



Canadian Grain Commission  
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Canada

# Quality of western Canadian wheat exports

February 1–July 31, 2003

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Quality

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# Quality of western Canadian wheat exports

## February 1–July 31, 2003

### Introduction

This bulletin reports quality data for cargoes of all classes of western Canadian wheat exported by ship from February 1 to July 31, 2003. Two types of information are presented:

- Distribution tables for moisture content, test weight and other grade determining factors assessed during grading of individual cargoes by Industry Services, Canadian Grain Commission, at time of vessel loading.
- Quality data (wheat and flour characteristics, milling, end-use quality) for weighted composite samples that represent all cargoes of a given grade (and protein segregate where appropriate) exported during the six-month period. For Canada Western Red Spring wheat and No. 1, 2 and 3 Canada Western Amber Durum wheat, composites representing Atlantic and Pacific shipments are prepared and tested. For the other wheat classes only one series of composites representing all cargoes (Atlantic and Pacific) exported from Canada during the period are reported. Quality data is not available for classes or protein segregates where insufficient sample was received for compositing due to low/no tonnage exported.

# Canada Western Red Spring wheat

Canada Western Red Spring (CWRS) wheat is well known for its excellent milling and baking quality. Three milling grades are available, the top two of which are further segregated according to protein content. Guaranteed minimum protein content is reported on a 13.5% moisture basis.

Higher protein CWRS wheat is highly suitable for blending and for the production of high volume pan bread. It is also commonly used alone or in blends with other wheat for the production of hearth bread, steamed bread, noodles, flat bread and common wheat pasta.

To qualify for the milling grades in this class, wheat must be a registered variety—a variety equal in quality to the statutory standard, Neepawa. Varietal standards and registration ensure that a high degree of uniformity in quality is maintained in export shipments.

Currently, the predominant variety of Canada Western Red Spring wheat grown is AC Barrie.

**Table 1 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Atlantic export cargoes of Canada Western Red Spring wheat  
Third and fourth quarters 2002-2003**

	No. 1 CWRS				No. 2 CWRS				No. 3 CWRS
	Guaranteed minimum protein content								
	15.0	14.5	14.0	13.5	15.0	14.5	14.0	13.5	
Number of cargoes	2	5	5	1	1	13	16	2	18
Thousands of tonnes	15	29	25	6	1	91	207	16	305
<b>Moisture content, %</b>									
Weighted mean	12.4	12.5	12.8	11.5	12.3	13.8	13.8	13.7	13.7
Standard deviation	0.57	0.48	0.54	—	—	0.27	0.20	0.00	0.26
Minimum	11.8	12.0	12.1	11.5	12.3	13.1	13.3	13.7	13.2
Maximum	12.6	13.1	13.5	11.5	12.3	14.1	14.0	13.7	14.2
<b>Test weight, kg/hl</b>									
Weighted mean	83.3	83.6	82.3	84.5	83.8	80.3	80.1	79.9	78.6
Standard deviation	0.49	0.64	1.11	—	—	0.50	0.56	0.92	0.61
Minimum	83.1	82.5	81.1	84.5	83.8	79.5	79.2	79.1	77.3
Maximum	83.8	84.1	83.5	84.5	83.8	81.1	81.2	80.4	79.4
<b>Wheats of other classes, %</b>									
Weighted mean	0.21	0.27	0.33	0.28	0.75	0.40	0.32	0.39	0.42
<b>Cereal grains other than wheat, %</b>									
Weighted mean	0.09	0.11	0.10	0.15	0.09	0.15	0.14	0.13	0.22

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 2 - No. 1 Canada Western Red Spring wheat  
Atlantic export cargo composites  
Third and fourth quarters 2002-2003**

