

Moats hard red winter wheat

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Fowler, D. B. 2012. **Moats hard red winter wheat**. Can. J. Plant Sci. **92**: 191–193. Moats is a hard red winter wheat (*Triticum aestivum* L.) that is eligible for grades of the Canada Western Red Winter (CWRW) wheat class. It has excellent stem and leaf rust resistance and higher grain yield and protein concentration than the Central Winter Wheat Cooperative Registration Trial CWRW grain quality check cultivar, CDC Buteo. Its grain yield is similar to the high-yielding Registration Trial check cultivar, CDC Falcon, and lower than Accipiter, which is a more recent high-yielding winter wheat cultivar released in the Canada Western General Purpose wheat class. A suitable combination of grain quality, rust resistance and yield make Moats widely adapted in the winter wheat production area of western Canada.

Key words: *Triticum aestivum* L., cultivar description, hard red, wheat (winter), Canada Western red winter

Fowler, D. B. 2012. **Le blé d'hiver roux vitreux Moats**. Can. J. Plant Sci. **92**: 191–193. Moats est une variété de blé d'hiver (*Triticum aestivum* L.) roux vitreux admissible aux classes de la catégorie « Blé rouge d'hiver de l'Ouest canadien » (CWRW). Ce cultivar se caractérise par une excellente résistance à la rouille de la tige et des feuilles, ainsi que par un rendement grainier et une concentration de protéines supérieurs à ceux de CDC Buteo, la variété CWRW témoin pour la qualité employée pour les essais coopératifs d'homologation du blé d'hiver dans les provinces centrales. Moats a un rendement grainier similaire à la variété témoin à rendement élevé utilisée dans le cadre des essais d'homologation CDC Falcon, mais produit moins qu'Accipiter, un cultivar de blé d'hiver à haut rendement plus récent, homologué pour la classe « Blé à des fins générales de l'Ouest canadien ». La qualité du grain, la résistance à la rouille et le rendement grainier forment une combinaison qui fait de Moats une variété très bien adaptée à la zone de l'Ouest canadien où l'on cultive le blé d'hiver.

Mots clés: *Triticum aestivum* L., description de cultivar, blé roux, blé (d'hiver), Blé rouge d'hiver de l'Ouest canadien

Moats hard red winter wheat (*Triticum aestivum* L.) was developed at the Department of Plant Sciences, University of Saskatchewan, Saskatoon, SK. The Variety Registration Office, Plant Production Division, Canadian Food Inspection Agency issued registration no. 6903 for Moats on 2010 Dec. 02.

Pedigree and Breeding Method

Moats was selected from the progeny of a McClintock/CDC Falcon cross where McClintock = GN567/Norstar and CDC Falcon = Norstar*2/Vona//Abilene. McClintock is a registered Canada Western Red Winter (CWRW) wheat cultivar. CDC Falcon (Fowler 1999) is hard red winter wheat cultivar that was registered in the CWRW wheat class. The F₁ cross was made in the University of Saskatchewan phytotron in 1999. The F₁ and F₂ generations were produced in a greenhouse. F₂-derived F₃ lines were grown in a field nursery in Saskatoon in 2000–2001 where winter-hardiness, height, straw strength, and disease reaction were evaluated. Single row selections were made in the fall of 2001. These selections were grown in yield trials in 2001–2002 and 2002–2003. Single head selections were grown as head rows under irrigation in a special field nursery inoculated with leaf (*Puccinia recondita* Rob. ex Desm.)

and stem (*Puccinia graminis* Pers. f. sp. *tritici* Eriks. & E. Henn) rust at Saskatoon in 2003–2004 where a single row was selected and designated S01–285-7*R. The agronomic performance and disease reactions of S01–285-7*R were evaluated in trials grown in Saskatchewan in 2004–2005 and 2005–2006 and S01–285-7*R was entered into the Central Winter Wheat Cooperative Registration Trials from 2006–2007 to 2009–2010.

Performance

Analyses of variance were conducted using a mixed effects model where cultivars were considered as fixed and location-years as random effects. Fisher's protected LSD test was used to identify significant differences in the mean value of Moats compared with the check cultivars.

