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MEMORANDUM

TO: Wheat Cultivar Release & Recommendation Committee

FROM: Jim Berg, Phil Bruckner, and Jake Tracy, Winter wheat breeders

DATE: January 5, 2022

RE: Proposal for protected MAES public cultivar release of **MTS18149**

The following motion and supporting documentation will be presented for consideration at the 2022 MAES Cultivar Release and Recommendation Meeting in Bozeman:

Motion: That MTS18149 hard red winter wheat be approved for release in 2022.

Pedigree: MTS18149 derives from 2015 backcross between the semi-solid variety Loma (MAES, 2016) to AAC Gateway [Agriculture and Agri-Food Canada (Lethbridge, Alberta), 2012]

MTS18149	Loma*2/AAC Gateway

Recommendation: Protected MAES Public Release.

Name: to be determined (possible names = MT Fairview, MT Turner)

Selection history: Following the 2015 cross (15X6), these are steps in the development of MTS18149:

2015-2016	15 seeds of cross 15X6 sent to Heartland Plant Innovations (HPI) in Manhattan, KS in 2015. 184 doubled haploid lines were returned in the summer of 2016.
2017	Doubled haploid 15X6-DH67 and cohorts grown in 6' widely spaced rows (2' between each row) at the Post Farm to maximize seed production.
2018-Multi	MTS18149 (DH_3, now handled like an F8) tested in Preliminary C Doubled Haploid Sawfly Test at Bozeman and Big Sandy. MTS18149 selected for above average solidness and low sawfly cutting % at Big Sandy.
2019-Multi	MSU Sawfly trials, 2019 to 2021, 13 Location-years. Milling & baking quality evaluation initiated.
2019-Multi	MTS18149 (DH_4) tested in the MSU Advanced trial (7 LY). M&P heads selected.
2020-Multi	MTS18149 (DH_5) tested in the Montana Intrastate (9 LY) & Off-station (7 LY) trials.
2021-Multi	MTS18149 tested in the Montana Intrastate (9 LY) & Off-station (12 LY) trials.
2021-region	MTS18149 entered in the USDA Northern Regional Performance Nursery (NRPN)

Purification/seed stocks: Purification and increase of MTS18149 was initiated in 2020 when 132 headrows derived in the DH_4 generation were evaluated for phenotypic uniformity & stem solidness. 109 linerows were bulked as Breeder seed and increased at Bozeman in 2021. Breeder seed of MTS18149 was planted fall 2021 for 2022 Foundation seed production [7 acres Bozeman Bart Farm]. MTS18149 has been genetically uniform and stable over two generations of seed increase with few visually obvious plant variants.

Table 1. Agronomic characteristics of MTS18149 vs. a set of solid-stemmed varieties, 2019-2021[1/]

Variety	Test weight	Winter survival	Heading date		Plant height	Lodging	Protein	Sawfly cutting	Falling Number
	lb/bu	%	Julian	Calendar	in	%	%	%	
location-years	47	3	20		45	1	44	15	4
Bobcat	60.1	69	166.3	15-Jun	26.6	34	13.7	**10**	397
Judee	**60.5**	58	165.4	14-Jun	28.0	46	**14.3**	25	386
Loma	59.7	83	168.1	17-Jun	27.1	38	13.8	27	355
MTS18149	59.8	75	168.7	18-Jun	26.4	36	13.9	17	380
StandClear CLP	**60.6**	79	165.5	14-Jun	28.3	44	13.5	35	396
Warhorse	59.4	76	166.1	15-Jun	27.9	49	**14.1**	**12**	440
LSD (0.05)	**0.4**	**ns**	**0.5**		**0.5**	**-**	**0.2**	**7**	**44**

1/ = includes 2020-2021 Intrastate, 2020-2021 Off Station, and 2019-2021 Sawfly tests

bold = indicates highest (or most desirable) value within a column

Description: MTS18149 is an awned, white-glumed, semisolid-stemmed, semi-dwarf hard red winter wheat. MTS18149 has medium-late maturity, 169d heading from 1 January, 2 to 3d later than Warhorse and Bobcat, , and similar to Loma (Table 1). MTS18149 is semi-dwarf (*Rht B1b*) and short (26.4 inches, n=45), significantly shorter than Loma, Warhorse, and Judee, but similar to Bobcat (Table 1). MTS18149 is resistant to stripe rust, has adequate stem solidness, and is resistant to cutting by the wheat stem sawfly. Grain protein of MTS18149 is similar to Loma and Bobcat, higher than StandClear CLP, and lower than Judee and Warhorse.

