

PROJECT TITLE: MALT BARLEY YIELD TRIAL – 2007

PROJECT LEADER:

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COOPERATOR:

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OBJECTIVE: To select the best adapted experimental lines for release and to determine the best adapted varieties of malt barley for eastern Montana.

MATERIALS AND METHODS:

Dryland site:

Dryland:

Planted: Apr 23 Harvested: Jul 26
Soil type: Williams clay loam
Previous crops: 2006 - fallow, 2005 – safflower, 2004 - small grain plots
Residual soil N to 3 ft: 85 lb N/ac
Residual soil P to 6 in: 35 ppm
Applied fertilizer: None
Herbicides: BroxM (1.5 pt/ac) applied May 30

Precipitation April – August, 2007: 9.80 inches
Ave (59 yr) precipitation April – August: 9.46 inches
Precipitation September 2006 – August 2007: 15.90 inches
Ave (59 yr) precipitation September – August: 13.87 inches

Comments:

Above average precipitation and cool temperatures in May with standing water in some plots.
Hot and dry in July and August.

Irrigated:

Planted: May 3 Harvested: Aug 6
Soil type: Savage silty clay
Previous crops: 2006 – safflower, 2005 – sugarbeets, 2004 – barley
Residual soil N to 4 ft: 120 lb N/ac
Residual soil P to 6 in: 23 ppm
Applied fertilizer: none applied
Irrigated (sprinkler) on: June 28
Herbicides: BroxM (1 pt/ac) and Curtail (1.75 pt/ac) applied June 4

Precipitation April – August, 2007: 10.44 inches
Ave (59 yr) precipitation April – August: 9.46 inches
Precipitation September 2006 – August 2007: 15.90 inches
Ave (59 yr) precipitation September – August: 13.87 inches

Comments:

Above average precipitation and cool temperatures in May. Hail storm on June 17 damaged small grain plots, especially those early lines that were in the boot.

RESULTS:

Dryland: Agronomic data from the dryland malt barley yield trial are shown in Table 1. Four varieties yielded significantly more than the check variety, Harrington. Five-year summaries for yield, test weight, protein contents and percent plump seed are shown in Tables 2-5.

Irrigated: Agronomic data from the irrigated malt barley yield trial are shown in Table 6. Fourteen varieties yielded significantly less than the check variety, Harrington. Five-year summaries of yield, test weight, protein contents, percent plump, and lodging indices are shown in Tables 7-11.

FUTURE PLANS: New experimental lines and varieties of malt barley will continue to be tested under dryland and irrigated conditions to identify those which will perform best under these conditions. Closer cooperation with North Dakota State University will allow testing of experimental lines from North Dakota as well as from Montana, so that when those lines are released as varieties, information will be available as to their performance in this region.

Table 1. Agronomic data obtained from a malt barley yield trial conducted under dryland fallow conditions at the Eastern Agricultural Research Center, Sidney, Montana.

entry	heading*	height, cm	percent protein	test wt, lb/bu	percent plump	percent regular	yield, bu/ac	
Conrad	59.0	73.3	11.89	50.0	88.3	10.3	86.7	a
Xena	59.3	77.3	10.90	50.7	84.7	14.3	84.6	a
Geraldine	60.7	65.7	10.93	50.7	75.7	22.7	81.8	a
Eslick	58.7	72.3	12.24	49.3	75.0	23.3	81.8	a
Boulder	57.0	76.3	11.95	52.3	88.7	10.0	76.8	
Legacy	55.3	77.3	10.23	47.8	72.7	24.3	76.8	
Stellar	53.0	81.7	11.09	47.3	83.0	16.0	76.6	
Cargill 36	61.0	69.3	10.65	48.2	83.7	15.3	75.7	
Metcalfe	57.7	77.7	11.14	50.2	86.7	11.7	75.3	
Haxby	56.0	73.0	12.95	52.0	81.7	16.3	74.8	
Scarlett	63.0	62.7	10.83	48.8	88.0	10.7	73.9	
Drummond	54.3	81.7	11.62	47.8	77.3	22.0	73.9	
Hays	58.0	71.7	12.05	47.8	72.7	23.0	73.5	
Copeland	62.3	62.0	10.62	48.5	84.7	14.3	72.4	
Harrington	59.0	71.0	10.50	50.0	89.0	9.7	71.8	
Hockett	55.0	68.0	11.28	50.7	88.0	10.7	67.8	
Tradition	55.3	80.7	10.77	49.2	78.7	16.7	67.6	
Craft	57.7	77.3	12.43	51.3	89.3	9.3	67.0	
Merit	60.3	70.0	11.01	48.3	89.7	10.0	66.5	
Average	58.0	73.1	11.32	49.5	83.0	15.3	75.0	
probability	<0.001	0.008	0.003	<0.001	<0.001	<0.001	0.003	
CV (S/MEAN)	2.4	8.8	6.6	1.6	6.3	29.8	7.8	
CV (SE/MEAN)	1.4	5.1	3.8	0.9	3.7	17.2	4.5	
LSD (0.05)	2.3	10.7	1.24	1.3	8.7	7.5	9.7	