Quality parameter*	No. 1 CWRS		No. 2 CWRS		No. 3 CWRS**
	Guaranteed minimum protein content				
	14.5	14.0	14.5	14.0	
<b>Wheat</b>					
Weight per 1000 kernels, g	30.9	29.9	30.9	29.3	29.2
Protein content, %	14.8	14.4	14.9	14.4	14.2
Protein content, % (dry matter basis)	17.1	16.6	17.2	16.7	16.4
Ash content, %	1.68	1.63	1.66	1.69	1.66
Falling number, s	405	390	350	355	275
PSI	53	54	53	53	54
<b>Milling</b>					
Flour yield					
Clean wheat basis, %	75.9	76.0	75.5	75.1	74.1
0.50% ash basis, %	74.4	75.0	75.0	74.6	73.6
<b>Flour</b>					
Protein content, %	14.3	13.9	14.2	13.7	13.4
Wet gluten content, %	38.4	37.0	37.7	37.2	36.1
Ash content, %	0.53	0.52	0.51	0.51	0.51
Grade colour, Satake units	-1.4	-1.3	-0.4	-0.3	0.0
AGTRON colour, %	70	71	64	62	60
Starch damage, %	7.3	7.4	7.4	7.3	7.7
Amylograph peak viscosity, BU	585	525	350	295	140
Maltose value, g/100g	2.4	2.5	2.5	2.7	3.2
<b>Farinogram</b>					
Absorption, %	66.7	65.2	65.9	65.9	66.2
Development time, min	6.25	6.50	6.75	6.25	5.50
Mixing tolerance index, BU	30	35	35	35	30
Stability, min	8.5	9.0	9.0	8.5	8.0
<b>Extensogram</b>					
Length, cm	22	21	23	23	24
Height at 5 cm, BU	295	345	305	305	260
Maximum height, BU	580	660	600	585	490
Area, cm <sup>2</sup>	165	185	185	180	160
<b>Alveogram</b>					
Length, mm	128	122	129	110	119
P (height x 1.1), mm	109	108	103	112	112
W, x 10 <sup>-4</sup> joules	448	455	432	419	435
<b>Baking (Canadian short process baking test)</b>					
Absorption, %	73	71	72	71	71
Mixing energy, W-h/kg	12.4	14.4	15.5	13.6	13.0
Mixing time, min	8.8	10.1	11.4	9.6	9.1
Loaf volume, cm <sup>3</sup> /100 g flour	1075	1075	1090	1130	1135

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

\*\* Not segregated by protein content

**Table 3 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Pacific export cargoes of Canada Western Red Spring wheat  
Third and fourth quarters 2002-2003**

	No. 1 CWRS				No. 2 CWRS					No. 3 CWRS	No. 4 CWRS
	Guaranteed minimum protein content										
	15.0	14.5	14.0	13.5	15.0	14.5	14.0	13.5	13.0		
Number of cargoes	1	7	19	2	5	9	13	20	1	19	2
Thousands of tonnes	7	102	279	7	43	175	230	245	4	365	5
<b>Moisture content, %</b>											
Weighted mean	13.3	13.2	12.9	12.1	13.6	13.8	13.8	13.9	14.0	14.0	14.1
Standard deviation	—	1.10	0.63	0.57	0.38	0.43	0.33	0.21	—	0.17	0.35
Minimum	13.3	11.0	11.6	12.0	13.0	12.8	13.2	13.5	14.0	13.5	13.9
Maximum	13.3	13.7	13.7	12.8	14.0	14.1	14.3	14.3	14.0	14.2	14.4
<b>Test weight, kg/hl</b>											
Weighted mean	81.8	82.5	82.4	83.3	80.0	80.7	80.5	80.8	80.0	79.0	78.0
Standard deviation	—	0.46	0.59	1.34	0.52	0.45	0.57	0.56	—	0.58	1.91
Minimum	81.8	81.9	81.3	81.7	79.7	80.0	80.1	79.7	80.0	78.4	76.7
Maximum	81.8	83.3	83.5	83.6	81.1	81.3	82.2	82.1	80.0	80.5	79.4
<b>Wheats of other classes, %</b>											
Weighted mean	0.61	0.19	0.34	0.67	0.36	0.63	0.82	0.46	0.97	0.74	0.55
<b>Cereal grains other than wheat, %</b>											
Weighted mean	0.15	0.15	0.15	0.19	0.19	0.23	0.24	0.22	0.21	0.34	0.61

