

Parata hard red spring wheat

D. Spaner, M. Iqbal, A. Navabi, K. Strenzke, and B. Beres

Abstract: Parata is a hard red spring wheat developed at the University of Alberta. In three years of testing in the Parkland Cooperative Registration Test, Parata was higher yielding ($P < 0.05$) than AC Splendor (5.9 %) and CDC Teal (4.1 %) but similar to CDC Osler and AAC Connery. Parata matured earlier than CDC Teal, CDC Osler and AAC Connery and 1.6 days later than AC Splendor. Parata was shorter than all checks except AAC Connery and exhibited lodging resistance better than AC Splendor and CDC Osler. Test weight of Parata was greater than all checks by at least 1 kg hL^{-1} , while seed mass was within the range of the check cultivars. Parata was rated resistant to the prevalent races of stem and stripe rust in three years of testing. It was rated R/MR in two years and MS in one year for leaf rust; and was I in two years and S in one year for common bunt. The FHB disease indices for Parata ranged from MS (1 rating) to MR in six station years. Three years of end-use quality evaluation has indicated that Parata is acceptable for the CWRS class, with improvements especially in flour yield and flour ash.

Key words: spring wheat, Canada western red spring, grain quality, flour ash, grain yield.

Résumé : Parata est une variété de blé roux vitreux de printemps mise au point à l'Université de l'Alberta. Au cours des trois années d'essais réalisés dans le cadre du Parkland Cooperative Registration Test, Parata a obtenu un meilleur rendement ($P < 0,05$) qu'AC Splendor (5,9 %) et CDC Teal (4,1 %), et enregistré un rendement similaire à celui de CDC Osler et d'AAC Connery. Parata parvient à maturité plus tôt que CDC Teal, CDC Osler et AAC Connery, et 1,6 jour plus tard qu'AC Splendor. La paille de Parata était plus courte que celle de tous les cultivars témoins sauf AAC Connery et la variété résistait mieux à la verse qu'AC Splendor et CDC Osler. Le poids spécifique de Parata dépasse celui des témoins d'au moins 1 kg par hL , alors que la masse de ses semences se situe dans la plage des autres cultivars. Parata a résisté aux races courantes de rouille de la tige et de rouille jaune lors des trois années des essais. La variété a été cotée deux ans résistante/modérément résistante et un an modérément sensible à la rouille des feuilles, ainsi que deux ans résistante et un an sensible à la carie. Parata s'est révélée modérément sensible (note 1) à modérément résistante à la brûlure de l'épi causée par *Fusarium* pour six stations-années. Par ailleurs, trois années d'évaluation en fonction de l'usage final indiquent que Parata est acceptable pour la classe CWRS, avec des améliorations au niveau du rendement meunier et du taux de cendre de la farine. [Traduit par la Rédaction]

Mots-clés : blé de printemps, blé roux de printemps de l'Ouest canadien, qualité du grain, taux de cendre de la farine, rendement grainier.

Introduction

Parata hard red spring wheat (*Triticum aestivum* L.) was developed at the University of Alberta, Edmonton AB, Canada. It is eligible for all grades of the Canada Western Red Spring (CWRS) class. Parata was assigned registration No. 7764 by the Variety Registration Office,

Plant Production Division, Canadian Food Inspection Agency (CFIA) in 2015.

Pedigree and Breeding Method

The hard red spring wheat Parata was selected from the cross "AC Splendor/AC Domain//CDC Go" made at

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the University of Alberta in the winter of 2006–2007. AC Domain (Townley-Smith and Czarnecki, 2008), AC Splendor (Fox et al., 2007) and CDC Go are registered CWRS cultivars.