Moats is a hard red winter wheat cultivar with a grain yield potential (Table 1) that is similar to CDC Falcon (Fowler 1999) and falls between Accipiter (Fowler 2011) and CDC Buteo (Fowler 2010). CDC Buteo was the Central Winter Wheat Cooperative

Abbreviations: CWRW, Canada Western Red Winter Wheat; CWGP, Canada Western General Purpose

Table 1. Grain yield of Moats compared with CDC Buteo, CDC Falcon, and Accipiter. Data from the Central Winter Wheat Co-operative Registration trials 2007–2010^z

Cultivar	Alberta	Saskatchewan	Saskatchewan Irrigation ^y	Southern Manitoba	Mean
CDC Buteo	6695	4344	5286	5713	5412
CDC Falcon	7121	4279	5971	5640	5553
Accipiter	7567	4698	6242	5782	5887
Moats	7194	4542	5770	5707	5658
LSD ($P=0.05$)	462.2	272.2	546.7	NS	190.2
No. of tests	6	9	4	8	27

^zAll means are weighted by the number of tests within a zone. Alberta locations included Lethbridge, Olds, and Lacombe. Saskatchewan locations included Saskatoon, Clair, Indian Head, Melfort, and Saskatoon (Irrigation). The Manitoba locations were Brandon, Winnipeg, and Carman.

^yRust nursery.

NS, non-significant differences.

Registration Trial CWRW check cultivar, CDC Falcon was the high-yielding check, and Accipiter was a more recent high-yielding winter wheat cultivar release in the Canada Western General Purpose (CWGP) wheat class. The CWGP wheat class was introduced in 2007 to encourage the development and production of new cultivars to fill the high energy demands of the biofuel and livestock feed markets.

The time to heading and maturity for Moats is similar to CDC Falcon, 1 d earlier than CDC Buteo, and 2 d earlier than Accipiter (Table 2). The plant height of Moats is similar to that of CDC Buteo and it is taller than both CDC Falcon and Accipiter. It is more susceptible to lodging than CDC Falcon and Accipiter. The average protein concentration of Moats was higher than all the reference cultivars when data from 15 station years of replicated Central Hard Red Winter Wheat Co-operative Registration trials were evaluated. The grain protein yield was higher for Moats than CDC Buteo and CDC Falcon and similar to Accipiter. Moats has resistant stem rust and moderately resistant to resistant leaf rust ratings (Table 3). It has an intermediate to very susceptible common bunt (*Tilletia laevis* Kuhn in Rabenh. and *T. caries* [DC.] Tul. & C. Tul.) rating.

Moats had lower test weight, flour yield corrected to 0.50% ash, and particle size index and higher amylo-graph peak viscosity, flour ash, starch damage, and loaf

volume unit⁻¹ protein than the Central Winter Wheat Cooperative Registration Trial grain quality check cultivar, CDC Buteo (Table 4). The remainder of the grain quality (Table 4) measurements gave similar values for Moats and CDC Buteo. This combination of grain protein concentration, milling properties, dough functionality, and baking performance was judged as acceptable for grades of the CWRW wheat class.

Best management practices are employed in the Central Winter Wheat Co-operative Registration trials with the result that the level of winter damage experienced is normally very low. However, CDC Buteo, CDC Falcon, Accipiter, and Moats were included in 2008–2009 and 2009–2010 trials planted on summerfallow fields with minimal snow trapping potential. The average winter survival of Moats was significantly higher than CDC Falcon and similar to Accipiter and CDC Buteo in six of these trials where winter damage was recorded (Table 2).

Other Characteristics

PLANT. Winter growth habit; coleoptile colour reddish; juvenile growth semi-prostrate; leaves medium green; flag leaf medium green, narrow to mid-wide, short to medium length, intermediate to upright attitude; sheath and leaf blades glabrous; auricles reddish, glabrous; tillers many; straw medium length, internode hollow,

Table 2. Agronomic performance of Moats compared with CDC Buteo, CDC Falcon, and Accipiter

Character	CDC Buteo	CDC Falcon	Accipiter	Moats	LSD ($P=0.05$)	No. tests
<i>(A) Central Winter Wheat Co-operative Registration trials 2007–2010</i>						
Heading date (DOY) ^z	176	175	177	175	0.6	25
Maturity (DOY)	216	215	217	215	1.0	21
Plant height (cm)	87	74	81	88	1.8	27
Lodging (1–9) ^y	3.2	2.1	2.0	3.0	0.63	11
Protein (%)	11.9	12.0	11.6	12.3	0.29	15
Protein yield (kg ha ⁻¹)	552	573	594	614	34.6	15
<i>(B) Regional trials planted on summerfallow 2008–2010</i>						
Winter survival (%)	91	74	87	92	14.8	6

^zDay of year.

