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MEMORANDUM

FROM: Phil Bruckner, Winter wheat breeder

DATE: January 3, 2018

RE: Release of MTF1435 forage winter wheat (cross ID 08X337x14-4)

Pedigree: MTF1435 = MT08186/3/Yellowstone*2/98X168-1
MT08186 is a low PPO plant selection from Yellowstone.
98X168-1 (MTS9720//PI191303/Elkhorn) is an unreleased awnless forage line,

Recommendation: Licensed, outside Montana **Name:** To be determined

Selection history: MTF1435 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. MTF1435 derives from three crossing cycles of Yellowstone (or derivatives) winter wheat to an unreleased, awnless forage line 98X168-1. Following the 2008 cross, these are steps in development of MTF1435:

2009gh	08X337 F1 population grown in PGC, 8 plants harvested.
2010Post	F2 plant rows grown, 20 heads harvested.
2011Post	F3 head rows grown, 08X337x14 selected (C1439), HB + hds. harvested.
2012Post	F4 head rows grown, 08X337x14-4 selected (J2000). HB harvested.
2013P+M+FE	F5 line grown in Single Rep. Observation nursery at 3 locations, 08X337x14-4 selected.
2014	F6 line designated MTF1435 and tested in multi-location Preliminary and Forage trials.
2015	MTF1435 (F7) tested in multi-location Advanced and Forage trials. M&P heads taken.
2016	MTF1435 tested in multi-location Preliminary and Forage trials.
2016Post	126 F7:8 headrows evaluated for phenotypic uniformity. 105 linerows selected and bulked as Breeder seed.
2017	MTF1435 tested in multi-location Intrastate, Off-station, and Forage trials.
2017Post	MTF1435 Breeder seed increased

General performance and characteristics: MTF1435 is a tall, awnless winter wheat line developed for forage production in Montana. MTF1435 has been tested in Montana grain and forage trials since 2014. Milling and baking quality was evaluated from 2014 to 2016. **No data is available regarding the adaptation and performance of MTF1435 outside Montana.**

From 2014 to 2017, MTF1432, MT1435, and Willow Creek winter wheat were tested in 20 Montana forage trials. Compared to Willow Creek, MTF1435 has similar forage yield and superior seed yield (Table 1). Seed yield in nine Montana environments was 3220 lb./acre for MTF1435, 135% higher than Willow Creek in the

same trials.

Table 1. Grain and Forage Production Characteristics of MTF1435 and check lines in Montana 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 & 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 grain trials from 2014 to 2017, MTF1435 showed grain yields 8 to 14 bu/acre lower than Yellowstone (Table 2). Yellowstone is a cultivar with very high grain yield and is currently the leading planted cultivar in Montana. Test weight of MTF1435 was similar to that of Yellowstone. Depending on the trial, MTF1435 was 6 to 7" taller than Yellowstone and headed about 1 day later than Yellowstone. All lines showed good resistance to stripe rust over the testing period. Relative to MTF1435, MTF1432 has higher grain yield (4 to 12 bu/acre) but is 1-2 lbs./bu lower in test weight. MTF1432 heads a day or two later than MTF1435 and is 3 to 4 inches shorter than MTF1435.

In 2017, Yellowstone was accidently left out of the Intrastate trial, so no direct yield comparisons could not be made. MTF1435 produced similar grain yields to Northern and Decade over 23 sites in 2017 trials (Table 3). Relative to Decade, MTF1435 was lower in test weight and winter survival, 3 days later in heading, 7 inches taller, lower for grain protein, and much better for stripe rust resistance (Table 4). Relative to Northern,

MTF1435 is similar for test weight, winter survival, heading date, and stripe rust resistance, lower in grain protein, and 7 inches taller. All available grain production information indicates MTF143 has average 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	Winter	Heading date		Plant	Lodging	Protein	Saw fly	Stripe	Coleoptile
	w eight	survival			height	%		cutting	rust	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), MTF1435 showed lower PPO, shorter mixing time, and lower bake water absorption than Decade and Yellowstone but good overall end-use qualities.

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 MTF1435 was initiated in 2016 when 126 F_7-derived F_8 headrows were grown at Bozeman with selection for phenotypic uniformity, retaining 105 linerows which

were bulked as breeder seed. Breeder seed of MTF1435 was increased in 2017 at Bozeman. Foundation seed is planted for 2018 harvest (7.7 acres, Marsh fields).

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.

MTF1435 is proposed for licensed release outside Montana based on improved seed yield in comparison to Willow Creek, at similar forage yield potential.