

## CDC Vivid durum wheat

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Pozniak, C. J. 2013. **CDC Vivid durum wheat**. *Can. J. Plant Sci.* **93**: 137–141. CDC Vivid 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 protein concentrations and low grain cadmium. CDC Vivid is strong-strawed and has similar maturity and disease resistance to the current check cultivars.

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

Pozniak, C. J. 2013. **Le blé dur CDC Vivid**. *Can. J. Plant Sci.* **93**: 137–141. Vivid est une variété de blé dur adaptée à la zone de production du blé dur des Prairies canadiennes. Ce cultivar de hauteur classique se caractérise par un rendement grainier potentiel élevé et un grain très pigmenté, riche en protéines et pauvre en cadmium. CDC Vivid a une paille robuste et est aussi précoce et résistant à la maladie que les cultivars témoins actuels.

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

CDC Vivid, a spring durum wheat (*Triticum turgidum* L. var. *durum*), was developed at the Crop Development Center, University of Saskatchewan, and received registration No. 7220 from the Canadian Food Inspection Agency on 2012 Jun. 27.

### Pedigree and Breeding Method

CDC Vivid is derived from the cross “DT529/9468-DQ\*3//Strongfield” made at the Crop Development Centre (CDC), University of Saskatchewan in the summer of 2002. DT529 derives from the cross D92288/D91430, and 9468-DQ\*3 derives from the same cross as Strongfield (AC Avonlea/DT665) (Clarke et al. 2005). The F<sub>1</sub> generation was increased at a contra-season nursery near Christchurch, New Zealand, and resulting F<sub>2</sub> plants were grown in a space-planted nursery at Saskatoon in 2003. Desirable F<sub>2</sub> plants were selected and bulked at harvest, and the F<sub>3</sub> seed increased near Christchurch, New Zealand. The F<sub>4</sub> generation was space planted in a leaf rust (caused by *Puccinia triticina* Eriks.) and stem rust (caused by *Puccinia graminis* Pers.:Pers. f.sp. *tritici* Eriks. & E. Henn.) nursery at Saskatoon in 2004, and 300 single plants were selected and grown as F<sub>5</sub> head rows at Saskatoon in 2005. The rust races used in this nursery were representative of those found in disease surveys the previous year (McCallum and Seto-Goh 2008; Fetch 2009). The F<sub>5</sub> head row D02.97.34 was identified as having acceptable yield, maturity and height in F<sub>6</sub> yield trials conducted at Saskatoon and Swift Current, Saskatchewan in 2006. In the same year, reaction to Fusarium head blight (FHB) caused by *Fusarium graminearum* Schwabe was

evaluated at an endemic nursery at Carman, Manitoba. Resistance to leaf rust and stem rust were assessed in the F<sub>6</sub> and F<sub>7</sub> generations in a epiphytotic leaf and stem rust nursery at Saskatoon that was inoculated with mixtures of prevalent races (McCallum and Seto-Goh 2009; McCallum et al. 2010; Fetch et al. 2011). Grain protein concentration and yellow pigment content were estimated using near infrared reflectance spectroscopy and gluten strength was estimated using the gluten index (Approved Method 38-12, American Association of Cereal Chemists 2000) on F<sub>6</sub> harvested grain. DNA marker testing was performed in the F<sub>6</sub> generation using *ScOpc20* (Wiebe et al. 2010) and revealed that D02.97.34 lacked the amplicon associated with high grain cadmium. D02.97.34 was further evaluated at Saskatoon, Lethbridge, Regina and Swift Current in the Western Durum Wheat A-test in 2007. Reaction to Fusarium head blight (FHB) was assessed in the Western Durum Wheat A-Test in a nursery near Portage la Prairie, MB, and for leaf and stem rust at nurseries established near Glenlea, MB. D02.97.34 was evaluated as DT562 in the Durum wheat co-operative registration tests over 4 yr (2008–2011). 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](http://www.pgdc.ca/committees_wrt.html)). In co-operative trials, the stem rust races were TPMK, TMRT, RHTS, QTHS, RTHJ, RKQS, and MCCF (Roelfs et al. 1988; Fetch et al. 2011). The leaf rust inocula comprised a mixture of prevalent races

**Table 1. Grain yield (kg ha<sup>-1</sup>) of CDC Vivid and check cultivars in the Durum Cooperative Test (2008–2011)<sup>z</sup>**

