CULTIVAR DESCRIPTION

# Coleman hard red spring wheat

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Spaner, D., Navabi, A., Strenzke, K., Iqbal, M. and Beres, B. 2015. **Coleman hard red spring wheat**. Can. J. Plant Sci. **95**: 1037–1041. 'Coleman' hard red spring wheat is an awned, hollow-stemmed cultivar of high yield potential adapted to the wheat growing regions of western Canada. Averaged over 30 site-years, during 3 yr of testing in the Parkland Wheat Cooperative Registration Test (2010–2012), Coleman was higher yielding than Katepwa (8.5%) ($P \leq 0.05$), AC Splendor (5.8%) ($P \leq 0.05$), CDC Teal (2.1%) and CDC Osler (2%), exhibited maturity, height and lodging resistance similar to, or in the range of the checks, had higher test weights than the checks and showed good resistance to leaf, stem and stripe rust. Coleman exhibited Fusarium head blight resistance greater than and DON contamination levels lower than the check cultivars. Coleman exhibited susceptible reactions to common bunt and loose smut. End-use quality attributes of Coleman meet the specifications of the Canada Western Red Spring (CWRS) wheat market class.

**Key words:** Spring wheat, Canada western red spring, rust resistance, grain yield

Spaner, D., Navabi, A., Strenzke, K., Iqbal, M. et Beres, B. 2015. **Le blé de printemps de force rouge Coleman**. Can. J. Plant Sci. **95**: 1037–1041. Le blé roux vitreux de printemps Coleman est une variété barbue à tige creuse au rendement potentiel élevé, bien acclimatée aux régions de l'Ouest canadien où l'on cultive le blé. Au cours des trois années d'essais (2010–2012) réalisés dans le cadre des essais d'homologation coopératifs sur le blé de la région des prairies-parcs, Coleman a donné un rendement moyen, sur 30 années-sites, supérieur à celui de Katepwa (8,5 %) ($P \leq 0{,}05$), d'AC Splendor (5,8 %) ($P \leq 0{,}05$), de CDC Teal (2,1 %) et de CDC Osler (2 %). La variété se caractérise par une maturité, une taille et une résistance à la verse similaires à celles des témoins ou approchant celles-ci. Son poids spécifique est plus élevé que celui des témoins et Coleman résiste bien à la rouille des feuilles, à la rouille de la tige et à la rouille jaune. Coleman résiste mieux à la brûlure de l'épi causée par Fusarium que les variétés témoins, et le cultivar est moins contaminé par le DON. Toutefois, il montre une certaine sensibilité à la carie et au charbon nu. Au niveau de la qualité du produit final, Coleman respecte les exigences de la catégorie commerciale « blé roux de printemps de l'Ouest canadien » (CWRS).

**Mots clés:** Blé de printemps, blé roux de printemps de l'Ouest canadien, résistance à la rouille, rendement grainier

Coleman 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. Coleman was assigned registration no. 7479 by the Variety Registration Office, Plant Production Division, Canadian Food Inspection Agency (CFIA) in 2013.

## Pedigree and Breeding Method

The hard red spring wheat Coleman was selected from the cross ''CDC Go/3/(FRTL/NEMURA)//McKenzie'' made at the University of Alberta in the winter of 2004–2005. FRTL/NEMURA was a line selected for crossing from a CIMMYT scab nursery grown at the University of Alberta in 2004. FRTL is an abbreviation of 'Firetail', which derives from ''Fong Chan 3/Tyrant//Veery #9'', while NEMURA derives from the cross ''Neuzucht/Bezostaya 1//Alondra/4/Nadadores 63//Triumph/CI12406/3/Emu''. CDC Go and McKenzie (Graf et al. 2003) are two registered CWRS cultivars.

The $F_1$ seed from the final cross was grown in the field in Edmonton in 2005. Two hundred seeds from individual heads were advanced using single seed descent without selection for two generations at the Lacombe Field Crop Development Centre during the winter of 2005–2006. In 2006, space-planted $F_4$ hill plots were grown in a stripe rust nursery where selections were made on the basis of rust reaction, plant type, maturity and straw strength. The 70 heads from selected hill plots were grown as individual rows near Lincoln, New Zealand, during the winter of 2006–2007, where selection was based on plant type, maturity and straw strength. Seed from selected $F_5$ rows was grown as single entries in an unreplicated yield trial in Edmonton in 2007 and as hill

plots in a stripe rust nursery near Creston, BC, Canada. Based on cumulative agronomic, disease resistance and quality data, one of the lines was evaluated as 0518* F4SSD43 in replicated yield trials at one Saskatchewan and five Alberta environments in 2008. This line was further evaluated as entry number 7 in the Parkland B Test, and subsequently evaluated as PT765 in the Parkland Wheat Cooperative Registration Test from 2010 to 2012.

