Application for Release of MT-25FWW and MT-26FWW Awnletted Winter Wheat

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Motion 1. That MT-25FWW and MT-26FWW each be released as a **specialty crop** by the Montana Agricultural Experiment Station in 2005.

Motion 2. That the decisions for the method for release ("public", "protected public" or "licensed") of these lines be deferred until adequate notification and discussions have occurred. It is proposed that one be released as a public, and the other as a licensed variety.

Motion 3. That the decision for variety names be deferred until #2 above is completed.

Background and Justification: The acreage and interest in cereal forages have dramatically increased in the past 10 years. Since 2000, over 300,000 acres of cereals have been harvested for hay in Montana annually. MAES has actively tested both winter and spring cereals for forage production, but breeding efforts have been fairly limited. Awnletted cereals are desirable for dry hay production, and these have gained producer acceptance (eg. 'Haybet'). Under dryland conditions in central and western Montana, winter cereals are generally superior to spring cereals as forages because of better production levels and their water use and growth patterns (although barley has superior forage quality). Under irrigation in western Montana, winter cereals are an excellent crop for rotations prior to re-seeding alfalfa. Winter cereals are a better fit for many livestock producers in terms of workload scheduling to plant and harvest annual forages.

This project was initiated in 1997 to develop "awnless" winter wheat lines that could be used as dual-purpose crops – forage or grain. Many triticale lines tested by MAES are clearly superior to MT-25FWW and MT-26FWW for forage and/or grain production. However, acreages of winter triticale or spelt have continued to remain low, possibly because no secondary markets exist if these crops are harvested for grain. These lines are being considered for release as specialty crop varieties, and to serve as a benchmark for future releases. (The specialty crop designation is chosen because these lines have not been tested adequately for grain yield, and despite having 19 forage trials at 7 locations over 4 years, there are some crop insurance policy issues related to "forage" cereals).

Breeding History: In 1997, Bruckner provided bulk seed of six awnletted winter wheat lines in his program (SROB 632, SROB 633, SROB 639, PI 191303, and segregating populations 30 and 316). MT-25FWW and MT-26FWW trace to elite headrow selections from SROB 632 and SROB 633, respectively:

ID	Gen.	Source	ID	Gen.	Source
1997SROB632	S_x	PI 262578	1997SROB633	S_x	PI 306505
"632"	S_{X+1}	1997SROB632	"633"	S_{X+1}	1997SROB633
632Bulk1	S_{X+2}	Bozeman 1998 seed from 632	633Bulk1	S_{X+2}	Bozeman 1998 seed from 633
632Bulk2	S_{X+3}	CARC 1999 seed from 632Bulk1	633Bulk2	S_{X+3}	CARC 1999 seed from 633Bulk1

99H-3947	S_{X+3}	Elite headrow (n=45) from 632Bulk1	99H-3375	S_{X+3}	Elite headrow (n=50) from 633Bulk1
2002FWW-25	S_{X+4}	0.5A increase of 99H-3947, CARC (hail)	2002FWW-26	S_{X+4}	0.25A increase of 99H-3375, Bozeman
-	-	-	FWW-26 Lot 03-02	S_{X+5}	10A increase of 2000FWW-26
-	-	-	2005FWW-26	S_{X+6}	1A increase of FWW-26 Lot 03-02

SROB 632 is PI 262578, and its accession (in 1959) was from the cultivar 'Ul'ijanovka' developed in Russia. (USDA, ARS, National Genetic Resources Program–GRIN. [Online Database] National Germplasm Resources Laboratory, Beltsville, MD. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/obs.pl?1199231 accessed 1/3/05).

SROB 633 is PI 306505, and this accession (received in 1965) was a local cultivar in Romania called 'Lunnija 56'. The collection site is listed as North (46.000) – East (25.000). (USDA, ARS, National Genetic Resources Program–GRIN. [Online Database] National Germplasm Resources Laboratory, Beltsville, MD. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/acc_search.pl?accid=306505 accessed 1/3/05).