	2008			2009			2010			2011			4-yr mean		
	Zone1	Zone2	Mean	Zone1	Zone2	Mean	Zone1	Zone2	Mean	Zone1	Zone2	Mean	Zone1	Zone2	Mean
AC Avonlea	4517	4270	4359	6211	4279	4922	4466	3607	3895	4312	3700	3823	4966	3972	4270
AC Morse	4691	4256	4413	5961	4172	4771	4907	3746	4133	4245	3876	3949	5043	4009	4323
AC Navigator	4384	4483	4446	5772	4499	4921	3635	3631	3633	3793	3667	3692	4506	4060	4186
Strongfield	4322	4383	4360	6258	4405	5021	4658	3749	4053	4487	3886	4008	5012	4119	4387
Commander	4384	4561	4499	6244	4569	5128	4307	3767	3943	4164	3940	3983	4852	4219	4407
CDC Vivid	4550	4611	4590	6061	4386	4945	4665	4126	4301	4695	4141	4250	5037	4330	4541
<b>LSD<sub>0.05</sub></b>	<b>430</b>	<b>267</b>	<b>250</b>	<b>525</b>	<b>215</b>	<b>249</b>	<b>445</b>	<b>338</b>	<b>279</b>	<b>907</b>	<b>208</b>	<b>231</b>	<b>413</b>	<b>191</b>	<b>204</b>
No. Stations	4	7	11	4	8	12	3	6	9	2	8	10	13	29	42

<sup>z</sup>Zone 1 (Black soils): Indian Head, SK; Brandon and Souris, MB; Langdon, ND; Zone 2 (Brown and Dark brown soils): Avonlea, Moose Jaw, Pense, Regina, Scott, Saskatoon, Stewart Valley, and Swift Current, SK; Biesecker, Lethbridge, and Vulcan, AB.

**Table 2. Agronomic performance and grain protein concentration (%) of CDC Vivid and check cultivars in the Durum Cooperative test (2008–2011)**

	Maturity (d) <sup>z</sup>			Test wt. (kg hL <sup>-1</sup> ) <sup>z</sup>			Kernel wt (mg) Mean	HT (cm) Mean	Lodg (1–9) Mean	% protein <sup>z</sup>		
	Zone1	Zone2	Mean	Zone1	Zone2	Mean				Zone1	Zone2	Mean
AC Avonlea	102	112	110	75.5	79.5	78.4	43.9	89	2.2	14.4	13.5	14.0
AC Morse	102	112	110	75.0	78.9	77.8	43.5	85	1.7	13.8	13.1	13.2
AC Navigator	104	113	111	75.9	80.2	78.9	46.3	79	2.4	13.8	12.7	13.0
Strongfield	102	112	110	76.3	80.4	79.2	44.6	87	2.4	14.6	13.4	13.7
Commander	102	112	110	74.8	79.4	78.1	46.6	76	2.2	14.0	12.7	13.0
CDC Vivid	103	112	110	76.2	80.1	79.0	44.0	87	1.6	14.4	13.4	13.6
<b>LSD<sub>0.05</sub></b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0.9</b>	<b>0.4</b>	<b>0.5</b>	<b>0.9</b>	<b>2</b>	<b>0.4</b>	<b>0.4</b>	<b>0.3</b>	<b>0.2</b>

<sup>z</sup>Zone 1 (Black soils): Indian Head, SK; Brandon and Souris, MB; Langdon, ND; Zone 2 (Brown and Dark brown soils): Avonlea, Moose Jaw, Pense, Regina, Scott, Saskatoon, Stewart Valley, and Swift Current, SK; Biesecker, Lethbridge, and Vulcan, AB.