*days from planting

a indicates significantly greater yield than check variety, Harrington

Table 2. Relative yielding abilities of malt barley varieties in bu/ac as compared to Harrington when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Conrad	--	--	--	77.8	82.3	86.7	82.3	112.2
Xena	--	--	--	76.7	83.4	84.6	81.6	111.2
Haxby	85.3	--	111.4	84.5	81.1	74.8	87.4	110.1
Eslick	--	--	--	81.9	76.5	81.8	80.1	109.2
Stellar	--	--	--	83.8	76.0	76.6	78.8	107.5
Craft	89.3	76.6	104.0	76.4	90.9	67.0	84.0	107.3
Tradition	91.9	--	103.0	71.0	90.9	67.6	84.9	106.9
Legacy	78.6	70.9	107.5	80.1	85.8	76.8	83.3	106.3
Geraldine	--	--	--	75.2	76.4	81.8	77.8	106.1
Cargill 36	--	--	--	--	--	75.7	75.7	105.4
Hockett	87.1	--	107.8	72.7	81.6	67.8	83.4	105.0
Boulder	--	--	--	67.3	84.7	76.8	76.3	104.0
Metcalf	--	72.7	103.8	74.5	85.8	75.3	82.4	103.6
Scarlett	--	--	--	--	--	73.9	73.9	102.9
Drummond	--	68.8	101.4	73.1	86.1	73.9	80.7	101.4
Harrington	72.2	72.9	104.9	74.7	73.5	71.8	78.3	100.0
Hays	--	--	--	63.6	82.8	73.5	73.3	100.0
Merit	77.7	61.0	98.2	70.2	81.9	66.5	75.9	96.9
Copeland	--	--	100.6	72.5	68.0	72.4	78.4	96.5

¹ Intrastate trial ² malt barley trial

NOTE: Average yields in this summary should not be compared to each other since they are not grown in the same years. Compare only to the check variety.

Table 3. Relative test weights of malt barley varieties in lb/bu as compared to Harrington when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Boulder	--	--	--	51.3	52.0	52.3	51.9	109.1
Haxby	52.3	--	52.8	50.3	53.0	52.0	52.1	108.5
Craft	51.5	51.3	51.7	50.7	50.8	51.3	51.2	107.4
Hockett	50.8	--	51.0	50.0	50.8	50.7	50.7	105.6
Geraldine	--	--	--	49.7	48.0	50.7	49.5	104.1
Metcalfe	--	48.2	50.0	47.7	50.5	50.2	49.3	103.3
Tradition	49.5	--	49.7	48.3	50.7	49.2	49.5	103.1
Xena	--	--	--	48.5	47.7	50.7	49.0	103.0
Drummond	--	50.3	50.0	47.5	50.2	47.8	49.2	102.9
Eslick	--	--	--	48.2	49.0	49.3	48.8	102.7
Conrad	--	--	--	47.8	48.7	50.0	48.8	102.7
Stellar	--	--	--	47.5	49.5	47.3	48.1	101.2
Legacy	47.7	48.5	48.7	46.0	49.0	47.8	48.0	100.6
Harrington	47.3	46.2	50.0	45.8	46.8	50.0	47.7	100.0
Hays	--	--	--	46.8	46.8	47.8	47.1	99.2
Copeland	--	--	48.5	45.5	46.8	48.5	47.3	98.3
Scarlett	--	--	--	--	--	48.8	48.8	97.6
Merit	46.7	44.0	45.8	45.5	46.2	48.3	46.1	96.6
Cargill 36	--	--	--	--	--	48.2	48.2	96.4

¹ Intrastate trial ² malt barley trial

NOTE: Average test weights in this summary should not be compared to each other since they are not grown in the same years. Compare only to the check variety.

