

Vesper hard red spring wheat

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Thomas, J., Fox, S., McCallum, B., Fetch, T., Gilbert, J., Menzies, J., Wise, I., Smith, M., Gaudet, D., Niziol, D., Humphreys, G. and Brown, D. 2013. **Vesper hard red spring wheat**. *Can. J. Plant Sci.* **93**: 315–321. Vesper is a high-yielding, hard red spring wheat that is adapted to the wheat-growing regions of Manitoba and Saskatchewan. In the Central Bread Wheat Cooperative Registration Trials of 2007, 2008 and 2009, Vesper out-yielded five check cultivars by an average of 12%, and Unity, which was the highest yielding check, by 4.6%. Lodging, height and maturity scores of Vesper were all intermediate (similar to the check mean). Pre-harvest sprouting resistance of Vesper was equivalent to the poorer checks (Katepwa and CDC Teal). Kernels of Vesper were heavier than all five checks and test weight was high (exceeded only by Unity). Vesper was resistant to leaf rust and was moderately resistant to stem rust and Fusarium head blight. Vesper was intermediately resistant to loose smut and was susceptible to common bunt. Spikes of Vesper showed two forms of resistance to wheat midge: antibiotic resistance (no larvae observed in the field) and antixenotic resistance (reduced egg numbers laid by caged ovipositing females). Over 3 yr of testing, end use quality of Vesper was rated as eligible for the Canada Western Red Spring (CWRS) market class of wheat. Kernels of Vesper were relatively hard with consequent high water absorption.

Key words: *Triticum aestivum* L., cultivar description, disease resistance, insect resistance, lodging, plant height, grain yield, end-use quality

Thomas, J., Fox, S., McCallum, B., Fetch, T., Gilbert, J., Menzies, J., Wise, I., Smith, M., Gaudet, D., Niziol, D., Humphreys, G. et Brown, D. 2013. **Le blé roux vitreux de printemps Vesper**. *Can. J. Plant Sci.* **93**: 315–321. Vesper est une variété à haut rendement de blé roux vitreux de printemps bien adaptée aux régions du Manitoba et de la Saskatchewan où l'on cultive le blé. Lors des essais coopératifs centraux d'homologation du blé panifiable de 2007, 2008 et 2009, le rendement de Vesper a surpassé celui des cinq cultivars témoins d'en moyenne 12 % et celui de Unity, le témoin au rendement le plus élevé, de 4,6 %. Vesper a obtenu une note intermédiaire (semblable à la moyenne des témoins) pour la verse, la hauteur et la maturité. La résistance à la germination sur pied de Vesper équivaut à celle des témoins les moins résistants (Katepwa et CDC Teal). Le grain de Vesper est plus lourd que celui des cinq témoins et se caractérise par un poids spécifique élevé (surpassé uniquement par celui de Unity). Vesper résiste à la rouille des feuilles et résiste modérément à la rouille de la tige ainsi qu'à la brûlure de l'épi par *Fusarium*. Vesper démontre une résistance intermédiaire au charbon nu, mais est sensible à la carie. Les épis de Vesper résistent de deux façons à la cécidomyie du blé : antibiotique (aucune larve observée au champ) et antixénotique (diminution du nombre d'œufs pondus par les femelles dans les gîtes de ponte). Après trois ans d'essais sur la qualité de l'utilisation finale, la variété Vesper a été jugée admissible à la catégorie marchande « blé roux de printemps de l'Ouest canadien » (CWRS). Les grains de Vesper sont relativement vitreux, ce qui entraîne une forte absorption d'eau.

