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CULTIVAR DESCRIPTION

AAC Stronghold durum wheat

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Abstract: AAC Stronghold durum wheat [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.] is adapted to the durum production area of the Canadian prairies. Averaged over 3 yr, AAC Stronghold yielded significantly more grain than AC Navigator. AAC Stronghold had a protein concentration significantly less than Strongfield but significantly more than Brigade. AAC Stronghold had a plant height significantly shorter than Brigade, Strongfield, and AAC Cabri, with a lodging score significantly less than Strongfield and AAC Cabri. AAC Stronghold has a solid stem, which confers resistance to cutting by the wheat stem sawfly (*Cephus cinctus* Norton). AAC Stronghold had low grain cadmium concentration and stronger gluten than Strongfield. AAC Stronghold is eligible for grades of Canada Western Amber Durum.

Key words: Triticum turgidum, durum wheat, cultivar description, grain yield, solid stem, cadmium uptake.

Résumé : AAC Stronghold est une variété de blé dur [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.] adaptée à la région des Prairies canadiennes où l'on pratique cette culture. Sur trois ans, en moyenne, AAC Stronghold a sensiblement donné plus de grain qu'AC Navigator. Le grain d'AAC Stronghold est sensiblement moins protéiné que Strongfield, mais nettement plus que Brigade. La nouvelle variété est passablement plus courte que Brigade, Strongfield et AAC Cabri, mais avec une cote pour la résistance à la verse nettement inférieure à celle de Strongfield et AAC Cabri. AAC Stronghold se caractérise par une tige pleine qui rend le cultivar résistant aux ravages du cèphe du blé (*Cephus cinctus* Norton). Le grain d'AAC Stronghold renferme peu de cadmium et son gluten est plus ferme que celui de Strongfield. AAC Stronghold est admissible aux classes de la catégorie blé dur ambré de l'Ouest canadien. [Traduit par la Rédaction]

Mots-clés : Triticum turgidum, blé dur, description de cultivar, rendement grainier, tige pleine, absorption du cadmium.

Introduction

AAC Stronghold durum wheat [*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.] was developed at the Swift Current Research and Development Centre (SCRDC), Agriculture and Agri-Food Canada (AAFC), Swift Current, SK. Plant Breeder's Rights grant of rights certificate no. 5769 was granted on 11 May 2018 and AAC Stronghold received registration no. 8085 from the Variety Registration Office, Canadian Food Inspection Agency, Ottawa, ON, on 8 July 2016.

Pedigree and Breeding Methods

AAC Stronghold (experimental names: DT862, A0719-KZ06) was selected from the cross DT805/DT795 made in 2007 at SCRDC. DT805 (A0138-KZ01) is a breeding line derived from a cross of 9667A-AV6/DT704//Strongfield. Strongfield (Clarke et al. 2005*b*) is a high-yielding, high grain protein concentration, low cadmium uptake Canadian durum cultivar. DT795 (A0050-EC03) is a solid stem breeding line derived from the cross of 94D11-K*3B/Strongfield//9688A-245D2, where the solid stem

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line 9688A-245D2 was derived from the cross of DT663/W9262-260D1//DT665/DT673. The solid stem line W9262-260D1 was derived from the cross Kyle*2/Biodur, where Kyle (Townley-Smith et al. 1987) is a widely adapted high cadmium uptake, hollow stem Canadian cultivar and Biodur is a low cadmium uptake, solid stem cultivar from Germany. The parents were haplotyped with molecular markers linked to *Cdu1* controlling cadmium uptake and *Sst1* controlling stem solidness (Houshmand et al. 2007; Knox et al. 2009).