In 1998 and 1999, the six awnletted lines were grown in forage yield trials and bulk seed was harvested after rouging awned heads and off types. In 1998 and 1999, 274 headrows of these six lines were evaluated for plant height, leafiness, maturity and yield of forage and grain at Fort Ellis. Replicated forage plots were grown from selected headrows in 2000. MT-25FWW traces to headrow 99H-3947 (one of 45 from SROB 632), and MT-26FWW was from 99H-3975 (one of 50 from SROB 633) that had uniform appearance and performance in replicated plot trials in 2000. Data for these lines are presented in comparison with the other four contemporary awnletted lines, check winter wheat varieties, and numerous triticale or spelt lines under evaluation.

Variety Descriptions: MT-25FWW and MT-26FWW are tall, late-maturing HRWW lines. They are apically awnletted, with light amber to tan heads. Glumes and leaves are non-pubescent. Kernel color is red. In developing a forage cereal "ideotype" (with limited resources) Cash and Bruckner visually observed many winter wheat lines for traits related to forage production. Generally tall, leafy and late-maturing cereals are advantageous for hay or haylage production (tonnage and quality) under irrigated or high rainfall conditions (but not necessarily all dryland conditions). In preliminary observation of the awnletted wheat lines in comparison to check winter wheat, rye, spelt or triticale there were notable differences in height, leafiness, leaf blade widths, maturity, awn structure, head and foliar disease symptoms, and the retention and condition of leaves ("stay-green"?) approaching grain maturity.

Plant height and maturity: At Bozeman (Table 4) and Three Forks under irrigation (no data), MT-25FWW and MT-26FWW are both typically over 4 feet tall, with limited lodging at hay harvest. MT-26FWW is significantly taller than 'Tiber' and 'Neeley', but similar to 'Newturk' and MT-25FWW. Both lines are 7 to 9 days later to heading than Tiber, and subsequently later to approach the ideal stage of forage harvest (Table 3). MT-25FWW appears to be slightly shorter and earlier than MT-26FWW, but these differences are not significant. (Some discrepancies in plant height and maturity data were likely due to the harvest dates chosen to accommodate the maturity of the majority of the other trial entries). In general, plant height and maturity of these lines seem to be intermediate between triticale and spelt.

Leaf widths vary considerably in winter cereals, and flag leaf widths have been measured. MT-26FWW has wider flag leaves (15.1 mm) than those of Tiber (12.5 mm, *P*=0.08) and MT-25FWW (11.9 mm, *P*=0.02) [Table 5]. For comparison, Haybet is 12 mm and 'Westford' is 19 mm.

Forage yields of MT-25FWW and MT-26FWW have been tested in 19 trials (Tables 1 and 2). These lines had similar performance (*P=0.16*), but were superior to three of the other awnletted lines tested (Table 2). Forage yields ranged from 1.1 to 3.5 tons per acre on dryland, and from 2.6 to 5.2 tons per acre at high rainfall or irrigated sites (Table 1). Across all trials, forage yields of these lines were 2 to 8% (NS) lower than those of Tiber, 'Cardinal' and Neeley, but 12 to 14% higher (*P*< 0.05) than Newturk winter wheat. MT-25FWW and MT-26FWW have had forage yields equal to, higher or lower than those of triticale and spelt, depending on varieties tested.

Grain yields of MT-25FWW and MT-26FWW have ranged from 26 (dryland) to 65 (high rainfall) bushels per acre (Table 6). No test weight data were collected in the replicated trials. Despite the inadequate research data, the grain yields in two seed increases of MT-26FWW (>68 bushels per acre) indicate that seed production potential is adequate. Plant heights, late maturity, potential for lodging, shatter, threshability and other traits of these lines that have not been evaluated could likely be obstacles for seed production under irrigated conditions.

Forage quality of MT-25FWW and MT-26FWW has not been thoroughly tested in the replicated trials due to lack of resources. At the milk stage, they had 9 to10% crude protein and about 55% TDN (total digestible nutrients) [Table 7]. Nitrate accumulation of the winter cereals has not been adequately tested, but in general appear to be lower than that of the spring cereals. Obviously, there are many agronomic trials that need to be done to optimize forage yield and quality of MT-25FWW, MT-26FWW and other winter cereals.