Parata was developed using a modified bulk breeding method. The F₁ generation (10 seeds) from the final cross during the winter of 2006–2007 was planted in greenhouse to obtain F₂ generation. The F₂ generation was space planted in two 25 m row plots in the field at the University of Alberta, Edmonton Research Station (ERS), Edmonton AB in the summer of 2007. Two hundred heads were selected from disease resistant, early maturing, short and not lodged F₂ plants and bulked. The F₃ generation was grown in two 25 m row plots near Lincoln, New Zealand in the winter of 2007–2008, where selections were made as described in the F₂ generation. The F₄ generation was grown in 10 m² space planted plots at the ERS during the summer of 2008 and selected on the basis of plant type, maturity, lodging and disease resistance. Twenty nine chosen heads were harvested and grown as F₅ head-rows in New Zealand in the winter of 2008–2009. There, a line was selected on the basis of plant type, early maturity, straw strength and reaction to yellow and leaf rust. Seed from this bulked F₆ head-row was grown as a single entry in an un-replicated yield trial in Edmonton in 2009, and leaf and stem rust, bunt and leaf spot nurseries in Edmonton, and a stripe rust nursery near Creston, BC. Based on cumulative agronomic, disease resistance and quality data, one of the lines was evaluated as UAW0601*F6MBK013 in replicated yield trials at one Saskatchewan and five Alberta environments in 2010. UAW0601*F6MBK013 was evaluated in the Parkland B test in 2011 as entry number 10 and subsequently evaluated as PT772 in the Parkland Wheat Cooperative Registration Test from 2012 to 2014.

Evaluation in the Parkland Wheat Cooperative Registration Test followed protocols described by the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWR 2013). The data for the test were analyzed for individual years and combined following a mixed model design in SAS (SAS Institute Inc. 2003), with environments and replications as random effects and genotype as a fixed effect. Response of test entries and checks to several diseases was determined in specialized disease nurseries for three years (2012–2014). Seedling infection types for leaf and stem rust were assessed using prevalent races. Reactions to leaf and stem rust in the field were measured for each test year in epiphytotic nurseries near Glenlea, MB based on the modified Cobb scale (Peterson et al. 1948). Response to loose smut was determined as described by Menzies et al. (2003). Fusarium head blight reaction of test entries was assessed in field tests near Glenlea and Carman, MB following artificial inoculation with FHB races (Gilbert and Woods 2006). A mixture of prevalent races was used to determine the response of Parata to common bunt (Fox and McCallum 2006). End-use suitability analyses were

conducted at the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB, following standard protocols of the American Association of Cereal Chemists (AACC 2000). Eligibility for the CWRS market class was determined using AACC protocols at the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB. Canadian grain commission first determined the grain grade and protein content for the check cultivars for all test locations and then provided a common site-blending formula for the checks and candidate cultivars to develop composite samples. Grain samples from test locations with serious down-grading factors were excluded from the composite. Quality data from the composite samples of Parata and check cultivars for individual year were used as a replication to estimate least squares means for all quality traits over the three test years. We assessed Parata's seedling and plant characteristics in a description trial grown at Edmonton during 2014 and 2015. We planted the trial each year, in a randomized complete block design (RCBD) with 3 blocks. The trial included the reference cultivars CDC Go, McKenzie (Graf et al. 2003) and Coleman (Spaner et al. 2015). All characteristics were recorded as prescribed in the Objective Description Form of the Variety Registration Office, Canadian Food Inspection Agency.

Performance

In three years of testing in the Parkland Cooperative Registration Test, Parata was higher yielding ($P < 0.05$) than AC Splendor (5.9%) and CDC Teal (4.1%) and similar yielding to CDC Osler and AAC Connery (Table 1). Parata matured earlier than CDC Teal, CDC Osler and AAC Connery and 1.6 days later than AC Splendor. Parata was shorter than all checks except AAC Connery and exhibited lodging resistance better than AC Splendor and CDC Osler, similar to CDC Teal and less than AAC Connery (Table 1). Test weight of Parata was greater than all checks by at least 1 kg h L⁻¹, while seed mass was in the range of the check cultivars (Table 1).

Other Characteristics

Seedling characteristics

Anthocyanin colouration of coleoptile: strong/present.
Juvenile growth habit: semi-erect (unvernalized).
Pubescence of lower leaf sheath: glabrous.
Colour of lower leaf blade: light green.
Pubescence of lower leaf blade: glabrous.