Table 3. Disease Reactions of CDC and check cultivars grown in the Durum Cooperative test (2008–2011)

Year	Entry	Stem rust <sup>z</sup>	Leaf rust <sup>z</sup>	Stripe rust		Common bunt <sup>z</sup>	Loose smut	Leaf spots <sup>x</sup>	FHB index <sup>y</sup>		DON <sup>w</sup> (mg kg <sup>-1</sup> )
				Lethbridge	Creston				Carman	Glenlea	
2008	AC Avonlea	R	R	–	–	MR	I	7.5	44	24	25.5
	AC Morse	R	R	–	–	VR	MS	8.8	50	17	20.5
	AC Navigator	R	R	–	–	VR	–	8.5	61	20	39.5
	Strongfield	R	R	–	–	VR	MS	7.0	54	23	30.5
	Commander	R	R	–	–	R	MS	7.3	62	16	36.9
	CDC Vivid	R	R	–	–	VR	I	7.5	65	23	31.7
	LSD <sub>0.05</sub>								10	14	
2009	AC Avonlea	RMR	R	–	–	R	S	–	26	49	23.9
	AC Morse	R	R	–	–	R	MS	–	34	54	36.9
	AC Navigator	RMR	R	–	–	R	MS	–	36	41	35.6
	Strongfield	R	R	–	–	R	MS	–	38	59	27.3
	Commander	R	R	–	–	R	S	–	29	57	27.2
	CDC Vivid	R	R	–	–	R	MR	–	29	65	30.4
	LSD <sub>0.05</sub>								14	15	
2010	AC Avonlea	R	R	–	–	MS	I	7.2	55	38	41.0
	AC Morse	R	R	–	–	R/MR	MS	9.7	69	21	38.1
	AC Navigator	R	R	–	–	R/MR	MR	8.5	74	43	40.2
	Strongfield	R	R	–	–	R/MR	I	7.7	53	44	49.0
	Commander	R	R	–	–	R/MR	I	7.7	59	59	52.4
	CDC Vivid	R	R	–	–	R/MR	I	8.1	62	46	38.4
	LSD <sub>0.05</sub>								15	22	
2011	AC Avonlea	MR	R	25	30	MR	MR	7.5	–	17	7.8
	AC Morse	MR	R	12	20	MR	MS	7.9	–	25	11.3
	AC Navigator	R	R	12	Trace	R	R	8.8	–	21	16.2
	Strongfield	R	R	14	10	MR	MR	7.3	–	15	7.8
	Commander	R	R	16	0	R	R	7.8	–	15	16.7
	CDC Vivid	R	R	9	0	MR	I	7.8	–	22	7.1
	LSD <sub>0.05</sub>									12	

<sup>z</sup>VR, very resistant; R, resistance; MR, moderately resistant; I, intermediate resistance; MS, moderately susceptible; S, susceptible.

<sup>y</sup>Fusarium head blight index: (% infected spikelets × % infected heads)/100. Indices are averages from replicated trials at Carman and Glenlea, MB.

<sup>x</sup>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.

<sup>w</sup>Deoxynivalenol (DON) measured on composites of replications at Glenlea, MB.

isolated from the western Canadian prairies as determined from yearly survey studies (McCallum et al. 2010, 2011). 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* Kuhn in Rabenh., and *T. tritici* (Bjerk.) G. Wint. In Rabenh.] (Hoffman and Metzger 1976) were evaluated in the Durum Cooperative tests. Stripe rust (caused by *Puccinia striiformis* Westend. f. sp. *tritici*. Eriks) was evaluated at Creston, British Columbia and Lethbridge, Alberta in 2011. Reactions to FHB were evaluated near Glenlea and Carman, MB.

To generate Breeder Seed, approximately 200 single spikes of CDC Vivid were selected from a rogued F<sub>8</sub> increase grown at Saskatoon in 2008. Heads were then grown as single 1-m row plots in 2009 and off-type rows were discarded. The remaining head rows were harvested individually and used to establish 145, 27-m rows in 2010. Because of poor weather conditions in 2010, remnant seed from 2009 was used to re-establish the rows in 2011. Again, off type rows were discarded and

the 136 remaining breeder lines were composited to form the Breeder Seed.

## Performance

### Agronomy

Averaged over 42 station-years, CDC Vivid yielded, 8% more than AC Navigator and 6% more than AC Avonlea and exhibited similar yield to Commander (Table 1). In Zone 2, CDC Vivid expressed significantly higher grain yield ( $P < 0.05$ ) than Strongfield, AC Avonlea, and AC Morse. CDC Vivid is a conventional height cultivar, similar in height to AC Avonlea and Strongfield, but with superior lodging resistance (Table 2). Time to maturity and 1000-kernel seed weight of CDC Vivid were similar to Strongfield. The test weight of CDC Vivid was better than AC Avonlea, AC Morse, Commander, and AC Navigator, and was similar to Strongfield (Table 2). Grain protein concentration of CDC Vivid was similar to Strongfield, and higher than AC Morse, AC Navigator and Commander.

