CULTIVAR DESCRIPTION

Napoleon Amber durum wheat

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Humphreys, D. G., Townley-Smith, T. F., Leisle, D., McCallum, B., Gaudet, D., Gilbert, J. and Menzies, J. 2010. **Napoleon Amber durum wheat**. Can. J. Plant Sci. **90**: 863–867. Napoleon is an amber durum wheat (*Triticum turgidum* L. var. *durum*) that meets the end-use quality specifications of the Canada Western Amber Durum wheat class. Napoleon was evaluated in the Durum Cooperative Test in 1996, 1997 and 1998 as DT484. Overall, Napoleon had significantly higher grain yield than all checks except AC Avonlea, and Napoleon had higher grain yields in the Black soil zone compared with the Brown soil zone. Napoleon had maturity similar to AC Morse and AC Avonlea, but was 1 d earlier maturing than Kyle and 2 d later maturing than Hercules. Napoleon was similar to AC Avonlea in height, but was significantly taller than AC Morse, and significantly shorter than Kyle and Hercules. Napoleon had lower lodging scores than Hercules and Kyle, but had higher lodging scores than AC Avonlea and AC Morse. Napoleon is resistant to leaf rust, stem rust, and common bunt, and moderately susceptible to loose smut, leaf spot and Fusarium head blight. Napoleon is the first low cadmium durum cultivar registered in Canada.

Key words: *Triticum turgidum* L. var. *durum*, Canada Western Amber Durum, durum wheat, cultivar description, yield, disease resistance

Humphreys, D. G., Townley-Smith, T. F., Leisle, D., McCallum, B., Gaudet, D., Gilbert, J. et Menzies, J. 2010. **Blé dur ambré Napoleon**. Can. J. Plant Sci. **90**: 863–867. Napoleon est un blé dur ambré (*Triticum turgidum* L. var. *durum*) qui répond aux critères de qualité de la classe du blé dur ambré du l'ouest canadien. Napoleon a été évalué lors d'essais coopératifs pour la certification des blés durs ambrés en 1996, 1997 et 1998. Napoleon a démontré des rendements en grains supérieurs aux cultivars témoins à l'exception de AC Avonlea. Les rendements en grains de Napoleon variaient selon la région et étaient supérieurs dans la zone des sols noirs comparée à la zone des sols bruns. Napoleon a démontré une précocité semblable à AC Avonlea et à AC Morse mais Napoleon était un jour plus hâtif que Kyle et deux jours plus tardif que Hercules. Napoleon était de taille semblable à AC Avonlea mais était significativement plus grand que AC Morse et significativement plus petit que Kyle et Hercules. Napoleon s'est démontré plus résistant à la verse que Hercules et Kyle mais moins résistant que AC Avonlea et AC Morse. Napoleon était résistant à la rouille foliaire, à la rouille noire et à la carie du blé. Napoleon était sensible au charbon nu, la tâche des feuilles et la fusariose. Napoleon est le premier cultivar de blé dur enregistré au Canada qui possède une fiable teneur en cadmium.

Mots clés: *Triticum turgidum* L. var. *durum*, blé dur ambré de l'Ouest canadien, blé dur, description du cultivar, rendement, résistance aux maladies

Napoleon, an amber durum wheat (*Triticum turgidum* L.), was developed at the Cereal Research Centre (CRC), Agriculture and Agri-Food Canada (AAFC) in Winnipeg, MB. It received restricted registration No. 5258 from the Variety Registration office of the Canadian Food Inspection Agency on 2001 Mar. 05. Napoleon is adapted to the wheat-growing areas of the Canadian prairies. Napoleon meets the kernel colour and end-use quality characteristics of the Canada Western Amber Durum (CWAD) wheat class.

