CULTIVAR DESCRIPTION

Waskada hard red spring wheat

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Fox, S. L., Thomas, J. B., Wise, I. L., Smith, M. A. H., Humphreys, D. G., Brown, P. D., Townley-Smith, T. F., McCallum, B. D., Fetch, T. G., Menzies, J. G., Gilbert, J. A., Fernandez, M. R., Despins, T. and Niziol, D. 2009**. Waskada hard red spring wheat.** Can. J. Plant Sci. **89**: 929–936. Waskada is a hard red spring wheat that meets the end-use quality specifications of the Canada Western Red Spring wheat class. Waskada was found to be adapted to the wheat growing regions of the Canadian prairies based on data from the Central Bread Wheat Cooperative Registration Test in 2004, 2005 and 2006. In comparison with the check cultivars (Katepwa, McKenzie, CDC Teal, AC Barrie, and Superb), the grain yield of Waskada was similar to that of the best check in Manitoba and in Saskatchewan. Waskada matures 1 d later than AC Barrie and 1 d earlier than Superb. Waskada had similar height and lodging characteristics as Katepwa and McKenzie. The test weight of Waskada was 1.3 kg hL^{-1} higher than McKenzie, the best check. Waskada demonstrated moderate resistance to leaf rust but very good resistance to stem rust. Resistance to common bunt and loose smut was good, being similar to the more resistant checks Superb and Katepwa, respectively. Resistance to Fusarium head blight was better than the best check in four determinations made over the 3 yr of registration testing. Waskada appears to deter egg laying by the orange blossom wheat midge. Waskada has good preharvest sprouting resistance with similar or lower sprouting scores than the best check in 4 yr of testing, and it also maintained its falling numbers after natural or artificial weathering of spikes. End-use quality tests identified that Waskada had significantly higher amylograph viscosity than all checks except Superb. Waskada had a significantly lower loaf volume than CDC Teal and AC Barrie and was within the range of the checks for other quality traits.

Key words: *Triticum aestivum* L., cultivar description, red spring wheat, test weight, preharvest sprouting, Fusarium head blight, wheat midge oviposition deterrence

Fox, S. L., Thomas, J. B., Wise, I. L., Smith, M. A. H., Humphreys, D. G., Brown, P. D., Townley-Smith, T. F., McCallum, B. D., Fetch, T. G., Menzies, J. G., Gilbert, J. A., Fernandez, M. R., Despins, T. et Niziol, D. 2009. **Le blé roux vitreux de printemps Waskada**. Can. J. Plant Sci. **89**: 929–936. Waskada est une variété de blé roux vitreux de printemps répondant aux spécifications de la catégorie Blé roux de printemps de l'Ouest canadien pour la qualité à l'utilisation finale. D'après les résultats des essais d'homologation de 2004, 2005 et 2006 de la Central Bread Wheat Cooperative, la variété est bien acclimatée aux régions de culture du blé des Prairies canadiennes. Comparativement aux cultivars témoins (Katepwa, McKenzie, CDC Teal, AC Barrie et Superb), Waskada a un rendement grainier similaire à celui de la meilleure variété témoin au Manitoba et en Saskatchewan. Waskada parvient à maturité un jour plus tard que AC Barrie et un jour plus tôt que Superb. Le cultivar pousse à la même hauteur et présente les mêmes propriétés de résistance à la verse que Katepwa et McKenzie. Le poids spécifique de Waskada dépasse celui de McKenzie, le meilleur témoin, de 1,3 kg hL^{-1}. Waskada résiste modérément à la rouille des feuilles, mais oppose une très bonne résistance à celle de la tige. La variété résiste bien à la carie et au charbon nu, sa résistance étant similaire à celles de Superb et de Katepwa, les témoins respectivement les plus résistants aux deux maladies. Waskada a mieux résisté à la brûlure de l'épi par *Fusarium* que le meilleur témoin lors des quatre analyses effectuées durant les trois années d'essais précédant l'homologation. Waskada semble résister à la ponte des œufs par la cécidomyie orangée du blé. Le cultivar résiste bien à la germination sur pied avant la récolte, avec une proportion de plants germés semblable ou inférieure à celle du meilleur témoin lors des quatre années d'essai. Waskada conserve aussi son indice de Hagberg après l'altération sur pied naturelle ou artificielle des épis. Selon les tests sur la qualité à l'utilisation finale, Waskada présente une viscosité sensiblement plus élevée à l'amylographe que celle de tous les cultivars témoins sauf Superb. Waskada donne un pain sensiblement moins volumineux que CDC Teal et AC Barrie, mais ses autres paramètres qualitatifs se situent dans la fourchette des valeurs témoins.