In 2007, F_1 seeds were planted in the greenhouse to increase F_2 seed. In the spring of 2008, approximately 8000 seeds of the F_2 generation were space-planted at 14 cm intervals within a row in an irrigated epiphytotic field nursery near Swift Current. Genotypes susceptible to prevalent races of leaf rust (*Puccinia triticina* Erikss.) and stem rust [(*Puccinia graminis* Pers.:Pers. f. sp. *tritici* (Erikss. & E. Henn.)] were planted as disease spreaders every 10th row. Between the spreader rows, five rows of spring-planted winter wheat were alternated with four rows of F_2 seed at a row spacing of 23 cm. The winter wheat cultivar CDC Kestrel (Fowler 1997), which is susceptible to leaf and stem rust, was used to contribute to the multiplication of rust inoculum. Spreader rows were inoculated by injecting, with a syringe and needle, a water suspension of leaf rust and stem rust spores into a sample of plants every 3 m. Representative leaf rust races found the previous year were applied (McCallum and Seto-Goh 2006). The stem rust races used were QTHJF (C25), RHTSC (C20), RKQSC (C63), RTHJF (C57), TMRTF (C10), and TPMKC (C53) (Roelfs and Martens 1988; Fetch et al. 2015). Leaf spotting diseases developed through natural infection. Individual plants were selected for plant height, straw strength, maturity, and resistance to leaf spotting diseases, leaf rust, and stem rust.

The F_3 seeds from individual spikes from 261 selected F_2 plants were grown in 2-m-long rows in a contra season nursery near Lincoln, New Zealand, in 2008–2009. Based on plant height, days to maturity, and straw strength, 137 rows were selected, and the rows were harvested individually to produce the seed used for agronomic and disease trials in Canada. In 2009, the 137 F_4 lines, their parents, and other check cultivars were grown in unreplicated 2.74 m^2 four-row plot experiments near Swift Current and Regina, SK. The traits grain yield, plant height, time to maturity, straw strength, and leaf spotting infection were assessed. Seven spikes per F_4 line from within plots grown near Swift Current were selected for plant height, straw strength, and leaf spotting disease symptoms caused primarily by tan spot [*Pyrenophora tritici-repentis* (Died.) Drechs., anamorph *Drechslera tritici-repentis* (Died.) Shoemaker] and stagonospora nodorum blotch [*Phaeosphaeria nodorum* (Müll.) Hedjar., anamorph *Stagonospora nodorum* (Berk.) Castell. & Germano]. The grain quality traits protein concentration, yellow pigment concentration, gluten strength, and volume weight were assessed on grain harvested from field trials. Based on this suite of agronomic, disease, and quality traits, 21 F_4 lines were selected.

In 2009–2010, 147 F_5 lines (from the 21 $F_{4:5}$ families at seven spikes per F_4 line) were grown in 2-m-long rows near Leeston, New Zealand and selected primarily on plant height, straw strength, and days to maturity. After selection, 86 $F_{4:6}$ lines were grown in 2010 under dryland conditions near Swift Current and Regina and under irrigation near Lethbridge, AB. Twenty-eight genotypes were selected based on agronomic performance, disease resistance, and quality traits assessed as described for the F_4 generation.

Four F_7 genotypes were grown in the 2011 Durum A-level tests as a two replicate lattice design with four-row plots planted near Swift Current, Regina, and Indian Head, SK, Lethbridge, AB, and Brandon, MB, to assess agronomic performance as described for the F_4 generation. Check cultivars in the Durum A tests were AC Avonlea (Clarke et al. 1998), AC Morse, AC Navigator (Clarke et al. 2000), Brigade (Clarke et al. 2009), Commander (Clarke et al. 2005*a*), and Strongfield. Remnant seed from the yield trials was bulked over replications within a location and a subsample from each location that graded better than No. 3 Canada Western Amber Durum was used to assess end-use suitability by the Central Quality Lab, Cereal Research Centre, Winnipeg, MB. Assessment included grain protein concentration, yellow pigment concentration, milling properties, gluten strength, and Hagberg Falling Number. Response to loose smut [*Ustilago tritici* (Pers.) Rostr.] was tested with a mixture of races T26, T32, and T33 (Nielsen 1987) under field conditions near Swift Current. Response to leaf rust and stem rust were evaluated in hill plots in a rust nursery near Glenlea, MB, using a mixture of races similar to that in the F_2 rust nursery. Response to leaf spotting pathogens was assessed from within the yield plots under conditions of natural inoculum. Response to *Fusarium* head blight (FHB) caused by *Fusarium graminearum* Schwabe [teleomorph *Gibberella zeae* (Schwein.) Petch] was assessed in nurseries near Portage la Prairie and Carman, MB (Bokore et al. 2017). Plots at Carman were scored for incidence (%) and severity (%), and at Portage la Prairie, the plots were scored on a 1–9 scale on increments of 10% incidence and severity symptoms. Scoring for FHB was performed when a significant differential reaction was observed among checks. These procedures identified the line A0719-KZ06, which met all of the selection criteria at each stage of selection.

