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MEMORANDUM

FROM: Phil Bruckner, Winter wheat breeder

DATE: January 3, 2018

RE: Release of MTF1432 forage winter wheat (cross ID 07X197x1-2-21)

Pedigree: MTF1432 = Yellowstone*2/98X168-1
98X168-1 (MTS9720//PI191303/Elkhorn) is an unreleased awnless forage line,

Recommendation: Public, protected **Name:** To be determined

Selection history: MTF1432 is a forage line developed as a possible replacement to (or supplement to) Willow Creek forage wheat (released in 2005). Willow Creek is widely grown in Montana as a one-cut annual hay crop used by livestock in winter maintenance diets. MTF1432 derives from two crossing cycles of Yellowstone winter wheat to an unreleased, awnless forage line 98X168-1. Following the 2007 cross, these are steps in development of MTF1432:

2008gh	07X197 F1 population grown in PGC, 6 plants harvested.
2009Post	F2 plant rows grown, 07X197x1 selected (D145), 20 heads harvested.
2010Post	F3 head rows grown, 07X197x1-2 selected (K798), HB + hds. harvested.
2011FE	F4 line grown in Forage Obs. Nursery. 60+ heads harvested.
2012Post	F5 head rows grown, 07X197x1-2-21 (J139) selected. HB harvest.
2013P+M+FE	F6 line grown in Single Rep. Observation nursery at 3 locations, 07X197x1-2-21 selected.
2014	F7 line designated MTF1432 and tested in multi-location Preliminary and Forage trials.
2015	MTF1432 (F8) tested in multi-location Advanced and Forage trials. M&P heads taken.
2016	MTF1432 tested in multi-location Preliminary and Forage trials.
2016Post	126 F8:9 headrows evaluated for phenotypic uniformity. 119 linerows selected and bulked as Breeder seed.
2017	MTF1432 tested in multi-location Intrastate, Off-station, and Forage trials.
2017Post	MTF1432 Breeder seed increased

General performance and characteristics: MTF1432 is a tall, awnless winter wheat line developed for forage production. MTF1432 has been tested in grain and forage trials since 2014. Milling and baking quality was evaluated from 2014 to 2016.

From 2014 to 2017, MTF1432, MT1435, and Willow Creek winter wheat were tested in 20 Montana forage trials. Compared to Willow Creek, MTF1432 has similar forage yield and forage quality, but superior seed yield (Table 1). Seed yield in nine Montana environments was 3896 lb./acre for MTF1432, 163% higher than

Willow Creek in the same trials.

Table 1. Grain and Forage production characteristics of MTF1432 and check cultivars in Winter Annual Forage Trials, 2014-2017.

Variety	Field Analysis						Forage Analysis			
	Yield	Test weight	Heading date		Plant height	Dry matter yield	Protein	ADF	NDF	TDN
	lb/a	lb/bu	Julian	Calendar	in	ton/a	%	%	%	%
location-years	9	9	15		16	20	6	6	6	5
Trical 102	2976	49.4	161.8	11-Jun	52.2	**4.04**	11.4	32.8	63.8	65.2
MTF1432	**3896**	**58.7**	164.5	14-Jun	35.6	3.45	11.2	31.5	60.7	66.7
MTF1435	3220	**59.0**	162.7	12-Jun	39.4	3.54	11.6	32.3	62.4	65.8
Willow Creek	2383	**59.7**	168.3	17-Jun	43.8	3.37	11.4	33.0	62.6	64.9
LSD (0.05)	**388**	**1.1**	**0.9**		**2.4**	**0.31**	**ns**	**ns**	**ns**	**ns**

Table 2. Performance of MTF1432 and MTF1435 in Montana Preliminary and Advanced grain trials compared to a parental cultivar, Yellowstone, 2014-2016.

Year & Trial	# Loc.	Line/check	Grain yield	Test weight	Plant height	Heading date	Stripe rust	Grain protein
			Bu/A	Lb/bu	inch	Days from Jan. 1	% severity	%
2014 Prel.	4	Yellowstone	94.5	60.1	35.6	166	-	12.8
		MTF1432	94.8	59.1	39.8	169	-	12.7
		MTF1435	82.7	59.9	42.6	167	-	12.9
		5%lsd	12.5	1.3	2.4	2	-	0.7
2015 Adv.	5	Yellowstone	64.3	58.7	34.2	159	6.5	12.3
		MTF1432	62.6	57.5	37.9	162	1.5	12.4
		MTF1435	56.7	59.5	41.6	160	5.5	12.5
		5%lsd	8.4	1.2	1.2	1	-	0.7
2016 Prel.	3	Yellowstone	92.1	61.4	32.5	162	3	10.6
		MTF1432	85.9	59.9	35.6	163	6	10.7
		MTF1435	78.6	61.4	38.7	162	10	10.4
		5%lsd	12.6	1.5	1.6	1	8	ns

In Montana Preliminary and Advanced grain trials from 2014 to 2016, MTF1432 showed high grain yields similar to Yellowstone (Table 2). Yellowstone is the parental cultivar having very high grain yield and is currently the leading planted cultivar in Montana. Test weight of MTF1432 was 1.2 to 1.5 lb./bu lower than that of Yellowstone. Depending on the trial, MTF1432 was 3 to 4" taller than Yellowstone and headed 1 to 3 days later than Yellowstone. All lines showed good resistance to stripe rust over the testing period. MTF1432 and Yellowstone had similar grain protein in these yield trials.

