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MEMORANDUM:

To: Wheat Cultivar Release & Recommendation Committee

From: Joyce Eckhoff

Date: January 9, 2011

RE: Proposal for protected MAES public (F.2.b) cultivar release of MT03012 durum

Motion: That MT 03012 durum wheat be approved for release in 2012.

Pedigree: MT03012 is a line selected from a Male Sterile Facilitated Recurrent Selection composite cross population. The population was a blend of several MSFRS populations from Arizona that were first grown at the Eastern Agricultural Research Center in 1987. This population has been maintained annually at the EARC since 1996 by crossing varieties adapted to the area onto male sterile plants, and by harvesting seed set on male sterile plants.

Recommendation: Protected MAES public release (F.2.b).

Name: To be named 'Silver'

Selection history: MT03012 was selected as a single head from an F₂ generation in 2000. Seed from the selected plant were grown in the greenhouse in the winter of 2000-01. The progeny produced seed during the winter months and were considered to be day length insensitive. The line was advanced using head rows, and was selected from an F₆ head row in 2003.

Table 1. Description of nurseries and data sets describing the performance of MT03012 in Montana, 2005-2011.

Year	Trial	Loc. planted	Loc. harvested	Loc. for quality eval.
2005	Early yield #1	3	3	2
2006	Statewide durum yield	10	10	10
2007	Statewide durum yield	9	8	6
2008	Statewide durum yield	8	7	6
2009	Statewide durum yield	8	8	7
2010	Statewide durum yield	8	7	7
2011	Statewide durum yield	8	8	8 pending
Total		54	51	38 + 8 pending

Characteristics/comparisons:

Yield: Yield in bu/ac of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 2. When all sites were considered, MT03012 yielded 3.1 bu/ac less than Mountrail in 51 location years. . MT03012 had significantly greater yield than Mountrail in 2 location years (3.9%), was not significantly different from Mountrail in 38 location years (74.5%) and was significantly lower than Mountrail 11 times (21.6%). When dryland sites only were considered, MT03012 yielded 1 bu/ac less than Mountrail in 43 location years. MT03012 had significantly greater yield than Mountrail in 2 location years (4.7%), was not significantly different from Mountrail in 36 location years (83.7%) and was significantly lower than Mountrail 5 times (11.6%).

Yield in bu/ac of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 3a. When analyzed across years and sites, MT03012 yielded significantly less than Mountrail. Yield in bu/ac of MT03012 compared to Mountrail, Alkabo and Grenora across years at dryland sites only using a paired t-test is shown in Table 3b. There was no significant difference in yield between Mountrail and MT03012 on the dryland sites.

Test weight: Test weight in lb/bu of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 4. In 51 location years, test weight of MT03012 was 0.5 lb/bu greater than Mountrail. . MT03012 had significantly greater test weight than Mountrail in 7 location years (16.3%), was not significantly different from Mountrail in 31 location years (72.1%) and was significantly lower than Mountrail in 5 location years (11.6%).

Test weight in lb/bu of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 5. There was no significant difference between MT03012 and Mountrail in test weight across years and locations.

Grain protein: Grain protein as percent of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 6. In 52 location years, grain protein of MT03012 was 0.19% lower than Mountrail. MT03012 had significantly greater test weight than Mountrail in 3 location years (20.0%), was not significantly different from Mountrail in 11 location years (73.3%) and was significantly lower than Mountrail once (6.7%).

Grain protein as percent of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 7. There was no significant difference between MT03012 and Mountrail in grain protein across years and locations.

Maturity: Maturity as days from planting until heading of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 8. In 52 location years, maturity of MT03012 was 3.7 days earlier than Mountrail. MT03012 was not significantly different from Mountrail in 2 location years (5.7%) and was significantly lower than Mountrail 35 times (94.6%).

Maturity as days from planting until heading of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 9. MT03012 was significantly earlier in maturity than Mountrail.

Plant height: Plant height in cm of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 10. In 51 location years, height of MT03012 was 12.9 cm less than Mountrail. MT03012 was not significantly different from Mountrail in 10 location years (26.3%) and was significantly shorter than Mountrail 28 times (73.7%).

Plant height in cm of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 11. MT03012 was significantly shorter than Mountrail across years and locations.

Stem solidness & tolerance to sawfly cutting: Percent cutting by sawfly of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 12. In 9 location years, cutting of MT03012 was 4.1% lower than Mountrail. MT03012 not significantly different from Mountrail in percent sawfly cutting in 5 location years (55.6%) and was significantly lower than Mountrail 4 times (44.4%).

Percent cutting by sawfly of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 13. There was no significant difference between MT03012 and Mountrail in sawfly cutting across years and locations.

Stem solidness of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 14. MT03012 had significantly more solid stems than Mountrail at 2 location years (50.0%) and was not significantly different from Mountrail at 2 location years (50.0%).

Semolina extraction: Semolina extraction as percent of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 15. In 38 location years, semolina extract of MT03012 was 0.4 % lower than extraction of Mountrail.

