CDC Vantta durum wheat

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Source: Canadian Journal of Plant Science, 102(6) : 1201-1208

Published By: Canadian Science Publishing

URL: https://doi.org/10.1139/cjps-2022-0118

Canadian Journal of Plant Science

Cultivar description

CDC Vantta durum wheat

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Abstract

CDC Vantta durum wheat (*Triticum turgidum* L. subsp. *durum*) is adapted to the durum production area of the Canadian prairies. CDC Vantta combines high grain yield potential, strong straw, and a semi-dwarf growth habit. CDC Vantta is resistant to leaf and stripe rusts and common bunt, and expresses high yellow pigment in the grain and superior pasta colour compared with check cultivars. CDC Vantta has low cadmium concentration and is eligible for grades of the Canada Western Amber Durum class.

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

Résumé

La variété de blé dur (Triticum turgidum L. subsp. durum) CDC Vantta convient à la culture du blé dur dans les Prairies canadiennes. Le cultivar se caractérise par un rendement grainier potentiel élevé, une paille robuste et un port semi-nain. CDC Vantta résiste à la rouille des feuilles et à la rouille jaune ainsi qu'à la carie. Son grain jaune, très pigmenté, donne aux pâtes alimentaires une plus belle couleur que celle obtenue avec les variétés témoins. Avec un grain à faible teneur en cadmium, CDC Vantta est admissible à la catégorie « blé dur ambré de l'Ouest canadien ». [Traduit par la Rédaction]

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

Introduction

CDC Vantta, a spring durum wheat (*Triticum turgidum* L. subsp. *durum*), was developed at the Crop Development Centre (CDC), University of Saskatchewan, Saskatoon, SK, Canada, and received registration no. 9455 from the Canadian Food Inspection Agency (CFIA) on 15 October 2021. Plant Breeders' Rights protection was filed with the CFIA (no. 21-10716).

Breeding methods and pedigree

CDC Vantta is derived from the cross D06.76.042/D05.15.089 made at the CDC, University of Saskatchewan, Saskatoon, SK, Canada, in 2012. D06.76.042 derives from the cross DT722/DT741//DT760 and D05.15.089 from DT722/DT752//A0042-CK01. The F_1 generation was increased in a polyhouse and resulting F_2 generation was grown in a space-planted nursery of approximately 10 000 plants at Saskatoon in 2013. In total, 300 single F_2 spikes were selected based on acceptable plant height and time to maturity and subjected to single seed descent in the F_3 and F_4 generations. The $F_{4:5}$ generation was planted as head rows at a contra-season nursery near Christchurch, New Zealand, during the winter of 2014/2015. DNA marker testing was conducted on the F_5 embryos, and lines carrying the allele for reduced lipoxygenase activity (Hessler et al. 2002; Carrera et al. 2007) and for low cadmium accumulation (Wiebe et al. 2010) were advanced and grown in unreplicated F_6 yield trial at Saskatoon during summer 2015. The line D012.008X.112 was identified as having acceptable plant height, time to maturity, straw strength, and grain yield. 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 (Canadian Grain Commission 2019). In 2016, D012.008X.112 was evaluated with appropriate check cultivars for agronomic traits in replicated yield trials in the Saskatoon area at the University of Saskatchewan Kernen and Goodale Research Farms, Swift Current, Regina, and Elrose, SK. In the same year, resistance to leaf and stripe rusts was evaluated in inoculated nurseries at Saskatoon and resistance to *Fusarium* head blight (FHB) was evaluated at Saskatoon, SK and Carman, MB for disease incidence (%) and severity (%). In 2017, D012.008X.112 was advanced and evaluated at Kernen, Goodale, Swift Current, Indian Head, Stewart Valley, SK, and Lethbridge, and Taber, AB as an entry in the Durum Western B Test (and associated disease nurseries) and advanced after evaluation of end-use functionality on a composite sample. Check cultivars in the Durum Western B test were Strongfield (Clarke et al. 2005), AC Navigator (Clarke et al. 2000), AAC Cabri (Singh

Table 1. Grain yield (kg ha^{-1}) of CDC Vantta and check cultivars in the Durum Wheat Cooperative Registration Test (2018–2020) in black and brown soil zones.

