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MEMORANDUM

TO: Wheat Variety Release Committee

FROM: Hwa-Young Heo and Jason Cook, Spring Wheat Breeders

DATE: January 25th, 2023

RE: Proposal for protected MAES public cultivar release of MT1809

The following motion and supporting documentation are presented for consideration at the 2023 MAES Variety Release Meeting in Bozeman, MT:

Motion: Release MT1809 hard red spring wheat as an AOSCA registered public variety with PVP Title V protection.

Pedigree: Vida/ Elgin-ND

CONTRIBUTORS

- Dr. Jason Cook, Ms. Nancy Blake, Ms. Deanna Nash, Dr. Hwa-Young Heo, MSU Bozeman, MT
- Dr. Jed Eberly, MSU-CARC, Moccasin, MT
- Dr. Chengci Chen, and Dr. Frankie Crutcher, MSU-EARC, Sidney, MT
- Ms. Peggy Lamb MSU-NARC, Havre,
- Dr. Ken Kephart and Dr. Kent McVay, MSU-SARC, Huntley, MT
- Dr. Justin Vetch MSU-WTARC, Conrad, MT
- Dr. Clint Bierman MSU-NWARC, Creston, MT
- Mr. Doug Holen, MSU Foundation Seed, Bozeman, MT
- Mr. Craig Cook and Mr. Donny Gray, 2nd Nature Research, LLC, Bozeman, MT
- Dr. Dale Clark and Mr. Trevor Schafer, Nutrien Ag Solutions, Bozeman, MT
- Dr. Xianming Chen USDA-ARS, Pullman, WA
- Dr. Matthew Rouse, USDA-ARS, St. Paul, MN
- Dr. Jason Fiedler, USDA-ARS, Fargo, ND
- Dr. Mike Pumphrey, WSU, Pullman, WA
- Dr. Zhaohui Liu, NDSU, Fargo, ND

The rationale for releasing MT1809 is based on having high yield in Montana rainfed environments, good grain protein content, moderate aluminum tolerance, moderate resistance to fusarium head blight, resistance to foliar disease and high falling numbers. MT1809 was derived from the cross 'Vida' (Lanning et al., 2006) /'Elgin-ND' (Mergoum et al., 2016). Vida was released by the Montana Agriculture Experiment Station (MAES) in 2006 for having high yield in rainfed environments and is currently the most widely grown spring wheat variety in Montana. Elgin-ND was released by the North Dakota Agricultural Experiment Station in 2013 for having high yield and grain protein content and good end-use quality. Elgin-ND is also resistant to fusarium head blight, stem rust, tan spot and bacterial leaf blight.

Yield and other agronomic measurements were collected from the Advanced Yield Trial (AYT) during the 2020 – 2022 growing seasons totaling 30 location-years including 24 rainfed and 6 irrigated growing environments. Average yield performance of MT1809 across rainfed environments was 1.5 bu/ac higher than 'Vida' (Lanning et al., 2006) (Table 1). Across all location-years, MT1809 yielded 2.2 bu/ac more than Vida and was the second highest yielding line in the AYT across all environments (Table 2). Across all environments, MT1809 grain protein content was 0.6% higher than Vida and 0.2% lower than 'Dagmar' (Heo et al., 2020) (Table 3). Test weight was 59.5 lbs/bu across all environments and heading date was 0.9 day earlier than Vida (Table 4). Solid-stem scores for MT1809, Vida and Dagmar (Heo et al., 2020) were 12.5, 13.4, and 19.4, respectively. Sawfly cutting data collected from Fort Benton, MT was 36.9%, 26.7% and 23.9% for MT1809, Dagmar and Vida, respectively (Table 4). Sawfly cutting at Havre, MT for MT1809, Vida and Dagmar were 23.2%, 14.6% and 2.7%, respectively. MT1809 is not as resistant to sawfly as Vida and Dagmar, but it is not as susceptible to sawfly as 'Lanning' (Heo et al., 2016), which had 74.3% cutting at Fort Benton and 51% cutting at Havre. MT1809 is moderately tolerant to plant available aluminum, whereas Vida and Dagmar are susceptible to aluminum (Table 4).

Data collected from 29 Off-Station Yield Trials consisting of 22 rainfed and 7 irrigated growing environments during the 2021-2022 growing season allowed for additional comparisons between MT1809 and commonly grown varieties in Montana (Table 5). In irrigated environments, MT1809 was the highest yielding variety and the third highest yielding variety across all environments. Sawfly cutting was analyzed from seven locations where MT1809 was cut 22.7% verses Vida, Dagmar and Lanning that were cut 18.2%, 9.8%, and 32.8%, respectively. Falling numbers were obtained from five off-station environments where MT1809 had a falling number of 393, which was comparable to Dagmar's falling number of 391, and substantially higher than Vida's falling number of 366.