The four lines from the population designated A0719, including A0719-KZ06 were tested in the 2012 Durum-B test in an alpha-lattice design with two replications grown near Swift Current, Regina, Saskatoon, and Floral, SK, Lethbridge, AB, and Brandon, MB, using the same check cultivars as in the 2011 Durum A tests. Response to diseases was measured using protocols

Table 1. Grain yield (kg ha^{-1}) of AAC Stronghold and check cultivars in the Durum Cooperative Test, 2013–2015, in Zones 1 and 2.[a]

	2013			2014			2015			2013–2015		
	Zone 1	Zone 2	Mean[b]	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean
AC Navigator	3556	4540	4367	4045	3349	3490	3640	3099	3197	3733	3668	3688
Brigade	4891	5156	5108	5170	4173	4375	4062	3415	3540	4719	4254	4345
Strongfield	4174	4816	4701	4896	3748	3978	4160	3231	3391	4413	3926	4023
AAC Cabri	4619	4951	4891	5078	3874	4113	3734	3549	3594	4473	4130	4202
Mean of checks	4310	4866	4767	4797	3786	3989	3899	3324	3431	4342	3995	4058
AAC Stronghold	4732	4825	4809	5874	3900	4286	4277	3452	3593	4930	4061	4225
LSD$^{c}_{0.05}$	670	245	241	782	355	335	828	181	203	506	246	223
No. of tests	2	9	11	2	8	10	2	9	11	6	26	32

[a]Zone 1 (Black Soils): Indian Head, Brandon; Zone 2 (Brown and Dark Brown Soils): Swift Current, Stewart Valley, Saskatoon, Lethbridge, Vulcan, Moose Jaw (2013, 2015), Pense, Scott, Vanguard.
[b]Means are LS means obtained from the PROC MIXED procedure in SAS.
[c]LSD, least significant difference ($P \leq 0.05$) includes the genotype × environment interaction variation.

Table 2. Agronomic characteristics of AAC Stronghold and check cultivars in the Durum Wheat Cooperative Test, 2013–2015.

	Days to maturity[a,b]			Test weight[a] (kg hL^{-1})			1000-kernel weight[a] (g)	Height[d] (cm)	Lodging[e] (1–9)
	Zone 1	Zone 2	Mean[c]	Zone 1	Zone 2	Mean			
AC Navigator	98.7	102.6	102.1	73.2	79.0	78.0	44.3	77.2	2.2
Brigade	99.9	105.0	104.2	74.0	79.6	78.7	42.9	98.1	2.0
Strongfield	97.3	101.6	101.0	74.4	78.8	78.1	41.5	89.5	3.1
AAC Cabri	99.1	103.3	102.7	74.7	79.7	78.8	40.7	93.0	3.0
AAC Stronghold	100.2	103.6	103.1	75.1	79.7	79.0	44.0	87.4	1.4
LSD$^{f}_{0.05}$	2.8	1.2	0.9	2.0	0.7	0.7	1.1	2.3	0.8
No. of tests	4	24	28	5	26	31	31	32	14

[a]Zone 1 (Black Soils): Indian Head, Brandon (2013, 2015); Zone 2 (Brown and Dark Brown Soils): Swift Current, Stewart Valley, Saskatoon, Lethbridge, Vulcan, Moose Jaw (2013, 2015), Pense, Scott, Vanguard.
[b]All Zone 1 and Zone 2 locations except Stewart Valley (in Zone 2).
[c]Means are LS means obtained from the PROC MIXED procedure in SAS.
[d]Includes Brandon 2014.
[e]Swift Current (2014), Moose Jaw (2015), Saskatoon (2014), Stewart Valley, Brandon (2013), Pense, Vanguard, Indian Head (2014).
[f]LSD, least significant difference ($P \leq 0.05$) includes the genotype × environment interaction variation.