The level of winterhardiness of MT-25FWW and MT-26FWW appear to be good. In several forage trials (Table 1) differential winter injury was noted for some entries, but none has been observed in these lines. As observational evidence of winterhardiness, severe winterkill (> 70% stand loss) occurred in a half-pivot of 'Bobcat' winter triticale near Willow Creek, MT in 2004. An adjacent 0.5-acre strip of MT-26FWW had less than 10% stand loss. The GRIN database indicates that both PI 262578 and PI 306505 have a true winter habit (no facultative expression), and our observations confirm this.

Disease and insect resistance of MT-25FWW and MT-26FWW are not known. During the selection process of the awnletted winter wheat lines, about 8% were discarded due to head smut or other diseases. The GRIN database indicates that PI 262578 is resistant to powdery mildew, but is moderately or fully susceptible to dwarf bunt, leaf rust and most isolates of stripe rust. It is also susceptible to the cereal leaf beetle, Russian wheat aphid and the Hessian fly. PI 306505 is resistant to dwarf bunt, fairly resistant to powdery mildew, but susceptible to leaf rust and most isolates of stripe rust. It is susceptible to the Russian wheat aphid and the Hessian fly.

Breeder Seed Status: Both MT-25FWW and MT-26FWW were derived from old introduced HRWW cultivars. They have similar growth characteristics, performance, and potential in Montana. The largest difference between these lines is the current level of seedstock available. In 2001, nine promising awnletted lines were planted for seed increases at CARC and Bozeman. MT-25FWW and four other lines grown in 0.5-acre increases at CARC were hailed out. Presently, about 120 grams of remnant 99H-3947 remains.

MT-26FWW was increased at Bozeman, and subsequent seed increases (0.5 to 20 acres) have been harvested near Willow Creek in 2003 and 2004 to enable large-scale testing. In September 2004, eight 7 to 10-acre fields were planted near Three Forks, Hamilton, Bozeman, Moccasin, Judith Gap, Jordan and Miles City for hay production in 2005. In addition, a new 1-acre MSU increase was planted at Fort Ellis.

Discussion of Specific Motions:

Motion 1. That MT-25FWW and MT-26FWW each be released as a **specialty crop** by the Montana Agricultural Experiment Station in 2005.

MT-25FWW and MT-26FWW awnletted winter wheat will be very useful varieties for livestock producers, and they can serve as a benchmark for future releases of winter cereals. These lines are being considered for release as **specialty crops** because they have not been tested adequately for grain yield, and there are some crop insurance policy issues related to "forage" cereals. The best and most consistent performance of these lines has been in Gallatin County under irrigation or in high rainfall conditions. If MT-25FWW and MT-26FWW are recommended solely for District 2, then insufficient data are available for their consideration as "forage crops". *(Need to discuss the recommended areas of production and use).*

Motion 2. That the decisions for the method for release ("public", "protected public" or "licensed") of these lines be deferred until adequate notification and discussions have occurred.

The intended plan for release of an awnletted winter wheat has always been to make it an unprotected variety for low-cost and widespread use. Based on the pedigrees and limited amounts of data for MT-25FWW and MT-26FWW, application for PVP is highly questionable. So, the two best options are an unprotected public variety, or to allow a licensee to take full responsibility and liability for a variety. *It is proposed that one line be released as a public, and the other as a licensed variety.*

For MT-26FWW, we have had immense assistance from a local farm corporation for land, crop management, harvest and seed cleaning, as well as financial support from numerous grant funds – these clearly favor a public release. In late December MONTECH, LLC requested an exclusive license for a "forage winter wheat". This group currently consists of 16 Montana seed companies with broad experience in both public and proprietary forage seeds. There are divergent opinions on how "best" to release these lines. *A suitable option might be to produce MT-25FWW (very limited seed) as an unprotected public variety, and to offer MT-26FWW (2005 Breeder seed) to potential licensees. For the licensing process, MSU Technology Transfer is requested to negotiate a contract to collect fees at a level comparable to that of the "research fees" for other wheat varieties ($0.30 per bushel) that will be forwarded to the Forage Program. (The suggested action by the committee is to defer how these lines are released until ample discussion has occurred. This could be handled by email, conference call, or at summer conference, and would enable a critical look at the on-farm trials of MT-26FWW in 2005).*

Motion 3. That the decision for variety names be deferred until #2 above is completed. *(Suggested names are welcome for the public variety).*

Table 1A. Forage Yield Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat (part 1 of 2).