Plant characteristics at booting

Growth habit: erect.
Pubescence of flag leaf sheath: glabrous.
Waxiness of flag leaf sheath: weak.
Colour of flag leaf blade: light green.
Pubescence of flag leaf blade: glabrous.
Waxiness of flag leaf blade: pronounced.
Flag leaf length: medium to long.

Table 1. Least squares means for 6 traits of Parata and check cultivars in the Parkland Wheat Cooperative Registration Tests (2012–2014).

	Grain Yield (kg ha ⁻¹)	Maturity (d)	Lodging (1–9)	Plant Height (cm)	Test Weight. (kg h L ⁻¹)	Seed Mass (g 1000 k ⁻¹)
Katepwa	4472	98.2	2.7	102	78.4	33.2
CDC Teal	4646	98.9	1.9	98	78.1	33.3
AC Splendor	4566	96.4	2.5	100	77.9	34.3
CDC Osler	4831	98.3	2.6	96	78.8	33.3
AAC Connery	4898	98.7	1.3	88	79.1	34.6
Parata	4835	98.0	2.0	95	80.2	33.9
No. of Environments	34	30	26	32	34	34
LSD (0.05)	202	0.73	0.42	1.5	0.8	2.9

Note: LSD, least significant difference.

Flag leaf width: medium.

Flag leaf curvature: rectilinear to slightly curved.

Flag leaf attitude: upright to intermediate.

Anthocyanin colouration of flag leaf auricles: absent or very weak.

Pubescence of flag leaf auricle margins: glabrous.

Plant characteristics after heading

Culm neck shape: straight to very slightly curved.

Upper internode pubescence: glabrous.

Upper internode waxiness: absent to weak.

Rachis margin pubescence: slightly to strongly pubescent.

Stem colour at maturity: white.

Anthocyanin intensity of straw at maturity: absent.

Pith in cross section (middle of internode below the neck): hollow.

Plant height: Parata is taller than AAC Connery but shorter than AC Splendor, CDC Teal and Katepwa.

Lodging: Parata lodged more than AAC Connery but less than AC Splendor, CDC Osler and Katepwa.

Maturity: Parata is earlier maturing than CDC Teal but later than AC Splendor.

Spike characteristics

Shape: parallel-sided.

Attitude at maturity: erect.

Density: medium.

Length: medium.

Waxiness: weak to medium

Colour at maturity: white.

Awedness: awned.

Length of awns at tip of spike: shorter than spike.

Awn colour: white.

Awn attitude: spreading.

Glume characteristics

Lower glume length: medium.

Lower glume width: between narrow and medium.

Lower glume pubescence: glabrous.

Lower glume shoulder shape: square to elevated.

Lower glume shoulder width: medium to wide.

Lower glume beak shape: acuminate (moderately curved).

Lower glume beak length: medium.

Glume colour at maturity: white.

Lowest lemma beak shape: straight to slightly curved

Kernel characteristics

Texture: hard.

Colour: medium to light red.

Kernel size: small

Kernel length: short

Kernel width: narrow to medium

Kernel shape: ovate

Kernel cheek shape: angular

Kernel brush hair length: short

Kernel brush size: small

Germ shape: oval to round

Germ size: small

Kernel crease width: mid-wide

Kernel crease depth: mid-deep

Test weight: Parata has higher test weight than all the reference cultivars.

Disease reactions

Parata was rated resistant to the prevalent races of stem rust and Intermediate (I) to Resistant to those of stripe rust in three years of testing (Table 2). It was rated Resistant/Moderately Resistant in two years and Moderately Susceptible in one year for leaf rust and was I in two years and Susceptible in one year for common bunt (Table 2). It showed an MS reaction in two years and an I reaction in one year for leaf spot. The FHB disease indices for Parata ranged from MS (1 rating) to MR (in six station years) and was better than CDC Teal and AC Splendor and similar to CDC Osler and AAC Connery (Table 3).

End-use suitability

Three years of end-use quality evaluation (Table 4) conducted by the Canadian Grain Commission, Grain Research Laboratory, indicated that Parata was acceptable for all grades of the CWRS wheat class. Grain and flour protein of Parata was within the range of the check cultivars (Table 4). Parata gave a higher flour

Table 2. Disease reactions for Parata and check cultivars in the Parkland Wheat Cooperative Registration Tests (2012–2014).