In 2017, Yellowstone was accidently left out of the Intrastate trial, so no direct yield comparisons could not be made. MTF1432 produced similar grain yields to Northern and Decade over 23 sites in 2017 trials (Table 3). Relative to Decade, MTF1432 was lower in test weight and winter survival, 5 days later in heading, 5 inches taller, similar for grain protein, and much better for stripe rust resistance (Table 4). Relative to Northern, MTF1432 is similar for winter survival and stripe rust resistance, lower in test weight and grain protein, 2 days

later in heading, and 5 inches taller. All available grain production information indicates MTF1432 has average to high grain yield potential, significantly superior to Willow Creek.

Table 3. Yield of MTF1432 and MTF1435 and check varieties in 2017 Off-station and Intrastate Trials.

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		1	6	6	5	4	1	23
MTF1432		107.5	68.0	60.2	70.2	38.0	**43.5**	61.9
Northern		90.4	**70.8**	58.1	71.7	40.0	36.7	61.7
MTF1435		100.8	63.9	60.3	67.1	35.8	**42.4**	59.5
Decade		42.7	64.9	58.7	65.6	40.7	**50.7**	57.6
LSD (0.05)		**10.2**	**8.7**	**ns**	**5.0**	**ns**	**13.2**	**4.0**

Table 4. Agronomic characteristics of MTF1432 and MTF1435 and check varieties, 2016-2017.

Variety	Test weight	Winter survival	Heading date		Plant height	Lodging %	Protein	Saw fly cutting	Stripe rust	Coleoptile length
	lb/bu	%	Julian	Calendar	in		%	%	%	in
location-years	23	1	8		21	4	23	3	2	1
Decade	60.7	**62**	155.0	4-Jun	28.4	37	12.4	44	74	2.9
MTF1432	58.7	34	160.0	9-Jun	33.1	50	12.2	46	**11**	2.9
MTF1435	59.9	45	158.3	7-Jun	35.5	50	12.1	40	**14**	3.4
Northern	60.1	37	158.1	7-Jun	28.2	46	**12.7**	42	**8**	2.6
LSD (0.05)	**0.5**	**16**	**1.1**		**0.8**	**ns**	**0.2**	**ns**	**22**	**0.2**

In milling and baking quality evaluations over eight environments (Table 5), MTF1432 showed excellent end-use qualities comparable to Decade and parental cultivar, Yellowstone.

Table 5. Mill and bake characteristics of MTF1432 and MTF1435 and check varieties, 2014-2016: Combined Preliminary A Tests (2014 and 2016) and Advanced (2015) Tests

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	8	8	8	8	8	8	8	8	8	8	8
Decade	0.259	74.7	69.9	11.6	0.40	**4.5**	8.2	**65.8**	21.7	**76.0**	1038
MTF1432	0.140	81.6	**71.9**	11.5	0.41	**4.1**	9.3	64.2	20.0	**75.1**	1041
MTF1435	**0.079**	81.0	**71.2**	11.5	0.41	3.6	5.3	63.5	8.6	73.2	1053
Yellowstone	0.200	79.6	70.1	11.4	0.41	3.8	7.7	64.1	14.5	**74.9**	1069
LSD (0.05)	**0.051**	**2.7**	**0.7**	**ns**	**ns**	**0.5**	**2.1**	**1.5**	**4.5**	**1.7**	**ns**

Purification/seed stocks: Purification and increase of MTF1432 was initiated in 2016 when 126 F_8-derived F_9 headrows were grown at Bozeman with selection for phenotypic uniformity, retaining 119 linerows which were bulked as breeder seed. Breeder seed of MTF1432 was increased in 2017 at Bozeman. Foundation seed is planted for 2018 harvest (5 acres, Post Farm; 5 acres, NARC, Havre).

Summary:
Two forage-type winter wheat lines have been developed by the MAES winter wheat breeding program over the past decade. Genetically these two lines are closely related, both 'Yellowstone' backcross derivatives. Both lines were selected in 2013 and tested in Montana grain and forage trials from 2014 to 2017. Although genetically similar, MTF1432 and MTF1435 are agronomically unique. Notably MTF1432 is 2 days later in heading and 3-4" shorter in height. In all trials MTF1432 has shown higher grain yield than MTF1435. Both are tall, awnless wheats with good stripe rust resistance. Compared to Willow Creek, the widely grown winter wheat cultivar these lines are intended to replace, MTF1432 and MTF1435 are similar in dry matter forage yield and forage qualities (crude protein, ADF, NDF, TDN). Both lines are earlier and shorter than Willow Creek and produce significantly higher seed yields.

MTF1432 is proposed for protected public release in Montana based on improved seed yield in comparison to Willow Creek, at similar forage yield potential.