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MEMORANDUM

TO: Wheat Cultivar Release & Recommendation Committee

FROM: Phil Bruckner, Winter wheat breeder

DATE: January 6, 2005

RE: Proposal for protected MSU public (F.2.b) cultivar release of MT00159 HRWW

The following motion and supporting documentation is presented for consideration at the 2005 Cultivar Release and Recommendation Meeting in Bozeman:

MT00159

Motion: That MT00159 hard red winter wheat (HRWW) be approved for release in 2005.

Pedigree: Promontory/Judith

Recommendation: Protected MSU Public Release (F.2.b). Joint release with NDSU.

Potential names: To be named prior to Foundation seed release. No great names agreed on yet.

Selection history: MT00159 originated from crosses 93X542 (Promontory/Judith) and 93X543 (Judith-dwf/Promontory) made in 1993. The F₁ populations were grown in the field in 1994. A composite of F₂ seed of the two closely related populations was made and planted as an F₂ space-planted population (93X542c) at Fort Ellis in 1995. The F₃ bulk population was planted at Sidney in 1996. Survival of F₃ populations at Sidney in 1996 was extremely low and only seven plants were harvested from 93X542c. In 1997, the seven F₃-derived F₄ plant rows were grown in Bozeman and 93X542cC6 was selected based on visual criteria for uniformity, productivity, and acceptable agronomic type and harvested in bulk after reselection of seven individual heads from the row. [The 93X542cC6 selection was designated MT9982. MT9982 was tested from 1999 through 2003 and increased for release before being discarded in favor of MT00159 in 2004]. F₅ reselection headrow 93X542cC6-6 was selected at Fort Ellis in 1998 and harvested in bulk. 93X542cC6-6 was subsequently tested in the 1999 Single Rep Observation Nursery B (SROB) grown at Bozeman and Fort Ellis. In 2000, 93X542cC6-6 was designated MT00159 and tested in the Preliminary B trial at four locations (2 loc-harvested). In 2001, MT00159 was tested in the MT Advanced trial at six locations (5 loc-harvested). From 2002 through 2004, MT00159 was evaluated in the Montana Intrastate trial planted at eight locations (total 22 LY) and from 2003 through 2004, MT00159 was tested in Montana Off-station nursery planted at 12-14 on-farm locations (total 22 LY). Quality has been evaluated in multi-location Montana trials since 2000. In 2004, MT00159 was an entry in the USDA Northern Regional Performance Nursery (NRPN) planted at approximately 20 sites across the Northern Great Plains.

Purification/seed stocks: The increase of MT00159 was initiated in 2002. A set of 99 F₈-derived F₉ headrows was grown at Fort Ellis with selection for height, maturity, and visual uniformity. In 2003, 84 4-row line row

plots of MT00159 were grown at the Post farm with 28 variable and/or variant line rows being discarded. A 2003 note to myself indicates that there was a lot of height variability within line rows but that all line rows had similar variability. Remaining line rows with uniform appearance were harvested in bulk. In 2004 breeder seed of MT00159 was increased at the Post Farm. Plants rogued from the breeder seed increase included variant plants taller in height, awnless, and red chaffed (16, 2, 67 in 1.56A, <0.1% total variants). MT00159 is planted at Williston, ND (12A), Sidney (6A irr.), and Moccasin (13A) for 2005 Foundation seed production.

Table 1. Description of nurseries and data sets describing the performance of MT00159 in Montana, 2000-2004.

Year	Trial	Loc. planted	Loc. harvested	Loc. For Quality Eval.
2000	Preliminary B	4	2	2
2001	Advanced	6	5	4
	Combined data set			
2002	Intrastate	8	6	4
2003	Intrastate	8	8	4
2003	Off-station	14	12	0
2004	Intrastate	8	8	4 pending
2004	Off-station	14	10	0

Description: MT00159 is a very high-yielding, winter hardy HRW wheat line with medium test weight, maturity, height, and grain protein. MT00159 has excellent baking quality and good Asian noodle quality. The line is moderately resistant to TCK smut and stripe rust. MT00159 potentially could occupy acreage currently planted to Neeley, Tiber, CDC Falcon, Paul, Promontory, and Morgan.

Table 2. Mean performance of MT00159 in the 2000 Preliminary B nursery at two locations.