2012	Stem Rust		Loose Smut		Leaf Rust		Common Bunt		Stripe Rust		Leaf Spot			
	Sev.	Rxn	%	Rxn	Sev.	Rxn	Sev.	Rxn	Sev.	Rxn	Glenlea		Melfort	
Entry	Sev.	Rxn	%	Rxn	Sev.	Rxn	Sev.	Rxn	Sev.	Rxn	Score	Rxn	Score	Rxn
Katepwa	2.0	R	8	R	58	MS	20	I	23	I	33	S	7.3	I
CDC Teal	2.0	R	49	I	20	MR	24	I	3	R	10	MR	7.0	I
AC Splendor	2.0	R	36	I	38	I	17	MR	20	I	20	MS	7.3	I
CDC Osler	2.0	R	23	MR	2.0	R	17	MR	20	I	13	I	7.7	I
AAC Connery	2.0	R	9	R	15	MR	12	MR	0.1	VR	5	R	6.7	MR
Parata	2.0	R	68	MS	40	MS	21	I	10	I	9	MR	9.0	MS

2013	Stem Rust				Leaf Rust				Common Bunt		Stripe Rust		Leaf Spot					
	Glenlea		Winnipeg		Ug99		Leaf Rust		Common Bunt		Lethbridge		Creston		Melfort		Sw. Current	
Entry	Sev.	Pust.	Sev.	Pust.	Sev.	Pust.	Sev.	Rxn	Sev.	Rxn	Sev.	Rate	Sev.	Rate	Score	Rate	Score	Rxn
Katepwa	1	R	10	I	Tr	R	63	S	20	I	45	MS	65	S	10.7	S	7.3	I
CDC Teal	1	R	30	I	5	RMR	7	R	18.3	MR	20	MR	15	R	7.3	I	7.8	I
AC Splendor	1	R	7	R	Tr	MS	17	MR	17.5	MR	20	MR	25	MR	9.7	S	8.0	I
CDC Osler	1	R	5	R	20	MSS	2	R	17	MR	15	R	65	S	9.0	MS	7.5	I
AAC Connery	1	R	2	R	5	M	10	MR	24	I	10	R	5	R	7.0	I	7.8	I
Parata	1	R	7	R	5	M	9.0	R	37	S	20	MR	5	R	11.0	S	8.5	MS

2014	Stem Rust				Loose Smut				Leaf Rust		Common Bunt		Stripe Rust		Leaf Spot			
	Brandon		Morden		Loose Smut		Morden		Common Bunt		Creston		Lethbridge		Melfort		Sw. Current	
Entry	IR	Sev.	Sev.	IT	%inf	Rate	Sev	Pust*	Sev.	Rxn	Sev.	Rxn	Sev.	Rxn	Score	Rxn	Score	Rxn
Katepwa	1	r	1	r	0.0	R	75	2MSS/S	10	MR	15	—	60	S	7.0	I	7.5	I
CDC Teal	30	i	1	r	6.5	R	17	3M	15	I	5	—	7	R	7.0	I	7.3	I
AC Splendor	1	r	1	r	9.8	R	27	MR/2M	8.3	MR	5	—	10	R	7.7	I	7.3	I
CDC Osler	1	r	1	r	30	MR	3.3	MR/0/M	5.8	MR	5	—	20	MR	7.0	I	7.3	I
AAC Connery	1r	15i	1	r	10	MR	1.7	MR/0/0	1.5	R	5	—	2	R	7.0	I	7.0	I
Parata	1	r	1	r	28	MR	5.3	2MR	16.3	I	0	—	15	MR	10.3	S	7.3	I

Note: Rxn, Reaction (VR = Very resistant; R = Resistant; MR = Moderately resistant; I = Intermediate; MS = Moderately susceptible; S = Susceptible; Tr = Traces of disease). Sev., Severity.