MT1809 was evaluated in several disease screening nurseries for disease ratings. MT1809 is resistant to prevalent races of *P. tritici-repentis* and the predominant North Dakota *Septoria nodorum* isolate (Table 6). MT1809 has a similar level of fusarium head blight

resistance as MT Sidney over three years of testing at the Eastern Ag Research Center (Table 7). MT1809 is susceptible to stripe rust (Table 8) but is resistant to common races of stem rust (Table 9).

End-use quality was tested at six AYT locations grown in 2020 - 2021. Among the 13 lines evaluated, MT1809 had higher mixing tolerance and bake water absorption than Vida and above average loaf volume (Table 10). Mixing tolerance and water absorption was lower than Dagmar. Compared to Vida, MT1809 end-use quality is slightly better.

References:

Heo, H.-Y., Lanning, S. P., Lamb, P. F., Nash, D., Wichman, D. M., Eberly, J., . . . Talbert, L. E. (2020). Registration of 'Dagmar' hard red spring wheat. *Journal of Plant Registrations*, 14(1), 43-48. doi:https://doi.org/10.1002/plr2.20023

Heo, H.-Y., Lanning, S. P., Lamb, P. F., Nash, D., Wichman, D. M., Kephart, K. D., . . . Talbert, L. E. (2016). Registration of 'Lanning' Hard Red Spring Wheat. *Journal of Plant Registrations*, 10(3), 287-290. doi:10.3198/jpr2016.03.0016crc

Lanning, S. P., Carlson, G. R., Nash, D., Wichman, D. M., Kephart, K. D., Stougaard, R. N., . . . Talbert, L. E. (2006). Registration of 'Vida' wheat. *Crop Science*, 46(5), 2315-2316. doi:10.2135/cropsci2006.03.0167

Mergoum, M., Simsek, S., Zhong, S., Acevedo, M., Friesen, T. L., Alamri, M. S., . . . Liu, Z. (2016). 'Elgin-ND' Spring Wheat: A Newly Adapted Cultivar to the North-Central Plains of the United States with High Agronomic and Quality Performance. *Journal of Plant Registrations*, 10(2), 130-134. doi:https://doi.org/10.3198/jpr2015.07.0044crc

Table 1. Grain yield (bu/ac) comparisons between MT1809 and check varieties grown in 24 Advanced Yield Trial (AYT) **rainfed** location-years from 2020 to 2022. Twenty common varieties were grown in all three years and were incluced in the combined analysis. Underlined values indicate varieties were not significantly different from the highest yielding line. Table sorted based on combined means.

Loc.	Bozeman (rain-fed)	Conrad	Fort Benton	Havre	Hingham/ Rudyard	Huntley/ Billings	Moccasin	Sidney (rain-fed)	Williston	Combined Loc/Yr
Year	2020-2022	2021	2020-2022	2020-2022	2021-2022/ 2021	2020-2021/ 2022	2020-2022	2020-2022	2021-2022	N = 24
MT 1939	84.7	54.1	43.3	43.9	27.6	68.1	38.0	50.1	39.9	50.2
MT 1809	**86.1**	**42.8**	**41.2**	**47.9**	**29.8**	**66.0**	**37.2**	**50.2**	**41.5**	**50.1**
NS PRESSER CLP	79.9	50.2	39.2	41.1	29.8	66.7	37.2	51.2	41.3	48.6
VIDA	82.8	44.6	38.7	44.1	27.8	65.9	37.3	49.7	41.0	48.6
DAGMAR	81.9	48.2	38.5	46.6	26.7	63.1	38.5	50.1	38.3	48.4
MT SIDNEY	77.0	46.5	34.9	40.9	26.9	65.0	34.9	46.8	39.2	46.0
WB 9719	80.8	45.1	39.8	40.6	27.2	62.3	29.4	45.9	37.1	45.7
MS RANCHERO	83.2	48.9	34.5	39.7	27.3	58.8	36.6	42.4	35.7	45.4
SY ROCKFORD	83.7	46.9	30.8	40.9	20.8	61.8	35.3	45.4	40.5	45.2
WB 9879 CLP	73.7	50.1	40.6	42.1	24.9	62.0	33.8	42.1	38.0	45.1
LANNING	77.8	46.4	36.6	40.3	24.1	59.0	37.3	45.2	38.0	45.1
DUCLAIR	76.1	38.7	41.8	41.7	22.8	65.2	34.0	39.2	35.4	44.7
CHOTEAU	74.5	43.6	39.7	42.4	22.6	62.2	31.7	43.6	36.6	44.5
REEDER	73.4	47.7	35.4	40.6	25.5	59.0	33.6	47.1	37.8	44.4
WB GUNNISON	71.4	46.0	37.9	42.2	27.9	60.3	34.1	39.9	35.4	44.1
SY LONGMIRE	71.2	43.6	39.2	41.5	22.7	63.2	28.9	42.2	41.1	43.9
MCNEAL	67.8	35.6	37.4	38.4	24.8	60.7	35.8	41.7	37.2	43.0
CORBIN	72.5	46.4	34.6	40.9	25.3	59.1	30.8	39.5	35.0	42.7
SY INGMAR	76.3	41.7	29.7	39.6	21.8	59.4	27.0	46.0	40.8	42.5
SY 611 CL2	72.3	42.3	29.1	37.4	22.7	61.1	31.8	45.0	35.4	42.1
Mean (n=20)	77.4	45.5	37.1	41.6	25.5	62.5	34.2	45.2	38.2	45.5
P value	<0.001	ns	<0.001	<0.001	<0.05	ns	<0.01	<0.001	ns	<0.001
LSD (0.05)	5.9	-	5.1	4.6	4.6	-	5.7	4.0	-	2.1