2000 Preliminary B	Grain yield	Test weight	Heading date	Plant height	Grain protein	Flour yield	Flour ash	Bake absorptior	Loaf volume
	bu/ac	lb/bu	days	inch	%	%	%	%	cc
Judith	89.6	60.1	157.5	37.7	14.1	69.4	0.37	72.6	1098
MT00159	88.3	60.7	161.3	32.2	14.2	68.8	0.38	73.1	1035
Neeley	87.5	60.8	161.8	34.8	14.1	66.7	0.36	71.2	1003
Rampart	80.8	61.3	158.7	35.3	14.8	67.7	0.37	73.0	1075
Morgan	80.6	60.5	163.9	35.8	14.3	63.8	0.36	67.3	1025
Isd 5%	ns	0.6	2.2	ns	ns	1.7	ns	3.4	ns
# env.	2	2	3	2	2	2	2	2	2
cv %	8.5	0.4	0.7	4.5	4.4	0.9	5.0	1.7	3.0

Table 3. Mean performance of MT00159 in the 2001 Montana Advanced nursery at five locations.

2001 Advanced	Grain yield	Test weight	Heading date	Plant height	Grain protein
	bu/ac	lb/bu	days	inch	%
Neeley	40.3	59.2	165.1	22.1	14.7
MT00159	38.8	58.9	162.8	23.0	14.4
Morgan	38.0	59.0	165.2	23.1	14.9
Judith	37.3	58.2	160.0	22.5	14.7
MT0097	37.3	60.0	163.0	21.3	14.9
Genou	37.1	59.1	163.1	21.9	15.2
Rampart	34.0	59.5	163.4	22.0	15.8
Isd 5%	ns	ns	1.6	1.1	0.6
# env.	5	5	5	5	5
cv %	10.1	1.5	0.8	3.9	3.0

Table 4. Mean performance of MT00159 in end-use quality evaluations of grain from the 2001 Montana Advanced nursery at four locations.

2001 Advanced	Flour yield	Flour ash	Bake absorption	Loaf volume	L0	L24	Noodle score	Hardness	Chewiness	Hardness	Chewiness
	%	%	%	cc				0 min	0 min	5 min	5 min
Rampart	65.3	0.34	73.6	1213	84.4	73	283	1547	778	1196	557
Genou	65.2	0.34	72.4	1185	83.9	72.8	286				
MT0097	68.0	0.38	72.6	1166	84.7	75.1	321	1530	754	1230	532
MT00159	65.8	0.37	73.3	1119	85.2	75.9	329	1588	806	1243	565
Judith	66.7	0.37	73.0	1110							
Morgan	64.0	0.37	70.7	1104							
Neeley	63.2	0.36	71.7	1104	85.7	76.1	328	1602	804	1259	558
Isd 5%	1.7	ns	1.5	74	0.8	1.2	23	ns	ns	ns	ns
# env.	4	4	4	4	4	4	4	4	4	4	4
cv %	1.7	5.8	1.4	4.3	0.6	1.0	4.9	4.0	5.4	4.3	5.6

Table 5. Mean performance of MT00159 in the 2002-04 Montana Intrastate and the 2003-04 Montana Off-station yield nurseries (44 location-years).

2002-04 Combined	Grain yield	Test weight	Heading date	Plant height	Grain protein	Winter survival
	bu/ac	lb/bu	days	inch	%	%
MT00159	65.5	59.2	164.4	32.9	13.2	51.0
Pryor	63.0	59.0	165.4	30.4	12.9	41.8
Promontory	60.8	61.0	162.6	32.0	13.0	37.6
Neeley	60.2	59.3	165.3	33.4	13.4	43.7
MT0097	59.9	59.6	165.0	32.2	13.4	52.2
Falcon	59.9	59.5	162.9	29.2	13.0	55.0
Paul	59.9	58.2	164.8	30.9	13.2	49.8
Jerry	58.6	59.4	164.3	34.9	13.4	58.7
Morgan	57.3	59.2	166.0	33.6	13.2	57.7
Isd 5%	2.1	0.5	0.7	0.6	0.3	7.0
# env.	44	43	26	44	43	9
cv %	8.3	1.9	0.8	4.6	4.5	15.0

Table 6. Mean performance of MT00159 in quality evaluations of grain from the 2002-03 Montana Intrastate nurseries (8 location-years).