	2018			2019			2020			2018–2020		
Entry	Black[a]	Brown[b]	Mean	Black	Brown	Mean	Black	Brown	Mean	Black	Brown	Mean
AC Navigator	4841	4174	4333	4247	4637	4556	4484	4598	4573	4529	4491	4496
Brigade	5598	4191	4540	5706	5201	5306	5425	4901	5007	5580	4833	4978
Strongfield	4891	4023	4236	5007	4909	4938	5338	4839	4924	5085	4650	4727
AAC Cabri	4965	4299	4463	5235	5248	5249	4897	4566	4624	5026	4755	4805
CDC Vantta	**5277**	**4543**	**4727**	**5485**	**5440**	**5445**	**4546**	**4554**	**4547**	**5082**	**4888**	**4930**
$LSD_{0.05}$[c]	534	340	286	673	371	317	707	242	227	419	324	311
No. of tests	2	6	8	2	7	9	2	9	11	6	22	28

[a]Black soils: Indian Head, SK; Brandon, MB.
[b]Brown and dark brown soils: Moose Jaw, Pense (2018 and 2019), Scott, Saskatoon, Stewart Valley, Swift Current, Hodgeville, Elrose (2020), SK; Lethbridge, Brooks (2018 and 2019), Vauxhall (2020), AB.
[c]Least significant difference at 5% significance level.

Table 2. Maturity, test weight, 1000-kernel weight, height, and lodging of CDC Vantta and check cultivars in the Durum Wheat Cooperative Registration Test (2018–2020) in black and brown soil zones.

Entry	Maturity (days)			Test weight (kg hL^{-1})			Mean 1000-kernel weight (g)	Mean height (cm)	Mean lodging[c] (1–9)
	Black[a]	Brown[b]	Mean	Black	Brown	Mean			
AC Navigator	98.2	100.2	99.8	80.3	81.9	81.6	46.5	76	2.0
Brigade	99.1	100.8	100.4	80.6	80.7	80.7	44.0	94	1.5
Strongfield	96.8	98.4	98.0	81.0	81.0	81.0	44.0	87	2.2
AAC Cabri	99.5	99.6	99.4	81.0	81.4	81.4	41.8	91	2.6
CDC Vantta	**101.3**	**102.3**	**102.0**	**80.4**	**82.0**	**81.7**	**42.5**	**77**	**1.4**
$LSD_{0.05}$[d]	3.8	0.9	0.8	1.4	0.9	0.9	1.4	3	1.1
No. of tests	4	19	23	6	23	29	29	29	7

[a]Black soils: Indian Head, SK; Brandon, MB.
[b]Brown and dark brown soils: Moose Jaw, Pense (2018 and 2019), Scott, Saskatoon, Stewart Valley, Swift Current, Hodgeville, Elrose (2020), SK; Lethbridge, Brooks (2018 and 2019), Vauxhall (2020), AB.
[c]Lodging scored on a 1–9 scale, where 1 = all plants in a plot are erect and 9 = all plants in a plot are lying horizontal.
[d]Least significant difference at 5% significance level.

Table 3. Grain protein concentration (%) of CDC Vantta compared with check cultivars in the Durum Wheat Cooperative Registration Test (2018–2020) in black and brown soil zones.

