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MEMORANDUM

TO: Wheat Cultivar Release & Recommendation Committee

FROM: Phil Bruckner, Winter wheat breeder

DATE: January 6, 2005

RE: Proposal for licensed (F.2.c) cultivar release of MT0097 HRWW

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

MT0097

Motion: That MT0097 hard red winter wheat (HRWW) be approved for release in 2005.

Pedigree: Erhardt//Judith/CDC Kestrel

Recommendation: License release (F.2.c, Exclusive). This is an excellent line but not as good as contemporary line, MT00159.

Potential names: To be named by licensee

Selection history: MT0097 originated from cross 93X224 made in 1993. The F₁ population was germinated and vernalized in the greenhouse then transplanted to the field in June 1993. F₂, F₃, F₄, and F₅ bulk populations were grown in Fort Ellis, Sidney, North Havre, and Huntley, respectively, from 1994 to 1997. In 1997, 130 individual heads were selected from the F₅ bulk at harvest maturity. In 1998, F₅-derived F₆ headrow 93X224E39 was selected based on visual criteria for uniformity, productivity, and acceptable agronomic type and bulk harvested. 93X224E39 was subsequently tested in the 1999 Single Rep Observation Nursery A (SROA) grown at Bozeman, Havre, and Moccasin. In 2000, 93X224E39 was designated MT0097 and tested in the Preliminary A trial at five locations (3 loc-harvested). In 2001, MT0097 was tested in the MT Advanced trial at six locations (5 loc-harvested). From 2002 through 2004, MT0097 was evaluated in the Montana Intrastate trial planted at eight locations (total 22 LY) and from 2003 through 2004, MT0097 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, MT0097 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 MT0097 was initiated in 2002. A set of 99 F₉-derived F₁₀ headrows were grown at Fort Ellis with selection for height, maturity, and visual uniformity. In 2003, 80 4-row line row plots of MT0097 were grown at the Post farm with 23 variable and/or variant line rows being discarded. Remaining line rows with uniform appearance were harvested in bulk. In 2004 breeder seed of MT0097 was increased at the Post Farm. Plants rogued from the breeder seed increase included variant plants taller in height, awnless, and red chaffed (<0.1% total variants). Approximately 5 acres of MT0097 is planted at the Bozeman

Post Farm for 2005 Foundation seed production.

Table 1. Description of nurseries and data sets describing the performance of MT0097 in Montana, 2000-2004.

Year	Trial	Loc. planted	Loc. harvested	Loc. For Quality Eval.
2000	Preliminary A	5	3	3
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: MT0097 is a high-yielding, winter hardy HRW wheat line with good test weight, grain protein, and milling and baking quality. The line has moderate resistance to stem rust and good resistance to stripe rust. MT0097 potentially could occupy acreage currently planted to Neeley, CDC Falcon, Paul, and Morgan.

Table 2. Mean performance of MT0097 in the 2000 Preliminary A nursery at three locations.

2000 Preliminary A	Grain yield	Test weight	Heading date	Plant height	Grain protein	Flour yield	Flour ash	Bake absorption	Loaf volume
	bu/ac	lb/bu	days	inch	%	%	%	%	cc
Neeley	82.1	60.4	161.8	34.8	13.1	65.8	0.36	68.9	973
MT0097	81.3	61.2	161.3	34.0	13.7	69.7	0.39	71.4	998
Rampart	75.8	60.4	159.0	33.8	14.2	65.6	0.37	73.3	1012
Judith	75.7	59.5	158.4	35.5	13.7	68.6	0.36	71.5	1073
Morgan	75.0	59.9	163.5	34.5	13.1	63.8	0.36	68.0	925
lsd 5%	ns	ns	1.1	ns	ns	2.5	ns	ns	ns
# env.	3	3	3	3	3	3	3	3	3
cv %	5.9	1.0	0.4	2.6	7.5	2	3.0	2.8	5.6