2002-04 Combined	Flour yield	Flour ash	Bake absorption	Loaf volume	L0	L24	Noodle score	Hardness	Chewiness	Hardness	Chewiness
	%	%	%	cc				0 min	0 min	5 min	5 min
Paul	62.8	0.38	71.4	1148	84.4	74.0	249	1549	768	1237	547
MT0097	67.0	0.39	71.7	1119	84.4	74.1	250	1583	780	1277	546
MT00159	65.1	0.40	74.9	1118	84.9	75.2	268	1676	855	1315	612
Falcon	61.8	0.40	71.9	1100							
Promontory	65.2	0.37	71.4	1099	84.7	76.1	289	1550	746	1198	508
Neeley	63.4	0.38	72.3	1084	84.6	74.8	264	1606	783	1271	523
Pryor	64.9	0.38	70.5	1062							
Jerry	65.8	0.38	72.4	1058							
Isd 5%	1.2	ns	1.7	45	ns	0.6	8	77	51	57	42
# env.	8	8	8	8	8	8	8	8	8	8	8
cv %	1.9	7.5	2.3	4.1	0.5	0.8	3.1	4.7	6.3	4.5	7.4

Table 7. Mean performance of MT00159 in six Montana Cropping Districts (44 location-years). Data compiled from the 2002-04 Montana Intrastate and the 2003-04 Montana Off-station yield nurseries.

Grain Yield, 2002-04 bu/acre	Overall	District 1	District 2	District 3	District 4	District 5	District 6
MT00159	65.5	111.0	112.6**	62.0**	50.4**	60.6**	58.1
Pryor	63.0	103.3	106.2	61.8	49.6	58.1	51.9
Promontory	60.8	103.1	112.2	56.5	50.1	55.8	47.8
Neeley	60.2	98.0	104.4	57.7	45.9	56.3	53.0
MT0097	59.9	102.1	107.5	54.8	43.8	57.3	54.6
Falcon	59.9	96.9	103.1	54.9	47.2	58.2	52.3
Paul	59.9	91.1	108.5	57.6	45.6	56.5	51.6
Jerry	58.6	90.9	100.4	52.6	46.1	57.3	55.4
Morgan	57.3	93.6	96.7	52.0	43.2	54.8	56.5
Isd 5%	2.1	ns	7.9	4.2	2.4	2.9	ns
# env.	44	3	3	13	9	10	6
cv %	8.3	8.1	4.3	9.6	5.4	5.8	9.9

Characteristics/comparisons:

Yield. In 44 location-years (LY) of testing in the Montana Winter Wheat Intrastate and Off-station nurseries average yield of MT00159 (65.5 bu/a) was statistically higher than that of all other lines (Tables 5, 7). The line had the highest statewide yield in each of the past three years in the Montana Intrastate trial (data not shown). Yield of MT00159 was 4%, 8%, 9%, and 9% higher than high-yielding cultivars, Pryor, Promontory, Neeley, and CDC Falcon, respectively, over this 3 year period. MT00159 is broadly adapted and winter hardy, producing the highest mean yield of tested lines in all cropping districts. MT00159 also yielded well in the 2000 Preliminary B and 2001 Advanced nurseries (Tables 2, 3).

Test weight. Test weight of MT00159 (59.2 lb/bu) over 43 LY was lower than the test weight of Promontory, similar to the test weights of CDC Falcon, Jerry, Neeley, Morgan, and Pryor, and higher than the test weight of Paul (Table 5).

Winter survival. Based on nine environments where differential winter survival occurred, MT00159 exhibits good winter survival similar to CDC Falcon and Paul (Table 5). Winter survival of MT00159 was less than that of Jerry and Morgan but superior to survival of Neeley, Pryor, and Promontory in these environments.

MT00159 is of **medium maturity**, heading about the same date as Paul and Jerry (Tables 5).

Plant height. MT00159 is similar in height to Neeley, averaging 33 inches (Table 5, 44 LY). MT00159 is taller than CDC Falcon, Pryor, Paul, and Promontory, and shorter than Jerry and Morgan. Straw strength of MT00159 is excellent with no cases of significant lodging occurring in 44 trials (Table 8).

Maximum **coleoptile length** of MT00159 is medium (~3.0 inches), similar to Jerry, Paul, CDC Falcon, and Judith (Table 8).

Grain protein content of MT00159 is medium, similar to Paul and Morgan (Table 5), but lower than that of Rampart and Genou (Table 3).

