: CDC Precision durum wheat is adapted to the durum production area of the Canadian prairies. This conventional height durum wheat cultivar combines high grain yield potential with high grain pigment and low grain cadmium. CDC Precision is resistant to prevalent races of leaf, stem and stripe rust, and common bunt and expresses end-use quality suitable for the Canada Western Amber Durum (CWAD) class.

Key words: Triticum turgidum L. var *durum*, durum wheat, yield, yellow pigment, cultivar description.

Résumé : La variété de blé dur CDC Precision est acclimatée aux zones des Prairies canadiennes où l'on cultive le blé dur. Ce cultivar de taille classique combine un rendement grainier potentiel élevé à un grain très pigmenté, pauvre en cadmium. CDC Precision résiste aux races courantes de rouille des feuilles, de rouille de la tige, de rouille jaune et de carie. Sa qualité en fonction de l'usage final en autorise le classement en tant que blé dur ambré de l'Ouest canadien (CWAD). [Traduit par la Rédaction]

Mots-clés : Triticum turgidum L. var *durum*, blé dur, rendement, pigment jaune, description de cultivar.

Introduction

CDC Precision, a spring durum wheat (*Triticum turgidum* L. var. *durum*), was developed at the Crop Development Centre (CDC), University of Saskatchewan, Saskatoon, SK and received registration No. 7832 from the Canadian Food Inspection Agency (CFIA) on 23 Oct. 2015. A Plant Breeders' Rights protection was filed with the CFIA (No. 15-8655).

Pedigree and Breeding Method

CDC Precision is derived from the cross CDC Verona/DT724//DT765 made at the CDC in the summer of 2004. CDC Verona (Pozniak et al. 2009) is a registered cultivar developed at the CDC. DT724 derives from the cross DT666/DT665 and DT765 from DT513/DT696. The F_1 generation was increased at a contra-season nursery in New Zealand and the resulting F_2 plants were grown in a space-planted nursery at Saskatoon, SK. In 2005, more than 400 single F_2 spikes were selected and bulk-threshed to produce the F_3 generation, which was increased in bulk at a contra-season nursery in New Zealand. In 2006, the F_4 generation was grown in a space-planted nursery of approximately 6000 plants, and just over 400 single spikes were selected. The $F_{4:5}$ rows were planted in 2007 at Saskatoon and D04.66.020 was identified as having acceptable plant height, maturity, and straw strength. D04.66.020 was evaluated in un-replicated F_6 yield trials conducted at Saskatoon in 2008. Quality evaluations on F_6 harvested seed indicated appropriate yellow pigment, and acceptable grain protein concentration and gluten strength for the Canada Western Amber Durum class. In the same year, resistance to leaf rusts (caused by *Puccinia triticina* Eriks.) and Fusarium head blight (FHB, caused by *Fusarium graminearum* Schwabe) were evaluated in endemic nurseries at Saskatoon and Carman, MB, respectively. The rust races used in the nursery were representative of those found in disease surveys the previous year (McCallum and Seto-Goh 2008, 2009; Fetch 2009). In 2009, D04.66.020 was evaluated for agronomic traits in replicated yield trials in the Saskatoon area at the University of Saskatchewan Kernen and Goodale farms, Swift Current, and Moose Jaw. In the same year, resistance to leaf rusts and FHB were evaluated in endemic nurseries at Saskatoon, and Carman, respectively. Leaf spot reaction, primarily caused by tan spot (*Pyrenophora tritici-repentis* Died.) and septoria (*Septoria tritici* Roberge in Desmaz.), was noted in trials from Kernen, Goodale, and Swift Current. DNA marker testing with the gene-specific marker *HMA3-B1* was conducted and confirmed

Received 26 May 2016. Accepted 24 October 2016.

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Table 1. Grain yield (kg ha^{-1}) of CDC Precision and check cultivars in the Durum Cooperative Registration Trial 2012–2014[a].

	2012			2013			2014			2012–2014			2013–2014		
	Black[a]	Brown[b]	Mean	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean
Brigade	—	—	—	4891	5156	5108	5170	4173	4375	—	—	—	5008	4653	4725
AAC Cabri	3070	3822	3595	4619	4951	4891	5078	3874	4113	4243	4240	4219	4874	4415	4509
AC Navigator	2138	3055	2780	3556	4540	4367	4045	3349	3490	3195	3685	3569	3777	3975	3949
Strongfield	2934	3359	3232	4174	4816	4701	4896	3748	3978	3996	3992	3987	4561	4302	4350
CDC Precision	3791	4068	3982	5138	5032	5051	5295	4087	4328	4777	4381	4468	5243	4547	4685
$LSD_{0.05}$	472	382	308	668	245	240	761	356	334	249	355	234	553	301	267
No. of tests	3	7	10	2	9	11	2	8	10	7	24	31	4	17	21

[a]Black soils: Indian Head, SK; Brandon and Souris, MB (2012).
[b]Brown and Dark Brown soils: Moose Jaw (2012–2013), Pense (2014), Regina (2012), Scott, Saskatoon, Stewart Valley, Swift Current, Vanguard (2013–2014), SK; Lethbridge, Vulcan, AB.