Table 3. Mean performance of MT0097 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
lsd 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 MT0097 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 MT0097 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 MT0097 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 MT0097 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 MT0097 (59.9 bu/a) was statistically equivalent to Promontory, Neeley, CDC Falcon, Paul, and Jerry (Tables 5, 7). Yield of MT0097 was also statistically equivalent to Promontory, Neeley, CDC Falcon, Paul, and Jerry in all cropping districts except district 4 (central) where MT0097 yielded significantly less than both Promontory and CDC Falcon (Table 7). Although check sets were different in the 2000 Preliminary A and 2001 Advanced nurseries (Tables (2, 3), yield response of MT0097 was consistent with this description which can be summarized as good but not great grain yield.

Test weight. Test weight of MT0097 (59.6 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 MT00159, and higher than the test weights of Pryor and Paul (Table 5).

Winter survival. Based on nine environments where differential winter survival occurred, MT0097 exhibits excellent winter survival statistically equivalent to winter hardy cultivars Jerry, Morgan, and CDC Falcon (Table 5). Winter survival of MT0097 was superior to survival of Neeley, Pryor, and Promontory in these environments.

MT0097 is of **medium to late in maturity**, heading about the same date as Pryor and Neeley (Tables 5).

Plant height. MT0097 is similar in height to Promontory, averaging 32 inches (Table 5, 44 LY). MT0097 is taller than CDC Falcon, Pryor, and Paul, and shorter than Jerry, Morgan, and Neeley. Straw strength of MT0097 is good, with significant lodging occurring only once in 44 trials (Table 8, 2004 Kalispell. MT0097 yield was 120.4 bu/acre at that site).

Maximum **coleoptile length** of MT0097 is medium (~3.0 inches), similar to Jerry, Paul, CDC Falcon, and Judith (Table 8).

Grain protein content of MT0097 is medium to high, similar to Neeley and Jerry (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 MT0097 is relatively high, similar to that of Judith and Jerry (Tables 2, 4, 6). **Baking qualities** of MT0097 are within acceptable ranges with relatively high dough absorption and excellent loaf volume similar to Rampart, Genou,

Paul, and MT00159 (Tables 4, 6). MT0097 has relatively poor potential for Asian noodle products (Table 4, 6).

Table 8. Coleoptile length and lodging of MT0097 in 2002 to 2004 Montana trials.

	2002 2003 2004 3 yr.				2002 2003 2004 2004			
	Boz.	Boz.	Boz.	mean	Boz.	3880	3880	Kal.
	coleoptile length				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 MT0097. In seedling stem rust evaluations conducted by the USDA-ARS Cereal Disease Lab (Table 9), MT0097 showed a resistant reaction to stem rust isolates QTHJ and QFCS and has at least one gene for resistance. Parental lines Erhardt and Judith remain resistant to predominant races of stem rust in Montana. MT0097 has shown excellent 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, MT0097 is susceptible to leaf rust, wheat soil borne mosaic virus, and the Great Plains biotype of Hessian fly (Table 10).

Stem solidness & Tolerance to sawfly cutting. MT0097 has a hollow stem and no tolerance to wheat stem sawfly has been observed.

In summary, MT0097 is a high-yielding, winter hardy HRW wheat line with good test weight, grain protein,

and milling and baking quality. The line has resistance to stem rust and good resistance to stripe rust. Performance of MT0097 is good but not outstanding. However, this line is satisfactory in performance and quality for production in Montana and may be of interest to companies marketing seed and varieties in MT.

MT0097 potentially could occupy acreage currently planted to Neeley, CDC Falcon, Paul, and Morgan. Relative to Neeley: MT0097 is shorter, more winter hardy, higher in flour yield, inferior for Asian noodle products. Relative to CDC Falcon: MT0097 is later, taller, higher in protein, higher in flour yield, and lower in grain yield in district 4. Relative to Paul: MT0097 is higher in test weight, taller, higher in flour yield. Relative to Morgan: MT0097 is higher in yield, earlier, and shorter.

Table 10. Misc. observations and disease reaction of MT0097 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				-0.5				
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