Semolina extraction as percent of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 16. There was no significant difference between MT03012 and Mountrail in semolina extraction across years and locations.

Semolina color: Semolina color of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 17. In 38 location years, semolina color of MT03012 was 0.1 greater than Mountrail.

Semolina color of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 18. There was no significant difference between MT03012 and Mountrail in semolina color across years and locations.

Mixograph score: Mixograph score of MT03012 compared to Mountrail, Alkabo and Grenora across years is shown in Table 19. In 38 location years, mixograph score of MT03012 was 2.4 greater than Mountrail.

Mixograph score of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test is shown in Table 20. MT03012 had significantly greater mixograph score than Mountrail across years and locations.

Table 2. Yield of MT03012 in bu/ac as compared to Mountrail, Alkabo and Grenora.

	2005	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007
entry	Williston	Sidney Dry	Sidney Irr	Williston	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Moore	Huntley	Bozeman	Williston
Mountrail	57.3	69.0	69.3	25.5	34.4	88.3	79.3	63.2	25.8	31.5	16.6	39.0	57.1	37.1
Alkabo	56.7	67.0	69.3	25.5	35.8	87.2	75.1	64.1	27.1	37.0	17.0	31.5	55.6	40.4
Grenora	56.7	67.3	68.7	25.7	32.4	83.4	83.7	63.0	29.7	39.0	15.8	35.3	58.4	38.1
MT03012	55.7	65.7	67.3	23.1	32.3	70.1	77.5	65.0	29.9	29.4	16.2	36.6	59.5	33.7
average	38.8	41.5	78.9	23.2	32.8	76.7	82.5	62.7	29.2	33.1	15.7	33.3	56.6	32.5
CV (S/mean)	6.8	9.1	8.7	6.0	8.6	5.3	7.2	10.5	12.0	9.0	7.5	9.7	4.6	4.86
LSD 0.05	4.3	6.2	11.3	2.3	4.6	6.7	9.8	NS	5.8	4.9	1.9	5.3	4.2	2.6

	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
entry	Sidney Dry	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston	Williston	Sidney Dry	Sidney Irr	Conrad Dry	Moccasin	Havre
Mountrail	51.9	86.6	35.3	36.5	29.8	73.7	44.5	30.3	31.5	109.1	36.8	11.7	39.8	
Alkabo	47.6	87.8	41.3	35.0	29.0	71.9	46.2	30.9	32.1	109.1	40.3	19.0	40.5	
Grenora	48.8	88.4	39.7	37.0	30.1	74.2	43.4	29.0	32.4	82.8	41.6	14.9	41.4	
MT03012	45.7	74.3	37.8	36.5	27.0	68.2	48.9	31.9	32.6	79.9	39.9	15.9	44.5	
average	44.7	82.6	38.2	37.2	29.4	70.1	43.4	30.4	33.2	88.9	45.3	17.7	44.6	
CV (S/mean)	8.8	7.84	10.4	10.4	7.7	6.8	8.05	5.6	7.2	14.3	8.3	31.1	6.9	
LSD 0.05	6.4	10.7	6.6	6.4	3.7	NS	5.8	2.8	4.0	8.2	6.2	NS	5.0	

	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010	2010
entry	Huntley	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	
Mountrail	62.1	45.4	29.8	99.9	83.2	74.9	26.9	41.1	55.9	35.6	57.3	61.2	78.4	
Alkabo	63.3	43.8	27.3	96.7	73.6	67.5	29.1	41.4	49.2	35.7	55.9	59.4	83.4	
Grenora	60.8	46.2	30.0	106.6	78.5	72.8	26.5	42.8	54.8	35.6	58.3	70.5	89.5	
MT03012	61.8	41.1	29.5	83.8	75.8	69.9	27.9	40.1	49.2	31.8	43.8	43.9	68.8	
average	62.2	41.9	30.1	90.8	71.5	74.1	27.9	43.1	51.7	32.5	54.1	49.5	78.7	
CV (S/mean)	7.1	6.1	8.2	7.6	6.8	13.3	9.0	9.03	10.5	8.4	5.8	11.8	6.708	
LSD 0.05	NS	4.2	4.0	11.3	7.9	16.2	4.1	6.4	NS	4.5	6.6	9.6	8.7	

Table 2 (continued).

entry	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011	Average	Average
	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley	Bozeman	All sites	Dryland sites
Mountrail	41.8	58.0	82.8	32.9	41.1	54.5	60.8	20.3	39.4	54.5	50.4	51.0	45.4
Alkabo	44.4	60.7	91.2	34.7	38.1	49.7	68.1	20.3	39.5	58.0	51.0	51.0	45.8
Grenora	39.9	57.7	78.3	34.1	37.7	54.0	67.2	18.3	36.5	59.3	50.9	51.1	45.8
MT03012	38.3	55.3	84.3	31.0	35.4	33.2	76.9	21.1	40.4	61.7	51.1	47.9	44.4
average	41.4	60.7	83.4	28.4	34.6	39.16	60.8	19.6	37.5	55.4	47.6		
CV (S/mean)	8.0	7.8	6.1	9.1	11.9	11.3	15.3	18.6	9.3	5.2	8.07		
LSD 0.05	NS	7.8	8.4	4.3	6.8	7.3	15.4	6.0	5.8	4.7	6.4		

Indicates MT03012 significantly greater than Mountrail

Indicates MT03012 significantly lower than Mountrail

Tables 3a and 3b. Yield of MT03012 in bu/ac as compared to Mountrail, Alkabo and Grenora across years. Table 3a compares all sites across years using a paired t-test. Table 3b compares dryland sites only across years using a paired t-test.