	2018			2019			2020			
Entry	Black[a]	Brown[b]	Mean	Black	Brown	Mean	Black	Brown	Mean	Mean for 2018–2020
AC Navigator	13.4	14.2	14.0	12.9	12.9	12.9	14.0	13.5	13.6	13.5
Brigade	13.3	14.5	14.2	12.0	13.4	13.1	13.4	13.9	13.8	13.7
Strongfield	14.6	14.7	14.6	13.0	14.0	13.8	14.7	14.2	14.3	14.2
AAC Cabri	13.7	14.7	14.4	11.5	13.3	12.9	14.5	14.0	14.1	13.8
CDC Vantta	**13.3**	**13.9**	**13.8**	**11.0**	**12.9**	**12.4**	**14.3**	**13.9**	**13.9**	**13.4**
$LSD_{0.05}$[c]	0.9	0.5	0.4	1.2	0.5	0.5	1.1	0.4	0.4	0.4
No. of tests	2	7	9	2	7	9	2	9	11	29

[a]Black soils: Indian Head, SK; Brandon, MB.
[b]Brown and dark brown soils: Moose Jaw, Pense (2018 and 2019), Scott, Saskatoon, Stewart Valley, Swift Current, Hodgeville, Elrose (2020), SK; Lethbridge, Brooks (2018 and 2019), Vauxhall (2020), AB.
[c]Least significant difference at 5% significance level.

Table 4. Disease reactions of CDC Vantta and check cultivars grown in the Durum Wheat Cooperative Registration Test (2018–2020).

Year	Entry	Stem rust		Leaf rust	Stripe rust	Common bunt	Loose smut	Leaf spot[a]
		Morden	Brandon					
2018	AC Navigator	1R	10I	0R	4R	0R	14R	3.6
	Brigade	1R	5MR	0R	28I	0R	9R	4.6
	Strongfield	1R	1R	0R	8R	0R	13R	5.5
	AAC Cabri	10MR	5MR	0R	5R	0R	0R	3.8
	CDC Vantta	**1R**	**10MS**	**0R**	**9R**	**0R**	**11R**	**3.2**
2019	AC Navigator	1R	10MR	2R	13MR	2R	43MS	5.4
	Brigade	1R	1R	10R	13MR	0R	39MS	5.0
	Strongfield	1R	5MR	0R	8R	5R	31MS	4.8
	AAC Cabri	1R	1R	2R	5R	10MR	4R	4.9
	CDC Vantta	**5I**	**10I**	**12MR**	**5R**	**0R**	**28I**	**4.6**
2020	AC Navigator	1R	–	0R	5R	–	70S	7.1
	Brigade	1R	–	0R	70S	–	71S	5.6
	Strongfield	1R	–	0R	5R	–	70S	6.2
	AAC Cabri	1R	–	0R	5R	–	93S	5.3
	CDC Vantta	**1R**	–	**2R**	**5R**	–	**88S**	**4.5**

Note: Leaf rust scored from Morden, stripe rust and common bunt from Lethbridge, and loose smut from Morden (2018) and Swift Current (2019 and 2020). R, resistant; MR, moderately resistant; I, intermediate resistance; MS, moderately susceptible; S, susceptible.
[a]Mean adult plant resistance rated at mid-grain fill using the McFadden scale where <5 = R, 6 = MR, 7 = I, 8–9 = MS, and 10–11 = S. 2018 measurements were from Kernen; 2019 from Kernen, Indian Head, Swift Current, Stewart Valley; and 2020 from Brandon, Elrose, Hodgeville, Swift Current.

Table 5. *Fusarium* head blight (FHB) reactions of CDC Vantta and check cultivars evaluated in the Durum Wheat Cooperative Registration Test (2018–2020).