Table 3. Grain protein concentration (13.5% moisture basis) of AAC Stronghold and check cultivars measured on grain samples bulked across replications at each location of the Durum Cooperative Test, 2013–2015.

	2013			2014			2015			2013–2015
	Zone 1[a]	Zone 2	Mean[b]	Zone 1	Zone 2	Mean	Zone 1	Zone 2	Mean	Mean
AC Navigator	13.5	12.9	13.0	12.8	13.3	13.2	14.8	13.5	13.7	13.4
Brigade	12.7	12.7	12.7	12.8	13.0	12.9	14.1	12.8	13.0	13.0
Strongfield	14.7	13.6	13.8	13.5	13.9	13.8	15.2	13.5	13.8	13.9
AAC Cabri	13.9	13.1	13.3	13.5	13.9	13.8	16.3	13.1	13.7	13.6
AAC Stronghold	13.2	13.1	13.1	13.7	13.5	13.5	15.0	13.4	13.7	13.5
LSD$^{c}_{0.05}$	1.2	0.4	0.4	—	0.6	0.6	0.9	0.6	0.5	0.3
No. of tests	2	9	11	1	8	9	2	9	11	31

[a]Zone 1 (Black Soils): Indian Head, Brandon; Zone 2 (Brown and Dark Brown Soils): Swift Current, Stewart Valley, Saskatoon, Lethbridge, Vulcan, Moose Jaw (2013, 2015), Pense, Scott, Vanguard.
[b]Means are LS means obtained from the PROC MIXED procedure in SAS.
[c]LSD, least significant difference ($P \leq 0.05$) includes the genotype × environment interaction variation.

Table 4. Summary of disease reactions to stem rust, leaf rust, stripe rust, common bunt, loose smut, and leaf spot of AAC Stronghold and check cultivars grown in the Durum Cooperative Test, 2013–2015.

	Year	Stem rust		Leaf rust	Common bunt		Loose smut		Leaf spot	Stripe rust			
									SC	LB		CT	
		Rating	Severity[a] (%)	Rating	Rating	Incidence (%)[b]	Rating	Incidence (%)[c]	Rating	Infection response[d]	Severity[e] (%)	Infection response	Severity (%)	Infection response
AC Navigator	2013	5 MR		R	1 R		35 MR		9.3 MS	60 S		15 R	
	2014	7 MR		R	1 R		7 R		9.8 S	5 R		15	
	2015	15 MR		R	0 R		0 R		—	15 I		—	
Brigade	2013	1 R		R	1 R		0 R		8.3 MS	15 R		15 R	
	2014	7 MR		R	1 R		3 R		8.5 MS	25 MR		25	
	2015	5 R		R	0 R		0 R		—	25 I		—	
Strongfield	2013	1 R		R	7 R		8 R		8.3 MS	15 R		5 R	
	2014	1 R		R	1 R		11 MR		8.8 MS	5 R		5	
	2015	2 R		R	1 R		0 R		—	10 MR		—	
AAC Cabri	2013	1 R		R	4 R		14 R		7.8 I	10 R		5 R	
	2014	10 MR		R	0 R		8 R		8.5 MS	20 MR		15	
	2015	5 R		R	1 R		0 R		—	5 R		—	
AAC Stronghold	2013	1 R		R	26 I		2 R		7.8 I	10 R		15 R	
	2014	1 R		R	0 R		6 R		7.3 I	20 MR		5	
	2015	5 MR		R	1 R		4 R		—	10 MR		—	

Note: SC, Swift Current; LB, Lethbridge; CT, Creston. Rating: VR, very resistant; R, resistant; MR, moderately resistant; I, intermediate; MS, moderately susceptible;
S, susceptible.

[a]Severity is a percentage of the stem infected with stem rust using the Modified Cobb Scale.
[b]Percentage of total spikes with common bunt symptoms.
[c]Percentage of total plants with loose smut symptoms.
[d]Adult plant, rated mid-grainfill at Swift Current McFadden scale (0 = no symptoms, 11 = severe symptoms) (McFadden 1991).
[e]Severity is a percentage of the leaf infected with stripe rust using the Modified Cobb Scale.