All sites			
	n	diff	probability
Mountrail	51	-3.1	0.005
Alkabo	51	-3.1	0.002
Grenora	51	-3.2	0.003

Dryland sites			
	n	diff	probability
Mountrail	43	-1	0.219
Alkabo	43	-1.4	0.055
Grenora	43	-1.4	0.086

	number	percent
greater than Mountrail	2	3.9
same as Mountrail	38	74.5
lower than Mountrail	11	21.6
total	51	

	number	percent
greater than Mountrail	2	4.7
same as Mountrail	36	83.7
lower than Mountrail	5	11.6
total	43	

Table 4. Test weight in lb/bu of MT03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007
entry	Williston	Sidney Dry	Sidney Irr	Williston	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Moore	Huntley	Bozeman	Williston
Mountrail	60.7	59.5	60.3	56.6	57.3	61.0	60.3	59.4	55.0	58.4	52.0	59.5	58.0	58.3
Alkabo	62.0	60.7	61.7	58.8	57.5	60.8	61.3	61.1	54.6	61.5	54.2	59.9	59.7	60.0
Grenora	60.7	59.2	60.7	57.0	56.7	60.2	60.4	59.9	55.7	60.2	52.6	59.8	59.7	58.8
MT03012	61.3	58.5	59.5	58.3	57.8	60.0	62.7	61.9	55.4	58.5	53.8	59.8	60.3	59.2
average	60.8	59.4	59.6	57.2	57.3	60.4	61.2	60.0	55.2	58.8	52.8	59.3	59.2	58.1
CV (S/mean)	0.4	1.3	1.8	0.6	1.8	0.9			2.8	1.1	1.2	1.3		0.6
LSD 0.05	0.5	1.2	1.7	0.7	1.7	0.9			2.6	1.4	1.4	1.3		0.8

	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008
entry	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston	Sidney Dry	Sidney Irr	Conrad Dry	Moccasin	
Mountrail	61.5	60.2	61.3	57.5	58.1	55.0	63.4	56.3	56.5	57.3	62.8	59.6	56.8	
Alkabo	62.7	61.0	61.9	59.9	58.9	58.0	63.5	58.4	59.4	59.0	64.2	61.2	60.7	
Grenora	61.8	59.8	61.2	58.5	57.9	56.9	63.2	57.5	57.8	58.3	62.8	60.7	59.9	
MT03012	62.5	59.3	62.7	59.1	57.9	54.6	64.0	58.7	57.0	58.0	62.7	59.7	57.5	
average	61.7	58.0	61.3	58.1	58.2	55.7	63.5	57.7	57.7	58.1	62.9	60.8	58.64	
CV (S/mean)	0.9	2.0			1.0	1.3	0.6		0.5	1.0	1.0		1.5	
LSD 0.05	0.9	1.8			1.0	1.5	0.6		0.6	1.0	1.0		1.9	

	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010	2010
entry	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	
Mountrail	55.7	60.7	62.0	61.8	62.5	60.8	63.1	59.0	58.4	60.8	58.2	60.8	57.3	62.1	
Alkabo	58.3	63.0	63.3	62.3	63.8	61.5	63.8	60.6	58.6	60.8	60.5	61.3	57.5	63.1	
Grenora	57.4	62.9	63.1	61.5	62.0	60.7	63.9	59.4	57.5	60.0	58.4	60.0	57.8	62.8	
MT03012	55.6	61.9	62.5	62.3	61.0	61.0	63.9	58.2	58.2	60.4	58.0	60.0	54.3	61.4	
average	57.1	61.8	62.0	62.1	61.7	60.6	63.2	58.8	58.6	61.1	58.0	60.4	55.3	61.7	
CV (S/mean)	1.4	0.9	0.4	0.8	0.5		1.4	0.8	0.6	0.5	0.5	0.7	2.9	0.949	
LSD 0.05	1.3	1.0	0.6	0.9	0.5		1.5	1.0	0.5	0.5	0.7	0.9	2.7	1.0	

Table 4 (continued).

