

## Enterprise durum wheat

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Singh, A. K., Clarke, J. M., DePauw, R. M., Knox, R. E., Clarke, F. R., Fernandez, M. R. and McCaig, T. N. 2010. **Enterprise durum wheat**. Can. J. Plant Sci. **90**: 353–357. Enterprise durum wheat [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.] is adapted to the durum production area of the Canadian prairies. It combines high grain yield, grain protein concentration, test weight, yellow grain pigment, and low grain cadmium concentration. Enterprise has slightly weaker straw strength, similar days to maturity, and improved fusarium head blight resistance compared with Strongfield.

**Key words:** *Triticum turgidum* L. subsp. *durum* (Desf.) Husn., durum wheat, cultivar description, grain yield, yellow pigment, cadmium

Singh, A. K., Clarke, J. M., DePauw, R. M., Knox, R. E., Clarke, F. R., Fernandez, M. R. et McCaig, T. N. 2010. **Le blé dur Enterprise**. Can. J. Plant Sci. **90**: 353–357. Enterprise est une variété de blé dur [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.] adaptée à la zone de culture du blé dur des Prairies canadiennes. Elle se caractérise par un rendement grainier élevé, une forte concentration de protéines dans le grain, un poids spécifique élevé, un grain pigmenté jaune et une faible teneur en cadmium dans le grain. Enterprise est dotée d'une paille légèrement plus faible, a la même précocité et résiste plus à la brûlure de l'épi par *Fusarium* que Strongfield.

**Mots clés:** *Triticum turgidum* L. subsp. *durum* (Desf.) Husn., blé dur, description de cultivar, rendement grainier pigment jaune, cadmium

Enterprise durum wheat was developed at the Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, Swift Current, Saskatchewan. Filing for Plant Breeders' Rights protection (09-6628) was accepted on 2009 Apr. 22, and Enterprise received registration No. 6629 from the Canadian Food Inspection Agency on 2009 Jul. 23.

### Pedigree and Breeding Method

Enterprise was selected from the cross 9488C-CK02 Strongfield made in 2000 at the Semiarid Prairie Agricultural Research Centre, Swift Current, SK. Line 9488C-CK02 (also known as DT716) was developed at SPARC-AAFC and is derived from a three way cross DT663//8982-TB04/8980-AG3E. Strongfield is a registered durum wheat cultivar (Clarke et al. 2005). F<sub>1</sub> plants were grown near Christchurch, New Zealand. The F<sub>2</sub> generation was grown in a space-planted field nursery near Swift Current in 2001 and selected for plant height, straw strength and days to maturity. Seeds of individual spikes from selected plants were grown in 2-m long F<sub>3</sub>

rows near Christchurch in 2001–2002. The F<sub>4</sub> generation was grown in unreplicated yield trials near Swift Current and Regina, SK, in 2002 and evaluated for grain yield, days to maturity, straw strength, grain pigment and grain protein concentration by Near Infrared/Visual Reflectance Spectroscopy, and gluten strength (gluten index). Four spikes per selected line were sown as individual F<sub>5</sub> head rows in a nursery near Irwell, New Zealand. The F<sub>6</sub> generation was grown in unreplicated yield trials near Lethbridge, AB, and Swift Current and Regina, SK, in 2003, and selected for agronomic performance, leaf spot disease resistance, and quality (protein, pigment, gluten strength). An F<sub>4,7</sub> line designated A0013-KC02 was advanced to the Durum Western A-2 Test in 2004 and selected for agronomic performance, quality and disease resistance, where disease evaluations included loose smut [*Ustilago tritici* (Pers.) Rostr.] assessment with races T26, T32 and T33 under field conditions near Swift Current, SK; leaf rust (*Puccinia triticina* Eriks.) and stem rust (*Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks. and E. Henn.) evaluation near Glenlea, MB, using a mixture of races; and leaf spot reaction from yield plots near Lethbridge, AB, and Swift Current, SK, under natural inoculum. In 2005, A0013-KC02 was advanced to the Durum "B" test and tested for leaf and stem rust near Winnipeg, MB, using a mixture of prevalent races, for

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**Table 1. Grain yield (kg ha<sup>-1</sup>) of Enterprise and check cultivars in the Durum Cooperative Test, 2006 to 2008<sup>z</sup>**