*2MSS/S means MSS reaction in 2 reps and S reaction in 1 rep; 3M means M reaction in all 3 reps; 0 means immune reaction.

Table 3. Fusarium head blight reaction for Parata and check cultivars in the Parkland Wheat Cooperative Registration Tests (2012–2014)

2012	Glenlea					Carman			Ottawa	Prince Edward Island		
	Mean VRI	VRI Rate	DON (ppm)	ISD	ISD Rate	Mean VRI	VRI Rate	Mean VRI	VRI (0–100)	FDK (0–10)	DON (ppm)	
Katepwa	8	MR	3.2	15	MR	43	MS	42	55	9	1.3	
CDC Teal	19	MS	7.4	21	I	71	S	75	52	7	1.3	
AC Splendor	24	S	8.5	24	MS	54	MS	82	57	9	0.5	
CDC Osler	12	I	3.4	16	I	40	I	38	48	8	3.9	
AAC Connery	8	MR	4.6	15	MR	28	I	43	48	5	1.4	
Parata	17	MS	4.5	21	I	48	MS	37	63	7	1.3	

2013	Glenlea			Portage		Carman			Ottawa		Prince Edward Island		
	Mean VRI	VRI Rate	DON (ppm)	ISD	ISD Rate	Mean VRI	VRI Rate	FDK %	Mean VRI	DON (ppm)	Mean VRI	FDK (0–9)	DON (ppm)
Katepwa	27	MS	27	22	MS	27	I	9	42	3.2	51.5	8	9
CDC Teal	7	S	83	33	S	83	S	22	68	1.3	44.7	7	11
AC Splendor	27	S	58	33	S	58	S	16	40	7.4	50.3	6.7	9
CDC Osler	18	MS	49	24	MS	49	MS	15.1	57	2.4	41.3	7.7	9
AAC Connery	8	I	20	19	I	20	MR	5.7	20	3.3	40.5	6.7	12
Parata	18	MS	25	23	MS	25	MR	12	22	.	56.2	7.7	13

2014	Brandon	Morden				Carmen					Ottawa		Prince Edward Island		
	Mean VRI	Mean VRI	DON (ppm)	ISD	ISD Rate	Mean VRI	VRI Rate	ISD	ISD Rate	DON (ppm)	Mean VRI	DON (ppm)	Mean VRI	FDK (0–9)	DON (ppm)
Katepwa	23	69	34	24	R	23	I	4.5	R	4	43	6.9	24	8.5	12
CDC Teal	61	61	44	30	R	61	S	10	I	12	73	17	18	7.5	24
AC Splendor	48	81	50	34	MR	48	MS	9.1	I	11	55	13	28	9.0	28
CDC Osler	26	48	27	19	R	26	I	5.8	MR	6.0	62	5.9	20	7.3	24
AAC Connery	20	37	39	26	MR	20	I	4.1	I	3.4	28	5.3	22	6.8	13
Parata	21	40	36	24	R	21	21	6.7	MR	7.6	28	5.3	33	8.3	23

Note: Visual Rating Index (VRI) = ((R1inc*R1sev) + (R2inc*R2sev) + (R3inc*R3sev))/3. Rate: R, resistant; MR, moderately resistant; I, intermediate; MS, moderately susceptible; S, susceptible; FDK, Fusarium Damage Kernels; DON, deoxynivalenol; Incidence + Severity + Don (ISD) = (0.2*mean incidence + 0.2*mean severity + 0.6*mean DON).

Table 4. Quality data^a for Parata and check cultivars from the Parkland Wheat Cooperative Registration Tests (2012–2014).