entry	2010 Moccasin	2010 Havre	2010 Huntley	2011 Williston	2011 Sidney Dry	2011 Sidney Irr	2011 Conrad	2011 Moccasin	2011 Havre	2011 Huntley	2011 Bozeman	Average All sites	Average Dryland sites
Mountrail	59.9	58.4	63.2	59.0	61.0	59.8	58.9	55.2	59.9	56.7	61.6	59.2	58.9
Alkabo	62.2	58.7	64.2	60.1	62.0	60.3	61.0	58.7	60.9	58.1	61.4	60.5	60.4
Grenora	60.7	58.0	64.0	58.3	60.7	60.2	60.2	56.9	60.6	56.5	61.2	59.7	59.5
MT03012	59.5	56.6	63.5	57.5	60.5	56.8	60.6	57.1	60.4	57.7	62.5	59.5	59.4
average	60.5	57.9	63.4	57.8	60.3	57.37	59.1	57.4	60.0	57.0	61.2		
CV (S/mean)	1.1	1.0	0.5	1.4	1.1	1.7	2.2	1.2	0.7	1.4			
LSD 0.05	1.4	1.0	0.5	1.7	1.1	1.6	2.2	1.5	0.7	1.3			

Indicates MT03012 significantly greater than Mountrail

Indicates MT03012 significantly lower than Mountrail

Table 5. Test weight in lb/bu of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability
Mountrail	52	0.3	0.151
Alkabo	52	-1.0	<0.001
Grenora	52	-0.2	0.259

	number	percent
greater than Mountrail	7	16.3
same as Mountrail	31	72.1
lower than Mountrail	5	11.6
total	43	

Table 6. Grain protein content as percent of MT03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007
entry	Williston	Sidney Dry	Sidney Irr	Williston	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Moore	Huntley	Bozeman	Williston
Mountrail	16.9	14.05	13.62	16.11	14.35	11.59	12.86	14.39	18.28	14.67	19.81	14.88	14.23	15.01
Alkabo	16.5	13.84	13.56	15.86	14.89	11.91	13.20	13.25	17.76	13.70	18.95	14.84	14.22	14.52
Grenora	16.7	13.97	13.55	15.29	13.63	12.10	13.62	13.39	17.56	13.21	19.33	14.39	13.93	14.65
MT03012	17.2	14.03	13.95	16.07	14.06	12.33	11.95	13.44	16.63	15.44	18.75	14.88	13.83	14.66
average	16.9	13.92	13.62	15.64	14.10	12.01	13.0	13.50	17.46	14.44	19.21	14.57	14.03	14.47
CV (S/mean)	1.5	3.7	3.4		4.9	3.8								
LSD 0.05	0.5	0.83	0.75		1.14	0.75								

	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008
entry	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston	Sidney Dry	Sidney Irr	Conrad Dry	Moccasin	
Mountrail	12.08	15.24	13.99	15.33	16.10	16.17	9.85	16.00	15.33	14.75	11.17	12.57	14.51	
Alkabo	12.23	15.26	13.93	14.54	15.44	15.54	9.31	15.91	14.47	14.39	10.95	12.28	13.15	
Grenora	12.70	14.95	13.83	14.75	15.66	14.95	10.52	15.37	15.17	14.65	11.57	12.73	12.97	
MT03012	11.95	15.71	13.51	14.97	16.04	15.47	11.42	14.75	15.30	14.24	11.77	12.82	13.53	
average	12.04	15.41	13.60	14.71	15.63	15.39	10.42	15.15	14.86	14.36	11.18	12.25	13.28	
CV (S/mean)	4.3	2.9								3.1	5.2			
LSD 0.05	0.85	0.73								0.73	0.96			

	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010	2010
entry	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	
Mountrail	17.23	12.10	13.48	14.60	13.70	12.77	12.84	15.40	13.78	13.12	15.41	11.88	12.88	11.75	
Alkabo	16.28	11.2	13.43	14.31	12.81	12.58	13.01	14.38	14.34	12.25	14.92	12.01	13.01	11.83	
Grenora	15.83	11.6	13.25	13.96	14.13	12.27	12.57	14.08	13.78	13.42	14.83	12.69	13.08	12.12	
MT03012	16.01	12.40	13.33	13.46	13.67	12.76	12.42	14.60	13.78	14.19	14.40	12.92	13.91	11.73	
average	15.70	12.00	13.34	13.70	13.49	12.09	12.50	14.64	13.78	12.71	14.47	12.58	13.57	11.69	
CV (S/mean)				3.2	4.6							3.6	1.8		
LSD 0.05				0.71	1.0							0.94	0.40		

Table 6 (continued).

entry	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011	Average	Average
	Havre	Moccasin	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley	Bozeman	All sites	Dryland sites
Mountrail	11.96	12.21	11.31	14.41	15.77	15.08	13.46	16.08	15.03	15.40	11.38	14.17	14.34
Alkabo	11.85	11.26	10.70	13.95	16.09	15.34	13.05	16.43	15.24	14.79	13.31	13.90	14.02
Grenora	11.86	11.62	10.95	13.92	15.79	15.34	13.49	15.24	14.37	14.56	14.55	13.93	14.01
MT03012	12.52	12.61	11.14	14.46	15.90	16.31	13.39	14.90	14.64	14.82	12.75	14.07	14.15
average	11.73	12.00	10.79	14.24	15.77	15.83	13.43	15.00	14.67	14.54	12.74		
CV (S/mean)					3.0	2.1							
LSD 0.05					0.79	0.55							