Table 2. Maturity, test weight, 1000-kernel weight, height, and lodging of CDC Precision and check cultivars in the Durum Cooperative Registration Trial 2012–2014[a].

	Maturity (d)			Test weight (kg hL^{-1})			1000-kernel		
	Black[a]	Brown[b]	Mean	Black	Brown	Mean	weight (g)	Height (cm)	Lodging (1–9)
Brigade	98	106	105	75.3	79.6	78.7	41.4	103	2.1
AAC Cabri	97	105	105	75.9	79.5	78.6	39.3	97	3.0
AC Navigator	97	105	103	72.9	78.4	77.2	42.3	81	1.8
Strongfield	97	104	102	75.4	78.5	77.7	39.8	93	2.9
CDC Precision	97	104	103	76.7	79.6	78.9	39.7	97	2.0
$LSD_{0.05}$	2	1	1	1.2	0.8	0.7	1.1	2	0.9
No. of tests	6	19	25	6	24	30	30	30	15

[a]Black soils: Indian Head, SK; Brandon and Souris, MB (2012).
[b]Brown and Dark Brown soils: Moose Jaw (2012–2013), Pense (2014), Regina (2012), Scott, Saskatoon, Stewart Valley, Swift Current, Vanguard (2013–2014), SK; Lethbridge, Vulcan, AB.

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D04.66.020 carries the allele for low grain cadmium concentration. In 2010, D04.66.020 was further evaluated at Swift Current, Regina, Lethbridge, and Kernen in the Durum Wheat A Test (and associated disease nurseries), and advanced after evaluation of end-use functionality on composite samples. In 2011, D04.66.020 was evaluated in the Durum Wheat B test and as DT577 in the Durum wheat co-operative tests over 3 yr (2012–2014).

The variables measured and the operating protocols followed in the Durum Wheat Cooperative test were those approved each year by the Prairie Recommending Committee for Wheat Rye and Triticale (current operating procedures can be found at http://www.pgdc.ca/committees_wrt.html). In agronomic performance trials, the check cultivars over all 3 yr of trialing were: Strongfield (Clarke et al. 2005), AC Navigator (Clarke et al. 2000), and AAC Cabri. In 2013, Brigade (Clarke et al. 2009) was added as a check. In the cooperative trials, the stem rust races were TPMK, TMRT, RHTS, QTHS, RTHJ, RKQS, and MCCF (Roelfs and Martens 1988; Fetch et al. 2011). The leaf rust inoculum comprised a mixture of prevalent races isolated from the western Canadian prairies as determined from yearly survey studies (McCallum et al. 2010, 2011, 2013). Resistance to races T26, T32, and T33 of loose smut [*Ustilago tritici* (Pers.) Rostr.] (Nielsen 1987) and L1, L16, T1, T6, T13, and T19 of common bunt [*Tilletia laevis* Kühn in Rabenh., and *T. tritici* (Bjerk.) G. Winter in Rabenh.] (Hoffmann and Metzger 1976) were evaluated in the Durum Cooperative Registration Trial. End-use quality was assessed at the Grain Research Laboratory, Canadian Grain Commission using approved methods (AACC 2000) each year on composite grain samples from all locations with acceptable physical condition (grade Canada Western Amber Durum #3 or better) to give a target grain protein concentration of 13%.

Data presented here were analyzed using SAS PROC MIXED (Littell et al. 2006), with replications, sub-blocks, agroecological zones, locations, and years considered as random effects, and entries considered fixed. The *diff* command was used to estimate the standard error of the difference between entries, and was used to estimate an F-protected least significant difference (LSD) at a significance level of 5% ($LSD_{0.05}$). For end-use quality data, years were considered as replications.

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Table 3. Grain protein concentration (%) of CDC Precision compared with check cultivars in the Durum Cooperative Registration Trial 2012–2014[a].

