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MEMORANDUM

FROM: Suchismita Mondal, Winter Wheat Breeder

DATE: January 2, 2023

RE: Release of MTF20189 forage winter wheat

Pedigree: MTF20189 = MT10121*2/Mv11-04

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

Selection history: MTF 20189 is a forage line developed from the cross of MT10121*2/Mv11-04. The variety Mv11-04 or Mv Laura was released in 2007 by Agricultural Research Institute in Romania, Hungary. It is an early maturing, awnless cultivar with good heat stress tolerance and good resistance to yellow rust. It was selected from the Facultative and Winter Wheat Observation Nursery (FAWWON) grown in 2009 at Post Research Farm. Following the cross in 2015 with an advanced line MT10121, these selection and generation advancement steps were followed:

2010 Cross conducted in greenhouse in 2010
2011 F1 is backcrossed to MT10121 in greenhouse 2011
2012 BCF1 grown at Post research farm in Bozeman, MT
2013 F2 population grown at Ft Ellis
2014 F3 population grown at Williston, ND
2015 F4 population grown at Sidney, MT
2016 F5 population grown at Post Farm, 120 heads harvested
2017 HRs sown at Ft Ellis
2018 Selected HRs sown at Ft Ellis
2019 Selected awnless HR grown in Forage Observation nursery at Post Research Farm
2020 MTF20189 tested in multi-location Winter cereal forage trials
2021 MTF20189 tested in multi-location advanced yield trial and Winter cereal forage trials
2022 MTF20189 tested in multi-location Intrastate, Off-station, and Winter cereal forage trials
2022 MTF Breeder seed increased at Post Research Farm

General performance and characteristic: MTF20189, a tall awnless winter wheat line developed for forage production. MTF20189 has been tested in replicated grain and forage trials since 2020. Milling and baking quality was evaluated in 2021 and 2022.

From 2020 to 2022, MTF20189 was tested in winter cereal forage trials along with Ray and Willow Creek. MTF20189 has similar forage yield and higher seed yield in comparison to Willow Creek (Table 1). It is earlier by 4 days compared to Ray and 7 days compared to Willow Creek. While it is taller than Ray, it appears to have excellent straw strength, given that there was no lodging at any locations, which is lacking in the tall variety Willow Creek. Test weight was higher compared to both Ray and Willow Creek.

MTF20189 was included as part of the advanced yield trial and grown in 7 locations across Montana. Trial analysis of data from 5 locations shows MTF 20189 is comparatively taller and had lower grain yield than Warhorse and Yellowstone (Table 2). Test weight was comparable to the checks, with low PPO and similar milling and baking quality to Yellowstone.

In 2022, MTF20189 was included in Intrastate and Off Station trials. Yield and agronomic data from the Intrastate trial shows similar results as that observed in Advanced trials (Table 3). Being a hollow line is shows similar susceptibility to wheat stem sawfly cutting as Yellowstone. MTF 20189 shows good resistance to stripe rust as evaluated by Washington State University in 2021 and 2022 (Table 4). Forage line Ray was part of the off-station nurseries and based on average yield comparisons MTF20189 had lower seed yield (not significant at any site), while height, test weight and protein were comparatively higher.

Table 1. Grain and forage production characteristics of MTF20189 and check cultivars, Ray and Willow Creek in Winter Cereal Forage Trials, 2020-2022

Cultivar/Line	Field production Data[1]						Forage quality data[2]		
	Yield (bu/ac)	Dry matter yield (t/ha)	Heading date (Julian)	Plant height (in)	Test weight (lb/bu)	Lodging[3]	Protein (%)	ADF (%)	NDF (%)
location-years[1]	11	11	11	11	11		9	9	9
Ray	**63.7**	4.31	174	**33.9**	59.5	0	10.9	36.9	61.3
Willow Creek	51.4	**4.91**	177	42.8	60.1	9.5	10.5	36.6	60.9
MTF20189	**59.9**	**4.72**	**170**	42.2	**61.6**	0	10.9	36.8	60.5
LSD (0.05)	7.9*	0.48*	1.26	2.5*	1.2*		0.9	1.4	2.8
CV (%)	10.7	11.6	0.67	6.7	2.16		0.13	3.4	4.1

Bold indicates significantly higher/lower value for the trait based on LSD
*Significant genotypic differences estimated at $p<0.05$
1/ Bozeman, Corvallis, Havre, and Moccasin from 2020-2022
3/ Lodging notes taken at Bozeman in 2020 and 2022, 0- no lodging and 10 – whole plot lodged, notes taken 3 weeks after heading

Table 2. Yield, agronomic characteristics, and mill and bake traits of MTF20189 in comparison check varieties Warhorse and Yellowstone in Advanced yield trials during 2021.

Cultivar/Line	Yield, (bu/ac)	Test weight, (lb/bu)	Heading Date (Julian)	Plant Height (in)	Sawfly Cutting (%)	Protein (%)	PPO	Single kernel hardness	Wheat Protein (%)	Flour		Mixograph			Baking		
										Flour yield (%)	Flour protein (%)	Tolerance	Mixing time min	Water absorption (%)	Mixing time min	Water Absorption (%)	Loaf Volume
Locations	5	5	4	5	2	5	4	4	4	4	4	4	4	4	4	4	4
Warhorse	43.4	58.2	168	28.9	**10**	**14.3**	0.202	84.1	14.3	66.0	13.0	2.7	4.6	64.3	8.0	74.3	1074.8
Yellowstone	**52.1**	57.6	168	30.4	38	13.6	0.190	78.9	14.0	**67.3**	12.9	**4.1**	8.5	65.0	17.7	75.7	1096.5
MTF20189	42.9	58.7	168	**39.2**	48	**14.6**	**0.052**	74.9	14.5	**67.4**	13.3	**4.1**	4.0	64.9	8.0	75.0	1103.0
LSD (0.05)*	4.6*	1*	1.5*	1.8*	23.1*	0.5*	0.032*	8.1	0.7	1.3*	0.6*	0.9*	1.9*	1.8	3.8*	2.2*	76.6*
CV (%)	7.8	1.6	0.6	5.6	36.4	3.2	13.1	9.98	4.5	1.5	4.3	18.1	20.7	27	22.9	2.7	6.4