Table 4. Relative protein contents of malt barley varieties in percent as compared to Harrington when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Craft	12.6	13.3	13.1	11	13.3	12.4	12.6	111.8
Haxby	11.5	--	12.7	10.7	12.8	13	12.1	109.2
Boulder	--	--	--	10.3	12.7	12	11.7	108.0
Hays	--	--	--	11.5	11.3	12	11.6	107.4
Eslick	--	--	--	9.9	12.4	12.2	11.5	106.5
Metcalfe	--	13.3	12.5	10.5	12.2	11.1	11.9	105.5
Xena	--	--	--	10.4	12.7	10.9	11.3	104.9
Conrad	--	--	--	9.8	12.3	11.9	11.3	104.9
Drummond	--	12.3	12.4	10.5	12.4	11.6	11.8	104.8
Scarlett	--	--	--	--	--	10.8	10.8	102.9
Geraldine	--	--	--	10.2	12.2	10.9	11.1	102.8
Merit	11.7	12.3	11.9	10.6	12	11	11.6	102.7
Copeland	--	--	12	10.1	12.5	10.6	11.3	101.8
Tradition	12	--	12.6	9.5	11.5	10.8	11.3	101.4
Cargill 36	--	--	--	--	--	10.6	10.6	101.0
Harrington	11.2	12.1	12	10.1	11.8	10.5	11.3	100.0
Hockett	11.6	--	11.6	9.7	11.3	11.3	11.1	99.8
Stellar	--	--	--	10	10.9	11.1	10.7	98.8
Legacy	11.7	11.2	11.6	10.2	10.6	10.2	10.9	96.8

¹ Intrastate trial ² malt barley trial

NOTE: Average protein percents in this summary should not be compared to each other since they are not grown in the same years. Compare only to the check variety.

Table 5. Relative percent plump of malt barley varieties as compared to Harrington when grown under dryland conditions at the EARC, Sidney, Montana.

Variety	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Craft	72	73	94	89	84	89	83.5	109.4
Boulder	--	--	--	94	87	89	90.0	108.4
Drummond	--	74	86	80	87	77	80.8	106.3
Conrad	--	--	--	92	81	88	87.0	104.8
Metcalf	--	42	92	88	89	87	79.6	104.7
Hockett	73	--	95	94	87	88	87.4	104.5
Stellar	--	--	--	86	90	83	86.3	104.0
Harrington	78	40	91	86	74	89	76.3	100.0
Tradition	70	--	89	88	91	79	83.4	99.8
Copeland	--	--	94	86	73	85	84.5	99.4
Merit	73	40	88	89	75	90	75.8	99.3
Scarlett	--	--	--	--	--	88	88.0	98.9
Cargill 36	--	--	--	--	--	84	84.0	94.4
Haxby	63	--	91	85	73	82	78.8	94.3
Eslick	--	--	--	79	70	75	74.7	90.0
Legacy	57	56	80	66	79	73	68.5	89.7
Xena	--	--	--	84	53	85	74.0	89.2
Hays	--	--	--	76	70	73	73.0	88.0
Geraldine	--	--	--	80	60	76	72.0	86.7

¹ Intrastate trial ² malt barley trial

NOTE: Average plump percents in this summary should not be compared to each other since they are not grown in the same years. Compare only to the check variety.