	2006			2007			2008			2006–2008
	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean	Mean
Enterprise	4528	4346	4424	3650	3400	3472	4491	4642	4586	4154
AC Avonlea	4202	4075	4126	3093	3285	3236	4515	4270	4359	3899
AC Morse	4570	4055	4266	3304	3478	3422	4690	4256	4413	4033
AC Navigator	4432	4408	4421	3151	3418	3341	4385	4483	4446	4061
Strongfield	4495	4390	4434	3416	3415	3410	4321	4383	4359	4057
Commander	4516	4571	4547	3366	3614	3540	4384	4561	4499	4187
LSD <sub>.05</sub>	433	275	238	319	187	179	430	268	250	198
No. tests	5	7	12	3	8	11	4	7	11	34

<sup>z</sup>Zone 1 (Black soils): Indian Head, Souris, Glenlea (2006), Brandon, Langdon (2007 excluded due to high CV); Zone 2 (Brown and Dark Brown soils): Swift Current, Stewart Valley, Saskatoon, Regina, Lethbridge, Biesecker, Vangaurd (2007), Avonlea.

Fusarium head blight (FHB) near Brandon, MB, with *F. graminearum* infested corn seed, and for loose smut with races T26, T32 and T33 near Swift Current. Based on agronomic, quality and disease performance, A0013-KC02 was advanced to the Durum Cooperative Test. From 2006 to 2008, A0013-KC02 was tested in the Durum Cooperative Test as DT787. The Cooperative Test entries were evaluated in inoculated nurseries for resistance to leaf and stem rust, loose smut and FHB near Glenlea and near Carman, MB, and for common bunt near Lethbridge, AB. Stem rust inoculum consisted of races of TPM, TMR, QTH, RKQ, RHT, RTH, whereas leaf rust inoculum consisted of a mixture of prevalent races. The stem rust races comprised a group of historical races representing a range of virulence genes (Fetch 2005), whereas the races of leaf rust used were representative of recently occurring races (McCallum and Seto-Goh 2006). The loose smut inoculum consisted of races T26, T32 and T33, while common bunt [*Tilletia laevis* Kuhn in Rabenh., and *T. tritici* (Bjerk.) G. Wint. in Rabenh.] seed was inoculated with a 1:1 composite of the common bunt species *Tilletia tritici* and *T. laevis* in a 1:1:1:1:2:2 mixture of the races T-1, T-6, T-13, T-19, L-1

and L-16. This composite represents the virulence spectrum of most locally collected bunt isolates. The race designations are those described by Roelfs and Martens (1988) for stem rust, Long and Kolmer (1989) for leaf rust, Hoffmann and Metzger (1976) for common bunt, and Nielsen (1987) for loose smut. Reaction to Fusarium head blight caused by *Fusarium graminearum* Schwabe [teleomorph *Gibberella zeae* (Schwein. Petch)] was assessed in artificially inoculated field tests near Glenlea and Carman, MB (Gilbert and Woods 2006). Leaf spot reaction was determined with natural infestation at locations in Saskatchewan and Manitoba.

The 139 breeder lines originate from 96 rows grown near Swift Current in 2007 and additional 60 rows grown near Christchurch in 2007–2008, and these breeder rows originate from F<sub>4,9</sub> plants grown in 2006.

### Performance

Enterprise yielded 2.4% more than Strongfield and 6.5% more than AC Avonlea, and similar to the highest-yielding check, Commander, in 3 yr of cooperative testing (Table 1). Days to maturity of Enterprise were similar to AC Avonlea and 1 d later than

**Table 2. Agronomic characteristics of Enterprise and check cultivars in the Durum Cooperative Test, 2006–2008<sup>z</sup>**

	Days to maturity <sup>y</sup>			Test weight (kg hL <sup>-1</sup> ) <sup>z</sup>			1000-kernel wt (g) <sup>z</sup>	Height (cm) <sup>z</sup>	Lodging (1–9) <sup>x</sup>
	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean			
Enterprise	95	102	99	77.3	81.1	79.8	38.9	91	3.2
AC Avonlea	94	102	99	75.6	79.9	78.4	42.2	92	2.3
AC Morse	94	101	98	74.8	79.3	77.7	41.7	87	1.8
AC Navigator	96	103	101	76.2	81.0	79.3	43.7	80	2.0
Strongfield	94	101	99	76.5	80.6	79.2	42.1	89	2.5
Commander	95	102	99	75.1	80.2	78.4	44.1	77	1.8
LSD <sub>.05</sub>	2	1	1	1.2	0.6	0.6	1.4	3	0.7
No. tests	10	18	28	13	22	35	35	35	12

<sup>z</sup>Zone 1 (Black soils): Indian Head, Souris, Glenlea (2006), Brandon, Langdon; Zone 2 (Brown and Dark Brown soils): Swift Current, Stewart Valley, Saskatoon, Regina, Lethbridge, Biesecker, Vanguard (2007), Avonlea.