Mots clés: *Triticum aestivum* L., description de cultivar, blé roux de printemps, poids spécifique, germination sur pied, brûlure de l'épi par *Fusarium*, anti-oviposition de la cécidomyie du blé

Waskada is a high-yielding, high test weight, preharvest sprouting resistant, hard red spring wheat (*Triticum aestivum* L.) cultivar developed by Agriculture and Agri-Food Canada (AAFC), Cereal Research Centre, Winnipeg, Manitoba, and released in 2006. This cultivar is the first spring wheat to be registered in Canada with the *Fhb2* resistance gene derived from Sumai 3 (Cuthbert et al. 2007) and which has also demonstrated oviposition deterrence to wheat midge. It was given the registration number 6317 by the Plant Variety Registration Office, Plant Production Division, Seed Section, Canadian Food Inspection Agency, Agriculture and Agri-Food Canada, on 2007 Aug. 14.

Waskada is adapted to the wheat-producing regions of the prairies and meets the end-use quality characteristics of the Canada Western Red Spring (CWRS) wheat class. Waskada is named after a small farming village in Manitoba.

Pedigree and Breeding Method

Waskada was selected from the cross BW278/2*Superb made in 1998 at the Agriculture and Agri-Food Canada Cereal Research Centre, Winnipeg (Table 1). BW278 derives from the cross AC Domain*2/Sumai 3 (T. F. Townley-Smith, unpublished data) and Superb derives from the cross Grandin*2/AC Domain (Townley-Smith, unpublished data). Using the methods described by Fedak et al. (1997), the 863 BC_1F_1-derived doubled haploid lines from BW278/2*Superb were produced. Following a winter increase, these lines were grown in a field nursery and were selected for agronomic traits including height and straw strength. The nursery was inoculated to allow for selection for disease resistance to leaf and stem rust caused by *Puccinia triticina* Eriks. and *P. graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn., respectively, and Fusarium head blight caused by *Fusarium graminearum* Schwabe [teleomorph *Gibberella zeae* (Schwein.) Petch]. Selection for kernel appearance, grain protein concentration, flour yield and dough strength were carried out on lines retained from the field nursery. Following a New Zealand winter nursery increase in 2000–2001, approximately 10% of the original 863 lines were yield tested. The line 98B19*K156 was then tested in the preregistration tests CBWA1 and CBWB in 2002 and 2003, respectively, before being entered into the Central Bread Wheat Cooperative (CBWC) test in 2004, designated as BW357.

In the CBWC, agronomic performance was evaluated using a three-replicate rectangular lattice, 30 entry yield test grown at 10 locations/year (Manitoba: Glenlea, Portage La Prairie, Souris, Morden, Brandon, Dauphin (2006 only); Saskatchewan: Regina, Indian Head, Kelvington (2004 and 2005 only), Saskatoon, Melfort)

Table 1. Population size and activities at each generation leading to the registration of Waskada hard red spring wheat