End-use quality. Based on experimental milling using a Brabender Automat Mill, flour yield of MT00159 is medium to high, similar to that of Judith and Rampart (Tables 2, 4, 6). **Baking qualities** of MT00159 are within acceptable ranges with relatively high water absorption and excellent loaf volume similar to Rampart, Genou, and Paul (Tables 4,6). MT00159 has good potential for Asian noodle products (Table 4,6) with noodle brightness (L24) and noodle scores similar to Neeley. Noodles made from MT00159 are harder and chewier

than noodles made from other cultivars (Table 6).

Table 8. Coleoptile length and lodging of MT00159 in 2002 to 2004 Montana trials.

	2002 2003 2004 3 yr. Boz. Boz. Boz. mean coleoptile length				2002 2003 2004 2004 Boz. 3880 3880 Kal. Lodging			
	inch				0-9 scale	0-9 scale	0-9 scale	index
Rampart	4.7	4.1	3.6	4.1	-	7.3	2.0	1.2
Neeley	3.5	3.2	3	3.2	0.0	0.0	3.0	1.7
Jerry	3.2	2.9	2.6	2.9	0.3	0.0	2.3	29.3
Paul	3.2	2.8	2.5	2.8	1.7	3.7	1.7	58.8
MT0097	3.0	2.8	2.5	2.8	0.0	0.3	0.0	56.8
Falcon	2.9	2.9	2.4	2.7	0.1	2.0	0.0	-2.5
Judith	3.3	2.6	2.3	2.7	0.4	0.0	-	1.7
MT00159	3.2	2.5	2.4	2.7	0.0	0.0	2.0	-1.4
Pryor	3.2	2.6	2.3	2.7	0.0	0.0	0.0	-0.4
Promontory	2.8	2.7	2.2	2.6	0.0	0.3	1.7	5.4
Morgan	2.6	2.3	2.1	2.3	0.6	0.0	0.0	24.7
LSD(5%)	0.6	0.2	0.4	0.2	1.5	2.7	ns	30.3
CV %	8.5	4.1	8.3	5.1	116.0	84.8	169.4	134.6

0=none 0=none 0=none
9=100% 9=100% 9=100%

Table 9. Seedling reaction to differential stem rust isolates of check lines and Montana experimental entries in the 2004 USDA-ARS Northern Regional Performance Nursery.

2004 NORTHERN REGIONAL PERFORMANCE NURSERY - StemRust SEEDLING TRIAL							
Entry	Line/selection	Stem rust isolates					Bruckner interpretation
		TPMK 74-MN-1409	QTHJ 69-MN-399	TTTT 02 MN 84 A-1	RCRS 97 ND 82A	QFCS 03 ND 76C	
1	Kharkof	3+	3,1	3+,2+	;/;1/4	4;/;2	
2	Harding	0;	1	;/;2C	0;	;	
3	Nuplains	3	1	1	0;	0;	
4	Nekota	0;	2+	3,;	0;	0;	
38	MTR9997	4	3, 1	3	3+	4	SUSC
39	MT0097	3- low if	0	3, 1	3	0	Some Rest.
40	MT00159	3-2	4	3	3,2	4	SUSC

Data provided by James Kolmer, USDA-ARS Cereal Disease Lab, Minneapolis, MN

Disease reaction of MT00159. In seedling stem rust evaluations conducted by the USDA-ARS Cereal Disease Lab (Table 9), MT00159 was susceptible to all tested stem rust isolates. In the 2000 Fort Ellis stem rust nursery MT00159 was rated as susceptible (Table 10). MT00159 has shown good resistance to stripe rust in several trials including 2004 Kalispell (Table 10), two locations in Washington, and one location in Fayetteville, AR (Table 11). Based on disease screening evaluations in the regional nursery, MT00159 is susceptible to leaf rust, wheat soil borne mosaic virus, and the Great Plains biotype of Hessian fly (Table 10). Based on limited testing MT00159 has moderate resistance to dwarf bunt (TCK smut) (Table 12).

Stem solidness & Tolerance to sawfly cutting. MT00159 has a hollow stem and no tolerance to wheat stem sawfly has been observed.

In summary, MT00159 is a very high-yielding, winter hardy HRW wheat line with medium test weight, maturity, height, and grain protein. This line is the highest yielding winter wheat line that has ever been

developed at Montana State University. MT00159 has excellent baking quality and good Asian noodle quality. The line is moderately resistant to TCK smut and stripe rust. MT00159 potentially could occupy acreage currently planted to Neeley, Tiber, CDC Falcon, Paul, Promontory, and Morgan.