Table 2. Grain yield (bu/ac) comparisons between MT1809 and check varieties grown in 30 Advanced Yield Trial (AYT) **rain-fed and irrigated** location-years from 2020 to 2022. Twenty common varieties were grown in all three years and were incluced in the combined analysis. Underlined values indicate varieties were not significantly different from the highest yielding line. Table sorted based on combined means.

Loc.	Bozeman (rain-fed)	Conrad	Fort Benton	Havre	Hingham/ Rudyard	Huntley/ Billings	Moccasin	Sidney (rain-fed)	Williston	Bozeman (irrigated)	Kalispell (high rainfall)	Sidney (irrigated)	Combined Loc/Yr
Year	2020-2022	2021	2020-2022	2020-2022	2021-2022/ 2021	2020-2021/ 2022	2020-2022	2020-2022	2021-2022	2022	2021-2022	2020-2022	n = 30
MT 1939	84.7	54.1	43.3	43.9	27.6	68.1	38.0	50.1	39.9	113.7	101.4	84.7	59.1
MT 1809	**86.1**	**42.8**	**41.2**	**47.9**	**29.8**	**66.0**	**37.2**	**50.2**	**41.5**	**112.3**	**90.3**	**87.3**	**58.5**
DAGMAR	81.9	48.2	38.5	46.6	26.7	63.1	38.5	50.1	38.3	105.3	86.3	86.0	56.6
NS PRESSER CLP	79.9	50.2	39.2	41.1	29.8	66.7	37.2	51.2	41.3	105.1	89.2	82.3	56.5
VIDA	82.8	44.6	38.7	44.1	27.8	65.9	37.3	49.7	41.0	107.0	82.3	84.4	56.3
MT SIDNEY	77.0	46.5	34.9	40.9	26.9	65.0	34.9	46.8	39.2	102.4	97.7	82.6	55.0
MS RANCHERO	83.2	48.9	34.5	39.7	27.3	58.8	36.6	42.4	35.7	105.2	94.1	86.7	54.8
WB 9719	80.8	45.1	39.8	40.6	27.2	62.3	29.4	45.9	37.1	113.2	84.8	86.5	54.6
SY ROCKFORD	83.7	46.9	30.8	40.9	20.8	61.8	35.3	45.4	40.5	110.7	93.0	84.0	54.4
DUCLAIR	76.1	38.7	41.8	41.7	22.8	65.2	34.0	39.2	35.4	114.2	92.5	80.0	53.7
SY LONGMIRE	71.2	43.6	39.2	41.5	22.7	63.2	28.9	42.2	41.1	109.8	89.3	87.0	53.4
LANNING	77.8	46.4	36.6	40.3	24.1	59.0	37.3	45.2	38.0	100.0	80.7	82.7	53.1
WB 9879 CLP	73.7	50.1	40.6	42.1	24.9	62.0	33.8	42.1	38.0	107.4	81.2	78.7	53.0
CHOTEAU	74.5	43.6	39.7	42.4	22.6	62.2	31.7	43.6	36.6	109.6	81.6	78.9	52.5
REEDER	73.4	47.7	35.4	40.6	25.5	59.0	33.6	47.1	37.8	96.5	80.8	82.8	52.4
WB GUNNISON	71.4	46.0	37.9	42.2	27.9	60.3	34.1	39.9	35.4	102.2	87.1	77.1	52.2
SY 611 CL2	72.3	42.3	29.1	37.4	22.7	61.1	31.8	45.0	35.4	102.7	84.6	86.4	51.4
SY INGMAR	76.3	41.7	29.7	39.6	21.8	59.4	27.0	46.0	40.8	98.8	82.8	84.0	51.3
CORBIN	72.5	46.4	34.6	40.9	25.3	59.1	30.8	39.5	35.0	101.6	88.8	75.6	51.0
MCNEAL	67.8	35.6	37.4	38.4	24.8	60.7	35.8	41.7	37.2	93.3	78.5	76.7	50.4
Mean (n=20)	77.4	45.5	37.1	41.6	25.5	62.5	34.2	45.2	38.2	105.5	87.3	82.7	54.0
P value	<0.001	ns	<0.001	<0.001	<0.05	ns	<0.01	<0.001	ns	<0.001	ns	ns	<0.001
LSD (0.05)	5.9	-	5.1	4.6	4.6	-	5.7	4.0	-	5.4	-	-	2.2

Table 3. Grain protein content (%) comparisons between MT1809 and check varieties grown in 30 Advanced Yield Trial (AYT) **rain-fed and irrigated** location-years from 2020 to 2022. Twenty common varieties were grown in all three years and were included in the combined analysis. Underlined values indicate varieties were not significantly different from the highest grain protein content value. Table sorted based on combined means.