Name	Gen.	Year	Activity – Number of lines – Locations
	F_0	1998	Cross was made in a growth cabinet.
98B19	F_1	1998	Make 863 doubled haploids, CRC.
98B19*K156	DH	1999	Greenhouse winter increase, Indian Head, SK.
98B19*K156	DH	2000	1 m row nursery near Portage la Prairie, MB. Selection for agronomics, seed appearance, resistance to diseases including rusts, Fusarium headblight and leaf spots, protein concentration, flour yield, and dough strength measured by mixograph.
98B19*K156	DH	2000	New Zealand winter nursery, 1.5 m row. Selection for agronomics and leaf rust resistance.
98B19*K156	DH	2001	Yield test 85 lines, single replicate at four locations (MB: Glenlea, Brandon, Morden, Portage la Prairie). Selections based on agronomics, disease resistance and quality performance.
98B19*K156	DH	2002	Trial 8 lines in the Central Bread Wheat "A" test. Forty other lines were screened at this test level in 2001 and 2003. Yield test, 2 replicates at 5 locations (MB: Glenlea, Brandon: SK: Indian Head, Regina and Melfort).
98B19*K156	DH	2003	Trial 5 lines in the Central Bread Wheat "B" test. Seven other lines were screened in this test in 2002 and 2004. Yield test, 3 replicates at 8 locations (MB: Glenlea, Brandon, Morden; SK: Indian Head, Regina, Melfort, Saskatoon; AB: Beaverlodge).
BW357	DH	2004-6	Central Bread Wheat "C" registration test. Two other lines were also tested in this registration test in 2002 and 2003. Yield test, 3 replicates at 10 locations (MB: Glenlea, Portage la Prairie, Brandon, Morden, Souris Dauphin; SK: Indian Head, Regina, Melfort, Kelvington, Saskatoon). Dauphin replaced Kelvington as a test location in 2006.
Breeder Seed Production			
BW357	DH	2004	Breeder seed spikes: Approximately 250 random spikes were selected from a rogued increase plot grown at Indian Head, SK. Due to dry conditions, 61 spikes were rejected due to poorly developed seed.
BW357	DH	2005	Breeder seed isolation rows: 189 lines were grown in 1 m rows grown at Portage La Prairie with 10 m isolation distance from any other wheat. All lines were harvested individually but five lines were not advanced due to low seed yield.
BW357	DH	2006	Breeder seed rows: each of the 184 isolation rows was used to seed a pair of 15 m rows grown at Indian Head, SK, with 10 m isolation distance from other wheat, totalling 368 rows. One line (2 rows) was discarded prior to harvest due to presence of awnless plants. The remaining uniform plots were inspected and harvested in bulk producing 547 kg of breeder seed.

operated by Agriculture and Agri-Food Canada (AAFC), AgriPro Wheat, and the University of Saskatchewan. For registration decisions regarding cultivar merit, Waskada was compared with five check cultivars: Katepwa (Campbell and Czarnecki 1987), McKenzie (Graf et al. 2003), CDC Teal (Hughes and Hucl 1993), AC Barrie (McCaig et al. 1996) and Superb. At the Cereal Research Centre, disease severity in artificially inoculated field nurseries was estimated for leaf rust and stem rust using the modified Cobb scale (Peterson et al. 1948). Several greenhouse seedling evaluations were conducted to observe infection type reactions to *P. triticina* races MBDS (12-3), MGBJ (74-2), TJBJ (77-2) and MBRJ (128-1) (McCallum and Seto-Goh 2006) and to *P. graminis* f. sp. *tritici* races TMRTK (C10), RKQSR (C63), TPMKR (C53) RTHJT (C57), QTHST (C25) and RHTSK (C20) (Roelfs and Martens 1988; Fetch 2005). Fusarium head blight was evaluated in field nurseries that were spray inoculated with a macroconidial suspension and evaluated using a visual index (% incidence × % severity/100) (Gilbert and Woods 2006). Resistance to the disease loose smut caused by *Ustilago tritici* (Pers.) Rostr. was also estimated (Menzies et al. 2003). Evaluations for resistance to common bunt caused by *Tilletia tritici* (Bjerk.) R. Wolff and *T. laevis* Kuhn in Rabenh. (Gaudet and Puchalski 1989; Gaudet et al. 1993) were conducted at the Lethbridge Research Centre of AAFC. End-use quality of composite samples was evaluated by the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB. The samples for each entry were composited from test locations selected based on the grading of the check cultivars. Grain from locations where the checks produced poor-quality grain was not included in quality composites. Annual statistical analysis of experiments was conducted using Agrobase Generation II (Agronomix Software Inc. 2006). The SAS PROC MIXED procedure (SAS Institute, Inc. 2006) was used to perform a multiyear analysis: for agronomic data, a mixed model was used with environments and replications set as random variables and cultivars set as a fixed variable. For end-use quality data, the analysis was similar except that there were no replicated observations within years.