Key words: *Triticum aestivum* L., description de cultivar, résistance à la maladie, résistance aux ravageurs, verse, hauteur du plant, rendement grainier, qualité pour l'utilisation finale

Parentage

Vesper is a hard red spring wheat (*Triticum aestivum* L.) that was developed at the Cereal Research Centre (CRC), Agriculture and Agri-Food Canada (AAFC), Winnipeg, MB, and was registered for cultivation by the Variety Registration Office, Plant Production Division, Canadian Food Inspection Agency (registration number

6890; date 2010 Nov. 15). Plant Breeder's Rights were obtained 2011 Nov. 17 and given the certificate number 4216. Vesper (BW415=BB21-GV5) derived from an inter-cross of two different F₁s made in 1999 at the Cereal Research Centre of Agriculture and Agri-Food Canada (AAFC) in Winnipeg. The female parent of the cross was Augusta/Hard White Alpha//3*AC Barrie while the pollen parent was BW150*2//Tp/Tm/3/2*Superb/4/94B35-R5C/5/Superb. Augusta is a soft white winter wheat (Everson et al. 1986) and is a source

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Table 1. Coefficients of parentage of Vesper wheat

Parent	Parentage	Coefficient of parentage (%)	
		Method 1 ^z	Method 2
AC Barrie	Neepawa/Columbus//Pacific	43.8	43.8
Superb	Grandin*2/AC Domain	34.4	–
Grandin	Len//Butte*2/ND507/3/ND593	9.4	35.2
AC Domain	BW83/ND585	–	8.6
Augusta	Genesee/Redcoat,B2747//Yorkstar	3.1	3.1
Caldwell	Benhur sib*2/Siete Cerros	3.1	3.1
Hard White Alpha	AC Foremost/Alpha 16	3.1	3.1
BW150	Katepwa*6/RL4509	2.3	2.3
<i>Triticum persicum</i> / <i>T. monococcum</i>		0.8	0.8
HRS parentage (includes BW150)		89.8	89.8
Other parentage		10.2	10.2

^zMethod 1 considers parentage in terms of Superb while Method 2 considers parentage in terms of the parents of Superb instead.

Table 2. Timelines and selection activities in the development of Vesper Wheat

Year	Generation	Identity	Activity	Locations and number of lines	Selection criteria
1997 to 2001			Cross assembly		
2002	F1	BB21	Seed increase		Seed number and appearance
2002 to 2003	F2	BB21-GV	Winter Nursery	New Zealand – 182 rows	Agronomics and leaf rust
2003	F2:F3	BB21-GV	Unreplicated yield tests	2 to 4 sites in MB and SK – 121 lines	Agronomics, pest resistance, quality
2003 to 2004	F3:F4	BB21-GV5	Winter nursery	New Zealand – 667 reselections in rows	Agronomics and leaf rust
2004	F3:F5	BB21-GV5	Unreplicated Yield Tests	2 to 4 sites in MB and SK – 170 lines	Agronomics, pest resistance, quality
2005	F3:F6	BB21-GV5	2 replicate “A” test	5 sites in MB and SK – 23 lines	Agronomics, pest resistance, quality
2006	F3:F7	BB21-GV5	3 replicate “B” test	8 sites in MB and SK, 4 lines	Agronomics, pest resistance, quality
2007 to 2009	F8 to F10	BW415	3 replicate “C” test	10 sites in MB and SK – 1 line	Agronomics, pest resistance, quality
2007	F8	BW415	Pedigreed seed stocks	Indian Head – 250 selected spikes	Seed number and plumpness
2008	F9	BW415	Pedigreed seed stocks	Morden – 204 × 1-m rows	Uniformity, Agronomics, seed colour
2009	F10	BW415	Pedigreed seed stocks	Indian Head – 168 isolated long rows	Uniformity, Agronomics, seed colour
2010	F11	BW415	Breeder Seed	Bulk of 153 lines (523 kg)	–

Table 3. Agronomic characteristics of Vesper and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

Variable	Grain yield			% of checks	Height (cm)	Lodging (1–9)	Maturity (d)	Bulk density (kg hL ⁻¹)	Kernel weight (mg)
	Manitoba	Saskatchewan	All sites						
Units	(kg ha ⁻¹)								
Mean									
Katepwa (BW49)	3615	4476	4023	91	100	2.5	97.5	76.4	32.1
McKenzie (BW205)	4157	4848	4478	101	96	2.7	98.3	77.7	31.7
CDC Teal (BW616)	3842	4603	4208	95	94	1.9	97.8	76.3	32.4
Unity (BW362)	4421	5118	4733	107	96	2.7	98.8	78.7	32.9
5603HR (BW388)	4472	4888	4650	105	97	2.3	100.4	77.8	31.8
Vesper (BW415)	4711	5254	4938	112	95	2.3	98.7	78.3	35.9
LSD	507	209	249	6	2	0.8	1.1	0.9	1.5
No. of site years	14	14	28	28	31	13	29	30	30
Mean of checks	4101	4787	4418	100	97	2.4	96.6	77.4	32.2