^y1, all plants vertical; 9, all plants horizontal.

Table 3. Disease reactions of Moats compared with CDC Buteo, CDC Falcon, and Accipiter. Leaf and stem rust data are from artificial leaf and stem rust infections using epidemic mixtures supplied by Agriculture and Agri-Food Canada in Winnipeg. Common bunt data are from trials inoculated by Agriculture and Agri-Food Canada staff at Lethbridge, AB

	CDC Buteo	CDC Falcon	Accipiter	Moats
<i>(a) Stem rust</i>				
2008W	30MR ^y	30MR	10R	TrR
2009W	20MR-30S	20MR	5R-MR	2R
2009S ^z	R	R	R	R
2010W	5MR	5MR	5R-MR	TrR
2010S	R	R	R	R
<i>(b) Leaf rust</i>				
2008W	5MR	10MR	5MR	5MR
2009W	15MR-MS	20MR-MS	15MR-MS	5R
2009S	R	R	R	R
2010W	5R-MR	15MR	5MR	TrR
2010S	R	20MR	R	TrR
<i>(c) Bunt</i>				
2008Le ^z	61VS	52VS	55VS	36VS
2009Le	68VS	53VS	45VS	311-MS
2010Le	62VS	34VS	62VS	42VS

^zS, Saskatoon; W, Winnipeg; Le, Lethbridge.

^yPercent infection and type of reaction: VS, very susceptible; S, susceptible; MS, moderately susceptible; MR, moderately resistant; TrR, trace/resistant, R, resistant.

Table 4. Wheat and flour analytical data^z for Moats compared with CDC Buteo. American Association of Cereal Chemists methods were followed for determining the various end-use suitability traits

Character	CDC Buteo	Moats	LSD (<i>P</i> =0.05)
Test weight (kg hL ⁻¹)	83.8	83.0	0.63
Kernel weight (mg)	34.6	34.2	NS
Wheat protein (%)	10.9	11.4	NS
Flour protein (%)	10.2	10.7	NS
Protein loss (%)	0.7	0.7	NS
Falling number (sec)	407	420	NS
Amylograph peak viscosity (BU)	545	736	104.2
Flour yield (% corrected to 0.50 ash)	81.0	78.3	2.31
Flour ash (%)	0.39	0.44	0.014
Flour colour (Agtron)	85.7	82.7	NS
Starch damage (%)	6.5	7.2	0.57
Particle size index (%)	57.0	53.3	1.43
Farinogram absorption (%)	58.3	58.9	NS
Farinogram DDT (min)	5.4	5.2	NS
Farinogram stability (min)	8.5	11.0	NS
Farinogram MTI (BU)	37.5	25.0	NS
Remix loaf volume (cm ³)	750	848	NS
Loaf volume unit ⁻¹ protein	73.7	79.5	5.0
Crumb structure	4.8	4.9	NS
Crumb colour	5.9	5.9	NS
Test bake absorption (%)	58	58	NS
Test bake mixing time (min)	2.5	3.1	NS

^zEnd-use quality testing conducted by the Grain Research Laboratory of the Canadian Grain Commission on composite samples from each of the 2008, 2009, and 2010 Central Winter Wheat Co-operative Registration Trials.

NS, non-significant differences.

culm neck straight, anthocyanin coloration at maturity absent, stem color light yellow at maturity.

SPIKE. Oblong, lax to mid-dense, inclined, medium length, awned; glumes mid-wide, mid-long to long, slightly pubescent, white; glume shoulders oblique, narrow; glume beak medium length, acuminate.

KERNEL. Red, hard, small to mid-size, ovate; cheeks rounded to angular; brush small, mid-long; crease narrow to mid-wide, mid-deep to shallow; germ small, round to oval.

Maintenance and Distribution of Pedigreed Seed

Breeder seed will be maintained by the Department of Plant Sciences, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 5A8. Distribution and multiplication of pedigreed seed stocks are handled by SeCan Association, 501-300 March Rd., Kanata, Ontario, Canada K2E 2E2.

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Fowler, D. B. 1999. CDC Falcon winter wheat. *Can. J. Plant Sci.* **79**: 599–601.

Fowler, D. B. 2010. CDC Buteo hard red winter wheat. *Can. J. Plant Sci.* **90**: 707–710.

Fowler, D. B. 2011. Accipiter hard red winter wheat. *Can. J. Plant Sci.* **91**: 363–365.