Although Waskada was derived through doubled haploid breeding, a conventional approach to producing breeder seed was used to ensure efficient and effective removal of off-types. Breeder seed of Waskada was produced by randomly selecting approximately 250 spikes from a BW357 seed increase plot in 2004 that was rogued to uniformity in appearance. Of these spikes, 189 were grown as an isolated group of 1 m rows at Portage la Prairie, MB, in 2005 and 184 lines were retained. In 2006, these lines were grown as 15 m two-row plots at Indian Head, SK, with one line discarded due to the presence of awnless offtypes. The remaining 183 uniform lines were inspected by the Canadian Food Inspection Agency and bulk harvested to produce 547 kg of breeder seed. One kind of off-type plant was rogued from the plot with a frequency of 1 awnless to 15 800 awned plants.

Performance

The grain yields for Waskada were similar to the best check in all comparisons in 3 yr of testing in the Central Bread Wheat Cooperative test (Table 2). Waskada was about 1.5 d earlier maturing than Superb and 1 day later than AC Barrie (Table 3). Waskada was 11 cm taller than Superb, the shortest check in this test, and exhibited lodging scores similar to Katepwa and McKenzie. Waskada showed significantly higher test weight than any of the checks and had kernel mass similar to the checks.

Waskada has fair resistance to the prevalent races of leaf rust, but has good resistance to stem rust. Resistance to common bunt and loose smut was good

Table 2. Yield (kg ha^{-1}) of Waskada and five checks in the Central Bread Wheat Coop, 2004–2006

	Manitoba[z]				Saskatchewan				All Sites			
Cultivar	2004	2005	2006	Mean	2004	2005	2006	Mean	2004	2005	2006	Mean
Katepwa	4497	3476	3765	3874	5537	3933	3339	4037	4887	3761	3594	4026
McKenzie	5085	4173	4292	4428	6143	4252	3716	4460	5482	4222	4061	4517
CDC Teal	5030	3707	3927	4177	5404	4263	3686	4235	5170	4054	3831	4288
AC Barrie	4796	3357	3714	3938	5506	4112	3469	4137	5062	3829	3616	4109
Superb	5125	3591	4236	4374	5804	4469	3953	4519	5379	4140	4123	4505
Waskada	5311	4171	4226	4525	5434	4465	4194	4490	5357	4355	4213	4592
LSD ($P = 0.05$)[y]	629	381	324	351	585	291	420	389	449	256	249	202
No. of tests	5	3	6	14	3	5	4	12	8	8	10	26

[z]Manitoba test locations: Glenlea, Portage la Prairie, Brandon, Morden, Souris, Dauphin; Saskatchewan test locations: Indian Head, Regina, Melfort, Kelvington, Saskatoon. In 2006, the Dauphin site was added and the Kelvington site was discontinued. Yield data from Morden, MB, in 2005 were not due to variable soil conditions exacerbated by persistent wet weather in May and June of that year.
[y]LSD of means was based on the checks and Waskada and calculated using the SAS PROC MIXED procedure (SAS Institute, Inc. 2006).

(Table 4). Waskada has good resistance to Fusarium head blight, expressing lower reactions than any of the checks during the 3 yr of testing. The improved Fusarium head blight resistance could be due in part to the presence of *Fhb2* derived from Sumai 3, which may have been transferred through BW278. However, an examination of the genetic region around *Fhb2*, bounded by the flanking markers *Xwmc397* and *Xwmc398* (Cuthbert et al. 2007), indicated that recombination occurred between these two markers in Waskada. Further work is being conducted to verify whether *Fhb2* is present in Waskada.