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 4 - No. 1 Canada Western Red Spring wheat  
Pacific export cargo composites  
Third and fourth quarters 2002-2003**

Quality parameter*	No. 1 CWRS			No. 2 CWRS			No. 3 CWRS**
	14.5	14.0	15.0	14.5	14.0	13.5	
<b>Wheat</b>							
Weight per 1000 kernels, g	29.7	31.0	30.2	30.9	31.5	32.5	30.7
Protein content, %	14.8	14.3	15.2	14.8	14.4	13.7	14.1
Protein content, % (dry matter basis)	17.1	16.6	17.6	17.1	16.6	15.9	16.3
Ash content, %	1.59	1.54	1.65	1.64	1.62	1.59	1.62
Falling number, s	360	385	325	350	350	325	290
PSI	53	53	55	54	54	54	55
<b>Milling</b>							
Flour yield							
Clean wheat basis, %	75.4	75.4	74.9	74.8	75.0	75.2	73.9
0.50% ash basis, %	75.9	76.4	74.4	75.3	74.5	75.7	73.4
<b>Flour</b>							
Protein content, %	14.2	13.8	14.7	14.3	13.9	13.3	13.5
Wet gluten content, %	38.5	37.8	39.9	39.5	37.6	36.2	36.0
Ash content, %	0.49	0.48	0.51	0.49	0.51	0.49	0.51
Grade colour, Satake units	-1.4	-1.5	-0.2	-0.7	-1.0	-1.3	-0.1
AGTRON colour, %	70	72	60	63	68	68	59
Starch damage, %	7.5	7.7	7.6	7.6	7.6	7.6	7.8
Amylograph peak viscosity, BU	440	440	280	285	290	320	160
Maltose value, g/100g	2.5	2.6	2.6	2.5	2.5	2.6	2.9
<b>Farinogram</b>							
Absorption, %	67.9	68.1	68.1	68.1	67.1	66.7	66.7
Development time, min	6.75	6.50	7.00	7.00	6.75	6.00	6.00
Mixing tolerance index, BU	25	20	25	25	25	25	30
Stability, min	9.5	9.0	8.5	9.5	8.0	9.0	8.5
<b>Extensogram</b>							
Length, cm	21	20	22	21	21	21	22
Height at 5 cm, BU	325	335	320	310	305	300	315
Maximum height, BU	575	580	615	580	565	560	560
Area, cm <sup>2</sup>	165	160	185	165	160	160	165
<b>Alveogram</b>							
Length, mm	116	111	150	124	117	112	114
P (height x 1.1), mm	121	121	116	122	118	116	121
W, x 10 <sup>-4</sup> joules	461	435	536	491	455	425	448
<b>Baking (Canadian short process baking test)</b>							
Absorption, %	72	72	73	73	72	71	71
Mixing energy, W-h/kg	12.6	12.3	14.0	14.7	13.4	13.2	13.0
Mixing time, min	8.7	8.6	9.5	9.8	9.2	9.0	8.8
Loaf volume, cm <sup>3</sup> /100 g flour	1100	1120	1120	1115	1080	1105	1090

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

\*\* Not segregated by protein content



# Canada Western Amber Durum wheat

Canada has an international reputation as a reliable supplier of high quality durum wheat, furnishing about two thirds of the world's exports in recent years. The attributes of Canadian durum that attract demand are reliability of supply, cleanliness, uniformity and consistency within and between shipments, and excellent end-product quality.

Canada has a strong commitment to quality. This extends to strict varietal control to protect the inherent quality of all grades of amber durum wheat and to strict adherence to wheat grade standards. The requirement that only durum varieties of high intrinsic quality are registered is a cornerstone of the Canadian grading system.

Currently, the predominant variety of Canada Western Amber Durum wheat grown is Kyle.