Characteristics/comparisons:

Yield. In 50 location-years (LY) of testing in the Montana Winter Wheat Intrastate, Off-station, and Sawfly nurseries average yield of MTS18149 (61.8 bu/a) was similar to the yield of Loma, StandClear CLP, and Bobcat and 5 bu/acre higher than Warhorse and Judee (Table 2). MTS18149 is competitive with other solid stem cultivars for yield in most Districts (Table 2), but most importantly in the Havre and Conrad areas where wheat stem sawfly (WSS) is the biggest issue and yield of MTS18149 is 5 to 10% higher than that of Warhorse and Judee. Additionally, MTS18149 had the highest yield of all solid-stemmed varieties in the Sidney/Williston area where sawflies may become an issue.

Yield in infested environments. Table 3 shows direct comparison of MTS18149 to the same set of cultivars in 14 environments that were heavily infested by wheat stem sawfly (average cutting by WSS>10%). In these WSS-infested environments, MTS18149 is second in yield to Bobcat and has low cutting incidence (significantly lower than the other semisolid varieties; Loma, StandClear CLP, and Judee) by sawfly (Table 3).

Table 2. Yield of MTS18149 compared to other solid-stemmed varieties, 2019-2021[1/]

Variety	Districts							All Locations
	1	2	3	4	5	5	6- Sidney &	
	Kalispell	Bozeman	Huntley[2/]	Moccasin[3/]	Conrad[4/]	Havre[5/]	Williston	
location-years	3	5	11	7	2	18	4	50
Loma	**153.3**	**87.9**	**59.8**	47.8	86.9	**48.0**	**46.9**	**62.3**
MTS18149	**142.8**	**87.1**	57.4	49.2	84.4	**49.5**	**48.1**	**61.8**
StandClear CLP	125.8	**85.3**	**62.5**	50.3	80.4	**47.2**	**42.3**	**60.4**
Bobcat	127.0	**83.0**	**59.3**	46.3	82.6	**49.6**	**45.3**	**60.2**
Warhorse	129.8	74.9	57.9	46.3	77.9	44.4	**39.9**	56.8
Judee	121.9	**83.1**	56.3	46.3	72.7	45.0	34.7	56.4
LSD (0.05)	**18.6**	**5.2**	**4.0**	**ns**	**ns**	**2.5**	**8.4**	**2.2**

bold = indicates highest value within a column

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

1/ = includes 2020-2021 Intrastate, 2020-2021 Off Station, and 2019-2021 Sawfly tests

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

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

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

5/ includes data from Big Sandy, Fort Benton, Hingham, Gildford, Loma, Turner

Table 3. MTS18149: Yield Performance under Sawfly Pressure (test average cutting ≥10%) and % Sawfly Cutting (2019-2021)

Variety	Yield bu/a	Sawfly Cutting (%)
location-years	14	14
Bobcat	**53.5**	**10**
MTS18149	**52.7**	19
Loma	**51.5**	28
StandClear CLP	**50.6**	37
Warhorse	47.9	**12**
Judee	47.8	27
LSD (0.05)	**2.9**	**7**

bold = indicates highest value within a column

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

Table 3. Stem solidness ratings of MTS18149 compared to other solid-stemmed varieties, (2019-2021)

	Stem Solidness Rating (scale 5-25, higher = more solid)							
	2021	2020	2019	2019-21	Bozeman	Conrad	Havre[1/]	Moccasin
location-years	9	9	5	23	5	3	14	1
Bobcat	**22.8**	**24.1**	**23.7**	**23.5**	**22.9**	**24.0**	**23.2**	**23.8**
Warhorse	20.0	22.7	**22.9**	21.7	20.4	**22.6**	22.0	**23.2**
Judee	17.9	21.0	21.5	19.9	19.1	21.3	19.8	22.1
StandClear	17.6	21.7	20.9	19.9	19.4	20.3	20.3	18.3
Loma	17.3	21.3	21.4	19.7	17.8	20.9	20.0	21.8
MTS18149	16.5	22.2	21.0	19.7	17.5	21.6	19.9	**22.6**
LSD (0.05)	**1.3**	**1.0**	**1.2**	**0.8**	**1.9**	**1.7**	**1.0**	**2.3**

bold = indicates highest value within a column

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

1/ includes Big Sandy, Carter/Ft Benton, Gildford, Hingham, Kremlin, and Loma

Stem solidness. Stem solidness of MTS18149 over years and locations is similar to Loma, Judee, and StandClear CLP and significantly less than Warhorse and Bobcat (Table 4).