of the *Sml* gene that provides resistance to wheat midge *Sitodiplosis mosellana* (Géhin). Hard White Alpha derives from the cross AC Foremost/Alpha 16. AC Foremost is a bunt and loose smut resistant backcross derivative of Biggar wheat (Thomas et al. 1997) while Alpha 16 is a leaf-rust-resistant reselection of Alpha

(87W153, Wesley et al. 1999). BW150 (Katepwa*6/RL4509) carries the leaf rust resistance gene *Lr21* while Tp/Tm is an amphiploid of *Triticum persicum*/*Triticum monococcum* that carries resistance to tan spot (*Pyrenophora trititici-repentis*). *Lr21* was recovered in Vesper; however, the resistance to tan spot was not. 94B35-R5C

Table 4. Post-harvest sprouting resistance of Vesper and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

	Sprouting score (1–9)			Falling number of weathered grain			
				Growth cabinet			Field
	2007	2008	2009	2007	2008	2009	2008
Katepwa	8.5	5.8	5	229	96	88	253
McKenzie	7.2	2.1	6.3	300	198	172	351
CDC Teal	4.6	6.4	6.6	110	73	72	258
Unity	7.6	1.7	3.9	331	266	130	378
5603HR	6.7	1.9	3	313	248	217	326
Vesper	6.4	7.3	5.3	249	134	135	243

is derived from the cross Grandin*2/Caldwell. AC Barrie (McCaig et al. 1996), Katepwa (Campbell and Czarnecki 1987) and Superb (Townley-Smith et al. 2010) are all CWRS varieties. Grandin is a Dark Northern Spring (DNS) variety from North Dakota State University (Frohberg et al. 2006). Caldwell is a soft red winter wheat (Patterson et al. 1982), which also carries the gene *Sm1*; however, fragment size profiles of the SSR marker *barc35* indicated that *Sm1* in Vesper derives from Augusta rather than Caldwell (Thomas, unpublished). Since the complicated parentage of Vesper

makes it difficult to readily assess the source of genetic background, we have also calculated coefficients of parentage (Falconer 1989) for the principal parents (Table 1). The largest contributors to the parentage of Vesper are AC Barrie followed by Superb and Grandin. However since the parentage of Superb is Grandin*2/AC Domain it is equally true that the top three parents are AC Barrie, Grandin and AC Domain (Table 1). Therefore, the coefficient of parentage has been calculated considering Superb as a parent (Method 1) and calculated using the parents of Superb (Method 2).

Table 5. Rust and Smut reactions of Vesper wheat and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