Evaluation in the Parkland Wheat Cooperative Registration Test followed protocols described by Fox and McCallum (2006). 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 genotypes as a fixed effect. Response of test entries and checks to several diseases was determined in specialized disease nurseries for 3 yr (2010–2012). 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 (FHB) 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 Coleman to common bunt (Fox and McCallum 2006). The 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 (2000). Eligibility for the CWRS market class was determined using American Association of Cereal Chemists protocols at the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB. We assessed Coleman's seedling and plant characteristics in a description trial grown at Edmonton during 2013 and 2014. We planted the trial each year in a randomized complete block design (RCBD) with 3 blocks. The trial included the reference cultivars CDC Go and McKenzie. All characteristics were recorded as prescribed in the Objective Description Form from the Variety Registration Office, Canadian Food Inspection Agency.

## Performance

In 3 yr of testing in the Parkland Wheat Cooperative Registration Test, Coleman was higher yielding than Katepwa (8.5%) ($P \leq 0.05$), AC Splendor (5.8%) ($P \leq 0.05$), CDC Teal (2.1%) and CDC Osler (2%) (Table 1). Coleman matured 2.9 d ($P \leq 0.05$), 1.4 d, 1.2 d and 0.5 d later than the checks AC Splendor, Katepwa, CDC Osler and CDC Teal, respectively (Table 1). Coleman was slightly shorter (NS) than Katepwa but taller ($P \leq 0.05$) than the remaining checks, while the lodging resistance was in the range of the checks.

## Other Characteristics

### Seedling characteristics

*Anthocyanin colouration of coleoptile*: Present.
*Juvenile growth habit*: 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.
*Flag leaf width*: Medium.
*Flag leaf curvature*: Slightly curved.
*Flag leaf attitude*: Upright, intermediate and drooping.
*Anthocyanin colouration of flag leaf auricles*: Strong.
*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*: Medium.
*Rachis margin pubescence*: Strongly pubescent.
*Stem colour at maturity*: White to yellow.
*Anthocyanin intensity of straw at maturity*: Absent.
*Pith in cross section (middle of internode below the neck)*: Slightly thickening.

**Table 1. Agronomic data for Coleman and check cultivars in the Parkland Wheat Cooperative Registration Test (2010 to 2012)**

| Entry | Yield (kg ha$^{-1}$) | Yield (% checks) | Maturity (d) | Height (cm) | Lodging (1–9) | Test wt. (kg hL$^{-1}$) | Seed mass (g 1000 k$^{-1}$) |
|---|---|---|---|---|---|---|---|
| Katepwa | 3845 | 96.3 | 100.4 | 97.3 | 2.6 | 76.1 | 33.2 |
| CDC Teal | 4088 | 102.4 | 101.3 | 93.1 | 2.1 | 75.7 | 33.8 |
| AC Splendor | 3943 | 98.8 | 98.9 | 94.3 | 2.7 | 75.6 | 35.1 |
| CDC Osler | 4092 | 102.5 | 100.6 | 91.8 | 3.1 | 75.2 | 32.4 |
| **Coleman** | **4173** | 104.5 | **101.8** | **96.4** | **2.8** | **77.2** | **34.6** |
| Station years | 34 | | 33 | 33 | 11 | 37 | 37 |
| $SE_{diff}$ | 152 | | 0.69 | 1.2 | 0.4 | 0.44 | 0.78 |

**Table 2. Disease reactions for Coleman and check cultivars in the Parkland Wheat Cooperative Registration Tests (2010–2012)**

| | | | | | | | Stripe rust[x] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Field leaf rust[z] | | | Field stem rust[y] | | | 2010 | 2010 | 2011 | 2012 |
| Entry | 2010 | 2011 | 2012 | 2010 | 2011 | 2012 | Lethbridge | Creston | Lethbridge | |
| Katepwa | 77 S | 33 I | 58 MS | 20 I | 20 MR | 2 R | 10 I | 25 S | 38 I | 33 I |
| CDC Teal | 10 R | 0.3 R | 20 MR | 15 I | 30 I | 2 R | 1 R | 5 R | 25 I | 10 VR |
| AC Splendor | 14 MR | 15 MR | 38 I | 15 RMR | 10 R | 2 R | 2 R | 8 I | 50 MS | 28 MR |
| CDC Osler | 0 R | 0 R | 2 R | 10 R | 30 I | 2 R | 30 S | 20 S | 37 I | 30 MR |
| **Coleman** | **0 R** | **8.7 R** | **5 R** | **10 RMR** | **30 I** | **5 R** | **1 R** | **0 R** | **23 I** | **18 MR** |