ID	Generation	Source	1998 Bozeman (HR)	1999 Ft. Ellis (HR)	1999 Three Forks (Irr)	1999 Three Forks (Dry)	1999 CARC Fallow	1999 CARC Recrop	1999 SARC (Irr)	1999 WARC (HR)
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	4.68	**5.15**	**3.51**	**3.12**	**2.76**	**2.88**	**4.87**	3.44
MT-26FWW	S_{X+1} to S_{X+6}	Bruckner 1997SROB633	4.34	**4.97**	**2.98**	**2.72**	**2.93**	**3.16**	**4.84**	3.28
(Other contemporary awnletted winter wheat lines)										
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	4.66	4.68	**2.81**	**3.49**	**3.00**	**2.88**	4.15	3.56
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	4.29	4.20	**3.18***	2.07*	2.05	1.82	3.45	3.24
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	4.03	4.00	1.14*	1.30*	1.74*	1.65*	2.11*	3.23
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	4.63	4.61	**2.49**	2.12	**2.49**	**2.58**	**4.98**	3.26
(Winter wheat checks)										
Tiber			4.79	**5.26**	-	-	-	-	-	-
Cardinal			-	-	-	-	-	-	**5.06**	-
Neeley			-	-	-	-	-	-	**5.01**	-
Newturk			-	-	-	-	2.37	2.56	-	-
(Awnletted triticale checks)										
Frostat			-	-	-	-	-	-	-	-
88DLO 1233			-	-	-	-	-	-	-	-
Winterness										
(Spelt checks)										
Sindelar light			-	-	-	-	**2.56**	2.29	-	-
SP 949			-	-	-	-	**3.05**	2.41	-	-
		Trial Mean	4.43	4.60	2.69	2.86	2.48	2.36	4.31	3.34
		lsd (P = 0.05)	NS	0.48	2.30	1.41	0.61	0.69	0.48	NS
		CV%	16.2	6.2	53.7	35.0	14.1	17.3	7.9	12.0

Values in **bold** within a column are not significantly different from the highest yields.
* Winter injury noted.

Table 1B. Forage Yield Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat (part 2 of 2).

ID	Generation	Source	2000 Three Forks (Dry)	2000 Sheridan (Dry)	2000 CARC Fallow	2000 CARC Recrop	2000 SARC (Irr)	2000 Bozeman (HR)	2002 Bozeman (HR)	2002 CARC Fallow NW	2002 CARC FallowSW	2002 CARC Recrop	2002 Sheridan (Dry)
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	**2.47**	**2.56**	3.08	2.15	2.42	**4.33**	**3.34**	3.20	3.10	**1.92**	1.12
MT-26FWW	S_{X+1} to S_{X+6}	Bruckner 1997SROB633	**2.60**	**2.60**	3.58	2.34	2.64	**3.97**	**3.23**	2.75	3.04	**1.63**	**1.25**
(Other contemporary awnletted winter wheat lines)													
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	**2.16**	**2.68**	3.28	1.95	2.70	3.13	**3.19**	3.61	3.05	**1.74**	**1.23**
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	-	-	-	-	-	-	-	-	-	-	-
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	0.65*	2.31	2.83	2.12	2.50	2.60	2.71	2.68	2.75	**1.73**	1.07
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	**1.69**	2.08	3.12	2.34	2.94	2.93	**3.30**	2.75	2.84	**2.04**	**1.30**
(Winter wheat checks)													
Tiber			-	-	-	-	-	-	-	-	-	-	-
Cardinal			-	-	-	-	-	-	-	-	-	-	-
Neeley			-	-	-	-	-	-	-	-	-	-	-
Newturk			**2.30**	**2.62**	2.94	1.84	2.63	**3.73**	-	-	-	-	-
(Awnletted triticale checks)													
Frostat			**2.28**	1.82	4.16	3.00	3.85	**3.93**	**3.64**	2.38	2.73	**2.14**	**1.49**
88DLO 1233			**1.59**	1.93	3.10	1.45	3.16	**3.60**	-	-	-	-	
Winterness			-	-	-	-	-	-	**3.93**	2.74	2.91	**2.11**	**1.48**
(Spelt checks)													
Sindelar light			**1.82**	**3.08**	3.22	2.18	2.73	3.07	-	-	-	-	-
SP 949			**2.26**	**2.66**	3.98	2.90	2.92	**4.07**	-	-	-	-	-
		Trial Mean	1.87	2.33	3.30	2.23	2.86	3.02	3.56	2.84	2.85	1.92	1.39
		lsd (P = 0.05)	1.19	0.69	NA	NA	NA	1.61	0.74	NS	NS	0.54	0.26
		CV%	39.0	17.9	NA	NA	NA	26.8	14.6	16.8	14.7	16.6	13.10