Table 4. Average values for quality traits measured on yearly composite samples of CDC Vivid and check cultivars evaluated in the 2008, 2009 and 2011<sup>z</sup> Durum Cooperative tests

	Grain protein (%)		Yellow pigment (mg kg <sup>-1</sup> )		Semolina			Alveograph					Grain Cd (mg kg <sup>-1</sup> )		
	FN <sup>y</sup> (s)		Protein (%)		b*	a*	Yield (%)	ash (%)	Pasta b*	GI <sup>x</sup> (%)	P	W		L	P/L
AC Avonlea	378	13.3	12.4	8.2	32.70	4.50	67.1	0.62	62.96	11	50	121	100	0.52	0.222
AC Morse	425	13.1	12.0	8.0	32.04	4.26	66.7	0.64	61.97	49	78	193	80	0.99	0.186
Strongfield	383	13.4	12.3	8.6	33.02	5.03	67.2	0.60	61.72	57	73	199	87	0.88	0.084
AC Navigator	428	12.7	11.7	9.2	33.64	6.46	68.1	0.64	67.07	62	95	233	76	1.26	0.254
Commander	442	12.5	11.6	9.6	34.44	5.86	67.7	0.60	67.91	92	128	305	65	2.02	0.260
CDC Vivid	392	13.4	12.5	10.8	35.94	6.16	66.4	0.65	64.88	68	85	222	79	1.09	0.089
<b>LSD<sub>0.05</sub></b>	<b>35</b>	<b>0.4</b>	<b>0.3</b>	<b>0.3</b>	<b>0.44</b>	<b>0.68</b>	<b>0.4</b>	<b>0.02</b>	<b>2.01</b>	<b>5</b>	<b>8</b>	<b>22</b>	<b>12</b>	<b>0.27</b>	<b>0.013</b>

<sup>z</sup>Quality data from 2010 was not used for deliberations by the Quality Evaluation Team because of the poor grade of composite samples.<sup>y</sup>Falling number.<sup>x</sup>Gluten Index.

### Disease

CDC Vivid is resistant to prevalent races of leaf and stem rust, and has excellent common bunt resistance, like the checks (Table 3). Leaf spot reaction was similar to AC Avonlea. CDC Vivid is susceptible to FHB like the check cultivars. The deoxynivalenol (DON) levels of CDC Vivid were in the range of the check cultivars (Table 3). Reaction to loose smut was variable, but CDC Vivid expresses resistance similar to AC Avonlea. CDC Vivid showed a resistant reaction to stripe rust when assessed under natural infection at Lethbridge and Creston in 2011.

### End-use Suitability

Grain protein concentration of CDC Vivid was similar to Strongfield in Zone 1 and Zone 2 (Table 2) and in quality composite samples (Table 4). CDC Vivid has low cadmium concentration like Strongfield, but expresses yellow pigment higher than all of the check cultivars. The high yellow pigment was reflected in greater pasta b\* values when compared with Strongfield, AC Avonlea, and AC Morse (Table 4). The average falling number of CDC Vivid was within the range of the check cultivars, similar to Strongfield and AC Avonlea (Table 4). CDC Vivid 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. Averaged over all years of testing, CDC Vivid showed higher semolina protein concentration (0.2%) than Strongfield.

### Other Characteristics

**SPIKE:** Spikes of CDC Vivid are tapering, mid-dense, mid-long, erect, with white awns that are longer than the spike; the width of the lower glumes are narrow, while the length of the glumes are mid-long and slightly pubescent; glume shoulders are sloping and are narrow; the glume beak is slightly curved.

**KERNEL:** Kernels are amber in color, midsize to large, and elliptical; cheeks are angular; crease is mid-deep to shallow, and mid-wide; brush is short; embryo is mid-sized.

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

### Maintenance and Distribution of Pedigreed Seed

CDC Vivid consists of a composite of 136 F<sub>8:10</sub> breeder lines. Breeder seed will be maintained by the Crop Development Centre, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 5A8. A Plant Breeders' Rights application has been filed. CDC Vivid will be added to the OECD list of cultivars. Distribution and multiplication of pedigreed seed stocks will be

handled by Viterra, 2625 Victoria Avenue, Regina, Saskatchewan, Canada S4T 7T9.

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