**Table 5 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Export cargoes of Canada Western Amber Durum wheat  
Third and fourth quarters 2002-2003**

	No. 1 CWAD		No. 2 CWAD		No. 3 CWAD	
	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific
Number of cargoes	3	3	25	6	24	4
Thousands of tonnes	21	49	249	57	438	65
<b>Moisture content, %</b>						
Weighted mean	11.9	12.9	13.4	12.6	14.0	13.7
Standard deviation	0.59	0.85	0.50	1.04	0.20	0.33
Minimum	11.6	12.3	12.2	11.9	13.4	13.4
Maximum	12.7	13.9	14.1	14.3	14.3	14.2
<b>Test weight, kg/hl</b>						
Weighted mean	82.8	82.6	81.7	82.2	80.1	80.3
Standard deviation	0.81	0.25	0.43	0.58	0.45	0.41
Minimum	81.7	82.4	80.9	81.4	79.2	79.7
Maximum	83.2	82.9	82.6	83.2	80.8	80.7
<b>Vitreous kernels, %</b>						
Weighted mean	84.6	84.7	71.4	79.3	50.7	61.6
<b>Wheats of other classes, %</b>						
Weighted mean	0.81	0.47	0.99	0.94	0.91	0.66
<b>Cereal grains other than wheat, %</b>						
Weighted mean	0.15	0.18	0.19	0.20	0.17	0.18

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 6 - Canada Western Amber Durum wheat  
Export cargo composites  
Third and fourth quarters 2002-2003**

Quality parameter*	No. 1 CWAD		No. 2 CWAD		No. 3 CWAD	
	Atlantic	Pacific	Atlantic	Pacific	Atlantic	Pacific
<b>Wheat</b>						
Weight per 1000 kernels, g	39.8	42.5	41.0	41.7	42.7	40.0
Protein content, %	13.3	13.8	13.2	13.2	13.0	12.8
Protein content, % (dry matter basis)	15.4	15.9	15.3	15.3	15.1	14.8
SDS sedimentation, ml	36	33	32	34	32	33
Ash content, %	1.60	1.63	1.65	1.64	1.69	1.68
Yellow pigment content, ppm	7.5	7.1	7.5	7.3	7.7	7.1
Falling number, s	390	350	345	355	255	285
Milling yield, %	76.5	76.9	76.6	75.6	75.0	75.3
Semolina yield, %	67.1	67.6	66.8	65.8	65.6	65.5
PSI, %	37	38	38	38	38	37
<b>Semolina</b>						
Protein content, %	12.3	12.8	12.2	12.2	12.0	12.0
Wet gluten content, %	31.4	32.5	31.1	31.5	30.9	30.2
Dry gluten content, %	10.7	10.9	10.4	10.5	10.4	10.1
Ash content, %	0.67	0.67	0.68	0.68	0.66	0.65
Yellow pigment content, ppm	6.8	6.3	6.6	6.5	6.8	6.3
AGTRON colour, %	78	74	74	75	70	72
Minolta colour:						
L* (L)	87.1	87.5	87.5	87.4	87.0	87.1
a* (a)	-2.8	-2.8	-2.7	-2.8	-2.8	-2.8
b* (b)	30.7	29.0	29.3	29.6	29.7	28.7
Speck count per 50 cm <sup>2</sup>	24	31	36	44	42	45
Falling number, s	470	395	405	395	335	335
<b>Spaghetti</b>						
<b>Dried at 70°C</b>						
Minolta colour:						
L* (L)	77.1	76.2	76.0	76.7	74.6	75.5
a* (a)	2.2	2.6	2.8	2.3	3.4	2.8
b* (b)	61.2	58.6	59.0	60.0	59.9	58.3
Cooking quality, CQP	37	41	32	37	35	30

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for semolina.

# Canada Western Extra Strong wheat

Canada Western Extra Strong (CWES) wheat is a red spring wheat. The most widely grown cultivar is Glenlea.

Flour milled from this wheat is characterized by very strong gluten. Dough made from CWES wheat flour cannot be properly developed at the normal farinograph speed of 63 rpm and must be tested at the higher speed of 90 rpm to obtain a true mixing peak.