Pedigree and Breeding Method

Napoleon was selected from the cross Vic/DT384//DT471 made in 1989 at the Agriculture and Agri-Food Canada (AAFC) Cereal Research Centre (CRC). Vic is a durum wheat variety developed at North Dakota State University (Quick et al. 1980). DT384 is a CWAD breeding line developed from a composite cross made in 1972 at CRC, and DT471 is a breeding line derived from the cross Arcola/Lloyd. F_1 plants were grown in the 1989–1990 winter nursery in Brawley, California. Plant selections were made in the F_2 population, which was grown in Glenlea, MB, in 1990, for stem and leaf rust resistance, maturity, height, straw strength, head type and kernel smudge tolerance. The F_3-derived F_4 generation was evaluated in the 1991 rust nursery at Glenlea, MB, and the F_5 lines as head rows in the 1991–1992 winter nursery in California. Selected rows were bulk harvested and yield tested as F_6 lines at Glenlea in 1992. The best yielding lines with low

cadmium content were selected. The F_7 generation was grown as head rows in the 1992–1993 winter nursery in California and entered into replicated multi-location yield trials as F_8 and F_9 lines in 1993 and 1994, respectively. In 1995, a selected line from the F_9 test was designated RL7278 and entered into the Durum Wheat "B" test. The line was subsequently given the designation DT494 and entered into the Durum Wheat Cooperative test where it was evaluated for 3 yr (1996–1998). The variables measured and the protocols followed in the Durum Cooperative test have been described by Graf and Fox (2000). For the end-use quality evaluations, a composite sample was generated each year from the sites of the Durum Cooperative test with the highest grades and suitable grain protein content.

Area of Adaptation

Napoleon is best adapted to the Black soil zone of the Prairie Provinces.

Performance

Overall, Napoleon yielded significantly more than all checks except AC Avonlea (Table 1) but the relative yield performance was influenced by soil zone. In the Black soil zone (Zone 1), Napoleon yielded 3% more than AC Avonlea, 7% more than AC Morse 12% more than Kyle and 15% more than Hercules. However, in the Brown soil zone (Zone 2), Napoleon had similar grain yield compared with AC Avonlea, Kyle and AC Morse, but yielded 12% more than Hercules (Table 1). Napoleon was significantly later maturing than Hercules (+2 d); significantly earlier maturing than Kyle (−1 d) and had maturity similar to the other check varieties (Table 1). Napoleon is similar to AC Avonlea in height but is significantly taller than AC Morse, and significantly shorter than Kyle and Hercules. Napoleon was 8 cm taller than AC Morse and 3 and 9 cm shorter than Hercules and Kyle, respectively. Napoleon had lower lodging scores than Hercules and Kyle, but had higher lodging scores than AC Avonlea and AC Morse. Napoleon had test weight similar to AC Morse, but had significantly lower mean test weight compared with AC Avonlea, Kyle and Hercules (Table 1). Napoleon had significantly larger kernels than all check cultivars and had significantly lower mean cadmium content compared with all check cultivars except Hercules (Table 1).

Other Characteristics

SPIKE. Parallel, dense, erect, strong waxy bloom, white at maturity, awned; glumes are mid-wide, mid-long to long, glabrous; lower glume shoulders are mid-wide and elevated; glume beak is short to medium length and slightly curved.

KERNEL. Colour is medium amber, size is large, mid-long to long, mid-wide and elliptical shape; cheeks are angular to slightly rounded; brush is mid-size to small, with short to very short hairs; mid-size, to large oval shaped embryo; mid-wide and mid-deep crease.

DISEASE REACTION. Napoleon was resistant to leaf rust, stem rust, common bunt and root rot. Napoleon was susceptible to moderately susceptible to loose smut, leaf spot and Fusarium head blight in all three years of testing (Table 2).

The leaf rust races used to inoculate cooperative tests were increased from collections made the previous

Table 1. Agronomic data for Napoleon and check cultivars based on data collected in the Durum Wheat Cooperative test (1996–1998)