| | Fusarium head blight | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | | | 2011 | | | 2012 | | | | |
| | Glenlea | | Carman | Glenlea | | Carman | Glenlea | Carman | | | |
| Entry | VRI[w] | DON[v] (ppm) | VRI | VRI | DON (ppm) | VRI | VRI | VRI | DON (ppm) | ISD[u] | ISD Rate |
| Katepwa | 15 MR | 10.2 | 30 MS | 11 I | 2.64 | 30 MS | 8 MR | 43 | 3.2 | 14.6 | MR |
| CDC Teal | 22 I | 14.8 | 50 S | 18 MS | 5.41 | 51 S | 19 MS | 71 | 7.4 | 21.1 | I |
| AC Splendor | 19 I | 19.2 | 41 MS | 23 S | 4.37 | 38 MS | 24 S | 54 | 8.5 | 24.4 | MS |
| CDC Osler | 8 R | 7.7 | 31 MS | 11 I | 2.79 | 15 I | 12 I | 40 | 3.4 | 15.7 | I |
| **Coleman** | **12 MR** | **5.7** | **22 I** | **2 R** | **1.29** | **13 I** | **9 MR** | **39** | **2.7** | **13.9** | **MR** |

| | Common bunt[t] | | | Loose smut[s] | | |
|---|---|---|---|---|---|---|
| Entry | 2010 | 2011 | 2012 | 2010 | 2011 | 2012 |
| Katepwa | 9 I | 15 I | 20 I | 8 R | 0 R | 8 R |
| CDC Teal | 23 MS | 19 I | 24 I | 25 MR | 17 MR | 49 I |
| AC Splendor | 19 MS | 22 I | 17 MR | 16 MR | 16 MR | 36 I |
| CDC Osler | 16 I | 31 MS | 17 MR | 12 R | 41 I | 23 MR |
| **Coleman** | **15 I** | **47 S** | **22 I** | **72 MS** | **50 I** | **82 S** |

[z]Leaf rust rating scale based on severity: 0–10 R, 11–30 MR, 31–39 I, 40–60 MS, >60 S.
[y]Severity = percent of the stem infected with stem rust using the Modified Cobb Scale.
[x]Mean severity (percent leaf surface infected for average infected plants).
[w]Visual rating index = ((R1inc*R1sev) + (R2inc*R2sev) + (R3inc*R3sev))/3; Rating scales varied for the 3 yr.
[v]DON = deoxynivalenol.
[u]ISD = incidence + severity + DON = (0.3*mean incidence + 0.3*mean severity + 0.4*mean DON). ISD rating = <8.0 = R; 8.1–15 = MR; 15.1–22 = I; 22.1–30 = MS; >30.1 = S.
[t]Bunt: Rating: 0–4.70% = R; 4.71–11.65% = MR; 11.66–18.60% = MR-I; 18.61–32.50% = I; 32.51–39.45% = I-MS; 39.46–46.40% = MS; 46.41–53.35% = S; 53.36–100% = V.
[s]Loose smut: Reaction = R = 0–15%; MR > 15%–35%; I > 35–55%; MS > 55–75%; S > 75%.
Disease response category: R = resistant, MR = moderately resistant, I = intermediate, MS = moderately susceptible, S = susceptible.

**Table 3. Quality data[z] for Coleman and check cultivars from the Parkland Wheat Cooperative Registration Tests (2010–2012)**

| Variety | Wheat protein (%) | Flour protein (%) | Protein loss (%) | Falling number (Sec) | Amylo-graph peak | Clean Flour yield | Flour yield PB 0.50 Ash | Flour ash (%) | Flour color (Agtron) | Starch damage (mega-zeme) | Particle size index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Katepwa | 13.8 | 13.2 | 0.7 | 402 | 560 | 74.8 | 77.2 | 0.4 | 90.1 | 7.8 | 54.7 |
| CDC Teal | 14.3 | 13.8 | 0.5 | 405 | 592 | 75.0 | 78.2 | 0.4 | 90.1 | 7.1 | 57.7 |
| AC Splendor | 14.7 | 14.0 | 0.7 | 423 | 668 | 74.9 | 76.5 | 0.5 | 90.9 | 6.7 | 56.7 |
| CDC Osler | 14.3 | 13.6 | 0.6 | 467 | 798 | 74.5 | 76.3 | 0.5 | 89.8 | 7.4 | 54.3 |
| Checks Mean | 14.3 | 13.7 | 0.6 | 424 | 655 | 74.8 | 77.0 | 0.4 | 90.2 | 7.3 | 55.8 |
| Coleman | 14.0 | 13.3 | 0.7 | 393 | 670 | 75.1 | 77.7 | 0.4 | 87.9 | 7.7 | 54.7 |
| $SE_{diff}$ | 0.2 | 0.2 | 0.1 | 11 | 40 | 0.2 | 0.3 | 0.0 | 1.6 | 0.1 | 0.2 |