Values in **bold** within a column are not significantly different from the highest yields.
* Winter injury noted.

Table 2. Comparative Forage Yield Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat Lines and Check Varieties.

"Check Variety"	Generation	Source	N Head to Head Comparisons	Check Mean tons DM/A	Check Mean %	MT-26FWW Mean tons DM/A	MT-26FWW Mean %	Check vs. MT-26FWW ($P > t_{paired}$)
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	19	3.16	*102*	3.10	*100*	0.163
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	19	3.05	*99*	3.10	*100*	0.318
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	6	3.18	*80*	3.92	*100*	0.014
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	13	2.66	*89*	2.94	*100*	0.003
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	19	2.87	*93*	3.10	*100*	0.013
(Winter wheat checks)								
Tiber			2	5.03	*108*	4.66	*100*	NS*
Cardinal			1	5.06	*105*	4.84	*100*	NS
Neeley			1	5.01	*104*	4.84	*100*	NS
Newturk			8	2.62	*88*	2.98	*100*	0.003
(Awnletted triticale checks)								
Frostat			11	2.86	*108*	2.69	*100*	0.188
88DLO 1233			6	2.47	*82*	2.96	*100*	0.041
Winterness			5	2.63	*113*	2.38	*100*	0.087
(Spelt checks)								
Sindelar light			8	2.62	*89*	2.98	*100*	0.038
SP 949			8	3.03	*102*	2.98	*100*	0.364

NS*: $P > 0.05$ by F test.

Table 3. Heading Date and Rate of Maturity Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat.

ID	1998 Bozeman (HR) Grain Maturity DOY139	DOY174	DOY181	DOY196	1999 CARC Fallow Heading Date DOY	1999 SARC Irr. Heading Date DOY	2000 Sheridan, WY Dry Heading Date DOY	2002 CARC Fallow Heading Date DOY	2002 Sheridan, WY Dry Heading Date DOY	2002 Bozeman (HR) Grain Maturity at Haying DOY = 182
MT-25FWW	Veg.	60% HE	Anth.	Milk	174	161	155	179	166	Boot, 40%HE
MT-26FWW	Veg.	Boot, 10%HE	100% HE	Early Milk	175	163	159	180	167	Boot, 20%HE
(Other contemporary awnletted winter wheat lines)										
"639"	Veg.	40% HE	100% HE	Milk	174	162	156	179	168	Boot, 50%HE
"191303"	Veg.	Boot	100% HE	Clear	180	168	-	-	-	-
"SegPop-30"	Veg.	90% HE	Anth.	Early Dough	173	164	154	179	167	75%HE
"SegPop-316"	Veg.	95% HE	Anth.	Milk	171	158	151	177	166	80%HE
(Winter wheat checks)										
Tiber	Veg.	100% HE	Late Anth.	Dough	-	-	-	-	-	-
Cardinal	-	-	-	-	-	154	-	-	-	-
Neeley	-	-	-	-	-	158	-	-	-	-
Newturk	-	-	-	-	170	-	155	-	-	-
(Awnletted triticale checks)										
Frostat	-	-	-	-	-	-	149	175	159	Late Anth./Water
88DLO 1233	-	-	-	-	-	-	145	-		-
Winterness	-	-	-	-			-	178	167	Anth.
(Spelt checks)										
Sindelar light	-	-	-	-	180	-	162	-	-	-
SP 949	-	-	-	-	177	-	158	-	-	-
	-	-	-	-	176	161	155	177	167	-
	-	-	-	-	1.4	1.0	2.7	0.8	NA	-
	-	-	-	-	0.5	0.1	1.1	0.3	NA	-