Cultivar	Wheat and flour characteristics					Milling performance					
	Wheat protein (%)	Flour protein (%)	Protein loss (%)	Falling number (s)	Amylograph peak viscosity (BU)	Clean flour yield	Flour yield PB 0.50 Ash	Flour ash (%)	Starch damage (mega-zeme)		
2012											
Katepwa	14.6	13.9	0.7	410	695	75.0	79.0	0.42	8.0		
CDC Teal	14.9	14.3	0.6	410	730	75.0	79.5	0.41	7.4		
AC Splendor	15.4	14.7	0.7	435	770	75.1	78.5	0.43	7.1		
CDC Osler	15.0	14.4	0.6	495	860	74.8	78.0	0.44	7.4		
AAC Connery	15.2	14.4	0.8	445	615	75.2	79.5	0.41	7.2		
Parata	15.0	14.3	0.7	455	860	76.1	80.5	0.39	7.7		
2013											
Katepwa	13.2	12.4	0.8	475	620	75.8	77.0	0.44	8.6		
CDC Teal	13.5	13.1	0.4	470	680	76.2	77.0	0.44	8.2		
AC Splendor	14.1	13.3	0.8	465	650	75.9	76.0	0.46	7.9		
CDC Osler	13.6	12.9	0.7	540	785	75.6	75.5	0.47	8.4		
AAC Connery	13.6	12.8	0.8	425	655	75.9	77.0	0.44	8.2		
Parata	14.0	13.5	0.5	480	705	76.2	78.0	0.42	8.0		
2014											
CDC Teal	14.5	13.7	0.8	410	620	76.0	79.5	0.39	6.1		
AC Splendor	14.9	14.1	0.8	410	650	75.9	78.5	0.41	6.3		
CDC Osler	14.0	13.2	0.8	475	790	74.7	77.5	0.43	6.9		
AAC Connery	14.1	13.4	0.8	415	550	75.3	78.0	0.42	6.6		
Parata	14.8	13.8	1.0	425	705	75.7	79.5	0.39	6.7		
Cultivar	Dough Properties							Baking Quality (CSP) ^b			
	Farinogram				Extensogram			Absorption (%)	Mixing Time (min)	Mixing energy (W-h kg ⁻¹)	Loaf volume (cm ³ 100g ⁻¹)
	Absorption (%)	Dough Development Time (min)	Mixing Tolerance Index (BU)	Stability (min)	Area (cm ²)	Maximum height (BU)	Length (cm)				
2012											
Katepwa	66.6	8.0	25	11.0	.	.	.	67	3.5	8.9	1165
CDC Teal	67.3	9.0	5	24.5	.	.	.	68	4.3	10.9	1195
AC Splendor	68.3	10.3	5	29.0	.	.	.	68	4.1	9.8	1130
CDC Osler	67.7	6.5	10	15.5	.	.	.	67	3.1	8.5	1180
AAC Connery	67.1	7.3	20	16.5	.	.	.	67	4.4	10.9	1115
Parata	67.7	13.5	5	28.5	.	.	.	67	5.1	13.2	1120
2013											
Katepwa	68.1	4.3	20	11.0	69	325	16.3	72	3.5	6.4	1075
CDC Teal	68.3	7.8	30	11.0	99	353	21.3	72	3.6	8.3	1130
AC Splendor	68.8	8.3	15	22.5	106	420	19.8	73	4.2	8.8	1115
CDC Osler	68.6	6.0	5	13.0	74	300	18.5	72	3.2	6.2	1090
AAC Connery	69.1	6.8	25	12.0	87	371	18.2	73	4.1	8.4	1020
Parata	68.4	8.3	15	16.0	105	432	19.0	72	5.0	10.8	1085

(continued).

Table 4. (concluded).

Cultivar	Dough Properties				Baking Quality (CSP) ^b					
	Farinogram		Extensogram		Absorption (%)	Mixing Time (min)	Mixing energy (W-h kg ⁻¹)	Loaf volume (cm ³ 100g ⁻¹)		
	Absorption (%)	Dough Development Time (min)	Mixing Tolerance Index (BU)	Stability (min)					Area (cm ²)	Maximum height (BU)
2014										
CDC Teal	63.2	5.8	30	8.0	146	486	23.7	67	11.6	1010
AC Splendor	65.6	6.5	20	11.5	150	502	23.7	70	11.6	990
CDC Osler	64	5.5	25	7.5	109	423	20.2	68	9.0	1030
AAC Connery	64.4	7.3	35	10.5	135	517	20.5	68	15.4	960
Parata	64.8	7.0	25	10.0	115	450	20.0	69	13.9	960

^aQuality data were obtained by Grain Research Laboratory of the Canadian Grain Commission using approved methods of American Association of Cereal Chemists (AACC 2000).