Table 6. Agronomic data obtained from a malt barley yield trial conducted under sprinkler irrigated conditions at the Eastern Agricultural Research Center, Sidney, Montana.

entry	heading*	height, cm	grain protein	test wt, lb/bu	percent plump	percent regular	yield, bu/ac
Eslick	55.7	81.3	12.26	49.0	87.7	9.3	69.8
Harrington	56.3	81.0	12.61	47.3	83.3	13.0	67.2
Copeland	56.7	90.7	11.61	46.8	89.3	8.3	62.3
Conrad	55.3	77.0	13.20	46.8	87.0	10.7	62.0
Scarlett	57.3	72.7	13.69	48.2	93.0	5.3	61.3
Craft	53.7	82.0	13.37	49.0	84.3	13.3	59.6
Haxby	53.3	70.7	12.43	49.5	81.0	14.7	59.0 x
Xena	56.3	76.3	11.83	47.3	81.7	15.3	58.4 x
Geraldine	60.0	78.0	13.30	49.2	80.7	15.0	56.8 x
Cargill 36	56.7	76.0	13.20	47.8	90.0	8.3	56.6 x
Tradition	53.0	81.3	11.10	45.8	78.0	17.7	55.5 x
Hays	59.3	77.7	11.76	43.0	62.0	30.0	55.4 x
Merit	55.3	80.0	12.11	45.0	82.3	15.3	54.3 x
Hockett	53.3	74.7	11.93	46.5	81.0	14.0	52.1 x
Metcalfe	55.0	81.0	13.11	47.3	84.0	12.7	52.0 x
Calgary	55.7	61.3	13.34	47.3	81.3	15.3	48.6 x
Drummond	52.0	75.0	11.94	45.3	80.3	17.7	46.4 x
Boulder	54.7	68.0	13.26	50.0	85.3	11.3	44.6 x
Legacy	52.7	74.7	12.69	45.3	76.7	21.0	43.8 x
Stellar	52.3	75.7	11.51	44.3	74.3	22.0	36.6 x
Average	55.2	76.8	12.51	47.1	82.2	14.5	55.1
probability	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CV (S/MEAN)	3.6	6.8	5.4	1.5	3.6	15.7	9.0
CV (SE/MEAN)	2.1	3.9	3.1	0.9	2.1	9.1	5.2
LSD (0.05)	3.3	8.6	1.12	1.2	4.8	3.8	8.2

*days from planting

x indicates significantly lower yield than check variety, Harrington

Hail on June 16 damaged the crop, particularly the early varieties

Table 7. Relative yielding abilities of malt barley varieties in bu/ac as compared to Harrington grown under irrigation at the Eastern Agricultural Research Center, Sidney, Montana.

Cultivar	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Conrad	--	--	--	129.3	109.2	62.0	100.2	116.5
Eslick	--	--	--	125.2	105.0	69.8	100.0	116.3
Xena	--	--	--	125.3	103.9	58.4	95.9	111.5
Legacy	130.4	142.3	151.2	117.6	110.4	43.8	116.0	111.4
Tradition	131.0	--	141.8	113.2	113.6	55.5	111.0	110.2
Copeland	--	--	126.9	128.7	104.2	62.3	105.5	109.6
Geraldine	131.3	128.2	--	128.5	98.8	56.8	108.7	109.3
Haxby	128.3	--	144.4	120.8	97.6	59.0	110.0	109.2
Calgary	--	--	--	125.1	107.1	48.6	93.6	108.9
Drummond	--	130.2	138.2	118.4	111.6	46.4	109.0	107.7
Craft	137.0	131.1	128.1	113.5	99.9	59.6	111.5	107.1
Boulder	--	--	--	121.0	104.7	44.6	90.1	104.8
Hockett	121.6	--	127.9	115.0	98.9	52.1	103.1	102.3
Merit	121.6	122.9	139.4	108.4	91.5	54.3	106.4	102.2
Stellar	--	--	--	123.2	103.0	36.6	87.6	101.9
Metcalf	--	117.5	122.2	120.8	94.1	52.0	101.3	100.1
Harrington	118.6	120.8	127.3	97.2	93.5	67.2	104.1	100.0
Hays	--	--	--	94.2	85.9	55.4	78.5	91.3
Scarlett	--	--	--	--	--	61.3	61.3	91.2
Cargill 36	--	--	--	--	--	56.6	56.6	84.2

¹ Intrastate trial ² malt barley trial

NOTE: Average yields in this summary should not be compared to each other since they are not grown in the same years. Compare yields only to the check variety.
Hail in 2007 damaged crop, particularly early maturing varieties.