	2012			2013			2014			2012–2014	2013–2014
	Black[a]	Brown[b]	Mean	Black	Brown	Mean	Black	Brown	Mean	Mean	Mean
Brigade	—	—	—	12.7	12.7	12.7	12.8	13.0	12.9	—	12.9
AAC Cabri	16.0	14.2	14.8	13.9	13.1	13.3	13.5	13.9	13.8	14.1	13.5
AC Navigator	15.3	14.3	14.6	13.5	12.9	13.0	12.8	13.3	13.2	13.8	13.1
Strongfield	16.2	14.9	15.3	14.7	13.6	13.8	13.5	13.9	13.8	14.5	13.9
CDC Precision	15.1	13.6	14.0	13.4	13.3	13.3	13.3	13.3	13.3	13.7	13.3
$LSD_{0.05}$	0.9	0.6	0.5	1.2	0.4	0.4	—	0.6	0.6	0.3	0.3
No. of tests	3	7	10	2	9	11	1	8	9	30	20

[a]Black soils: Indian Head, SK; Brandon and Souris, MB (2012).
[b]Brown and Dark Brown soils: Moose Jaw (2012–2013), Pense (2014), Regina (2012), Scott, Saskatoon, Stewart Valley, Swift Current, Vanguard (2013–2014), SK; Lethbridge, Vulcan, AB.

Table 4. Disease reactions of CDC Precision and check cultivars grown in the Durum Cooperative Registration Trial 2012–2014.

Year	Entry	Stem rust	Leaf rust	Stripe rust	Common bunt	Loose smut	Leaf spots[a]	FHB index[b]		DON[c] (mg kg^{-1})
								Carman	Glenlea	
2012	Brigade	—	—	—	—	—	—	—	—	—
	AAC Cabri	MR	R	VR	R	MR	8.0	56.5	27.5	10.3
	AC Navigator	I	R	R	R	I	10.0	65.5	10.2	33.7
	Strongfield	MR	R	R	R	MR	7.8	54.5	11.7	12.5
	CDC Precision	MR	R	VR	R	MS	8.3	42.2	16.3	8.8
2013	Brigade	R	R	R	R	R	8.3	22.7	7.0	—
	AAC Cabri	MR	R	R	R	R	7.8	33.8	15.3	—
	AC Navigator	R	R	S	R	MR	9.3	50.5	8.7	—
	Strongfield	R	R	R	R	R	8.3	30.0	10.3	—
	CDC Precision	R	R	R	R	R	8.3	27.2	15.3	—
2014	Brigade	R	R	MR	R	R	8.5	18.8	—	30
	AAC Cabri	R	R	MR	R	R	8.5	32.3	—	32
	AC Navigator	R	R	R	R	R	9.8	56.2	—	42
	Strongfield	R	R	R	R	MR	8.8	39.8	—	35
	CDC Precision	R	R	R	R	MR	8.5	21.5	—	21

Note: VR, very resistant; R, resistant; MR, moderately resistant; I, intermediate resistance; MS, moderately susceptible; S, susceptible.
[a]Adult plant rated at mid-grain fill at Swift Current, using the McFadden Scale where <5 = 6, 6 = MR, 7 = I, 8–9 = MS, and S = 10–11.
[b]Fusarium head blight index: (% infected spikelets × % infected heads)/100. Indices are averages from replicated trials at Carman and Glenlea, MB.
[c]Deoxynivalenol measured on composites of replications at Glenlea in 2012 and Carman in 2014.

Performance

Agronomy: Averaged over 31 station-years, CDC Precision yielded 12% more than Strongfield, 25% more than AC Navigator, and 6% more than AAC Cabri (Table 1). CDC Precision yielded similar to Brigade in 2013–2014. CDC Precision expresses conventional height similar to AAC Cabri, with lodging resistance similar to Brigade and AC Navigator (Table 2). Maturity of CDC Precision was similar to Strongfield and test weight was similar to the highest checks Brigade and AAC Cabri. Kernel weight was within the range of the checks. Grain protein concentration of CDC Precision was similar to AC Navigator over the 3 yr, higher than Brigade in 2013–2014, and lower than the other checks (Table 3).

Disease: CDC Precision was resistant to prevalent races of leaf and stem rust, and has excellent common bunt resistance, similar to the checks. Leaf spot reaction was similar to the most resistant checks, and loose smut reaction was similar to the checks (Table 4). The FHB reaction of CDC Precision was within the range of the check cultivars, and the average DON concentration was lower than the checks (Table 4).

Table 5. Average values for quality traits measured on yearly composite samples of CDC Precision and check cultivars evaluated in the 2012–2014 Durum Cooperative Registration Trial.

			Semolina							Alveograph				
	Grain protein (%)	FN[a] (s)	Yellow pigment	Protein (%)	*b**	Yield (%)	Ash (%)	GI[b] (%)	Pasta *b**	P	W	L	P/L	Grain Cd (ppm)
Brigade	12.9	393	10.2	11.8	32.4	66.1	0.68	89	63.7	82	248	94	0.88	0.070
AAC Cabri	13.5	393	10.3	12.4	33.1	66.7	0.65	67	65.5	79	205	89	0.52	0.064
AC Navigator	13.0	412	10.2	12.1	32.3	67.8	0.70	78	64.0	57	162	111	0.91	0.224
Strongfield	13.8	365	9.2	12.8	31.1	66.3	0.63	70	62.9	67	183	90	0.76	0.078
CDC Precision	13.0	382	11.3	12.0	34.0	66.5	0.69	84	65.9	75	210	93	0.82	0.072
$LSD_{0.05}$	0.3	43	0.3	0.3	0.7	0.6	0.02	8	1.0	8	24	13	0.15	0.012

[a]FN, falling number.
[b]GI, gluten index.