The wheat midge (*Sitodiplosis mosellana* Géhin) resistant cultivar Unity has the antibiotic midge resistance gene *Sm1* (Thomas et al. 2005), while the check cultivars do not. However, recent field and laboratory experiments have demonstrated that Waskada expresses oviposition deterrence to the wheat midge, resulting in fewer eggs being laid on spikes and fewer midge larvae causing yield losses compared with the susceptible cultivars (Table 5). This is the first report of oviposition deterrence to wheat midge in a spring wheat cultivar.

Assessments of preharvest sprouting resistance by exposure of spikes to weathering in a rain simulator and field (Humphreys and Noll 2002) demonstrated that Waskada tolerated weathering and maintained falling number. Waskada sprouted less frequently than any of the other cultivars in all comparisons (Table 6).

The end-use quality of Waskada was suitable for the CWRS class, exhibiting milling and baking performance similar to the check cultivars. Waskada had significantly higher amylograph viscosity than all checks except Superb (Table 7). However, Waskada was found not to contain the waxy starch mutations that can be detected by primer set #4 as described in McLaughlin et al. (2001) (Curtis Pozniak, personal communication).

Other Characteristics

Plant characteristics were rated on experimental plots grown in 2006 and 2007 at Portage La Prairie, MB, for collection of data for Plant Breeders Rights.

Seedling characteristics

Coleoptile colour. Green. Weak anthocyanin colouration.
Juvenile growth habit. Semi-erect.
Seedling leaves. Slightly pubescent leaf sheaths and glabrous blades of lower leaves.

Adult plant characteristics

Growth habit. Semi-erect.
Leaves. Moderately recurved.
Flag leaf. Dark green with glabrous sheath and blade. The auricle colouration is slight, and auricle margins are slightly pubescent. Leaf sheath has a slightly waxy bloom.
Flag leaf attitude. Upright.
Upper culm internode. Slight curvature at maturity and slightly waxy. It is hollow stemmed and has a thin wall.
Culm colour. Medium glaucousity.
Maturity. Medium, 1.1 d later than AC Barrie and 1.4 d earlier than Superb (Table 3). The straw exhibits no anthocyanin colouration just prior to maturity and has white straw when plants are fully mature.
Plant height. This line is intermediate in height, about 11 cm taller than Superb but similar in height to Katepwa and McKenzie (Table 3).
Lodging resistance. Intermediate; similar to Katepwa and McKenzie (Table 3).

Spike characteristics

Shape. Oblong (parallel-sided).
Size. Similar to McKenzie; slightly shorter than Superb.
Density. Medium dense.
Attitude. Erect.
Rachis. Sparse hairiness of convex surface of apical segment and strong pubescence of margins.
Colour. Medium to strong glaucosity; white colour at maturity.
Awns. Awned.

Spikelet characteristics

Glumes. Medium length; narrow to medium width; lower glume is slightly pubescent; glume shoulders are slightly sloping; narrow to medium shoulder width; glume beak is acuminate and of medium length; sparse internal glume hairs. Glumes are white at maturity.
Lemma. Slightly curved beak shape.

Kernel characteristics

Shape. CWRS; ovate in shape with rounded to slightly angular cheeks.
Size. Small to medium-sized with short to medium length and medium width.
Brush. Small to medium with short to mid-long brush hairs.
Embryo. Medium-sized round shape; crease is narrow and mid-deep.

Maintenance and Distribution of Pedigreed Seed Stocks

The Agriculture and Agri-Food Canada Experimental Farm, Indian Head, Saskatchewan, will maintain the Breeder Seed of Waskada. Multiplication and distribution of other classes of pedigreed seed will be handled by Secan, 501-300 March Road, Kanata, Ontario, Canada K2K 2E2.