Table 5. Summary of *Fusarium* head blight disease reactions of AAC Stronghold and check cultivars grown in the Durum Cooperative Test, 2013–2015.

		Fusarium head blight														FDK[d]	
		Carman		Portage		Morden		Ottawa	Glenlea	PEI	DON (ppm)				ISD[c] MD		ISD[c] CM		CM	PEI
	Year	Index[a]	Rating	Index	Rating	Index	Rating	Score[b] (1–00)	Index	Index	CM	MD	OT	PEI	Score	Rating	Score	Rating	%[d]	1–9[e]
AC Navigator	2013	51 MS		21 MS		—		73	9	73	—	—	17	17	—		—		—	9
	2014	56 S		—		89 S		90	—	49	42	118	19	87	74 S		28 S		31	9
	2015	56 MS		—		68 S		—	—	—	70	91	23	26	58 S		45		48	8
Brigade	2013	23 MR		17 I		—		48	7	48	—	—	12	15	—		—		32	9
	2014	19 I		—		16 R		37	—	46	30	101	5	47	62 S		20 S		23	9
	2015	30 MS		—		29 MR		—	—	—	45	20	8	19	14 MR		29		45	7
Strongfield	2013	30 I		17 I		—		90	10	72	—	—	9	22	—		—		19	9
	2014	40 MS		—		42 I		53	—	52	35	80	26	56	51 MS		24 S		24	9
	2015	39 MS		—		67 S		—	—	—	36	40	13	18	27 MS		24		39	8
AAC Cabri	2013	34 I		17 I		—		45	15	46	—	—	16	21	—		—		16	8
	2014	32 MS		—		41 I		27	—	47	32	72	14	44	46 I		22 S		15	8
	2015	41 MS		—		57 MS		—	—	—	41	37	13	17	25 I		27		41	7
AAC Stronghold	2013	43 MS		20 I		—		70	11	64	—	—	19	16	—		—		19	8
	2014	33 MS		—		43 MR		48	—	43	31	106	16	33	66 S		21 S		18	9
	2015	44 MS		—		64 MS		—	—	—	47	69	28	11	44 S		31		31	7

Note: DON, deoxynivalenol in parts per million; PEI, Prince Edward Island; CM, Carman; MD, Morden; OT, Ottawa. Disease response category: R, resistant; MR, moderately resistant; I, intermediate resistant; MS, moderately susceptible; S, susceptible.

[a]*Fusarium* head blight disease index = (percentage of infected heads × percentage of diseased florets on infected heads)/100.

[b]Score is based on a 1–100 scale of spikes infected with *Fusarium* head blight.

[c]ISD, incidence-severity-DON index calculated as (0.2 × mean incidence) + (0.2 × mean severity) + (0.6 × DON).

[d]FDK, *Fusarium*-damaged kernels on a weight of kernels with *Fusarium* symptoms as a percent of the total sample weight.

[e]FDK, *Fusarium*-damaged kernels on a 1 (low) to 9 (high) scale.

Table 6. Stem solidness[a] rating of each of five internodes on plants grown near Swift Current, 2013–2015, of AAC Stronghold, durum checks, and hexaploid wheat checks.

	Ploidy	Internode 1[b]	Internode 2	Internode 3	Internode 4	Internode 5
AC Navigator	Tetraploid	2.8	2.6	2.0	1.5	1.3
Strongfield	Tetraploid	3.1	2.7	2.2	1.5	1.3
AAC Raymore	Tetraploid	4.8	4.7	4.6	4.5	4.3
AAC Cabri	Tetraploid	4.9	4.9	4.7	4.5	4.1
AAC Stronghold	Tetraploid	5.0	5.0	4.9	4.7	4.5
AC Abbey	Hexaploid	3.8	3.3	2.8	2.2	1.7
AC Eatonia	Hexaploid	4.4	4.2	3.6	2.5	1.8
Glenlea	Hexaploid	3.1	2.4	2.0	1.5	1.2
Lancer	Hexaploid	4.8	4.6	3.9	2.6	1.8
Lillian	Hexaploid	4.0	3.9	3.4	2.4	1.6
$LSD^{c}_{0.05}$		1.0	0.9	0.9	0.7	0.5