Indicates MT03012 significantly greater than Mountrail

Indicates MT03012 significantly lower than Mountrail

Table 7. Grain protein content as percent of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability
Mountrail	52	-0.10	0.332
Alkabo	52	0.17	0.118
Grenora	52	0.14	0.135

	number	percent
greater than Mountrail	3	20.0
same as Mountrail	11	73.3
lower than Mountrail	1	6.7
total	15	

Table 8. Maturity (days from planting until heading) of MT 03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007
entry	Williston	Sidney Dry	Sidney Irr	Williston	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston
Mountrail	57.3	69.0	69.3	53.0	55.0	53.0	67	70	67.7	73.7	63.3	61	58.7
Alkabo	56.7	67.0	69.3	52.0	55.3	51.7	68	69	64.3	73.3	63.3	60	57.3
Grenora	56.7	67.3	68.7	51.3	54.0	51.3	67	69	65.7	72.7	62.7	60	56.7
MT03012	55.7	65.7	67.3	53.0	52.0	48.0	63	63	60.0	70.3	59.0	57	57.0
average	57.4	67.8	69.3	52.4	54.2	51.0	66.3	68.4	64.8	73.3	62.6	60.0	58.7
CV (S/mean)	1.0	1.1	0.9	1.0	1.2	1.6			1.9	0.7	0.9		0.6
LSD 0.05	0.9	1.2	1.0	0.9	1.1	1.4			2.0	0.9	1.0		0.8

	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008
entry	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad Dry	Havre
Mountrail	61.3	55.0	62	63	61.0	71.7	86.0	65	63.0	67.0	59.7	61	67	67.0
Alkabo	60.7	54.7	62	62	58.7	71.3	85.7	65	61.3	67.0	58.0	61	65	67.3
Grenora	60.0	54.3	62	62	60.0	71.7	85.3	65	62.0	66.0	59.0	60	65	67.7
MT03012	58.0	54.0	59	60	57.0	68.0	80.3	62	58.0	63.0	56.7	59	61	65.3
average	60.2	55.6	62.0	62.4	59.6	70.9	84.7	64.8	60.1	65.3	58.3	59.8	63.5	66.7
CV (S/mean)	1.5	1.2			0.8				1.3	1.3	1.5			0.4
LSD 0.05	1.5	1.1			2.4				1.3	1.4	1.4			1.1

	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010
entry	Moccasin	Huntley	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	
Mountrail	77.0	104.7	61.0	62.0	52.0	61	79	67.3	68.7	92.3	61.7	67.5	49.7	
Alkabo	76.3	102.7	59.0	61.3	51.7	60	78	66.0	67.3	92.7	61.0	67.0	49.0	
Grenora	76.3	102.3	59.3	61.7	51.0	60	78	67.0	68.0	91.0	60.7	66.5	48.0	
MT03012	73.7	98.7	55.0	57.7	48.0	58	76	63.3	64.0	87.0	58.0	64.0	48.3	
average	75.7	102.1	58.2	60.2	50.8	59.8	77.6	66.1	66.6	90.5	60.1	65.7	48.5	
CV (S/mean)	0.5	0.4	1.1	1.3	1.3			0.6	0.47	0.5	1.0	1.3	0.8	
LSD 0.05	1.4	1.2	1.0	1.2	1.1			1.8	1.4	1.3	1.0	1.8	0.7	

Table 8 (continued).

entry	2010	2010	2010	2011	2011	2011	2011	2011	2011	2011	2011	2011	Average
	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley	Bozeman	All sites
Mountrail	61	84	71.3	84.0	54.3	55.0	58.7	74.0	80.7	69.3	78.7	64	66.6
Alkabo	60	83	70.7	83.0	54.0	54.0	58.7	72.3	80.0	68.7	78.0	62	65.8
Grenora	60	83	70.7	81.3	53.7	54.3	55.7	71.3	80.0	70.3	78.3	62	65.6
MT03012	56	81	68.7	79.3	52.3	50.0	55.0	67.0	76.0	66.7	73.7	59	62.9
average	59.7	83.1	70.2	81.7	53.8	53.3	57.7	71.0	79.4	68.9	76.9	62.1	
CV (S/mean)			0.5		0.8	1.8	1.1	0.6	0.6	0.6	2.0		
LSD 0.05			1.5		0.7	1.6	1.0	1.9	0.8	1.9	0.2		

Indicates MT03012 significantly greater than Mountrail

Indicates MT03012 significantly lower than Mountrail

Table 9. Maturity (days from planting until heading) of MT 03012 compared to Mountrail, Alkabo and Grenora across years using paired t-test.

	n	diff	probability
Mountrail	52	-3.7	<0.001
Alkabo	52	-2.9	<0.001
Grenora	52	-2.7	<0.001

	number	percent
greater than Mountrail	0	0.0
same as Mountrail	2	5.7
lower than Mountrail	35	94.6
total	37	