Table 3. Summary of agronomic traits of Waskada and five checks in the Central Bread Wheat Coop, 2004–2006

	Maturity (d)				Height (cm)				Lodging[z] (1–9 scale)				Test weight (kg hL^{-1})				Kernel weight (mg kernel^{-1})			
Cultivar	2004	2005	2006	Mean	2004	2005	2006	Mean	2004	2005	2006	Mean	2004	2005	2006	Mean	2004	2005	2006	Mean
Katepwa	109.8	98.2	86.2	98.1	101	97	100	99	3.6	2.4	2.5	2.6	75.9	76.3	78.3	76.9	33.6	32.3	30.8	32.2
McKenzie	110.4	100.3	86.1	99.3	97	97	97	97	3.3	3.1	2.3	2.8	78.1	78.1	78.2	78.2	33.3	32.5	30.1	31.9
CDC Teal	111.3	99.6	86.0	99.0	94	92	95	94	2.7	2.0	1.9	2.0	76.5	77.6	77.7	77.3	35.5	33.2	31.0	33.1
AC Barrie	112.8	100.6	86.7	100.0	96	95	96	95	2.2	2.3	1.6	1.9	77.1	78.2	78.6	78.0	35.4	33.3	31.9	33.5
Superb	117.0	101.9	88.5	102.5	90	86	89	88	1.5	2.1	1.8	1.7	76.5	78.1	78.7	77.8	37.5	34.9	35.8	36.1
Waskada	114.2	101.8	87.3	101.1	101	99	99	99	3.6	2.6	2.4	2.7	78.5	79.2	80.4	79.4	35.4	33.0	32.8	33.8
LSD ($P = 0.05$)	1.7	1.7	1.5	1.8	2.0	2.1	2.3	2.1	0.8	0.8	0.9	0.8	1.0	0.7	0.9	0.9	1.9	1.5	1.2	1.3
No. of tests	8	9	10	27	8	9	10	27	7	6	4	17	8	9	10	27	8	9	10	27

[z]Lodging scale: 1 = vertical, 9 = flat.

Table 4. Disease severities and ratings[z] of Waskada and five checks in the Central Bread Wheat Coop, 2004–2006

	Stem rust[y] (% severity, rating)			Leaf rust[x] (% severity, rating)			Fusarium head blight index[w] (% incidence × % severity/100, rating)				Loose smut[v] (% infection, rating)			Common bunt[u] (% infection, rating)		
Cultivar	2004	2005	2006	2004	2005	2006	2004 Carman	2005 Carman	2006 Glenlea	2006 Carman	2004	2005	2006	2004	2005	2006
Katepwa	3 R	15 MRMS	7 RMS	45 MSS	65 S	42 MS	29 MS	25 MS	24 MR	31 MS	11 MR	16 MR	16 MR	32 I	40 I	18 I
McKenzie	5 RMR	10 RMR	5 MS	<1 R	1 R	0 R	43 S	38 S	30 MR	17 I	30 MR	58 MS	49 I	2 R	5 MR	2 VR
CDC Teal	15 MR	15 MRMS	15 I	7 MR	29 MR	20 MR	76 S	63 S	61 S	63 S	19 MR	25 MR	41 I	70 S	36 I	15 MR-I
AC Barrie	15 MR	10 MRMS	10 RMS	40 MRMS	55 MS	57 MS	23 I	20 I	36 I	26 I	48 I	43 I	68 MS	46 S	28 I	17 I
Superb	trace R	17 MR	10 RMR	13 MR	78 S	63 S	43 S	12 MR	33 I	29 I	36 I	40 I	13 MR	29 I	14 MR	4 VR
Waskada	trace R	10 RMR	5 RMR	11 MR	55 MS	37 I	18 I	5 MR	28 MR	8 MR	15 MR	24 MR	9 R	20 I –	11 MR	3 VR