Table 4. Plant Height (cm at Hay Harvest) Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat.

ID	Generation	Source	1998 Bozeman HR	1999 Fort Ellis HR	1999 CARC Fallow	1999 SARC Irr.	2000 Sheridan, WY Dry
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	**131.3**	132.3	93.1	91.3	99.7
MT-26FWW	S_{X+1} to S_{X+6}	Bruckner 1997SROB633	**143.5**	**145.7**	**100.8**	**105.0**	113.5
(Other contemporary awnletted winter wheat lines)							
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	**133.0**	133.2	**102.4**	**100.0**	106.7
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	122.0	113.3	**99.1**	93.8	-
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	90.0	103.0	81.3	82.0	76.2
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	120.0	124.0	**94.8**	**103.0**	92.7
(Winter wheat checks)							
Tiber			115.0	126.7	-	-	-
Cardinal			-	-	-	79.0	-
Neeley			-	-	-	83.5	-
Newturk			-	-	**101.6**	-	102.9
(Awnletted triticale checks)							
Frostat			-	-	-	-	**124.0**
88DLO 1233			-	-	-	-	112.4
Winterness			-	-	-	-	-
(Spelt checks)							
Sindelar light			-	-	**100.8**	-	102.4
SP 949			-	-	**105.0**	-	106.2
		Trial Mean	123.6	120.2	98.7	92.2	97.8
		lsd (P = 0.05)	11.0	3.6	10.2	6.0	8.0
		CV%	3.0	2.6	6.1	4.6	4.9

Values in **bold** within a column are not significantly different from the highest values.

Table 5. Flag Leaf Width (mm at Hay Harvest) Summary of MT-25FWW and MT-26FWW Awnletted Winter Wheat.

ID	Generation	Source	1998 Bozeman (HR)	1999 Fort Ellis (HR)	2002 Bozeman (HR)
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	11.0	13.0	11.8
MT-26FWW	S_{X+1} to S_{X+6}	Bruckner 1997SROB633	**15.0**	**14.8**	15.5
(Other contemporary awnletted winter wheat lines)					
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	**15.0**	15.3	15.3
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	**18.0**	**18.3**	-
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	**18.0**	**18.7**	**18.1**
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	**16.0**	**17.3**	15.1
(Winter wheat checks)					
Tiber			12.0	13.0	-
Cardinal			-	-	-
Neeley			-	-	-
Newturk			-	-	-
(Awnletted triticale checks)					
Frostat			-	-	**18.3**
88DLO 1233			-	-	-
Winterness			-	-	15.5
(Spelt checks)					
Sindelar light			-	-	-
SP 949			-	-	-
		Trial Mean	14.0	17.7	15.9
		lsd (P = 0.05)	5.8	1.6	2.3
		CV%	15.0	7.9	10.0

Values in **bold** within a column are not significantly different from the highest values.

Table 6. Grain Yields of MT-25FWW and MT-26FWW Awnletted Winter Wheat.