[a]Solidness rated on a 1 (stem cavity hollow and thin walled) to 5 (stem cavity completely filled with pith) scale. Mean of solidness rating based on 10 plants per entry per rep.
[b]Internode 1 is basal internode and internode 5 is the neck.
[c]LSD, least significant difference ($P \leq 0.05$) includes the genotype × environment interaction variation.

similar to that for the A-level tests described above. Remnant seed from the yield trials was used to prepare a composite, using degrading factors as a consideration for suitability for inclusion in the composite, to assess the same end-use suitability parameters as in the Durum A-level test, by the Central Quality Lab. This procedure identified the line A0719-KZ06, which met all of the selection criteria at each stage of selection.

A0719-KZ06 was advanced to the Durum Wheat Cooperative Test and evaluated as DT862 from 2013 to 2015. The Durum Wheat Cooperative Test was grown in four-row plots at up to 12 locations annually in a two replicate 5 × 6 lattice design including four check cultivars in two repetitions and two replications. The check cultivars were AAC Cabri (Singh et al. 2017), AC Navigator, Brigade, and Strongfield. The Durum Wheat Cooperative Test operating protocols are described in the Prairie Recommending Committee for Wheat Rye and Triticale operating procedures (Anonymous 2015). The PROC MIXED procedure in SAS version 9 (SAS Institute Inc. 2003) was used to analyze the data annually and to perform a combined analysis over years, using a mixed model with sub-blocks, replications, zones, locations, and years considered random effects and genotypes considered fixed effects (Littell et al. 2006). The diff command was used to estimate the standard error of the difference between entries, which in turn was used to estimate an *F*-protected least significant difference (LSD) at a significance level of 5% ($LSD_{0.05}$).

The Durum Wheat Cooperative Test entries were evaluated in inoculated disease nurseries near Brandon, Portage la Prairie, and Morden, MB, to determine the response to leaf rust, stem rust, and loose smut. *Fusarium* head blight was assessed in inoculated nurseries near Carman, Glenlea, Portage la Prairie, and Morden, MB, Ottawa, ON, and Charlottetown, PEI. Inoculum composition for leaf rust, stem rust, and loose smut was as described above. Response to common bunt caused by *Tilletia laevis* Kühn in Rabenh., and *Tilletia tritici* (Bjerk.) G. Winter in Rabenh., was assessed in a nursery grown near Lethbridge using a mixture of prevalent races: T-1, T-6, T-13, T-19, L-1, and L-16 (Hoffmann and Metzger 1976; Gaudet and Puchalski 1989). Leaf spotting reaction was determined based on natural infection at Swift Current.

A sample of grain of DT862 and the check cultivars from each location was submitted to the Canadian Grain Commission to determine grain grade and protein concentration. End-use suitability was determined on a composite sample made up from sites with grain samples representative only of the top durum wheat grades available. The quantity of grain from a location was adjusted to achieve a final composite protein concentration approximating that of the average for the crop that year. A consistent quantity of grain within a location for all experimental lines was used to make up the composite each year. All end-use suitability analyses were performed by personnel at the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB, following protocols of the AACC (American Association of Cereal Chemists 2000).

Performance

In 3 yr of cooperative testing, the grain yield of AAC Stronghold was significantly greater than AC Navigator in both zones (Table 1). Averaged over zones, AAC Stronghold was significantly later maturing than Strongfield but earlier than Brigade (Table 2). Test weight (kg hL^{-1}) of AAC Stronghold was significantly heavier than AC Navigator and Strongfield. The 1000-kernel weight (g) of AAC Stronghold was significantly heavier than Strongfield and AAC Cabri, but similar to the other checks. AAC Stronghold had plant height significantly shorter than Brigade and AAC Cabri, while

Table 7. End-use suitability[a,b] measured on yearly composites of AAC Stronghold and check cultivars from 2013 to 2015 in the Durum Cooperative Test.