Test weight. Test weight of MTS18149 (59.8 lb/bu, n=47) is similar to Loma and Bobcat, higher than Warhorse and lower than Judee and StandClear CLP (Table 1).

Falling number. Falling number is moderate (value = 380, n=4), similar to all check cultivars except sprout-resistant Warhorse.

Milling and baking quality. Based on experimental milling using a Brabender Automat Mill, flour yield of MTS18149 is high with flour ash content similar to Warhorse and intermediate flour protein (Table 5). MTS18149 has low PPO (polyphenol oxidase) like Loma. MTS18149 has strong dough mixing characteristics with high water absorption, and relatively long mixing time. Baking qualities of MTS18149 are acceptable with intermediate loaf volume similar to Loma and Warhorse (Table 5).

Table 5. Mill and bake characteristics of MTS18149, Intrastate and Sawfly Tests, 2020

Variety	PPO [1/]	Kernel	Flour			Mixograph			Baking		
		hardness	yield	protein	Ash	tolerance	mix time	absorption	mix time	absorption	volume
			%	%	%	(1-6)	min	%	min	%	cc
location-years	7	7	7	7	7	7	7	7	7	7	7
Bobcat	0.306	74.1	**72.2**	12.5	**0.39**	**3.1**	5.5	65.2	13.8	76.3	1088
Judee	0.238	79.6	71.2	**13.2**	0.42	**3.4**	5.7	66.2	10.7	76.5	**1179**
Loma	**0.156**	82.7	**72.6**	**12.8**	0.41	**3.0**	7.1	**68.5**	18.6	**79.2**	**1141**
MTS18149	**0.140**	82.3	**72.9**	**12.8**	0.43	**3.1**	7.2	**67.3**	20.2	**78.8**	1127
StandClear CLP	0.289	73.8	**72.4**	12.6	**0.39**	**3.3**	5.0	64.8	10.3	76.0	1056
Warhorse	0.260	88.6	70.6	**13.0**	0.43	2.0	5.1	**67.2**	9.8	**78.2**	1135
LSD (0.05)	**0.035**	**3.8**	**0.9**	**0.44**	**0.01**	**0.8**	**0.9**	**2.3**	**2.6**	**2.0**	**40**

bold = indicates highest value within a column

bold = 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

Disease and insect resistance. Characterization of MTS18149 for disease and insect resistance included Montana trials and cooperative evaluations at Washington State University (Pullman, WA) and the USDA Cereal Disease Laboratory (St. Paul, MN).

MTS18149 has moderate stem solidness and good resistance to cutting by wheat stem sawfly (Tables 1, 3, & 4).

MTS18149 was tested for reactions to natural infections of *Puccinia striiformis* f. sp. *tritici* in Pullman and Mount Vernon, WA from 2019 to 2021. Across locations and over years, MTS18149 had a highly resistant reaction with infection type (IT) 2 to moderate resistant reaction (IT 5) with low severity, 5-15%.

MTS18149 was grown in field tests in St. Paul (2019) and was found to have a moderately susceptible reaction to stem rust.

Based on 2021 NRPN evaluation, MTS18149 is susceptible to leaf rust.

MTS18149 was seedling tested for aluminum tolerance at Rockford, WA (low pH = 3.5-4 in top 5" of soil) in 2019 and received scores of 3 at two different evaluation dates. 4's were the highest scores (highest = most tolerant) of any of the 198 Montana lines tested that year. Additionally, MTS18149 was the highest yielding line in the Turner Off Station winter wheat test in 2020 (66.9 bu/a, 7 bu/a higher than the next highest variety, with the test average = 53.2) where low soil pH (= 5.3) was noted by Peggy Lamb.

MTS18149 is a high-yielding, semisolid-stem, semi-dwarf cultivar with good resistance to cutting by wheat stem sawfly. At Conrad and Havre field testing sites where wheat stem sawfly is a problem, grain yield of MTS18149 is more than 10% higher than the current, predominant solid stem cultivars Judee and Warhorse. MTS18149 combines high yield potential, acceptable test weight, grain protein content, and milling and baking quality with excellent stripe rust resistance, moderate stem solidness, and good resistance to cutting by wheat stem sawfly. MTS18149 has exhibited good aluminum/acid soil tolerance.