Table 8. Relative test weights of malt barley varieties in lb/bu as compared to Harrington grown under irrigation at the Eastern Agricultural Research Center, Sidney, Montana.

Cultivar	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Boulder	--	--	--	51.0	50.8	50.0	50.6	106.9
Haxby	52.8	--	53.7	51.2	49.8	49.5	51.4	106.8
Craft	53.0	52.8	52.5	50.7	50.2	49.0	51.4	105.9
Eslick	--	--	--	50.3	48.7	49.0	49.3	104.2
Geraldine	51.3	52.5	--	50.8	48.0	49.2	50.4	104.1
Hockett	51.3	--	52.0	50.8	48.3	46.5	49.8	103.4
Conrad	--	--	--	51.0	48.8	46.8	48.9	103.2
Scarlett	--	--	--	--	--	48.2	48.2	101.9
Xena	--	--	--	49.7	47.7	47.3	48.2	101.9
Metcalf	--	49.0	51.3	50.2	47.8	47.3	49.1	101.8
Calgary	--	--	--	49.2	47.8	47.3	48.1	101.6
Cargill 36	--	--	--	--	--	47.8	47.8	101.1
Copeland	--	--	49.2	49.3	46.8	46.8	48.0	100.6
Tradition	50.0	--	48.8	49.0	48.0	45.8	48.3	100.4
Harrington	49.7	50.2	49.0	47.0	47.7	47.3	48.5	100.0
Merit	49.2	49.5	49.0	47.7	44.8	45.0	47.5	98.0
Drummond	--	48.3	48.8	47.5	46.2	45.3	47.2	97.9
Legacy	48.2	48.5	48.0	48.3	45.7	45.3	47.3	97.6
Stellar	--	--	--	47.3	44.5	44.3	45.4	95.8
Hays	--	--	--	46.0	44.3	43.0	44.4	93.9

¹ Intrastate trial ² malt barley trial

NOTE: Average test weights in this summary should not be compared to each other since they are not grown in the same years. Compare test weights only to the check variety.
Hail in 2007 damaged crop, particularly early maturing varieties.

Table 9. Relative protein contents of malt barley varieties in percent as compared to Harrington grown under irrigation at the Eastern Agricultural Research Center, Sidney, Montana.

Cultivar	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Calgary	--	--	--	14.6	13.0	13.3	13.6	112.7
Craft	11.3	12.1	12.0	14.2	13.2	13.4	12.7	112.2
Boulder	--	--	--	14.2	12.3	13.3	13.3	109.6
Haxby	11.8	--	11.7	14.0	12.0	12.4	12.4	108.8
Scarlett	--	--	--	--	--	13.7	13.7	108.7
Conrad	--	--	--	13.3	12.4	13.2	13.0	107.2
Drummond	--	11.2	11.5	14.4	12.0	11.9	12.2	105.9
Metcalfe	--	11.5	10.9	12.8	12.2	13.1	12.1	105.0
Hays	--	--	--	13.3	13.0	11.8	12.7	105.0
Cargill 36	--	--	--	--	--	13.2	13.2	104.8
Eslick	--	--	--	13.6	11.7	12.3	12.5	103.6
Geraldine	10.2	11.0	--	13.3	11.8	13.3	11.9	103.5
Tradition	10.5	--	11.6	14.2	11.2	11.1	11.7	103.0
Merit	10.2	11.3	10.9	12.7	12.3	12.1	11.6	102.4
Xena	--	--	--	13.1	11.8	11.8	12.2	101.1
Hockett	10.7	--	10.6	13.2	10.9	11.9	11.5	100.7
Legacy	10.0	10.0	10.6	14.1	10.7	12.7	11.4	100.3
Harrington	10.3	11.0	10.3	12.7	11.0	12.6	11.3	100.0
Copeland	--	--	11.1	12.1	11.5	11.6	11.6	99.4
Stellar	--	--	--	13.4	11.0	11.5	12.0	98.9

¹ Intrastate trial ² malt barley trial

NOTE: Average protein contents in this summary should not be compared to each other since they are not grown in the same years. Compare protein contents only to the check variety. Hail in 2007 damaged crop, particularly early maturing varieties.