Table 10. Plant height in cm of MT03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007
entry	Williston	Sidney Dry	Sidney Irr	Williston	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Moore	Huntley	Bozeman	Williston
Mountrail	69.0	68.0	89.7	65.3	69.7	82.7	99.1	96.5	65.0	81.0	63	82.2	89.7	72.0
Alkabo	73.0	76.0	89.3	59.0	69.0	82.7	91.4	91.4	60.2	80.0	75	73.2	84.7	77.3
Grenora	66.0	65.7	88.0	62.0	71.7	88.7	94.0	91.4	68.8	83.7	75	76.9	90.2	74.0
MT03012	60.7	65.0	79.7	55.7	58.0	71.3	73.7	68.6	57.7	70.0	61	69.4	67.8	69.3
average	59.6	62.6	79.0	59.1	66.0	80.3	86.1	84.1	63.4	77.1	70.8	73.6	81.5	68.1
CV (S/mean)	6.1	7.1	5.6	6.3	5.1	6.9			9.5	9.3		3.5	4.39	4.0
LSD 0.05	6.0	7.2	7.3	6.1	5.5	9.1			9.9	11.8		4.2	5.9	4.5

	2007	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	2008	2008	2008
entry	Sidney Dry	Sidney Irr	Conrad Irr	Conrad Dry	Havre	Moccasin	Huntley	Bozeman	Williston	Sidney Dry	Sidney Irr	Conrad Dry	Moccasin	
Mountrail	81.3	85.3	88.9	71.1	66.1	86	98.3	90.0	67.3	62.3	92.3	76.2	57.3	
Alkabo	75.7	77.7	96.5	68.6	66.1	89	94.7	88.0	65.7	67.0	83.3	81.3	61.0	
Grenora	78.3	81.7	86.4	68.6	61.7	83	92.5	85.0	60.0	64.3	69.7	76.2	54.7	
MT03012	63.0	75.7	71.1	63.5	57.9	68	72.1	71.8	59.7	58.0	64.0	68.6	56.3	
average	68.1	75.1	78.4	65.4	62.7	75.0	82.6	76.8	61.1	63.4	71.1	71.3	57.3	
CV (S/mean)	8.9	5.2			7.4				6.7	4.9	7.7		8.5	
LSD 0.05	9.9	6.3			6.1				2.6	5.1	9.0		8.1	

	2008	2008	2009	2009	2009	2009	2009	2009	2009	2009	2009	2010	2010	2010	2010
entry	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Bozeman	Conrad	Moccasin	Havre	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	
Mountrail	83.8	103.9	63.7	51.0	88.7	88.6	81.3	64.7	70.5	91.2	83.0	71.5	89.3	110.3	
Alkabo	82.9	99.8	64.0	49.0	86.3	86.4	78.7	68.7	67.1	91.7	80.0	74.0	85.7	104.3	
Grenora	77.4	94.7	64.7	50.0	81.3	79.8	76.2	64.3	66.3	82.3	76.7	75.0	84.3	100.0	
MT03012	72.6	75.4	61.3	46.7	72.3	69.6	66.0	54.3	61.1	73.7	69.0	59.0	73.0	77.0	
average	73.7	86.3	57.6	47.7	75.0	79.9	58.9	57.4	62.8	81.5	71.7	67.3	77.3	87.4	
CV (S/mean)	5.67	5.5	5.6	6.0	4.3			9.3	4.8		4.3	8.1	4.8	2.833	
LSD 0.05	2.7	3.1	5.3	4.7	5.3			8.8	5.0		5.1	11.4	6.1	4.1	

Table 10 (continued).

entry	2010 Moccasin	2010 Havre	2010 Huntley	2011 Williston	2011 Sidney Dry	2011 Sidney Irr	2011 Conrad	2011 Moccasin	2011 Huntley	2011 Bozeman	Average Dryland sites
Mountrail	87.7	91.9	108.2	69.3	62.0	68.3	99.0	61.0	96.5	84.5	80.0
Alkabo	89.7	91.3	102.6	69.0	64.7	71.3	99.3	61.0	96.8	85.2	79.7
Grenora	83.3	86.7	96.0	69.7	62.0	66.3	91.7	57.0	95.8	80.5	77.2
MT03012	69.0	76.1	86.1	66.7	56.0	58.7	74.7	53.0	74.9	71.0	67.1
average	76.2	81.0	90.5	64.3	58.8	63.9	81.7	57.0	83.3	75.1	
CV (S/mean)	3.5	3.9		6.1	6.0	5.6	3.7	10.7	2.4	6.6	
LSD 0.05	4.4	5.3		6.5	5.8	6.0	5.0	10.0	1.3	8.2	

Indicates MT03012 significantly greater than Mountrail

Indicates MT03012 significantly lower than Mountrail

Table 11. Plant height in cm of MT03012 compared to Mountrail, Alkabo and Grenora. across years using a paired t-test.

	n	diff	probability
Mountrail	51	-12.9	<0.001
Alkabo	51	-12.6	<0.001
Grenora	51	-10.1	<0.001

	number	Percent
greater than Mountrail	0	0.0
same as Mountrail	10	26.3
lower than Mountrail	28	73.7
total	38	

Table 12. Percent sawfly cutting of MT03012 compared to Mountrail, Alkabo and Grenora.