End-use Suitability: Grain protein concentration of CDC Precision was higher than Brigade and similar to AC Navigator in the field (Table 3) and composite samples (Table 5). CDC Precision has low cadmium concentration like Strongfield, but expresses yellow pigment higher than all of the check cultivars (Table 5). The high yellow pigment was reflected in significantly greater pasta *b** values than all of the checks except AAC Cabri. The average falling number of CDC Precision was within the range of the check cultivars, but higher than Strongfield. CDC Precision is a conventional gluten strength type, with gluten index and alveograph parameters similar to AC Navigator. Semolina milling yield and semolina ash content were within the range of the check cultivars.

Other Characteristics

SPIKES: Spikes of CDC Precision are tapering to parallel-sided, dense, long and erect, with an absent waxy bloom. Spikes express white awns that are longer than the spike; the lower glumes are medium in width, while glumes are medium long and slightly pubescent; glume shoulders are elevated and narrow; the glume beak is slightly curved; the lemma beak is straight.

KERNELS: Kernels are amber in color, medium sized, and elliptical; cheeks are slightly angular; crease is mid-deep, and mid-wide to wide; brush is short; embryo is medium sized.

END-USE SUITABILITY: CDC Precision is eligible for grades of the Canada Western Amber Durum wheat class.

Maintenance and Distribution of Pedigreed Seed

Approxmiately 190 Single spikes of CDC Precision were selected from a $F_{4:10}$ increase grown at Saskatoon in 2012. The $F_{10:11}$ spikes were threshed and grown as single 1 m row plots in 2013 and off-type rows discarded. The remaining head rows were harvested individually and used to establish one hundred and sixty-nine 27 m rows in 2014. Off-type rows were again discarded and bulk harvested to produce Breeder Seed. In total, 149 $F_{10:12}$ breeder lines were composited to form the Breeder Seed. CDC Precision consists of a composite of 149 $F_{10:12}$ breeder lines. Breeder seed will be maintained by the Crop Development Centre, University of Saskatchewan, Saskatoon, SK S7N 5A8, Canada. CDC Precision will be added to the OECD list of cultivars. Distribution and multiplication of pedigreed seed stocks will be handled by Alliance Seed 24th Floor, 333 Main Street, Winnipeg, MB R3C 4E2, Canada. Commercial launch of CDC Precision is anticipated in 2017–2018.

Acknowledgements

Financial support from the Saskatchewan Ministry of Agriculture, the University of Saskatchewan, and the Wheat Producer Check Off (administered by the Western Grains Research Foundation) is gratefully acknowledged. Appreciation is expressed to the following: A.K. Singh and R.M. DePauw (Swift Current Research and Development Centre, AAFC, Swift Current, SK), B. Beres (Lethbridge Research Centre, AAFC, Lethbridge, AB), and T. Ferguson (CPS Canada, Saskatoon, SK) for agronomic performance testing; C. Briggs (CDC, University of Saskatchewan, Saskatoon, SK), B. Fu and L. Schlichting (Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB), and D. Niziol (Cereal Research Centre, AAFC, Winnipeg, MB) for end-use suitability analysis; A. Brule-Babel, (University of Manitoba, Winnipeg, MB), and J. Gilbert (Cereal Research Centre, AAFC, Winnipeg, MB), and M. Fernandez (Swift Current Research and Development Centre, AAFC, Swift Current, SK) for assessing reaction to Fusarium head blight and/or leaf spots; J.G. Menzies (Morden Research and Development Centre, AAFC, Morden, MB) for determining reaction to loose smut, and R. Kutcher (University of Saskatchewan, Saskatoon, SK), T. Fetch (Brandon Research and Development Centre, AAFC, Brandon, MB), and C. McCartney and B. McCallum (Morden Research and Development Centre, AAFC, Morden, MB) for assessing reaction to stem

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and leaf rust; D.A. Gaudet and T. Despins (Lethbridge Research and Development Centre, AAFC, Lethbridge, AB) for assessing reaction to common bunt; D.A. Gaudet and H. Randhawa (Lethbridge Research and Development Centre, AAFC, Lethbridge, AB) for assessment of stripe rust, and D. Benallack (University of Saskatchewan, Saskatoon, SK) for maintenance of Breeder Seed. The technical support provided by R. Lawrie, R. Babonich, H. Lazarko, C. Beierle, C.V. Tang, T. Stephens, M. Torrico, J. Ens, and K. Wiebe (CDC, University of Saskatchewan, Saskatoon, SK) is gratefully acknowledged.

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