Year	Entry	FHB index[a]			DON (mg kg^{-1})		ISD[b]	
		Carman	Morden	Ottawa	Carman	Morden	Carman	Morden
2018	AC Navigator	38.0	41.3	46.3	23.6	33.9	16.9	23.1
	Brigade	13.9	13.3	12.0	9.5	7.2	7.6	5.9
	Strongfield	31.3	42.5	41.5	13.9	19.6	10.8	14.5
	AAC Cabri	36.0	30.7	18.0	16.2	17.7	12.3	13.0
	CDC Vantta	**20.3**	**27.4**	**32.0**	**14.8**	**15.5**	**11.2**	**11.5**
2019	AC Navigator	54.2	55.4	–	56.0	33.7	–	–
	Brigade	23.3	32.1	–	21.8	11.5	–	–
	Strongfield	45.9	50.4	–	23.3	25.6	–	–
	AAC Cabri	39.9	39.7	–	23.2	21.8	–	–
	CDC Vantta	**48.2**	**52.3**	–	**30.3**	**28.4**	–	–
2020	AC Navigator	40.6	39.8	–	38.4	44.3	–	–
	Brigade	12.3	6.3	–	28.3	22.2	–	–
	Strongfield	52.0	33.0	–	16.8	32.7	–	–
	AAC Cabri	27.8	11.1	–	22.8	22.0	–	–
	CDC Vantta	**33.2**	**21.6**	–	**26.0**	**48.1**	–	–

Note: DON, deoxynivalenol; –, data not available.
[a]*Fusarium* head blight index = (% of infected heads × % of diseased florets on infected heads)/100.
[b]ISD (incidence/severity/DON) index = (0.2 × mean incidence) + (0.2 × mean severity) + (0.6 × mean DON).

et al. 2017), and Brigade (Clarke et al. 2009). D012.008X.112 was evaluated as DT1012 in the Durum Wheat Cooperative Registration Test (DWCRT) over 3 years (2018–2020).

The variables measured and the operating protocols followed in the DWCRT were those approved each year by the Prairie Recommending Committee for Wheat, Rye and Triticale (http://pgdc.ca/committees_wrt_pd.html). In the agronomic performance trials, the check cultivars over all 3 years of trialing were Strongfield (Clarke et al. 2005), AC Navigator (Clarke et al. 2000), AAC Cabri (Singh et al. 2017), and Brigade (Clarke et al. 2009). Reactions to leaf and stem rust were evaluated in independent nurseries with appropriate races. In the DWCRT, the stem rust races were TPMKC, TMRTF, RHTSC, QTHJF, RTHJF, RKQSC, and MCCFC (Roelf and Martens 1988; Fetch et al. 2021). The leaf rust inoculum consisted of a mixture of prevalent races isolated from the

Table 6. Average values for quality traits measured on yearly composite samples of CDC Vantta and check cultivars evaluated in the Durum Wheat Cooperative Registration Test (2018–2020).

			Semolina							Alveograph				
Entry	Grain protein (%)	FN (s)	Yellow pigment	Protein (%)	*b**	Yield (%)	Ash (%)	GI (%)	Pasta (b*)	*P*	*W*	*L*	*P*/*L*	Grain Cd (ppm)
AC Navigator	13.7	462	10.1	12.6	33.1	68.1	0.67	73	65.8	74	203	96	0.77	243
Brigade	13.9	418	10.2	12.8	33.2	66.1	0.67	90	64.9	75	261	121	0.63	79
Strongfield	14.5	388	9.2	13.4	31.8	66.5	0.64	76	63.2	67	194	97	0.70	91
AAC Cabri	14.2	413	10.5	13.1	33.7	65.8	0.65	69	66.4	64	189	113	0.57	72
CDC Vantta	**14.0**	**510**	**14.4**	**12.7**	**37.7**	**67.2**	**0.66**	**97**	**68.7**	**112**	**316**	**80**	**1.40**	**72**
$LSD_{0.05}$[a]	0.4	44	0.4	0.4	1.1	0.7	0.02	9	0.7	8	31	12	0.11	18

Note: FN, falling number; *b**, yellowness; GI, gluten index; *P*, dough tenacity; *W*, dough baking strength; *L*, dough extensibility; Cd, cadmium.
[a]Least significant difference at 5% significance level

western Canadian prairies as determined from yearly survey studies (McCallum et al. 2021). 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 *Tilletia tritici* (Bjerk.) G. Wint. in Rabenh.) (Hoffman and Metzger 1976) were evaluated. End-use quality was assessed each year at the Grain Research Laboratory, Canadian Grain Commission, using approved methods (American Association of Cereal Chemists 2000) on composite grain samples as per approved protocols (http://pgdc.ca/committees_wrt_pd.html). Briefly, composite samples consisted of grain samples representing only the top durum wheat grades available. In each year, the quantity of grain from a location was adjusted to achieve a final composite protein concentration approximating the average for the crop in that given year.