Loc.	Bozeman (rain-fed)	Conrad	Fort Benton	Havre	Hingham/ Rudyard	Huntley/ Billings	Moccasin	Sidney (dry)	Williston	Bozeman (irrigated)	Sidney (irrigated)	Kalispell (high rainfall)	Combined Loc/Yr
Year	2020-2022	2021	2020-2022	2020-2022	2021-2022/ 2021	2020-2021/ 2022	2020-2022	2020-2022	2021-2022	2022	2020-2022	2021-2022	n = 30
SY INGMAR	15.3	14.3	16.5	15.4	16.1	15.7	17.4	14.9	15.5	15.2	14.6	11.3	15.4
LANNING	15.5	13.0	16.1	15.4	16.2	15.8	15.8	15.2	15.8	15.6	15.3	11.2	15.3
WB 9879 CLP	15.2	13.2	16.0	15.6	15.9	15.2	16.5	15.2	16.1	14.7	14.5	10.6	15.2
DAGMAR	15.5	14.5	15.7	15.5	15.9	15.4	15.8	15.0	15.2	15.7	15.1	10.7	15.1
SY 611 CL2	15.1	13.9	16.0	15.1	15.8	15.1	15.9	15.3	16.0	15.2	14.5	10.6	15.0
MCNEAL	15.3	13.1	15.3	15.0	15.9	15.3	15.5	15.3	15.7	16.2	15.0	10.9	15.0
SY LONGMIRE	14.7	13.5	16.0	15.3	16.1	15.2	17.0	14.9	15.4	14.4	14.3	10.6	15.0
CHOTEAU	14.7	13.4	16.1	15.3	15.7	15.1	16.3	14.8	16.7	14.5	14.7	10.3	15.0
MT 1809	**15.4**	**12.9**	**15.4**	**15.1**	**15.9**	**15.2**	**15.8**	**15.0**	**15.6**	**15.6**	**14.5**	**10.5**	**14.9**
REEDER	15.3	12.9	15.5	15.0	15.3	15.0	15.8	14.9	15.8	15.5	14.7	11.1	14.9
CORBIN	14.5	13.7	15.3	15.6	15.6	14.8	16.3	14.8	16.3	14.9	14.8	10.1	14.9
DUCLAIR	14.4	13.9	15.0	15.5	15.8	14.8	15.7	14.7	16.5	14.1	14.4	10.6	14.8
MT SIDNEY	14.8	13.3	15.6	15.4	15.5	14.5	15.8	14.7	15.4	15.0	14.3	10.9	14.8
SY ROCKFORD	14.6	13.9	15.4	15.2	15.7	14.9	15.9	14.8	14.7	14.0	14.2	11.2	14.7
WB 9719	14.5	12.5	15.2	14.8	14.9	14.7	16.3	14.6	15.3	14.0	14.1	10.5	14.5
NS PRESSER CLP	15.1	12.9	15.6	14.8	14.8	15.0	15.6	14.2	14.9	15.0	13.9	10.6	14.5
MT 1939	14.6	13.3	15.3	14.9	14.6	14.5	15.4	14.0	15.5	14.8	14.2	11.0	14.5
VIDA	14.4	12.9	14.9	14.7	14.8	14.6	15.5	14.0	15.4	14.5	14.1	10.4	14.3
WB GUNNISON	14.1	12.5	14.7	14.5	14.8	14.4	15.6	14.3	15.3	13.8	13.9	10.6	14.2
MS RANCHERO	14.3	13.3	15.1	14.7	14.2	14.6	15.2	13.9	15.4	14.1	13.8	10.3	14.2
Mean (n=20)	14.9	13.4	15.5	15.1	15.5	15.0	15.9	14.7	15.6	14.8	14.4	10.7	14.8
P value	<0.001	ns	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	ns	ns	<0.001	ns	<0.001
LSD (0.05)	0.6	-	0.9	0.3	1.0	0.7	1.0	0.6	-	-	0.7	-	0.2

Table 4. Agronomic trait comparisons between MT1809 and check varieties grown in 30 Advanced Yield Trial (AYT) rain-fed and irrigated location-years from 2020 to 2022. Twenty common varieties were grown in all three years and were included in the combined analysis. Underlined values indicate varieties were not significantly different from the optimum value. After MT1809, the table was sorted alphabetically based on variety name.