[z]Disease rating class: VR = very resistant, R = resistant, RMR = resistant to moderately resistant, MR = moderately resistant, I = intermediate rating, MRMS = moderately resistant to moderately susceptible, MSS = moderately susceptible to susceptible, S = susceptible.
[y]Caused by *Puccinia graminis* Pers.:Pers. f. sp. *tritici* Eriks. E. Henn. Races used include TMRTK, RKQSR, TPMKR, QTHST, RHTSK and MCCFR.
[x]Caused by *P. triticina* Eriks. Inoculum was a composite of all leaf rust disease survey collections made the previous year from Manitoba and Saskatchewan (McCallum and Seto-Goh 2006).
[w]Caused by *Fusarium graminearum* Schwabe [teleomorph *Gibberella zeae* (Schwein.) Petch]. Fusarium head blight index = (% infected spikelets × % infected spikes)/100.
[v]Caused by *Ustilago tritici* (Pers.) Rostr. Races used include T2, T9, T10 and T39. Rating based on previous and current tests after artificial inoculation.
[u]Caused by *Tilletia tritici* (Bjerk.) R. Wolff and *T. laevis* Kuhn in Rabenh. The inoculum used was a composite of races T-1, T-6, T-13, and T-19 of *T. tritici* and L-7 and L-16 of *T. laevis* mixed in a 1:1:1:1:2:2 ratio (vol/vol).

Table 5. Yield losses caused by wheat midge damage of Waskada and check cultivars in 2007 and 2008

	% yield loss[z]											
	2007[y]							2008[x]				
Cultivar	Lacombe	Swift Current	Saskatoon	Regina	Melfort	Indian Head	Brandon	Kernen	Outlook	Watrous	Melfort	Scott
AC Barrie								22.6	5.8	37.1	2.2	4.5
Katepwa	23.9	6.1	12.2	24.6	9.6	38.2	25.2					
CDC Teal	23.1	1.7	7.7	19.8	6.6	33.1	17.4					
Unity	6.5	1.7	3.8	4.0	2.2	18.1	4.8	1.3	0.2	3.8	0.1	0.5
Waskada	8.0	1.6	8.1	10.6	3.8	27.7	12.4	6.6	2.8	9.1	0.5	2.7
LSD	5.3	2.2	4.0	4.7	4.0	9.7	6.7	8.7	2.5	2.3	0.7	3.5

[z]Caused by *Sitodiplosis mosellana* (Géhin) and assessed as loss of seed weight compared with undamaged kernels. Losses were estimated from classification of seed dissected from wheat spikes. Seeds were classified into three groups: undamaged, midge damaged with seed weight greater than 1/3 of weight of undamaged seed and midge damaged with seed weight less than 1/3 weight of undamaged seed. The latter classification of seed is assumed to be completely lost as these small seeds would not be retained when mechanically harvested. Data were collected in 2007 from the Saskatchewan Agriculture Development Fund Project #20070092: ''Agronomic and quality impacts of midge on wheat'' and from the Saskatchewan Variety Performance Group trial in 2008.
[y]Randomized complete block experiment, four replicates at all sites, 10 spikes/cultivar/replicate.
[x]Randomized complete block experiment, three replicates at all sites, 10 spikes/cultivar/replicate.

Table 6. Falling numbers and sprouting scores of Waskada and five checks from yield tests grown in 2003–2006. Quality composite samples were created from grain harvested from 4, 5 and 8 locations for respective years of the Central Bread Wheat Coop

	Falling number (s)							Sprouting score[z] (1–9 scale)					
	Quality composite				Field weathered[y]	Artificially weathered[x]			CBWB	CBWC			
Cultivar	2004	2005	2006	Mean	2006	2004	2006	Mean	2003	2004	2005	2006	Mean
Katepwa	330	385	380	365	226	324	151	238	7.3	1.9	8.4	6.5	6.0
McKenzie	375	410	365	383	382	381	343	362	2.8	1.3	6.3	1.4	3.0
CDC Teal	355	360	380	365	240	218	116	167	4.7	4.9	8.5	4.4	5.6
AC Barrie	385	355	410	383	361	352	252	302	6.0	3.8	5.9	2.8	3.7
Superb	355	375	380	370	315	388	259	324	5.4	2.3	4.7	2.5	3.2
Waskada	400	385	385	390	361	400	314	357	1.5	1.2	1.4	1.3	1.4
LSD ($P=0.05$)				38				82					2.0
Replicates	1	1	1	3	1	1	1	2	1	1	1	1	4