<sup>y</sup>All Zone 1 and Zone 2 locations, except Langdon (in Zone 1) and Stewart Valley (in Zone 2).

<sup>x</sup>Souris (2006–2008), Brandon (2006), Glenlea (2006), Indian Head (2006), Langdon (2007), Avonlea (2008), Kernen (2007–2008), Regina (2007–2008).

Strongfield in the Brown and Dark Brown soil zones (Table 2). Days to maturity of Enterprise were not significantly different from the other check cultivars. Test weight ( $\text{kg hL}^{-1}$ ) of Enterprise was higher than the other checks and significantly higher than all but AC Navigator and Strongfield, while the 1000-kernel weight (g) was significantly lower than that of the checks. Enterprise was of intermediate height between AC Avonlea and Strongfield. Enterprise had significantly weaker straw than the checks except Strongfield.

Grain protein concentration of Enterprise was similar to the conventional gluten checks AC Avonlea and Strongfield and higher than AC Morse (Table 3). Enterprise has low grain cadmium concentration similar to Strongfield, and significantly greater yellow pigment concentration than the checks. Enterprise has gluten index similar to Strongfield and AC Navigator. Semolina yield of Enterprise was similar to AC Avonlea, AC Morse and Strongfield.

Enterprise was resistant to leaf and stem rust in all years of evaluation (Table 4). The common bunt reaction was very resistant in 2006 and 2007, while in 2008 its reaction was intermediate. In 2 out of 3 yr, the loose smut reaction was lower (rated "Intermediate") than the checks, and was overall rated as moderately susceptible. Three years of testing indicated that Enterprise has leaf spot reaction (field rating of natural infection, primarily tan spot [*Pyrenophora tritici-repentis* (Died.) Drechs., anamorph *Drechslera tritici-repentis* (Died.) Shoemaker], and septoria nodorum blotch [*Phaeosphaeria nodorum* (E. Müll.) Hedjaroude, anamorph *Stagonospora nodorum* (Berk.) Castell. & E.G. Germano] similar to AC Avonlea, Strongfield and Commander, and lower than the other checks (Table 4). It has an FHB index lower than AC Avonlea and Strongfield in 2006 and lower than all of the checks at Carman. On average, its FHB reaction was better than all checks at Glenlea, where in 2006 and 2008 it performed better ("I") than the rest of checks; however, in 2007 it was similar to the susceptible checks (Table 4). The overall rating for FHB was moderately susceptible.

### Other Characteristics

**SPIKES:** Tapering, mid-dense to dense, erect to incline; awned; white awns; glumes mid-wide, mid-long, glabrous.  
**KERNEL:** Colour amber; mid-size to large, elliptical; cheeks angular; crease shallow to mid-deep, mid-wide; brush short to mid-long, short; embryo large, oval.  
**END-USE SUITABILITY:** Eligible for the grades of Canada Western Amber Durum wheat market class.

### Maintenance and Distribution of Pedigreed Seed

Breeder seed will be maintained by the Seed Increase Unit, Agriculture and Agri-Food Canada, Indian Head, Saskatchewan, Canada S0G 2K0. Distribution and multiplication of pedigreed seed stocks will be handled by Canterra Seeds, 201-1475 Chevrier Boulevard, Winnipeg, Manitoba, Canada R3T 1Y7.