	Mean grain yield (kg ha^{-1})						Maturity (d)							
Cultivar	1996	1997	1998	Zone 1[z]	Zone 2[y]	Overall mean	Zone 1	Zone 2	Overall mean	Height (cm)	Lodging[x] (1–9)	Test weight (kg hL^{-1})	Kernel weight (mg)	Cadmium content[w] (mg kg^{-1})
Hercules	3718	3666	4065	3955	3730	3821	93.1	99.7	96.5	97	3.2	79.7	41.4	0.140
Kyle	4012	4117	4341	4094	4207	4161	95.8	102.3	99.1	103	5.0	80.1	40.7	0.205
AC Morse	4039	4147	4450	4295	4164	4217	94.5	101.3	98.0	86	2.0	78.9	41.8	0.176
AC Avonlea	4077	4238	4600	4447	4221	4313	94.5	101.8	98.3	93	2.3	79.9	42.1	0.217
Napoleon	**4243**	**4252**	**4557**	**4588**	**4194**	**4354**	**95.2**	**101.0**	**98.3**	**94**	**2.8**	**78.7**	**43.2**	**0.090**
LSD ($P < 0.05$)[v]	235	250	230	276	107	133	1.0	1.1	0.7	2	0.6	0.3	0.7	0.079
Station years	10	11	11	13	19	32	13	14	27	30	17	32	32	3

[z]Zone 1 includes: Brandon, Elgin, Glenlea, Morden, Indian Head (1996); Brandon, Elgin, Portage la Prairie, Indian Head (1997); Brandon, Elgin, Glenlea and Indian Head (1998).
[y]Zone 2 includes: Elrose, Kernen, Lethbridge, Regina, Swift Current, Steward Valley, Irricana (1996); Elrose, Kernen, Lethbridge, Regina, Swift Current, Steward Valley (1997); Elrose, Kernen, Lethbridge, Regina, Swift Current, Steward Valley (1998).
[x]Lodging scale: 1 = vertical; 9 = flat.
[w]Cadmium content determined on coop composite samples by Grain Research Laboratory in 1996–1998.
[v]Fisher Protected LSD of means is based on the checks and Napoleon. For year means, locations were treated as blocks and genotype × location effect as the error term. For Zone and overall means, location-years were treated as environments and the genotype × environment effect used as the error term. LSDs were calculated using locations means from the Durum Coop reports using GenStat Release 10.2(PC/Windows) Copyright 2007, Lawes Agricultural Trust (Rothamsted Experimental Station).

Table 2. Disease reactions of Napoleon and check cultivars in the Durum Wheat Cooperative test (1996–1998)

	Leaf rust[z]			Stem rust[y]			Root rot (%)			Loose smut (%)[x]			Leaf spot[w]			Fusarium head blight index[v]			Common Bunt[u]			*Septoria nodorum*[w]			*Septoria tritici*[w]		
Cultivar	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998	1996	1997	1998
Hercules	tr R	tr R	VR	1 R	1 R	1 R	10.7	12.0	16.3	33 MR	50 MS	83 HS	8.4 MS	9.3 MS	8.6 MS	–	64	34 I	R+	R+	R+	7.7	–	10.0	9.7	–	9.7
Kyle	tr R	tr R	VR	1 R	1 R	1 R	6.7	12.0	24.5	26 MR	0 R	67 S	9.2 MS	9.4 MS	8.8 MS	–	74	30 I	R+	R+	R+	6.5	–	9.7	9.0	–	9.7
AC Morse	tr R	tr R	VR	1 R	1 R	1 R	2.7	9.3	27.8	77 HS	100 HS	–	9.8 MS	10.7 S	9.4 MS	–	82	42 MS	R	R	R	6.8	–	10.0	8.5	–	10.0
AC Avonlea	tr R	tr R	VR	1 R	1 R	1 R	8.0	13.3	36.0	100 HS	100 HS	0 R	8.3 MS	8.6 MS	8.3 MS	50	69	53 S	R+	R+	R+	6.3	–	9.0	9.5	–	10.0
Napoleon	**tr R**	**tr R**	**VR**	**1 R**	**1 R**	**1 R**	**6.7**	**5.3**	**17.3**	**75 S**	**67 S**	**25 MR**	**8.2 MS**	**8.3 MS**	**8.7 MS**	**–**	**53**	**38 MS**	R+	R+	R+	**8.0**	**–**	**9.0**	**9.7**	**–**	**9.0**