		Percent infection			Mean	Resistance rating ^z			Overall
		2007	2008	2009		2007	2008	2009	
<i>Leaf rust (% leaf tissue sporulating; observed at Portage la Prairie, MB)</i>									
BW49	Katepwa	50.0	70.0	10.0	43.3	MS	MSS	R	MS
BW205	McKenzie	0.0	0.0	0.0	0.0	R	R	R	R
BW616	Teal	2.0	10.0	5.0	5.7	R	MR	R	R
BW362	Unity	0.0	0.5	3.0	1.2	R	R	R	R
BW388	5603HR	8.0	0.0	2.0	3.3	R	R	R	R
BW415	Vesper	2.0	0.0	5.0	2.3	R	R	R	R
<i>Stem rust (% leaf and stem tissue sporulating; observed at Glenlea, MB)</i>									
BW49	Katepwa	0.5	5.0	3.0	2.8	R	R	R	R
BW205	McKenzie	0.5	10.0	5.0	5.2	R	RMR	R	R
BW616	Teal	0.5	15.0	10.0	8.5	R	I	RMR	MR
BW362	Unity	0.5	15.0	7.0	7.5	R	RMR	R	R
BW388	5603HR	2.0	20.0	5.0	9.0	R	RMR	R	R
BW415	Vesper	0.5	15.0	15.0	10.2	R	RMR	RMR	R
<i>Loose Smut (% heads infected)</i>									
BW49	Katepwa	32.0	0.0	3.0	11.7	MR	R	R	R
BW205	McKenzie	29.0	11.0	22.0	20.7	MR	R	MR	MR
BW616	Teal	20.0	14.0	13.0	15.7	MR	R	R	R
BW362	Unity	59.0	11.0	30.0	33.3	MS	MR	MR	I
BW388	5603HR	43.0	21.0	25.0	29.7	I	R	MR	MR
BW415	Vesper	55.0	11.0	35.0	33.7	MS	R	I	I
<i>Bunt (% heads infected; observed at Lethbridge, AB)</i>									
BW49	Katepwa	11.0	18.0	21.0	16.7	R	MR-I	I	MR
BW205	McKenzie	4.0	1.8	5.0	3.6	R	R	R	R
BW616	Teal	13.5	23.0	31.0	22.5	MR	I	I	I
BW362	Unity	1.0	2.0	2.0	1.7	VR	VR	R	R
BW388	5603HR	3.5	15.0	7.0	8.5	VR	MR	MR	MR
BW415	Vesper	38.5	33.0	20.0	30.5	VS	I-MS	S	S

^zDisease 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.

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Table 6. Resistance rating of Fusarium head blight symptoms of Vesper hard red spring wheat and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

	Visual rating index							Five-point resistance rating						Average encoded rating ²	Overall resistance rating
	Glenlea			Carman				Glenlea			Carman				
	2007	2008	2009	2007	2008	2009	Mean	2007	2008	2009	2007	2008	2009		
Katepwa	37.8	2.0	9.2	22.0	22.8	11.0	17.5	MS	R	R	I	I	I	2.50	I to MR
McKenzie	33.7	18.5	25.7	24.3	27.7	7.6	22.9	MS	MS	I	I	I	MR	3.17	I
Teal	50.7	20.3	20.7	46.0	77.8	43.3	43.1	S	S	I	S	S	S	4.67	S
Unity	36.5	0.9	16.5	5.5	26.6	11.9	16.3	MS	R	MR	MR	I	I	2.50	I to MR
5603HR	38.1	0.7	21.8	24.6	29.7	15.4	21.7	MS	R	I	I	I	I	2.83	I
Vesper	22.2	3.5	13.2	4.1	10.7	12.3	11.0	I	MR	R	R	MR	I	2.17	MR

²Resistance ratings were encoded as follows: R = 1, MR = 2, I = 3, MS = 4 and S = 5 prior to averaging.

Overall hard red spring wheat parentage (DNS plus CWRS) is 89.8% (including BW150). Therefore, Vesper represents a substantial influx (10.2%) of new parentage in this gene pool, which has struggled with relatively higher coefficients of parentage compared with US breeding programs (van Beuningen and Busch 1997).

Breeding

Table 2 summarizes timelines and selection activities in the development of Vesper. For the most part, experimental methods used in collecting data on agronomics, pest resistance and end use quality presented in this variety description are described in the Prairie Grain Development Committee website (URL: http://www.pgdc.ca/committees_wrt.html) and Fox et al. (2009). Wheat midge resistance protocols were described by Smith and Lamb (2001). To eliminate white seeded lines from breeder seed (Table 2), 400 kernels of each of the 168 breeder lines were soaked in a solution of sodium hydroxide as described by DePauw and McCaig (1983).

Agronomic Characteristics

Vesper yielded significantly ($P < 0.05$) more grain than Katepwa (21%), CDC Teal (17%), McKenzie (10%) and 5603HR (7%) (Table 3). Though not statistically significant, Vesper also out-yielded Unity (the highest-yielding check) by 5%. Vesper was slightly shorter, more lodging resistant and earlier maturing than the average of the five checks. Susceptibility of Vesper to pre-harvest sprouting (Humphreys and Noll 2002) was marginally better than Katepwa and CDC Teal which were the least resistant among the five checks (Table 4).

