Registration of 'MDM' Wheat

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'MDM' (J980628, WA007936) hard white winter wheat (HWW) (*Triticum aestivum* L.) (Reg. No. CV-1017, PI 634716) was released in 2005 by the Agricultural Research Center of Washington State University (WSU) in cooperation with the USDA-ARS. MDM is a semidwarf cultivar adapted to the low- to intermediate-rainfall (<460 mm average annual precipitation) HWW-growing regions of Washington. It was released for its high grain yield, disease resistance, and excellent quality attributes. MDM is named in honor of Michael D. Moore (deceased), wheat producer from Kahlotus, WA. Moore was a strong supporter of WSU wheat research and contributed for many years toward the improvement of winter wheat for the low rainfall areas of Washington.

Stephen Jones selected MDM ('Klasic' [PI 486139]/5*'Eltan' [PI 536994]) in the BC_4F_6. Klasic is a hard white spring cultivar developed by Northrup King Company, and Eltan (Peterson et al., 1991) is a soft white winter (SWW) cultivar broadly adapted to the Pacific Northwest. The original cross and subsequent backcrosses were made in the WSU Wheat Plant Growth Center. Seed from each BC_4F_1 plant was used to establish a BC_4F_2 field plot (355 total) at Pullman, WA, in 1998. The BC_4F_3 seed was advanced without selection in 1999. On the basis of general adaptation, maturity, resistance to stripe rust (caused by *Puccinia striiformis* Westend. f. sp. *tritici*), grain yield, test weight, and milling and baking quality, 73 lines were selected in 2000 and planted as BC_4F_4 replicated plots in two advanced field nurseries in eastern Washington. Using similar selection criteria, 12 BC_4F_5 lines were planted in five replicated nurseries across eastern Washington in 2001, of which three were advanced in 2002 and tested at 16 eastern Washington locations as BC_4F_6 breeding lines. In addition, approximately 100 single spikes from each of the three lines were planted as head rows at Pullman. One line (J980628) emerged from the field nurseries as superior in grain yield and test weight. Heads from this line were randomly selected, and 100 were planted as head rows. All of the 100 BC_4F_6 head rows were harvested, and seed hardness (AACC, 2003) was determined from a subsample of each head row. BC_4F_7 seed from the 35 head rows of J980628 that were hard (>70 Single Kernel Characterization System kernel hardness index) were then bulked and planted in replicated commercial field trials as WA007936. In 2003 approximately 2000 $BC_4F_{7:8}$ spikes were selected from a pure seed increase of WA007936 at Pullman and grown as individual head rows, under irrigation, at Othello, WA. Those head rows were evaluated and selected for phenotypic uniformity, maturity, and resistance to disease. Nonconforming rows (<10%) were removed before harvest, and Breeder seed of MDM was produced from the bulked $BC_4F_{7:9}$ seed.

MDM is an intermediate-height, semidwarf, HWW cultivar that is phenotypically and agronomically very similar to Eltan for every trait other than seed hardness. It has an awned, lax, fusiform spike with long midwide, white glumes. The kernels are elliptical, white, hard, and midlong, with a midwide, mid-deep crease and a midsized medium-length brush. The germ is mid-sized.

Evaluations of Breeder and Foundation seed lots indicate that MDM may contain a naturally occurring variant of up to one red seed in 10,000 (0.01%). Plant "off-types" may occur at the rate of 1 in 10,000 (0.01%) for plant height (5–25 cm taller), awn length (awnletted to normal), and awn color (red or tan).

MDM exhibits resistance to snow mold (caused by *Typhula idahoensis* Remsberg and *T. ishikariensis* Imai) and stripe rust similar to Eltan. MDM was tested for stripe rust in field nurseries with natural infection across Washington State from 2002 to 2004. Stripe rust was well developed in all locations in each of the 3 yr. In most tests MDM had infection types (ITs) from 0 (no symptom) to 5 (moderately resistant). In a few tests it had IT 8 (susceptible) or mixed ITs, but severity was never greater than 40%. In 2005 MDM was included in an experiment of randomized split-block design including 24 winter wheat cultivars with four replications to determine yield losses caused by stripe rust and responses to fungicide application. The plots were planted on 24 Oct. 2004, and fungicide treated plots were sprayed with 292 mL ha^{-1} propiconazole (Tilt [Syngenta, Greensboro, NC]) on 19 May 2005 when most of the cultivars were at the jointing stage and the susceptible check genotype