Bold indicates significantly higher/lower value for the trait based on LSD
*Significant genotypic differences observed for all traits at $p<0.05$

Table 3. Yield (bu/ac) of MTF20189 in comparison to Warhorse and Yellowstone as check varieties in Intrastate trial 2022

Cultivar/Line	District								All Locations
	1	2	3	4	5	5	6	6	
	Kalispell	Bozeman	Huntley	Moccasin	Ft Benton	Havre	Sidney	Williston	
Warhorse	**128.2**	104.5	**44.1**	45.5	22.2	57.1	63.3	20.8	**66.0**
Yellowstone	126.3	**123.0**	**39.3**	50.5	26.2	61.9	66.0	26.1	**70.7**
MTF20189	110.8	75.6	19.1	46.8	26.1	55.0	58.3	23.4	55.8
LSD (0.05)	27.2*	12.9*	5.6*	14.1*	8.3*	7.2*	13.6*	9.5*	5.5*
CV (%)	11.1	5.6	6.5	16.4	16.1	6.4	11.5	22.6	11.2

Bold indicates significantly higher/lower value for the trait based on LSD
*Significant genotypic differences observed for all traits at p<0.05

Table 4. Agronomic characteristics of MTF20189 in comparison to check varieties Warhorse and Yellowstone in Intrastate trial 2022. Stripe rust data available for 2021 and 2022

Cultivar/Line	Test Weight (lb/bu)	Heading Date (Julian)	Plant Height (in)	Stem Solidness (5-25)	Stems Infested (0-5)	Sawfly Cutting (%)	Protein (%)	Stripe rust (% infection)	
Locations	8	6	8	3	2	2	8	2 (2021)	3 (2022)
Warhorse	56.5	169	29.4	21.7	2.7	**5.3**	**13.6**	80	10
Yellowstone	57.2	168	30.9	7.9	5.0	92.1	12.6	100	30
MTF20189	57.0	169	**40.7**			79.6	**14.0**	**15**	**5**
LSD (0.05)	1.7*	1.0*	1.0*	2.1*	1.4*	19.1*	0.6*		
CV (%)	4.3	0.8	5.1	9.3	20.7	14.7	5.0		

Bold indicates significantly higher/lower value for the trait based on LSD
*Significant genotypic differences observed for all traits at p<0.05

Table 5. Seed yield (bu/ac) of MTF20189 in comparison to Ray, Warhorse, and Yellowstone as check varieties in Off Station Trials during 2022

Cultivar/Line	District				All Locations
	1	3	4	5	
	NWARC[1]	SARC[2]	CARC[3]	NARC[4]	
Locations	1	5	3	1	
Warhorse	55.2	47.6	37.9	27.7	42.3
Yellowstone	74.2	46.7	37.3	**40.2**	42.3
Ray	61.3	45.8	34.5	**34.7**	38.6
MTF20189	57.1	42.5	35.2	**32.3**	35.0
LSD (0.05)	ns	4.9*	4.9*	3.9*	2.8
CV(%)	23.2	9.3	12.4	5.6	10.1

Bold indicates significantly higher/lower value for the trait based on LSD
ns – no significant genotypic difference for yield at Creston
*Significant genotypic differences observed for grain yield at p <0.05
1/ includes data from Creston
2/ includes data from Huntley irrigated, Rapelje, Hysham, Molt, and Fly Creek
3/ includes data from Denton, Geraldine, and Belt
4/ includes data from Loma

Table 6. Agronomic characteristics of MTF 20189 in comparison to check varieties Ray, Warhorse, and Yellowstone Off-station 2022

Cultivar/Line	Test Weight (lb/bu)	Plant Height (in)	Sawfly Cutting (%)	Protein (%)
Locations	9	10	2	9
Warhorse	**58.5**	27.6	**9.0**	**13.5**
Yellowstone	**58.0**	**29.7**	48.0	13.0
Ray	56.9	**32.3**	58.0	13.2
MTF20189	**58.1**	**38.3**	43.0	**14.1**
LSD (0.05)	0.5*	1.0*	20.6*	0.3*
CV (%)	1.3	6.1	39.3	3.1

Bold indicates significantly higher/lower value for the trait based on LSD
*Significant genotypic difference observed for all traits at p<0.05

Purification/seed stocks: Purification and increase of MTF20189 was initiated in 2021 when 130 HRs were grown at Bozeman with selection for phenotypic uniformity, retaining 113line rows which were bulked as breeder seed. Breeder seed of MTF20189 was increased in 2022 at Bozeman.

Summary:

MTF20189 is an early, tall, and awnless hard red winter line developed for forage production areas. The forage trial data shows that MTF20189 has high forage yield and good seed yield, high test weight, excellent winter hardiness and resistance to stripe rust. Forage quality evaluations (crude protein, ADF, NDF) are similar to Willowcreek and Ray. MTF20189 has a strong combination of both forage and seed yield with good straw strength.

MTF20189 is proposed for protected public release in Montana based on earliness, lodging tolerance, higher seed yield, and similar forage yield to Willow Creek. It will be a suitable replacement for Willow Creek in regions where taller forage varieties are preferred.