The strong physical dough properties of CWES wheat make it ideal for blending and for specialty products in which very high gluten strength is needed.

Two milling grades have been established for this class.

**Table 7 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Export cargoes of Canada Western Extra Strong wheat  
Third and fourth quarters 2002-2003**

No. 2 CWES	
Number of cargoes	2
Thousands of tonnes	9
<b>Moisture content, %</b>	
Weighted mean	13.3
Standard deviation	0.64
Minimum	12.6
Maximum	13.5
<b>Test weight, kg/hl</b>	
Weighted mean	80.3
Standard deviation	0.28
Minimum	80.2
Maximum	80.6
<b>Wheats of other classes, %</b>	
Weighted mean	2.18
<b>Cereal grains other than wheat, %</b>	
Weighted mean	0.49

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 8 - Canada Western Extra Strong wheat  
Export cargo composites  
Third and fourth quarters 2002-2003**

Quality parameter*	No. 2 CWES
<b>Wheat</b>	
Weight per 1000 kernels, g	39.9
Protein content, %	13.8
Protein content, % (dry matter basis)	16.0
Ash content, %	1.49
Falling number, s	290
Flour yield, %	74.6
PSI	50
<b>Flour</b>	
Protein content, %	13.2
Wet gluten content, %	32.0
Ash content, %	0.54
Grade colour, Satake units	-0.3
AGTRON colour, %	62
Starch damage, %	8.7
Amylograph peak viscosity, BU	180
Maltose value, g/100g	3.3
<b>Farinogram</b>	
Absorption, %	65.3
Development time (90 rpm), min	10.50
<b>Extensogram</b>	
Length, cm	24
Height at 5 cm, BU	380
Maximum height, BU	720
Area, cm <sup>2</sup>	240
<b>Alveogram</b>	
Length, mm	92
P (height x 1.1), mm	150
W, x 10 <sup>-4</sup> joules	533
<b>Baking (Remix-to-peak baking test)</b>	
Absorption, %	66
Remix time, min	4.0
Loaf volume, cm <sup>3</sup> /100 g flour	980

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

# Canada Prairie Spring Red wheat

Canada Prairie Spring Red (CPSR) wheat, used alone or in blends, has quality characteristics suitable for the production of various types of hearth bread, flat bread, noodles and related products.

The most commonly grown varieties eligible for milling grades of CPSR are AC Crystal and AC Taber.

**Table 9 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Export cargoes of Canada Prairie Spring Red wheat  
Third and fourth quarters 2002-2003**

	No. 2 CPSR
Number of cargoes	4
Thousands of tonnes	44
<b>Moisture content, %</b>	
Weighted mean	14.2
Standard deviation	0.22
Minimum	13.9
Maximum	14.4
<b>Test weight, kg/hl</b>	
Weighted mean	79.9
Standard deviation	0.38
Minimum	79.3
Maximum	80.1
<b>Wheats of other classes, %</b>	
Weighted mean	1.21
<b>Cereal grains other than wheat, %</b>	
Weighted mean	0.43

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 10 - Canada Prairie Spring Red wheat  
Export cargo composites  
Third and fourth quarter 2002-2003**

Quality parameter*	No. 2 CPSR
<b>Wheat</b>	
Weight per 1000 kernels, g	42.7
Protein content, %	13.7
Protein content, % (dry matter basis)	15.8
Ash content, %	1.53
Falling number, s	285
Flour yield, %	74.0
PSI	58
<b>Flour</b>	
Protein content, %	12.9
Wet gluten content, %	33.1
Ash content, %	0.48
Grade colour, Satake units	-0.1
AGTRON colour, %	59
Starch damage, %	6.9
Amylograph peak viscosity, BU	230
Maltose value, g/100g	2.4
<b>Farinogram</b>	
Absorption, %	64.8
Development time, min	7.50
Mixing tolerance index, BU	30
Stability, min	9.5
<b>Extensogram</b>	
Length, cm	19
Height at 5 cm, BU	440
Maximum height, BU	740
Area, cm <sup>2</sup>	195
<b>Alveogram</b>	
Length, mm	107
P (height x 1.1), mm	121
W, x 10 <sup>-4</sup> joules	451
<b>Baking (Remix-to-peak baking test)</b>	
Absorption, %	63
Remix time, min	2.7
Loaf volume, cm <sup>3</sup> /100 g flour	850

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.