ID	Generation	Source	1998 Bozeman HR (bu/a)	1999 CARC Fallow (bu/A)	2002 CARC Fallow (lb/A)
MT-25FWW	S_{X+1} to S_{X+4}	Bruckner 1997SROB632	**64.6**	49.3	2254
MT-26FWW	S_{X+1} to S_{X+6}	Bruckner 1997SROB633	**65.5**	**51.8**	1556
(Other contemporary awnletted winter wheat lines)					
"639"	S_{X+1} to S_{X+4}	Bruckner 1997SROB639	**54.4**	33.3	1461
"191303"	S_{X+1} to S_{X+4}	Bruckner 1997SROB PI 191303	**69.5**	36.8	-
"SegPop-30"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 30	**70.6**	40.8	1567
"SegPop-316"	S_{X+1} to S_{X+4}	Bruckner 1997Segregating Pop. 316	**79.5**	49.7	1902
(Winter wheat checks)					
Tiber			**76.0**	-	-
Cardinal			-	-	-
Neeley			-	-	-
Newturk			-	**60.2**	-
(Awnletted triticale checks)					
Frostat			-	-	1924
88DLO 1233			-	-	-
Winterness			-	-	1667
(Spelt checks)					
Sindelar light			-	-	-
SP 949			-	-	-
		Trial Mean	65.9	46.0	1831
		lsd (P = 0.05)	22.3	8.5	NS
		CV%	11.5	10.5	NA

Values in **bold** within a column are not significantly different from the highest values.
(No test weight data were collected).

Table 7. Forage Quality Analyses of MT-25FWW and MT-26FWW Awnletted Winter Wheat.

Table 7A. 1999 Lines sampled at Fort Ellis 7/99 at clear to milk stage. Forage quality on 100% DM basis, wet chemistry by MidWest Laboratories.

Line		% Whole Plant DM Heads	% Whole Plant DM Forage	%DM	CP%	ADF%	TDN%	NE_m Mc/lb	NE_g Mc/lb	S%	P%	K%	Mg%	Ca%
MT-25FWW (632Bulk$_1$)	Whole Plant	21.0	79.0	94.3	8.9	41.1	55.7	0.54	0.31	0.16	0.17	1.77	0.12	0.25
MT-26FWW (633Bulk$_1$)	Whole Plant	14.7	85.3	94.6	10.4	42.6	54.0	0.52	0.29	0.14	0.19	2.16	0.13	0.28
SegPop 316	Heads	23.6	-	94.1	13.7	29.7	68.7	0.69	0.43	0.18	0.33	1.02	0.15	0.15
SegPop 316	Forage	-	76.4	94.2	9.9	43.9	52.5	0.50	0.28	0.20	0.18	2.41	0.16	0.44
SegPop 316	Whole Plant (est.)	23.6	76.4	94.2	10.8	40.6	56.3	0.54	0.32	0.20	0.22	2.08	0.16	0.37

Table 7B. *In situ* dry matter disappearance (%ISDMD) of forage samples from 1999 replicated plots at forage harvest on 7/23/99 at Fort Ellis.

		Low	High	Mean
MT-25FWW (632Bulk$_1$)	Whole Plant	-	-	46.4
MT-26FWW (633Bulk$_1$)	Whole Plant	-	-	46.4
"639"	Whole Plant	-	-	**49.9**
"191303"	Whole Plant	-	-	48.6
"SegPop-30" (10 headrows)	Whole Plant	47.4	**58.3**	**51.1**
"SegPop-316" (10 headrows)	Whole Plant	43.9	**52.5**	47.9
Tiber	Whole Plant	-	-	47.8*
Sindelar light spelt	Whole Plant	-	-	41.1
320-6 spelt	Whole Plant	-	-	42.4
	Trial Mean		48.5	
	lsd (P = 0.05)		9.0	
	CV%		9.3	

*These data were fairly correlated with grain maturity; Tiber was in mid-dough and SegPop-30 was in early dough.

Table 7C. Forage quality of MT-26FWW lot 03-02 at Willow Creek, MT in 2004. Forage quality on 100% DM basis, wet chemistry by MidWest Laboratories.

%DM	CP%	ADF%	NDF%	TDN%	NO3-N%
92.2	9.6	43.2	51.3	53.5	0.01