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MEMORANDUM

TO: Wheat Cultivar Release & Recommendation Committee

FROM: Phil Bruckner and Jim Berg, Winter wheat breeders

DATE: January 9, 2013

RE: Proposal for protected MAES public (F.2.b) cultivar release of MTS0808

The following motion and supporting documentation is presented for consideration at the 2013 MAES Cultivar Release and Recommendation Meeting in Bozeman:

Motion: That MTS0808 solid-stem hard red winter wheat be approved for release in 2013, that MTS0808 be named 'Warhorse,' and that Warhorse be recommended for wheat stem sawfly-infested areas of districts 3, 4, and 5.

Pedigree: MTS0808 derives from a composite of 3 topcrosses made to the same 1999 F1 population: 00X182, MT9908 (MT85200/Redwin)//NuPlains/MTS9862 (MT91366/MTS92137); 00X183, Nuplains/MTS9862//MTW0047 (Judith/PI262605//S86-740); and 00X184, Nuplains/MTS9862//MTS0028 (Vanguard//MTSF1570/Norstar).

Recommendation: Protected MAES Public Release (F.2.b).

Name: To be named 'Warhorse' denoting a strong, powerful, spirited horse used for military service [also a lake & national wildlife refuge NE of Grassrange].

Selection history: MTS0808 originated from three topcrosses made in the greenhouse in 2000. The F₁ populations were grown at Bozeman in 2001. F₂, F₃, F₄, and F₅ bulk populations were grown at Fort Ellis, Loma, Loma and N.Havre from 2002 to 2005, respectively, using a modified bulk breeding method, with mass selection for survival, reduced plant height, favorable head morphology, stem solidness, and kernel plumpness. One hundred-thirteen heads which were selected from the F₅ population in 2005 were grown as F₆ headrows at Fort Ellis in 2006. Headrow 00X182cE39 was selected based on evaluation of stem solidness and visual criteria for uniformity, productivity, and acceptable agronomic type and harvested in bulk. 00X182cE39 was subsequently tested in the 2007 Sawfly Observation Nursery (SFO) grown at Bozeman, Havre, north Havre, and Fort Ellis. In 2008, 00X182cE39 was designated MTS0808 and subsequently tested in in the Sawfly yield trial from 2008 to 2012 (18 location years, LY), in the Advanced trial planted in 2009 (6 LY), in the Montana Intrastate trial from 2010 to 2012 (21 LY), and in the Off-station nursery planted in 2011 and 2012 (33 LY). Quality has been evaluated in multi-location Montana trials since 2008. In 2012, MTS0808 was an entry in the USDA Northern Regional Performance Nursery (NRPN) planted at approximately 20 sites across the Northern

Great Plains.

Purification/seed stocks: Purification and increase of MTS0808 was initiated in 2010 when 120 F₅-derived F₁₀ headrows were grown at Bozeman with selection for stem solidness and visual uniformity, retaining 90 linerows. Individual linerows were grown at Bozeman in 2011 and 87 were bulked based on visual uniformity, as a source of breeder seed. Breeder seed of MTS0808 was increased at the Bozeman Post Farm in 2012. Foundation seed of Warhorse is planted at Fort Ellis (19.3 A) for 2013 harvest.

Description: Warhorse is an awned, white-glumed, solid-stem, semi-dwarf hard red winter wheat. Warhorse has medium maturity, 172 d heading from 1 January, similar to ‘Genou’ and ‘Rampart’ (Table 1). Warhorse is semi-dwarf (*Rht1*) and medium-short (31.1 inches, n=74), similar to ‘Judee’ and ‘Bearpaw’. Warhorse is resistant to prevalent races of stem rust including UG99 (*Tmp*) and stripe rust, but susceptible to leaf rust. Warhorse is solid-stemmed, averaging 21.4 on the 5 (hollow) to 25 (solid) stem solidness scale, significantly more solid than Judee (19.6) and Genou (18.0) and similar in stem solidness to Rampart (21.1) and ‘Bearpaw’ (21.6) (Table 2).

Table 1. Agronomic characteristics of MTS0808 vs. solid-stemmed varieties, 2008-2012

Variety	Test weight lb/bu	Winter survival %	Heading date		Plant height in	Lodging %	Protein %	Sawfly cutting %	Stripe rust %	Coleoptile length in
			Julian	Calendar						
location-years	72	3	36		74	8	71	15	8	2
MTS0808	59.4*	44	172.2	21-Jun	31.1	1	13.2	4**	11**	3.2
Bearpaw	59.1	44	170.9	20-Jun	31.0	13	13.0	9	43	3.0
Genou	59.1	38	171.9	21-Jun	34.9	19	13.4	15	45	4.0*
Judee	59.6*	37	171.3	20-Jun	31.4	12	13.4	12	12*	3.5
Rampart	59.6**	33	172.0	21-Jun	34.4	21	13.8**	7*	29	4.2**
LSD (0.05)	0.4	ns	0.4		0.5	ns	0.2	4	13	0.3

1/ = includes 2008-12 Sawfly , 2010-12 Intrastate and 2011-12 Off Station tests

Table 2. MTS0808 vs. 4 solid-stemmed varieties ,2008-2012.