	Test weight (lb/bu)	Heading date (julian)	Plant height (inch)	Stem solidness[a] (5-25)	Sawfly cutting (%) (Fort Benton, 21-22)	Sawfly cutting (%) (Havre, 21-22)	Aluminum Tolerance[b] (Rockford, WA 20,22)
Environments	29	20	29	3	2	2	2
MT 1809	**59.5**	**177.7**	**28.0**	**12.5**	**36.9**	**23.2**	**MT**
CHOTEAU	59.9	177.8	27.7	21.7	20.0	7.0	T
CORBIN	60.7	175.9	27.8	13.3	24.7	6.5	S
DAGMAR	60.8	175.5	28.7	19.4	23.9	2.7	S
DUCLAIR	59.3	175.8	27.9	20.0	19.8	3.9	MT
LANNING	59.7	175.9	26.8	7.9	74.3	51.0	T
MCNEAL	59.3	179.3	29.1	7.7	76.4	40.4	T
MS RANCHERO	59.9	176.4	28.5	8.3	67.9	35.4	S
MT 1939	60.3	176.7	27.5	20.4	26.4	27.0	T
MT SIDNEY	60.7	176.7	28.1	9.7	68.6	18.1	S
NS PRESSER CLP	58.9	180.5	29.7	7.7	69.8	22.6	S
REEDER	60.3	178.1	28.7	7.3	56.6	42.9	T
SY 611 CL2	60.8	177.0	25.6	9.3	70.1	48.4	S
SY INGMAR	60.7	177.9	26.8	8.6	61.1	36.9	S
SY LONGMIRE	60.9	177.5	27.2	20.3	27.2	14.0	T
SY ROCKFORD	59.2	179.6	27.7	8.2	74.4	48.0	T
VIDA	59.9	178.6	28.4	13.3	26.7	14.6	S
WB 9719	62.3	179.3	26.7	6.6	61.4	50.7	-
WB 9879 CLP	60.1	178.3	27.6	23.0	11.3	2.1	T
WB GUNNISON	60.7	177.7	26.8	12.7	22.1	3.4	S
Mean (n=20)	60.2	177.6	27.8	12.9	46.0	24.9	
P value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
LSD (0.05)	0.4	0.6	0.6	1.7	27.8	18.9	

[a]5 = hollow stem, 25 = solid stem

[b]T = Tolerant, MT = Mostly Tolerant, S = Susceptible (Dr. Mike Pumphery, WSU, Pullman, WA)

Table 5. Yield and agronomic comparisons of MT 1809 with elite varieties grown in 29 Spring Wheat **Off-Station Yield Trial** location-years from 2021 to 2022. Varieties were grown in 22 rainfed and 7 irrigated environments. Twelve common varities were grown both years and were included in the analysis. Underlined values indicate values not significantly different from the optimum value. The table was sorted based on combined yield means.

	YIELD (bu/ac)			TEST WEIGHT (lb/bu)			GRAIN PROTEIN (%)			HEADING DATE (Julian)			HEIGHT (Inches)			SAWFLY CUT (%)	FALLING NUMBER		
Environments	22	7	29	22	7	29	22	7	29	4	1	5	22	7	29	9	4	1	5
Line/Variety	RAINFED	IRRI	TOTAL	RAINFED	IRRI	TOTAL	RAINFED	IRRI	TOTAL	RAINFED	IRRI	TOTAL	RAINFED	IRRI	TOTAL	TOTAL	RAINFED	IRRI	TOTAL
MT 1939	35.1	89.0	48.1	57.6	60.4	58.3	15.7	13.9	15.3	177.7	164.6	175.1	23.5	32.7	25.7	14.2	367	375	369
DAGMAR	34.4	87.0	47.1	58.6	61.0	59.1	16.2	14.5	15.8	177.5	163.0	174.6	24.2	33.8	26.5	9.8	401	363	391
MT 1809	**32.6**	**89.1**	**46.2**	**56.8**	**60.0**	**57.6**	**16.5**	**14.4**	**16.0**	**178.6**	**164.8**	**175.8**	**23.4**	**33.0**	**25.7**	**22.7**	**407**	**348**	**393**
VIDA	32.3	86.1	45.3	57.6	60.0	58.2	15.6	14.2	15.3	179.2	165.9	176.5	23.9	33.6	26.2	18.2	372	348	366
MT SIDNEY	31.4	86.1	44.6	58.0	60.7	58.7	16.0	14.0	15.5	178.1	164.3	175.4	24.4	33.2	26.5	24.0	414	357	400
LANNING	31.6	84.4	44.4	57.0	60.5	57.8	16.4	14.8	16.0	176.5	162.4	173.7	22.9	32.0	25.1	32.8	383	357	376
DUCLAIR	31.5	82.9	43.9	56.7	59.7	57.4	16.2	14.3	15.8	177.5	163.5	174.7	23.8	33.0	26.0	10.0	357	357	357
REEDER	29.1	87.3	43.1	57.9	61.3	58.7	16.2	14.7	15.8	179.0	165.6	176.3	24.1	34.9	26.7	30.3	375	358	371
SY SOREN	29.8	85.1	43.1	57.7	61.3	58.6	16.7	14.5	16.2	178.4	165.4	175.8	22.6	31.0	24.6	25.1	443	359	422
NS PRESSER CLP	30.9	81.5	43.1	56.7	59.3	57.3	15.8	14.2	15.4	180.8	167.1	178.0	24.4	34.1	26.8	24.8	397	335	381
BRENNAN	29.6	82.0	42.2	58.7	61.9	59.4	16.3	14.5	15.9	177.4	164.6	174.8	22.4	30.7	24.4	26.8	418	376	408
SY INGMAR	29.3	82.5	42.1	57.9	60.9	58.6	16.6	14.5	16.1	179.3	166.8	176.8	22.8	32.0	25.0	27.5	412	354	397
Mean(n=12)	31.5	85.2	44.4	57.6	60.6	58.3	16.2	14.4	15.7	178.3	164.8	175.6	23.5	32.8	25.8	22.2	395	357	386
P value	<0.001	ns	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001
LSD (0.05)	2.2	-	2.2	0.7	1.1	0.6	0.2	0.5	0.2	1.3	-	1.1	0.7	1.6	0.6	10.1	28	-	27