Data presented here were analysed annually and combined over all 3 years using the PROC MIXED procedure in SAS version 9.4 (Littell et al. 2006), with replications, sub-blocks, zones, locations, and years considered as random effects and entries considered as fixed. The *diff* command was used to estimate the standard error of the difference between entries, which was used to estimate an F-protected least significant difference at a significance level of 5% ($LSD_{0.05}$). For end-use quality data, years were considered as replications.

Performance

Agronomy

Averaged over 28 station-years, CDC Vantta yielded 10% more than AC Navigator, 4% more than Strongfield, 3% more than AAC Cabri, and similar to Brigade (Table 1). CDC Vantta expressed a semi-dwarf habit similar to AC Navigator, and is shorter than Brigade, Strongfield, and AAC Cabri (Table 2). CDC Vantta expressed a lower lodging score than Strongfield, AC Navigator, and AAC Cabri but similar to Brigade (Table 2). CDC Vantta was, on average, later maturing relative to the check cultivars (Table 2). The test weight of CDC Vantta was similar to AC Navigator and AAC Cabri but heavier than Strongfield and Brigade. CDC Vantta expressed a similar kernel weight to AAC Cabri, but lighter than AC Navigator, Brigade, and Strongfield (Table 2). Grain protein concentration of CDC Vantta was similar to AC Navigator and lower than Brigade, Strongfield, and AAC Cabri ($P > 0.05$; not significant from Brigade and AAC Cabri) (Table 3).

Disease and pest

CDC Vantta is resistant to prevalent races of leaf and stripe rust, and expressed a variable reaction for stem rust, with ratings ranging from MS to R (Table 4). CDC Vantta was resistant to common bunt (Table 4). Overall, FHB reaction and deoxynivalenol (DON) concentration of CDC Vantta were within the range of the check cultivars but were always better than the semi-dwarf check AC Navigator, except in Morden 2020 where it had a slightly higher DON concentration than the check cultivars (Table 5). Loose smut reaction of CDC Vantta was within the range of the check cultivars and leaf spot reaction was lower than all the check cultivars (Table 4).

End-use suitability

Grain and semolina protein concentration of CDC Vantta measured from composite samples was within the range of check cultivars and similar to Brigade (Table 6). CDC Vantta expressed low cadmium concentration similar to AAC Cabri and had significantly higher yellow pigment and pasta colour than all check cultivars (Table 6). The average falling number of CDC Vantta was significantly higher ($P < 0.05$) than all check cultivars. CDC Vantta exhibited strong gluten properties with a higher gluten index than all the check cultivars ($P > 0.05$; not significant from Brigade) and higher alveograph P/L value than all the checks (Table 6). The semolina yield and semolina ash of CDC Vantta were within the range of the checks (Table 6).

Other characteristics

SPIKES: express strong glaucosity at heading, have parallel-sided shape in profile, dense, yellow at maturity, erect attitude, and medium density of hairiness of convex surface of apical rachis segment. Spikes express black awns that are longer than the spike with a slightly spreading attitude; the width of the lower glumes is medium, while glumes are long and glabrous; glume shoulders are medium width and straight in shape; strongly curved glume beak; straight lemma beak.

KERNELS: amber in colour, medium in size, medium length and width, and elliptical shape; cheeks are angular; crease is deep and wide; brush is short; embryo is medium sized, with broad elliptical shape.