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PS 279 (Milus and Line, 1986) had 20% stripe rust severity. Stripe rust severities were recorded three times: 21 May (the jointing stage), 7 June (the early heading stage), and 21 June (the early flowering stage). The area under disease progress curve (AUDPC) was calculated for each replication of each cultivar for fungicide treated and untreated plots. Grain of each plot was measured at harvest on 15 August when the grain was naturally dry. MDM had mean AUDPC values of 273 for the untreated and 37 for treated plots, which were not significantly different from the values of the resistant cultivar Eltan (441 for untreated and 118 for treated plots) and much lower than the susceptible checks 'Hatton' (2473 for untreated and 776 for treated plots) ($P < 0.05$), and PS 279 (2326 for untreated and 79 for treated plots) ($P < 0.001$). Similarly, MDM produced a mean yield of 6144 kg ha^{-1} for untreated and 5994 kg ha^{-1} for treated plots, which were not significantly different from Eltan (5375 kg ha^{-1} for untreated and 5644 kg ha^{-1} for treated plots) but significantly different from the mean yield of Hatton (1881 kg ha^{-1} for untreated and 4435 kg ha^{-1} for treated) ($P < 0.05$). A similar study was conducted during the 2005–2006 growing season. MDM had mean AUDPC values of 286 for the untreated and 15 for the treated plots, which were not significantly different from Eltan (146 for untreated and 0 for treated plots) and much lower than PS 279 ($P < 0.05$). MDM produced a mean yield of 6321 kg ha^{-1} for untreated and 7207 kg ha^{-1} for treated plots, which were not significantly different from Eltan (7185 kg ha^{-1} for untreated and 7532 kg ha^{-1} for treated), but the untreated yield of MDM was significantly different ($P < 0.05$) from that of PS 279 (4733 kg ha^{-1}). Thus, MDM has a level of stripe rust resistance equivalent to that of Eltan and much better resistance than those of Hatton and other currently grown cultivars (data not shown) in the field. In greenhouse seedling tests performed under low temperature cycle (diurnal temperature gradually changing from 4°C at 2:00 a.m. to 20°C at 2:00 p.m.), MDM showed resistance to race PST-21, intermediate resistance to races PST-41, 58, and 95, and susceptibility to races PST-17, 37, 43, 45, 58, 78, 79, 97, 98, 100, and 105 of *P. striiformis* f. sp. *tritici*. In greenhouse adult-plant tests performed under high temperature cycle (diurnal cycle gradually changing from 10°C at 2:00 a.m. to 35°C at 2:00 p.m.), MDM had resistant to moderately resistant reactions to races PST-37, 43, 58, 97, 98, and 100 of *P. striiformis* f. sp. *tritici*. The contrasting reactions of the adult-plant vs. seedling tests indicate that MDM has non-race-specific high-temperature adult-plant resistance, which has proven to be durable in many wheat cultivars, including Eltan, grown in the Pacific Northwest (Chen, 2005). MDM showed moderate resistance to dwarf bunt (caused by *Tilletia controversa* Kühn) in tests under high disease pressure with a pathogenic race composite having virulence to the bunt resistance genes *Bt1, Bt2, Bt3, Bt4, Bt6, Bt7, Bt9, Bt10, Bt14*, and *Bt15* in inoculated field trials in 2003–2004. From 2002 to 2004, visual disease assessments in three inoculated field trials indicated that MDM is moderately susceptible to Cephalosporium stripe (caused by *Cephalosporium gramineum* Nisikado & Ikata), similar to Eltan, and moderately susceptible to eyespot foot rot (caused by *Tapesia yallundae* Wallwork & Spooner) slightly better than Eltan. In naturally infested fields, 2002–2004 visual disease assessments showed MDM to be susceptible to powdery mildew [caused by *Blumeria graminis* (DC.) E.O. Speer f. sp. *tritici* Em. Marchal.] and moderately susceptible to leaf rust (caused by *P. triticina* Eriks.). No formal evaluations were performed for Wheat Streak Mosaic Virus, Barley Yellow Dwarf Virus, or stem rust (caused by *P. graminis* Pers.:Pers. f. sp. *tritici* Eriks. & E. Henn.).

Grain yields of MDM typically exceed ($P < 0.1$) those of HWW cultivars Golden Spike (PI 614813) (Hole et al., 2002), Gary (PI 620632) (Souza et al., 2004) and NuHorizon, which was developed and released by General Mills in 2001. In 10 rainfed trials conducted from 2003 to 2004 in the low- to intermediate-precipitation zones (<460 mm annual precipitation) in Washington, grain yields of MDM, Golden Spike, Gary, and NuHorizon were 5469 kg ha^{-1}, 5416 kg ha^{-1}, 4938 kg ha^{-1}, and 4959 kg ha^{-1}, respectively. In the same yield trials, grain volume weight of MDM (772 g L^{-1}) was less than ($P < 0.1$) Golden Spike (778 g L^{-1}), Gary (775 g L^{-1}), and NuHorizon (810 g L^{-1}). MDM typically heads about 141 d of year, 3 d later ($P < 0.1$) than Golden Spike and Gary and 6 d later than NuHorizon. The average thousand-kernel weight of MDM (35.7 g) is less than ($P < 0.1$) Golden Spike (37.0 g), Gary (37.1 g), and NuHorizon (37.1 g). The average plant height of MDM is 99 cm, taller ($P < 0.1$) than Gary (86 cm) and similar to Golden Spike (100 cm) and NuHorizon (101 cm). Its coleoptile length (79 mm) is greater than ($P < 0.1$) Golden Spike (72 mm) and Gary (71 mm). In artificial freeze tests conducted in growth chambers at the WSU Wheat Plant Growth Center, the LT_{50} (temperature at which 50% of fully hardened plants survived) of MDM was –14.9°C, as compared to NuHorizon (–15.6°C), Golden Spike (–14.1°C) and Gary (–13.9°C).