Table 3. Grain protein concentration (expressed on 13.5% moisture basis) measured on location bulks across replications, and grain cadmium concentration, pigment concentration, and gluten index measured on yearly composites of Enterprise and checks from the 2006–2008 Durum cooperative test

	Protein concentration (%)										Gluten index (%)		
	2006		2007			2008			Mean	Cadmium ( $\text{mg kg}^{-1}$ )		Pigment ( $\text{mg kg}^{-1}$ )	Semolina yield (%)
	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2					
Enterprise	15.2	14.1	16.0	13.9	14.4	13.5	14.1	0.09	10.11	66.0	76		
AC Avonlea	15.1	14.3	15.8	14.2	14.1	13.7	14.2	0.21	8.19	66.0	27		
AC Morse	14.5	14.2	15.2	13.5	13.5	13.4	13.8	0.20	8.30	66.0	58		
AC Navigator	14.2	13.4	14.8	13.8	13.7	13.0	13.5	0.25	9.44	67.4	74		
Strongfield	14.9	14.2	16.0	14.2	14.4	13.7	14.2	0.09	8.64	66.2	72		
Commander	14.3	13.7	14.7	13.7	13.9	13.0	13.6	0.25	9.72	67.3	95		
LSD.05	0.8	0.5	0.6	0.4	0.6	0.5	0.3	0.01	0.36	0.5	8		
# Tests	4	7	3	8	3	7	32	3	3	3	3		

<sup>†</sup>Zone 1 (Black soils): Indian Head, Souris, Glenlea (2006), Brandon; Zone 2 (Brown and Dark Brown soils): Swift Current, Stewart Valley, Saskatoon, Regina, Lethbridge, Biester, Vanguard (2007), Avonlea.

Table 4. Summary of disease reactions of Enterprise and check cultivars grown in the Durum Cooperative Test, 2006–2008

	Year	Stem rust <sup>z</sup>		Leaf rust <sup>z</sup>		CB <sup>z</sup>		Loose smut		Leaf spot <sup>x</sup>	FHB			
		Rtn <sup>y</sup>	React. <sup>z</sup>	Rtn <sup>y</sup>	React. <sup>z</sup>	Rtn <sup>y</sup>	React. <sup>z</sup>	Rtn <sup>y</sup>	React. <sup>z</sup>		Carman		Glenlea	
											Ind <sup>w,v</sup>	React. <sup>z</sup>	Ind <sup>w</sup>	React. <sup>z</sup>
Enterprise	2006	3	R	0	R	0	VR	44	I	7.0	43.6	MS	37.0	I
	2007	3	R	0	R	1	VR	72	S	8.0	18.0	–	57.5	S
	2008	5	R	0	R	21	I–	45	I	7.5	29.8	I	14.6	I
AC Avonlea	2006	15	R-MR	0	R	1	VR	0	R	7.0	45.7	S	67.5	S
	2007	10	R-MR	0	R	1	VR	83	S	8.8	25.4	–	30.5	MS
	2008	5	R	0	R	13	MR	44	I	7.5	44.2	MS	24.5	S
AC Morse	2006	10	R-MR	0	R	0	VR	45	I	8.0	30.0	I	68.3	S
	2007	15	R-MR	0	R	0	VR	90	S	8.3	30.9	–	30.0	I
	2008	5	R	0	R	2	VR	60	I	8.8	50.1	S	17.0	MS
AC Navigator	2006	20	R-MR	0	R	0	VR	48	I	8.0	29.5	I	63.0	S
	2007	10	R-MR	0	R	0	VR	50	I	8.5	32.9	–	62.6	S
	2008	2	R	0	R	2	VR	–	–	8.5	60.7	S	19.7	MS
Strongfield	2006	15	R-MR	0	R	3	VR	–	–	7.5	39.8	MS	47.3	MS
	2007	5	R	0	R	0	VR	21	MR	7.5	18.5	–	68.4	S
	2008	2	R	0	R	4	VR	75	MS	7.0	54.0	S	22.7	S
Commander	2006	2	R	0	R	2	VR	0	R	7.0	33.5	MS	52.0	S
	2007	1	R	0	R	0	VR	100	S	8.5	35.1	–	55.3	S
	2008	2	R	0	R	7	R	66	MS	7.3	61.8	S	15.8	MS

<sup>z</sup>Reaction type: VR, very resistant; R, resistant; MR, moderately resistant; I, intermediate; MS, moderately susceptible; S, susceptible. CB = common bunt.

<sup>y</sup>Rtn = rating, % infection.

<sup>x</sup>Adult plant, rated mid-grainfill at Swift Current (2006, 2008) and Saskatoon (2007) McFadden scale (0 = no symptoms, 11 = severe symptoms) (McFadden 1991).

<sup>w</sup>Ind = index; where Fusarium head blight index: (% infected spikelets × % infected heads)/100.

<sup>v</sup>Carman 2007 rating were late and reaction type was not determined.

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