Sawfly, % cut entry	2006	2006	2007	2008	2009	2009	2010	2011	2011	average
	Moore	Havre	Havre	Havre	Havre	Moccasin	Havre	Havre	Moccasin	
Mountrail	1.0	2.3	2.3	30.0	18.3	5.0	18.3	30.0	6.0	12.6
Alkabo	0.8	2.3	3.7	30.0	21.7	4.5	26.7	30.0	4.7	13.8
Grenora	0.3	2.3	2.3	38.3	20.0	2.5	16.7	25.0	4.3	12.4
MT03012	0.0	1.0	1.0	6.7	11.7	0.5	23.3	30.0	2.0	8.5
average	0.5	1.5	1.5	18.5	10.0	1.2	11.3	18.8	2.2	
CV (S/mean)	95.1	131.9	89.1	59.7	39.73	77.7	63.0	30.4	47.2	
LSD 0.05	1.1	2.3	2.2	18.2	6.5	2.0	11.7	9.5	1.7	

Table 13. Percent sawfly cutting of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability		number	percent
Mountrail	9	-4.1	0.156	greater than Mountrail	0	0.0
Alkabo	9	-5.3	0.060	same as Mountrail	5	55.6
Grenora	9	-3.9	0.322	lower than Mountrail	4	44.4
				total	9	

Table 14. Stem solidness of MT03012 compared to Mountrail, Alkabo and Grenora.

stem solidness entry	2009	2009	2010	2010	average
	Sidney Dry	Sidney Irr	Sidney Dry	Sidney Irr	
Mountrail	13.7	7.5	11.3	10.7	10.8
Alkabo	9.4	7.0	10.7	7.8	8.7
Grenora	14.4	10.8	13.5	10.8	12.4
MT03012	18.4	13.8	12.5	10.4	13.8
average	13.4	10.1	12.6	11.6	
CV (S/mean)	16.3	19.1	16.8	19.3	
LSD 0.05	3.6	3.2	4.4	3.7	

Indicates MT03012 significantly greater than Mountrail Indicates MT03012 significantly lower than Mountrail

Table 15. Semolina extraction as percent of M03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007
entry	Sidney Dry	Sidney Irr	Bozeman	Conrad Irr	Moccasin	Moore	Conrad, Dry	Huntley	Havre	Sidney Dry	Sidney Irr	Williston	Bozeman	Havre
Mountrail	60.6	63.9	59.6	61.4	57.5	52.6	57.9	59.4	51.2	52.6	57.6	51.9	65.9	65.6
Alkabo	61.6	64.4	59.4	62.0	59.0	52.1	62.3	55.9	51.6	51.9	57.2	51.2	65.0	64.3
Grenora	60.5	63.9	59.7	59.4	56.1	49.8	58.2	56.3	48.4	51.6	56.5	49.8	64.6	64.6
MT03012	59.7	65.9	59.0	61.7	56.8	53.7	59.5	57.6	50.5	53.2	54.8	51.4	65.0	63.3
average	61.0	63.6	59.8	61.0	57.8	52.5	58.9	58.3	50.6	53.2	56.2	51.6	65.3	64.6
	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009
entry	Moccasin	Williston	Sidney- Dry	Sidney- Irr	Conrad	Huntley	Havre	Williston	Sidney dry	Sidney irr	Williston	Sidney Irr	Conrad	
Mountrail	59.0	66.8	67.3	67.9	61.0	64.2	58.7	57.9	61.0	68.8	66.8	69.2	65.4	
Alkabo	62.1	65.2	66.8	67.6	60.8	63.1	61.5	60.1	62.2	67.9	67.5	68.6	67.1	
Grenora	60.4	62.3	64.3	66.7	60.2	61.7	60.2	58.4	60.5	66.8	66.7	68.1	66.2	
MT03012	61.9	65.4	65.2	65.2	59.8	62.6	58.0	58.9	60.5	67.9	65.2	67.1	67.1	
average	61.7	63.9	66.5	63.7	61.3	62.5	59.3	59.2	60.5	67.5	65.3	67.7	66.4	
	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	average	
entry	Bozeman	Havre	Moccasin	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley			
Mountrail	70.0	67.5	62.4	62.4	61.1	64.4	65.7	68.9	59.3	65.4	66.0	62.2		
Alkabo	67.5	66.2	63.7	63.1	61.6	64.9	63.6	68.1	56.5	65.1	66.7	62.3		
Grenora	67.8	64.8	62.6	62.1	60.8	63.9	64.4	66.4	60.8	64.4	64.3	61.2		
MT03012	69.1	65.4	63.7	64.0	61.2	63.6	62.5	67.8	61.4	63.5	67.5	61.8		
average	67.7	65.5	63.3	64.7	60.3	64.4	62.9	67.3	61.8	64.2	66.3	62.2		

Table 16. Semolina extraction as percent of M03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability
Mountrail	38	-0.4	0.075
Alkabo	38	-0.5	0.065
Grenora	38	0.6	0.015