[z]Caused by *Puccinia triticina* Eriks. Inoculum was a composite of all leaf rust races increased from collections made the previous year (Kolmer and Liu 1997; Kolmer 1998, Kolmer 1999). Ratings indicate percent severity and pustule type, respectively.
[y]Caused by *Puccinia graminis* Pers. f. sp. *tritici* Eriks. & E. Henn. Races used include TMRT (C10), QTHS (C25), TPMK (C53), RTHJ (C57), RKQS (C63), and another TMRT (C95) (Roelfs and Martens 1988). Ratings indicate percent severity and pustule type, respectively.
[x]Caused by *Ustilago tritici* (Pers.) Rostr. Races include T26, T32 and T33 (Nielsen 1987; Menzies et al. 2009).
[w]McFadden's scale $<5 = R$; $6 = MR$; $7 = I$; $8–9 = MS$; $10–11 = S$ (McFadden 1991).
[v]Caused by *Fusarium graminearum* Schwabe. Visual Rating Index = (% severity × % incidence)/100.
[u]Caused by *Tilletia laevis* Kuhn in Rabenh and *T. tritici* (Bjerk.) R. Wolf. The inoculum used was a composite of races L1, L16 of T. laevis, and T1, T6, T13 and T19 of T. tritici mixed (vol/vol) in a 1:1:1:1:2:2 ratio (Gaudet and Puchalski 1989b), and represents the virulence spectrum of bunt isolates in western Canada (Gaudet and Puchalski 1989a).

Table 3a. Quality data for Napoleon and check cultivars based on data from the Durum Wheat Cooperative test (1996–1998). End-use quality testing was performed by the Grain Research Lab of the Canadian Grain Commission on a composite from each year of the Cooperative test

Cultivar	Wheat protein (%)	Hard vitreous kernels (%)	Falling number (s)	Sedimentation volume (ml)	Wheat ash (%)	Yellow pigment content (ppm)	Kernel size distribution[z]			
							VL (%)	L (%)	AV (%)	SM (%)
Hercules	13.7	81	357	47	1.60	7.5	5	34	44	15
Kyle	13.4	88	423	42	1.48	7.8	1	28	54	16
AC Morse	13.8	88	397	53	1.53	8.9	6	41	41	11
AC Avonlea	14.1	91	370	47	1.54	9.0	4	42	42	12
Napoleon	**13.8**	**88**	**392**	**52**	**1.48**	**10.0**	**3**	**38**	**45**	**13**
LSD ($P<0.05$)[y]	0.3	NS[x]	NS	4	0.05	0.3	2	5	3	NS
Station Years	3	3	3	3	3	3	3	3	3	3

[z]Fisher Protected LSD of means was based on the checks and Napoleon. Years were treated as blocks and year x cultivar interaction used as the error term to calculate LSD. Calculation was done using Agrobase 21.
[y]VL = very large; L = Large; AV = average; SM = small.
[x]ns = Cultivar effect not significant.

year (Kolmer and Liu 1997; Kolmer 1998, 1999). The stem rust races included: TMRT (C10), QTHS (C25), TPMK (C53), RTHJ (C57), RKQS (C63), and another TMRT (C95) (T. Fetch, personal communication). The races of loose smut included: T26, T32 and T33 (Menzies et al. 2009), and inoculum used for common bunt was a composite of races L1, L16 of T. laevis, and T1, T6, T13 and T19 of *T. tritici* mixed(vol/vol) in a 1:1:1:1:2:2 ratio (Gaudet and Puchalski 1989b), and represents the virulence spectrum of bunt isolates in western Canada (Gaudet and Puchalski 1989a). Race designations are described by Roelfs and Martens (1988) for stem rust, Neilsen (1987) for loose smut, and Hoffman and Metzger (1976) for common bunt. Screening for the reaction to *Fusarium* head blight was conducted as outlined in Gilbert and Woods (2006).

End-use suitability. Napoleon is eligible for all grades of the Canada Western Amber Durum wheat class (Table 3a, b, c). Napoleon had grain protein content significantly higher than Hercules, but was not significantly different from the other checks. Napoleon had significantly higher sedimentation volumes than all check varieties except AC Morse. Napoleon had significantly lower wheat ash than Hercules and AC Avonlea, but was similar to Kyle and AC Morse. Napoleon had significantly higher grain yellow pigment than all other checks. Corrected semolina yield was significantly lower than Kyle, but not significantly different from the other checks. Semolina protein, wet and dry gluten yields were significantly higher than Kyle, but not significantly different from the other checks. Gluten index was similar to AC Morse, but significantly higher than all other checks. Similar to the grain pigment, semolina yellow pigment was significantly higher than all checks. Napoleon had Agtron semolina colour significantly lower than Hercules and Kyle, but not significantly different from AC Morse and