Milling and baking evaluations were conducted by the USDA-ARS Western Wheat Quality Lab in Pullman using grain produced in rainfed breeding and commercial variety testing trials in Washington State from 2003 and 2004. Due to a lack of HWW cultivars for quality comparisons, HRW cultivars Finley (PI 586757) (Donaldson et al., 2000) ($n = 18$) and Hatton (CItr 17772) ($n = 10$) were used, as well as the strong gluten SWW cultivar Eltan ($n = 18$). Results from quality assessments were averaged over all trials in which MDM and the three previously mentioned cultivars were grown. MDM had a milling yield of 632 g kg^{-1}, equal to Eltan but less than ($P < 0.05$) Finley and Hatton (667 g kg^{-1}). MDM's dough mix time (3.7 min) is similar to Eltan (3.9 min), and longer than ($P < 0.05$) Finley and Hatton (2.9 min each). MDM is similar to Eltan and Hatton for flour protein concentration (107 g kg^{-1} vs. 106 g kg^{-1} and 108 g kg^{-1}, respectively) and loaf volume (870 mL, vs. 863 mL and 868 mL, respectively) but less than ($P < 0.05$) Finley (116 g kg^{-1} flour protein concentration, 966 mL loaf volume). Its alkaline noodle sheet brightness (L*) is less than ($P < 0.05$) Eltan (82.2 vs. 84.9, respectively), and its 24 h ΔL is greater ($P < 0.01$), (6.9 vs. 5.1, respectively).

U.S. Plant Variety Protection for MDM has been issued (PVP Certificate # 200600246). All seed requests should be sent to the corresponding author during the period of Protection by the Plant Variety Protection Certificate. Seed of this release is deposited in the National Plant Germplasm system, where it will be available after the expiry of the Plant Variety Protection for research purposes, including development and commercialization of new cultivars. It is requested that appropriate recognition be made if this cultivar contributes to the development of new germplasm or cultivars.

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Registration of 'ReGen' Alfalfa

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'ReGen' alfalfa (*Medicago sativa* L.) (Reg. No. CV-204, PI 643396) was developed by the Cornell University Agricultural Experiment Station, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca, NY. This cultivar was released in 2005. Experimental designation was NY 0131.

ReGen is the result of a three-way population cross. The initial cross was between two plant populations: 'Seedway 9558' and a population composed of germplasm related to 'Iroquois', 'Saranac AR', 'Oneida VR', and 'Vertus', followed by phenotypic recurrent selection for multiple disease resistance and selection in the field for plant vigor, freedom of diseases, resistance to lodging, and lower forage neutral detergent fiber and acid detergent fiber concentrations. This population cross was done by hand reciprocally to produce full-sib families between 100 clones per population. Progenies of this population cross were crossed with a population derived from 'Magnum III' after selection for resistance to anthracnose (Race 1) (caused by *Colletotrichum trifolii* Bain & Essary) (two cycles), Verticillium wilt (caused by *Verticillium albo-atrum* Reinke & Berthier) (two cycles), and Phytophthora root rot (caused by *Phytophthora megasperma* Drechs. f. sp. *medicaginis* T. Kuan & D.C. Erwin) (one cycle). Full-sib crosses between the populations were made by hand (74 clones per population). Seed of the Syn. 1 generation was a bulk of equal weight of seed per cross. The Syn. 2 generation (Breeder seed) was produced in 2001.

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ReGen is a dormant cultivar with fall dormancy similar to the FD3 check. It has high resistance to Fusarium wilt [caused by *Fusarium oxysporum* Schlecht. f. sp. *medicaginis* (Weimer) Snyd. & Hans.], Verticillium wilt, and anthracnose (Race 1); resistance to bacterial wilt [caused by *Clavibacter michiganensis* subsp. *insidiosum* (McCull.) Davis et al.] and Phytophthora root rot; and low resistance to Aphanomyces root rot (Race 1) (caused by *Aphanomyces euteiches* Drechs). In New York, ReGen averaged 1.08 Mg ha^{-1} (9%) per year more dry forage than Oneida VR, 1.95 Mg ha^{-1} (19%) more than 'Vernal', and 0.85 Mg ha^{-1} (7%) more than '5312' in three production years (Hansen et al., 2005). Concentrations of neutral detergent fiber and acid detergent fiber are similar to those of Vernal. Flower color of the Syn. 2 generation is 93% purple and 7% variegated.

In 2001 Breeder seed (Syn. 2) was produced under cage isolation in Caldwell, ID, in sufficient quantity to last the lifetime of the cultivar. The Department of Plant Breeding and Genetics at Cornell University maintains this seed under controlled environmental conditions. Foundation seed (Syn. 3) may be produced from Breeder seed in northern USA on stands no more than three years old unless by consent of the breeder. Certified seed (Syn. 3 or 4) may be produced from Breeder or Foundation seed on stands no more than six years old. Seed shall be sold by cultivar name only as a class of Certified seed. The National Alfalfa and Miscellaneous Legumes Variety Review Board reviewed ReGen favorably in 2006.

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