# Canada Western Red Winter wheat

Canada Western Red Winter (CWRW) wheat is a hard wheat exhibiting excellent milling quality. It is available in two milling grades. Flour produced from high grade CWRW wheat performs well in the production of hearth bread (such as French-style bread) and certain types of noodles, and is also suitable for the production of various types of flat bread, steamed bread and related products.

The most commonly grown varieties for milling grades of CWRW are CDC Clair and CDC Falcon.

**Table 11 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Export cargoes of Canada Western Red Winter wheat  
Third and fourth quarters 2002-2003**

	No. 2 CWRW
Number of cargoes	3
Thousands of tonnes	28
<b>Moisture content, %</b>	
Weighted mean	13.8
Standard deviation	0.32
Minimum	13.5
Maximum	14.1
<b>Test weight, kg/hl</b>	
Weighted mean	80.0
Standard deviation	0.55
Minimum	79.6
Maximum	80.7
<b>Wheats of other classes, %</b>	
Weighted mean	0.08
<b>Cereal grains other than wheat, %</b>	
Weighted mean	0.14

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.

**Table 12 - Canada Western Red Winter wheat  
Export cargo composites  
Third and fourth quarters 2002-2003**

Quality parameter*	No. 2 CWRW
<b>Wheat</b>	
Weight per 1000 kernels, g	26.2
Protein content, %	11.3
Protein content, % (dry matter basis)	13.1
Ash content, %	1.55
Falling number, s	245
Flour yield, %	74.6
PSI	60
<b>Flour</b>	
Protein content, %	10.4
Wet gluten content, %	24.1
Ash content, %	0.50
Grade colour, Satake units	-0.8
AGTRON colour, %	67
Starch damage, %	5.4
Amylograph peak viscosity, BU	140
Maltose value, g/100g	2.8
<b>Farinogram</b>	
Absorption, %	55.2
Development time, min	2.25
Mixing tolerance index, BU	40
Stability, min	6.0
<b>Extensogram</b>	
Length, cm	22
Height at 5 cm, BU	270
Maximum height, BU	485
Area, cm <sup>2</sup>	145
<b>Alveogram</b>	
Length, mm	126
P (height x 1.1), mm	58
W, x 10 <sup>-4</sup> joules	239
<b>Baking (Remix-to-peak baking test)</b>	
Absorption, %	54
Remix time, min	2.7
Loaf volume, cm <sup>3</sup> /100 g flour	860

\* Unless otherwise specified, data are reported on a 13.5% moisture basis for wheat and a 14.0% moisture basis for flour.



# Canada Prairie Spring White wheat

Canada Prairie Spring White (CPSW) wheat, used alone or in blends, has the quality characteristics suitable for the production of various types of flat bread, noodles, chapatis, crackers and similar products.

The most commonly grown varieties eligible for milling grades of CPSW are AC Vista and AC Karma.

**Table 13 - Moisture content, test weight and other grade determining factors<sup>1</sup>  
Export cargoes of Canada Prairie Spring White wheat  
Third and fourth quarters 2002-2003**

	No. 2 CPSW
Number of cargoes	1
Thousands of tonnes	1
<b>Moisture content, %</b>	
Weighted mean	13.9
Standard deviation	–
Minimum	13.9
Maximum	13.9
<b>Test weight, kg/hl</b>	
Weighted mean	79.3
Standard deviation	0.00
Minimum	79.3
Maximum	79.3
<b>Wheats of other classes, %</b>	
Weighted mean	4.92
<b>Cereal grains other than wheat, %</b>	
Weighted mean	0.12

<sup>1</sup> Canadian Grain Commission, Industry Services data for official loading samples tested at time of loading.