Table 17. Semolina color of MT03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007
entry	Sidney Dry	Sidney Irr	Bozeman	Conrad Irr	Moccasin	Moore	Conrad Dry	Huntley	Havre	Sidney Dry	Sidney Irr	Williston	Bozeman	Havre
Mountrail	24.7	22.9	23.5	22.6	23.5	23.0	23.4	23.4	22.0	22.9	20.8	21.7	21.5	21.0
Alkabo	28.1	27.0	25.4	25.2	25.2	24.4	25.6	25.1	24.3	25.0	23.8	23.2	24.0	23.0
Grenora	26.1	25.5	25.1	24.9	25.4	24.2	25.5	25.0	24.4	24.5	22.8	23.8	23.6	23.0
MT03012	25.6	24.3	22.4	22.7	22.6	21.6	22.9	22.5	22.0	22.6	22.8	20.9	21.1	20.9
average	25.3	23.4	23.8	23.8	24.0	23.1	24.2	23.5	23.0	23.2	22.3	21.9	22.3	21.7

	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009
entry	Moccasin	Williston	Sidney Dry	Sidney Irr	Conrad	Huntley	Havre	Williston	Sidney dry	Sidney irr	Williston	Sidney Irr	Bozeman	Havre	
Mountrail	22.4	21.5	20.4	20.0	22.1	22.0	22.0	21.9	21.4	19.7	23.3	20.1	21.0	24.8	
Alkabo	24.4	23.5	23.2	22.2	24.3	23.9	24.2	24.2	23.8	23.1	28.0	25.1	26.3	27.5	
Grenora	24.4	23.6	22.9	22.3	23.6	23.5	24.0	23.8	22.5	22.7	27.2	24.5	25.4	27.3	
MT03012	21.1	20.9	21.7	20.3	21.7	22.0	21.3	21.1	20.5	20.8	23.7	22.2	22.4	23.9	
average	22.6	21.9	21.9	21.3	23.0	22.9	22.6	22.5	21.8	21.5	25.8	23.8	24.6	26.3	

	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	average
entry	Conrad	Moccasin	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley		
Mountrail	22.5	24.8	21.8	26.3	23.4	23.5	22.9	27.1	22.4	24.1	22.6	
Alkabo	25.3	27.0	25.9	30.2	26.9	28.3	27.0	30.1	27.5	28.0	25.5	
Grenora	25.6	26.4	24.2	28.9	26.2	27.1	26.5	30.8	26.5	27.8	25.0	
MT03012	23.8	23.5	23.0	25.3	25.2	25.1	24.3	24.8	24.8	25.6	22.7	
average	24.8	26.5	24.4	28.1	26.4	26.6	26.3	28.6	26.5	27.2		

Table 18. Semolina color of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability
Mountrail	38	0.1	0.424
Alkabo	38	-2.8	<0.001
Grenora	38	-2.3	<0.001

Table 19. Mixograph scores of MT03012 compared to Mountrail, Alkabo and Grenora.

	2005	2005	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006	2007	2007
entry	Sidney Dry	Sidney Irr	Bozeman	Conrad, Irr	Moccasin	Moore	Conrad, Dry	Huntley	Havre	Sidney, Dry	Sidney, Irr	Williston	Bozeman	Havre
Mountrail	2	2	3	1	3	3	3	2	4	3	3	4	3	3
Alkabo	4	4	3	3	2	5	3	4	6	5	4	6	7	6
Grenora	4	5	3	4	2	6	3	2	6	4	4	5	6	6
MT03012	7	6	2	4	4	2	4	5	6	6	5	5	4	5

	2007	2007	2007	2007	2008	2008	2008	2008	2008	2008	2009	2009	2009	2009
entry	Moccasin	Williston	Sidney Dry	Sidney Irr	Conrad	Huntley	Havre	Williston	Sidney dry	Sidney irr	Williston	Sidney Irr	Bozeman	Havre
Mountrail	3	3	3	3	4	3	5	5	5	3	3	2	3	3
Alkabo	7	5	4	5	5	4	7	6	6	4	6	3	6	6
Grenora	5	4	4	5	5	4	6	6	6	5	6	3	5	6
MT03012	4	4	4	5	5	7	8	7	7	6	6	5	6	7

	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010	2010	average
entry	Conrad	Moccasin	Huntley	Williston	Sidney Dry	Sidney Irr	Conrad	Moccasin	Havre	Huntley		
Mountrail	3	3	4	3	2	2	2	4	3	2		3.0
Alkabo	4	7	4	7	2	3	3	4	4	2		4.6
Grenora	5	7	6	7	4	5	3	4	4	4		4.7
MT03012	5	7	6	7	6	6	5	6	6	4		5.4

Table 20. Mixograph scores of MT03012 compared to Mountrail, Alkabo and Grenora across years using a paired t-test.

	n	diff	probability
Mountrail	38	2.4	<0.001
Alkabo	38	0.8	0.009
Grenora	38	0.7	0.007