^bCanadian Short Process (150 ppm ascorbic acid).

yield with low ash content (Table 4). Parata's farino dough development time was higher than the check cultivars (except for AAC Connery in 2014). The CSP Peak time of Parata was also higher than the check cultivars. Mixing energy for Parata was higher than the check cultivars in two of the three test years (Table 4). For other end-use quality traits, Parata was within the range of check cultivars. Based on improved quality characteristics, Parata was recommended to be included as one of four check cultivars in the Parkland Bread wheat Cooperative registration tests.

Maintenance and Distribution of Breeder Seed

Breeder seed of Parata was created from 183 F₆ derived F₁₀ heads taken from the Parkland B seed increase at Edmonton, AB. in 2011. These heads were planted as head-rows in Edmonton, AB, in 2013. Of these, 140 (about 100–200 g of seed per row) were harvested separately. From each head-row, 30 g was planted into 15 m rows at Edmonton, AB., in 2014. Twenty-four rows were eliminated due to non-uniformity or the presence of off-types. One hundred and sixteen rows were harvested and bulked as 120 kg of clean breeder seed. Breeder Seed of Parata will be maintained by the University of Alberta's Cereal Breeding Program, Edmonton, AB.

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References

- American Association of Cereal Chemists. 2000. *Approved methods of the AACC*. 10th ed. AACC, St. Paul, MN.
- Fox, S.L., Townley-Smith, T.F., Kolmer, J., Harder, D., Gaudet, D.A., Thomas, P.L., Gilbert, J., and Noll, J.S. 2007. AC Splendor hard red spring wheat. *Can. J. Plant Sci.* **87**: 883–887. doi:10.4141/CJPS06042.
- Gilbert, J., and Woods, S. 2006. Strategies and considerations for multi-location FHB screening nurseries. Pages 93–102 in T. Ban, J.M. Lewis, E.E. Phipps, eds., *The global Fusarium initiative for international collaboration: A strategic planning workshop*. CIMMYT, El Batàn, Mexico.
- Graf, R.G., Hucl, P., Orshinshky, B.R., and Kartha, K.K. 2003. McKenzie hard red spring wheat. *Can. J. Plant Sci.* **83**: 565–569. doi:10.4141/P02-115.
- Menzies, J.G., Knox, R.E., Nielsen, J., and Thomas, P.L. 2003. Virulence of Canadian isolates of *Ustilago tritici*; 1964–1998,

- and the use of the geometric rule in understanding host differential complexity. *Can. J. Plant Pathol.* **25**: 62–72. doi:[10.1080/07060660309507050](https://doi.org/10.1080/07060660309507050).
- Peterson, R.F., Campbell, A.B., and Hannah, A.E. 1948. A diagrammatic scale for estimating rust intensity on leaves and stems of cereals. *Can J. Res.* **26**, Sec. C: 496–500.
- PRCWRT. 2013. Operating procedures. Prairie grain recommending Committee for Wheat, Rye and Triticale operating procedures. [Online] Available: <http://pgdc.ca/pdfs/wrt/Proposed%20PRCWRT%20OPS%20-%20FINAL%20DRAFT%20-%202013%20Updated%20-%20December%202015.pdf>, [2015 Dec. 12].
- SAS Institute, Inc. 2003. *SAS software. Version 9*. SAS Institute Inc., Cary, NC.
- Spaner, D., Navabi, A., Strenzke, K., Iqbal, M., and Beres, B. 2015. Coleman hard red spring wheat. *Can. J. Plant Sci.* **95**: 1037–1041. doi:[10.4141/cjps-2015-111](https://doi.org/10.4141/cjps-2015-111).
- Townley-Smith, T.F., and Czarnecki, E.M. 2008. AC Domain hard red spring wheat. *Can. J. Plant Sci.* **88**: 347–350. doi:[10.4141/CJPS07004](https://doi.org/10.4141/CJPS07004).