Table 10. Misc. observations and disease reaction of MT00159 observed in trials from 2000 to 2004.

	2000 Will. WSMV	2000 Hunt. Shatter	2000 Boz. Stem Rust	2004 Kal. Stripe Rust	2004 KSU Leaf Rust	2004 OSU Leaf Rust	2004 KSU Hessian fly	2004 OSU WSBMV
Promontory	0-3	0-3	rxn	%	rxn ¹	rxn ²	rxn ³	rxn ⁴
Rampart	2.3	0.5		-1.1				
Jerry				-0.2				
MT0097	0.5	0.5		-0.2	S	S	S	S
Morgan	0.5	1.1		0.9				
MT00159	0.5	1.9	S-	2	S	S	S	S
Judith	0.0	0.8		2.4				
Falcon				7.6				
Pryor				19.9				
Paul				23.5				
Neeley	1.8	1.4	S	27.6				
LSD(5%)	0.9	ns	-	28.5	-	-	-	-
CV %	34.8	50.2	-	184.4	-	-	-	-

0=none 0=none
3=worst 3=worst

Composite GP
culture biotype

1. Seedling leaf rust reaction determined by Dr. Bob Bowden using KS composite culture.
2. Seedling leaf rust reaction determined by Dr. Bob Hunger using composite culture.
3. Reaction to great plains biotype of Hessian fly determined by Elburn Parker, USDA-ARS, Manhattan.
4. Field wheat soil borne mosaic virus ratings made by Dr. Bob Hunger.

TABLE 11. STRIPE RUST PERCENT (%) AND INFECTION TYPE (T) ON CHECK CULTIVARS AND MT EXP. LINES IN THE WINTER HARD WHEAT NURSERY (EXP12, 04NRPN) AT WHITLOW FARM (LOC04) NEAR PULLMAN, WA AND MT VERNON, WA (LOC05) WHEN RECORDED AT THE INDICATED DATES AND STAGES OF P

ENTRY	LINE	2004 PLOT	STRIPE RUST						Stripe rust Fayetteville AR Field Reaction %	Bruckner interpret.
			LOC04		LOC05		LOC05			
			6/30/04		4/25/04		6/4/04			
			ST 10.5-11		ST 7-9		ST 10.5			
			%	T	%	T	%	T		
04NRPN	PS 279	1	100	8	80	8	100	8	-	
1	Kharkof	2	30	5	2	2	10	2	0	
2	Harding	3	100	8	10	5	50	8	15	
3	Nuplains	4	100	8	5	3	100	8	85	
4	Nekota	5	100	8	40	8	100	8	85	
5	Moreland	6	60	5	5	2	100	8	2	
38	MTR9997	40	100	8	80	8	100	8	7	Susc.
	PS 279	41	100	8	80	8	100	8	-	
39	MT0097	42	2	2	5	2	10	2	0	Rest. +
40	MT00159	43	40	5	5	2	5	2	0	Rest.

Infection types:

- 0: No visible signs or symptom
 - 1: Necrotic and/or chlorotic flecks; no sporulation
 - 2: Necrotic and/or chlorotic blotches or stripes; no sporulation
 - 3: Necrotic and/or chlorotic blotches or stripes; trace sporulation
 - 4: Necrotic and/or chlorotic blotches or stripes; light sporulation
 - 5: Necrotic and/or chlorotic blotches or stripes; intermediate sporulation
 - 6: Necrotic and/or chlorotic blotches or stripes; moderate sporulation
 - 7: Necrotic and/or chlorotic blotches or stripes; abundant sporulation
 - 8: Chlorosis behind sporulating area; abundant sporulation
 - 9: No necrosis or chlorosis; abundant sporulation
- IT 0-3 can be considered resistant, 4-6 intermediate, and 7-9 as susceptible.

Data provided by Xianming Chen, USDA-ARS, Pullman, WA

Table 12. Dwarf bunt reaction of MT00159 and check cultivars at Green Canyon, UT in 2004.

USDA TCK nursery	TCK bunt
	%
Promontory	0.0
Golden Spike	0.0
MT00159	7.5
Paul	57.5
Cheyenne	62.5
LSD (0.05)	9.7
CV %	24.7

Data provided by Dr. Blair Goates, USDA-ARS, Aberdeen, ID.