Table 10. Relative plump percent of malt barley varieties as compared to Harrington grown under irrigation at the Eastern Agricultural Research Center, Sidney, Montana.

Cultivar	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Scarlett	--	--	--	--	--	93	93.0	112.0
Cargill 36	--	--	--	--	--	90	90.0	108.4
Conrad	--	--	--	95	89	87	90.3	105.0
Boulder	--	--	--	93	89	85	89.0	103.5
Tradition	94	--	94	96	90	78	90.4	103.0
Hockett	92	--	97	95	87	81	90.4	103.0
Craft	94	93	95	92	86	84	90.7	102.3
Metcalfe	--	88	95	94	87	84	89.6	101.6
Copeland	--	--	94	90	80	89	88.3	101.4
Eslick	--	--	--	89	83	88	86.7	100.8
Harrington	91	93	90	85	90	83	88.7	100.0
Drummond	--	93	94	94	78	80	87.8	99.5
Haxby	92	--	96	91	76	81	87.2	99.3
Merit	93	87	87	90	81	82	86.7	97.7
Stellar	--	--	--	97	80	74	83.7	97.3
Legacy	91	91	87	97	71	77	85.7	96.6
Xena	--	--	--	89	78	82	83.0	96.5
Calgary	--	--	--	83	84	81	82.7	96.1
Geraldine	85	89	--	84	79	81	83.6	94.6
Hays	--	--	--	78	57	62	65.7	76.4

¹ Intrastate trial ² malt barley trial

NOTE: Average protein contents in this summary should not be compared to each other since they are not grown in the same years. Compare protein contents only to the check variety. Hail in 2007 damaged crop, particularly early maturing varieties.

Table 11. Relative lodging indices of malt barley varieties as compared to Harrington grown under irrigation at the Eastern Agricultural Research Center, Sidney, Montana.

Cultivar	2003 ¹	2003 ²	2004	2005	2006	2007	Ave	as % of Harrington
Harrington	4.7	3.3	0.7	6.0	0.3	0.0	2.5	100.0
Hays	--	--	--	4.4	0.0	0.0	1.5	69.8
Legacy	0.0	1.0	2.3	0.0	3.0	0.0	1.1	42.0
Metcalfe	--	3.7	0.0	0.3	0.0	0.0	0.8	38.8
Copeland	--	--	0.0	1.3	1.3	0.0	0.7	37.1
Haxby	2.3	--	0.0	0.0	0.3	0.0	0.5	22.2
Craft	0.0	1.3	0.0	1.3	0.7	0.0	0.6	22.0
Eslick	--	--	--	1.3	0.0	0.0	0.4	20.6
Merit	0.7	1.3	0.0	1.0	0.0	0.0	0.5	20.0
Tradition	0.3	--	1.3	0.0	0.0	0.0	0.3	13.7
Hockett	1.0	--	0.0	0.3	0.0	0.0	0.3	11.1
Stellar	--	--	--	0.0	0.7	0.0	0.2	11.1
Drummond	--	0.0	0.0	0.0	1.0	0.0	0.2	9.7
Geraldine	0.3	0.3	--	0.7	0.0	0.0	0.3	9.1
Conrad	--	--	--	0.3	0.0	0.0	0.1	4.8
Xena	--	--	--	0.0	0.0	0.0	0.0	0.0
Calgary	--	--	--	0.0	0.0	0.0	0.0	0.0
Boulder	--	--	--	0.0	0.0	0.0	0.0	0.0
Scarlett	--	--	--	--	--	0.0	0.0	0.0
Cargill 36	--	--	--	--	--	0.0	0.0	0.0

¹ Intrastate trial ² malt barley trial

NOTE: Average protein contents in this summary should not be compared to each other since they are not grown in the same years. Compare protein contents only to the check variety. Hail in 2007 damaged crop, particularly early maturing varieties.