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

Maintenance and distribution of pedigreed seed

Approximately 275 single spikes of CDC Vantta were selected from an F_9 increase grown at Saskatoon in 2018. The $F_{9:10}$ spikes were threshed individually and grown as single 1 m row plots in 2019, and off-type rows were discarded. The remaining 263 head rows were harvested individually and used to establish 27 m rows in 2020. Again, off-type rows were discarded and bulk harvested to produce breeder seed. In total, 245 $F_{9:11}$ breeder lines were composited to form the breeder seed. Breeder seed will be maintained by the CDC, University of Saskatchewan, Saskatoon, SK S7N 5A8, Canada. CDC Vantta will be added to the Organisation for Economic Cooperation and Development (OECD) list of cultivars. Distribution and multiplication of pedigreed seed stocks will be handled by SeCan, 400–300 Terry Fox Drive, Kanata, ON K2K 0E3, Canada.

Acknowledgements

Financial support from the Saskatchewan Ministry of Agriculture, the University of Saskatchewan, Saskatchewan Wheat Development Commission, Secan, and the Wheat Producer Check-Off (administered by the Western Grains Research

Foundation) is gratefully acknowledged. Appreciation is expressed to the following: Y. Ruan, R.D. Cuthbert, M. Knelsen, and M. Olfert (Swift Current Research and Development Centre, AAFC, Swift Current, SK, Canada) for coordinating registration trials and assessment of stem solidness; B. Beres and R. Dyck (Lethbridge Research and Development Centre, AAFC, Lethbridge, AB, Canada), E. Schuurmans (Indian Head Research Farm, AAFC, Indian Head, SK), D. Green (Brandon Research and Development Centre, AAFC, Brandon, MB, Canada), F. Kirigwi (Syngenta AgriPro, Pense, SK), D. Maxwell (Ag-Quest, Taber, AB), G. Ford (Scott Research Farm, AAFC, Scott, SK), M. Ismaeel (Nutrien Canada, Moose Jaw, SK), M. Bandara (Alberta Agriculture and Rural Development, Brooks, AB), R. Ragupathy (Lethbridge Research and Development Centre), and B. Nybo (Wheatland Conservation, Hodgeville, AB) for agronomic performance testing; C. Briggs (CDC, University of Saskatchewan, Saskatoon, SK), B. Xiao Fu (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), M.A. Henriquez (Morden Research and Development Centre, AAFC, Morden, MB), A. Burt (Ottawa Research and Development Centre, AAFC, Ottawa, ON, Canada), and A. Foster (Charlottetown Research and Development Centre, AAFC, Charlottetown, PEI, Canada) for assessing reaction to FHB; R. Knox (Swift Current Research and Development Centre) and J.G. Menzies (Morden Research and Development Centre) for determining reaction to loose smut; R. Kutcher (University of Saskatchewan) and B. McCallum (Morden Research and Development Centre) for assessing reaction to leaf rust; R. Aboukhaddour (Lethbridge Research and Development Centre) for assessing reaction to common bunt and stripe rust; T. Fetch (Brandon Research and Development Centre) for stem rust assessment; M. Fernandez (Swift Current Research and Development Centre) for assessing leaf spots; C. McCartney (University of Manitoba) and T. Wist (Saskatoon Research and Development Centre, AAFC, Saskatoon, SK) for assessing wheat midge; and D. Benallack (University of Saskatchewan) for maintenance of breeder seed. The technical support provided by R. Lawrie, R. Babonich, H. Lazorko, C. Stang, C.V. Tang, C. Howard, K. Cochet, D. Holder, T. Gierl, J. Bauche, M. Kist, A. Lichtenwald, X. Lin, L. Gerl, J. Ens, and K. Wiebe (CDC) is gratefully acknowledged.

Article information

History dates
Received: 6 June 2022
Accepted: 21 July 2022
Accepted manuscript online: 19 August 2022
Version of record online: 22 September 2022

Data availability
All the data supporting this manuscript are included in the manuscript text.

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Author notes
J.M. Clarke is deceased.

Competing interests
The authors declare that there are no competing interests.

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