	FN (s)	HVK (%)	Cd (mg kg^{-1})	Milling yld (%)	Semo yld (%)	Semo ash (%)	Wht prot (%)	Semo prot (%)	GI (%)	P/L	W (ergs)	Semo YP (mg kg^{-1})	Pasta colour b^*	Pasta colour a^*
AC Navigator	395	79.0	232	76.2	67.7	0.67	12.8	11.9	86.1	1.01	217	10.1	64.8	5.0
Brigade	345	73.7	74	74.8	66.2	0.66	12.6	11.6	95.8	0.92	256	10.2	63.7	4.5
Strongfield	345	77.0	78	74.8	66.1	0.61	13.3	12.3	76.0	0.79	194	9.1	63.3	3.7
AAC Cabri	360	81.7	68	75.4	66.7	0.64	13.0	12.0	78.0	0.56	171	10.4	65.7	4.4
AAC Stronghold	388	78.3	81	74.6	66.8	0.65	13.3	12.1	84.9	1.23	222	9.7	65.0	4.4
SD[c]	5	—	0.001	0.4	0.4	0.006	0.06	0.05	3	0.04	6	0.04	0.3	0.1

Note: FN, Hagberg falling number; HVK, hard vitreous kernel; Cd, grain cadmium; Semo yld, semolina yield; Wht prot, wheat protein; GI, gluten index; P/L and W values determined through alveograph; Semo YP, semolina yellow pigment; spectrophotometer colour: b^*, yellowness, and a^*, redness, on the CIE scale.

[a]American Association of Cereal Chemists methods were followed by the Grain Research Laboratory (GRL), Canadian Grain Commission (CGC) for determining the various end-use suitability traits on a composite of 8–9 locations each year.

[b]Means are from 2013, 2014, and 2015 durum composites.

[c]SD, standard deviation based on repeated testing of check samples with replicate tests carried out over an extended period of time each season, provided by GRL, CGC.

being significantly taller than AC Navigator. Its lodging score was significantly less than Strongfield and AAC Cabri. The grain protein concentration of AAC Stronghold was similar to AC Navigator and AAC Cabri, significantly more than Brigade, and significantly less than Strongfield (Table 3).

AAC Stronghold was resistant to leaf rust, stem rust, and loose smut, moderately resistant to stripe rust, resistant to common bunt, and intermediately resistant to leaf spot (Table 4). The FHB symptoms of disease incidence and severity of AAC Stronghold were rated as moderately susceptible while deoxynivalenol (DON) accumulation was rated as susceptible (Table 5).

AAC Stronghold is a solid stemmed genotype (Table 6), a trait that reduces cutting by the wheat stem sawfly (*Cephus cinctus* Norton) (Holmes and Peterson 1961, 1962). AAC Stronghold has low grain cadmium concentration, similar to Strongfield (Table 7). The grain and milling attributes of AAC Stronghold were intermediate compared with the checks. AAC Stronghold had gluten index and alveograph W values significantly higher than Strongfield, as well as pasta b^* colour desirably higher. The semolina ash of AAC Stronghold was significantly higher than for Strongfield.

Other Characteristics

Straw (at maturity): thick pith in cross-section, no anthocyanin colouration.

Spikes: parallel-sided in profile, mid-dense to dense, erect; off-white at maturity; awns longer than spike, white at maturity.

Kernel: colour amber; kernel size large, elliptical, short brush hairs.

Lower glume: medium length and width; glabrous.

Lower glume shoulder: very narrow to medium width; slightly sloping shape.

Lower glume beak: narrow to medium length, straight to slightly curved shape.

End-use suitability: eligible for grades of the Canada Western Amber Durum wheat market class.

Maintenance and Distribution of Pedigreed Seed

The 107 Breeder Lines originated from random $F_{4:9}$ single plants of A0719-KZ06 grown as 108 pre-Breeder Lines in 3-m-long rows in isolation near Swift Current in 2014 and again as 15-m-long rows near Indian Head in 2015. Breeder Seed will be maintained by the Seed Increase Unit of the Research Farm, Indian Head, SK S0G 2K0, Canada. Distribution and multiplication of pedigreed seed stocks will be handled by SeCan Association, 400-300 Terry Fox Drive, Ottawa, ON K2K 0E3, Canada (www.secan.com).

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