[z][(no. spikes with 0 sprouts) $\times 1$ + (no. spikes with 1 sprout) $\times 2$ + (no. spikes with 2 sprouts) $\times 3$ + (no. spikes with 3–5 sprouts) $\times 5$ + (no. spikes with >3 sprouts) $\times 9$)/ total number of spikes evaluated. Spikes were collected at maturity and stored at –20°C until they were evaluated. The mean was calculated over the 5 yr of tests using SAS PROC MIXED procedure.
[y]Field weathered samples are harvested when declines in falling number were observed for the sprouting susceptible cultivar Roblin.
[x]Collected at maturity, this material is placed in a rain simulator at 15°C for 48 h, dried and then seed is ground into meal for falling number determination.
[w]The CBWB is a preregistration test.

Table 7. Wheat and flour analytical data for Waskada and five checks in the Central Bread Wheat Coop, 2004–2006. End-use quality testing was conducted by the Grain Research Lab of the Canadian Grain Commission on composite samples created from grain harvested from 4, 5 and 8 locations for respective years of the Central Bread Wheat Coop

												Farinograph 54–21[z]				Canadian Short Process (150 ppm ascorbic acid)[y]						
Cultivar	Test weight (kg hL^{-1})	Kernel weight (mg $kernel^{-1}$)	Wheat protein[x] (%)	Flour protein[x] (%)	Falling number (s) 56-81B	Amylograph (BU) 22-10	Flour yield (%) w	Flour ash (%) 08-01	Agtron colour (%) 14-30	Starch damage (%) 76-31	Particle size Index 55-30	Absorption (%)	Dough development time (min)	Mixing tolerance index (BU)	Stability Index (min)	Loaf Volume (cm^3)	Loaf appearance	Crumb structure	Crumb Colour	Absorption (%)	Mixing energy (Wh kg^{-1})	Mixing time (min)
Katepwa	80.8	33.6	13.6	12.9	365	462	74.5	0.46	78	8.1	54	66.6	5.4	23	9.2	1112	7.4	6.1	7.8	70	5.9	3.6
McKenzie	81.6	34.6	13.8	13.1	383	557	75.8	0.45	81	8.4	52	68.0	5.6	32	8.2	1085	7.6	6.1	7.7	71	6.3	3.8
CDC Teal	80.8	34.7	14.2	13.7	365	473	75.0	0.43	78	7.3	56	66.7	7.3	22	16.4	1157	7.7	6.1	7.8	70	6.4	3.9
AC Barrie	81.4	35.1	13.8	13.1	383	530	75.6	0.44	80	7.5	55	65.2	5.3	18	13.7	1127	7.6	6.1	7.7	70	7.5	4.6
Superb	81.3	38.5	12.9	12.2	370	587	75.7	0.45	76	8.3	53	67.0	6.3	27	15.3	1077	7.5	6.0	7.7	71	7.0	4.5
Waskada	82.4	36.4	13.6	13.2	390	710	75.8	0.44	81	7.8	53	67.5	7.0	25	13.3	1070	7.5	6.1	8.0	71	6.6	4.2
LSD ($P = 0.05$)[v]	0.9	2.0	0.4	0.3	38	134	0.8	0.03	3	0.5	1.8	0.8	2.3	11	8.9	38	0.3	0.2	0.2	2	1.1	0.4

[z]American Association of Cereal Chemists (AACC) (2002). Approved Methods of the AACC, 10th Ed., The Association, St. Paul, MN, 2002.
[y]Preston et al. (1982).
[x]Williams et al. (1998).
[w]Dexter and Tipples (1987). All millings at the Canadian Grain Commission's Grain Research Laboratory (GRL) are performed in rooms with environmental control maintained at 21°C and at 60% relative humidity. Common wheat is milled on an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black et al. (1980). Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis.
[v]LSD of means was based on the checks and Waskada and calculated using the SAS proc-mixed procedure. Data consists of single measurements in each of the 3 yr of testing.

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