| | Farinograph | | | | Canadian short process (150 ppm ascorbic acid) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety | Absorption (%) | Dough development time (min) | Mixing tolerance index (BU) | Stability (min) | Absorption (%) | Peak Time | Mixing energy (W-h $kg^{-1}$) | Loaf volume (cc) | Appear-ance | Crumb structure | Crumb color |
| Katepwa | 66.2 | 6.2 | 21.7 | 11.7 | 66.7 | 3.9 | 7.8 | 1105 | 7.4 | 5.9 | 7.7 |
| CDC Teal | 66.6 | 8.9 | 11.7 | 22.7 | 66.7 | 4.3 | 8.8 | 1188 | 7.6 | 6.0 | 7.9 |
| AC Splendor | 67.1 | 10.0 | 11.7 | 29.3 | 67.0 | 4.0 | 8.0 | 1125 | 7.5 | 6.0 | 7.9 |
| CDC Osler | 67.6 | 9.2 | 13.3 | 15.7 | 67.3 | 3.2 | 6.4 | 1148 | 7.6 | 5.9 | 7.4 |
| Checks Mean | 66.9 | 8.6 | 14.6 | 19.8 | 66.9 | 3.9 | 7.8 | 1142 | 7.5 | 6.0 | 7.7 |
| Coleman | 66.0 | 8.7 | 11.7 | 31.5 | 67.0 | 5.1 | 10.2 | 1103 | 7.5 | 6.0 | 8.0 |
| $SE_{diff}$ | 0.5 | 1.9 | 5.8 | 5.8 | 0.9 | 0.2 | 0.7 | 20 | 0.1 | 0.2 | 0.1 |

[z]Quality data were obtained by Grain Research Laboratory of the Canadian Grain Commission using approved methods of American Association of Cereal Chemists.

Spike characteristics
*Shape*: Fusiform.
*Attitude at maturity*: Erect.
*Density*: Medium.
*Length*: Medium.
*Waxiness*: Medium to strong.
*Colour at maturity*: White.
*Awnedness*: Awned.
*Length of awns at tip of spike*: Shorter than spike.
*Awn colour*: White.
*Awn attitude*: Slightly spreading.
*Hairiness of convex surface of apical rachis segment*: Sparse.

Glume characteristics
*Lower glume length*: Medium.
*Lower glume width*: Between narrow and medium.
*Lower glume pubescence*: Glabrous.
*Lower glume shoulder shape*: Wanting to oblique.
*Lower glume shoulder width*: Very narrow to narrow.
*Lower glume beak shape*: Acuminate.
*Lower glume beak length*: Short.
*Glume colour at maturity*: White.
*Lowest lemma beak shape*: Slightly curved.

Kernel characteristics
*Texture*: Hard.
*Colour*: Medium red.
*Kernel size*: Medium to large.
*Kernel length*: Medium to long.
*Kernel length*: Medium.
*Kernel shape*: Elliptical.
*Kernel cheek shape*: Slightly rounded.
*Kernel brush hair length*: Short.
*Kernel brush size*: Medium.
*Germ shape*: Oval.
*Germ size*: Mid-size to small.
*Kernel crease width*: Mid-wide.
*Kernel crease depth*: Mid-deep.
*Phenol reaction*: Brown to black.

Disease reactions
Coleman expressed a resistant reaction to the prevalent races of leaf rust and ranged from resistant to intermediate for stem rust and stripe rust in 3 yr of testing (Table 2). It was rated intermediate to susceptible for common bunt and loose smut over the 3 yr of testing (Table 2). The FHB disease indices for Coleman were R to MR at Glenlea over the 3 testing years and I to MR at Carman; it was similar to Katepwa in 3 of 6 site years and lower than all other checks. DON levels for Coleman were lower than all of the checks (Table 2).

End-use suitability
Three years of end-use quality evaluation (Table 3) conducted by the Canadian Grain Commission, Grain Research Laboratory, indicated that Coleman was acceptable for all grades of the CWRS wheat class. Test weight of Coleman was greater ($P \leq 0.05$) than all of the check cultivars in all years (Table 3). Grain and flour protein of Coleman was within the range of the check cultivars and it exhibited strong dough characteristics (Table 3).

## Maintenance and Distribution of Breeder Seed

Breeder Seed of Coleman derives from 150 $F_6$ derived $F_{10}$ heads taken from the Parkland Coop yield trial at Ellerslie, AB, in 2011. These heads were planted as headrows near Lincoln in New Zealand. Of these, 120 rows were harvested separately (about 100–200 g per row). From each headrow, 50 g of seed was planted into 50-m rows at Edmonton (Michener), AB, in 2012. Fifteen rows that were non-uniform and had off types were eliminated, and 105 rows were bulk harvested from which we obtained 200 kg clean Breeder Seed. Breeder Seed of Coleman will be maintained by the University of Alberta's Cereal Breeding Program, Edmonton, AB.

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