Table 6. 2021 Fungal leaf spot evaluation of MT1809 compared to other regionally adapted varieties (Dr. Zhaohui Liu, NDSU, Fargo, ND).

Line	Ptr ToxA[1]	Ptr Race 1[2]	Ptr Race 5[2]	Sn4[3]
MT 1809	**0**	**2**	**2**	**2.5**
BRENNAN	0	2.5	2	2.5
SY SOREN	0	2	1	2.5
CHOTEAU	0	2.5	3.5	0.5
CORBIN	1	4.5	3	4.5
DAGMAR	0	2	4	0.5
DUCLAIR	0	3.5	3.5	0.5
LANNING	0	1.5	4	2
MCNEAL	0	1	1	1
MS RANCHERO	0	1.5	2	4
NS PRESSER CLP	1	2.5	1.5	3.5
REEDER	1	2	4.5	3.5
SY INGMAR	1	3.5	3.5	3
SY ROCKFORD	0	1.5	1	3.5
VIDA	0	2	1	2
WB 9879 CLP	0	4	2	1
WB GUNNISON	1	3.5	2.5	3.5
MT SIDNEY	0	2	4	0.5
MT 1939	0	3.5	3.5	0.5
Salamouni (check)	0	1.5	1	1
Glenelea (check)	1	4	2.5	4

[1]*P. tritici-repentis* (Ptr) ToxA: 0=insensitive; 1=sensitive, ND=no

[2]Evaluation with Ptr races 1 (predominant in North Dakota) and 5 using a 0-5 scale, 1,2=resistant, 3=moderately susceptible, 4, 5=highly susceptible, ND=no data.

[3]Evaluation with *Septoria nodorum* isolate Sn4 (predominant in North Dakota) using 0-5 scale, 0-2=resistant, 3=moderately susceptible, 4,5=highly susceptible.

Table 7: Fusarium head blight (FHB) resistance of MT1809 compared to other regionally adapted control varieties evaluated in Sidney, MT from 2019 to 2022. Table sorted based on DON values. (Dr. Frankie Crutcher, MSU-EARC, Sidney, MT)