Pest Resistance

Vesper was resistant to leaf rust, moderately resistant to stem rust, intermediate for resistance to loose smut and was moderately susceptible to common bunt (Table 5). Inoculations of seedlings of Vesper with *Puccinia triticina* races MBDS, MBRJ, MGBJ, TDBG, and TJJJ (McCallum et al. 2009) all resulted in resistant reactions. Similarly, with seedling inoculations with *P. graminis* races TMRTK, RKQSR, TPMKR, RTHJT, QTHST and RHTSK (Fetch 2005), all disease reactions

Table 7. Ratings of Vesper and Check cultivars for antibiotic wheat midge resistance in the Central Bread Wheat Cooperative Trial, 2007–2009

Cultivar	Year	Infested heads	Total heads	Infested total	Resistance rating	
BW388	5603HR	2009	18.000	30	0.60	S
BW049	Katepwa	2007	37.000	41	0.90	S
BW049	Katepwa	2008	7.000	35	0.20	I
BW205	McKenzie	2007	36.000	37	0.97	S
BW205	McKenzie	2008	20.000	36	0.56	S
BW205	McKenzie	2009	20.000	30	0.67	S
BW252	Superb	2007	32.000	36	0.89	S
BW616	Teal	2007	26.000	28	0.93	S
BW616	Teal	2008	13.000	36	0.36	MS
BW394	Shaw	2007*	0.000	28	0.00	R
BW394	Shaw	2008*	0.000	18	0.00	R
BW362	Unity	2007*	7.000	37	0.19	MR
BW362	Unity	2009	0.000	30	0.00	R
BW415	Vesper	2007	0.000	24	0.00	R
BW415	Vesper	2008	0.000	18	0.00	R
BW415	Vesper	2009	0.000	30	0.00	R

were resistant. Based on visual symptoms, Vesper was more resistant to Fusarium head blight than any of the checks (Table 6). Low numbers of Fusarium-damaged kenels were also noted in the production of breeder seed in 2010 (D. Gehl, personal communication). However, these reduced symptoms did not translate into lower levels of DON, which were similar to the intermediate checks. Vesper was slightly superior to the best check for fungal leaf spots and slightly below the best check for crown root rot (data not shown). Vesper displayed two types of resistance to wheat midge. Antibiotic resistance to feeding larvae (Table 7) was exhibited by the absence of larvae in spikes sampled from infested yield trials (McKenzie et al. 2002). Antixenotic resistance toward caged, ovipositing females (Lamb et al. 2002) is shown by significantly fewer wheat midge eggs laid per infested spike; in this trial, the resistant check Waskada (Fox et al. 2009) received 25% of the eggs that were laid on the susceptible check AC Barrie (Fig. 1); Vesper was equivalent to the resistant check Waskada at 26% of AC Barrie (Fig. 1).

End-use Quality

Comparison with the check varieties demonstrated that the high yield of Vesper wheat did not adversely affect its average grain protein content or flour protein content, which were higher than all the checks except for CDC Teal (Table 8). Milling performance (flour yield, flour ash and flour colour) of Vesper was also good (Table 8). Higher starch damage, lower particle size index and higher water absorption (Tables 8 and 9) all suggested that the kernel texture of Vesper was relatively hard. Farinograph and baking data (Table 9) showed that the dough strength of Vesper fell within the current range of CWRS cultivars. End-use quality of