	Stem Solidness Rating (scale 5-25, higher = more solid)						Stem Solidness by location, 2008-2012				
	2012	2011	2010	2009	2008	2008-12	Bozeman	Conrad	Havre	Moccasin	Sidney
location-years	8	8	9	2	5	32	8	4	12	7	1
Bearpaw	20.8*	21.7**	22.0**	20.7*	22.1	21.6**	19.2*	22.2	22.8**	21.5*	23.1*
MTS0808	20.4*	21.6*	21.5*	21.5*	22.4	21.4*	19.3**	22.8	22.1*	21.7**	23.2**
Rampart	21.0**	21.5*	20.3	22.4**	21.4	21.1*	17.9	22.6	22.7*	20.9*	22.8*
Judee	18.5	20.1	19.2	20.0*	21.0	19.6	16.3	21.6	20.7	19.9	22.8*
Genou	18.4	18.3	17.3	16.3	19.2	18.0	13.8	20.2	19.5	19.0	19.2
LSD (0.05)	1.2	1.0	1.0	3.0	ns	0.6	1.2	ns	0.9	1.4	2.6

In 14 sawfly-infested environments, grain yield of Warhorse was similar to that of Judee and Bearpaw. Cutting by wheat stem sawfly of Warhorse (4%) was superior to all solid-stem cultivars except Rampart (Table 3). Warhorse, similar to Judee, Bearpaw, and WB Quake (data not shown), is targeted toward wheat stem sawfly-infested areas of north central Montana.

Table 3. Performance of MTS0808 vs. solid-stemmed varieties in sawfly-infested environments, 2008-2012.

Variety	Yield (bu/a)						Sawfly Cutting (%)					
	Havre	North Havre	Loma	Turner	Willow Creek	Average	Havre	North Havre	Loma	Turner	Willow Creek	Average
location-years	6	1	4	2	1	14	6	1	4	2	1	14
MTS0808	60.5**	50.4**	60.8**	31.9	43.2**	54.5**	3**	15*	5**	2	1	4**
Judee	58.5*	55.6*	57.1*	38.2	39.4*	53.6*	7*	38	20	5	2	12
Bearpaw	59.0*	48.7*	54.9*	38.1	34.6	52.3*	7*	23*	13*	12	2	10
Genou	52.3	48.7*	47.0	38.1	36.2*	47.4	11	45	21	13	2	16
Rampart	50.9	44.0	49.8	33.1	29.7	46.1	5*	13**	12*	6	1	7*
LSD (0.05)	5.6	9.1	6.6	ns	8.5	3.5	4	15	8	ns	7	4

Table 4. Yield of MTS0808 vs. solid-stemmed varieties, 2008-2012.

Variety	Districts							All Locations
	1 Kalispell	2 Bozeman ^{1/}	3 Huntley ^{2/}	4 Moccasin ^{3/}	5 Conrad ^{4/}	5 Havre ^{5/}	6- Sidney & Williston	
location-years	3	10	14	14	11	15	5	72
MTS0808	113.9**	72.0*	60.7*	45.4**	64.6**	57.8**	53.6	61.0**
Judee	104.6*	74.4**	59.6*	39.1	63.1*	56.4*	47.0	58.5*
Bearpaw	67.6	64.2	63.2**	42.7	59.1*	55.8*	55.3	56.8
Rampart	83.8*	63.1	53.9	35.5	54.4	49.4	46.8	51.5
Genou	60.6	60.4	54.1	38.8	55.5	50.7	45.7	51.2
LSD (0.05)	36.3	7.2	4.4	2.4	5.9	3.6	ns	2.6

** = indicates highest value within a column

* = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

1/ includes data from Dry Creek, Willow Creek

2/ includes data from Forsyth, Fort Smith, Hardin area, Lodge Grass, Molt, Rapelje

3/ includes data from Belt, Denton, Geraldine, Winifred

4/ includes data from Choteau, Cut Bank, The Knees, Shelby

5/ includes data from North Havre, Loma, Turner

6/ = includes 2008-12 Sawfly , 2010-12 Intrastate and 2011-12 Off Station tests

Characteristics/comparisons:

Yield. In 72 location-years (LY) of testing in the Montana Winter Wheat Intrastate, Sawfly, and Off-station nurseries average yield of Warhorse (61.0 bu/a) was similar to the yield of Judee, but greater than the yields of Bearpaw, Genou, and Rampart (Table 4).

Test weight. Test weight of Warhorse (59.4 lb/bu, n=72) was similar to all other solid stem cultivars (Table 1).

Grain protein content of Warhorse is medium to high, lower than Rampart but similar to that of Genou, Bearpaw, and Judee (Table 1).

Milling and baking quality of Warhorse is acceptable and similar to currently deployed Montana cultivars

(Table 5). In summary, Warhorse is a hard red winter wheat with high PPO, intermediate flour yield and flour protein content, medium dough strength and water absorption, and average loaf volume similar to Judee (Table 5).

Table 5. Mill and bake characteristics of MTS0808 vs. solid-stemmed varieties; 2008-2011 Sawfly Test and 2010-2011 Intrastate Test

Variety	PPO ^{1/}	Kernel hardness	Flour yield %	Flour protein %	Flour Ash %	Baking mix time min	Baking absorption %	Loaf volume cc
location-years	20	20	20	20	20	20	20	20
Bearpaw	0.450	79.1	67.9*	10.4	0.40*	8.1	70.8	968
Genou	0.466	75.9	67.2	10.7	0.41	13.4	72.2	1012
Judee	0.426	75.8	65.6	10.4	0.40**	9.6	70.1	1064**
MTS0808	0.448	86.1	66.8	10.5	0.42	7.7	71.7	1029
Rampart	0.415	78.2	68.4**	11.4	0.40*	12.9	73.1**	1061*
LSD (0.05)	ns	2.7	1.4	ns	0.01	1.5	1.0	29

** = indicates highest value within a column

* = indicates varieties with values equal to highest variety within a column based on Fisher's protected LSD (p=0.05)

^{1/} low is best for noodles

Warhorse is proposed as a potential replacement for Genou, and a supplement to Judee and Bearpaw, adding diversity to the set of solid stem cultivars available for production in Montana. Warhorse combines high yield potential, high stem solidness, low cutting by wheat stem sawfly, and short plant height.