Variety	% Severity[a]	% Incidence[b]	Disease Index[c]	% FDK[d]	DON (ppm)
2019					
MT Sidney	21.7 C	74.4	17.4 C	4.7 C	2.5 B
MT 1809	**23.2 C**	**73.3**	**17.9 C**	**5.3 C**	**3.5 B**
Vida	37.1 BC	82.2	30.6 BC	6.7 BC	5.9 AB
Lanning	46.4 B	87.8	40.7 BC	15.0 B	6.9 AB
Dagmar	50.4 B	91.1	46.7 AB	15.0 B	9.3 A
McNeal	72.2 A	98.9	71.4 A	38.3 A	10.5 A
Mean	41.9	84.6	37.4	14.2	6.5
***P* value**	<0.0001	0.24	0.0001	<0.0001	0.0007
HSD (0.05)	20.4	37.8	25.596	8.8	4.8
2020					
SY Ingmar	1.1 C	6.7 D	0.1 B	4.0 C	0.7 B
MT 1809	**1.7 C**	**18.9 CD**	**0.4 B**	**3.3 C**	**0.8 B**
MT Sidney	1.2 C	15.6 CD	0.2 B	3.3 C	0.8 B
Reeder	3.2 BC	25.6 B-D	0.8 B	4.7 C	1.6 B
Dagmar	7.9 BC	50.0 AB	4.0 B	5.3 C	2.0 B
Vida	5.2 BC	34.4 B-D	2.0 B	6.0 C	2.7 AB
Lanning	7.4 BC	51.1 AB	4.1 B	7.3 BC	3.9 AB
McNeal	33.9 A	78.9 A	26.9 A	18.3 A	4.1 AB
MT 1939	10.2 B	38.9 BC	4.1 B	14.3 AB	6.7 A
Mean	8	35.6	4.7	7.4	2.6
***P* value**	<0.0001	<0.0001	<0.0001	<0.0001	0.002
HSD (0.05)	8	30.9	7.3	7.6	4.4
2021					
Vida	12.9 B-D	46.7 AB	6.1 B	0.3 B	0.2 B
MT 1809	**4.8 CD**	**26.7 B**	**2.2 B**	**0.5 B**	**0.3 AB**
Lanning	8.3 B-D	46.7 AB	4.0 B	1.3 B	0.3 AB
MT Sidney	11.8 B-D	45.6 B	5.5 B	3.3 B	0.4 AB
SY Ingmar	2.9 D	31.7 B	0.9 B	0.5 B	0.5 AB
Dagmar	13.7 B-D	55.6 AB	7.6 B	1.7 B	0.7 AB
Reeder	15.5 BC	53.3 AB	8.2 B	1.7 B	1.1 AB
MT 1939	18.6 B	56.7 AB	10.9 B	1.0 B	1.6 AB
McNeal	30.0 A	75.6 A	22.9 A	11.7 A	2.5 A
Mean	13.7	50	8	2.7	0.8
***P* value**	<0.0001	0.0036	<0.0001	<0.0001	0.0495
HSD (0.05)	9.8	29.5	9.2	5.7	2.3
2022					
MT Sidney	28.1 C	90	25.2 C	48.3	7.3 B
MT 1809	**33.0 BC**	**94.4**	**31.3 BC**	**33.3**	**10.6 B**
SY Ingmar	34.8 BC	91.1	31.9 BC	38.3	15.4 AB
Dagmar	42.3 A-C	96.7	40.9 A-C	37.5	17.1 AB
Reeder	48.8 A-C	100	48.8 A-C	48.3	18.6 AB
Vida	42.2 A-C	94.4	40.3 A-C	45	19.2 AB
McNeal	68.1 A	97.8	66.6 A	60	28.8 AB
MT 1939	58.2 AB	100	58.2 AB	60	36.3 A
Lanning	44.7 A-C	100	44.7 A-C	45	38.8 A
Mean	43	96.1	41.6	42.9	19.5
***P* value**	0.0019	0.05	0.0017	0.3736	0.003
HSD (0.05)	27	14.1	28.3	42.5	28.4

Letters in common were not statistically different according to a Tukey's HSD test ($P<0.05$).

[a]Severity: Average percent area of head covered by disease. Thirty heads were evaluated for

[d]Fusarium damaged kernels

Table 8. 2022 spring wheat stripe rust (*Puccinia striiformis*) evaluation under natural infection, 2022 (Dr. Xianming Chen, USDA-ARS, Pullman, WA).

Location	Pullman, WA		Mt. Vernon, WA[b]				Central Ferry, WA	
Observation Date	7/5		5/19		6/27		6/23	
Growth Stage	Fks 10.54		Fks 2		Fks 10.54		Fks 10.5	
InfectionType (IT)[a]/Severity(%)	IT	%	IT	%	IT	%	IT	%
MT 1809	**8**	**70**	**8**	**30**	**8**	**70**	**8**	**40**
CHOTEAU	8	70	8	20	3,8	50,80	8	40
CORBIN	5	60	8	10	8	90	8	30
DAGMAR	3	30	8	30	8	80	5	40
DUCLAIR	7	70	8	30	7	80	8	80
LANNING	7	70	8	20	7	80	8	40
MCNEAL	8	60	8	20	9	100	9	90
MS Ranchero	3	30	8	20	2	10	2	10
MT 1939	7	70	8	20	8	80	8	80
MT SIDNEY	8	50	8	20	8	80	8	50
NS PRESSER CLP	8	80	8	30	6	70	8	40
REEDER	8	80	8	20	8	90	2	15
SY 611 CL2	3	30	8	30	9	90	8	30
SY INGMAR	8	80	8	30	8	90	2	10
SY Longmire	8	80	7	30	9	90	5	40
SY ROCKFORD	8	80	8	10	8	90	8	80
VIDA	8	60	3	20	5	60	2	10
WB 9879 CLP	3	30	8	20	3	20	8	60
WB GUNNISON	8	80	8	20	8	90	2	15

[a] Infection Type (IT) was recorded based on the 0-9 scale with ITs 8 and 9 combined as 8 (the most susceptible reaction) in field data. Generally IT 0-3 are considered resistant, 4-6 intermediate, and 7-9 susceptible. Heterogenous reactions of an entry were indicated by two or more ITs separated by "," for most plants with the first IT and few plants with the second IT or connected with "-" for entries containing plants with continuous ITs.