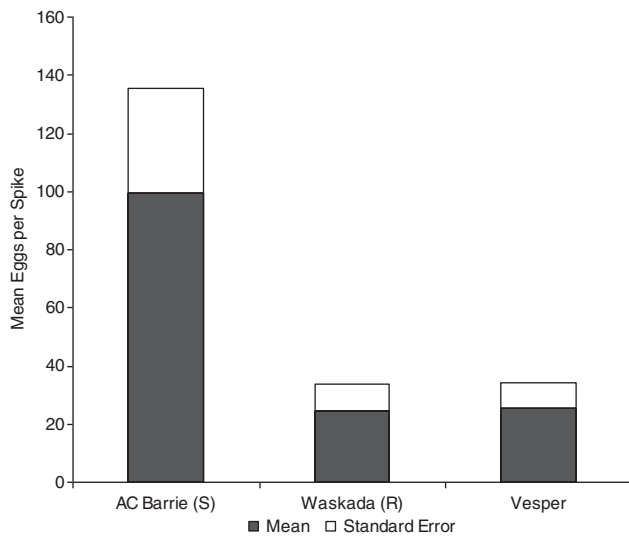


Fig. 1. Egg laying frequency by caged wheat midge on Vesper wheat compared with resistant (Waskada) and susceptible (AC Barrie) checks.

Table 8. Grain and flour characteristics of Vesper and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

	Test weight (g L ⁻¹)	Kernel weight (mg)	Grain protein (%)	Flour protein (%)	Protein loss (%)	Falling number (s)	Amylograph viscosity (BU) ²	Flour yield (%)	Flour ash (%)	Agtron colour (reflectance)	Starch damage (%)	Particle size index (%)
Katepwa	801	33.5	14.0	13.4	0.6	430	650	75.6	0.5	79.7	7.5	55.3
McKenzie	807	34.4	13.9	13.2	0.6	423	683	76.4	0.5	80.7	8.1	50.7
CDC Teal	799	34.3	14.5	14.1	0.4	430	677	76.2	0.5	81.0	6.6	56.0
Unity	821	35.7	14.0	13.4	0.6	445	927	77.5	0.5	81.7	8.0	51.7
5603HR	815	33.3	14.0	13.5	0.5	437	718	76.1	0.5	81.3	7.5	54.0
Check Mean	809	34.2	14.1	13.5	0.6	433	731	76.4	0.5	80.9	7.6	53.5
Vesper	816	39.7	14.3	13.7	0.6	415	683	77.5	0.4	81.0	8.7	51.3

²BU, Brabender units.

Table 9. Dough rheology and baking of Vesper wheat and check cultivars in the Central Bread Wheat Cooperative Trial, 2007–2009

	Farinograph					Canadian short process loaf					
	Water Absorption (%)	Mixing time (min)	Mixing tolerance index (BU)	Mixing stability (min)	Loaf volume (mL)	Loaf appearance (AU)	Crumb structure (AU)	Crumb colour (AU)	Water absorption (%)	Energy input (watt hours kg ⁻¹)	Mixing time (min)
Katepwa	65.7	6.1	20.0	11.8	1132	7.8	5.9	7.9	66.3	8.2	3.6
McKenzie	66.5	4.9	21.7	8.8	1117	7.8	6.1	7.9	67.0	8.9	4.1
CDC Teal	65.7	9.4	11.7	19.5	1178	7.7	6.1	7.9	66.3	10.0	4.1
Unity	66.6	6.3	30.0	8.7	1133	7.7	6.2	7.9	66.0	9.6	4.1
5603HR	64.3	6.6	20.0	11.0	1092	7.7	6.1	7.8	64.7	9.9	4.5
Check Mean	65.8	6.7	20.7	12.0	1130	7.7	6.1	7.9	66.1	9.3	4.1
Vesper	69.1	6.3	23.3	10.6	1142	7.7	5.9	7.9	69.0	9.8	3.9

^aBU, Brabender units.

Vesper has been rated acceptable for delivery into the CWRS class.

Plant Description

Compared with other CWRS cultivars, Vesper exhibited few distinctive botanical traits. Stems were unpigmented and hollow with little pith; foliage and culms were weakly glaucous; auricles were pink; height was standard (mid-tall, i.e., Waskada > Vesper > Unity); heads were mid-dense, upright and awned with a mid-wide glume shoulder and an acuminate beak; kernels were mid-red, vitreous, ovate, mid-large (Vesper > Superb).

Seed Stocks and Commercialization

Breeder seed is maintained at the Agriculture and Agri-Food Canada seed farm at Indian Head, Saskatchewan, and is multiplied, marketed and sold by SeCan, 501-300 March Road, Kanata, Ontario, Canada K2K 2E2.

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