Table 3b. Semolina analytical data for Napoleon and check cultivars based on data from the Durum Wheat Cooperative test (1996–1998). End-use quality testing was performed by the Grain Research Laboratory of the Canadian Grain Commission on a composite from each year of the Cooperative test

Cultivar	Semolina yield (%)	Semolina ash (%)	Corrected semolina yield[z] (%)	Semolina protein (%)	Wet gluten (%)	Dry gluten (%)	Gluten index (%)	Yellow pigment (ppm)	Agtron colour	Minolta colour[y]			Speck visual	Brownness
										L^*	a^*	b^*		
Hercules	66.5	0.64	68.6	12.8	34.4	12.9	28	6.6	80	88.1	−3.0	31.3	34	0.10
Kyle	66.2	0.61	70.7	12.3	32.8	11.9	19	7.3	79	88.3	−3.1	32.7	25	0.09
AC Morse	65.4	0.62	69.1	12.8	33.7	12.7	59	8.4	77	88.0	−3.2	34.8	26	0.10
AC Avonlea	65.7	0.62	69.0	13.0	35.2	13.2	26	8.6	77	88.0	−3.3	35.4	24	0.09
Napoleon	**65.4**	**0.65**	**67.1**	**12.8**	**34.2**	**12.9**	**56**	**9.5**	**76**	**87.4**	**−3.3**	**37.4**	**14**	**0.09**
LSD ($P<0.05$)[x]	NS[w]	NS	NS	0.2	1.0	0.5	8	0.3	2	NS	NS	0.7	9	0.01
Station years	3	3	3	3	3	3	3	3	3	3	3	3	3	3

[z]Corrected to constant ash 0.67%, Corr. Yield = yield −(SA −0.67)/0.014.
[y]Minolta colours, L^* = lightness; a^* = red/green; b^* = yellow/blue.
[x]Fisher Protected LSD of means was based on the checks and Napoleon. Years were treated as blocks and year × cultivar interaction used as the error term to calculate LSD. LSDs were calculated using locations means from the Durum Coop reports using Agrobase 21 softeware (Agronomix Software Inc., Winnipeg, MB, Canada).
[w]NS, cultivar effect not significant.

Table 3c. Spaghetti flour analytical data for Napoleon and check cultivars based on data from the Durum Wheat Cooperative test (1996–1998). End-use quality testing was performed by the Grain Research lab of the Canadian Grain Commission on a composite from each year of the Durum wheat Cooperative test

Cultivar	Minolta colour			CQP-N[z] units
	*L**	*a**	*b**	
Hercules	77.8	1.4	63.2	35
Kyle	78.0	1.3	64.6	40
AC Morse	77.4	1.6	65.3	53
AC Avonlea	78.0	1.4	66.5	57
Napoleon	**77.4**	**2.2**	**68.3**	**48**
LSD ($P<0.05$)[y]	0.3	NS[x]	2.1	4
Station years	3	3	3	3

[z]Cooking quality for micro-processed spaghetti.
[y]Fisher Protected LSD of means was based on the checks and Napoleon. Years were treated as blocks and year × cultivar interaction used as the error term to calculate LSD. Calculation was done using Agrobase 21.
[x]NS, cultivar effect not significant.

AC Avonlea, and Minolta *b** value was significantly higher than all checks. Napoleon had significantly lower semolina speckiness compared with all check varieties.

Maintenance and Distribution of Pedigreed Seed

Breeder seed was developed from random spike selections harvested from a F_9 increase plot. Spikes were grown as head rows at Glenlea, MB, in 1997 and as long rows near Indian Head, SK, in 1998, where approximately 360 kg of breeder seed was produced from 216 breeder's lines. Breeder seed will be maintained by the AAFC Seed Increase Unit, Indian Head, SK. Distribution and multiplication of pedigree seed stocks is the responsibility of Canterra Seeds Ltd. 1475 Chevrier Boulevard, Winnipeg, Manitoba, Canada R3T 1Y7.

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