[b] Entries with a high IT in the first note, but a low IT in the second note at Mt. Vernon may indicate the lines have high-temperature, adult-plan (HTAP) resistance.

Table 9. 2021 hard red spring wheat uniform regional nursery seedling and field stem rust (*Puccinia graminis*) scores. (Matthew Rouse, USDA-ARS, St. Paul, MN).

	Race (Seedling Scores)[a]									
Line	QFCSC 06ND76C	QTHJC 75ND717C	MCCFC 59KS19	RCRSC 77ND82A	RKRQC 99KS76A-1	TPMKC 74MN1409	TTTTF 01MN84A-1-2	GFMNC 12WA147-2	QCCSM 75WA165-2A	Adult plant stem rust[b]
MT1809	**0;**	**2-**	**2-;**	**;2-**	**2**	**2-**	**;1**	**;2-**	**;2-**	**5R-MR**
Marquis	2-	22+	4	3+	-	3+	23	2+	2	60MS-S
Chris	0	1+	0;	;	-	3-	;	0	0	30MS
Prosper	0;	2-	;1-	;2-	2-	2-	;1	;	;2-	30R-MR
Linkert	;	;2-	;2-	;	2-	2-	;;;1?	;2-	2-	5R-MR
Boost	;	2-	;	2-	2	2-	;1/2	0;	;2-	60MR-MS
MTSidney	;	2	2-;	2-;	2	2-	;1	;	2-;	10R-MR
MT1939	;	2-	;2-	2-	2	2-	1;	;2-	;1-	5R-MR
MT1855	1;	2-	2-	2-	2-2	2	2	2-;	12-	30MS-S
MT1927	;2-	2-	2-;	2-	2	2-	2	2-;	2-;	5MR
Line E (check)	4	4	4	4	4	4	4	4	4	100S
LMPG-6 (check)	3	3-	3+	3	4	3	3	3	3+	90S
NA101/MqSr7a (check)	13c	3+	3+	13	1+3-	4	;1	23c	1+3-	60MS-S

[a]Seedling rating scale: 0 to 4 infection type scale where 3 - 4 considered susceptible; "/" denotes hetergeneous, the predominant type given first; "LIF" denotes low infection frequency, or fewer number of pustules; "C" stands for excessive chlorosis; "N" stands for excessive necrosis; "Sr2M" referred to seedling chlorosis, similar to Sr2 expression in seedling under certain environments.

[b]Field stem rust nusery was inoculated with a bulk of 5 races: QFCSC (95MN1080), QTHJC (69MN399), RCRSC (00MN99C), RTQQC (04MN74-1), and TMPKC (74MN1409). Stem rust disease severity (estimated % of stem tissue covered by rust pustules) and infection responses (R, MR, MS, and S) were noted at growth stages between milk and soft dough.

Table 10. Combined analysis of end-use quality between MT1809 and check varieties grown in six Advanced Yield Trial (AYT) location-years from 2020 to 2021. End-Use quality samples were from Bozeman, MT (2020-2021), Havre, MT (2020), Moccasin (2020) and Sidney, MT (2020-2021). Thirty-one entries were common in all locations and used in the combined analysis. Underlined values indicate values that were not significantly different from the optimum value. After MT1809, the table was sorted alphabetically based on variety name.

Variety/Line	Flour yield (%)	Flour protein (%, 14% m.b.)	Mixing tolerance	Mixo mixing time (min.)	Mixo water absorption (%)	Bake mix time (min.)	Bake water absorption (%)	Loaf volume (cc)
MT 1809	**71.2**	**12.9**	**2.3**	**2.8**	**67.3**	**5.1**	**77.0**	**1110**
CHOTEAU	71.0	13.1	1.5	3.2	67.5	6.1	76.9	1120
CORBIN	71.3	12.6	2.2	5.1	66.0	11.4	75.8	996
DAGMAR	70.1	13.2	2.8	3.7	67.9	7.3	78.0	1098
DUCLAIR	70.3	12.8	3.2	3.9	67.0	8.6	77.1	1117
LANNING	70.3	13.6	2.8	4.1	68.8	9.1	79.8	1162
MCNEAL	69.1	12.8	3.8	6.4	69.5	**14.6**	80.4	1140
MT 1939	69.5	12.8	2.8	3.6	67.5	8.4	78.0	1059
MT SIDNEY	70.8	13.0	1.8	4.4	66.6	10.1	77.0	1086
REEDER	69.4	13.1	1.8	3.0	65.1	5.6	75.2	1101
SY INGMAR	70.9	13.7	3.5	5.1	67.5	12.5	78.9	1148
VIDA	72.1	12.3	1.7	3.2	66.8	6.8	76.0	1097
WB 9879 CLP	69.1	13.5	2.0	2.5	66.7	3.8	75.8	1036
MEAN (n=31)	70.2	13.0	2.8	4.3	67.3	9.4	77.7	1091
P value	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001
LSD (0.05)	1.3	0.7	1.0	1.4	2.6	4.0	2.9	85